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Executive Summary

The eighth session of the WCRP/CLIVAR VAMOS Panel (VPM8) was hosted by the Servicio Meteorológico Nacional (SMN), Mexico City, Mexico, 7-9 March, 2005. VPM8 consisted of a VAMOS Modeling Workshop, the Panel meeting and it was followed by MESA and NAME SWG meetings (9-11 March) at the same venue. The event was attended by 85 participants from 8 countries.

VAMOS implementation includes 3 science components (North American Monsoon Experiment (NAME), Monsoon Experiment South America (MESA) and VAMOS Oceans-Clouds-Atmosphere-Land Study (VOCALS)), the VAMOS Data Information Server and the VAMOS Programs Project Office. The chairs of the corresponding science working groups (SWGs) reported on recent progress of their programmes.

During 2004 the NAME 2004 enhanced observation period was completed. More than 30 universities and government laboratories in the U.S., Mexico, Belize and Costa Rica participated in the experiment. NAME provides a template for future observing systems that might be designed for monitoring the North American Monsoon (NAM). The NAME 2004 data sets provide the research community with a means for more comprehensive understanding of climate variability and predictability across the NAM region. The field campaign strengthened international collaboration across Pan America, especially between participating operational and research groups.

MESA is now integrating the objectives of the different projects in South America (SALLJEX, PLATIN, LBA) into a unified program in order to facilitate the understanding, simulation and prediction of the South American Monsoon System (SAMS), its variations and its links with the extratropics. During 2004, considerable progress was made on SALLJEX data quality control and the generation of new datasets. Preliminary studies using SALLJEX data are providing quantitative information on the regional errors of global reanalyses and confirming that regional models are capable of simulating the basic features of low-level warm season circulations over tropical South America, but have difficulties in reproducing the observed diurnal cycle. The VAMOS/PLATIN Group made a successful contribution to the first phase of the GEF Framework Program for the La Plata Basin (LPB), producing surveys of the LPB's hydroclimate, including the systems used for its prediction and monitoring.

The goal of VOCALS is to understand, simulate, and predict the Southeast Pacific cool-ocean climate regime and its interactions with the larger-scale coupled ocean-atmosphere-land system on diurnal to interannual time scales. VOCALS has developed in response to the awareness that present models have large errors in the stratus deck region off northern Chile and Peru and that such regions play a significant role in the global climate system. Models have difficulty getting sea surface temperatures (SSTs) and shortwave radiative forcing correct in this region. Since October 2000 a series of cruises to the region and data from a surface mooring located near the center of the climatological maximum in cloud cover have provided observations that have matured the foci and plans of VOCALS. A multinational, multi-investigator process study is planned for the region during October 2007.

A first proposal for the Intra-Americas Sea (IAS) program was presented at VPM8. The IAS includes the Caribbean Sea and the Gulf of Mexico. In this prospectus, the IAS region is defined as a broad area covering the IAS itself, the adjacent lands, and the ocean off the west coast of Central America. The need for a research program to study physical and dynamical processes underlying rainfall variability and prediction in the IAS regions and its surroundings was outlined. The VAMOS panel has encouraged the IAS program to develop its science plan, including organization of a science working group and timeline of activities.

The VAMOS Modeling Workshop was organized to review the status of modeling relevant to VAMOS research, to bring together leading modeling groups focused on VAMOS topics, and to develop recommendations for a long-term modeling strategy. The workshop was organized into four sessions: Physical Processes in the Monsoon Regions, Climate Forecast in the Monsoon Regions, VOCALS modeling activities, and Integrated MESA–NAME–VOCALS Modeling Activities. Key presentations on VAMOS modeling and issues from NAME, MESA and VOCALS were discussed at the Workshop. The importance of an end-to-end prediction system was highlighted: from SST prediction to surface temperature and precipitation forecasts over Pan America to hydrologic modeling and applications. As a result of the discussion a modeling strategy based on a three tiered approach was recognized. A number of important issues need to be considered: (i) modeling and predicting SST variability in the Pan-American Seas with emphasis on MESA, NAME and VOCALS activities; (ii) predicting the Pan-American monsoon onset, maturation and demise; (iii) model evaluation and improvement; (iv) application of multi-model ensembles using the Climate Testbed, (v) use of operational climate forecasts to develop products and applications; (vi) improving the prediction of droughts and floods in the Pan-American domain; (vii) development of downscaling towards hydrometeorological modeling; (viii) and simulating, understanding and predicting the diurnal cycle in the Pan American Domain. The importance of data assimilation, analysis and assessing the observing system were also recognized. Finally it was also recommended that the science community exploit data from field campaigns carried out by MESA, NAME and VOCALS to improve models and observing systems.

The VAMOS panel Executive Session reviewed the implementation strategy of a Modeling Group for VAMOS, and discussed panel recommendations for the VAMOS science components.. A second issue of the VAMOS NEWSLETTER was approved. The panel decided to continue publishing the newsletter on an annual basis, and focusing on specific themes of interest to a broad audience. The venue and date of the 9th VAMOS panel meeting was discussed. The panel approved a back-to-back meeting with the 8th AMS International Conference on SH Meteorology and Oceanography, to be held in Foz do Iguazu, Brazil, April 22-23, 2006. Finally, the panel considered the rotation of old members and made plans for the nomination of new members to be endorsed by the CLIVAR SSG.

The panel wishes to express special thanks to Dr. Michel Rosengaus, Director of Servicio Meterologico Nacional of Mexico (SMN), for his support to host the 8th VAMOS panel meeting, and to Dr. Miguel Cortez (SMN) for coordinating an excellent meeting. The key contributions of V. Detemmerman (WCRP) and M. Patterson (NOAA OGP) to the panel were also warmly acknowledged.

Carolina Vera and Wayne Higgins
Co-chairs
WCRP/CLIVAR/VAMOS

1. Welcome and Opening Remarks

The WCRP/CLIVAR panel on the Variability of American Monsoon (VAMOS) held its Eighth Annual Meeting (VPM8) at the Servicio Meteorológico Nacional (SMN), Mexico City, Mexico, 7-9 March, 2005. Dr. Miguel Cortez, representative of SMN opened the meeting welcoming all participants (see list in Appendix 1) and expressing that his organization was very pleased to host the meeting. After providing some logistical information he offered the participants the excellent facilities of his institution.

Prof. Carlos Ereño, representative of the International CLIVAR Project Office (ICPO) for VAMOS, also welcomed the participants and greeted the audience on behalf of Dr. Howard Cattle, the ICPO Director. He thanked Dr. Cortez for kindly supporting the VAMOS meeting, making us feel at home, and added some logistical details of interest.

Dr. Michele Rosengaus, Director of the SMN, gave a welcoming address that highlighted the importance of providing climate predictions to decision-makers. In particular, he presented his interesting experience with the Technical Committee of Hydraulic Works Operations, where measures are adopted of social and political relevance to the region. He recognized that climate forecasts are not as long or skillful as necessary to make solid, objective, sound decisions on the operation of dams over all of Mexico. There are many questions without answers, closely related to the long term forecasting. A copy of Dr. Rosengaus's speech is found in Appendix 3.

2. Reports and Scientific Presentations

2.1 CLIVAR Report

Prof. Antonio Busalacchi, co-chair of CLIVAR's Scientific Steering Group (SSG), provided an overview of CLIVAR. After introducing the general aspects of the program, with emphasis on the science-applications relationship, he provided details on the challenges for the future which emerged from the CLIVAR 2004 Conference. These include:

- Being asked to do more with less
  - Advance prediction skill
  - Reduce uncertainty
  - Societal relevance
- Link between climate change and climate variability
- Cascade from global to regional scales
- Global synthesis and integration of regional/basin implementation
- Role of predictive capability for applications in CLIVAR
- Transition from research to operations for climate
- Support to developing nations

He then referred to the CLIVAR assessment process, its organization and implementation, who carried it out and the presentations at SSG-13. Prof. Busalacchi also made a brief review of the key outcomes of CLIVAR to date and the ones that emerged from the CLIVAR 2004 Conference and the CLIVAR Assessment, in which he highlighted the Pan WCRP monsoon activity (with GEWEX). A major outcome was the proposal for a new CLIVAR structure under the principle "think globally, act regionally" which implies a greater interaction between a global CLIVAR and the regional panels as well as among panels. Another emphasis was the need for a continued programme assessment. On an annual basis CLIVAR progress will be assessed against the major global themes: ENSO, Anthropogenic Climate Change, Monsoons, and Decadal Variability. Each year a topical workshop will be held for one of the four themes. The need for an increased ACC presence on the SSG was also recognized. The global perspective/framework would be provided by GSOP, WGSIP, WGCM, WGOMD, and CCD; and the global to regional perspective by the Monsoon Panels for VAMOS, VACS, and AAMP and Ocean Basin Panels for Atlantic, Pacific, Indian, and Southern Oceans.

As to the VAMOS-GEWEX interactions, Prof. Busalacchi reported on the status and structure of the PLATIN SSG; and the ongoing enhanced monitoring and planning for the VOCALS. He also discussed VAMOS participation in the WCRP Monsoon Workshop, and the possibility of a CEOP reference site for LPB.

Prof. Busalacchi closed his presentation with a reference to the WCRP COPES (Coordinated Observation & Prediction of the Earth System) program, its objectives, central themes, stressing that CLIVAR had *the* central role to deliver COPES.

2.2 VAMOS Chair Report

Drs. Wayne Higgins and Carolina Vera, VAMOS Panel co-chairs, split the presentation of the VAMOS Chair's report. Dr. Higgins summarized the outstanding contributions of Prof. Roberto Mechoso, which included the development of the overall VAMOS strategy: (i) Identification of a unifying science theme (American Monsoon Systems); (ii) Structure based on science programs of broad interest (e.g. SALLJEX and NAME 04); (iii) Implementation based on individuals with vested interests; (iv) Panel membership based on strong, active people; and (v) Constant updating of the milestones for success. VAMOS Implementation includes 3 science components (North American Monsoon Experiment (NAME), Monsoon Experiment South America (MESA) and VAMOS Oceans-Clouds-Atmosphere-Land Study (VOCALS)), the VAMOS Data Information Server and the VAMOS Programs Project Office. Dr. Higgins discussed implementation highlights during the past year, which included the NAME 2004 field campaign (JJAS 2004), organization of the MESA SWG and Science and Implementation plan, and planning for the VOCALS field campaign in the eastern Pacific. Details of MESA, NAME and VOCALS implementation are found in the complete presentation, which is posted on the VAMOS webpage (www.joss.ucar.edu/vamos/VPM8/VPM8_Agenda.html).

Dr. Vera discussed the CLIVAR Self Assessment, which was an activity designed to measure CLIVAR progress to date against CLIVAR objectives, and to provide the SSG with the necessary input to determine what steps might be necessary to ensure future progress. The Assessment provided a set of General Recommendations for CLIVAR and a set of Specific Recommendations for VAMOS. The General Recommendations were: (i) to focus on a few major topics: ENSO, Monsoons, Decadal Variability, and Anthropogenic Climate Change; (ii) to give more attention to the integration of activities across the various panels; (iii) to give ACC and the anthropogenic modification of natural variability the same emphasis as the other themes; and (iv) to increase emphasis on data management and links to applications. Each Panel will be asked to report on a specific list of topics, including contributions to the 4 major themes, a summary of contributions to annual workshops, activities related to regional assessment of predictability and variability in global models, and cross panel linkages. The SSG emphasized the achievements of the VAMOS program, including the progress and success of the VAMOS Panel. Some specific recommendations were: (i) to develop a cross-VAMOS modeling strategy and implementation plan to ensure strong linkages between MESA, NAME and VOCALS; (ii) to continue with yearly VAMOS Panel meetings, particularly to continue annual assessments of VAMOS science components (NAME, MESA, and, VOCALS); (iii) to be a strong player in the CLIVAR-GEWEX coordination of monsoon modeling

activities; and (iv) to focus more attention on the intersection between VAMOS and the IAI. Dr. Vera also described the VAMOS relationships to other programs (GEWEX, CLIVAR Atlantic and Pacific Panels, WGSIP, WGCM, GCOS, IAI and START). Though VAMOS interactions with these groups are generally quite strong, there are needs for improvement with several of the groups (notably the Atlantic Panel). Carolina also discussed the VAMOS Panel decision on a Modeling Group for VAMOS (MGV), the roster of the MGV, and the charge to the group (see “Charge to the Modeling Group for VAMOS”, section 3.2). She outlined the challenges facing VAMOS, including needs to strengthen linkages between process studies, process modelers and climate modelers via Climate Process and modeling Team (CPT) efforts. One mechanism for this is the emerging NOAA Climate Test Bed facility, which has been organized to accelerate the transition of intraseasonal-to-interannual climate research and development into improved NOAA climate forecasts, products and applications. Dr. Vera ended the presentation by discussing the VAMOS legacy: (i) A vibrant international community performing coordinated research on the climate and hydrology of the Americas, sensitive to the leading concerns of the international research community and to the needs of the weather, climate and hydrology regional prediction centers; (ii) A climate monitoring network spanning the Americas and the tropical Oceans (contributions of SALLJEX, NAME04 and VOCALS); (iii) enhanced scientific infrastructure in the region, particularly in the less advanced countries (K-12 Education Modules, Teachers in the Field; graduate research programs; cooperative networks for research and real-time monitoring, etc.); and (iv) a comprehensive, updated, and accessible database for the climate and hydrology in the Americas, available on the UCAR/JOSS VAMOS site:
(www.joss.ucar.edu/vamos/data/index.html).

2.3 ICPO Report

Prof. Ereño gave an overview of CLIVAR and the International CLIVAR Project Office (ICPO), which included the functions of ICPO within the CLIVAR organization. He provided details on the special issues of CLIVAR Exchanges published last year and the ones planned for 2005. He informed meeting participants that Katy Hill, who was coordinating the Pacific panel, TIP, GSOP, data issues, and served as a link with carbon programmes, would leave in April to do a PhD. Mike Sparrow, ICPO representative in the Southern Ocean panel, would leave in August to take up a new career in teaching. He also informed that a modelling post would be established to replace Andreas Villwock (who left at the end of 2003) and a web-expert post has been requested in a funding bid to the UK NERC. The rest of the vacancies would be recruited as appropriate. He then showed a list with the key responsibilities of the current ICPO staff with the following dedication: Cattle (100%), Boscolo (50%), Ereño (25%), Sparrow (30%), Hill (100%), Yan (100%), and Grapes (100%). Prof. Ereño provided details on the proposed new ICPO structure, which is basically intended to organize the office in four big thematic groups, i.e., Modeling; Prediction and Detection; on one hand and groups for Climate observations, Oceans, and Monsoons. He closed the presentation showing some statistics of the CLIVAR 2004 Conference: 640 Registered Attendees (the largest WCRP Conference ever!); 56 Countries; 650+ Posters; 35 Oral presentations; 9 Discussants; 4 Press briefings (17 panelists, 5 moderators; several stories went to print); 80+ students, 16 poster awards; 14 Major sponsors

2.4 VAMOS International Project Office

Dr. Gus Emmanuel (UCAR JOSS) described the VAMOS Project activities during 2004, which were centered on the preparations for and field implementation necessary to accomplish the scientific objectives as described in the NAME Science Implementation Plan. The Project Office, assisted by the National Meteorological Service of Mexico (SMN) and the Science Office at the US

Embassy in Mexico City secured the necessary permits to conduct the field phase of the experiment and to import all necessary hardware, including expendables, into Mexico. The Project Office was also instrumental in arranging the contractual arrangements for the use of the Mexican Navy oceanographic ship "Altair" for a 42-day period during July and August, 2004. The "Altair" period coincided with the participation of the NOAA WP-3D aircraft which operated from the Mazatlan International Airport. The base of operations for NAME was established at the Atmospheric Sciences Department facilities, University of Arizona, in Tucson. The NAME Forecast Office was located at the National Weather Service (NWS) facilities located on the University of Arizona Campus.

2.5 VAMOS Data Management Update

José Meitín gave a brief summary of the various VAMOS-related data activities at UCAR Joint Office for Science Support since the last panel meeting in Guayaquil.

NAME - The NAME-2004 field campaign was executed from June to September. A number of unique instruments were deployed during the 4 month Enhanced Observing Period. These included the digitizing of data from 2 SMN operational radars, a polarized research radar, various wind profilers, 2 research ships.and a research aircraft. Additionally, several hundred raingauges were deployed to monitor the onset and strength of the monsoon. Available data (and further details) can be found at the NAME data management page located at http://www.joss.ucar.edu/name/dm/

PACS – The long-term enhanced climate monitoring and archival which provides the backbone datasets to the various process study campaigns such as VAMOS-related field projects (e.g.SALLJEX, EPIC, NAME) continues. The PACS database provides stability and continuity using common formats, a data portal, and ease of data access. The satellite climatology consists of various high-resolution sectors that are routinely produced and archived by UCAR/JOSS (2000 to present). Further details (and links to these datasets) are provided at the PACS data management page located at http://www.joss.ucar.edu/pacs/.

EPIC - Approximately 150 data sets have been submitted to the EPIC data base. Airborne Doppler radar analysis products and final, quality-controlled data from the AXBT ocean probes have submitted for inclusion in the EPIC archive. Further details (and links to these datasets) are available from the EPIC data management page located at: http://www.joss.ucar.edu/epic/dm/

SALLJEX – The SALLJEX data archives continue to grow as new, research model runs are provided to the research community. Some longer term precipitation datasets are still being developed. Further details can be found at: http://www.joss.ucar.edu/salljex/dm/.

PLATIN – The La Plata Basin initiative (and its field component PLATEX) were discussed during the GHP-10 and CEOP meetings in Montevideo, Uruguay, last September. Further details are available from the PLATIN data management page located at http://www.joss.ucar.edu/platin/dm/.

CEOP - Data management activities for CEOP that are important for VAMOS include the continued development of *in-situ* data sets from 35 Reference Sites distributed globally in various climate regimes (July 2001 through December 2004). These data sets consist of an hourly and 30-min "composites" of designated upper air, surface, and sub-surface parameters all converted to a common format and analyzed using uniform quality control procedures. All Reference Site data are being archived (and available on-line) from UCAR/JOSS. CEOP model output (from 10 numerical weather prediction centres) consists of 3-D gridded fields and Model location time series (MOLTS) corresponding to each Reference Site. These files are being archived at the German Computing Centre at the Max Planck Institute and are available on-line. Satellite data are being archived at the

University of Tokyo (Japan). Planning for a CEOP Phase II period (2006-2010) and development of a Science and Implementation Plan are underway. Further details (and links to these datasets) are available from the CEOP data management page located at http://www.joss.ucar.edu/ghp/ceopdm/.

2.6 VOCALS Status Report

Dr. Robert Weller made a presentation on the VAMOS Ocean Cloud Atmosphere Land Study (VOCALS). The goal of VOCALS is to better understand, simulate, and predict the Southeast Pacific cool-ocean climate regime and its interactions with the larger-scale coupled ocean-atmosphere-land system on diurnal to interannual time scales. VOCALS has developed in response to the awareness that present models have large errors in the stratus deck region off northern Chile and Peru and that such regions play a significant role in the global climate system. Models have difficulty getting sea surface temperature (SST) and shortwave radiative forcing correct in this region.

Since October 2000 a series of cruises to the region and data from a surface mooring located near the center of the climatological maximum in cloud cover have provided observations that have matured the foci and plans of VOCALS. Strong interest has developed in cloud-aerosol feedbacks and their role in pockets of open cells (POCS) or relatively clear regions embedded in the stratus deck that have been observed during these pilot activities. The TAO buoy array to the north, a Chilean Navy (SHOA) buoy at 20S, 75W, and observing activities at San Felix Island provide additional elements of the setting for VOCALS. VOCALS science foci are on: atmospheric, oceanic, and coupled model biases and model improvements in the southeast Pacific and other sub-tropical cool-ocean regimes; southeast Pacific aerosol-cloud interaction and implications for aerosol indirect effects and the regional climate; SST spatial variability and the ocean heat and other property budgets over the region; and the influence of South America and remote forcing from tropics and mid-latitudes on this region on diurnal to interannual (ENSO) time scales.

The pilot observations have shown great space/time variability in the aerosol concentrations and the presence of a daily gravity wave initiated by Andean slope heating which enhances the diurnal cycle of cloud cover offshore. They have also shown that at the long-term surface buoy that the heat budget is not in local balance, with additional cooling needed. It is hypothesized that Rossby waves that propagate west from the coast play a role in bringing additional cooling to the area.

It is planned to conduct a multinational, multi-investigator process study in the region in October 2007. The work that needs to be done to prepare was discussed as well as the plans for 2007. Tasks at hand include: 1) global and mesoscale model evaluation and improvement (e.g. parameterization development) using multiscale data sets, sensitivity studies, and improved understanding of physical processes, 2) observational synthesis of existing data sets, including buoy, satellite, and reanalysis data, 3) detailed planning of the open ocean and coastal components of the 2007 field program, and 4) coordination with oceanographic, aerosol, cloud process communities, including CLIVAR cloud CPT, SOLAS, NOAA Climate testbed, ARM, CloudSat, GCSS and others. Each fall there is a cruise to the long-term buoy, which can be used for additional sampling; the TAP array could be enhanced with radiation sensors; and remote sensing data (MODIS, CloudSat, Calypso) should be studied.

A get together in Chile of a small group to begin to work on logistics and coordination was discussed and will likely go forward. Subsequent to that more work remains to be done to coordinate with coastal oceanographers and meteorologists from Chile and neighboring countries.

2.7 MESA Status Report

Dr. Carolina Vera provided an overview of the status of the MESA Program, with emphasis on the MESA reorganization activities.

Until VPM7, MESA was organized in regional programs, and there it was recommended that MESA should start integrating the objectives of the different projects in South America (SALLJEX, PLATIN, LBA) in an unified program in order to facilitate the understanding, simulation and prediction of the different components of the South American Monsoon System (SAMS), their variations and links with the extratropics. Significant progress has been made in that sense. The Scientific Working Group for the Monsoon Experiment in South America (MESA) was appointed and the scientific and implementation plan is being drafted. MESA is currently being organized in three main priority research areas (PRAs), PRA1: Diurnal and mesoscale variability, PRA2: intraseasonal variability and PRA3: interannual (and longer timescale) variability (including climate change). The MESA web page (www.joss.ucar.edu/mesa) has also been organized that includes full information about the Program.

During 2004, new progresses have been made on SALLJEX data quality control and generation of new datasets. In particular, the SALLJEX Precipitation Dataset (that includes daily precipitation observations from around 1700 stations for the 2002-2003 austral summer) has been made available in the SALLJEX data web page at UCAR/JOSS. In addition, daily gridded fields of precipitation for South America at 1° and 2.5° resolution for the period 1940-2003 are available, based on the information provided by around 7,900 stations over South America (Liebmann and Allured, 2005, BAMS).

Preliminary studies using SALLJEX data are providing quantitative information on the regional errors of global reanalyses and confirming that regional models are capable of simulating the basic features of low-level warm season circulations over tropical South America, but have difficulties in reproducing the observed diurnal cycle. They are also addressing the important role of initial surface conditions for prediction of rainfall associated with SALLJ, and mechanics for maintenance of heat lows like the northwestern Argentinean low. Coordinated Modeling Experiments for the SALLJEX period have been performed and described in the section 3.3.3 of this Report (Saulo-Berbery's talk in the VAMOS Modeling Workshop). The CLIVAR-Exchanges newsletter No. 29 was devoted to SALLJEX and a SALLJEX overview paper was submitted to BAMS. Also, more than 12 PhD theses and 10 Ms theses related with SALLJEX are currently undergoing in Argentina, Brazil, and USA

The VAMOS/PLATIN Group made a successful contribution to the first phase of the GEF Framework Program for the La Plata Basin (LPB), producing surveys of the LPB's hydroclimate, including the systems used for its prediction and monitoring. The PLATIN participation in the second phase has been approved and a structure for the discussion of future plans, including PLATIN scientists and personnel from NWS and water agencies is starting to emerge. The participation of the VAMOS/PLATIN Group in the GEF Program is unquestionably a great example of how WCRP/CLIVAR science can be applied to solve societal needs, while at the same time it provides additional funding for climate monitoring, field campaigns, as well as regional database enhancement. Additional information about the status of the La Plata Basin Project is reported in section 2.8 of this Report.

There has been some recent progress on climate change research for South America particularly because of the preparation of the second national communications to the UNFCC by the different South American countries, and because of the proximity of the writing of the South America climate related chapters of AR4 (being several VAMOS/MESA scientists highly involved in both activities already). Both activities rely on the possibility of having reasonable climate change scenarios over South America but current global climate models have deficiencies in reproducing some of the key features of the South America climate. In that sense, MESA has endorsed two different initiatives: i) the implementation of the CLARIS, a EU-funded "Europe-South America Network for Climate Change Assessment and Impact Studies" project, aimed at strengthening collaborations between research groups in Europe and South America to develop common research strategies on climate change and impact issues in the subtropical region of South America; ii) Around 13 analyses from the MESA community were submitted to the Call of Climate Model Simulations for the IPCC AR4 made by WGCM. Preliminary results of those analyses were presented by Rafael Terra en the VAMOS Modeling Workshop (see section 3.4.8 of this Report).

Regarding MESA relationships with other programs, VAMOS/MESA made an important contribution to GCOS Action Plan over South America providing specific recommendations for upper-air network enhancement, ocean monitoring, and improvement of daily historical database. MESA has discussed possible joint activities with the START/AIACC Program intended to improve the use of climate simulations to develop climate change scenarios in South America needed for vulnerability and adaptation studies. WGSIP-MESA joint activities of regional evaluations of Global Model seasonal simulations over South America are being performed that provide quantitative measures of the skill of the global models in reproducing mean and variability of South American climate.

The 1st MESA SWG meeting was held right after VPM8 between 9 and 11 March in Mexico City, and consisted of a series of presentations and discussions highlighting the key scientific basis for MESA, observational needs, modeling strategy, phases of implementation as well as Program organization. Extensive information about the meeting as well as a description of its conclusions is available in the Appendix 6 of this Report.

2.8 PLATIN Status Report

Dr. Pedro L. Silva Dias provided a summary of recent LPB science and organizational activities. New studies have been reported on the ENSO impact, floods in the Uruguay River, assessment of AGCM simulations, coupling of meteorological models to distributed hydrological models, the CPTEC reanalysis and forecasts of the SALLJEX period, including the additional radiosonde data.

LPB became a GEWEX CSE and as such there are several technical requirements that have to be satisfied as a result: (a) CPTEC and IRI, both NWP and climate prediction centers, have committed cooperation with LPB. Several national and international sources provide funding for LBP research, (b) LPB includes several monitoring and experimental networks (e.g. PACS SONET, SALLJEX), as well as flux tower; (c) A PLATIN Database is available for data storage at UCAR JOSS, which also coordinates data management support; (d) the LPB's data policy is inspired by CEOP and used in SALLJEX. Researchers commit to the exchange of scientific information and data in conformity with the general practice of WCRP (e) the LPB is contributing to the evaluation of GEWEX global data products by generating in-situ data.

The relationship between LBA and LPB was presented at the GEWEX SSG (2005) by M. Silva Dias. The main points of LBA are: (a) focus on biosphere-atmosphere interactions in the Amazon Basin; (b) the program is fully institutionalized and there is a network of participants is functioning; (c) the participants are Amazonian countries with international partners in USA and Europe, (d) LBA is finishing Phase I and the synthesis phase is currently in operation; (e) LBA Phase II, beginning 2006, is strongly focused on the ecosystem/atmosphere/chemistry coupled models and aerosol-radiation-precipitation issues; (f) there is funding for: 14 flux towers and a network of S-band Doppler radars, radiosondes and surface weather stations maintained by the SIPAM program; (h) mostly Brazilian funding for research and maintenance of observations; (i) NASA will be funding the synthesis of Phase I, there are ongoing projects with Europe. The main points in LPB are: (a) LPB focus on water resources in the La Plata Basin, (b) the science planning phase has just ended; (c) LPB is taking advantage of already on going activities to get momentum such as PROSUR and CLARIS; (d) LPB has a strong activity in distributed hydrology model with input from CPTEC models; (e) there is an ongoing effort on super-ensemble of models from different institutions/countries for NWP purposes; (f) MERCOSUR countries are actively involved with growing activities with the regional weather centers; (g) the LPB Implementation Plan is being prepared ; (h) an important funding source is expected from the GEF; (f) Data up to now consists of the operational network of participating countries

The GEF Framework Program generated surveys of the LPB's hydroclimate, including the systems used for its prediction and monitoring. The PLATIN-related activities in the same program are focused on the development of plans on different aspects of the LPB's hydroclimate. These plans can be an integral part of the LPB CSE's implementation plan. As part of the survey, a detailed analysis of the observational network has been compiled. The survey of the MWP activities indicated that a large number of regional forecasting systems are now available (based on several regional models such as the ETA, WRF, MM5, ARPS, RAMS and the LAHM). There are ongoing activities on the optimal combination of the available forecasts (including the global models and ensemble forecasting with global models. The survey detected rather limited efforts on data assimilation of the conventional and remote sensing data in most of the NWS regional centers except at CPTEC. Distributed hydrological modeling is now available for several sub-basins such as the Taquari, Uruguay, upper Paraguay and the Pantanal will be included next. The GEF/LPB activities are now focused on the generation of the implementation plan and 4 groups have been established: Group 1: Regional climate and hydrological scenarios; Group 2: Land use change and other regional processes; Group 3: Meteorological and climatological observational and prediction systems and Group 4: Hydrological observational and prediction systems. The GEF implementation plan is planned for June 2005. The activities related to the GEF funding in groups 3 and 4 are mostly directed to implementation of operational tools in hydrological and meteorological operational systems. Activities 1 and 2 have a stronger research component.

The science questions of a field experiment in LPB (PLATEX) are under discussion. The main scientific issues are: (a) Strong variability of streamflows on several time scales; (b) relative contributions to variability of climate and land use change are not well known; (c) Effects of advection of aerosols from biomas burning from tropical areas are largely unknown, (d) Strong contribution of MCS to total precipitation- (e) the predictability issue related to the observation system:data frequency, location of obs., new systems (profilers, radars, new satellite data…).

In conclusion, the current activities in the LPB program are conducive to the development of a comprehensive implementation plan for the basin. The comprehensive implementation plan is urgent.

2.9 NAME Status Report

Dr. Wayne Higgins summarized the various activities of NAME, with emphasis on NAME 2004 which was carried out during June-September 2004. Dr. Higgins stressed that NAME activities have been formulated to improve our physical understanding of the monsoon in southwestern North America and to determine the degree of predictability of warm season precipitation over the region. Perhaps the most unique characteristic of the program, aside from its joint CLIVAR-GEWEX implementation, is that the modeling and field activities have been planned in tandem. NAME 2004 enhanced observations were motivated, in part, by model assessment activities (such as NAMAP) in advance of the field campaign. This rich data set will continue to be employed in modeling and data assimilation studies towards improved understanding and more realistic simulations of the monsoon. These efforts are especially germane to the new NOAA Climate Test Bed initiative. Given the high temporal resolution of the NAME 2004 data sets, the diurnal cycle is resolved more accurately, which in turn will contribute to a better understanding of prediction problems associated with the NAM.

More than 30 universities and government laboratories in the U.S., Mexico, Belize and Costa Rica participated in the NAME 2004 field experiment. A host of equipment was supported (see the JOSS/NAME website for the field and data catalogs). NAME Intensive Observing Periods (IOPs) were aimed at sampling a number of key synoptic and mesoscale features that are typical of the monsoon in Northwest Mexico and the Southwest US, including (1) monsoon onset, (2) low-level circulations associated with MCCs, outflow boundaries and gulf surges, (3) broad scale moisture transport associated with easterly waves and tropical storms, and (4) rainfall patterns and variability across the NAME domain. Nine successful Intensive Observing Periods (IOPs) aimed at these features were called in July and August and a tenth IOP was called in September to observe the landfall of Hurricane Javier.

Dr. Higgins also discussed the NAME 2004 Data Analysis and Seventh NAME Science Working Group Meeting (SWG-6), which was held 9-11 March, 2005 in Mexico City. The meeting brought together participants from the NAME 2004 field campaign and those intending to use the data in follow-on modeling and prediction activities aimed at accelerating improvements in warm season precipitation forecasts, products and applications. The objectives of the workshop were to review the NAME 2004 Enhanced Observing Period (EOP), including the status and quality of the NAME 2004 data sets, and to review progress on NAME modeling and diagnostic studies (including climate model assessments, climate data assimilation, climate forecast system development). The NAME SWG was also asked to make recommendations for a course of action to accelerate the transition of this research into improved operational climate forecasts, products and applications in concert with the emerging NOAA Climate Test Bed (CTB). A NAME Data Analysis and SWG-7 meeting report (www.joss.ucar.edu/name/) summarizes (i) the contents of the NAME 2004 data set, including dates of deliverables; (ii) NAME 2004 value added products; (iii) the strategy for post NAME 2004 modeling and data assimilation activities to improve simulations and predictions of warm season precipitation with coupled climate models; and (iv) a list of "Synthesis Products" that are expected to emerge from NAME and the plans for achieving them.

NAME provides a template for future observing systems that might be designed for monitoring the NAM. The NAME 2004 data sets provides the research community with a means for more comprehensive understanding of climate variability and predictability across the NAM region. The field campaign strengthened international collaboration across Pan America, especially between participating operational and research groups. The NAME modeling strategy provides a template for improved simulations and predictions of the monsoon system and its variability with coupled models.

2.10 Reports from Regional Programs

2.10.1 US CLIVAR Report

A short presentation was made by Dr. Bob Weller to summarize the status of the U.S. CLIVAR program. The U.S. CLIVAR scientific steering committee is in the process or reorganizing. The previous panel structure, which mirrored the international panel structure, will phase into three new panels and a number of limited lifetime working groups. The new panels will target: 1) processes and model improvements, 2) phenomenology, observations and syntheses, and 3) predictions and applications interfaces. U. S. CLIVAR will look to international panels, such as VAMOS, for guidance and advice on regional issues and programs and will maintain strong ties to such panels by putting forward U.S. candidates to serve on those panels. At the same time it will established focus groups to carry forward planning and implementation of regionally-specific programs. At this time, planning for process studies in U.S. CLIVAR has brought forward two programs of interest to VAMOS: an eastern tropical Pacific program, PUMP (Pacific Upwelling and Mixing Physics), and the VAMOS Ocean Cloud Atmosphere Land Study (VOCALS), which focuses on the stratus clouds and coupled dynamics of the stratus cloud region off northern Chile.

2.10.2 IAI Report

Prof. Ereño presented a short overview of the activities of the Inter-American Institute for Global Change Research (IAI). His presentation included details on the IAI's mission and goals. The IAI is a governmental organization composed by nineteen countries from the Americas. The current IAI science agenda includes four themes:

- Understanding Climate Change and Variability in the Americas
- Comparative Studies of Ecosystems, Biodiversity, Land Use and Cover and Water Resources in the Americas
- Understanding Global Change Modulations of the Composition of the Atmosphere, Oceans and Fresh Water
- Understanding the Human Dimensions and Policy Implications of Global Change, Climate Variability and Land Use

The IAI is currently running three programs: 1st Round of the IAI Small Grant Program (SGP I) – US$ 380K, 1-year; 2nd Round of the IAI Small Grant Program (SGP II) – US$ 640K, 1-year; and Collaborative Research Network Program (CRN) – US$ 11 Mio., 5-year. A second round of CRN will be the major IAI activity in the next 5 years, with a total expected volume of US$ 11.4 Mill, and intended to fund 10 – 12 projects that are planned to start in late 2005 or early 2006.

The IAI Training and education goal is to increase and strengthen capacity building in the Americas, with special emphasis on scientific excellence, policy awareness, integrated multidisciplinary research, multinational collaboration, and IAI human network. Mechanisms to accomplish this include graduate fellowships through research programs, workshops, scientific meetings, seminars, and IAI training institutes. Plans for Institutes in 2005 include the Institute on Vulnerability Associated with Climate Variability and Change in South America (Paraguay) and the Institute on Climate and Health (Jamaica).

More information can be found at http://www.iai.int/

2.11 CPPA Program

Dr. Mike Patterson and Dr. Jin Huang presented a summary of NOAAs Climate Prediction Program for the Americas (CPPA). CPPA is a merged program consisting of NOAAs PACS (Pan America Climate Studies) and GAPP (GEWEX Americas Prediction Project) programs. PACS and GAPP have a common goal: to improve climate forecasts through improved physical process understanding and representation in climate models. PACS has expertise in ocean-atmosphere interaction and global modeling, while GAPP has expertise in land-atmosphere interactions and regional modeling. CPPA blends the two existing PACS and GAPP programs into a single process research program which aims at extending the scope and improving the skill of intreaseasonal-to-interannual climate prediction over the Americas.

Research will focus on:
- determining the predictability of warm-season precipitation over the Americas on intraseasonal and longer time scales;
- achieving an improved understanding and more realistic simulation of ocean, atmosphere, and land process which give rise to climate predictability;
- defining, developing, and improving the requisite observing and prediction systems for monitoring and predicting climate variations in the Americas; and
- providing decision support through interpretation of climate forecasts for water resource management applications.

Study regions in the stage of post field synthesis include: the Core NA Monsoon (NAME 2004) and GEWEX Continental Scale International Project (GCIP) for North America, and LBA and SALLJEX for South America. On the other hand, programs on Western Mountain Hydroclimate, and IAS & NA Climate programs for North America, and La Plata Basin for South America are in the initial analysis and planning stages.

CPPA employs a broad range of research approaches to achieve its objectives, including:: data Set development, data mining, management, empirical studies, modeling and predictability studies (including atmosphere, ocean, land, coupled, on different spatial scales including global, regional, cloud resolving and nested), enhanced observations, field experiments, application research, and testbed monitoring and prediction.

After reviewing the major accomplishment/products for FY03-05, the social and scientific motivations for this Pan-American program were presented, as well as the importance of CPPA within NOAAs Strategic Planning Goals, and the changing US CLIVAR structure. Its contribution to Climate Change Science was also highlighted.

CLIVAR PanAm and GAPP research are coordinated internationally through the CLIVAR-VAMOS and GEWEX Hydrometeorology Panels, respectively. CPPA will also foster International Collaboration providing different types of support, as for meetings for scientific planning, travel of international PIs and their students, forecaster exchanges, training courses, graduate education opportunities at US institutions, and others.

The next steps include Integrating Research & Operations, Deliverables to Build Observing and Analysis Systems, Deliverables to Operational Climate Prediction, and Deliverables to Assessments/Applications.

2.12 Intra Americas Seas Program

Dr. Chidong Zhang (University of Miami) described the Intra-Americas Sea (IAS) Study of Climate Process (IASCLIP) based on the document that can be found at http://www.clivar.org/publications/wg_reports/vamos/pdf_files/IASCLIP.pdf, which also contains the list of its co-authors.

The Intra Americas Sea includes the Caribbean Sea and the Gulf of Mexico. The IAS region is defined as a broad area covering the IAS itself, the adjacent lands, and the ocean off the west coast of Central America.

The project is mainly on the vulnerability of the region to climate variability, particularly in relation to the associated natural disasters (flood and drought and tropical cyclones), and the affected water resources and ecosystems. On the other hand, previous climate change has left footprints on corals, sediments, and tree rings. Correct interpretation and explanation of such proxy data from the IAS region will benefit from an improved understanding of the physical and dynamical processes in the current climate. Climatic phenomena in the IAS region have substantial effects on the local geochemical system and ecosystem, being an ideal location for studying air-land-sea interaction. Moreover, current GCMs have great difficulty in correctly simulating the distribution and variability of rainfall and winds in the IAS region

Relevant scientific issues for IAS, are rainfall variability, the Western Hemisphere Warm Pool (WHWP), IntraAmericas Low-Level Jet (IALLJ), IntraTropical Convergence Zone (ITCZ), North Atlantic Subtropical High (NASH), Tropical Cyclones (TC), and Land-Air-sea Interaction (LASI). Dr. Zhang said the IAS region plays an important role in the climate of the Americas and the western Hemisphere for two reasons: its convective heating center is the largest in the western Hemisphere in boreal summer and it supplies moisture to precipitation in both South and North Americas.

This research program is envisioned as one that bridges the gaps between climate research for North America (NAME) and South America (MESA/SALLEX/PLATIN) and for the Pacific (TEPPS, EPIC, VOCAL) and Atlantic (AMI, AMMA)

The IASCLIP program embraces two themes: mechanisms for intraseasonal to interdecadal variability and prediction of rainfall in the IAS region, and the roles of the IAS region in the climate variability and prediction of Americas and the western Hemisphere

After reviewing the objectives and research targets, Dr. Zhang listed several hypotheses which would be evaluated by the project, including the factors that affect the predictability of climate variability in the IAS region, the role of extreme events on climate variability and climate change, and the air-land-sea interaction and latitudinal interaction as the thrusts of climate variability in the IAS region.

To close his presentation, Dr. Zhang listed the possible future actions, from the establishment of a SWG or CPT to complete the Science and Implementation Plan. Three stages are planned for the program:

I: quantify errors and uncertainties in models (global and regional, atmosphere and coupled) and data assimilation products
II: if desirable, conduct process studies to collect in situ observations needed for model validation and improvement
III: post field observations data analysis and modeling

2.13 Demand-driven Information for Assessment and Management of Climate-related Risks

Andrew W. Robertson, from the International Research Institute for Climate Prediction (IRI) gave a presentation, coauthored with Lisa Goddard, and Walter E. Baethgen. In the IRI's "demand-driven" approach, users are involved in the process from the beginning. It is their problems and decisions that determine what climate information would be more appropriate, and how/when that information would need to be communicated. Three fundamental components were highlighted for assessment and management of climate-related risks (i) *basic scientific knowledge* of the relevant climate variability, its impact, and viable solutions, (ii) *institutional mapping* of policy makers and decision makers, and (iii) *tailored information* that can be understood by policy makers and used directly by decision makers.

Some new IRI Projects in Latin America include (a) Climate Information and Monitoring Systems to Evaluate Risks in Agricultural Production in Paraguay & Uruguay, (b) Improving Climate Risk Assessment and Mgmt in Agricultural Production in the three regions of Paraguay/Bolivia, Southern Brazil/Argentina/Uruguay, and Northeastern Brazil, and (c) prospective new projects in Colombia concerning Dengue & Malaria Early Warning Systems, Flood Characterization & Risk Management, and Water Mgmt for Hydroelectric Power Generation.

In mapping the three fundamental components into these projects, basic scientific knowledge issues that occur repeatedly are the need for improved forecasts (SST, reducing model biases, identifying differences between physical limitations and model limitations of predictability), downscaling, and need for better data. Institutional mapping, for the example of reservoir management over NE Brazil, highlights the complexity of the participatory approach to water allocation with many competing "agents;" it illustrates how even the very best climate information can have little or no effect if it is not considered in the framework of Institutions, Policies, Social characteristics, etc. Tailored climate information for this example includes dynamic "rule curves" for reservoir management, based on seasonal climate forecasts.

The need to address these three fundamental components is dictated by the projects. The specific details of projects may differ, but their general needs (scientific knowledge; institutional mapping; tailored climate information) do not. The IRI, together with regional partners, works to develop the institutional mapping and clarify tailored information needs. Considerable impact from scientific advances is possible through the coordinated efforts of research groups/panels such as VAMOS. Great opportunity also exists to demonstrate the value of the scientific research through its application in the types of regional & sectoral projects that IRI is involved in.

3. VAMOS Modeling Workshop

3.1 VAMOS Modeling

Dr. Ben Kirtman summarized some of the ongoing CLIVAR Working Group activities on Seasonal to Interannual Prediction (WGSIP) that could be of interest to the VAMOS panel:

1) The WGSIP panel is coordinating ongoing tier-2 seasonal forecasts using prescribed but predicted SSTs. These activities include the Season Model Intercomparison (SMIP2) Historical Forecast Project (HFP). The intent is to mimic actual operational forecast setting as no future information can be used as the forecast evolves. WGSIP facilitates access to this data for the entire climate community.

2) The WGSIP panel is coordinating ongoing tier-1 seasonal forecasts. A tier-1 model predicts the SST as part of the coupled system. WGSIP facilitates access to this data for the entire climate community.

3) WGSIP is participating in numerical experimentation designed to address the relative strengths and weaknesses of a tier-1 and a tier-2 prediction system.

4) WGSIP is developing standards or best practices for seasonal forecasting and a process for monitoring real-time forecast.

5) WGSIP is taking the lead in the implementation of the COPES-TFSP Seasonal Prediction Experiment. WGSIP is also working with the CLIVAR regional panels and the TFSP to develop a seasonal forecast skill and capability catalogue. This catalogue will also serve the CLIVAR community as a central web site providing links to available seasonal forecast data.

6) WGSIP continues to collaborate with GEWEX in regarding land-atmosphere coupling and initialization. In particular, WGSIP is working closely with the GLACE Land Surface Initialization activity.

3.2 Charge to the Modeling Group for VAMOS

Dr. Carolina Vera reviewed the charge to the Modeling Group for VAMOS (MGV):

(1) Review the status of modeling relevant to VAMOS research.
(2) Organize a Workshop at VPM8 (March 2005) to bring together leading modeling groups focused on VAMOS topics.
(3) Prepare a "VAMOS Modeling Implementation Plan", including a strategy for VAMOS contributions to modeling, emphasizing joint MESA-NAME-VOCALS activities, as well as unique ones, and provide linkages to other programs (e.g. WCRP)
(4) The Plan will be reviewed by CLIVAR SSG and it should be presented at the WCRP Pan Monsoon Workshop, to be held in June 2005.

The VAMOS Modeling Implementation Plan should take in consideration the following statements:

- VAMOS can provide unique contributions to model development in the areas of:
  - Land Surface Processes (NAME and MESA)
  - Boundary Layer Clouds (VOCALS)
- VAMOS can also provide important contributions to improvement of model performance in the areas of:
  - Representation of orography
  - Cloud-Radiation interactions
  - Diurnal cycle, particularly for convection over land
  - Atmosphere-ocean interactions
- VAMOS will also use models for:
  - Hypothesis testing
  - Assess the impact on predictability of data collected in process studies

The VAMOS modeling Implementation Plan should include modeling strategies to address:

Basic "universal" problems relevant to American Monsoons
- Poor simulation of warm season continental climates
- Poor simulation of diurnal cycle (related to above)
- Poor predictions of warm season precipitation

Resolution issues
- Need to resolve key phenomena
- Application specific (e.g. regional impacts, extreme events)
- Computational issues: need for long runs, large ensembles

Physics issues
- Limitations of convection parameterizations, but intimately linked to surface interactions, atmospheric boundary layer, clouds, etc.
- Schemes largely untested at high resolution

Prediction issues

- Role of SSTs (especially other than ENSO)
- Role of land surface feedbacks (strength, time scales)
- Role of intraseasonal variability (e.g. MJO)
- Seasonal differences in predictability

3.3 Physical Processes in the Monsoon regions

3.3.1 Diurnal Cycle and Mesoscale Variability in SAMS *(Pedro L. Silva Dias, Institute of Astronomy, Geophysics and Atmospheric Sciences, University of São Paulo, Brazil)*

This presentation provided an overview of the main mechanisms associated with the diurnal variability of convection in South America and of the mechanism controling the formation of precipitating systems.

The presentation began with an overview of the causes for the night formation of MCS's in the SA continent: (1) a large scale mountain-valley circulation during nighttime, between the Andes Mountains and the Paraná River valley, providing low level convergence in the valley, (2) the intensification of the low level jet from the north, during the night, due to: (a) the decoupling from the convective boundary layer, (b) thermal differential heating over sloping terrain or (c) due to intensification of the thermal low (Chaco or NOA) during Chaco jet events when the LLJ diurnal cycle has a larger amplitude. It is reasonably well accepted by the research community today that it is necessary to have a pre-existing condition associated with an upper level jet, associated divergence, and eventually a short wave through middle levels adding to the favorable conditions usually present at the initiation time. Similar conditions have been observed associated with the MCC of North America and other regions. However, there are clear links to the intraseasonal and interannual variability and therefore there is a strong control exerted by upper level flow and low level jet. The linkage to the upper level flow and low level jet provides some clues to the predictability of the occurrence of the MCS's in longer time scales.

Several modeling studies on MCS's are available. J. Paegle's diurnal cycle of convective weather (observations at surface stations), the Nocolini, Paegle and Altinger work on the numerical simulation of convection and boundary layer convergence (ideal experiments in calm conditions, with an ideal flow and simulation of a real case with a PBL model interacting with a convective model to see the effect of the topography and of a cyclonic circulation in the diurnal cycle of vertical motions at the PBL top over Argentina). There are important studies with the ETA model (Berbery and Collini work) and the Nicolini and Saulo paper on the diurnal cycle of the September 1997-February 1998 period and for the Chaco LLJ events. There are RAMS simulations of one particular MCS case with emphasis in the impact of data assimilation (the Nicolini et al 2002 paper and the Nicolini, M., Y. García Skabar, A. G. Ulke and A. C. Saulo, 2002). The RAMS model performance in simulating precipitation during strong low-level jet events over South America. Meteorologica has also been explored (Meteorologica, Special Issue for the South American Monsoon System, 27, 89-98). The role of horizontal resolution has been discussed by Hallak (MSc thesis at IAG/USP in 2000) and the impact of cloud microphysical processes. This work explores the role of precipitation efficiency in developing the MCS system.

The three dimensional structure of the MCS's in northern Argentina/Paraguay are better understood after SALLJEX. The radar and TRMM data and the aircraft meteorological data provided unique data sets. It is now quite clear that some of the MCS's are rather inefficient from the point of view of conversion of liquid water to precipitation. This is a challenge to models and needs to be studied in detail because of the implications on the predictability and on data assimilation issues. Modeling studies on the S. American MCS's in northern Argentina clearly show the importance of properly modeling the diurnal cycle.

Another important issue associated to mesoscale systems in tropical S. America is the potential role of deforestation in realistic patterns in setting up pasture/forest breeze circulation that may eventually lead to increased precipitation. There are several model studies (Silva Dias et al. 2002 – JGR and Avissar et al. 2002 – JGR) exploring this possibility. However, just recently the first observational evidences were produced. There are now satellite precipitation studies indicating that there may be more precipitation over deforested areas in the wet season, less in the dry season, i.e., increased seasonality and a possible northward shift of the equatorial-tropical transition zone (Durieux, Machado & Laurent, 2003). The satellite evidences indicate that the diurnal cycle is very strongly related to the role of the shallow clouds that are important to set up the proper environment for deep convection in the later part of the day. This effect is missing in most models. However, Souza's (2001) PhD thesis explores the possible implications of a new shallow cumulus parameterization, with closure based on the Second Law of the Thermodynamics, that provide a strong control of the surface processes on the development of the convective shallow clouds. Just recently, the Souza scheme was implemented in the CPTEC global model and new results were shown, indicating a significant improvement in the description of the diurnal cycle of precipitation in the Amazon and Central Brazil.

The potential impact of biomass burning aerosols in the organization of convective systems during the transition season in tropical and sub-tropical S. America was also explored in the presentation. So far the effect of the aerosols has been explored from the point of view of the radiative impact. It has been shown by Freitas et al (2005) that biomass burning aerosols emitted in the southern Amazon may reduce precipitation in northern Argentina, Paraguay and Southern Brazil. The role of biomass burning aerosol in the cloud microphysics processes remains to be explored. Modeling of these effects is very strongly tied to ability to model diurnal cycle and convective systems

In summary:

- There is need for a more accurate numerical scheme for description of flow along the Andes;
- Coupling between surface processes and convective parameterization is critical;
- Diurnal cycle of MCS shows some sensitivity to soil moisture initialization;
- Different models – different diurnal cycle;
- Improve biomass burning emissions modelling;
- Soil moisture initialization and control on convection are issues;
- Data assimilation and the impact of model errors in the diurnal cycle need attention;
- Improve cloud parameterization for low resolution models, in particular for the role of shallow convection and the linkage to surface processes;
- There is an important issue on precipitation efficiency and the potential role of aerosols.

3.3.2 Diurnal Cycle in NAMS

In his presentation, Dr. Siegfried Schubert made an assessment and analysis of the warm season diurnal cycle over the continental United States and Northern Mexico using global atmospheric model simulations.

The diurnal cycle of warm season rainfall was analyzed in three global atmospheric general circulation models (NCEP, GFDL, and NASA). While the models have similar convective schemes based on buoyancy closure, they are characterized by different diurnal cycles in the North American Monsoon (NAM) region.

A set of sensitivity tests with the NASA model showed that the source of the differences among the models appears to be from the implementation details of the convection scheme and the interaction with the boundary layer. Sensitivities to horizontal resolution in the model were also tested. High-resolution runs (0.5 deg.) resolved the key local and mesoscale features (e.g. land-sea breeze). However, increased resolution has less of an impact on the simulated diurnal cycle of convection, suggesting the need for improvements in model physics (especially in the convection scheme). Several AGCM development issues were identified in the study, in which the vertical dynamic and thermodynamic structures from the NAME 2004 field observation are key elements to be verified with the current models. .

3.3.3 MESA-SALLJEX Modeling *(Celeste Saulo, Universidad de Buenos Aires, Argentina)*

A report about modeling activities related to SALLJEX was presented to VPM8. This report encompassed the main activities in this regard carried out by MESA community, which can be categorized as follows:

- Model intercomparison experiment
- Data Assimilation efforts
- Model Development

The Model Intercomparison Experiment -comprised of 4 experiments using different initial and/or boundary conditions and/or resolution- has been used to illustrate some preliminary results of SALLJEX data assimilation efforts and also of model development associated with the improvement of forecasts during SALLJEX period. A key aspect of the first two experiments has been to assess the degree of dispersion of forecasts generated with identical initial and lateral boundary conditions, and very similar domain, while changing the horizontal resolution from relatively low (80 km, exp #1) to relatively high (exp #2) (Paegle et al, Exchanges vol 29).

The 3rd and 4th experiments had been proposed at VPM7, as a continuation of the model intercomparison activity. This second set of experiments was conceived to assess the impact of SALLJEX data in the representation of the same Mesoscale Convective System that was not well captured by regional models (exp #1 and #2). Using CPTEC enhanced analysis, which included SALLJEX radiosonde data, the referred case study has been re-run by many participants (Exp. #3). Also, since CPTEC operational analysis is not the same as GDAS analysis used in the 1st and 2nd experiments, the use of this analysis was also proposed to have an alternative control run (exp. #4).

For this particular case, there is stronger impact due to different analyses (GDAS vs CPTEC operational) than due to ingesting SALLJEX radiosondes into CPTEC analysis. The largest differences between SALLJEX and no-SALLJEX analyses have been found at 06 and/or at 18 UTC particularly over stations where strong convective activity was present. It has been suggested that such a large difference could prevent the ingestion of data, since the impact could be so large that the objective analysis scheme could reject the special data. This result should be checked for all the SALLJEX period.

Models are also sensitive to other factors such as resolution and convective parameterization (best results from Kain Fritsch in this particular case). The high degree of dispersion between model runs and between the analyses suggests that this particular situation is characterized by a “lack of predictability” and/or a strong influence of analyses errors or “errors of the day”. Results showing a better performance of an ensemble of forecasts derived from a breeding vector technique support this idea.

Some questions posed after this report were:

- Which could be a feasible level of "intercomparison of model results" within VAMOS?
- Soil moisture intialization impact (LBA, for example) suggests need for improvement in assimilation
- Synergism between the stronger low level jets, MCS and upper level circulation points to the issue of whether current assimilation techniques will "accept" data at UTC times that imply a strong change in the circulation. It seems that CPTEC analysis handled this reasonably well, though smoothing the impact.

3.3.4 North American monsoon Model Assessment Project (NAMAP)

Dr. Dave Gutzler reported on planning for a collaborative modeling effort ('NAMAP2') to compare and assess simulations of the 2004 warm season across the NAME domain. This effort is a follow-on to the successful NAMAP assessment, which included four regional and two global models, that was carried out prior to the NAME 2004 field campaign. Over the next several months, NAMAP2 collaborators will develop protocols for comparable atmospheric model simulations of summer 2004, including a common SST field and time-varying lateral boundary conditions for regional models. The purpose of NAMAP2 will be (a) to generate a set of common atmospheric model control runs that can be used as a basis for model sensitivity studies; (b) to assess the general quality and shortcomings of these control simulations (comparing the results with NAMAP runs); and (c) to apply the knowledge gained from this assessment to an operational forecast model under development at NOAA NCEP. Participation is open. An immediate need is to develop a suitable SST data set for the NAME 2004 field campaign season (Pingping Xie and Wanqui Wang of NOAAs Climate Prediction Center have taken on this task), including a treatment of the Gulf of California that is superior to current operational products.

3.3.5 Land-surface Processes in South American Monsoon System *(Carlos A Nobre, CPTEC-INPE, Brazil)*

7th VAMOS Panel Meeting identified the following Predictability issues:

- Unique feature of South America precipitation (that is mostly convective in nature):

  air entering from the ocean is not unstable enough to participate in convection; <u>the land-surface has an outstanding role</u>. Seasonal predictability, marine ITCZ are associated with high skill. Further south, the entrance into the land reduces seasonal predictability.

- Complexity of orography is also a source of unpredictability.
- The dynamic equilibrium between different large scale regimes and local forcings: very hard to predict. Interannual variability is very strong.
- A stationary heat source over Amazon is enough to explain the pattern of circulation of SA. How does the external forcing interact with that? Is there an intrinsic mode that will respond to the external forcing?
- How do the SST anomalies in the Atlantic affect the seasonal predictability over S. America?
- <u>How do local soil moisture conditions (including vegetation biophysical processes) affect the seasonal predictability over S. America</u>?

To illustrate the role of land surface processes in SAMS, four modeling examples were discussed:

- The correct specification of soil moisture as an initial condition for short range forecasting reduces significantly the wet bias in rainfall forecasts over the SACZ.
- Land use change, mostly Amazon deforestation, may decrease moisture transports from the Amazon Basin into the Plata Basin. However, it does not follow immediately that rainfall will decrease in the Plata Basin since it is not only determined by southward moisture transports, but to the 3-D dynamics of the atmosphere.
- Role of land surface processes in South American monsoon development. A sensitivity study explicitly considering the physiological effect of vegetation shows that it produces a better simulation of SAMS in comparison to a land surface sub-model without that effect, but where the albedo was specified as for vegetation. The surface partition of energy was much better represented, which produced different latitudinal and longitudinal thermal gradients at the surface. Those in turn determine the changes in circulation via changes in heating gradients, which changed precipitation.
- Aerosol and dynamic vegetation during the transition from the dry to wet season in SW Amazonia. Dynamic vegetation models coupled to atmospheric models indicate that the large aerosol content of the boundary layer due to biomass burning influence the development of vegetation in the transition from dry to wet season. The basic mechanism is related to more available diffuse radiation on a aerosol-rich atmosphere, inducing more photosynthesis.

Observational issues to be tacked by MESA

- Satellite estimates of vegetation biophysical parameters.
- Use and assessment of land data assimilation systems (e.g., NCEP, CPTEC, others).
- Critical need for soil moisture observations for model validation (systematic effort to carry out 'data archealogy' for soils and soil moisture measurements, mostly from agricultural research stations).
- Need of long term surface flux network for SAMS (expansion on initial existing network out of LBA and other initiatives; there are over 10 surface flux towers in the SAMS region)

3.3.6 Land-surface Processes in NAMS *(Dennis P. Lettenmaier, Department of Civil and Environmental Engineering, University of Washington, Seattle, USA)*

A set of hypotheses underlying a linkage between land surface processes and the strength of NAMS summer precipitation were outlined, along with an approach to evaluating the chain of hypotheses. The hypotheses are constructed around the idea that anomalously wet (dry) monsoon years tend to be preceded by anomalously dry (wet) antecedent winter precipitation, and/or anomalously low (high) snowpack in the previous winter. These hypotheses are based on the idea that wet antecedent conditions, and/or suppressed solar radiation absorption, lead to suppressed land-ocean contrast and hence weak monsoon conditions over the NAMS domain. The reverse (low antecedent soil moisture and/or early snowmelt) leads to strong monsoon conditions. The reality is, of course, somewhat complicated, but the two hypothesized mechanisms form a simple physical basis that is supported by various previous studies – primarily statistical in nature – that have suggested linkages of the nature indicated above. It was shown that for the suggested mechanism(s) to be viable, three conditions are required: 1) anomalously wet antecedent winter conditions (and/or anomalously persistent winter snow) lead to enhanced spring and early summer soil moisture; 2) enhanced spring and early summer soil moisture lead to suppressed land-ocean temperature contrast at the onset of the monsoon season; and 3) suppressed land-ocean temperature at the onset of the monsoon season lead to anomalously weak monsoon conditions. It was also shown, using a long-term coincident data set of precipitation, temperature, and derived (using the VIC macroscale model) soil moisture that the first condition is met – that is, over most of the period 1950-2000, over the southwestern U.S., anomalously wet winter conditions lead to soil moisture anomalies that persisted into the late spring. However, the second condition breaks down – suppressed surface (soil) temperatures at the onset of the monsoon generally did not accompany anomalously wet conditions in the late spring. The reason appears to be that that while the first condition can be substantiated, soil moisture storage is not large enough to allow anomalies to persist through the high evaporation early summer season. Therefore, late spring soil moisture anomalies are not associated with anomalies of the same sign at the onset of the monsoon, and as a consequence, suppressed land-ocean temperature contrasts at the onset of the monsoon are not, in general, associated with late spring soil moisture anomalies. Instead, anomalies in NAMS strength appear to be more associated with variations in synoptic conditions, as evidenced by Z500 anomalies over the western U.S. Further elucidation of the mechanisms controlling variation in NAMS strength will most likely require controlled experiments using coupled land-atmosphere models.

3.3.7 Air-sea Interaction in the SAMS Region *(Carlos A Nobre, CPTEC-INPE, Brazil)*

This talk covered aspects of the mechanisms and predictability issues related to the formation of the Intertropical Convergence Zone (ITCZ) and South Atlantic Convergence Zone (SACZ), which affect climate variability over South America. The key issue discussed is the formation of deep cumulus convection over cold waters, as it is the case of the SACZ. It was shown that while ITCZ interannual variability, both position and strength, is very well captured by SST forced AGCM simulations, rainfall variability associated with the SACZ as simulated by sst-forced AGCM integrations is negatively correlated with observations.

Preliminary results of coupled ocean-atmospheric research related to summer rainfall variability over South America done at CPTEC shows a significant improvement of predicted summer rainfall associated with the SACZ, while showing a degradation of the rainfall interannual variability associated with the ITCZ. It is speculated that both results are a consequence of coupled SST-cloud-radiation feedback. In the former case, the o-a coupling partially corrects the thermodynamic imbalance of AGCM experiments, with their inherent inability to generate atmospheric convection over cold waters. In the latter case, the lack of low stratus cloud decks over the eastern Atlantic in the coupled model results in excessive solar radiation reaching the ocean surface, thus generating an erroneous east-west SST gradient, which in turn generates erroneous atmospheric convection patterns. So far, these results are encouraging in the sense that coupled ocean-atmospheric models may generate seasonal rainfall forecasts over South America and South Atlantic with better skill then AGCM simulations currently do.

3.3.8 Regional Air-sea Interaction in the NAMS Region *(Luis Farfán, CICESE, La Paz B.C.S., Mexico)*

Luis Farfán discussed issues on the regional air-sea interactions in the NAMS. This included the diurnal cycle of convection over the Mexican mainland and its propagation toward the Gulf of

California during the evening. The presence of a warm pool (SST>28°C) is an outstanding feature along the gulf, along with its limited zonal extent and a contrasting pool over the Pacific that is adjacent to Baja California. Atmospheric data from the North American Regional Reanalysis for August 2003 were taken to illustrate the structure of low-level circulations, including the spatial distribution of winds and moisture. The development of tropical cyclones was indicated as a source of low- to mid-level moisture and the occurrence of landfall events for cases that have a storm track over the gulf.

3.4 Climate Forecasts in the Monsoon Regions

3.4.1 Seasonal Forecasts in SAMS *(Iracema F.A. Cavalcanti, CPTEC/INPE, Brazil)*

The main aspects of South America Monsoon, its simulations, products from seasonal prediction, aspects of predictability, challenges to seasonal prediction in the SAMS area, and future activities to improve the predictions were discussed. Seasonal prediction over South America has been performed mainly by CPTEC/INPE, IRI, the UK Met Office, ECMWF with the products available on the internet. Monsoon features that need to be simulated by the models are:variability in seasonal, intraseasonal, interannual and synoptic timescales, as well as the diurnal cycle. The ability to simulate in a long range integration, features associated with frontal systems, Bolivian High, South Atlantic Convergence Zone and meso-scale (Mesoscale Convective Systems and Low Level Jet), reveal the base for analysis of seasonal prediction in the monsoon region. Results of a climate simulation with CPTEC/COLA AGCM show that the seasonal, variability is well represented by the model. The summer and winter precipitation (SACZ in the summer and lack of rain over central and SE Brazil) as well as atmospheric flow at high and low levels (Bolivia High in the summer, orientation of trade winds over northern South America) are some examples of monsoon features represented by the model. The model represents some features of intraseasonal variability and displays a diurnal cycle in precipitation. However, the Southeast and Central Brazil, which comprise a large part of the South America Monsoon region, have the lowest predictability of South America, and the models display large spread among ensemble members.

Anomaly precipitation and probability maps of seasonal prediction are products available monthly at the institutions mentioned above. A multi-model approach has been conducted by IRI, considering several AGCMs. Seasonal prediction using Regional Models is in development, Eta at CPTEC and RegCM at IRI. Improvements in the parameterization schemes, to radiation and convection, the introduction of a new vegetation field, a more realistic soil moisture field, and variability of CO_2 and ozone are activities in development at CPTEC. Future implementations are: the use of coupled ocean-atmospheric modeling; use of regional models; application of new techniques to interpret model results; analysis of the diurnal cycle, intraseasonal variability and application of cluster analysis in seasonal prediction results.

3.4.2 Influence on Initial Conditions *(Jae Schemm, and Kingtse Mo, NOAA/NWS/NCEP/CPC, USA)*

The impact of initial conditions on summer precipitation over North America for July-September was examined by comparing long term simulations of the Atmospheric Model Inter-comparison Project (AMIP) type with the ensemble simulations initialized at the end of June each year. Both types of simulations use the observed sea surface temperatures (SSTs) as boundary conditions, and hence, the differences come from the initial conditions. Experiments were performed using both the NCEP Global Forecast System (GFS) T126L28 model with 28 vertical levels and the T62L64 model with 64 levels in the vertical.

The impact of initial conditions on precipitation is dependent on regions. For the Great Plains, the AMIP runs in both resolutions have dry and warm biases and fail to capture interannual variability. The simulations with the T126L28 and the T62L64 models are similar and are closer to the observations. The realistic initial conditions improve precipitation and surface temperature simulations. For the monsoon region, the horizontal resolution has larger impact. The T126L28 model is able to capture the relationship between evaporation and soil moisture, and better resolve the orography of the region and the Gulf of California. That minimizes errors in precipitation. Also over the North American monsoon region, the model is able to capture the relationship between evaporation and soil moisture.

3.4.3 Predictability of the Intraseasonal Variability of the South American Summer Monsoon *(Vasubandhu Misra, Center for Ocean-Land-Atmosphere Studies, COLA, USA)*

This study reveals the inadequacy of the Center for Ocean-Land-Atmosphere Studies (COLA) Atmospheric General Circulation Model (AGCM) and National Center for Environmental Prediction (NCEP) reanalysis to resolve the variance of the intraseasonal anomalies of outgoing longwave radiation (OLR) over the South American summer monsoon (SASM) domain and the equatorial eastern Pacific Ocean (EEPO) owing to their coarse horizontal resolution. However, when the NCEP reanalysis is downscaled by roughly a factor of 2.5 using the regional spectral model (RSM, Control-A experiment) the simulation of the seasonal mean variance of intra-seasonal anomalies of OLR improves significantly. But downscaling the results of the COLA AGCM (control-B experiment) by roughly a factor of 4 led to no further improvement.

Using the novel technique of anomaly nesting which replaces the climatology of the COLA AGCM of the nested variables at the lateral boundaries of the RSM with the NCEP reanalysis climatology (AN experiment), the simulation of the intraseasonal variance of OLR improves significantly over control-B runs. This improvement is shown to coincide with a distinct diurnal variation of the intraseasonal scales displayed in the AN integrations which compare reasonably well with control-A integrations. It is shown that the diurnal cycle in the COLA AGCM is excessive and extends into the open oceans which is contrary to NCEP reanalysis and other independent observations. As a result the energy at other scales in the COLA AGCM are muted. In the AN runs this diurnal bias is rectified which seems to enhance the skill of the regional model at intraseasonal scales.

3.4.4 VAMOS Modeling Strategy *(Kingtse Mo, NOAA/NWS/NCEP/CPC, USA)*

The major goal of VAMOS modeling is to improve seasonal forecasts over the Pan America region from the time scales from monthly to seasonal. The proposed VAMOS modeling strategy adopts an end-to end forecast system from predicting global SSTs using an ocean-atmosphere coupled model to forecast large scale atmospheric circulation anomalies on the continental scale, to precipitation or anomalies on the regional scale by either downscaling using a regional model or using a high resolution global model directly. Over the core monsoon region, moist convection in the presence of complex terrain and land/sea contrasts; land/atmosphere interactions in the presence of complex terrain; and regional air-sea interactions can be modeled using high resolution regional models or using explicit cloud resolving model. To focus on regional applications, a regional model can be used to downscaling for hydrological applications, fire weather prediction and environmental related application.

The NOAA Climate testbed offers the VAMOS community opportunities and computer resources. It will be a win-win situation to collaborate within the framework of the climate testbed.

3.4.5 NOAA Climate Test Bed *(Wayne Higgins, NOAA/NWS/Climate Prediction Center, USA)*

NOAA National Centers for Environmental Prediction (NCEP) and the NOAA Climate Program Office jointly established the NOAA Climate Test Bed (CTB) facility at NCEP. The NOAA CTB will (i) enhance a cooperative partnership between NOAA operational and research centers and the broader external research community by providing an operational testing facility, (ii) deliver opportunities for goal directed research using the Climate Forecast System, other climate models, and a state of the art multi-model ensemble approach to improving climate prediction, (iii) accelerate the transition of research advances into enhanced NOAA operational climate forecasts, products and applications, and (iv) increase the range and scope of applications, and the economic benefit, of operational climate forecasts for policy-making and decision-making by end users.

The CTB facility includes infrastructure (computing support; management and administrative staff; system and science support) and transition projects. Near-term CTB science projects (climate model assessments, multi-model ensembles, climate products and applications) are carried out by reallocated NCEP personnel with some NOAA climate program augmentation funds. Additional needs for the CTB to support the external community (computing support, system administration, data management, software (models and data sets) support, and scientific collaboration) in advance of a competitive grants program have been identified. The competitive grants program will begin in FY 2006 to facilitate collaborative research with the external community on CTB transition projects.

The CTB includes a Management Team, an Oversight Board (OB), an external independent Science Advisory Board (SAB), and a Climate Science Team (CST). The Management Team consists of the CTB director (NCEP/CPC), the CTB deputy director (NCEP/EMC), and the CTB program manager (NOAA/Climate Program Office). The Oversight Board sets overall policy and directions of the CTB and reports to the director of NCEP and the director of the NOAA Climate Program. Members of the SAB provide independent expert advise to the CTB management team on scientific priorities and directions and provide their findings to the OB. The CTB CST consists of NOAA and external scientists who lead CTB transition projects.

During the first quarter of FY2005 the CTB also established Terms of Reference, developed a “White Paper” that includes a statement of need, established a “Transition to Operations Plan”, established an Annual Operating Plan within NCEP, and developed a CTB website (www.cpc.ncep.noaa.gov/products/ctb). The website provides information on the CTB mission, science priorities, current activities and all of the CTB documentation mentioned above.

3.4.6 Hydrometeorological Modeling in SAMS *(Hugo Berbery, University of Maryland, USA)*

A review of modeling needs and techniques needed to address the main scientific hydrometeorological issues of the South American Monsoon System (SAMS) was presented.

Three main scientific questions that require modeling approach were identified and possible approaches were discussed. First, what is the role of the remote processes (e.g., Ocean and Amazon forcings) in the dynamics and moisture supply of the monsoon? Second, have changes in land cover or land use affected the precipitation regimes and resulting runoff of the region? Lastly, how can models help address the hydrological needs of the region (namely flood/drought prediction, hydropower needs, soil moisture availability).

To help address the above questions the presentation offered a survey and evaluation of models that are being run over South America, including the Eta and WRF models. Emphasis was put on the coupling of regional mesoscale models with distributed hydrological models and river routing schemes. This area of research is well advanced and appears promising to help bridge the gap between atmospheric-only and hydrologic-only approaches to the above questions. The advantages of the ensemble approach not only for the atmospheric but also the hydrologic model products were discussed. The presentation was completed with a discussion of a hierarchy of hydrodynamic models being employed to assess the possible La Plata River flood scenarios resulting from climate change.

3.4.7 Hydrometeorological Modeling in NAMS *(Dennis P. Lettenmaier, Department of Civil and Environmental Engineering, University of Washington, Seattle, USA)*

Progress within the North American Monsoon Experiment in three aspects of hydrometeorological modeling was reviewed. The first is real-time macroscale modeling (nowcasts) during the summer, 2004 field campaign over NAME Tier 1. The VIC macroscale hydrology model was run in real-time during summer 2004 using model forcings taken primarily from the NCEP Eta Data Assimilation System (EDAS). These real-time simulations are now being re-run at the University of Washington using observed precipitation data acquired from SMN, quality controlled after the fact, as well as summer 2004 data from the NAME Event Raingauge Network (NERN). The second area summarized is the status of retrospective VIC simulations over NAME Tier 2 from 1925 to present. The retrospective simulations (from 1925 to present) are being run using precipitation forcings taken from a combination of the ERIC2 (IMTA, covering 1940-98), SMN Data322 (pre-1940), and SMN daily historical precipitation data post-1995) provided by SMN courtesy of Dr. Miguel Cortez. All data sets are being reviewed in cooperation with Dr. Art Douglas of Creighton University. As part of the retrospective macroscale hydrological model evaluation effort, simulations have been performed for a set of fifteen gauged (and modestly affected by regulation) watersheds relatively uniformly spaced over Mexico. Adjustments of model soil parameters performed to match predicted and observed runoff were then extended over the name Tier 2 domain by interpolation. Hydrologic predictability in the context of the University of Washington west-wide experimental hydrologic forecast system is reviewed. Over most of the west-wide domain, hydrologic predictability is controlled by winter snow accumulation, and spring melt. The possibility of extending the UW west-wide system south, over part of NAME Tier 1, would have the scientific benefit of allowing evaluation of hydrologic predictability in a summer-dominant precipitation regime. Finally, basin scale hydrologic modeling activities being carried out by Dr. David Gochis (NCAR) were reviewed briefly.

3.4.8 Climate Change Simulations of the South American Monsoon System *(Rafael Terra, IMFIA, Universidad de la República, Uruguay)*

The motivation of the presentation was to give an overview of the Climate Change Research taking place in South America by reviewing and presenting preliminary results of the analysis projects presented to the IPCC AR4 initiative. Of a total of approximately 250 analyses, 12 were related to Climate Change and South America, 7 of which are being coordinated under the CLARIS (A Europe-South America Network for Climate Change Assessment and Impact Studies) project. What follows is the list of topic and PIs.

- **Dominant large-scale patterns influencing the seasonal predictability of precipitation over South America. PIs**: C. Vera, CIMA/UBA; G. Silvestri, UBA; B. Liebmann (NOAA/CDC)

- **Frequency changes in daily weather regimes over South-Eastern South America. PIs**: J.-P. Boulanger, CNRS; G. Cazes and C. R. Mechoso, (Uruguay-UCLA).
- **Analysis of regional circulation regimes over southern South America and their response under global warming. PI**: S. A. Solman, CIMA (UBA-CONICET).
- **Surface climate response associated with Southern Annular Mode (SAM) changes. PIs**: A. Carril, INGV; C. Menéndez CIMA/UBA.
- **Future scenarios of atmospheric circulation, precipitation and temperature in the South America Monsoon Region**. **PIs**: I. Cavalcanti, P. Silva Dias, D. Herdies, C. Cunningham, H. Camargo, T. Tarasova, K. Andrade, (CPTEC-Brazil)
- **Sensitivity of South American Monsoon-related Features to Anthropogenic Changes in Radiative Forcing. PIs**: A. Seth, S. Rauscher (IRI-USA), and M. Rojas (Chile)
- **Poleward penetration of the monsoon over the South American continent in a changing climate. PI**: R. Terra, (IMFIA-Uruguay)
- **Tropical Extratropical interactions in present and future times: The connections between La Plata and the Amazon Basins. PIs**: J. Marengo, C. Campos, M. de Mello and W. Soares (CPTEC-Brazil).
- **Tropical South Atlantic/South America scenarios; assess ocean circulation changes associated with tropical-extratropical exchanges. PI**: I. Wainer, USP.
- **The ENSO effects in the atmospheric circulation and in the climate of southern South America. PIs**: V. Barros, I. Camilloni, M. Doyle (CIMA/UBA, Argentina).
- **Analysis of extreme indeces. PIs**: M. Rusticucci and O. Peñalba, UBA; J. Marengo, CPTEC/INPE; M. Renom, UR; M. Núñez and C. Menéndez, CIMA/UBA.
- **The comparative analysis of interannual variability of global climate characteristics of the two hemispheres using adiabatic invariants. PI**: I. Pisnitchenko (CPTEC, Brazil).

3.5 VOCALS Modeling Activities

3.5.1 Challenges of ocean modeling in the VOCALS domain *(Arthur J. Miller, Scripps Institution of Oceanography, USA)*

Some of the more important ocean modeling problems that could be addressed within the VOCALS framework include resolving mesoscale eddies, assessing sensitivities to air-sea coupling and including phytoplankton production of aerosols in the coupled system. Mesoscale eddies generated in the upwelling zones of the Peru-Humboldt Current can influence the large-scale open-ocean regions. These eddies can transport large amounts of cold water into the SST field and and they can set the properties of the thermocline and haloclines as they intersect the coastal regions. These effects are only beginning to be studies in high-resolution ocean models. Eventually the effects of these eddies need to be included in regional coupled models as well.

Surface heat fluxes and wind stresses can be influenced by the evolving ocean SST, especially due to the SST influence on changing the stability of the atmospheric boundary. Wind stresses can also be influenced by the changing surface current field. These effects needs to be studied using high-resolution regional and basin-scale coupled models to assess the importance of these feedbacks in the atmospheric boundary layer response and to investigate their influence on ocean current stability properties.

As the ocean physical system promotes phytoplankton blooms in the coastal upwelling zones and in open-ocean regions, key types of phytoplankton produce volatile organic compounds such as dimethylsulfide. These can result in atmospheric aerosols that can influence the radiation budget of the atmospheric boundary layer and serve as cloud condensation nuclei.

These effects are very poorly understood but could help to explain certain features of the large-scale patterns of stratus in the VOCALS region. A regional coupled ocean-atmosphere-ecosystemmodel that includes all these effects in the VOCALS domain would be a great challenge and a useful tool in this framework.

3.5.2 Modeling Challenges: ENSO, E Pacific and VOCALS *(Ben Kirtman, Climate Dynamics GMU, Center for Ocean-Land-Atmosphere Studies, COLA, USA)*

The current status of coupled model in the VOCALS region was assessed. The assessment included four very different models. The challenges noted below were universal among all the models, suggesting that these issues are related to a fundamental lack of understanding of the key physical processes.

1) The well known and long standing double ITCZ problem is apparent in SST and rainfall across a range of different models. Current model results suggestion that modest increases in resolution do not solve the problem. However, these increases may still be too small to adequately resolve the key physical process in the VOCALS region.

2) All the models produce mixed-layer depths that are too shallow throughout most of the eastern Pacific. This suggests that mixing processes are poorly understood.

3) The models all produce thermoclines that are too diffuse. Some of the problem is related to resolution, but also is due to the fact the vertical and horizontal mixing in the ocean is not well represented in the models.

4) The models produce excessive warming along eastern boundary. Some of this error has been corrected by improving the representation of the stratus cloud in the model. However, much of the problem persists and is related to the fact that the along shore winds are directed too far inland along the coast of South America.

5) Finally, the models produce annual cycles in the eastern Pacific that are too semi-annual, too weak and displaces too far to the west. The interannual variability typically extends too far to the west, is too narrowly confined to the equator and is too weak along the eastern boundary of South America.

3.5.3 **Boundary Layer Cloud Parameterization/modeling Issues of Relevance to VOCALS** *(Chris Bretherton Department of Atmospheric Sciences, University of Washington, USA)*

Dr. Chris Bretherton made a summary of the challenges related to the boundary-layer cloud parameterization:

- Stratocumulus (Sc) layers are too thin and inhomogeneous;
- Representation of shallow cumuli and transitions between stratocumulus and shallow cumuli must be improved;.
- Feedbacks between turbulence, clouds, radiation, surface fluxes crucial to cloud maintenance;
- Sharp, strong capping inversion over Sc;
- Precipitation and aerosols;
- Coasts;
- A good simulation requires careful formulation of turbulence, cloud fraction and microphysics, cumulus convection, and good vertical resolution.

A series of issues related to the importance of boundary-layer cloud parameterization to large-scale models include:

- Tropical mean/seasonal cycle biases in coupled models.
- Cloud feedbacks on climate perturbations, aerosol indirect effect.
- Cloudy boundary layer feedbacks on ENSO.
- West coast weather forecasting in S and N America

Tropical biases and cloudy boundary layers present persistent biases of coupled climate models which affect representation of winds, rainfall, radiation: double ITCZ, warm SSTs in eastern subtropical oceans, and the semiannual seasonal cycle of E Pacific equatorial SST. Boundary-layer clouds could be important to these biases as locally, stratus clouds cool both the ocean and the atmosphere and non local changes in winds, upwelling, and precipitation affect the entire tropical ocean.

The VOCALS strategy for improving cloud simulations consists, among others, on the validation of buoy, ship, satellite datasets. The engagement of all model types is also an important issue, as well as the interaction with CPT, and GCSS for parameterization development and model diagnosis through:

- Process modeling of aerosol-cloud-drizzle feedbacks, diurnal cycle.
- Planned partnerships with NOAA Climate Testbed and CAPT.
- Sensitivity studies

Dr. Bretherton concluded that VOCALS includes modeling groups at the cutting edge of most aspects of boundary layer cloud simulation and parameterization and that VOCALS/EPIC data from the WHOI buoy and cruises to it are being fruitfully compared with models. He said a central goal for VOCALS was to produce better simulations of SEP cloud feedbacks with ENSO, the seasonal cycle, and the diurnal cycle in all models. Interesting aerosol-cloud interaction in this region could be observed from VOCALS/EPIC data. Efforts to model this were in its initial stages, together with parameterization efforts in the GCM groups. He indicated richer interaction with NCEP would be greatly helpful to this effort.

3.5.4 Modeling of the MBL and Low-level Jet off the Coast of Western South America

(René Garreaud, Ricardo Muñoz, José Rutllant, Department of Geophysics, Universidad de Chile)

The existence of a southerly coastal jet off central Chile, revealed through satellite-derived surface winds, was reviewed in terms of its seasonal mean field and frequency of occurrence. The coastal jet is mostly a spring-summer phenomenon that occurs over 65% of the time with a modest standard deviation. A one-point correlation analysis among wind-speed, u and v wind components and liquid cloud amounts shows that near the coast the jet is co-located with a decrease in cloudiness, with a slight increase downwind (convergence within the MBL). Offshore the jet is associated with increased stratocumulus cloud cover and a stronger, southward displaced subtropical anticyclone (surface cold advection).

The 3-D structure of the coastal jet observed during the CIMAR 6 cruise (October 1-20, 2000) was simulated with the MM5-V3 model using the Gayno-Seaman PBL parameterization. The model shows a thinner and cloudier offshore MBL that becomes extremely shallow and cloudless near-shore. This MBL representation improved significantly when doubling the vertical resolution, although the coastal MBL was still too shallow.

In spite of the difficulties in capturing a realistic MBL, simulated surface winds follow closely those observed by satellite (QuikScat) and those measured in the afternoon at Point Lengua de Vaca

(30°S), where a strong diurnal cycle exists in contrast with a negligible one in the offshore coastal jet. The simulated steady-state 3-D structure of the coastal jet in a period of steady winds shows a cross-shore scale of about 500 km just downwind of a region of strong meridional thermal gradient. The jet core is located near the top of the MBL with weak zonal flow components (blocking effect of the coastal topography).

The model-derived steady-state dynamics of the jet reveals a close geostrophic adjustment in the cross-shore direction and a close balance between the pressure-gradient force and friction in the along-shore direction.

It was concluded that:

a) High vertical resolution is required to properly simulate the MBL off central Chile with the MM5/Gayno-Seaman model. High horizontal resolution and model validation is also needed in the 0-50 km coastal strip.

b) Operational runs of the MM5, even with coarse vertical resolution, are still able to resolve the timing, position and intensity of the surface coastal jet, leading to good perspectives for wind and cloud-cover forecasts.

3.5.5 Regional Coupled Ocean Atmosphere Models in the Southeast Pacific *(Yuqing Wang, International Pacific Research Center and Dep. Meteorology, University of Hawaii at Manoa, Honolulu, USA)*

This talk, first introduced the regional atmospheric model developed at the International Pacific Research Center (IPRC–RegCM) and the regional coupled ocean-atmospheric model (iROAM), which couples the IPRC–RegCM with the Modular Ocean Model Version 2 (MOM2) developed at the Geophysical Fluid Dynamical Laboratory (GFDL). Some results were highlighted from the applications of both the atmospheric model and the coupled model to the studies of eastern Pacific climate processes with the focus on the simulations of boundary layer stratus and stratocumulus clouds over the Southeast Pacific and the seasonal cycle of the equatorial tropical Pacific and the tropical instability waves (TIWs) in the coupled system. It was shown that the iROAM has considerable skill in simulating the eastern Pacific climate. This is achieved mainly due to the capability of its atmospheric component model (IPRC–RegCM) in simulating the boundary layer clouds over the Southeast Pacific. We propose that the regional coupled model can be used as a test bed for parameterizations (constrained by field observations) and as a useful tool to understand the coupled physical processes in the eastern Pacific.

Some scientific issues that need to be addressed in future studies were also discussed briefly, including 1) how strong is the TIW-induced wind & cloud variability and how does it affect the variations in ITCZ convection in a coupled system? 2) what is the role of shallow convection in the decoupled boundary layer? 3) what processes are responsible for the pronounced subseasonal variabilities in the stratus/stratocumulus clouds over the Southeast Pacific: cold advection from the southern ocean or forced by ITCZ convection to the north? 4) how does drizzle modify the subcloud layer and surface fluxes, affecting SSTs in a coupled system? 5) how do aerosols affect stratus clouds and how can we consider their effect realistically in numerical models? 6) how strong the synoptic-scale variability in the stratocumulus clouds, affecting the mean climate or lower frequency variability? 7) what are the roles of Andes in modifying both stratus clouds and the ITCZ in the eastern Pacific? 8) how does southeast Pacific stratus deck affect the seasonal cycle and ENSO?

3.6 Integrated MESA-NAME-VOCALS Modeling Activities

3.6.1 **Summary of the Session on Physical Processes in the Monsoon Regions** *(Chair: Luis Farfán, CICESE, La Paz B.C.S., Mexico)*

Diurnal cycle in SAMS

P. Silva Dias discussed the observed features of convective life cycle in South America and the development of nocturnal Mesoscale Convective Systems (MCSs), east of the Andes. The presence of low-level jets is considered to be essential in the occurrence of extreme weather systems. Regional scale model applications to provide a satisfactory simulation of MCSs were discussed.

Diurnal cycle in NAMS

Siegfried Schubert presented results from an on-going effort to assess and analyze the warm season diurnal cycle over the continental United States and northern Mexico in global atmospheric general circulation models (AGCMs). Specifically, the goals of the project are to: 1) assess and analyze the diurnal cycle in the NASA, NCEP and GFDL AGCMs; 2) improve our understanding of the important physical processes that drive the diurnal cycle; and 3) provide guidance for development of physical parameterizations. The results presented examined the sensitivity of the phase of the diurnal cycle of precipitation to the convection scheme in the NASA/GMAO model.

MESA-SALLJEX modeling

Hugo Berbery described the first modeling activities in MESA, in particular those related to SALLJEX (South America Low Level Jet EXperiment). A case study was chosen in which all models failed to reproduce the development of a MCS over northern Argentina. A model intercomparison initiative was started, in which all models were re-run under different resolutions and initial conditions. The first results suggest that resolution was not an issue. Neither was the type of analyses being ingested in tests performed with NCEP and CPTEC analyses. Current efforts are focused in the assimilation of additional SALLJEX data in order to see their impact on the forecast conditions.

NAMAP modelling

Dave Gutzler reported on planning for a collaborative modeling effort (NAMAP2) to compare and assess simulations of the 2004 warm season across the NAME domain. Over the next several months, NAMAP2 collaborators will develop protocols for comparable atmospheric model simulations, including a common SST field and time-varying lateral boundary conditions for regional models. The purpose of NAMAP2 will be: (a) to generate a set of common atmospheric model control runs that can be used as a basis for model sensitivity studies; (b) to assess the general quality, and general shortcomings, of these control simulations; and (c) to apply the knowledge gained from this assessment to operational forecast model development at NOAA/NCEP.

Land-surface processes in SAMS

Carlos Nobre presented 4 modeling examples on the role of land surface processes in the SAMS. Predictability issues were discussed as part of the future directions in MESA, including the mostly convective nature of precipitation. Changes in land use in the Amazon basin and southward water vapor transport were discussed by comparing (NCEP ACGM) ensemble simulations with the inclusion of vegetation and soil processes.

Land-surface processes in NAMS

Dennis Lettenmaier talked about the relation between wet/dry monsoons and previous winter season rain/snow pack with focus in the monsoon west region (extreme southwestern U.S.). It was found that: 1) winter precipitation is a potential predictor for summer monsoon, even though this relationship varies with time; 2) spring land surface conditions in the southwestern U.S. are strongly determined by previous winter precipitation; and 3) June positive height (500 mb) anomalies in dry years induce an increase in surface temperature in Arizona and Nevada.

Air-sea interactions in the SAMS region
Paulo Nobre covered aspects of mechanisms and predictability issues related to the formation of the ITCZ and South Atlantic Convergence Zone (SACZ) that affect climate variability over South America. The key issue discussed is the formation of deep cumulus convection over cold waters, as it is the case of the SACZ. It is shown that while ITCZ interannual variability, both position and strength, is very well captured by SST forced AGCM simulations, rainfall variability associated with the SACZ as simulated by SST-forced AGCM integrations is negatively correlated with observations.

Regional air-sea interaction in the NAMS region
Luis Farfán discussed issues on the regional air-sea interactions in the NAMS. This included the diurnal cycle of convection over the Mexican mainland and its propagation toward the Gulf of California during the evening. The presence of a warm pool (SST>28°C) is an outstanding along the gulf, along with its limited zonal extent and a contrasting pool over the Pacific that is adjacent to Baja California. Atmospheric data from the North American Regional Reanalysis for August 2003 were taken to illustrate the structure of low-level circulations, including the spatial distribution of winds and moisture. The development of tropical cyclones was indicated as a source of low- to mid-level moisture and the occurrence of landfall events for cases that have a storm track over the gulf.

3.6.2 Summary of the Session on Climate Forecasts in the Monsoon Regions *(Carlos A Nobre, CPTEC-INPE, Brazil)*

Seasonal Forecasts in SAMS, Iracema Cavalcanti

In general, seasonal predictability as assessed by a number of AGCM lack skill on the core of the SAMS, that is, the SACZ; they fare much better north and south of SACZ; in particular, for the CPTEC model, anomaly correlation maps show a high negative correlation for the SACZ region! Why is that so? (i) intrinsic unpredictability at those time scales; (i) possibility of systematic errors killing predictability: using the Grell convective scheme improved representation of rainfall for the SACZ all the way to the Amazon, that is, a better representation of large scale heat sources; (iii) missing fundamental physics; that seems to be the case, since coupled O-A seasonal simulations helped to get the sign of the anomaly right. Very promising!

Influence of Initial Conditions, J. Schemm, K. Mo

Comparisons of AMIP runs with an ensemble run with balanced soil moisture fields for NH summer for the NCEP CFS indicate that, though correct soil moisture IC matters, it is critical to correctly calculate surface fluxes, otherwise, the wrong partitioning of LH/SH downgrades the seasonal predictions as summer progresses; improvements due to enhanced resolution are not uniform in the region; in sum, it highlights the importance of land surface coupling through fluxes

Predictability of Intraseasonal Variability over SAMS Time Scales, V. Misra

Model resolution seems to play a key role in correctly reproducing intraseasonal variability (20-40 day) over the SAMS; indication that the capability to simulate correctly the diurnal cycle of precipitation is crucial for intraseasonal variability; therefore, though the diurnal cycle, land surface processes may play a greater role than anticipated for intraseasonal variability for SAMS

Proposed End-to-End Forecast System for VAMOS, K. Mo

A proposal for an end-to-end forecast system to serve the goals of VAMOS following a unified strategy of the NOAA Climate Test Bed (CTB) was made. Such an initiative can contribute to VAMOS by improving warm season precipitation prediction for Pan America on intraseasonal to interannual timescales. The CTB is a facility to accelerate the transition of research to applications. A CTB and VAMOS collaboration is a win-win association: a unique opportunity to link weather and climate over Pan America.

NOAA Climate Test Bed, W. Higgins

CTB Scientific Motivation: a complete forecasting system for S/I forecast applications and improved S/I forecasts. CTB Programatic Motivation: a facility for operational testing. Applications: carbon cycle, agriculture, fishing, water resources, air chemistry.. Infrastructure: supercomputer, software support, management; transition projects. Funding opportunities: Announcements of Opportunity. Linkages to CLIVAR, GEWEX, joint CLIVAR-GEWEX programs, etc.

Hydrometeorological Modeling in SAMS, H. Berbery

There is an array of hydrometeorological models for subcomponents (atmosphere, land surface, surface hydrology (macroscale, basin scale routing, floods); many of such models have been used to study the main features of the SAMS for a number of years; for instance, the Eta model simulations represent well the main circulation features of the SAMS, but there are many other models in use, each one with strong and weak points. Hydrological models forced by ensemble climate predictions (e.g. CPTEC's) have been shown to result in significant improvements of predicted streamflow for the Uruguay river, once bias was removed from the seasonal forecasts. A number of new hydrological models are in test for different basins in the SAMS. There is a critical need to develop Land Data Assimlation Systems for South America and to make the data available, as the importance of land surface conditions for seasonal predictions is generally recognised; many such land data sets do exist and initial efforts to develop a LDAS for South America are underway at CPTEC; it needed a systematic effort to produce those data.

Hydrometeorological Modeling in the NAMS, D. Lettenmaier

This presentation focused on the hydrological modeling for NAME: precipitation is the largest source of uncertainty to hydrological processes and highlights the difficulty of closing the water balance; effort is programmatically linked to IAHS Prediction of Ungauged Basins (PUBS) and the Hydrological Ensemble Prediction Experiment (HEPEX). For the latter, methods were derived to get rid of bias from ensemble predictions. An LDAS was derived for Mexico (in reality for all of NAME Tier 1 region, rescuing Mexican historical data starting on 1920´s. That was used for macroscale hydrological modeling: it has good partition of rainfall into runoff and evaporation at monthly time scales. Basin scale hydrological modeling for Mexican basins of NAME: simulates well the low runoff ratios of this typical arid region; water balance and sensitivity experiments were carried out on vegetation changes (crops). Some scientific issues: sources of predictability for the hydrologic system (IC versus climate forecast);); role of space-time variability of precipitation and its interaction with basin scale; hydrologic processes, and their representation (e.g., infiltration excess overland flow, groundwater/baseflow)

Climate change simulations of the SAMS, R. Terra

Activities under the sponsorship of IPCC AR4: assessment of models of variability of IPCC models (AAO, PSA1, PSA2: weaker projections than reanalysis; A2 emissions scenarios (GFDL) coupling of angular mode and ENSO increase for that scenario; GFDL scenario: southward migration of SAMS, with dryness; large increase of Tsurf over central South America; CO_2 increase simulations: SCAZ almost disappears, sharper ITCZ. First results of downscaling for southern South America: HadCM3/MM5: strong warming over northern Argentina/Paraguay, modest increase in rainfall

3.6.3 Summary of the Session on VOCALS Modeling *(Chair: Rafael Terra, IMFIA, Universidad de la República, Uruguay)*

Chris Bretherton (U. Washington) made a review of boundary layer (BL) cloud parameterization issues relevant to VOCALS, while José Rutllant (U. Chile) covered mesoscale modeling work of the marine BL and the low-level jet off the coast of western South America. Yuqing Wang (IPRC, Hawaii) showed regional coupled model simulations in the South Pacific.

From the talks it became clear that some of the operating physical mechanisms and feedbacks in the VOCALS regions have been well established (cloud-turbulence-radiative interactions in stratocumulus, dynamics of coastal jets, the role of mesoscale oceanic eddies in the offshore heat transport) while others are much less clear, for instance the role of aerosols and the interaction with Pockets of Open Cells (POCs). In those cases in which a basic understanding of the processes has been achieved, simulations with high enough resolution are quite successful. However, their parameterization in large-scale models remains a challenge and therefore most GCMs still perform poorly in the region.

The goal is to understand the functioning of the entire coupled system in the South East Pacific, for which the development of coupled ocean-atmosphere models is critical. Some of the outstanding coupled issues that were mentioned include the interaction between POCs and mesoscale oceanic eddies and the role of the coastal jet in coastal upwelling.

The parameterization challenges and associated GCM weaknesses motivate a unique aspect of VOCALS strategy, the multi-timescale approach. The combination of long-term monitoring and more intense observation periods is essential for the understanding of the feedbacks operating between faster and slower processes, which in turn underpins the development of parameterizations and the improvement of models. Some of the physical processes with distinct timescales that were discussed include: (i) Diurnal evolution of BL height due to local entrainment and remotely forced subsidence; (ii) Influence of synoptic variability –coastal lows- on stratocumulus; (iii) Understanding of the annual cycle of Sc incidence; (iv) Will stratocumulus incidence increase or decrease in a global warming scenario –thus constituting a negative or positive feedback-?

3.6.4 VAMOS Modeling *(Chair: Ben Kirtman, Climate Dynamics GMU, Center for Ocean-Land-Atmosphere Studies, COLA, USA)*

The agenda for this session on integrated VAMOS Modeling for MESA, NAME and VOCALS was as follows:

I. Introduction
- a. Objectives, Identify and Motivate Themes (**Kirtman**)
- b. Outline of Strategy (**Kirtman**)
- c. The importance of end-to-end prediction system: from SST prediction to surface temperature and precipitation forecasts over Pan America to hydrologic modeling and applications. (**Mo**,)

II. Modeling Strategy: A Three Tiered Approach

a. Introduce and Describe Three Tiered Approach (**Kirtman**; Plagiarize from NAME)

b. Modeling and Predicting SST Variability in the Pan-American Seas with emphasis on MESA, NAME and VOCALS activities (**Bretherton**; Miller; P. Nobre; Kirtman)

c. Predicting the Pan-American Monsoon Onset, Maturation and Demise. Models Evaluation and models improvements. Application of multi-model ensembles using Climate Testbed and use of operational climate forecasts to suggest products and applications. (**Cavalcanti**; Saulo; Mo)

d. Improving the Prediction of Droughts and Floods in the Pan-American Domain. Development of downscaling towards hydrometeorological modeling.
(**Saulo;** Mo; Cavalcanti).

e. Simulating, Understanding and Predicting the Diurnal Cycle in the Pan American Domain. (**Mo**; Farfan; Saulo)

III. Data Assimilation, Analysis and Assessing Observing System. Land, ocean and atmospheric assimilation for all 3 VAMOS Science components. Requirements for Improved Pan-American Climate Prediction and Studies (**Mo**; Peagle; C. Nobre; Plagiarize from NAME)

IV. Field campaigns: Exploit data from MESA, NAME and VOCALS field campaigns to improve models and observing systems. (**Mo**, Celeste, Farfan, Cavalcanti).

IV. Prediction and Global Scale Linkages (**Kirtman** and Plagiarize from NAME)

V. Road Map (TBD once themes written)

4. Presentations by Local Scientists *(Chair: Kingtse Mo, NOAA/NWS/NCEP/CPC, USA)*

- G. Raga examined the meso-scale circulation, convection and the transport of pollutants in the Gulf of Tehuantepec. She found that tropical emissions at the surface are transported to the upper troposphere and lower stratosphere by deep convection. A proposal was put forward to characterize the emissions in the region, to investigate the phenomena involved in the transport and dispersion of the pollutants emitted by a refinery, and to assess the role of convection in such transport. A field experiment took place in 2004 and was followed up by modeling. In the region of the refinery, there is evidence of land/sea breeze, but is modified significantly by the presence of convective clouds. More high resolution modeling in the regional scale is needed to determine the detrainment regions and convection-induced subsidence over land.

- L. B. Castillo studied streamflow patterns in the Gulf of California continental watershed. He found that there are two consistent regions: North region and South region. There are basins with combined effects between the two regions. The interannual variability of streamflow and rainfall in that region is highly correlated. There is one month delay between the peak of rainfall months and the streamflow maximum.

- M. J. Montero reported results (modeling & analysis) based on the NCAR GCM. He reported four cases: a) biomass burning aerosol climate effects through the NCAR-CCM3, (b) simulation of precipitation and temperature over Mexico with climatological and observed SSTs, (c) climate change study on Rio Bravo basin and (d) interanual and interdecadal variations of the NAM through the 21st century climate with multiple coupled GCMs.

Part 2- Special presentations

- V. Magaña reviewed the climate variability studies over the American warm pool and the mid summer drought. He reported on field campaigns in the eastern Pacific in 2004. There were 3 campaigns in the eastern Pacific and one in the Caribbean with radiosondes CTD, Tethersondes to measure radiation and aerosols with additional soundings in Mexico and Cuba. Data from the field campaigns indicate that the American warm pools are teleconnected through the low level jet, direct circulations and easterly waves. The mid summer drought is a part of the annual cycle of Mesoamerica.

- C. Zhang presented the proposed Intra American Seas program. The objectives are (a) to improve the understanding of climate processes key in the IAS region to the variability and predictability of rainfall in Americas; (b) to contribute to model improvement for prediction of rainfall on intraseasonal, seasonal, interannual and decadal timescales in the IAS region and Americas, and (c) to facilitate capacity building in the IAS region for local benefit from advancement of climate studies and forecast. The research includes both process and phenomena studies such as the warm pool, low level jet and moisture transport, orographic effects and the North Atlantic subtropical high, the ITCZ, easterly waves, drought, floods and midsummer drought.

4 VAMOS panel executive session

Drs. Wayne Higgins and Carolina Vera led off the VPM8 Panel Executive Session with a 6 point agenda that included (1) MGV Implementation Strategy, (2) Panel recommendations for VAMOS Science Components, (3) Panel recommendations for IASCLIP, (4) VAMOS NEWSLETTER, (5) 9th VAMOS Panel Meeting, and (6) VAMOS Panel Membership rotation

(1) MGV Implementation Strategy

Dr. Wayne Higgins reviewed the VAMOS Panel decision to organize a "Modeling Group for VAMOS". This Group will coordinate joint activities amongst VAMOS Science Components (i.e. MESA, NAME and VOCALS), make sure that the appropriate modelers participate, and facilitate links with operational centers. The group consists of two representatives from each of the 3 principal VAMOS components (NAME, MESA, VOCALS) plus a member linking VAMOS modeling to WCRP activities. (Farfan, Mo, Saulo, Cavalcanti, Bretherton, Miller, Kirtman). Dr. Higgins also reviewed the charge to the MGV: (i) Review the status of modeling relevant to VAMOS research; (ii) Organize a Workshop at VPM8 (March 2005) to bring together leading modeling groups focused on VAMOS topics; (iii) Prepare a report with recommendations for a long-term VAMOS modeling strategy to be reviewed by the CLIVAR SSG.

Dr. Kingtse Mo prepared a summary of the outcome of the VAMOS Modeling Workshop at VPM8 (Session 3 in this report). Dr. Higgins expressed that the strategy needs to be defined before the Pan-WCRP Monsoon Workshop, Irvine, California (June 15-17 2005) so that Dr. Ben Kirtman (Chair of the MGV) can present the strategy. Dr. Tony Busalacchi stressed that the MGV should make it clear how the VAMOS modeling strategy links to other WCRP programs.

(2) Panel recommendations for VAMOS Science Components

MESA: Dr. Carolina Vera gave a brief presentation on the strategy for MESA reorganization. The VAMOS Panel appreciates the work done by both SALLJ and PLATIN SWGs and recognizes their contributions. Starting in 2005, their formal structure as SWGs ends. A MESA SWG has been appointed to be responsible for the development of a scientific plan and a conceptual design for the future of MESA, that integrates LBA, SALLJEX, and PLATIN science questions related to the South American Monsoon System. An LPB implementation steering group has been appointed to design and accelerate progress on the GEWEX-CLIVAR LPB CSE. The group will be led by co-chairs (Dr. Hugo Berbery from CLIVAR/VAMOS and Dr. Assuncao Silva Dias from the GEWEX/GHP). Other members of the new group are under discussion and will be presented for approval of the VAMOS Panel and GEWEX/GHP by June 2005. The ultimate goal of the revised MESA program is to develop an integrated view of the American Monsoon Systems, related interhemispheric connections, monsoon predictability and prediction. MESA milestones that will contribute to this goal are:

FY04: Provide quantitative information of the model errors in SALLJEX. Evaluate impact of SALLJEX data on analysis and forecasts. Provide confirmation about the ability of the models to reproduce some of the elements of the low-level circulation of the SAMS. Prepare GEF-PLATIN survey reports
FY05: Perform SALLJEX Data Assimilation. Plan LPB CSE monitoring activities. Assess the IPCC-AR4 simulations in the SAM region. Plan GEF-Project full proposal.
FY06: Assess Seasonal prediction simulations in the SAMS region. Develop MESA climate indexes. Perform seasonal simulation of SALLJEX season. Present MESA and LPB CSE monitoring implementation Plan. Assess predictability of the SAM associated with Atlantic SST simulations. Perform regional downscaling of IPCC-AR4 simulations.
FY07: LPB CSE experiment implementation, data collection, and integration. Assess extreme event frequency changes in the regional climate change scenarios for South America and their impact on agricultural activities.
FY08: Evaluate the impact of soil moisture in simulations and predictions. Hydrological studies of LPB CSE monitoring data.

Ultimate goal: Build an integrated view of the American Monsoon Systems, related inter-hemispheric connection, monsoon predictability and prediction

NAME: Dr. Wayne Higgins discussed the successful outcome of the NAME 2004 field campaign and indicated that the NAME community is now leveraging the enhanced observations in modeling studies aimed at improved warm season precipitation simulations and forecasts over North America. Dr. Higgins discussed the NAME milestones, which have been revised to account for NAME Tier 3 activities:

FY04 – Implement NAME 2004 Field Experiment.
FY05 – Evaluate impact of data from NAME 2004 on operational analyses.
FY06 – Assess global and regional model simulations of the 2004 North American monsoon (NAMAP2).
FY07 – Evaluate impact of changes in model parameterization schemes (NAME CPT**).**
FY08 – Measure improvements in model simulations of monsoon onset and variability.
FY08 – Quantify the relative influence of oceanic and land surface boundary conditions on simulations of the NAME 2004 monsoon (NAME Tier 3)
FY09 – Implement recommended changes to operational climate prediction systems to improve the skill of warm season precipitation forecasts.

VOCALS: Due to the absence of a VOCALS representative at the Executive Session, the need for additional input from VOCALS was recognized.

(3) Panel recommendations for IASCLIP

The VAMOS Panel was impressed with the progress on IASCLIP. The prospectus presented by Dr. Chidong Zhang was clearly central to VAMOS science objectives and there are strong linkages to the other VAMOS science components. Dr. Carlos Nobre noted that the project was quite interesting, but he was not sure whether it should be the 4th VAMOS program or an integration between NAME and MESA. Dr. Jorge Amador stressed that the regional component should be maintained and that there should be an educational component. The importance of taking the educational component into account was recognized, and a suggestion was made to take advantage of the WMO training centers, such as Jamaica, Barbados and Costa Rica. The importance of contacting other organizations in the Caribbean and Central America was stressed.

The VAMOS Panel will be asked to endorse the program via e-mail. The panel has several suggestions that should strengthen the program. In particular, IASCLIP should focus on building partnerships with countries in the region (Central America, Carribbean, and northern South America) that are not currently involved. Local participation has been critical for each of the VAMOS Science Components. The IAI has a lot of experience with this, so IASCLIP may want to coordinate with them. The IASCLIP Program should begin to develop an implementation plan, in particular with strong linkages to the other VAMOS science components and to ongoing field activities such as AMMA and AMI. A number of IASCLIP science questions are in common to those of NAME and MESA (e.g. regarding moisture transport into the monsoon regions). Also, the IASCLIP team should consider the expected outcomes of the IASCLIP Program. The IASCLIP program needs clear milestones and endstate deliverables. We encourage IASCLIP to consider how the science questions are linked to specific activities.

(4) VAMOS Newsletter

The first issue of the *VAMOS NEWSLETTER* was very successful. Volunteers in VAMOS Field Programs (e.g. SALLJEX, NAME) appreciate this forum for updates on VAMOS, affirming their participation, etc. The VAMOS Panel recommends that the contents remain relatively light.

The VAMOS Panel would like to continue publishing the *VAMOS NEWSLETTER* on an annual basis. Future issues will focus on specific themes of interest to a broad audience. Issues will include recent highlights from each VAMOS Science Component, including enhanced monitoring activities and modeling activities related to the theme. Each year an Outline will be presented to the VAMOS Panel for consideration at the VPM's. Subsequently, the Panel and ICPO staff (Carlos Ereno) will solicit and gather contributions. The *VAMOS NEWSLETTER* will be published by early summer each year. The panel finally suggested and approved the central theme for the next issue: How is VAMOS contributing to improved understanding, monitoring and prediction of heavy rainfall events?

(5) 9th VAMOS Panel Meeting

The venue and date of the 9th VAMOS panel meeting was discussed. In April 2006, the 8th AMS International Conference on SH Meteorology and Oceanography will be held in Foz do Iguazu, Brazil. As we did in VPM3 in Chile in 2000, an option is to have the VAMOS Panel meeting back-to-back with the SH Conference (the best dates are April 22-23, 2006).

(6) VAMOS Panel Membership rotation

The panel members held a closed meeting to discuss the Terms of Reference and membership of the VAMOS panel. The appointments of Jorge Amador (U. Costa Rica), Herve Le Treut (LMD, France) and Rodrigo Núñez (SHOA, Chile) are completed. Jorge Amador was proposed for another term and Jean-Philippe Boulanger (LMD, France) and Luis M. Farfan (CICESE, Mexico) were proposed to replace the other two outgoing members. Andy Robertson, representative of IRI, informed he would resign from the panel and proposed Lisa Goddard (IRI) as a replacement

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Appendix 2: Agenda

WCRP/CLIVAR Eighth Annual Meeting of the VAMOS Panel, Mexico City, MX, 7-9 March 2005

8:00am	Registration

Monday, March 7, Morning Session, Plenary, Chair: M. Cortez (SMN)

8:20am	Opening of VPM8 – M. Cortez, C. Ereño (Organizing Committee)
8:30am	Welcome
	– Dr. Michel Rosengaus, Director, Servicio Meteorológico Nacional (SMN)
	– Dr. C. Vera and Dr. Wayne Higgins - VAMOS Co-Chairs
8:50am	VAMOS Chair's Report – C. Vera and W. Higgins
9:20 am	Break
09:50am	VOCALS Status Report – R. Weller
10:20am	MESA Status Report – C. Vera
10:40am	PLATIN Status Report – P. Silva Dias
11:00am	NAME Status Report – W. Higgins
11:30am	VAMOS International Project Office – G. Emmanuel
11:45am	VAMOS Database – J. Meitin, S. Williams
12:00 pm	CLIVAR Report – T. Busalacchi
12:15 pm	CLIVAR ICPO – C. Ereño
12:30 pm	Report from Regional Programs – R. Weller, C. Ereno
12:45 pm	CPPA Program – J. Huang and M. Patterson
1:00 pm	Lunch

Monday, March 7, Afternoon Session – VAMOS Modeling Workshop, Chair: V. Davydova (SMN)

2:00pm	CLIVAR Modeling – B. Kirtman
2:20pm	Charge to the Modeling Group for VAMOS – C. Vera

Physical Processes in the Monsoon regions, Chair: L. Farfan

2:30pm	Diurnal Cycle and Mesoscale variability in SAMS– P. Silva Dias
2:50pm	Diurnal Cycle in NAMS – S. Schubert
3:10pm	MESA-SALLJEX Modeling – C. Saulo , H. Berbery
3:30pm	NAMAP – D. Gutzler
3:50pm	Break

Physical Processes in the Monsoon regions, Chair: C. Saulo

4:10pm	Land-surface processes in SAMS– C. Nobre
4:30pm	Land-surface processes in NAMS – D. Lettenmaier
4:50pm	Air-sea interaction in the SAMS region – P. Nobre (invited request)
5:10pm	Regional Air-sea interaction in the NAMS region – L. Farfan
5:30pm	Summary of the session by the Chair and short plenary discussion
6:00pm	End of session
6:30pm	Icebreaker

Tuesday, March 8, Morning Session – VAMOS Modeling Workshop
Climate Forecasts in the Monsoon Regions, Chair: C. Nobre

8:00am	Seasonal Forecasts in SAMS– I. Cavalcanti

8:20amInfluence of Initial Conditions – J. Schemm
8:40amPredictability on Intraseasonal Time Scales – V. Misra (invited request)
9:00amVAMOS Modeling Strategy – K. Mo
9:20amBreak
9:50amNOAA Climate Test Bed – W. Higgins
10:10am Hydrometeorological Modeling in SAMS – H. Berbery
10:30am Hydrometeorological Modeling in NAMS – D. Lettenmaier
10:50am Climate change simulations of the South American Monsoon System – R. Terra
11:10 am Summary of the session by the Chair and short plenary discussion

VOCALS Modeling Activities, Chair: C. Bretherton

11:30am Challenges of ocean modeling in the VOCALS domain –A. Miller.
11:50am The modeling challenges of feedbacks between ENSO and the E Pacific seasonal cycle and the physical processes in the VOCALS region – B. Kirtman.
12:10pm Lunch

Tuesday, March 8, Afternoon Session – VAMOS Modeling Workshop
VOCALS Modeling Activities, Chair: R. Terra

2:00pm Boundary layer cloud parameterization/modeling issues of relevance to VOCALS – C. Bretherton.
2:20pm Modeling of the MBL and low-level jet off the coast of western South America – R. Garreaud.
2:40pm Regional coupled ocean atmosphere models in the Southeast Pacific - Yuqing Wang
3:00pm Break

Integrated MESA-NAME-VOCALS Modeling Activities, Chair: B. Kirtman

3:20 pm Brief summaries by the session chairs (L. Farfan/C. Saulo, C. Nobre, R. Terra/C. Bretherton)
4:30 pm Discussion on VAMOS Modeling
- Objectives
- Scientific Issues
  - * Questions common to MESA-NAME-VOCALS
- Scientific Priorities
  - * Model Development
  - * Climate Products and Applications
- Common Issues for MESA and NAME
- Special Issues for MESA, NAME, VOCALS
- Seasonal Prediction Experiments

6:00 pm End of session

Wednesday, March 9, Morning Session, Part 1 – Presentations by Local Scientists, Chair: Kingtse Mo

8:00 am Mesoscale circulations, convection and pollution in the Gulf of Tehuantepec – Graciela Raga (UNAM)
8:20 am Interannual variability of streamflow in the Gulf of California continental watershed –Luis Brito Castillo (SIBNOR)
8:40 am On climate change studies with the NCAR GCM – Martin J. Montero (IMTA)

Wednesday, March 9, Morning Session, Part 2, Special Presentations

9:00 am	Climate Variability Studies over the American Warm Pools - Victor Magaña
9:20 am	Break
9:40 am	Intra Americas Sea Program – C. Zhang
10:00 am	Demand-driven Information for Assessment and Management of Climate-related Risks. W. Baethgen, L. Goddard & A. Robertson

Wednesday, March 9, Morning Session, Part 3 – Panel Session

10:30 am	VAMOS Executive Session.
12:30 pm	End of VPM8

Appendix 3: Welcome Words from Michel Rosengaus, Director of Servicio Meterologico Nacional of Mexico (SMN)

Every Tuesday, at 10:00 A.M. sharp, I walk into one of the meeting rooms at the main building of the National Water Commission of Mexico (the CNA). There, I meet with several of the Under Directors of the CNA, frequently also the General Director. Also present are key people from the Federal Electricity Commission, the National Center for Disaster Prevention, the Engineering Institute of the National Autonomous University of Mexico, representatives of the Department of Agriculture and Food Production, the Department of Health and the Department of Communications and Transport. Many technical assistants to these people are also there. This regular meeting is called the Technical Committee of Hydraulic Works Operations (CTOOH in Spanish language initials). Its purpose is to decide on the operation of the hydraulic infrastructure of Mexico, and mainly the dams, for the next days, weeks and months. Decisions taken are not purely "hydraulic engineering" decisions. They have significant population safety, health, economic, food production and energy production consequences. The social and political stability of the regions in question are always present in the minds of all at the meeting. Even international consequences are taken into account, especially on the Bravo (or Grande) River (depending on which side of the border you are), the Colorado River and the Tijuana River.

The National Meteorological Service of Mexico (the SMN), a part of the CNA, is always present in order to inform the CTOOH mainly on the dynamic of rainfall in the past week as well as the forecast of rain in the next week. Usually on the first meeting of each month, the SMN also presents monthly and seasonal climatological forecasts out to 3 months into the future. Thus in early Spring (e.g. March) our forecasts do not even extend to the initial part of the rainy season (June), so we are not providing decision makers with the information they require to take solid, objective, sound decisions on the operation of dams over all of Mexico. Should agricultural users of water be allowed their full water rights under the present hydrologic situation? If we do, is the leftover water stored enough to provide human consumption to cities and towns for the rest of the dry season? If we keep storage levels high, will we have to make use of the overflow spillways during a possibly higher than normal rainy season? Is the level of the risk to the population downstream reasonable? If we leave water on the dams, how much will we loose to evaporation during the next dry season? Is that evaportation going to be for a normal season or for a warmer than normal season? What about solar radiation anomalies? Are rains going to start early, normal or late this year? Can we take the risk of overstoring temporarily in order to lower the levels using the electricity production infrastructure instead of the spillways which does not produce any economic benefit? Answers to all of these questions are intimately linked to long term forecasting. They have consequences far more important than going out to work with or without an umbrella.

Appendix 4: Local Scientists Presentations

Mesoscale circulations, convection and pollution in the Gulf of Tehuantepec *(Graciela Raga, Diana Pozo, Darrel Baumgardner and Julio Marín, Centro de Ciencias de la Atmósfera, Universidad Nacional Autónoma de México)*

In this study we explore the complexities of local atmospheric circulations in the transport of pollution and processing by convective clouds during the rainy season in Southern Mexico. A large refinery is located near the coast in the western region of the Isthmus of Tehuantepec, which has significant gaseous and particulate emissions. Biomass burning is also a large regional source of pollutants but has a definite seasonal variation, which the emissions from the refinery do not experience.

Measurements of particle concentrations, optical properties and composition made during a field campaign in June 2004 suggested the possibility of a recirculation of pollution during the course of the day. In particular, the meteorological variables indicated a clear signature of the land/sea breeze at the sampling site, absent only when the larger scale influence was evident (such as before, during and after the passage of easterly waves).

In order to explore the nature of the local circulations we utilized the mesoscale meteorological model MM5 to simulate some of the observed cases were the land/sea breeze was present at the sampling site. Three domains were used, the innermost one with 5km resolution, to capture the local circulations. The results indicated a fairly complex circulation in the gulf of Tehuantepec, not the simple conceptual model of the breeze. Further examination indicated that convection was present over the sea and generated convergence and divergence patterns that significantly modified the land/sea breeze. This was confirmed when simulations were performed in a dry mode, not allowing clouds to develop. These results showed more clearly the presence of a convergence region over the sea during the night and early morning, where the land breeze encounter the main flow over the sea. The shape of the coastline and the asymmetry in the topographical features contribute to the development of the convergence region at low levels. As the day progressed, there was evidence of the subsiding branch of the mountain breeze causing divergence at low levels over the sea. The difference in the steepness of the terrain at either side of the isthmus, causes a different pattern of low-level divergence over the gulf.

The HYSPLIT trajectory model was run using the output of the fine resolution MM5 simulation, to determine the fate of pollutants emitted by the refinery. The results indicate that some polluted parcels may be caught in the regions of low-level convergence and be transported very efficiently to high levels (above 8km) and processed through the clouds. Upcoming work will include simulations with a cloud model to estimate detrainment regions and chemical transformations within cloud droplets.

Interannual variability of streamflows in the Gulf of California continental watershed *(Luis Brito-Castillo, Centro de Investigaciones Biológicas del Noroeste S.C., Unidad Guaymas, Sonora, México)*

The literature focused in studying water resources in the Gulf of California continental watershed (GCCW) is scarce. Our goal was to describe the characteristics of the interannual variability of streamflows in the GCCW. To accomplish this goal a reconstruction of monthly streamflow series using simple and multiple regression models was performed. As predictors for the models monthly streamflow data from analogous rivers were used. To validate the results of the reconstruction, the paired Student's t-test and sign tests between observed and reconstructed series were performed. The reduction of error test was calculated to evaluate the skill of the reconstruction. Monthly data of streamflow reconstruction was possible from 1924 to 1999 to a total of 42 series. The internal homogeneity of each reconstructed series was evaluated using the paired Student's t-test and/or ANOVA test between samples of the series. The samples of individual series were separated at the breaking points of the homogeneity curve of the series. Results show that inhomogeneities of the series are coincident among series for the same period. This means that inhomogeneities of the series are not caused by local factors but by factors affected an entire region. Applying the Varimax-rotated Empirical Orthogonal Function Analysis to the reconstructed streamflow series between 1940 and 1998, with a=0.60 loading contour as the boundary between the regions, it was possible to delimit two regions: Northern (Yaqui-Mayo-Fuerte river basins) and southern (Baluarte-Acaponeta-San Pedro river basins). This result was consistent for summer (JASO) and winter (NDJF) and coincided with previous results reported in the literature. The statistically significant strength of the relationship (P<0.05) between rainfall and streamflow series in each region suggested that the reconstructed streamflows reproduced well the natural variability of the series.

On climate change studies with the NCAR GCM *(Martín Montero, Instituto Mexicano de Tecnología del Agua, Col. Progreso Jiutepec, Mexico)*

The Mexican Institute of Water Technology has, in recent years, incorporated a new line of research, climate change. This talk presents two of our main studies on this area working with the NCAR GCM.

The first study is about the global biomass burning aerosol climate effects though the NCAR-CCM3, in which AERONET data from the Amazon and Africa was incorporated into the GCM model, and the effect on climate was simulated through a 10-yr simulation with the smoke included and compared with another 10-simulation without the smoke included.

The second was a NCAR-CCM3 model evaluation of the precipitation and surface temperature fields in Mexico. The evaluation was carried on by performing two 10-yr simulations on the CONTROL case, one with the climatological SSTs, and the other with real observed SSTs. The observation data came from the Hansen database for temperature and GPCP for precipitation.

Climate over the Americas Warm Pools *(Víctor Magaña, Center for Atmospheric Sciences National Autonomous University of Mexico)*

The Climate Experiment over the Americas Warm Pools known as ECAC (*Experimento Climatico en las Albercas de Agua Caliente de las Americas*, in Spanish), conducted during the summer of 2001, became the first attempt to examine the atmospheric and oceanic processes during various periods of summer aimed at explaining some characteristics of the rainy season over Mesoamerica and the Caribbean. One of the main features of the summer climate over the northeastern Pacific warm pool is the occurrence of a relative minimum in precipitation between July and August, ie., the so-called Mid-Summer Drought (MSD). The analysis describes the temporal evolution of various meteorological parameters over the Americas warm pools that are related to the occurrence of the MSD. Contrary to what has been suggested by some authors, the bimodal structure of precipitation over the Pacific side of Mesoamerica is not a form of intraseasonal variability in convective activity related to the Madden Julian Oscillation, but a characteristic of the annual cycle in precipitation. The MSD – sea surface temperature (SST) - radiation relationships proposed by Magaña *et* al. (1999) partially hold during the summer of 2001, when the Climate Experiment over the Americas Warm Pools (ECAC) field campaigns were conducted, with the SST exhibiting a bimodal structure in the MSD region. The maximum in tropical convection over the Central America-Caribbean coast appears to play an important role in modulating convective activity in the surrounding regions, through induced subsidence related to direct circulations. The Caribbean Low

Level Jet (CLLJ) is in phase with maximum western Caribbean Sea convective activity, reaching maxima intensities in July.

Appendix 5: Acronyms

Most of the acronyms used in this report are listed here. More can be found at http://www.clivar.org/publications/other_pubs/iplan/iip/appendix_6_acro.htm

AMS	American Meteorological Society
AAMP	Asian-Australian Monsoon Panel
ACC	Anthropogenic Climate Change
AGCM	Atmospheric General Circulation Model
AIACC	Assessments of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors (START program)
AMI	tropical Atlantic Marine ITCZ
AMIP	Atmospheric Model Inter-comparison Project (NCEP)
AMMA	African Monsoon Multidisciplinary Analyses
AR4	Assessment Report No. 4 (IPCC)
ARM	Atmospheric Radiation Measurement Program
AXBT	Airborne eXpendable BathyThermograph
BAMS	Bulletin of the American Meteorological Society
Calypso	Satellite mission (dual wavelength elastic backscatter lidar)
CAPT	CCPP-ARM Parameterization Testbed
CCD	Climate Change Detection
CDC	Climate Diagnostic Center, NOAA
CEOP	Coordinated Observing Period of the GEWEX
CFS	Climate Forecast System, NCEP
CICESE	Centro de Investigación Científica y Educación Superior de Ensenada, México
CIMA	Centro de Investigaciones del Mar y la Atmósfera, UBA
CLARIS	A Europe-South America Network for Climate Change Assessment and Impact Studies
CLIVAR	Climate Variability and Predictability (WCRP component)
CloudSat	CloudSat spacecraft (cloud radar)
CNRS	Centre national de la recherche scientifique, France
COLA	Center for Ocean-Land-Atmosphere Studies
CONICET	Consejo Nacional de Investigaciones Científicas y Técnicas
COPES	Coordinated Observations and Prediction of the Earth System
CPPA	Climate Prediction Program for the Americas (NOAA)
CPT	Climate Process Team
CPTEC	Centro de Previsão de Tempo e Estudos Climáticos, Brazil
CRN	Collaborative Research Network Program (IAI)
CST	Climate Science Team
CTB	Climate Test Bed (NOAA)
ECMWF	European Centre for the Medium Range Weather Forecast
EDAS	Eta Data Assimilation System
EEPO	Equatorial Eastern Pacific Ocean
ENSO	El Niño – Southern Oscillation
EOP	Enhanced Observing Period
EPIC	East Pacific Investigation of Climate Processes in the Coupled Ocean-Atmosphere System

ET CCD	Expert Team on Climate Change Detection
EU	European Union
GAPP	GEWEX Americas Prediction Project (NOAA)
GCM	General Circulation Model
GCOS	Global Ocean Observing System
GCSS	GEWEX Cloud System Study
GDAS	Global Data Assimilation System
GEF	Global Environmental Facility
GEWEX	Global Energy and Water Cycle Experiment (WCRP component)
GEWEX CSE	GEWEX Continental Scale Experiment
GEWEX GHP	GEWEX Hydrometeorology Panel
GFDL	Geophysical Fluid Dynamics Laboratory, USA
GFS	Global Forecast System
GLACE	Global Land-Atmosphere Coupling Experiment
GMAO	Global Modeling and Assimilation Office
GSIP	Continental Scale International Project (GEWEX)
GSOP	Global Synthesis and Observation Panel
HEPEX	Hydrological Ensemble Prediction Experiment
HFP	Historical Forecast Project
IAI	Inter-American Institute for Global Change Research
IALLJ	Intra Americas Low-Level Jet
IAS	Intra-Americas Sea
IASCLIP	Intra-Americas Sea (IAS) Study of Climate Process
ICPO	International CLIVAR Project Office
IMFIA	Instituto de Mecánica de los Fluidos e Ingeniería Ambiental, Uruguay
IMTA	Instituto Mexicano de Tecnología del Agua, Mexico
INPE	Instituto Nacional de Pesquisas Espaciais, Brazil
IOP	Intensive Observing Period
IPCC	Intergovernmental Panel on Climate Change
IPCC AR4	Intergovernmental Panel on Climate Change - Assessment Report No. 4
IPRC	International Pacific Research Center
IRI	International Research Institute for Climate Prediction
ITCZ	Intra Tropical Convergence Zone
LASI	Land-Air-sea Interaction
LBA	Large Scale Biosphere-Atmosphere Experiment in Amazonia
LLJ	Low Level Jet
LMD	Laboratoire de Météorologie Dynamique, CNRS, France
LPB	La Plata Basin
MBL	Marine Boundary Layer
MCC	Mesoscale cellular convection
MCS	Mesoscale convective system
MERCOSUR	Mercado Común del Sur
MESA	Monsoon Experiment South America
Metoffice	UK Meteorological Office

MGV	Modeling Group for VAMOS
MODIS	Moderate Resolution Imaging Spectroradiometer
MOLTS	Model location time series
MWP	Meteorological Weather Processor
NAM	North American Monsoon
NAMAP	North American monsoon Model Assessment Project
NAME	North American Monsoon Experiment
NAME 2004	NAME field experiment 2004
NAMS	North American Monsoon System
NASA	National Aeronautics and Space Administration, USA
NASH	North Atlantic Subtropical High
NCEP	National Centers for Environmental Prediction, NOAA, USA
NERN	NAME Event Raingauge Network
NOA	Noroeste Argentino
NOAA	National Oceanic and Atmospheric Administration, USA
NOAA OGP	NOAA Office of Global Programs
NWP	Numerical Weather Prediction
NWS	National Weather Services
OB	Oversight Board
PACS	Pan America Climate Studies (NOAA)
PACS-SONET	Pan American Climate Studies Sounding Network
PBL	Planetary boundary layer
PLATEX	Field component of La Plata Basin
PLATIN	La Plata Basin Project
PLR	Outgoing Longwave Radiation
POCS	Pockets of open cells
PRA	Priority Research Area
PUBS	Prediction of Ungauged Basins
SAB	Science Advisory Board
SACZ	South Atlantic Convergence Zone
SALLJ	South American Low Level Jet
SALLJEX	South American Low Level Jet Experiment
SAM	Southern Annular Mode
SAMS	South American Monsoon System
SASM	South American summer monsoon
SGP	Small Grant Program (IAI)
SHOA	Servicio Hidrográfico y Oceanográfico de la Armada de Chile
SIPAM	Sistema de Proteção da Amazônia
SMI	Season Model Intercomparison
SMN	National Meteorological Service of Mexico
SOLAS	Surface Ocean–Lower Atmosphere Study
SSG	Scientific Steering Group
SST	Sea Surface Temperature
START	Global Change System for Analysis, Research & Training

SWG	Science Working Group
TAO	Tropical Atmosphere Ocean
TAP	Transarctic Acoustic Propagation
TC	Tropical Cyclones
TEPPS	Tropical Eastern Pacific Process Study
TFSP	Task Force on Seasonal Prediction (COPES)
TIW	Tropical Instability Waves
UBA	Univesidad de Buenos Aires, Argentina
UCAR	University Corporation for Atmospheric Research, USA
UCAR JOSS	UCAR Joint Office for Science Support
UCLA	University of California, Los Angeles, USA
UK NERC	UK National Environmental Research Council
UNFCC	United Nations Framework Convention on Climate Change
US CLIVAR	US contribution to CLIVAR
USP	Universidade de Sao Paulo
UTC	Coordinated Universal Time
VACS	Variability of the African Climate System
VAMOS	Variability of the American Monsoon Systems
VOCALS	VAMOS Oceans-Clouds-Atmosphere-Land Study
VPM7	7th meeting of CLIVAR VAMOS panel
VPM8	8th meeting of CLIVAR VAMOS panel
WCRP	World Climate Research Programme
WGCM	Working Group on Coupled Modelling (JSC/CLIVAR)
WGSIP	CLIVAR Working Group on Seasonal to Interannual Prediction
WHOI	Woods Hole Oceanographic Institution, USA
WHWP	Western Hemisphere Warm Pool

Appendix 6:

NAME 2004 Data Analysis and Seventh Science Working Group Meeting (SWG-7)
Mexico City, Mexico, March 9-11, 2005.

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Executive Summary

The NAME 2004 Data Analysis and Seventh NAME Science Working Group Meeting (SWG-6) was held 9-11 March, 2005 in Mexico City, Mexico. The meeting brought together participants from the NAME 2004 field campaign and those intending to use the data in follow-on modeling and prediction activities aimed at accelerating improvements in warm season precipitation forecasts, products and applications.

The objectives of the workshop were to review the NAME 2004 Enhanced Observing Period (EOP), including the status and quality of the NAME 2004 data sets, and to review progress on NAME modeling and diagnostic studies (including climate model assessments, climate data assimilation, climate forecast system development). The NAME SWG was also asked to make recommendations for a course of action to accelerate the transition of this research into improved operational climate forecasts, products and applications in concert with the emerging NOAA Climate Test Bed (CTB). These and other recommendations appear as a list of ACTION ITEMS in the next subsection.

The expected outcome of the NAME Data Analysis and SWG-7 meeting is a report that summarizes (i) the contents of the NAME 2004 data set, including dates of deliverables; (ii) NAME 2004 value added products; (iii) the strategy for post NAME 2004 modeling and data assimilation activities to improve simulations and predictions of warm season precipitation with coupled climate models; and (iv) a list of "Synthesis Products" that are expected to emerge from NAME and the plans for achieving them.

This report discusses progress on these items. It includes a list of ACTION items and summaries of the oral presentations. The Meeting Agenda, which was organized into six sessions (NAME 2004 overview; NAME 2004 Field Observations; NAME Diagnostic Studies; SWG-7 Executive Session; NAME Applications; Plans for using NAME 2004 Data in Modeling) is given in Appendix B. The Agenda and presentations are also available on the NAME webpage (www.joss.ucar.edu/name/dm/NAME_data_agenda.html).

Special Thanks are extended to our sponsors [OGP / CPPA (Jin Huang, Mike Patterson), US CLIVAR (David Legler), WCRP (Valery Detemmerman, Howard Cattle)], our local hosts [SMN (Miguel Cortez, Michel Rosengaus)] and those who provided logistical support for the meeting [SMN (Miguel Cortez), UCAR/JOSS (Gus Emmanuel, Jose Meitin), UCAR (Gene Martin, Tara Jay), WCRP (Carlos Ereno)

ACTION ITEMS:

The following Action Items resulted from the NAME 2004 Data Analysis and Seventh NAME Science Working Group (SWG-7) Meeting. They are organized into several categories: Documentation; Datasets; Modeling and Applications; Publications; Education Module; Meetings; and SWG Rotation. NAME SWG members, and NAME PIs are expected to contribute to the completion of these Actions.

Documentation

Action 1 Prepare and distribute NAME Data Analysis and SWG-7 Meeting Report (Higgins and SWG).

Action 2 Update and disseminate NAME Science and Implementation Plan (Higgins and SWG).

Action 3 Develop a list of NAME "Synthesis Products" that are expected to emerge from NAME and the plans for achieving them (SWG)

Action 4 Revise NAME milestones to make NAME Tier 3 activities more visible and explicit

Datasets

Action 5 Evaluate progress on the development of the NAME post-field phase data set, including dates of deliverables (SWG)

Action 6 Evaluate progress on NAME 2004 value added products (SWG)

Modeling and Applications

Action 7 Update strategy in NAME Modeling and Data Assimilation "White Paper" (Mo, SWG)

Action 8 Establish protocols, expand participation and carry out NAMAP2 (Gutzler, Mo, Schemm, Shi, Higgins).

Publications

Action 9 Publish an article entitled "The North American Monsoon Experiment (NAME) 2004 Field Campaign and Modeling Strategy" in the *Bulletin of the American Meteorological Society* (Higgins, SWG, NAME PIs).

Action 10 Contribute to a Special Issue of the *Journal of Climate* on NAME (SWG, PIs).

Education Module

Action 11 Release "beta-version" of NAME "Reports to the Nation" monograph at the NOAA booth during the March 31-April 3 National Science Teachers Association (NSTA)

Annual Conference in Dallas Texas. Distribute Questionaire for teachers to evaluate the document (OGP)

Action 12 Hold focused workshop in Tucson, AZ during the summer of 2005 inviting teachers that responded to the questionnaire (Action 1.10) in order to solicit more specific input on the use of the NAM Monograph and the lesson plans being developed by Steve Uyeda (OGP)

Action 13 Post photos from NAME 2004 on the JOSS web site so that they can be incorporated into the NAME "Reports to the Nation" monograph.

Action 14 Work with Steve Uyeda to complete remaining 6 of 10 lesson plans for NAME curriculum unit.

Action 15 Hold NAME Session at March 2006 NSTA Annual Conference focused on the North American Monsoon Presentations by NAME scientists. Walk through the education materials

<u>Meetings</u>

Action 16 Coordinate the Eighth NAME Science Working Group Meeting with the 9th VAMOS Panel Meeting in Foz do Iguazu, Brazil (March 2006).

Action 17 Coordinate future NAME SWG meetings with VAMOS Panel Meetings (Higgins, SWG).

Action 18 Organize a Special Session on NAME 2004 and NAME Modeling Activities at 30th Climate Diagnostics and Prediction Workshop, State College PA (24-28 October, 2005).

<u>SWG Rotation</u>

Action 19 Carry out the NAME SWG 2005 membership rotation (Higgins, SWG)

Action 20 Modify ToR for rotation of the NAME SWG chair (SWG)

1. Session Summaries

Dr. Miguel Cortez opened the NAME Data Analysis and SWG-7 meeting by welcoming everyone and making everyone feel at home. Everyone agreed that the facilities were excellent and appreciated the attention to detail by the SMN.

Dr. Michele Rosengaus, Director of the SMN, discussed why the North American monsoon is important for the National Water Commission of Mexico (the CNA). He also prepared a speech (delivered at the 8th VAMOS Panel meeting earlier in the week) that poignantly describes his interactions with the CNA, with emphasis on user needs for improved North American warm season precipitation forecasts.

Wayne Higgins also welcomed everyone to the meeting, and provided special thanks to the local hosts. He discussed the goal of the meeting, which was to bring together the participants from NAME 2004 and those intending to use the NAME 2004 data in follow-on modeling and prediction activities aimed at accelerating improvements in warm season precipitation forecasts, products and applications. Higgins also discussed the expected outcome of the meeting, which included this meeting report (see section 1.4 for details). Next Higgins presented a tribute to all of the NAME 2004 participants, which literally numbered into the hundreds. Finally, Higgins concluded his presentation by dedicating the meeting to Dr. Gandikota V. Rao (1934-2004).

1.1 NAME 2004 Overview (Chair: A. Douglas)

The introductory comments were followed by a short overview session that provided general information on NAME 2004, the NAME Forecast Operations Center, and NAME Project Office activities, including the NAME field data catalog and data management. Much of this information has been presented in earlier SWG meetings and SWG meeting reports (see the NAME webpage). A few key details are summarized below.

Title: NAME 2004 Overview
Author: W. Higgins, CPC
This talk summarized the various activities of NAME. Higgins stressed that NAME activities have been formulated to improve our physical understanding of the monsoon in southwestern North America and to determine the degree of predictability of warm season precipitation through critical areas of North America. Perhaps the most unique characteristic of the program, aside from its joint CLIVAR-GEWEX heritage, is that NAME modeling and field activities have been planned in tandem. NAME 2004 enhanced observations were motivated, in part, by model assessment activities (such as NAMAP) in advance of the field campaign. This rich data set will continue to be employed in modeling and data assimilation studies towards improved understanding and more realistic simulations of the monsoon. These efforts are especially germane to the new NOAA Climate Test Bed initiative. Given the high temporal resolution of the NAME data sets, the diurnal cycle should now be resolved more accurately and this in turn should lead to a better understanding of prediction problems associated with the NAM.

More than 30 universities and government laboratories in the U.S., Mexico, Belize and Costa Rica participated in the NAME 2004 field experiment. A host of equipment was supported by NAME (see the JOSS/NAME website for the field and data catalogs). NAME Intensive Observing Periods (IOPs) were aimed at sampling a number of key synoptic and mesoscale features that are typical of the monsoon in Northwest Mexico, including (1) monsoon onset, (2) low-level circulations associated with MCCs, outflow boundaries and gulf surges, (3) broad scale moisture transport associated with easterly waves and tropical storms, and (4) rainfall patterns and variability across the NAME domain. Nine successful Intensive Observing Periods (IOPs) aimed at these features were called in July and August and a tenth IOP was called in September to observe the landfall of Hurricane Javier.

NAME leaves a template for future observing systems that might be designed for monitoring the NAM. The data sets provides the research community with a more comprehensive understanding of climate variability and predictability across the NAM region. The experiment has strengthened international collaboration across Pan America, especially between participating operational and research groups. The NAME modeling strategy provides a template for improved simulations and predictions of the monsoon system and its variability with coupled models.

Title: NAME 2004 Forecast Operations Center
Author: E. Pytlak
Erik Pytlak presented an overview of the NAME Forecast Operations Center. The success of the center during the NAME 2004 Field Campaign can be attributed to the practice forecasting that took place during the summer of 2003. Bob Maddox arranged for a practice "run" of forecasting during this period. Kinks were ironed out relative to the development of forecast zones in Tier I, class limit guidance for the forecast zones (to aid forecasters with little experience in forecasting monsoon precipitation in Mexico) and zone verification procedures. Key synoptic features or events that might be forecast during NAME were also determined during the practice forecast period. During the practice run, ties were developed with CPC, SPC, NHC and the SMN. This helped to develop logistics for daily briefings between these centers. A number of forecaster exchanges also took place in 2003 between NWS and SMN personnel which helped to build knowledge and promote confidence in the joint forecast activities that took place in 2004.

Pytlak noted that the wet bias of the forecasts in 2003 was not as evident in 2004 and the overall skill scores of the forecasters improved in 2004. It was felt that real-time verification efforts aided the shift forecasters. The 5-day rotation period was somewhat short for the 32 FOC forecasters, but this rotation was unavoidable given constraints on NWS forecasters. A number of forecasters participated in a daily remote forecasting exercise via the JOSS/NAME webpage. It was noted that this type of remote forecast project appears to have value and should be considered in future field projects. Differences were noted in 2004 verification efforts when comparing station data forecast zone mean rainfall to the grid point derived forecast zone means. Pytlak noted that a number of field offices are now conducting research on synoptic features that were key to the NAME field experiment and some of these projects include: research on inverted troughs, backdoor cold fronts, and flash flood signatures in New Mexico.

Challenges for the FOC included difficulties with real time verification, and a language barrier between Spanish and English speaking forecasters. As the field experiment began to wind down (IOP days being used up) the number of remote forecasters decreased though the forecast center remained in full operation to support the tenth IOP during mid-September.

Title: NAME 2004 Project Office Activities
Author: G. Emmanuel
Gus Emmanuel presented an overview of NAME 2004 Field support by the VAMOS Project Office. The project office coordinated procurement of science permits, customs clearances and shipping of instrumentation into Mexico. Emmanuel noted that the SMN office and the American Embassy were helpful in last minute efforts to secure permits and to get equipment across the border. The office also assisted in the set up of the WP-3D site, and coordinated participation of the Mexican Navy ship *Altair* during the campaign. The project office helped coordinate Forecast Operations Center activities in Tucson and the aircraft operations center in Mazatlan. A series of pre-field experiment meetings were also coordinated through JOSS. Current NAME efforts are focused on the archival and quality control of NAME 2004 observations.

Title: NAME 2004 Field Data Catalog / Data Management Activities
Authors: J. Meitin, S. Loehrer and L. Cully
Jose Meitin gave an overview of the NAME 2004 Field Catalog maintained at JOSS. To date, JOSS has archived over 150,000 products associated with the NAME field experiment. Major data sets include NAME field and operations reports and products, model data sets, research project and mission tables, CPC verification products, NCEP operational analyses, observed precipitation data sets and satellite data sets. Meitin showed several examples of data sets and graphics that are currently available, including S-Pol radar data, SMN radar data with digitizers, CSU profiler data, and Vaisala low frequency lightning data at 5 minute intervals. JOSS is currently developing the metadata associated with the instrument sites and the quality control of the data sets.

JOSS data management was also instrumental in procuring data via ftp links to other servers (e.g. SST data sets, Quicksat winds). Numerous upper air datasets are archived (SMN countrywide radiosonde network, NWS network in the Southwestern U.S., the ISS (Glass) sites along the Gulf, Belize City (Belize), San Jose (Costa Rica), Phoenix (Salt River Project) and Yuma Proving Grounds). Surface data from the SMN (observatories, airports and automatic station sties) and the US Mesonets are also being archived for NAME. Meitin presented a detailed day-by-day overview of data set inventories for the NAME experiment (June 1-September 30, 2004) and prominent spikes in the quantity of data available are noted for all of the IOPs during NAME. It was stressed that PIs need to follow the guidelines for submitting data to JOSS in order to have standard metadata formats for the field data sets and to help maintain usable data formats for the scientific community.

High resolution radiosonde data are now on line from the *RV Altair,* NWS sties, Phoenix, San Jose (Costa Rica), and from the NCAR/EOL ISS and Glass sites. JOSS is currently working on the radiosonde data from the SMN and Belize. The NOAA/NSSL Pibal data sets and tethersonde data sets from Tesopaco are not available yet. During the meeting Victor Magana provided JOSS with high resolution rawinsonde, pibal and tethersonde data collected from the *RV El Puma*. In all, JOSS collected almost 6,000 high resolution soundings from 31 platforms. JOSS is still trying to work with the SMN on securing the Mexican Navy's data set from 16 operational sites in coastal Mexico. JOSS will also procure the GPS PW data sets processed for the NAME Tier I region by the University of Arizona. Additional post-processing efforts include a 5mb upper air data set (CSU and Pibal data sets), a surface composite data set (hourly and daily) and a precipitation data set (updated data as well as new data).

1.2 NAME 2004 Field Observations (Chair: D. Gochis)

Session 2 focused on the current status of NAME 2004 Field Observations. Thirteen investigators made presentations on their activities during NAME 2004 and their ongoing efforts to process, quality control (QC) and analyze the data. All investigators were asked to estimate when their data would be uploaded to the JOSS NAME data archive (www.joss.ucar.edu/name); this information is included in the summaries of each presentation below.

Title: NAME enhanced sounding network: Performance and results.
Authors: Paul Ciesielski and Richard Johnson, Colorado State University (CSU)
A brief overview of the operational, real-time sounding network was provided. While this included operational soundings from the U.S. NWS and Mexico SMN, emphasis was placed on the data collected at the NCAR Integrated Sounding System (ISS) sites at Puerto Penasco, Kino Bay and Los Mochis as well as the NCAR GLASS site at Loreto. Sounding data from the RV Altair was also discussed. Limited QC was performed in real-time and the available data were objectively

analyzed onto a (lon,lat)=(1°x1°) grid at 25 mb pressure intervals. All products are available as images on a CSU website linked to the NAME Field Data Catalog together with inventories of reporting stations. The sounding analysis system ran for 46 days and missing soundings accounted for about 4% of the total number of planned soundings. Ongoing planned activities include a comprehensive QC of all of the enhanced sounding data, and development of a final version of the gridded analyses at various spatial and temporal resolutions for different domains within the NAME region, with particular emphasis on the budget hexagon in the central-southern Gulf of California. These research-quality gridded analyses will use rawinsonde data, and whenever possible, pibal soundings, profiler winds, Quikscat surface winds and aircraft data. Preliminary diagnostic analyses averaged over the enhanced budget array highlighted large differences between continental and maritime averaged profiles. The QC'd individual sounding data at 5 mb vertical resolution is expected to be ready by early-summer with the complete gridded products to follow within 3 to 6 months.

Title: NWS & SMN soundings and SMN participation
Authors: Art Douglas, Creighton University and Miguel Cortez, SMN
SMN is currently securing all radiosonde data from SMN sites in Mexico from 15 June – 3 Sept. (Note: Budget cuts to SMN in FY05 may curtail soundings at several sites during the summer of 2005. These sites include Cancun, Zacatecas, Isla Socorro, Torreon, Guadalajara and Guaymas/Empalme). In addition to soundings, surface meteorology was collected at several SMN automated weather station sites and are to be integrated into the NAME data archive. A special observing network of temperature and relative humidity sensors was deployed in conjunction with NERN activities. These special sites, when combined with NERN data provide temperature (T), dewpoint temperature (Td) and precipitation measurements every 30 min, thus allowing for reasonable representation of the diurnal cycle. Preliminary diagnostics showed a dramatic increase of Td coincident with the onset of the monsoon at Mazocauhui, Sonora from -8°C to 16°C. Other features such as the passage of Mesoscale Convective Complexes (MCCs) could also be detected and analyzed from the T/Td-precipitation observing sites. A negative correlation between surface temperature and day of year (DOY) was noted which was thought to be heavily influenced by the 'green-up' of the regional vegetation as evidenced by animations of a remotely sensed Normalized Ddifferential Vegetation Index (NDVI). This relationship seemed to be most evident along the low elevations west of the Sierra Madre Occidental and towards the drier eastern side while the steep escarpment and high elevation pine forest regions showed little correlation. It was also noted that the remnants of hurricane Javier dropped very large amounts of rain in the Tier 1 region during mid-September. Rainfall data from the SMN and CNA sites is being integrated within the GASIR inventory. A preliminary analysis of this station data versus the operational CPC gridded product revealed a propensity for the CPC product to overestimate low elevation precipitation along the coastal regions and to underestimate precipitation along the high elevation terrain. Data from the T/Td network, the SMN automated weather stations and the GASIR raingauge archive should be available on the JOSS website within 1-2 weeks.

Title: PIBAL network/ and special raingauge measurements
Author: Michael Douglas, NOAA-NSSL
The PIBAL network consisted of a nested implementation of one network ('vegetation network', 7 sites), to observe the structure of the atmosphere around the central-southern Gulf of California region, while the larger network ('synoptic network', 23 sites) encompassed nearly all of NAME Tier I. The synoptic network was operated for approximately 4 months from June through September. The vegetation network operated with increased frequency to capture the diurnal cycle during daylight hours. On average approximately 30 observations were taken a day among the different sites. Preliminary diagnostics from the 12-13 July IOP were shown. Time-height cross-sections showed southeasterly morning average winds at Hermosillo at about 300m AGL while afternoon winds showed a much stronger inland wind component. Similar behavior present at 500m

AGL. Data from the vegetation flux network, consisting of a large deployment of simple wedge-accumulation raingauges, showed that there is a difference in the month when the maximum amount of precipitation occurred with inland sites peaking in July and coastal sites peaking in August. Tethersonde measurements, made at Tezopaco, Sonora are currently being processed. Graphics of data from the PIBALS are currently available on the NSSL PACS sonnet website. Data from the PIBALS are expected to be delivered to JOSS in approximately 2 months while the tethersonde data are expected in approximately 3 months.

Title: Research aircraft operations and results
Author: Michael Douglas, NOAA-NSSL
Aircraft operations during the 2004 field campaign were primarily focused on mesoscale and synoptic scale aspects of the thermodynamic structure over the Gulf of California. Seventy research hours were allocated into 10 flights of approximately 7 hours each. The stated program objectives were to obtain better moisture flux estimates (or dry air intrusions) intruding on the Gulf of California from the Eastern Pacific, better measurement of the GoC low level jet (LLJ), genesis conditions for gulf surges, the land-sea breeze along the eastern coast of the GoC and the planetary boundary layer structure over the Gulf and adjacent coastal plain. Flights were nearly always done in a continuous porpoising mode varying in altitude from 150 m to 2-3 km ASL. Continuous NW flow was observed off the west coast of Baja California and these observations should help in the development of an integrated lower troposphere moisture flux analysis product. Some flight legs were repeated to capture multiple samples from a particular site of interest such as the central gulf region. Both enhanced and depressed precipitation days were sampled with flight missions. Future activities include several kinds of diagnostic studies of features such as the LLJ and surge genesis. Aircraft data should also be useful in validating model output. One preliminary conclusion was that the LLJ winds appeared to be strongest over the center of the GoC away from topography indicating that the jet does not appear to be generated by classical 'terrain slope-jet' dynamics. Graphics of data from the flights are currently available on the NSSL website and in the JOSS Field Data catalog and the data are already available at JOSS.

Title: Overview of wind/flux/radiation observations at the ETL/AL flux site:
Author: Leslie Hartten: CIRES-Univ. of Colorado and NOAA Aeronomy Lab
Dynamical and thermodynamical data from the NOAA supersite near Estacion Obispo, Sinaloa were collected during NAME 2004. Planned re-deployments of the supersite during 2005 and 2006 should help bound the 2004 measurements and provide a crude estimate of interannual variability. The site was located 145 km NNW of Mazatlan, approximately 25 km from both the coast of the Gulf of California and the foothills of the Sierra Madre Occidental. Data from the site included soil temperature and soil moisture, net radiation, soil heat flux, surface meteorology and eddy covariance heat and moisture fluxes, 915–MHz wind and virtual temperature profiles, and GPS precipitable water. A 449-MHz profiler, deployed for precipitation characterization, was also operated in a wind mode, but there were some technical problems with the setup; work is underway to correct for them, but it is not certain that good wind data will be extractable. A calendar of data availability has been created showing days in which various platforms were operational. The permit problems forced deployment to be delayed until mid-July, and large convective storms did occasionally knock out the power supply to the site. However, 49-69 days worth of data were collected by the primary platforms by the time operations concluded on 20 September. Much of the surface meteorological, ceilometer, and 915-MHz profiler data are currently available from PI Clark King (Clark.W.King@noaa.gov). The surface flux, soil moisture, and radiation data should be available within one month (May 1). Results from the 449-MHz profiler should be available by mid-summer, 2005. Data and metadata will be posted on the JOSS web site by the end of May. Initial diagnostics from the 915-MHz profiler were discussed and time-height cross-sections revealed a mean diurnal cycle consisting of inland flow extending up to 1 km with winds aloft becoming more southerly. There was a weak land breeze at night at low levels while upper levels

exhibited more transience. Future analyses and sampling will focus on the diurnal cycle of the various data collected and their modulation by mesoscale transients such as gulf surges.

Title: NAME event raingauge network: Results and legacy issues
Authors: David Gochis, NCAR; Chris Watts, Jaime Garatuza, Julio Rodriguez,
The NERN was expanded by 6 additional gauges in 2004 which were targeted at improving coverage underneath the SMN precipitation radars at Obregon and Guasabe. Data from the 2004 field season has undergone a preliminary QC and has been posted to JOSS as a provisional dataset for use by other NAME PIs. A new feature of this year's QC was a "gross-error" check to the data in which large events were flagged and the raw data records were manually inspected for plausibility. The NERN is now in the process of being merged with other automated rain gauge data sets from 2004 and will eventually be part of an enhanced resolution hourly gridded product produced at NOAA/CPC. Analysis products from 2004 were compared with those from 2003, revealing that precipitation in 2004 was generally greater in most locations in the NERN sampling domain. Integrating data from 2002-2004 resulted in further smoothing of the diurnal cycle of precipitation products. The segregation of the diurnal cycle of precipitation intensity from the 0-500m elevation band from the rest of the network was presented as a distinguishing feature of the precipitation regime. This elevation band possessed the strongest precipitation intensities and strongest nocturnal precipitation signal and thus is suspected to have a greater maritime influence than those sites at higher elevations and further inland. Regional composites also revealed that averaged hourly precipitation intensities appeared to be higher in 2004 than in 2003 thus contributing to greater seasonal totals. NAME investigators using the NERN data are encouraged to contact the NERN team if they encounter any suspect precipitation estimates.

Title: NAME simple raingauge network
Authors: Rene Lobato, IMTA, Wayne Higgins, Wei Shi
The main objective for the project is to install approximately 1,100 gauges in the states of Sonora, Chihuahua, Durango, Sinaloa and Baja California. The data from the sites is not yet collected so the presentation focused on the plan for collection, QC and distribution to SMN and NOAA-CPC. Various agencies within Sonora are donating infrastructure, particularly communications. Data from most of the currently installed sites is now being reported daily to the collaborating agencies. The gauges used in this project are graduated cylinder funneled gauges with overflow containers similar to those used at NOAA cooperative sites. In addition to daily radio-reported values, hard copy archives are being kept. A simple user manual is distributed with each gauge upon installation and each gauge is GPS located. At present, 300 gauges have been installed. The plan for data flow is to have the data entered into a PC by the collaborating collection agencies and then sent to IMTA and SMN. Attempts are underway to standardize the data formats. IMTA has already created a simple MSWindows application for collectors to log in data. The planned network should provide good 'in-filling' with existing CNA/GASIR daily observation networks. The fully-integrated data collection system should be operational by the 2005 rainy season, with a goal of trying to provide much of the data in a daily operational capacity. Attempts are also underway to provide some sites with thermometers. Special note was given to the many people, volunteers and inhabitants of the region in which the first deployment of rain gauges was made. The assistance of these people was found to be exceptionally genuine and absolutely critical to the projects success.

Title: Profiler-based precipitation observations at the ETL/AL flux site
Author: Christopher Williams, NOAA ETL/AL
At the NOAA supersite several instruments were used to observe the vertical structure of precipitating cloud systems and estimate the vertical profile of hydrometeor drop size distributions (DSDs). The principal instruments in this effort were the 449 MHz profiler and the 2875MHz vertically pointing profiler. The systems identified 23 rain events and images and animations are available on the NOAA ETL/AL website. Specific measurements included reflectivity, Doppler

velocity, and spectrum variance. Calibration of the profiler reflectivities using SPol radar data are expected to become available by June. A more thorough analysis of the DSD measured from the profilers is expected by August. Other data will be released as available.

Title: Vegetation feedback and soil moisture projects
Authors: Chris Watts, U. Sonora, Michael Douglas NOAA NSSL
Two U.S. and 3 Mexican institutions operated 8 flux sites during NAME 2004 (3 sites in Mexico and 5 sites in Arizona). NDVI imagery sequences highlighted the dramatic green-up of the region surrounding the Tezopaco and Rayon, Sonora sites. 2003 data from Arizona show a very clear decrease in vapor pressure deficit in response to the onset of the monsoon. Initial data from Tezopaco in 2004 show significant contrasts between pre- and post-onset conditions and flux sites. The tower at Tezopaco was situated within and above the tropical deciduous forest. The Rayon site was situated in a subtropical scrub site. The third site at La Pintada was situated in desert scrub and buffel grass. July-September evapotranspiration measured 251 mm at Tezopaco, 139 mm at Rayon and 90 mm (July, August only) at La Pintada. The fraction of ET/precipitation was found to be relatively constant between the sites ranging from 0.53-0.63. One particularly interesting finding from 2004 was that while measured ET varies in close correspondence with precipitation the NDVI values do not seem to vary appreciably. Data from the flux towers is expected to be available during the summer of 2004.

Title: SMEX04
Authors: Francisco Muñoz, Duke Univ.; Tom Jackson, USDA; and Dennis Lettenmaier, UW,
The main goal of the SMEX program is to improve the mapping of soil moisture in the North American Monsoon region. The SMEX program ran from 2 – 27 August 2004 after being delayed from mid-July by aircraft mechanical problems. Two domains were sampled; one encompassing the Walnut Gulch (USDA/ARS experimental watershed) region in southeastern Arizona and the second in northern Sonora. The primary remote sensing platforms were a NRL P3 (flying both C- and L-band passive microwave radiometers) and the Aqua satellite AMSR-E (10 GHz band). Surface sites included micrometeorology and multilevel manual and automated soil moisture measurements. Flight operations were scheduled, to the extent possible, to follow rainfall events. AMSR-E overpasses (about every two days) will provide coincident retrievals at much coarser spatial resolution (roughly 25 km). The aircraft instruments provide products with a 3 km spatial resolution.. Unfortunately, the largest rainfall events during the sampling period at Walnut Gulch were modest (maximum 24-hour precipitation about 6 mm). although rainfall amounts at the northern Sonora site (Rayon tower) were much larger – about 25 mm on Aug 6, 28 mm on Aug 7, and 9 mm on Aug 13. Ongoing activities include the processing of aircraft data, satellite soil moisture processing and processing and QC of all ground-based measurements. Once completed the data will be archived to the National Snow and Ice Data Center archive to which JOSS will direct users form the NAME data archive. The SMEX group has an upcoming meeting in Phoenix during May 2005 and plans are being made to have a special issue of a yet to be determined journal on SMEX results. Some point measurements may become available to the community by the time of the May meeting.

Title: Oceanographic measurements aboard the R.V. Altair:
Author: Chris Fairall, NOAA ETL
The *R/V Altair* completed two cruises during the 2004 field campaign between 7 July and 12 Aug. The ship was deployed to a quasi-stationary location at the mouth of the Gulf of California. Shipboard measurements included 915 MHz wind profile measurements, rawinsondes, air-sea fluxes, near surface meteorology, precipitation and conductivity-temperature-density (CTD) measurements. Preliminary diagnostic analyses showed that the top of the marine boundary layer is typically less than 1000m ASL while additional shallow inversions typical of elevated residual layers were encountered at higher altitudes. The typical time of convective precipitation at the

Altair was found to be around 7-8 a.m. local time. Several surge events were documented during the field campaign. Comparisons of water, air and radiative temperature measurements showed that the radiative temperature was cooler than the 2 cm depth water temperature by about 2-3 degrees. The diurnal cycle of 2 cm depth water temperature was also found to be on the order of 2-3 degrees. Other data products from the shipboard platforms include time series of surface heat and moisture fluxes, solar radiation, and ocean heat flux. Cloud radiative forcing was also calculated. Observations of the diurnal cycle of IR cloud forcing suggests that cloud fraction is greatest at night and early morning and skies tend to be clear by 1500 local time. There was an apparent decrease in aerosol concentration throughout the field campaign as inferred from deviations of observed incoming solar radiation from a presumed clear sky model estimate. Raw data from the shipboard platforms are available on the NOAA ETL ftp site which is linked through the NOAA ETL/AL website.

Title: Oceanographic measurements (CICESE)
Authors: Miguel Lavin and Tereza Cavazos, CICESE, Michael Douglas, NOAA-NSSL
The *R/V Ulloa* made two separate cruises within the Gulf of California; 5-21 June and 6-22 August. The first cruise included several transects along the southern end of the GoC. During the first cruise 174 CTD casts were made, 17 drifters were deployed and 50 soundings were made (26 with wind measurements and 24 without). Cold water intrusion from the Eastern Pacific was measured and wind analyses revealed flow from the southwest overlying the cold tongue. The average latent heat flux in this region was ~ 94 W/m^2. Several animations were presented which illustrated the movement of the drifters northward, up the Gulf of California. From these animations it took a drifter approximately 2 weeks to traverse from the mouth of the Gulf to north of Isla Tiburon (central Sonora). Higher latent heat values were observed during the second cruise as were much slower drifter speeds. One conclusion from this study was that a lot of the seasonal heating in the GoC is through advection from warmer regions further south. Soundings, PIBALS and tethersonde measurements were also made aboard the CISESE vessel during both cruises. Soundings were made 4x daily with the 5am and 5pm soundings containing wind, temperature and humidity measurements while the other two soundings only contained temperature and humidity measurements. During the first cruise it was found the marine layer was quite shallow with a height of around 300m ASL and multiple inversion structures existed above. The second cruise showed a marked change in upper level winds from west to east occurring sometime between June and August. The marine layer inversion was less frequently observed during the August cruise than during the June cruise. Data from the shipboard instruments, soundings and drifters will be uploaded to JOSS by the end of April.

Title: S-Pol Data Collection and the SMN Radar Network
Author: Tim Lang, CSU
The NCAR S-band dual polarized Doppler radar was deployed near the coastal town of La Cruz, Sinaloa from 8 July through 21 August. Two modes of operation were used; a climatology mode (with a 200km range) and a storm microphysics mode (150 km range). Rain maps were created every 15 min in coordination with SMN radar scans. Work is currently underway to process and quality control the SPol data after encountering delays in acquiring the data from NCAR/ATD. In addition to rainfall estimates, calculations of Kdp (specific phase propagation), beam blockage and beam attenuation are also being made. The SMN radars operated as follows: Los Cabos - 15 July through the fall; Guasave - 10 June through the fall. Failure of a transmitter power supply at Obregon, resulted in a lack of data from that site. The SMN radar at El Palmito, Durango suffered a lightning strike prior to the field campaign and fuel shortages during the field campaign and was not fully operational for portions of the field campaign. All radar mosaics will therefore contain data only from the SPol, Guasave and Los Cabos radars. Cartesian gridded composites are being developed using the radar mosaics and will have 15min time resolution and 1, 2 and 5 km grid spacings. An SPol only product is also being planned which will have a 0.5 km horizontal and

vertical resolution along with hydrometeor identification. A case study from a storm event on 5 August, 2230-0330 UTC was presented which corresponded with IOP 7. It was observed that stratiform precipitation was not very closely connected with intense convective cells and that in general the MCS did not exhibit as well organized behavior as is commonly observed in MCSs in higher latitudes such as the U.S. Great Plains. An example of hydrometeor classification from the SPol radar was also provided which highlighted a deep region of hail and an associated bright band region of melting hail which induced a phase shift in the radar retrieved reflectivities. The hail was estimated to be of 2 cm in diameter above the melt layer and it was noted that large hail signal returns were commonly observed over the mountains of the Sierra Madre east of the SPol radar site. Rain rates up to 100 mm/hr were observed with the SPol radar. The CSU group is also working in collaboration with the NERN groups and the NHWG in the development of river basin average precipitation products for basins underneath the radar scanning umbrellas. Planned work includes using the mosaic products for diagnostic studies on the diurnal cycle, spatial variability of precipitation, vertical structure, mesoscale organization mechanisms such as easterly waves, convective versus stratiform precipitation comparisons and continental versus maritime precipitation regimes. The radar group is also collaborating with gage-based precipitation teams and the NOAA supersite team in the cross validation of precipitation estimates from the various platforms. Estimated delivery of the gridded radar composites in netCDF format to JOSS is expected to occur by mid-summer 2005.

1.3 NAME Diagnostic Studies (Chair: R. Johnson)

Title: Assessment of NCEP data assimilation systems during NAME04
Author: Kingtse Mo, CPC

During NAME04 EOP period (1 July – 15 August 2004) additional upper-air soundings from the United States and Mexico over the Tier I area were archived at the CPC/NCEP. A data-impact study has been organized that willperform data assimilation both with and without these soundings using both NCEP global and regional analysis systems. NCEP global systems: CDAS (200-km horizontal resolution and 28 levels in the vertical) and GDAS (50-km horizontal resolution and 64 vertical levels) and two regional systems: RCDAS (32 km and 45 vertical levels) and EDAS (12 km and 60 vertical levels). For the coarse resolution CDAS system, the data impact of the NAME soundings on both forecasts and analyses is small and limited to the Tier 1 area. The coarse resolution model is not able to take advantage of the additional soundings. A model with 50-km horizontal resolution or finer is needed to study the impact of the NAME soundings. For the RCDAS, the soundings improve the winds and specific humidity over the Tier I region. The low level moisture transport from the Gulf of California to the Southwest also shows substantial improvement. Future work: Perform a data-impact study using the 12-km Eta model; CDAS, RCDAS and EDAS data-impact studies using all NAME 2004 sounding data, once it becomes available.

Title: Diurnal Cycle of Cloudiness and Precipitation using Satellite Observations
Author: Pingping Xie, CPC

The diurnal cycle of NAMS cloud and precipitation fields were examined over Mexico and the southwestern US for warm seasons 2003 and 2004 using the global full- resolution IR data of Janowiak et al. (2001), the CMORPH satellite precipitation of Joyce et al. (2004), and the 3-dimensional precipitation data observed by the TRMM precipitation radar. Variations of cloudiness and precipitation are dominated by the diurnal cycle over the region. Cloud and precipitation systems start from higher elevations of the Sierra Madre Occidental in the morning, and move toward the coast as they reach the convective maximum later in the afternoon. The phase of the diurnal cycle is relatively stable, while the magnitude is modulated by changes on synoptic and intraseasonal time scales. Maxima of deep convection and precipitation appear 50-100 km west of the mountain crests.

Title: NAME Precipitation Assessment Project
Authors: Wei Shi, Wayne Higgins, CPC
Progress on a comprehensive precipitation assessment project carried out during NAME 2004 was reported. Intercomparisons of nine precipitation estimates, including a gauge-only gridded analysis, seven satellite estimates and one model forecast (GFS), were presented. The gauge analysis and the GFS compared favorably to each other. The satellite estimates tended to overestimate (underestimate) heavy (light) precipitation during NH summer when compared to the gauge analysis and the GFS. In order to improve satellite precipitation estimates, it is recommended that algorithm developers exploit NAME gauge based precipitation datasets that resolve the diurnal cycle in the core monsoon region of Northwest Mexico and the Southwest US. At the present time, it appears that gauge-based estimates offer the best prospects for forecast validation purposes.

Title: Diurnal Cycle of Rainfall and Wind Observed by S-Pol Radar during NAME
Authors: D.A. Ahijevych and R. E. Carbone, NCAR
S-band polarimetric radar (S-Pol) measured reflectivity and radial wind over the coastline of Mexican Sinaloa from July 10 to August 20, 2004. Low-level S-Pol sweep files were interpolated to a rotated Cartesian grid aligned with the Sierra Madre Occidental (SMO). The data were then binned according to hour of the day, eliminating multi-day oscillations and transients. What remained were signatures of the sea/land breeze circulation and continental rainfall. Twenty-four-frame movie loops of rainfall and wind illustrated the mean position and amplitude of the sea breeze front and the regular build-up of deep convection over higher terrain after 1300 local time (LT). The radial wind field indicated a sea breeze peak of 5 m/s at about 1500 LT with a shallower land breeze peak near 0400 LT (2.5 m/s). Hovmöller diagrams averaged in the along-coast dimension suggested a strong diurnal peak over land centered on 1800 local time with a tendency to move farther westward over water during the night in the presence of Gulf Surges and inverted troughs. On average, the westward propagation speed was about 4 m/s. In the future, a lower elevation angle will be used to characterize the land breeze and the analysis will also include SMN radars. With the additional coverage, we can begin to characterize the span and duration of organized rainfall episodes, as previously done by the authors over the continental U.S.

Title: Climate Variability Studies over the American Warm Pools
Author: Victor Magaña, UNAM
The R/V *El Puma* conducted a research cruise to the south of the mouth of the Gulf of California (GOC) from 3-17 August (ECAC5-NAME). Goals of the research were (1) to study the transition of the ocean and lower atmosphere from the warm pool of the eastern Pacific to the GOC, and (2) to investigate the heavy-rain area over the ocean to the west of Puerto Vallarta. Measurements included tethersonde, radiation, surface meteorology, CTD, aerosols, and rain chemistry. Tethersonde measurements were taken to 1 km. The observed depth of the ocean mixed layer was 20-30 m. It was also noted that many lower-tropospheric vortices, such as tropical cyclones, that amplify in the eastern Pacific have their origins in the Caribbean low-level jet, possibly from barotropic instability.

Title: Gulf Surges, the Diurnal Cycle, and Convective Outflows During NAME as Revealed by the NCAR ISS Array
Authors: R. Johnson, P. Rogers, P. Ciesielski, B. McNoldy, and R. Taft
Three NCAR Integrated Sounding Systems (ISSs) and one GPS sounding system (GLASS) were deployed along the GOC during the NAME EOP. The ISSs documented many aspects of the NAM along the GOC, including the characteristics of gulf surges, convective outflows, and the diurnal cycle. The strong 13 July gulf surge was associated with the passage of TS Blas to the south of the

GOC and was preceded by convective downdraft outflows at the ISS sites. Peak winds occurred at 1.2 km AGL at Los Mochis and Bahia Kino, while somewhat lower (700 m) at Puerto Peñasco. Peak winds in the convective outflows were near 300 m. Strongest winds in the gulf surge occurred at Puerto Peñasco (~20 m s^{-1}). These strong low-level winds, which occurred over an 8-10 h period, represented the first stage (or pulse) in the overall surge, which lasted 2-3 days accompanied by significant lower-tropospheric cooling. This first stage exhibited rapid movement (20-25 m s^{-1}) from Los Mochis to Puerto Peñasco, and was accompanied by a 3-4 hPa surface pressure rise to a new level, suggesting the characteristics of an internal bore or mixed Kelvin-wave bore. However, more work is needed to fully characterize this phenomenon. The ISS data also revealed a sharply contrasting behavior of the diurnal cycle from north to south, with a strong low-level nocturnal jet at Puerto Peñasco peaking near 500 m AGL around sunrise, but much weaker at Bahia Kino and nonexistent at Los Mochis. Prominent afternoon sea breezes were observed at Bahia Kino and Los Mochis.

Title: Model simulation of the moist surges along the Gulf of California during NAME
Author: Hugo Berbery, U. Maryland

The presentation first discussed the advective processes over the GoC during the NAME 2004 Field Campaign. A brief review highlighted the critical role of moisture surges along the Gulf for the development of precipitation in the southwest United States. Simulations with NCEP's workstation version of the Eta model were performed and a case study (Tropical Storm Blas) was analyzed and compared with observations. The model forecasts reproduced most aspects of the circulation fields, and the time evolution of precipitation was found to be well within the range obtained from different observational estimates of precipitation.

The second objective of the presentation was to present an assessment of the land surface-atmosphere interactions in the core monsoon estimated using the North American Regional Reanalysis products. As such, these results have to be interpreted in terms of interactions between the variables and not as the direction of possible feedbacks. The core monsoon reveals strong interactions between soil moisture and other surface and boundary layer parameters. Increases in soil moisture correspond to increases in latent heat and decreases in sensible heat, so that with more soil moisture the evaporation fraction is larger (and the Bowen ratio smaller). There is also an inverse correspondence between soil moisture and the lifting condensation level and, as expected, a direct correspondence with the low cloud cover. All these relationships are ultimately reflected in a direct relationship between soil moisture and observed precipitation.

Title: Relationships Between Gulf Surges and Tropical Cyclones in the Eastern Pacific Basin
Author: Wayne Higgins and W. Shi, CPC

Relationships between GoC moisture surges and tropical cyclones (TCs) in the eastern Pacific basin were examined. Standard surface observations were used to identify gulf surge events at Yuma, Arizona for a multi-year (July-August 1979-2001) period. The surges were related to TCs using National Hurricane Center 6-hourly track data for the eastern Pacific basin. CPC observed daily precipitation analyses and the NCEP Regional Reanalysis were used to examine the relative differences in the precipitation, atmospheric circulation and moisture fields for several categories of surge events, including those that were directly related to TCs, indirectly related to TCs and not related to TCs. It was shown that the response to the surge in the southwestern U.S. and northwestern Mexico is strongly discriminated by the presence or absence of TCs. Surges that are related to TCs tend to be associated with much stronger and deeper low-level southerly flow, deeper plumes of tropical moisture, and wetter conditions over the core monsoon region than surges that are unrelated to TCs. The response to the surge was also strongly influenced by the proximity of the TC to the GoC region. TCs that track towards the GoC region exert a stronger, more direct influence on Yuma surges than those that track away from the GoC.

Title: Diurnal Cycle of Precipitation based on CMORPH
Authors: V. Kousky, J. Janowiak and R. Joyce, CPC
A remarkable feature of the North American monsoon is the very large amplitude of the diurnal cycle of precipitation in the vicinity of the Sierra Madre Occidental (SMO) in northwest Mexico. Convective precipitation develops over the SMO during the early afternoon (1230-1300 LST), reaches maximum intensity just to the west of the SMO in early evening (1830-1900 LST), and weakens during the night (0030-0100 LST). The convective systems primarily move westward producing a nocturnal maximum along the coastal plain. At 28ºN there is also some indication of eastward propagation just to the east of the crest of the SMO. Another interesting feature of the North and Central American monsoon is the strong diurnal cycle in precipitation that occurs over nearby oceanic regions, sometimes extending hundreds of miles out to sea, especially west of Central America and to the east of the East Coast of the United States. Convection develops along the east coast of Central America early in the day, propagates to the west coast by evening and then continues westward over the ITCZ region of the Pacific, where a significant diurnal cycle in precipitation is evident several hundred kilometers from land. Over the southeastern United States precipitation is greatest during the late afternoon and early evening, while over the Atlantic the maximum occurs during the late night / early morning 300-400 kilometers east of the coast. For this region there is no apparent propagation of precipitating systems, but rather a distinct out-of-phase relationship in the strength of precipitation between land and the nearby Atlantic Ocean.

1.4 SWG-7 Executive Session (Chair: W. Higgins)

A NAME Executive Session, open to all SWG-7 attendees, was held on Thursday PM. Wayne Higgins chaired the meeting, which started with a show of hands by SWG members to establish a quorum. Higgins presented an 8-point agenda for the meeting, the last two points of which were covered by Dave Gutzler and Andrea Ray.

(1) SWG-7 Expected Outcome - SWG Assignments:

The expected outcome of the NAME Data Analysis and SWG-7 meeting is a report that summarizes (i) the contents of the NAME 2004 data set, including dates of deliverables; (ii) NAME 2004 value added products; (iii) the strategy for post NAME 2004 modeling and data assimilation activities (including NAMAP2) to improve simulations and predictions of warm season precipitation with coupled climate models; and (iv) a list of "Synthesis Products" that are expected to emerge from NAME and the plans for achieving them.

The Workshop report is intended to satisfy a CPPA Milestone for FY 2005. NAME Milestones are listed in section 4. Higgins pointed out that "CLIVAR bought NAME based on Tier III" and asked how Tier III could be made more visible in NAME Milestones. He suggested we “quantify the relative influence of the oceanic and land surface boundary conditions on simulations of the 2004 monsoon”, for FY07. Gutzler suggested expanding the milestone to "determine the effects of NAME 2004 enhanced observations on operational analyses to determine the influences of the monsoon on the larger scales". Mo and Higgins indicated that these studies are in progress. Gutzler asked whether the FY09 bullet was within the core monsoon or the Tier III region. Higgins is thinking the current operational domain should be expanded from the US into Mexico. Higgins charged the SWG to help improve NAME milestones.
Following SWG-7, the NAME Science and Implementation Plan will be updated and disseminated via the NAME web page (www.joss.ucar.edu/name).

Action 1 Prepare and distribute NAME Data Analysis and SWG-7 Meeting Report (Higgins and SWG).

Action 2 Update and disseminate NAME Science and Implementation Plan (Higgins and SWG).

Action 3 Develop a list of NAME "Synthesis Products" that are expected to emerge from NAME and the plans for achieving them (SWG)

Action 4 Revise NAME milestones to make NAME Tier 3 activities more visible and explicit

Action 5 Evaluate progress on the development of the NAME post-field phase data set, including dates of deliverables (SWG)

Action 6 Evaluate progress on NAME 2004 value added products (SWG)

Action 7 Update strategy in NAME Modeling and Data Assimilation "White Paper" (Mo, SWG)

Action 8 Establish protocols, expand participation and carry out NAMAP2 (Gutzler, Mo, Schemm, Shi, Higgins).

(2) BAMS article update:

Higgins described the history and current status of the BAMS Article entitled "The North American Monsoon Experiment (NAME) 2004 Field Campaign and Modeling Strategy". The proposal for the article was submitted to AMS on 1 November 2004, and accepted 1 December 2004. The article was iterated twice between the SWG Chair and the co-authors. The article was submitted to BAMS on 20 March 2005. The BAMS article has 36 authors. CPPA will sponsor color figures and page charges. Higgins noted that he has only about half of the figures in .eps form (needed for final submission), and urged co-authors who have not given him .eps versions to do so.

Action 9 Publish an article entitled "The North American Monsoon Experiment (NAME) 2004 Field Campaign and Modeling Strategy" in the *Bulletin of the American Meteorological Society* (Higgins, SWG, NAME PIs).

(3) Journal of Climate Special Issue:

Higgins explained that JCL was chosen for a Special Issue on NAME because NAME is a climate program, and JCL was receptive to a broad array of NAME studies (e.g. basic physical process understanding, applications, climate-scale, seasonal modeling activities). The submission deadline is 15 October, with publication planned for mid-2006. Authors should submit manuscripts electronically, and state that the article is for the NAME special issue. Andrew Weaver will handle the editing; he would like authors who have not already done so to send the names of 3 suggested reviewers to Higgins. Page charges should be covered by the authors from their grants.

Action 10 Contribute to a Special Issue of the *Journal of Climate* on NAME (SWG, PIs).

(4) NAME Education Module update:

The NAME Education module includes 4 basic elements: (i) Teachers in the Field; (ii) NAM Monograph; (iii) Curriculum Unit and Lesson Plans and (iv) Teacher Workshop Opportuinities. Higgins reported on the status of the last 3 of these.

A 500-copy print release of a "beta-version" of the NAME “Reports to the Nation” Monograph on the North American Monsoon will be made available at the NOAA booth during the March 31-April 3 National Science Teachers Association Annual Conference in Dallas Texas. Currently the monograph is also available on the NAME website (www.joss.ucar.edu/name/education/index.html). The beta version allows for iteration with science educators who can provide critical input and feedback before we go to a final version. A questionaire for teachers to evaluate the document will be distributed at the meeting.
Cover Art will be completed by John Kermond. Mike Patterson says the monograph has illustrations that are quite technical. He requested that people post photos from NAME on the JOSS web site so they could be incorporated into the monograph. Higgins also recommended that the Monograph be translated into Spanish.

OGP will hold a focused workshop in Tucson, AZ during the summer of 2005, inviting teachers that have responded via the questionnaire, in order to solicit more specific input on the use of the document and the lesson plans being developed by Steve Uyeda. Recommended modifications and final print and web-posting will be carried out thereafter.

A Curriculum unit and lesson plans for 6th through 9th grade are being developed by Steve Ugeda, a 9th grade teacher from Tucson. Mike Patterson said that 4 plans are done, mostly on weather scale. Mike suggested that Uyeda pair with someone to flesh out the remaining units (Erik Pytlak has volunteered). Mike hopes to have copies for the NSTA meeting.

NAME will organize a Special Session at the March 2006 NSTA conference focused on the North American Monsoon that will include presentations by NAME scientists and a walk through the NAME education materials

Action 11 Release "beta-version" of NAME “Reports to the Nation” monograph at the NOAA booth during the March 31-April 3 National Science Teachers Association (NSTA) Annual Conference in Dallas Texas. Distribute Questionaire for teachers to evaluate the document (OGP)

Action 12 Hold focused workshop in Tucson, AZ during the summer of 2005 inviting teachers that responded to the questionnaire (Action 1.10) in order to solicit more specific input on the use of the NAM Monograph and the lesson plans being developed by Steve Uyeda (OGP)

Action 13 Post photos from NAME 2004 on the JOSS web site so that they can be incorporated into the NAME “Reports to the Nation” monograph.

Action 14 Work with Steve Uyeda to complete remaining 6 of 10 lesson plans for NAME curriculum unit.

Action 15 Hold NAME Session at March 2006 NSTA Annual Conference focused on the North American Monsoon Presentations by NAME scientists. Walk through the education materials

(5) NAME SWG-8 - Modeling & Applications Workshop:

The Eighth NAME Science Working Group Meeting (SWG-8) will be coordinated with the Ninth VAMOS Panel Meeting (VPM9) in Foz do Iguazu, Brazil during April 2006. The 8th AMS International Conference on SH Meteorology and Oceanography will also be held at that time. The

SWG-8 meeting will focus on NAME modeling and applications studies, including climate model assessments, climate data assimilation, climate products and applications, and transition of R&D to operations (NOAA Climate Test Bed).

Because VAMOS is developing an integrated strategy for NAME, MESA and VOCALS activities (e.g. joint modeling activities), and because NAME is the North American implementation of VAMOS, future NAME SWG meetings will be coordinated with the VAMOS Panel meetings. NAME, MESA and VOCALS will coordinate so that there is no duplication of activities and participants can attend sessions on all 3 VAMOS Science Components.

There will be a Special Session on NAME 2004 and NAME Modeling Activities at the 30th Climate Diagnostics and Prediction Workshop, State College, PA, 24-28 October 2005.

Action 16 Coordinate the Eighth NAME Science Working Group Meeting with the 9th VAMOS Panel Meeting in Foz do Iguazu, Brazil (March 2006).

Action 17 Coordinate future NAME SWG meetings with VAMOS Panel Meetings (Higgins, SWG).

Action 18 Organize a Special Session on NAME 2004 and NAME Modeling Activities at 30th Climate Diagnostics and Prediction Workshop, State College PA (24-28 October, 2005).

(6) SWG 2005 rotation:

Several SWG members are eligible to rotate off the SWG in September 2005. These members are required to convey their intentions for continued participation on the SWG (optional 3 year term) to the SWG Chair by June 2005. A call for nominations will be initiated by the SWG Chair in June 2005. This will include a discussion of missing links on the SWG (e.g. applications, modelers, etc.).

Higgins invited a discussion on whether there should be a change to the ToR for the NAME SWG Chair? Gutzler said that when the SWG was set up, the Pan-American and VAMOS panels wanted the Chair in place through the field campaign. Berbery thought that having a Chair who was *not* a modeler as we entered the modeling phase of NAME could be an advantage.

Action 19 Carry out the NAME SWG 2005 membership rotation (Higgins, SWG)

Action 20 Modify ToR for rotation of the NAME SWG chair (SWG)

(7) US-CLIVAR Reorganization, presented by Dave Gutzler:

Dave Gutzler discussed the reorganization of US CLIVAR and in particular how that might affect NAME. Currently US CLIVAR uses “basin panels” to implement projects: Pacific, Atlantic, and Pan American. The Pan American Panel has implemented several process studies, including EPIC, SALLJEX, NAME 2004 and VOCALS (2007). There has always been close coordination between the CLIVAR VAMOS Panel and the US CLIVAR Pan American Panel.

When US CLIVAR reorganizes, the current panel structure will dissolve (in August 2005). Other working groups and the SSC will be reorganized. The primary motivation is to attract additional funding from several US agencies. Three new implementation panels will be formed: 1) Model development/process studies; 2) Observations/phenomena/diagnostics; 3) Prediction/applications.

Existing panel activities need to be mapped onto the new panel structure. This includes the activities of the NAME SWG.

Gutzler made 2 specific requests of NAME:

(1) Provide advice to the Pan American Panel on how the NAME SWG would like to map onto the new US CLIVAR Implementation Panels;
(2) Provide "NAME greatest hits" input to the Pan-American Panel to wrap up its contributions to US CLIVAR.

Regarding (1), there was a consensus at the meeting that the NAME SWG should link to the predictions/applications implementation panel. Regarding (2), the SWG felt that the recent BAMS article on NAME 04 and NAME Modeling Strategy would be a good contribution. This meeting report also has a list of NAME 2004 value added products, a list of NAME "Synthesis Products", and the latest NAME Milestones, which could also be used.

(8) NAME Products & Applications, presented by Andrea Ray:

Ray started by asking what products are coming out of NAME, and stating a need for a strategy for science that was relevant and accessible to applications communities. She noted that many groups beyond the atmospheric and hydrological communities have an interest in NAME issues, e.g. water management, fire, health, economics, drought. Ray sees the tasks ahead as: developing a list of products; organizing around targeted user communities; determining who will be the operational hosts; coordinating with regional climate centers in NW Mexico; collaboration with hydrological and human dimensions communities; communicating with potential users (e.g. through yearly monsoon outlooks).

Ray presented a strawman (1) to spin up an applications focus in the SWG, (2) to conduct a survey/poll of anticipated products, and (3) to develop a network of applications and human dimensions partners, and (4) to link to the emerging NOAA Climate Test Bed.

1.5 NAME Applications (Chair: A. Ray)

Title: Linking NAME research to hydrological applications: Planned research from the NHWG
Author: D. Gochis
The talk was centered on 3 key elements; (1) past and current activities of NHWG members; (2) current research 'threads' in NAME hydroclimatological research; and (3) opportunities for advancing NAME hydrometeorological/hydroclimatological research. Discussion of past and current activities charted the evolution of the NHWG from its original white paper submission in January 2001 and described how NHWG members participated in the NAME 2004 EOP. It was emphasized that the NHWG is clearly addressing monsoon hydrology across a wide range of space and time scales deemed essential for holistic characterization of NAM hydrological processes. Five hydrologic science objectives were articulated and classified as being either a 'basic' research effort or a 'coordinated-modeling' research effort. Current findings exploring the interannual and intraseasonal relationships of streamflow to monsoon rainfall were shared to motivate potential collaborations between climate modeling teams and hydrological applications teams. Next, six specific potential collaborations, or applications of ongoing NAME research, were identified. A final proposal was made to organize hydrological research efforts around a few key representative, data-rich basins in NW Mexico and the SW U.S. which are of significant interest to both NAME

scientists and managing agencies such as the SMN, CNA and stakeholders in Mexico and the NWS and stakeholders in Arizona. (The full presentation is available online at: www.joss.ucar.edu/name/dm/NAME_data_agenda.html and from speaker D. Gochis (gochis@rap.ucar.edu))

Title: Early Results on User Needs in the NAME region
Author: A.J. Ray

The talk discussed some aspects of the human and environment context of the monsoon region that influence how people might use monsoon information. It summarized work in the NAME region on water management in Mexico and the U.S.-Mexico Border (by Margaret Wilder and Bob Varady); fire management (by Tim Brown and Gregg Garfin); and drought. A study of Mexican water managers and users near the U.S.-Mexico border and in Sonora is being conducted to identify what kinds of climate products they use, what information is lacking, and what constraints / challenges exist. Urban water managers use a variety of meteorological and hydrological data, but climate data and forecasts are not well integrated into daily operational or longer-term planning practices. The study identified a number of constraints to the use of information as well as a number of opportunities. Ongoing work with fire managers in the U.S. has shown that monsoon information and forecasts are of high interest to fire management, because atmospheric conditions related to the monsoon have both fire producing and fire mitigating effects. Some specific monsoon issues of interest to fire managers include: (i) seasonal and medium-range forecasts of onset; predictions of strength and consistency of the monsoon; (ii) improving ability to predict wet versus dry thunderstorms; (iii) assessing the accuracy of GFS relative humidity forecasts; (iv) ability to recognize monsoon "false-start"; and (v) establishing monsoon definition/index relevant to fire management (current dew point definition is not useful for them). The monsoon is a factor in drought in the region, but the nature of drought is that it is not a unique issue but interacts with many other problems: fire, water management, health, land management, dryland agriculture and ranching. Because of this nature there are many definitions and perspectives on drought, but at the same time, this means that needs for drought information will often be related to the ongoing needs of each of these user communities.

Title: Linking NAME research to applications
Author: A.J. Ray

This talk continued discussion of the "Proposed Research Strategy for the NHWG," focusing on the steps NAME can take to engage potential users of NAME science and to plan to meet out year milestones related to forecasts and products (NAME FY08 milestone to bring operational monsoon forecasts on line and CPPA FY08 milestone to provide new operational drought monitoring products). User communities for NAME research include other scientists as well as operational providers of information and end users who are planners and managers with interests related to water, fire, health, ecosystems, severe weather, and drought. In order to ensure that products are useable, relevant, and accessible to user communities, NAME must coordinate with the appropriate partners in the hydrologic, applications, and human dimensions communities, and encourage studies in the NAME region.

The NHWG recommends spinning up an applications focus in the NAME SWG, including the following tasks and activities: (i) actively collaborate with hydrology, applications and human dimensions communities (U.S. and MX), and coordinate with RISAs, IRI, IAI, and other organizations that may contribute; (ii) develop a list of "Value Added" products (see section 2) and "Synthesis" products (see section 3) from NAME and NAME-related activities, and identify the target user community(s); (iii) develop a network of applications and HD researchers and activities in the NAME region; (iv) cultivate support for social science and applications in the region, and by researchers in the region; (v) explore development of a Regional Climate Center for NW Mexico and a Monsoon Outlook; (vi) begin active communication with potential users long before operational products come on line; (vii) develop a Monsoon Outlook/Assessment in format(s) appropriate for dissemination to non-atmospheric science communities, English and Spanish versions; (viii) NHWG should play a role in the NAME CPT, especially with respect to drought to ensure the optimal flow of forecast products.

1.6 Plans for using NAME 2004 data in modeling (Chair: L. Farfan)

Title: NAMAP2
Author: D. Gutzler, U. New Mexico

Dave Gutzler reported on planning for a collaborative modeling effort ('NAMAP2') to compare and assess simulations of the 2004 warm season across the NAME domain. This effort is a follow-on to the successful NAMAP assessment, which included four regional and two global models, that was carried out prior to the NAME 2004 field campaign. Over the next several months, NAMAP2 collaborators will develop a protocol for comparable atmospheric model simulations of summer 2004, including a common SST field and time-varying lateral boundary conditions for regional models. The purpose of NAMAP2 will be (a) to generate a set of common atmospheric model control runs that can be used as a basis for model sensitivity studies; (b) to assess the general quality and shortcomings of these control simulations (comparing the results with NAMAP runs); and (c) to apply the knowledge gained from this assessment to operational forecast model development at NOAA NCEP. Participation is open. An immediate need is to develop a suitable SST data set for the NAME 2004 field campaign season, including a treatment of the Gulf of California that is superior to current operational products.

Title: Issues for global modeling / diurnal cycle activities
Authors: S. Schubert and M. Lee, NASA/GSFC

The diurnal cycle of warm season rainfall was analyzed in three global atmospheric general circulation models (NCEP, GFDL, and NASA). While the models have similar convective schemes based on buoyancy closure, they are characterized by different diurnal cycles in the North American Monsoon (NAM) region. A set of sensitivity tests with the NASA model showed that the source of the differences among the models appears to be from the implementation details of the convection scheme and the interaction with the boundary layer. Sensitivities to the horizontal resolution in the model were also tested. High-resolution runs (0.5 deg.) resolved the key local and mesoscale features (e.g. land-sea breeze). However, increased resolution has less of an impact on the simulated diurnal cycle of convection, suggesting the need for improvement in model physics parameterizations (especially in the convection scheme). Several AGCM development issues were identified in the study, in which the vertical dynamic and thermodynamic structures from the NAME 2004 field observation are key elements to be verified with the current models. .

Title: NAME CPT / Issues for prediction
Author: Jae Schemm, CPC

A NAME Climate Process and modeling Team (CPT) has been established to link NAME climate process research to model development and testing activities at NCEP for warm season climate prediction. This project has been funded by NOAA/OGP CPPA program; participating scientists are J. Schemm, W. Higgins, K. Mo , S. Moorthi and G. White of NCEP/ NWS/NOAA, D. Gutzler of University of New Mexico, S. Schubert of GSFC/NASA and B. Mapes of University of Miami. The project builds on two existing NAME-related modeling efforts. One major component of this project is the organization and implementation of a second phase of NAMAP, based on the 2004 season. NAMAP2 will re-examine the metrics proposed by NAMAP, extend the NAMAP analysis to transient variability, exploit the extensive observational database provided by NAME 2004 to analyze simulation targets of special interest, and expand participation. Vertical column analysis will bring local NAME observations and model outputs together in a context where key physical processes in the models can be evaluated and improved.

The second component builds on the current NAME-related modeling effort focused on the diurnal cycle of precipitation in several global models, including those implemented at NCEP, NASA and GFDL. The activities will focus on the ability of the operational NCEP Global Forecast System (GFS) to simulate the diurnal and seasonal evolution of warm season precipitation during the NAME 2004 EOP, and on changes to the treatment of deep convection in the complicated terrain of the NAMS domain that are necessary to improve the simulations, and ultimately predictions of warm season precipitation. These activities will be strongly tied to NAMAP2 to ensure technology transfer from research to operations.

A feature common to both components of the project will be an examination of the sensitivity of the model simulations to large-scale oceanic and continental boundary conditions. These experiments will be designed to address seasonal predictability issues associated with the North American monsoon. The overarching climate predictability goals associated with NAME are best addressed with global models, but a joint research effort involving both global and regional models (especially for NAMAP2) will facilitate improvements to all of the models. These activities will be closely coordinated among the NCEP CPC, EMC Physics Group, NASA/GMAO, GFDL and the university research community involved in NAMAP2.

Title: NOAA Climate Test Bed
Author: Wayne Higgins

The Climate Test Bed (CTB) facility is proposed to accomplish the following goals: 1) assess scientific advances in coupled climate forecast models developed at various institutions towards the next generation NOAA operational climate forecast system; 2) accelerate synthesis and implementation of advances for NOAA operational climate forecasts; 3) evaluate new and enhanced climate forecast products for a wide range of applications (e.g. water resource management, drought prediction and information services, agriculture applications, wild fire risk outlooks); and 4) provide access to operational models, forecast tools and data sets to enable collaborative research that accelerates improvements of the operational models, tools and methods. The computer/human resource infrastructure, transition projects (base funded and Announcements of Opportunity), and NCEP contributions to CTB infrastructure were discussed.

Title: Warm-season convection over the U.S. continent: Simulation, modeling and parameterization
Author: Mitch Moncrieff

The study objectives were: 1) to simulate warm-season precipitating convection over the continental United States; 2) implement a three-pronged strategy: a) resolve convection; b) under- resolve it; c) parameterize convection; and 3) validation of the precipitation distribution from NEXRAD analysis. Models applied are the NCEP global analysis for background fields and lateral boundary conditions and MM5 run at cloud-system resolving resolutions. It was concluded that a representation of mesoscale dynamics presently missing from convective parameterizations and the parameterization of mesoscale circulations in climate models is necessary. In addition, the potential for NAME-related simulations was discussed and this includes large-scale forcing specified from objectively analyzed sounding data.

Title: Brief Discussion: Summary and recommendations for NAME modeling
Chair: Kingtse Mo

Kingtse Mo led a short plenary discussion that focused on how results from NAME 04 are being used to address modeling issues aimed at improved seasonal-to-interannual precipitation prediction. The NAME modeling community is in the process of updating the modeling strategy outlined in the NAME Modeling and Data Assimilation “White Paper” as follows:

(i) Develop an "End – to – End" forecast system for NAME [SST prediction on S-I timescales→ surface temperature and precipitation forecasts over North America on S-I timescales → hydrologic modeling, forecasts and applications];
(ii) Exploit the NAME 2004 enhanced observations to improve global and regional models and model validation data sets (includes global and regional analyses);
(iii) Focus on hydrologic modeling with strong links to hydrometeorological applications, especially drought/floods (NAME Hydrometeorological Working Group); and
(iv) Develop strong links to the NOAA Climate Testbed (NAME CPT; Climate Forecast System Assessments; multi-model ensembles; experimental prediction) to accelerate the transition of NAME research into improved NOAA operational climate forecasts, products and applications.

Updates to the NAME modeling strategy are incorporated into the latest version of the NAME "White Paper", which is posted on the NAME webpage (www.joss.ucar.edu/name).

Some specific ACTIONS in the near term:

(i) Issue the call and develop protocols for participation in NAMAP2 (Gutzler)
(ii) Develop an improved SST dataset for the GoC during the NAME 2004 period (Xie, Mo).
(iii) Develop a model verification data directory to link both measured and derived surface data for model verification (Johnson, Mo)
(iv) Develop several "Synthesis Products" based on NHWG efforts in hydrologic prediction (Gochis, NHWG).
(v) Add a more comprehensive section on hydrologic applications to the "White Paper" and S&IP (Ray, Gochis)

2. NAME Value Added Products

In addition to the enhanced observations gathered during NAME 04, the NAME community is compiling a set of NAME 2004 value added products that include derived quantities. Nominally NAME 2004 value added products cover the period of the NAME 2004 field campaign, but in many cases the period of record is longer. All of the products will be in a useful format for quantitative applications (as opposed to .gif files, pointers, or raw measurements). Many of the products (e.g. satellite, precipitation) are subsets for the NAME domain at high spatial and temporal resolution. The value added products will support NAME diagnostic, modeling and prediction activities aimed at improved understanding, more realistic simulations and more skilful predictions of the NAM.

The value added products are organized into 4 basic categories: boundary and surface conditions; atmospheric data assimilation and forecast products; precipitation products; and satellite products. Key individuals or groups responsible for these products are also indicated:

1. Boundary and surface conditions
- SST over the Gulf of California and vicinity;
- Soil moisture;
- Surface sensible and latent heat fluxes;
- Mixed layer depth and its diurnal cycle;
- Diurnal evolution of theta, q and winds;
- LCL of the surface (or lowest model level) air (to compare with observed cloud base height);
- Surface drag or friction velocity;

- Diurnal cycle of components of the surface energy budget.

2. **Atmospheric data assimilation and forecast products**
    - CDAS 2 with/without the NAME 2004 data;
    - EDAS using Eta 12 km model with/without the NAME 2004 data;
    - R-CDAS with/without the NAME 2004 data.

    Provider: CPC
    Contact: Kingtse.Mo@noaa.gov

3. **Precipitation products**
    - Gauge analyses (0.25° horizontal resolution and finer)
        - CPC merged US and Mexico daily precipitation analysis (0.25°, daily and hourly)
        - NAME Event Raingauge Network (NERN) (as fine as 5 minutes)
        - SMN Automated Weather Stations (10 min)
        - AGROSON automated agricultural weather stations

    - Satellite analyses (0.25° horizontal resolution and finer)
        - CPC Morphing Technique ("CMORPH") (daily, hourly)
        - Naval Research Laboratory/GEO (daily)
        - US-Irvine/PERSIANN (daily)
        - NASA/GSFC/3B42RT (daily, 3 hourly)

        - NESDIS/Merged AMSU-B Estimates (daily hourly)
        - NESDIS/"Hydro-Estimator" Estimates (daily)
        - NESDIS/GOES Multi-spectral Rainfall Algorithm (GMSRA) (daily)

Providers: CPC, Gochis et al., SMN, AGROSON and participants in the NAME Precipitation Assessment Project
Contact: Wei.Shi@noaa.gov

4. Satellite data products (CPC)
- SST
    - AMSR, GOES, MODIS, TRMM
    - Hourly observations from GOES over clear sky; up to 4x daily from microwave instruments of AMSR and TRMM over clear sky and most cloudy regions
- Surface Wind
    - QuikSCAT over oceans; 2x daily
- Soil Moisture
    - AMSR (new product); 2x daily
- Temperature / moisture profiles
    - AIRS (new product); up to 2x daily
- Clouds
    - AIRS, AMSR, GOES, MODIS, TRMM
    - Cloudiness / cloud top temperature from GOES
    - Total column cloud liquid water from AIRS, AMSR and MODIS
    - 3-D structure of cloud liquid water from TRMM
- Precipitation / Radar Reflectivity
    - AMSR, TRMM
    - Surface precipitation from AMSR, TRMM/TMI and TRMM/Precipitation Radar (PR)
    - 3-D structure of precipitation and Radar Reflectivity from TRMM/Precipitation Radar (PR)
    - TRMM Radar Reflectivity useful for comparison with ground radar observations

- Aerosol
    - MODIS; Up to 4x daily

Provider: CPC is gathering data from respective groups above
Contact: Pingping.Xie@noaa.gov

Comprehensive documentation of NAME 2004 value added datasets, including contact information, periods of availability, resolution, etc) will be available from UCAR JOSS on the NAME Data Management page (http://www.joss.ucar.edu/name/dm/name_dm_index.html).

3. NAME Program Synthesis Products

An important product of the NAME Program are Synthesis Products that show the progress the program is making to improved understanding and more skillful prediction of the North American monsoon and its variability. It is envisioned that all funded investigators have a responsibility to contribute to these products and that they will take leadership in developing and producing these products. NAME Synthesis Products will be developed to address specific NAME scientific questions that, when answered, will help achieve the NAME guiding goal, namely to determine the sources and limits of predictability of warm season precipitation over North America, with emphasis on time scales ranging from seasonal-to-interannual.

For NAME to realize its scientific goals, the SWG has established several working groups (e.g. NAME Climate Process and Modeling Team (CPT); NAME Hydrometeorological Working Group (NHWG)) and subprojects (e.g. the North American Monsoon Assessment Project (NAMAP); the NAME Precipitation Assessment Project (PAP)) within the program. These groups and subprojects, together with the NAME Field Observations PIs and the NAME Modeling and Diagnostic Studies PIs are responsible for the development of the NAME Synthesis Products, which are based on NAME research results and are critical products that demonstrate NAME research progress and usefulness to NOAA's Climate Prediction Program for the Americas (CPPA). Progress of the working groups and PI's towards these products will be reported to the NAME SWG, Program Mangers and JOSS/NAME Project Office.

The current products, groups or subprojects responsible for their compilation, and time horizon for their completion are as follows:

NAME Science Question*: Can we understand and simulate the North American monsoon system and its variability?*
2004 - Benchmark and assess current global and regional model simulations of the North American monsoon (NAMAP);
2004 - Implement the NAME 2004 Field Experiment for improved understanding and prediction of the monsoon (SWG);
2006 - Assess global and regional model simulations of the 2004 North American monsoon (NAMAP2);
2006 - Develop an improved understanding of the water budget and its variability within the NAM domain based on NAME 2004 enhanced observations and modeling (SWG);
2007 - Quantify surface fluxes and land-atmosphere climate feedbacks across the North American monsoon domain (SWG)

NAME Science Question*: What are the linkages between the North American monsoon system and the larger-scale climate system across North America and nearby oceans on seasonal-to-interannual*

time scales?
2006 - Evaluate the impact of additional data from the NAME 2004 field campaign on operational global and regional analyses and forecasts (SWG).

NAME Science Question*: What are the key factors governing the predictability of the monsoon, and in particular, the ability to predict warm season precipitation?*
2006 – Assess the impact of spatial resolution on the ability of coupled climate models to simulate the monsoon (CPT);
2007 – Reproduce the full diurnal cycle of observed precipitation over the core monsoon region in global coupled models by matching well-constrained monthly mean observations to within 20% (NAMAP2, CPT).
2008 – Quantify the relative influence of oceanic and land surface boundary conditions on simulations of the NAME 2004 monsoon (CPT).

NAME Science Question*: Are climate models more capable of predicting North American monsoon variability months to seasons in advance?*
2007 - Evaluate the impact of changes in model parameterization schemes (CPT);
2008 - Measure improvements in model simulations of monsoon onset and variability (CPT);
2009 - Implement recommended changes to operational climate forecast systems to improve the skill of warm season precipitation forecasts (CPT).

NAME Science Question*: How can the scientific contributions of NAME, in areas such as coupled land-atmosphere modeling and seasonal forecasting, best be transferred to the operational hydrology and water resources community?*
2006 - Improved rain gauge calibrated, real-time, quantitative precipitation estimates (QPE) from radar and satellite ready for use in data assimilation and hydrological models (PAP, NHWG);
2007 - Improved land data assimilation system (LDAS) for use in initialization of weather, climate and hydrological forecast models and for use in real-time drought monitoring and prediction (PAP, NHWG);
2008 - Improved suite of seasonal hydrologic forecast systems for water resource applications (NHWG);
2009 - Downscaled seasonal ensemble forecasts for streamflow / reservoir inflow and evaporative demand (NHWG).

NAME Science Question: ***How is improved understanding in the North American Monsoon conveyed to the broader community?***
2007 – Developed NAME educational materials for K-12, including a North American Monsoon monograph, curriculum unit and lesson plans.

4. Annual Milestones

The following annual milestones are used to track progress toward NAME objectives, including the NAME Synthesis Products discussed in section 3.

- ✓ FY04 - Implement NAME 2004 Field Experiment
- ✓ FY05 - Evaluate impact of data from NAME 2004 on operational analyses
- FY06 - Assess global and regional model simulations of the 2004 North American monsoon (NAMAP2)
- FY07 - Evaluate impact of changes in model parameterization schemes (NAME CPT)
- FY07 – Quantify the relative influence of oceanic and land surface boundary conditions on simulations of the NAME 2004 monsoon
- FY08 - Measure improvements in model simulations of monsoon onset and variability (includes NOAA operationl GFS/CFS)

FY09 - Implement recommended changes to operational climate forecast systems to improve skill of warm season precipitation forecasts

The NAME milestones have been updated starting in FY07 to emphasize NAME Tier 3 activities.

Appendix A. Agenda

NAME 2004 Data Analysis Meeting and
Seventh Meeting of the NAME Science Working Group (SWG-7)
Mexico City, MX, 9-11 March, 2005

(Draft 21 February 2005)

Wednesday 9 March 2005

2:00 pm	Welcome / Logistics, etc. – Miguel Cortez
2:10 pm	Reflections on NAME 2004 – Michel Rosengaus
2:20 pm	Goals / Objectives / Special Recognition – Wayne Higgins
Session 1:	**NAME 2004 Overview**
	Chair: Art Douglas
2:40 pm	NAME 2004 Overview – Wayne Higgins
3:00 pm	NAME 2004 Forecast Operations Center – Erik Pytlak
3:20 pm	NAME 2004 Project Office Activities – Gus Emmanuel
3:40 pm	NAME 2004 Field Data Catalog – Jose Meitin
4:00 pm	NAME 2004 Data Management – Jose Meitin, Scott Loehrer & Linda Cully
4:20 pm	***Break***
Session 2:	**NAME 2004 Field Observations**
	Chair: David Gochis
4:40 pm	Enhanced sounding network: Performance and results – Paul Ciesielski
5:00 pm	NWS & SMN soundings / SMN Participation – Art Douglas and Miguel Cortez
5:20 pm	PIBAL network / special raingauge measurements – Mike Douglas
5:40 pm	Research aircraft operations and results – Mike Douglas
6:00 pm	Overview of wind/flux/radiation observations at the ETL/AL flux site - Leslie Hartten
6:20 pm	***Adjourn***

Thursday 10 March 2005

Session 2:	**NAME 2004 Field Observations, cont.**
	Chair: David Gochis
8:30 am	NAME Event Raingauge Network: Results and legacy issues – David Gochis
8:50 am	NAME Simple Raingauge Network – Rene Lobato
9:10 am	Profiler-based precipitation observations at the ETL/AL flux site - Christopher Williams
9:30 am	Vegetation Feedback and Soil Moisture projects – Chris Watts, M. Douglas et al.
9:50 am	SMEX04 – Tom Jackson and Dennis Lettenmaier
10:10 am	***Break***
10:30 am	Oceanographic measurements (R/V Altair) – Chris Fairall
10:50 am	Oceanographic measurements (CICESE) – Mike Douglas, Miguel Lavin & Teresa Cavazos
11:10 am	S-pol radar data collection – Steve Rutledge
11:30 am	SMN radar network – Tim Lang
11:50 am	Overview of the observations made at the ETL/AL flux site – Christopher Williams, Clark King

12:10 pm ***Box Lunch***

Session 3: **NAME Diagnostics Studies**
Chair: Richard Johnson

1:10 pm Assessment of NCEP data assimilation systems during NAME04 –Kingtse Mo
1:30 pm Diurnal cycle of cloudiness and precipitation using satellite observations – Pingping Xie
1:50 pm NAME Precipitation Assessment Project – Wei Shi
2:10 pm Some preliminary findings from a dynamically-based precipitation climatology in the Mazatlan – Culiacan region – Rit Carbone
2:30 pm Climate Variability Studies over the American Warm Pools - Victor Magaña

2:50 pm ***Break***

3:10 pm Gulf surges, the diurnal cycle, and convective outflows during NAME as revealed by the NCAR ISS array – Richard Johnson
3:30 pm Moisture Surges during NAME: Eta model evaluation and diagnosis – Hugo Berbery
3:50 pm Relationships between gulf surges and tropical cyclones in the eastern Pacific basin – Wayne Higgins
4:10 pm The diurnal cycle of precipitation over the Americas based on CMORPH – Vern Kousky

Session 4: **Executive Session**
Chair: Wayne Higgins

4:30 pm **Executive Session (SWG)**

- NAME Data Analysis Panel Report assignments;
- BAMS Article
- SWG 2004 Rotation
- New Business (Extending the NAME timeline; Next meeting)

6:30 pm ***Adjourn***

Friday 11 March 2005

Session 5: **NAME Applications**
Chair: Andrea Ray

8:30 am The NAME Hydrometeorology Working Group / Engaging the International Community – David Gochis.
8:50 am **Hydroclimate in Mexico – Andrea Ray**
9:10 am Water Management in Mexico **–** Margaret Wilder

Session 6: Plans for using NAME 04 Data in Modeling
Chair: Luis Farfan

9:30 am Summary of the VPM8 Session on NAME Modeling & NAMAP2 – Dave Gutzler
9:50 am Issues for global modeling / diurnal cycle activities – Siegfried Schubert

10:10 am ***Break***

10:30 am NAME CPT / Issues for prediction – Jae Schemm
10:50 am NOAA Climate Test Bed – Wayne Higgins
11:10 am Warm-season convection over the U.S. continent: Simulation, modeling and parameterization – Mitch Moncrieff

11:30 am NAM biases in an NCEP reanalysis-like ('reforecast') model – Brian Mapes
11:50 am Effects of Assimilating Surface Measurements on the North American Monsoon: A Case Study Using a Regional Climate Model During the NAME 2004 – Kiran Alapaty
12:10 am Brief Discussion: Summary and recommendations for NAME modeling – Kingtse Mo

12:30 pm ***Adjourn***

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Appendix 7:

MESA Science Working Group
Panel Report from the 1st MESA SWG Meeting (SWG-1)
Mexico City, Mexico, March 9-11, 2005.

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Executive Summary

The 1st MESA Scientific Working Group Meeting (SWG-1) was held 9-11 March, 2005 in Mexico City, Mexico. The meeting brought together the members of the MESA SWG and a group of invited participants with expertise and interests relevant to the MESA objectives. The objectives of the meeting were: to review the MESA scientific questions, to review progress on MESA modeling and diagnostic studies, to discuss MESA applications on La Plata Basin, and future field campaigns. The MESA SWG was also asked to discuss, and organize the MESA implementation plan, and to review and update MESA milestones and time line.

SWG-1 meeting then consisted in a series of presentations and plenary discussions highlighting the key scientific basis for MESA, observational needs, modeling strategy, phases of implementation as well as Program organization. This report summarized the presentations and the plenary discussions made on these items.

Specific recommendations from SWG-1 are as follows:
<u>Program structure:</u>
- MESA is organized in three main priority research areas (PRAs), PRA1: Diurnal and mesoscale variability, PRA2: Intraseasonal variability and PRA3: Interannual and longer timescale variability (including climate change), with the issue about the SAMS evolution and variability as a cross-cutting theme

<u>MESA PRA-1:</u>
- Mechanisms forcing and organizing MCS in addition to the SALLJ include eastward propagating gravity waves excited by convection on the Andes slopes, and it is noted that group velocities of the waves may be dependent on latent heat profiles which in turn are dependent upon the precipitation system (nonlinear problem). Resolution and transient forcing is crucial for the ability to simulate MCSs and should be addressed.
- Soil hydrology is as uncertain as convection and should have close attention in data assimilation for the SALLJEX period.
- Moisture reanalysis is not good, with large imbalances in water budgets. Probable causes include errors in evapotranspiration, and poor resolution in both models and data.

<u>MESA PRA-2:</u>
- Diagnostic analyses need to pursue subjects related to: complex scale interactions that modulate intraseasonal variations; local versus remote forcing; remote contributions to the intraseasonal oscillation (ISO) in South America (SA) from the tropics and extra-tropics; and evaluation of climate and extended numerical forecasts.
- There was general agreement that simulation of the ISO over SA requires a coupled model to properly simulate the ocean-air interaction in the SACZ, sophisticated regional models with adequate land-air interactions to downscale the signal over the highly complex surface conditions of SA, and a variable resolution modeling approach that allows for local processes to feedback in the large scale circulation.

<u>MESA PRA-3:</u>
- Need to define MESA climate metrics like those to evaluate the monsoon onset and the ENSO influence in SA

- There are indications that coupling the meteorological model with other components of the climate system (ocean, biosphere) are important to understand the interannual to longer time scales in the SAMS region;
- Regional moisture recycling needs to be explored in the context of the memory of the system through soil moisture and the vegetation control on surface processes;
- Large-scale patterns have strong influence on SA although the associated predictability level might be very low.
- The role of the interdecadal (and longer-time) modulation in the interannual variability in SA needs to be addressed.

Modeling issues:

- Appropriate simulation of the diurnal cycle of convection is critical. Careful examination of the diurnal cycle of convection and related surface hydrology in a number of climate models is an important task for MESA. Metrics for the evaluation should be defined.
- Besides remote forcing, local land surface feedbacks can be important and may be associated with some predictability on intraseasonal timescales.
- It is recognized that coupled ocean-atmosphere models are the appropriate tools for seasonal prediction (and climate change) studies in SA.
- Crucially important, is the issue of developing clear metrics for the evaluation of the models on diurnal, intraseasonal and interannual time scales.
- There was an agreement that examination of trends and projections of future climate scenarios, is important not only for planning but also for understanding the context of present day variability. Diagnostic studies like those promoted for the IPPC-AR4 simulations should continue.

MESA enhanced observation activities:

- There is a need for a field experiment and enhanced monitoring activities in La Plata Basin (LPB) that will provide information to elucidate questions regarding the interannual and interdecadal variability in the basin as well as to develop datasets that can be used to calibrate and tune models employed in forecasts and climate simulations for the region.
- The priorities for the field experiment, will be (a) the installation of Flux Towers to measure surface fluxes, (b) measure soil moisture over diverse soil use and climate regimes, and (c) expand the rain gauge network to have better estimates of area-averaged precipitation, particularly that resulting from MCSs, for the sub-basins of LPB.
- The field experiment for LPB will be coordinated by the LPB CSE Implementation Steering Group with the MESA SWG and the group working on the GEF project for LPB.
- The enhancement of sustained surface and subsurface observations in western Subtropical South Atlantic through the installation of an atlas buoy in the SACZ region was also recommended. The feasibility of this activity will be evaluated by some members of the MESA SWG.

The meeting Agenda and the list of participants are given in the appendixes. The Agenda and presentations are also available on the MESA webpage:
www.joss.ucar.edu/mesa.

The MESA SWG is very grateful to Carlos Ereño (ICPO), Michel Rosengaus and Miguel Cortez and SMN team, and UCAR/JOSS (Gus Emanuel, Jose Meitín, Tara Jay and Gene Martin) for the excellent organization of the meeting. Special thanks are also extended to our sponsors [OGP / CPPA (Jin Huang, Mike Patterson), US CLIVAR (David Legler), WCRP (Valery Detemmerman, Howard Cattle)]. Finally, we wish to thank all the colleagues who contributed to this report.

1. MESA status and issues

Carolina Vera reviewed the current status of the MESA program with special emphasis on MESA reorganization and raised the following issues and questions.

Currently MESA has been organized in regional programs. It was proposed in the last VAMOS Panel meetings that MESA should start integrating the objectives of the different programs in South America (SALLJEX, PLATIN, LBA) in an unified program in order to facilitate the understanding, simulation and prediction of the different components of the South American Monsoon System (SAMS), their variations and connections with the extratropics.

Therefore, *the MESA implementation plan needs to be discussed in SWG-1 and written during the rest of 2005* in order to better address the main MESA goal related to the SAMS variability and the improvement of the SAMS monthly-to-seasonal prediction. It was suggested in VPM7 and in the informal MESA meeting held during the CLIVAR Conference, in Baltimore, MD, that that *MESA should concentrate its efforts in the region extended from the Amazon Basin to the La Plata Basin, encompassing the Monsoon core region*. Also, *MESA will be organized in three main priority research areas (PRAs), PRA1: Diurnal and mesoscale variability, PRA2: Intraseasonal variability and PRA3: Interannual and longer timescale variability (including climate change).*

A better understanding and improved simulation is expected on the SAMS evolution and variability. Specific scientific issues for PRA-1 include: diurnal cycle of circulation and precipitation, mesoscale convective processes, role of aerosols from biomass burning in SAMS; for PRA-2: dynamics of the SA see-saw pattern; ITCZ-SACZ interaction; influence of MJO on SAMS; relative roles of internal vs forced low-frequency variability; and for PRA-3: land surface forcing, impacts of land use change, role of remote and local SST (South Atlantic), global response to SAMS forcing, Sources and limits of predictability on SAMS region.

Finally, MESA future directions should also be coordinated with the implementation of the GEWEX-CLIVAR/VAMOS/La Plata Basin continental scale experiment (LPB CSE).

2. Summary of the sessions

2.1 Session 1. Review of the scientific basis for MESA

<u>2.1.1 PRA-1: Diurnal and Mesoscale Variability in the SAMS region</u>

Rain-Producing Systems for the SAMS and their Moisture Sources

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There are major, systematic, regional differences in the structure, intensity, and diurnal cycle of rainfall systems. The La Plata Basin (LPB) has a particularly extreme domination by large and intense MCSs. According to 5 years of TRMM data, the region of northeast Argentina, Uruguay, and extreme southern Brazil have almost 80 percent of their annual rainfall contributed by mesoscale convective systems (MCSs), the highest such percentage in the world.

Ever since the seminal work on mesoscale convective complexes (MCCs) by Velasco and Fritsch (1987), it has been well-known that MCCs are common in this region. However, it is the TRMM database that permits quantification of this domination and comparison to other regions of the world.

MCSs and MCCs have a nocturnal rainfall peak not only in the LPB but almost everywhere they are found in the world, over land or oceans. Specifically in the LPB, both TRMM and IR data confirm this nocturnal peak for the SALLJEX period. It is established that during SALLJEX (and in other years) that the South American low level jet (SALLJ) has a similar nocturnal maximum, so we explore whether the connection is direct or indirect. In spite of the time synchronization of the two phenomena, statistically speaking, we may speculate that the role of the SALLJ in MCSs is important, but mostly as a provider of high-CAPE air exported from the Amazon basin.

Further research on this and related issues should be pursued as high priority. When SALLJEX-period reanalyses are undertaken, it is recommended that they should assimilate high-resolution databases and also pay close attention to thermodynamic variables. There is ample evidence that without SALLJEX data, the details of the high theta-e air and high moisture flux are not captured well. These are an essential fuel for the LPB MCSs. Lastly, satellite and radar databases can provide important statistical constraints on convective intensity as well as rainfall.

The Diurnal Cycle of Precipitation over South America based on CMORPH

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The diurnal cycle of precipitation over the region of South America is examined using high spatial and temporal resolution analyses that have been produced by NOAA's Climate Prediction Center morphing technique (CMORPH) (Joyce et al. 2004). The 8-km spatial resolution (at the equator) and 30-minute temporal resolution of these analyses permit an in-depth look at the diurnal cycle of precipitation.

Major features of the summertime diurnal cycle, as depicted by CMORPH for the South American Monsoon, include an afternoon maximum in precipitation over the Andes and the high terrain in central and eastern Brazil, a nocturnal maximum in precipitation over areas just east of the Andes (western Argentina, central Bolivia and western Paraguay), and a nocturnal maximum over the Atlantic Ocean in the vicinity of the South Atlantic Convergence Zone (Fig. 1). A remarkable diurnal cycle in precipitation occurs in coastal areas of northern and northeastern South America. With daytime heating, precipitation rapidly develops along and just inland from the coast (Fig. 1, lower left panel), probably related to the sea breeze (Kousky 1980). This precipitation advances westward and southward, producing a nocturnal maximum in areas approximately 500 km inland from the coast (Fig. 1 upper left panel). The inland propagation of sea-breeze-induced rainfall systems is a feature most frequently found during late SH summer (December-February) and fall (March-May).

The seasonal average diurnal cycle for equatorial South America (Eq. – 5ºN) for March-May 2003 indicates that sea-breeze-induced precipitation systems propagate westward, reaching the western Amazon Basin in about two days (see dashed lines in Fig. 2). As these systems propagate inland they contribute to a nocturnal precipitation maximum in some areas and a diurnal precipitation maximum in other areas. A nocturnal or early morning precipitation maximum also occurs along the immediate coast and offshore in the vicinity of the Atlantic ITCZ and over the Pacific near the west coast of South America.

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Kousky, V. E., 1980: Diurnal rainfall variation in Northeast Brazil. *Mon. Wea. Rev.*, **108**, 488-498.

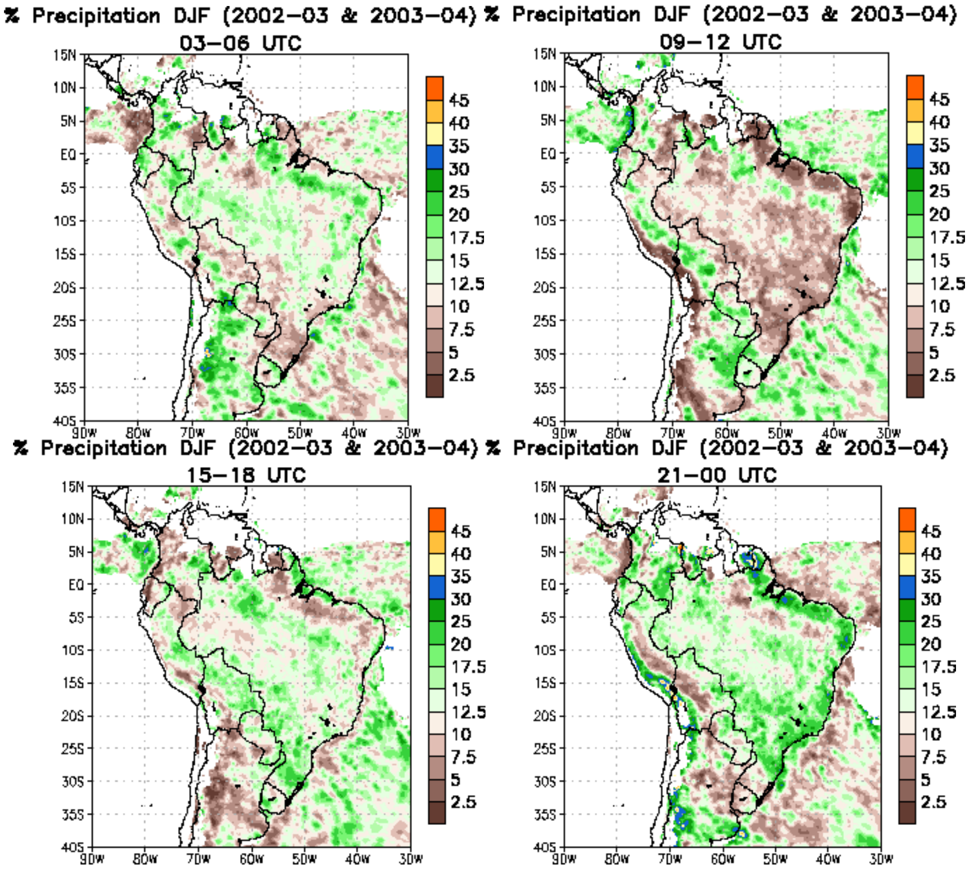

Figure 1. Mean percent of daily total precipitation for 03-06 UTC, 09-12 UTC, 15-18 UTC, and 21-00 UTC. The mean is computed for the combined December-February periods for 2002-03 and 2003-04. Note: if rainfall were distributed equally throughout the 24-h period then 12.5% would be the expected percentage of the daily total for each 3-h interval. Percentages have been masked out in regions where rainfall average less than 1 mm d^{-1}.

On the role of soil moisture in the precipitation processes of the South American Monsoon.

Estela Collini and E. Hugo Berbery

Ensemble simulations with the regional mesoscale Eta model are employed to investigate the feedbacks between soil moisture and precipitation over the South American Monsoon region. Earlier work has shown that moisture is supplied to the monsoon region in large part by advective processes through a Low-level Jet east of the Andes, although local soil conditions may modulate the intensity of precipitation. Recent studies have shown that soil moisture may have significant links to regional climate during summer, and that it increases the persistence of precipitation events. Other studies have shown that the predictability of precipitation over a given region can be increased if soil moisture effects are properly taken into account.

The ensemble simulations are performed for Octobers of different years, and with varying conditions of initial soil moisture. October is chosen because it is the month when the monsoon gets established. Changes in soil moisture affect the latent heat, sensible heat (and consequently the Bowen ratio), as well as the vertical structure of the troposphere. Our results suggest more sensitivity to drier conditions than to wetter states. This would suggest that the land surface in the monsoon area is near saturation; hence increasing soil moisture does not have a notorious effect. On the other hand, drier conditions at the surface favor less precipitation (which feeds back to lower soil moisture).

Notably, southward of the core monsoon the soil moisture effects tend to be more difficult to recognize, probably because El Niño has a strong influence in south eastern South America that overshadows the local effects. An important caveat is that the anomalies in soil moisture are assumed to be proportional to the total field. Therefore, local changes in soil moisture might have better defined effects. We have plans to investigate this last aspect.

Coupling between precipitation and the large scale flow on the diurnal cycle in the Amazon: sensitivity to ground wetness

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The influence of ground wetness on precipitation on the Central Amazon region during January was analyzed through tailored GCM simulations, emphasizing the role of the diurnal cycle.

The model's diurnal cycle in the selected region shows a quite uniform behavior. The diurnal variation of the large-scale ascending motion is out of phase with precipitation whose initiation seems to be dominated by surface forcing, unlike in the less continental regions where land-sea type of circulations play a role.

Sensitivity was studied with respect to ground wetness, which directly controls flux partitioning thus bypassing the vegetation dynamics. Surface roughness and albedo effects usually associated with deforestation are also precluded in the model setting in order to isolate the effect of ground wetness.

For a broad range (0.4 to 1.0) of the parameter multiplying ground wetness, the sensitivity of precipitation is quite small. Moreover, the precipitation grows as the sensitivity parameter is brought down from 1.0 to around 0.8 due to a compensating effect of enhanced mass (moisture) convergence that overcomes the reduced evaporation. The precipitation decreases sharply with the sensitivity parameter only for values smaller than 0.4 as convection in the box decreases.

As we look into the diurnal cycle, we notice that the evolution of ground and surface temperature is gradual through the entire range of the parameter. However, this is not the case for PBL humidity that clearly shows a change in the diurnal cycle at a value of 0.3 in the parameter. This feature is also evident in the precipitation distribution during the day and reflects a drastic change in the PBL diurnal evolution into a situation that is too dry to sustain convection, which collapses as the ground wetness gets smaller.

In view of the initial results, it is hypothesized that this sensitivity of precipitation to ground wetness is bound to depend on the region and the dominating diurnal destabilization mechanisms.

Diurnal variability during SALLJEX

Celeste Saulo (UBA – Argentina), Julia Paegle (U of Utah – USA), Ben Kirtman (COLA – USA)

The diurnal cycle over South America is discussed based on current analysis and observations. Analyses are: 1) the NCEP/NWS/NOAA Global Data Assimilation System available during SALLJEX and 2) COLA climate model output forced with observed SSTs. Observations are those obtained from the South American Low Level Jet Experiment and precipitation estimates from satellites as obtained with the NOAA CPC Morphing Technique (CMORPH). The latter produce estimates of precipitation at a high horizontal and temporal resolution. CMORPH shows an apparent eastward propagation of precipitation from the subtropical Andes foothills eastward towards the Argentine Pampas, with a well-defined nocturnal maximum over south-east South America (SESA). The COLA model does not capture the diurnal cycle of temperature and moisture over SESA, consistent with the lack of nocturnal precipitation over this region. Analyses agree with observations in depicting an anti-cyclonic turning of the wind with time of day within the planetary boundary layer.

Conclusions of the plenary discussion for PRA-1: Diurnal and Mesoscale Variability in the SAMS Region

E.J. Zipser, Chair; Rafael Terra, Rapporteur

<u>MCSs:</u>

- Mechanisms forcing and organizing MCS in addition to the SALLJ include eastward propagating gravity waves excited by convection on the Andes slopes, and it is noted that group velocities of the waves may be dependent on latent heat profiles which in turn are dependent upon the precipitation system (nonlinear problem).
- Resolution is crucial for the ability to simulate MCSs. Speculation is that without explicit convection in models with grid sizes less than 3 km, we should not expect accurate simulations.
- Another reason why MCSs are absent in many models may be the weakness of transient forcing from the large-scale model.

<u>Soil moisture:</u>

- Soil hydrology in pasture in the COLA model is bad and generates the warm bias in SESA (land model too coarse). Soil hydrology is as uncertain as convection and should have close attention in data assimilation for the SALLJEX period. It is a difficult issue but a very important one.

Reanalysis

- Moisture reanalysis is not good, with large imbalances in water budgets. Probable causes include errors in evapotranspiration, and poor resolution in both models and data.

Model intercomparisons and Diurnal cycles

- There is a consensus that devising a sound but workable strategy for intercomparisons is a high priority for MESA research. We should begin with models that are already operational in the region and perform seasonal SALLJEX simulations, in spite of the major effort required.
- After the mean, *the diurnal cycle is basic* for all other scales (i.e. resonance with intraseasonal). We may get the annual mean right for the wrong reasons. We should document the current status of the diurnal cycle in existing models. A suggestion is to undertake a small diagnostic project, with runs already available, and then perform new runs. (WGCIP can help on that.)
- An important metric of validation of the diurnal cycle for LBA has been flux towers and satellite data. If we are to do the diurnal cycle intercomparison, we should check with GCSS groups (they did an intercomparison for convection in the Amazon) and LBA experience. More controlled intercomparisons similar to those done by GCSS could use single column test cases with single column versions of the GCM. Radar experts should be in the group, as they may provide the information needed to test sub-grid scale aspects and parameterizations.

2.1.2 PRA-2: Intraseasonal variability in the SAMS region

Intraseasonal to interannual variability of extreme precipitation over southeastern South America during the Austral Summer

Leila M. V. Carvalho[1], Michel Nobre Muza[1] & Brant Liebmann[2]
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The occurrences of extreme precipitation on intraseasonal to interannual timescales are investigated over Southern (S) and Southeastern (SE) Brazil and Subtropical Western Atlantic (SA) during the austral summer. Pentad precipitation based on gauge observations and satellite estimates from 1979 to 2002 are used to identify extremes. Extreme precipitation and drought are investigated over regions with domain size 10^{o}x10^{o} latitude-longitude and 2.5^{o} spatial resolution. Precipitation time-series are filtered on intraseasonal timescales (20-90 days) and interannual timescales (periods > 370 days). Extreme wet and dry conditions are analyzed in each band-passed precipitation time-series separately and are determined based on the quartiles of the seasonal rainfall distribution, on each grid point for each timescale. Persistence of extreme events is also examined in this study.

The results indicate that extreme precipitation and drought on interannual timescale are modulated by El Niño-Southern Oscillation (ENSO) phases over S Brazil, Uruguay and Northeastern Argentina. Extreme precipitation over SE Brazil is related to phases of the South Atlantic TSM dipole and is more frequent during Neutral/La Nina episodes. Extremes over Subtropical Atlantic are clearly decoupled from those over SE Brazil.

Extreme precipitation on intraseasonal timescales does not show a clear relationship with ENSO phases, except when persistence of the events is considered.

On intraseasonal timescales, the Madden-Julian Oscillation phases modulate part of the variability of extreme rainfall and drought events. Nevertheless, lag composites of circulation during extreme events on intraseasonal timescales show the importance of an atmospheric mechanism characterized by the propagation of midlatitudes wave trains that originate from tropical disturbances over the Pacific. In addition, lag-composites suggest that extreme precipitation events in the South Atlantic convergence zone are associated with positive intraseasonal precipitation anomalies over the South Pacific convergence zone, east of the date line, 2 pentads before the event. Moreover, an enhancement of the zonal wind component in the upper-troposphere appeared to be an important dynamical forcing for the occurrence of extreme precipitation events. Extreme wet events over southern Brazil are related to a strengthening of the northerly low-level jet (eastern of the Andes) that corresponds to the 70th percentile of its seasonal (DJF) magnitude. On the other hand, extreme precipitation events over SE Brazil are associated with the strengthening of the northerly wind component over the tropical Atlantic near the northeast coast of Brazil, which corresponds to the 80th percentile of its seasonal magnitude.

This study shows that the precipitation seesaw between southern and southeastern Brazil appears more evident on intraseasonal time-scales. Nevertheless, the opposition in the signal of the extremes in the two regions was observed in less than 50% of the cases. The seesaw feature is much less evident on interannual timescale. Furthermore, less then ¼ of the extremes occurred simultaneously on intraseasonal and interannual timescales.

An Observational Analysis of Decadal Variations in the Madden-Julian Oscillation

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The Madden–Julian oscillation (MJO) is the most prominent mode of tropical intraseasonal variability. The MJO influences the variability of the monsoons in Asia–Australia and Americas. This modulation has been shown to affect rainfall as well as extreme events in many locations around the world. Furthermore, since the MJO involves intense tropical convective heating anomalies, tropical–extratropical interactions are known to be significant during its life cycle. Therefore, some studies have detected noticeable impacts on the skills of weather forecasts on medium–to–extended ranges as well as in potential predictability in the tropics and extra–tropics.

In a previous study, Slingo et al. (1999) investigated interannual variations in the MJO and relationships with ENSO. Using indices of equatorial intraseasonal activity in the zonal winds (200 h–Pa) derived from NCEP/NCAR reanalysis and Hadley Centre climate model simulations forced with observed SST, Slingo et al. (1999) found evidence of a positive trend in intraseasonal activity since the mid 1970's. This led

Slingo et al. (1999) to speculate that the MJO may become more active as tropical oceans experience prolonged warming.

In this study, we propose an index that specifically characterizes the occurrences of MJO events and their amplitudes from 1958 to 2003. Such index does not have any apparent spurious trends or discontinuities due to changes in observational sampling in the NCEP/NCAR reanalysis. More importantly, contrary to Slingo et al. (1999) results, we have not found statistically significant evidence that the MJO has experienced a steady increase in activity since the mid 1970's (i.e. a linear trend). In contrast, our results do indicate that the MJO exhibits considerable decadal variations but point to a different and much more complex behavior than the one suggested by Slingo et al. (1999). The MJO shows substantial changes in its occurrence and intensity and fluctuates between regimes of high and low activity. These changes in regimes exhibit characteristic time scales of about 8 yrs and 14 yrs.

Intraseasonal variability during SALLJEX

J. Nogues-Paegle (University of Utah), C. Saulo and C. Vera (University of Buenos Aires)
B. Kirtman and V. Misra (George Mason University and Center for Ocean-Land-Atmosphere Studies)

Intra-seasonal (IS) variability during the SALLJEX is examined to quantify the extent to which numerical integrations are able to sustain it with a focus on the source region of the western Pacific and its manifestation over South-America. Seasonal forecasts of the COLA model with prescribed SSTs, 15 day integrations of the MRF model operational in 1998 NCEP-NCAR (CDC Reforecast experiment), NCEP-NCAR Reanalysis and GDAS (NCEP operational Global Data Assimilation System) as well as GPCP (Global Precipitation Climatology Project) daily merged precipitation data from NASA Goddard Space Flight Center are used in the discussion. The SALLJEX period presents a well defined easterly propagating event from Dec 1 2002 - Jan 15 2003. The COLA model weakly reproduces the easterly propagation. The Re-forecasts lose it by day 5 and damp the IS signal by day 15. The two models fail to capture the IS variability over SESA, which is clearly present in the GPCP data. The evolution of low level jet events in central South America is poorly represented in the model integrations.

Local forcing and intraseasonal modulation of the South American summer monsoon: soil Moisture, sea surface temperature, and topography

Alice M. Grimm
Federal University of Parana, Brazil

The El Niño/La Niña impact on the summer monsoon in Brazil is not adequately assessed through seasonal analysis because it shows significant subseasonal variations. Grimm (2003, 2004) shows that there are abrupt changes of anomalies within the summer monsoon season, suggesting the prevalence of regional processes over remote influences during part of the season.

El Niño events impact on precipitation by enhancing or suppressing the mechanisms that produce rainfall. In the case of the summer monsoon, the driving mechanism is the establishment of a continental heat low and a thermal contrast between the continent and ocean, that brings about circulation anomalies. These anomalies provide enhanced moisture convergence, which leads to moistening and destabilization of the troposphere and thus, to enhanced convection. It seems that the surface temperature anomalies brought about by drought in spring (0) of El Niño events in the highlands of southeast Brazil set up the conditions for circulation anomalies that enhance convection in central-east Brazil during part of the monsoon season, especially January (+). This is the only month within the summer season of El Niño events in which monsoon-type circulation anomalies, associated with a regional anomalous heating, are enhanced. Topographic lifting effect in southeast Brazil may also be important in enhancing ascending motion, low-level convergence, and therefore, cyclonic anomaly with moisture convergence in this region. The more vigorous latent heat release can also reinforce the cyclonic circulation in the lower troposphere over that region.

Influence function analysis shows that while the anomalies of circulation over southeast Brazil in spring of El Niño years are probably due to remote influences from the tropical East Pacific, those in January are probably due to local influence.

During La Niña events the circulation, precipitation and temperature anomalies show opposite sign to those observed during El Niño episodes, but the intraseasonal variation is also present during the summer.

The probable role of regional processes is assessed through several simulations with the regional climate model RegCM3, in which the influence of given conditions for soil moisture, topography, changes in parameterizations, and even short term changes in the Atlantic SSTs are tested.

The results indicate a significant role of the soil moisture in setting up temperature anomalies and circulation anomalies that might explain the observed intraseasonal changes, as hypothesized by Grimm (2003, 2004). Intraseasonal changes in the Atlantic SST, off the southeast coast of Brazil, do also exert significant influence on regional rainfall. A very interesting effect of the orography in central-east Brazil on the monsoon circulation and precipitation is disclosed by sensitivity experiments with flat terrain in this region. This is a new aspect, for up to the moment the studies on the influence of orography on the South American climate have been focused on the role of the Andes Mountains.

Intraseasonal variability and model forecasting skill in the monsoon area of S. America

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The motivation for this work is based on the operational experience that model drift (bias) shows persistence and goes through cycles. Operational forecasters frequently ask the question: why are there periods with much higher model forecast skill? The hypothesis to be explored is that the Intraseasonal Oscillation may have some impact on model forecast skill through changes in the basic state and therefore on the “errors of the day". This work has been motivated by the goals of THORPEX (**www.wmo.int/thorpex**) which is an international research programme of WMO aimed at extending the limits of predictability, and at increasing the accuracy of high-impact weather forecasts from day 1 to day 14. In this report it is shown that the CPTEC and NCEP global models forecast skill, measured in terms of bias and mean square error at selected levels, show significant modulation on the time scale of 20-60 days. Both CPTEC and NCEP global models show similar behaviour. The prevailing period of the horizontal structure of the model bias is of the order of 5 to 15 days but there are longer periods. The propagation speed is of the order of 6 to 12 degrees/day. Both CPTEC and NCEP models underestimate/overestimate the geopotential height when and where precipitation is intense in low latitudes. Both CPTEC and NCEP models underestimate the initial growth of individual convective systems and the decay phase is excessively slow in the models. Both models have a negative bias in precipitation in the Amazonia, Bolivia and southern Brazil and present anticyclonic bias to the east of the NE coast of Brazil. NCEP underestimates the SACZ precipitation and CPTEC overestimates beyond 72 hr. The wavelet analysis of the model bias indicates significant intraseasonal control (SACZ, NE Brazil Upper Level Low, Bolivian High). The dynamical control of the intraseasonal variability on the model forecasting skill is possibly related to the changes in the basic flow and its effect on the dynamical instabilities. The fact that significant intraseasonal signal is found in the model forecasting skill provides some clues on how to predict predictability.

Conclusions of the plenary discussion for PRA-2: Intraseasonal variability in the SAMS region

Julia N-Paegle (moderator) Leila Vespoli de Carvahlo (rapporteur)

The discussion emphasized:

1) Observational studies:

i) to evaluate existing gridded and field data (e.g SALLJEX) to obtain measures of analysis fit to observations, inter-comparison of existing and future reanalysis with and without field data to obtain best data sets to study IS variability

ii) to describe remote and local forcing as well as the internal dynamics of ISO. Easy access to vegetation cover data, as well as other measured quantities of fluxes (including carbon) from towers, best cloud climatologies, precipitation estimates from space (CMORPH) Radar, gages and other data from remote platforms (including the extent of the Antarctic ice) would accelerate progress in this topic. This can be accomplished by establishing electronic pointers to such data sets.

2) Diagnostic analyses need to pursue subjects related to:

i) complex scale interactions that modulate intraseasonal variations from diurnal through inter-annual and decadal, and from mesoscale systems through planetary scale and inter-hemispheric interactions.

ii) local versus remote forcing through observational studies that include special surface data and simplified numerical (and theoretical) models .

iii) remote contributions to the SA ISO from the tropics and extra-tropics

iv) evaluation of climate and extended numerical forecasts. Do the GCM models we use have intraseasonal oscillations? Which models do? How does the ISO over South America affect regions outside South America?

v) there is a need to develop a model of the ISO and its manifestation over SA to test the veracity of its simulation by different models.

3) There is a recognition that ISO evolve on a time varying basic state and this offers opportunities and challenges to develop a numerical simulation strategy. The importance of IS variability in monsoonal rains has been established, and thus simulations of SAM onset need to consider which initial conditions containing IS signals offer best forecasts. Ensemble techniques based on initial states that span different phases of the ISO may not be suitable, and optional methods should be considered. There was general agreement that simulation of the ISO over SA requires a coupled model to properly simulate the ocean-air interaction in the SACZ, sophisticated regional models with adequate land-air interactions to downscale the signal over the highly complex surface conditions of SA, and a variable resolution modeling approach that allows for local processes to feedback in the large scale circulation.

4) Extended numerical integrations (from CPTEC and four different model runs) are available and could be diagnosed to examine the veracity of ISO simulations. For this to be efficiently accomplished, it is desirable to place such runs in an archive that can be easily accessed (such as the UCAR data portal or the NCEP NOMAD archive).

2.1.3 PRA-3: Interannual and longer-time variability in the SAMS region.

The main moisture flux sources in SAMS and evolution of the system
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CPTEC/INPE

Results of climate simulations using the CPTEC/COLA AGCM and Eta regional model are analysed to show some features of the South America Monsoon System. The vertically integrated moisture flux has a seasonal variability, and in the summer season, the sources of humidity to the SAMS are the North and South Atlantic and the Amazonia region. The orientation of the moisture flux changes with seasons, and there is a very distinct flux between summer and winter, that is captured by the models. However, the CPTEC/COLA AGCM shows stronger humidity flux to southeastern Brazil, than the reanalysis, that could explain the excess of precipitation in the southern part of SACZ. Changes during ENSO years are noticed in model results, consistent with observations. The Eta model also shows features of summer moisture flux to the monsoon region and the associated precipitation, and displays also a diurnal cycle of precipitation, temperature and wind flow. Recent experiments using the Grell ensemble convection parameterization on CPTEC/COLA AGCM, improved the climatological precipitation field over Amazonia. Other analysis and implementations are in progress to improve the results over SAMS region.

Dominant large-scale patterns influencing the seasonal predictability of precipitation over South America
C. Vera (CIMA/UBA-CONICET, Argentina)
G. Silvestri (CONICET, Argentina)
B. Liebmann (NOAA/CDC, USA)

The presence of the dominant modes of the coupled atmosphere–ocean system will obviously determine the predictability of any climate forecast on interannual timescales. In the case of southern South America, the El Niño–Southern Oscillation (ENSO) phenomenon provides some skill to forecast seasonal precipitation anomalies particular from spring to early fall (Grimm et al. 2000). Recently Silvestri and Vera (2003) showed that the Antarctic Oscillation, which is largely independent of ENSO, influences interannual precipitation changes over subtropical South America (especially during austral winter and spring). Nevertheless, the response of the precipitation variability over southeastern South America to the activity of the main leading modes of variability of the SH atmospheric circulation and SST anomalies, has not been systematically analyzed yet. The reanalysis datasets like that of the NCEP/NCAR (Kalnay et al. 1996) are instrumental for diagnostic studies of the physical origins of climate variability Higgins et al. 2000). Therefore, the first objective of this work is to describe the relative contributions of the leading modes of variability of the atmospheric circulation and the sea surface temperature in the SH to the precipitation variance over southeastern South America using NCEP/NCAR reanalyses.

How modes of variability will change under anthropogenic forcing and whether the response of the climate system to anthropogenic forcing will project onto modes of internal variability are some of the climate change key questions. However, in order to address those issues it is essential to assess whether the observed modes of variability are reasonably simulated by climate GCMs. Very recently, climate modeling groups around the world have been charged with performing an unprecedented set of coordinated 20th and 21st century climate change experiments, for the IPCC Fourth Assessment Report (AR4). Therefore, an additional objective of this work is to investigate the ability of the IPCC/AR4 climate models in reproducing the main features of the leading modes of variability SH circulation and their impact on South America precipitation. The variations of the activity of such leading modes on climate change simulations, and the assessment of climate change scenarios of precipitation over South America based on such variations will be subject of future works.

It is well known that the first leading pattern of circulation variability in the SH is related with zonally symmetric mass transfers between mid- and high latitudes, and it is known among other names as the Antarctic Oscillation pattern (Thompson and Wallace 1998). The second and third leading patterns correspond to the "Pacific-South America" (PSA) patterns (Mo 2000, and references therein). They are characterized by centers of anomalies extended from the tropics and a wavenumber 3 structure at middle latitudes in quadrature with each other. While the source region of the second leading pattern (PSA1), that it can be considered as the response of the SH circulation to the ENSO forcing, is located to the east of the dateline, that of the third leading pattern (PSA2) is in the vicinity of eastern Australia.

The analysis of the influence of the leading modes of Southern Hemisphere circulation onto precipitation variability over southeastern South America showed that ENSO produces large, reasonably reproducible spatial and temporal shifts in precipitation over tropical and subtropical South America during spring and summer, in agreement with previous works. The AAO has a significant contribution in spring while the PSA2 has it in summer and particularly during fall, when the contribution of ENSO and AAO is negligible. Results indicate that a significant portion of the skill of climate forecast models will not only arise from the ability to forecast the temporal and spatial variability of ENSO and the associated teleconnection patterns into midlatitudes but also from the ability to reproduce the circulation patterns associated with the AAO and the PSA2. It is worth to mention, however, that most of the AAO variability and a significant portion of that of PSA2 are due to atmospheric internal dynamics.

The analysis of the IPCC/AR4 climate model outputs of the climate of the 20th Century experiment (20C3M) made so far for the period (1969-1999) show that model are able to reproduce some of the features of the SH leading modes although the associated anomalies are weaker and misplaced. The ability of the models in representing the SH leading modes is related with their ability in reproducing ENSO features and the circulation along the subpolar regions of the SH. NASA/GISS model is not able to reproduce a significant response of SH circulation to ENSO while the GFDL model exhibit similar signatures than those observed. The variance explained by the AAO in both NASA/GISS (24%) and GFDL (21%) models is larger than observed (18%), and both models exhibit stronger air-sea interaction at subpolar latitudes associated with the AAO than that observed. Similar analysis are being performed for the other IPCC models trying to identify which are those that better reproduce the SH circulation variability and their influence over South American climate.

Interannual Variability during summer (DJF) in Observations and in the COLA model

J. Nogues-Paegle (University of Utah), C. Saulo and C. Vera (University of Buenos Aires)
B. Kirtman and V. Misra (GeorgeMason University and Center for Ocean-Land-Atmosphere Studies)

An assessment is made of the summer (DJF) inter-annual variability of rainfall and low-level winds over South America (SA) based on the following data sets: the Climate Prediction Center Merged Analysis of Precipitation (CMAP), Reanalysis 1 and 2 (R-1 and 2) and seasonal runs of the COLA model forced with observed SSTs. DJF precipitation averages from R-1 and 2 shift southward the Equatorial center of precipitation over the northern coast of SA and do not reproduce the continental maximum at 50-65W in the deep tropics. The COLA model reproduces to a certain extent this continental maximum. All three estimates have spurious topographic effects over the Andes. The ENSO dipole is poorly reproduced in the R-1 and 2 rainfall estimates in that the SESA pole is not apparent (except to a certain extent in the COLA model). Instead, all three estimates show an unrealistic maximum over the Andes. The ENSO response is overestimated in the EOF variance partition in the COLA model at the expense of other IA signals. SSTs anomalies in the South Atlantic (30-50W 20-30S) evoke a credible response in all analyses, except for the SST driven COLA simulations over the SST anomalies. Warm SSTs in this region of the South Atlantic are associated with a belt of 500 mb high pressure (25S) that extends through the Pacific and Atlantic oceans. This is partly a manifestation of a circulation response to ENSO and indicative of a contemporaneous correlation with Pacific SSTs.

Inter - El Niño variability and its impact on the South American Low-Level Jet east of the Andes during the austral summer.

Tércio Ambrizzi * *and Gyrlene A. M. Silva*
Dept. of Atmospheric Sciences
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The impact of the inter El Niño–Southern Oscillation (ENSO) variability on the South American Low-Level Jet east of the Andes (SALLJ) during the austral summer (defined as the period between December and February) was analyzed. The Bonner criterium 1 was applied to the NCEP-NCAR circulation fields for the period from 1981 to 2003 to identify the SALLJ episodes. The impact of the location of the maximum convection in the Eastern Central Pacific over the intensity and location of the SALLJ was investigated. The composites of the atmospheric circulation over the South American (SA) showed that the moisture transport from the tropics to the extratropics by the SALLJ is influenced by small displacements of the position of the quasi-stationary Rossby waves. The most important contribution of the large scale flow to generate the SALLJ occurred when the atmosphere was influenced by ENSO events. The composites showed that during strong El Niño events the SALLJ is maintained by the eastern trade winds, while the northern trade winds maintain the SALLJ during weak El Niño events. In strong La Niña events and in neutral conditions there is a secondary western flux from the Equatorial Eastern Pacific crossing the SA and contributing for the maintenance of the SALLJ. When baroclinic transients interact with the SALLJ in the region between 20ºS and 35ºS, they modify the localization and intensity of the jet. The displacement of the jet to the south or southeast influences the convective activity over the South Atlantic Convergence Zone. A dry baroclinic model was used in the research. The simulations suggested that changes in the position of the convective forcing over the equatorial center- eastern Pacific can influence the extratropical atmospheric response. The SALLJ was better configured when the forcing was located in the Niño 3.4 region.

Problems in Diagnosing Precipitation Trends in South America

Brant Liebmann.
NOAA/CDC

Problems that arise in the diagnosis of precipitation trends are discussed, with examples from South America. It is noted that trend calculations are much more sensitive to small errors than are calculations of interannual or subseasonal variability. There are two types of problems. The first comes from incomplete, or sparse data. Although these can cause quantitative errors in the analysis, it is shown that, for the examples considered, the tendencies are qualitatively correct despite the errors. Errors in the collection and recording of data, which add to the uncertainty, are not considered. The second, more serious problem, is that of the choice of record length from which to calculate the trend. Most studies are done by using the longest record available. In many cases, however, the tendency can change drastically when a different length of record is used, suggesting that the 'tendency' is actually decadal scale variability. It is suggested that the calculation of trend is actually rather meaningless unless it can be associated with environmental change (e.g., land use change, etc.).

Relative role of Pacific and Atlantic SST anomalies in streamflow variability in the São Francisco River.

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The objective of this work is to explore the possibility of improving medium range forecast on river discharge in reservoirs in the São Francisco Basin located in the eastern region of Brazil. The hypothesis is that there is a significant SST anomaly control on the precipitation regime. The river data spans the period 1950 to 2003.

Selected SST data is used: Atlantic Ocean (OA) – 40ºS to 15ºN, 60ºW to 15ºE; Pacific Ocean (OP) – 40ºS to 15ºN, 150ºE to 70ºW . Spatial means of the order of (3ºX3º) in the Atlantic Ocean and (5ºX5º) in the Pacific Ocean where determined in order to decrease the dimensionality of the statistical problem. Separate PC's for the Atlantic and Pacific oceans were determined in order to explore the skill of a Linear Regressions Model based on the time series of the PC's as predictors of the river discharge. As a consequence, the fitted forecasting model - and perhaps the model structure itself - may also need to be modified with each successive month that passes. Updating forecasts of future flows requires that the SST scores be updated every month, even if model parameters and model structure are not. The main conclusions are: (1) PC scores of SST anomalies in the Atlantic Ocean can be used to predict natural mean monthly inflows to the Sobradinho Reservoir; (2) Correlations between natural monthly inflows and Atlantic Ocean SST anomalies declined slowly as the forecast lead time increased; (3) Correlations between Sobradinho inflows and PC scores derived from Pacific Ocean SST anomalies were much smaller, but were still useful when used together with Atlantic Ocean SSTs to obtain predictor variables; (4) The better correlation between reservoir inflows and Atlantic SSTs is to be expected because of the relative proximity of that ocean as a source of heat and water vapour entering atmospheric circulation.

Conclusions of the plenary discussion for PRA-3: Interannual and longer-time variability in the SAMS region

P. Silva Dias (Chair), R. Terra (Rapporteur)

- Need to define metrics for evaluation of the beginning of the monsoon season. Is it possible to define monsoon start from the moisture flux point of view (a box in Central Brazil is a reliable measure or the flux along the northern boundary? Or is the moisture flux at 10S? Charge: to define the metrics and explore its use in diagnostic and operational work.
- Regional moisture recycling needs to be explored in the context of the memory of the system through soil moisture and the vegetation control on surface processes;
- There are indications that coupling the meteorological model with other components of the climate system (ocean, biosphere) are important to understand the interannual to longer time scales in the SAMS region;
- Some SH teleconnection patters are well studies such as the AAO, PSA1 and PSA2. However, there are other SH modes (e.g., summer connection between SACZ, SPCZ, SICZ) which are much less understood;
- Important issue on predictability: models reproduce the signal associates to major teleconnection patterns but the predictability is very low.
- What is the role of the interdecadal variability in the interannual and shorter time scales? E.g.: are the weak/strong ENSO cases uniformly distributed in time? Is the probability of occurrence of extreme events associated to the longer time scales? Proxy data such as glacier ice cores, tree rings, speleothemes should be used to identify the decadal and longer time scale control.
- There is a strong concern about the metrics for classification of the ENSO events (CDC) and the potential impact of the metrics on the analysis on long term series in order to explore the longer time variability.

2.2 MESA modeling issues

Summary of MESA modeling related activities discussed in plenary session of VMP8

Iracema F. A. Cavalcanti

INPE/CPTEC

In the plenary session, the discussions were mainly related to the choice of common topics to be explored on modeling the North and South America Monsoon systems. The main idea is to integrate field activities, modeling research and operational forecasting, in MESA, NAME and VOCALS. A list of topics with subjects presented on the workshop was proposed to start the discussion. The list should be reduced to a few topics, in order to focus the activities, and should be uniform for MESA, NAME and VOCALS.

The list of suggested topics was: Diurnal Cycle; Low Level Jets; PBL Processes; Orographic Effects: Coastal Winds, Precipitation; Mixed-Layer Processes; Low Level Cloudiness; Air-Sea Interactions; Air-Land Interactions; Warm Season Precipitation: Remote vs. Local Impacts; Regional Climate Change Assessment; Resolution Issues: Interactions with SSTs other than ENSO; Extra-Tropical Interactions; Predictability Assessment; Seasonality in Predictability; Low Frequency Modes; Prediction Assessment; Fresh Water Flux/Salinity Issues; Hemispheric Interactions; Scale Interactions: Temporal and Spatial (Transients…); Convergence Zone Processes (SACZ, ITCZ); Impact of Land Use Changes; Seasonal Predictability in a Changing Climate; Extreme Events; Intraseasonal Variability; Interactions with ENSO

There were several suggestions of themes:
1. Drought prediction in the Americas, which was changed to droughts and floods in the Americas.
2. Diurnal cycle, and the hydrological component, Cumulus convection and surface heating budgets. Simulation of nocturnal precipitation related to diurnal cycle.
3. Life cycle of NAMS and SAMS. Prediction of onset of monsoon. There is a need to identify metrics to the Monsoon onset.
4. Prediction of South Atlantic SST. There are social impacts in the prediction of droughts or floods in the region. The model responses are related to the interaction of air-sea. A more complete theme could be Prediction of SST surrounding Americas (air sea interaction).
5. There was a suggestion of a theme in environmental problems (droughts, fire, aerosols). Aerosol is important in the transition season. There is a need to look at surface process, deforestation.
6. The climate change issue can be included on other themes.

In the final discussion, the 5 selected themes were: **Diurnal cycle, Droughts and Floods, Life cycle of Monsoon, Predicting SST surrounding Americas, Data assimilation.**

Improvement in model predictability in the monsoon area of S. America: impact of a simple super-model ensemble

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Motivated by the SALLJEX Intercomparison Program in 2003 and the THORPEX goals to improve predictability through the proper combination of numerical weather forecasts produced by a large set of models, we have explored the potential predictability associated with the numerical products available in S. America. There are several models outputs currently available of regular basis in S. America. The global models are: CPTEC, NCEP, JMA, ECMWF, UKMO, CMS) and the regional models are: CPTEC(ETA), INMET (DWD), MASTER (BRAMS), SIMEPAR (ARPS, BRAMS), UFRJ (MM5, RAMS), UFSC(ARPS), FURGS (BRAMS), CEMIG (MM5), LNCC (ETA), UBA (ETA, LMD, RAMS), Univ. Chile (MM5). Approximately 14 models outputs are available on a daily basis. The question is: how can we combine several forecasts in an optimal way? A possible solution is based on basic concepts of data assimilation. The objective it to combine the several forecast through the optimization problem based on the cost function: $T= \sum (T_i-B_i)/MSE_i$, where T_i is the forecast provided by the i^{th} model B_i is the ith model bias and MSE_i is the i^{th} model mean square error. However, the model bias and MSE need an averaging period and how long is this period? Two years is the typical length for MOS. From the point of view of practical applications one should consider much shorter periods: 10, 15, 20, 30 days? Given that a strong intraseasonal signal has been detected in the model bias it is suggested that a shorter period may lead to stable results. The preliminary experience with the models available in S. America indicates that 15 days provides a rather stable statistical measure. It is concludes that the simple procedure based on data assimilation principles was quite successful and the results are routinely available at the MASTER Laboratory homepage (www.master.iag.usp.br). Future implementations are based on the optimal choice of the averaging period for computing bias and MSE. One possibility is to include longer time scales impact on model error (e.g., interannual). However, about 70% of the potential result has already been achieved and we need to improve 30%. This experience has been quite successful not only in terms of providing a realistic statistical estimate of the optimal forecast up to 7 days but also in terms of the exchange of experience among participating groups.

Evaluation of Nested Regional Model Ensemble Climatology for South America: Annual Cycle, Interannual variability, and Rainy Season Onset
Angie Seth, S. Rauscher and B. Liebmann

Multi-year ensemble integrations performed with RegCM3 nested in the ECHAM global atmospheric model and in NCEP/NCAR Reanalyses are analysed with emphasis on simulated annual cycle, interannual variability and rainy season onset. The regional model captures the gross features of the evolution of warm season rains and is quite good in the transition and dry seasons. However, during the primary warm season rains, the Amazon region exhibits a dry bias (similar to that seen in many models) and the subtropical continent shows excess precipitation. This bias results in a clear semi-annual cycle in the Amazon basin, which is not observed. The error in the annual cycle also affects the inter-annual variability in the southeast. Wetter than observed, the region does not respond as observed to inter-annual variations in tropical Pacific SST. Rainy season onset is well simulated in the Northeast and the Southeast, and improves upon the driving GCM, however the length of the season is not improved.

A sensitivity test is performed to the choice of convection scheme. The standard RegCM employs the Grell mass-flux, with single cloud updraft/downdraft and no lateral mixing with the stability based closure. The sensitivity test employs the Emanuel scheme, which is based on a bouancy mixing hypothesis. The results from the sensitivity test show substantial improvements in the large scale circulation including

SLP, low level winds, and moisture transport into the continent from the Atlantic Ocean. The annual cycle of precipitation is also much improved in the Amazon, and also in the Northeast and Southeast regions of the continent.

The South Atlantic Circulation and Climate

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This presentation discusses the low frequency variability of the South Atlantic circulation from observational and modeling results and links it to climate variability. Analysis of altimeter data indicates that the interannual variability of the basin-scale circulation is characterized by a dipole mode with peaks of opposing phases in the subtropics and the western subpolar region. The temporal structure of this mode was characterized by a strengthening of the oceanic circulation in the subtropical gyres from 1992 to 1996 and a weakening from 1996 to 2003. The subpolar expression of this dipole is characterized by a weakening of the recirculation cell over the Argentinean basin from 1992 to 1996 followed by a strengthening from 1996 to 2003. The sea level pressure and the wind stress curl show basin scale variations similar to those of the sea surface height anomaly (SSHA). The lowest mode of sea level pressure variability represents changes of the anticyclonic circulation over the subpolar basin. The structure of the wind stress curl shows changes similar to those of the SSHA. The good correspondence between the dominant modes of variability of sea surface heights and sea surface temperatures (SSTs) indicates that temporal and spatial structure of the South Atlantic SST dipole reported in previous studies, might be highly influenced by the inter-decadal variations of the basin scale, geostrophic circulation of the ocean.

Interannual and interdecadal variability observed in the tropical glacier studies

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Three new ice-cores were drilled in the tropical and subtropical part of the Andes. The first one, 137 meters long, was extracted from the ice sheet of the Illimani (16º37'S, 67º46'W), a 6350m high mountain in the southern part of the Cordillera Real, Bolivia. The second one, 40 meters long, stems from the Sajama (6542 m, 18º06'S, 68º53'W), situated in the western part of the Bolivian Highlands. The third one, 56 meters long, was obtained at the summit of Chimborazo (6280 m, 1.6ºS, 78.6ºW) in Ecuador close to the ENSO influence region (Pacific Ocean). The isotopic composition of the ice as well as a number of various tracers (dust, calcium ions, and electric conductivity) were analyzed in the laboratory and used for a year-by-year dating of the ice. A detailed comparison between the isotope signal of five different Andean high altitude sites (Huascarán, Quelccaya, Illimani, Sajama and Chimborazo) shows a nearly identical inter-annual variability in the 20th century. An Andean Isotope Index (AII) constructed from these Andean sites has been compared with general circulation model simulations [*Hoffmann et al.*, 2003]. The results suggest that the Andean high altitude records are primarily controlled by precipitation variability over the Amazon basin. The Illimani ice core record covers approximately the last 18 000 years BP and the analysis suggest that Illimani/Huascaran water isotope history can be explained in terms of a wetter/cooler conditions during glacial times to drier/warmer conditions in the Early Holocene [*Ramirez et al.*, 2003].

Chacaltaya Glacier is located in the Cordillera Real of Bolivia (5370 m, 16°S). Extending on an area of 0.06 km^2, this glacier is representative of small glaciers of the outer part of the Tropical Andes. A strong correlation exists between Chacaltaya mass balance and the reanalyzed NCEP-NCAR temperature at 500 hPa. Since temperature integrates all the fluxes at the glacier surface, it appears to explain the best part of the mass balance variance at year scale. Nevertheless, at local scale and at short-time scale, as demonstrated by the energy balance analysis conducted on the nearby Zongo Glacier, radiative fluxes and precipitation are the most important factors controlling the glacier evolution. Chacaltaya glacier accurately reflects the climate change occurring in the tropical Pacific-South American domain. The higher frequency and the changed spatiotemporal evolution of El Niño since the mid 1970's together with a generally warming troposphere over the tropical Andes, explains the recent dramatic shrinkage of glaciers in this part of the world.

Conclusions of the plenary discussion for MESA modeling issues
Leila Carvalho (Chair) Anjie Seth, (rapporteur)

This discussion of MESA modeling issues was organized first by timescales (diurnal, intraseasonal, interannual, decadal and climate change) then by modeling strategy (assessment and hypothesis testing), and finally by specific modeling activities (methodological improvements, data assimilation, and parameterization development).

Appropriate simulation of the diurnal cycle of convection is critical for the production of user relevant prediction information including subseasonal climate statistics such as extreme temperatures and rainfall. Errors in the simulation of the diurnal cycle can lead to biases in the annual cycle, in the regional response to remote SST forcing, and in local response to anthropogenic climate forcing. Thus, *careful examination of the diurnal cycle of convection and related surface hydrology in a number of climate models is an important task for MESA*. A range of models should be examined including models used for short-term weather forecasts and those employed for seasonal prediction and climate change studies. Evaluation of the simulated diurnal cycle could be performed with as few a 4 times daily data (6 hourly), however, if shifts are being examined it is possible that hourly data may be needed. There are also questions regarding in what terms the diurnal cycle should be defined, and the metrics used for evaluation. Consideration of specific metrics will have implications for the extension of monitoring networks (e.g., radar or automatic stations for the provision of pdfs). SALLJEX field observations are a critically important source of verification data for evaluations of simulated diurnal cycle as are TRMM and CMORPH.

It has been shown that on intra-seasonal timescales local land surface feedbacks can be important and may be associated with some predictability. Thus in addition to remote forcing of IS variability (e.g., MJO and PSA), it is important to examine local land surface feedbacks and both regional and global models can be used to test such hypotheses. For example, can an IS signal seen in surface flux tower data be replicated by the models? Does local variability have global effects? Can we use regional models to understand IS fluctuations in surface data and improve the model simulation? By moving beyond the mean to examining higher order statistics in the models our understanding of both problems and potential for improvement will be expanded. These issues should be examined in a number of models (including simple models) with analysis performed in a probabilistic manner. SALLJEX observations will provide the reference for understanding and evaluating tropical-extratropical variability in the models.

MESA modeling interest on inter-annual timescales begins with the simulation of ENSO teleconnections in South America. While many models perform well in the region of Nordeste, when forced with observed SST, the predictability of tropical Atlantic SST is poor, and fundamentally, the two-tier approach (prescribing SST in an atmospheric model) is flawed due to resulting inconsistencies in oceanic surface fluxes. Thus it is recognized that coupled ocean-atmosphere models are the appropriate tools for seasonal prediction (and climate change) studies, though much evaluation and improvement is needed of these models, including transient activity, horizontal and vertical resolution, and evaluation of derived variables. Finally, and crucially important, is the issue of developing clear metrics for the evaluation of the models on inter-annual time scales. How is the onset of the monsoon to be defined? Is monitoring needed of moisture flux, or other elements of the surface water balance? Are there other metrics which are more appropriate for the South American monsoon system?

On decadal and century time scales, long term trends provide a critical background state upon which interannual variability is manifested. Thus examination of trends and projections of future climate scenarios is important not only for planning but also for understanding the context of present day variability. There exist numerous global model and multi-model data repositories for present day (historical: CMIP, AMIP) climate integrations and future scenarios (IPCC) which are available in standardized data formats. These global models should be examined in detail for the South American region (and its influence globally). Analysis of these model data will provide a baseline which would guide directions of further model development and experimentation.

Given consideration of these timescale related issues, the MESA Modeling Strategy should include both Model Assessment and Hypothesis Testing. The model assessments should be comprised of (1) regional model assessment during SALLJEX, (2) seasonal simulation assessment, (3) IPCC AR-4 model simulation assessment, (4) Predictability studies for SALLJEX, (5) Diurnal cycle assessment (6) assessment of extremes. The hypothesis testing should include but may not be limited to (1) Synergy between SALLJ and MCS, (2) Mechanism for the NW Argentina heat low, (3) Sensitivity to soil moisture, (4) Coupled simulation for SACZ, (5) Basic mechanisms of diurnal, (6) Coupled simulations to understand multi-scale framework for SAMS variability [Not necessarily hypothesis driven, are models good enough], (7) the nature of convection on diurnal timescales, (8) changes in the basic state related to decadal variability, and (9) local and remote influence of SAMS globally.

2.3. MESA Applications

La Plata Basin, Climate and Hydrology Report

Pedro L. Silva Dias

This presentation is a review of the LPB science objectives and the current status of the organizational activities. The main science questions of LPB are: (a) How are droughts and floods in the Plata Basin characterized from a climatological and hydrological point of view? ; (b) How predictable is the regional weather and climate variability and its impact on hydrological, agricultural and social systems of the basin? And (c) What is the role of global climate change and land use change on regional weather, climate, hydrology and agriculture? The science plan was approved by CLIVAR and GEWEX and in GHP meeting in September 2002 the Plata basin program was proposed as a GEWEX CSE experiment. After some interaction with the LPB science committee, the GEWEX SSG approved the proposal in January 2004. LPB became a GEWEX CSE and as such there are several technical requirements that have to be satisfied as results: (a) CPTEC and IRI, both NWP and climate prediction centers, have committed cooperation with LPB. Several national and international sources provide funding for LBP research, (b) LPB includes several monitoring and experimental networks (e.g. PACS SONET, SALLJEX), as well as flux tower; (c) A PLATIN Database is available for data storage at UCAR JOSS, which also coordinates data management support; (d) the LPB's data policy is inspired by CEOP and used in SALLJEX. Researchers commit to the exchange of scientific information and data in conformity with the general practice of WCRP (e) the LPB is contributing to the evaluation of GEWEX global data products by generating in-situ data.

LPB has now two sites: (a) the operational site at *CPTEC - htpp://www.cptec.inpe.br/LPB – and (b the Joint Office for Science Support of the CLIVAR programs)* *www.joss.ucar.edu/platin*. The CPTEC site is the CSE activity and it is intended to contain updated information of weather and climate forecasts, available data and links to the related activities.

The GEF Framework Program generated surveys of the LPB's hydroclimate, including the systems used for its prediction and monitoring. The PLATIN-related activities in the same program are focused on the development of plans on different aspects of the LPB's hydroclimate. These plans can be an integral part of the LPB CSE's implementation plan. As part of the survey, a detailed analysis of the observational network has been compiled. The survey of the MWP activities indicated that a large number of regional forecasting systems are now available (based on several regional models such as the ETA, WRF, MM5, ARPS, RAMS and the LAHM). There are ongoing activities on the optimal combination of the available forecasts (including the global models and ensemble forecasting with global models. The survey detected rather limited efforts on data assimilation of the conventional and remote sensing data in most of the NMW regional centers except at CPTEC. Distributed hydrological modeling is now available for several sub-basins such as the Taquari, Uruguay, upper Paraguay and the Pantanal will be included next. The GEF/LPB activities are now focused on the generation of the implementation plan and 4 groups have been established: Group 1: Regional climate and hydrological scenarios; Group 2: Land use change and other regional processes; Group 3: Meteorological and climatological observational and prediction systems and Group 4: Hydrological observational and prediction systems. The GEF implementation plan is planned for June 2005. The activities related to the GEF funding in groups 3 and 4 are mostly directed to implementation of operational tools in hydrological and meteorological operational systems. Activities 1 and 2 have a stronger research component.

The science questions of a field experiment in LPB (PLATEX) are under discussion. The main scientific issues are: (a) Strong variability of streamflows on several time scales; (b) relative contributions to variability of climate and land use change are not well known; (c) Effects of aerosols advection from biomas burning from tropical areas are largely unknown, (d) Strong contribution of MCS to total precipitation- (e) the predictability issue related to observation system:data frequency, location of obs., new systems (profilers, radars, new satellite data, etc.).

2.4 Enhanced observation activities & Field campaigns
Moderator: Hugo Berbery, Rapporteur: Carolina Vera

The session had the purpose of discussing the need for a field experiment and enhanced monitoring activities in La Plata Basin (LPB). LPB is a region with strong interannual and interdecadal climate and streamflow variations and trends. The analysis of variability and trends is complicated by the confounding effects of land use change: deforestation, intensive agriculture trends and urbanization. In addition, the unknown effect of aerosols advection from biomass burning from tropical areas may be affecting the atmospheric radiation budget and the physics of clouds, adding another component to an already complicated system.

The field experiment should aim to provide information that can help elucidate the above issues, but also to develop datasets that can be used to calibrate and tune models employed in forecasts and climate simulations for the region. Recent research has shown that the improvement of land surface models that lead to a better representation of the land surface-atmosphere interactions are critical for improving model forecasts. Therefore, the priorities for the field experiment, will be (a) the installation of Flux Towers to measure surface fluxes, (b) measure soil moisture over diverse soil use and climate regimes, and (c) expand the rain gauge network to have better estimates of area-averaged precipitation, particularly that resulting from MCSs, for the sub-basins of LPB.

The field experiment for LPB will be coordinated with the group working on the GEF project for LPB.

Finally there was some discussion about the need for the enhancement of sustained surface and subsurface observations in western Subtropical South Atlantic. In agreement with the GCOS Regional Action Plan for South America, the installation of an atlas buoy in the SACZ region was recommended and the potential activity will be evaluated by some members of the MESA SWG.

3. MESA SWG Executive Session
Chair: Carolina Vera
MESA Implementation Plan

A Panel Session, open to all SWG-1 attenees, concluded the meeting. Carolina Vera opened the session presenting and discussing the outline of the MESA implementation plan and defining the writing assignments. The deadline for submission to the contributions by the MESA SWG members to the MESA Chair is 1 June 2005.

Memberships and Terms of Reference
The terms of reference for the MESA SWG members were discussed and there was an agreement to use the same terms of reference defined for the VAMOS Panel members as follows:

(1) The MESA SWG uses a 3/3 model

- ➢ 3 year appointment to the panel;
- ➢ One additional 3 year appointment at the discretion of the panel chair(s).

(2) The MESA Chair is held to the same guidelines
(3) It is very important to have some flexibility to retain active representatives from key programs.
(5) The MESA SWG Executive Session can be somewhat open to non members.

There was an agreement that the first round of rotations will be made as it follows:

Tercio Ambrizzi	**(2004-2007)**
E. Hugo Berbery	**(2004-2008)**
Leila Vespoli de Carvalho	**(2004-2009)**
Alice Grimm	**(2004-2007)**
Vern Kousky	**(2004-2008)**
Brant Liebmann	**(2004-2009)**
Julia Nogues-Paegle	**(2004-2007)**
José Marengo	**(2004-2008)**
Ricardo Matano	**(2004-2009)**
Carlos Nobre	**(2004-2007)**
Celeste Saulo	**(2004-2008)**
Anji Seth	**(2004-2009)**
Rafael Terra	**(2004-2007)**
Carolina Vera(Chair)	**(2004-2007)**
Ed Zipser	**(2004-2009)**

MESA milestones

The current MESA milestones presented at VPM8 executive session are:

- ✓ FY04: Provide quantitative information of the model errors in SALLJEX. Evaluate impact of SALLJEX data on analysis and forecasts. Provide confirmation about the ability of the models to reproduce some of the elements of the low-level circulation of the SAMS. Prepare GEF-PLATIN survey reports.
- ✓ FY05: Perform SALLJEX Data Assimilation. Plan LPB CSE monitoring activities. Assess the IPCC-AR4 simulations in the SAM region. Plan GEF-Project full proposal.

  FY06: Assess Seasonal prediction simulations in the SAMS region. Develop MESA climate indexes. Perform seasonal simulation of SALLJEX season. Present MESA and LPB CSE monitoring implementation Plan. Assess predictability of the SAM associated with Atlantic SST simulations. Perform regional downscaling of IPCC-AR4 simulations.

  FY07: LPB CSE experiment implementation, data collection, and integration. Assess extreme event frequency changes in the regional climate change scenarios for South America and their impact on agricultural activities.

FY08: Evaluate the impact of soil moisture in simulations and predictions. Hydrological studies of LPB CSE monitoring data.
Ultimate goal: Build an integrated view of the American Monsoon Systems, related inter-hemispheric connection, monsoon predictability and prediction

There was some discussion about the need to revise the MESA milestones and define MESA climate indices. Progresses about these two issues are expected to be made during 2005 and presented for consideration of the VAMOS Panel in VPM9.

MESA SWG-2 meeting

The venue for the next SWG meeting was not discussed but it will likely be the same than that for the VPM9, which will be right after the AMS International Conference for Southern Hemisphere Meteorology and Oceanography that will be held in Foz do Iguacu, Brazil between 24 and 28 April 2006.

Appendix 1: List of participants

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Appendix 2: Agenda

First Meeting of the MESA Science Working Group (SWG-1)
Mexico City, MX, 9-11 March, 2005
Program

Wednesday 9 March 2005

2:00 pm	Objectives/Meeting Organization – Carolina Vera
Session 1:	**Review of the scientific basis for MESA**
Session 1a:	**PRA-1: Diurnal and Mesoscale Variability in the SAMS region** *Chair: Tercio Ambrizzi*
2:20 pm	"Rain-producing systems for the SAMS and their moisture sources"-Ed Zipser
2:40 pm	"The diurnal cycle of precipitation over South America based on CMORPH" – Vern Kousky.
3:00 pm	"Soil moisture and the South American monsoon" Hugo Berbery
3:20 pm	"Coupling between precipitation and the large scale flow on the diurnal cycle in the Amazon, sensitivity to ground wetness."-Rafael Terra
4:00 pm	***Break***
4:30 pm	An evaluation of the diurnal cycle over the SALLJEX region in models and observations. C. Saulo et al.
4:50 pm	Plenary discussion about PRA-1 – Ed Zipser (moderator)
6:00 pm	***Adjourn***

Thursday 10 March 2005

Session 1b:	**PRA-2: Intraseasonal variability in the SAMS region** *Chair: Rafael Terra*
8:30 am	"Interannual and intraseasonal variability of extreme precipitation in Southeastern South America" –Leila Carvalho
8:50 am	"Prediction of the Madden-Julian oscillation and its influence in South America" – Charles Jones
9:10 am	"Modelled and Observed Intraseasonal Anomalies in the SAMS region". J. Nogues Paegle, et al.
9:30 am	Local forcing and Intraseasonal Modulation of the South American Summer Monsoon: Soil Moisture, Sea Surface Temperature, and Topography. – A. Grimm
9:50 am	***Break***
10:10 am	Intraseasonal variability and model forecasting skill in the monsoon area of S. America - Pedro L. Silva Dias, J. Aravequia, M. Schneider
10:30 am	Plenary discussion about PRA-2 – Julia Nogues-Paegle (Moderator)
12:10 pm	***Lunch***
Session 3:	**PRA-3: Interannual and longer-time variability in the SAMS region.** *Chair: Leila Carvalho*
2:00 pm	"The main moisture flux sources for SAMS and evolution of the system. – Iracema Cavalcanti
2:20 pm	Dominant large-scale patterns influencing the seasonal predictability of precipitation over South America. – C. Vera and G. Silvestri
2:40 pm	"Interannual response to SST over SA in the COLA model" – J. Nogues-Paegle et al.
3:00 pm	***Break***
3:20 pm	Inter-El Nino variability and its impact on the LLJ East of the Andes during Austral Summer. Tercio Ambrizzi.
3:40 pm	'Trends in Observed Seasonal Precipitation." Brant Liebmann.

4:00 pm Relative role of Pacific and Atlantic SST anomalies in streamflow variability in the São Francisco River. Andrea Cardoso and P. L.Silva Dias
4:20 pm Plenary discussion about PRA-3 – Pedro Silva Dias (moderator), Alice Grimm (rapporteur)
5:45 pm ***Adjourn***

Friday 11 March 2005
Session 2: Additional MESA modeling issues
Chair: Brant Liebmann
8:30 am Summary of the MESA Modeling related activities discussed in VPM8 – Iracema Cavalcanti- C. Saulo.
8:50 am Improvement in model predictability in the monsoon area of S. America: impact of a simple super-model ensemble Pedro L. Silva Dias, Demerval S. Moreira.
9:10 am Evaluation of Nested Regional Model Ensemble Climatology for South America: Annual Cycle, Interannual variability, and Rainy Season Onset by A. Seth, S. Rauscher and B. Liebmann
9:30 am ***Break***
9:50 am Issues for ocean modeling in the South Atlantic – Ricardo Matano
10:10 am Discussion: Summary and recommendations for MESA modeling – Iracema Cavalcanti (Moderator), Anji Seth (Rapporteur).
Session 3: **Other components of the climate system**
10:50 am Interannual and Interdecadal variability, observed in the tropical glacier studies. Edson Ramirez
11:10 am LPB-CSE: The Hidrometeorology component of MESA – Pedro Silva Dias, Hugo Berbery.
Session 4: **Enhanced observation activities & Field campaigns in MESA and LPB CSE**
11:30 am Presentations and open discussion – E. H. Berbery (Moderator), Carolina Vera (Rapporteur)
12:00 pm ***Lunch***
1:30 pm Discussion of enhanced observations and field campaigns (continues)
3:00 pm ***Break***
Session 5: **MESA SWG Executive Session**
Chair: Carolina Vera
3:30 pm **Executive Session (SWG) 1st part (open): Meeting synthesis**
- Presentation of main issues resulted from the plenary sessions by session moderators (Bullets in 1 slide, 5')
- Discussion of MESA implementation plan and MESA milestones: Action assignments
- MESA timeline
5:00 pm **Executive Session (SWG) 2nd part (closed)**
-SWG Term of References
- SWG Member rotation
-Next meeting
5:30 pm ***Adjourn***

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