

MONSOON ACTIVITIES IN WCRP AND THE YEAR OF TROPICAL CONVECTION**Prepared for JSC-28****February 14, 2007****1. Scientific impact, balance and relevance of WCRP overall**

Monsoons are a central component of the climate system: large enough to influence the global climate system yet small enough to have distinct regional characteristics and be responsive to the global circulation. Monsoonal circulations dominate southeast Asia and are also significant in Africa and the Americas. Through the efforts of CLIVAR and GEWEX, WCRP has clearly played a major role in launching and supporting monsoon studies. CLIVAR's Asian-Australian Monsoon and Indian Ocean Panels (AAMP and IOP) have focussed on the prediction of the Indian and Australian monsoons whilst the GEWEX Asian Monsoon Experiment (GAME) and the SCSMEX (South China Sea Monsoon Experiment), both focussed on the eastern Asian monsoon. These and the other regional monsoon experiments including the North American Monsoon Experiment (NAME), the Monsoon Experiment in South America (MESA), and the La Plata Basin (LPB), and more recently the African Monsoon Multidisciplinary Analysis (AMMA, see section 3.2) all have distinctly regional approaches to monsoon issues. These regional activities have made many contributions to our understanding of monsoon phenomena giving WCRP a high profile in the climate community and in nations affected by monsoon phenomenon.

Both CLIVAR and GEWEX have expertise in field projects, data analysis and modelling that they bring to study the three primary monsoon regions, Africa, Asia-Australia and Americas. AMMA has a focus on improving the understanding of the West African Monsoon (WAM) and its variability with an emphasis on daily-interannual timescales. Research on the Asian-Australian monsoon is directed at understanding the processes responsible for the onset, evolution and termination of the monsoon whilst research on the monsoons of the Americas emphasizes the determination of the sources and limits of predictability of warm season precipitation.

The plans developed under CLIVAR and GEWEX have provided leverage of funds for key activities such as the NAME, MESA GAME and SCSMEX field campaigns and analysis, interpretation, modelling and data banking activities. CLIVAR's AAMP has focussed on monsoon prediction and, through the IOP, has developed and is implementing plans for a sustained observing system for the Indian Ocean region. Both the Indian Ocean region and the eastern tropical Atlantic have impacts on the seasonal variability of precipitation on the African continent. The Tropical Atlantic Circulation Experiment (TACE) to run from 2006-2010, which has been organised under CLIVAR's Atlantic Panel will help to clarify the role of this region for predictions over West Africa. Likewise, CLIVAR's Pacific and Indian Ocean Panels provide relevant contributions to aspects of our understanding of the variability of the Asian and American monsoon systems as well as African climate variability more widely.

GEWEX contributed GAME, which had four regional experiments (southeast Asia, Tibetan Plateau, east Asia and Siberia). The intensive regional hydrometeorological observations

during GAME revealed many new aspects of large-scale hydrometeorology, including the role of organized meso-scale convective systems in the diurnal cycle of precipitation in Asian monsoon system in these regions. Data assimilation capabilities were developed for the Tibetan Plateau region which have been used to improve the Japanese Meteorological Agency model. Since the closure of GAME, GEWEX has launched the Monsoon Asian Hydro-Atmosphere Scientific Research and prediction Initiative (MAHASRI). CLIVAR has commented on the MAHASRI plan following a request from JSC-27. Since JSC-27, a number of new national and international activities in this area have emerged (see Annex B) suggesting, as discussed in Section 3.2 below, the need for more coordination.

The CEOP Inter-Monsoon Model Study (CIMS) has begun to be analyze monsoons within a global framework. Thus, for example, use of a monsoon "continentality" index developed through a comparison of the diurnal and seasonal variations in six major monsoon systems has brought out recent trends of increasing continentality for the West Africa monsoon, and to some extent the East Asian monsoon, thereby providing diagnostics for use in evaluating IPCC GCM simulations.

The first pan-WCRP monsoon workshop (organized by CLIVAR and GEWEX) held in June 2005 in Irvine California identified, both regionally-focused needs and common challenges for monsoon prediction across all the monsoon regions. Priority concerns include the need for: 1) improved representation by models of the diurnal cycle of convection and of the role of convection for the intra-seasonal oscillation as well as monsoons more widely; 2) for improved modelling of the surface fluxes, planetary boundary layer and cloud; 3) for identification of the roles of atmosphere-land coupling and of the role of dust and aerosols in developing monsoon precipitation, atmospheric moisture distribution and transport. The physical processes that control the monsoon systems and their successful prediction are at the core of modelling activities in the GEWEX Modelling and Prediction Panel's (GMPP) activities. The GLACE-2 project will examine the role of the land-surface in the predictability of monsoons while GMPP studies of convection parameterization in models will improve monsoon prediction. In collaboration with other programs and using results from monsoon studies and the Year of Tropical Convection (see below and Annex A), GMPP will lead the model development efforts of convection in WCRP. Within CIMS, a cross-cutting activity in Aerosol-Clouds-Precipitation-Climate is being coordinated with other parts of GEWEX, iLEAPS and IGAC. One recent focus has been an evaluation of the "elevated heat pump" hypothesis for the role of the Tibetan Plateau in the Asian monsoon and the possible influence of aerosols on this heat pump effect. CEOP inter-monsoon studies of aerosol-land-water cycle interactions complement CLIVAR monsoon studies which emphasize oceanic and coupled ocean-atmosphere effects.

In spite of this progress more work is needed on the common baseline problems of monsoon prediction, the role of the monsoons in the global climate system and their influence on and response to global change (see Section 3.3). In particular, to address the issues of the global water and energy cycle integration of the existing continental monsoon studies is required. The global monsoon concept combines these continental and adjacent oceanic monsoons and portrays the dominant mode of the global water and energy annual cycle. Precipitation has been used to objectively delineate the global monsoon domain and a corresponding set of metrics has been proposed for verification of models' simulation/prediction of the interannual-interdecadal variability and trend in the global monsoon system. A global monsoon system study has the potential to facilitate integration of the GEWEX and CLIVAR monsoon studies and integration of observational and modeling studies of the paleo-, present and future changes in the monsoon systems of the world.

A key overarching issue for monsoon prediction is the fundamental need for improved representation of tropical convection. The THORPEX/WCRP Year of coordinated observing, modelling and forecasting of organised tropical convection ("Year of Tropical Convection" - YOTC) activity is intended to exploit the vast amounts of existing and emerging observational

and computational resources in conjunction with the development of new high resolution modelling frameworks to advance the characterization, diagnosis, modelling and prediction of multi-scale convective/dynamic interactions and processes, including the two-way interaction between tropical and extra-tropical weather/climate. This activity and its ultimate success will be based on the coordination of a wide range of ongoing and planned international programmatic activities (e.g., GEWEX/CEOP, CLIVAR, THORPEX/TIGGE, EOS, GOOS). The significant data gathering, archiving and dissemination challenges associated with the vast amounts of satellite data, disparate in-situ data sets and high-resolution model output require the breadth and functionality of the data services anticipated to come from the new WMO Information System (WIS) which will support monsoon research as one of its initial projects. The current status of and future plans for YOTC activity is outlined in Annex A.

2. Policy relevance of monsoons in WCRP

Monsoon climates show clear seasonal variations between summer wet and winter dry seasons. Summer rains provide fundamental water resources for human activities in these regions. Thus, year-to-year variability of summer rainfall amounts and/or timing of monsoon onset/withdrawal have a striking impact on the people in these regions, particularly on those engaging in agriculture, the main industry in many parts of the monsoon regions. More than 60% of the world's population is affected by monsoons on an annual basis. Monsoons are responsible for floods leading to extensive death and damage on an annual basis. The failure of monsoon events gives rise to drought and crop failures leading to agricultural and community stresses. The capability to predict the onset and intensity of monsoons would enable societies to mitigate some of the negative impacts of the monsoons and to maximize their benefits. Facilitating the development under WCRP of effective monsoon research and prediction services would enable WCRP to demonstrate relevance to the governments responsible for many of the countries with the largest populations and the greatest vulnerability to poverty. Accurate monsoon forecasts on synoptic, subseasonal and seasonal time scales could enable aid agencies to more effectively administer their programs. *It is critical that WCRP, as the world's premiere climate research program, address the monsoon prediction issue through regional studies as well as global studies aimed at a comprehensive understanding of the role of monsoons in the climate system and an assessment of the vulnerability of these regional monsoon systems to global change.*

3. Organization and governance of WCRP

3.1 Overview

Monsoons form one of the CLIVAR SSG's cross-cutting science topics. Governance in CLIVAR is through the activities of its Asian Australian Monsoon and Indian Ocean Panels; Variability of the African Climate System (VACS) Panel (which links to AMMA—see section 3.1 below) and the Variability of the American Monsoon System (VAMOS) Panel which has, as its component activities the NAME, MESA and the VAMOS Ocean Cloud Atmosphere Land Study (VOCALS). The activities of all these panels are kept under review through the CLIVAR SSG and the CLIVAR monsoon coordinator (see below).

Governance in GEWEX is through CEOP with CIMS providing coordination on the global scale and each of the Regional Hydroclimate Projects (RHPs) providing input along with GMPP and the Global Radiation Panel through the GEWEX monsoon coordinator. LPB, LBA and CPPA report through CEOP to the GEWEX SSG on their monsoon activities. In addition, the GEWEX monsoon coordinator provides an annual brief to the GEWEX SSG on monsoon activities.

CliC also incorporates monsoon-relevant efforts, although this is primarily limited to the role of the snow and ice cover of the Tibetan Plateau, and the role of the cold Asian continent in the Asian winter monsoon.

Recognizing the strengths of CLIVAR and GEWEX to address monsoon issues, the JSC tasked CLIVAR and GEWEX to: 1) organize a follow-on to the 1st pan-WCRP monsoon workshop with an emphasis on the diurnal cycle (T. Yasunari as lead) and 2) to identify contact persons in both GEWEX and CLIVAR who would lead the implementation of coordinated monsoon activities on behalf of WCRP. These have been identified as Dr Jun Matsumoto for GEWEX and Professor Bin Wang for CLIVAR.

3.2 The regional perspective

For the American monsoon systems, both NAME and MESA are being undertaken as joint CLIVAR/GEWEX initiatives and the latest plans for MESA are included in the GEWEX LPB RHP. In terms of governance, CLIVAR leads the coordination of monsoon studies for the Americas. Good coordination has been achieved by populating the VAMOS Panel and its sub groups with a cross-representation of CLIVAR and GEWEX scientists.

The AMMA programme provides the focus for the West African Monsoon in both GEWEX and CLIVAR which co-sponsor the activity. AMMA has the status of an RHP in GEWEX whilst in CLIVAR the primary links are through the VACS Panel. AMMA objectives are being addressed through separately organised international coordination of ongoing activities, basic research, and a multi-year field campaign over West Africa and the tropical Atlantic including a special observing period in spring/summer 2006. AMMA also builds on existing surface hydrological measurements available through the GEWEX CATCH project, and CLIVAR Atlantic Panel observational projects over the ocean.

Coordination of activities over the Asian monsoon region are on-going but need to be strengthened across GEWEX and CLIVAR. Since JSC-27 when MAHASRI was approved, a number of national and international activities have emerged (see Annex B). There is general consensus on an Asian Monsoon Year (AMY, see Annex B) and some regional discussion has been initiated about an International Monsoon Year (IMY). These discussions emphasize the need for CLIVAR and GEWEX with the help of WCRP to more actively provide international coordination of monsoon research across the Asian-Australian monsoon region.

It is recommended that the JSC discuss options for strengthening coordination of Asian-Australian monsoon research. One potential mechanism that should be considered is a short term task team (one year maximum) co-chaired by the CLIVAR (B. Wang) and GEWEX (J. Matsumoto) with representations from the JSC, CLIVAR and GEWEX Panels and each of the component activities including YOTC and representatives. The team should be tasked with preparing a 5-year implementation plan for an overall integrated programme of regional monsoon research with an emphasis on the links between other monsoon studies around the world and the YOTC and on the plans for AMY activities.

3.3 The global perspective

Currently the primary coordinated global focus on the monsoons is through the CEOP CIMS activity. The GMPP and the WCRP Modeling Panel (WMP) also have a primary concern for model development related to monsoon prediction. There is a need now for a realistic assessment of our present capabilities in monsoon prediction, for which the datasets available through the CLIVAR Working Group on Seasonal to Interannual Prediction (WGSIP) and others, including SMIP (Seasonal Model Intercomparison Project), the ENSEMBLES, DEMETER and APCC CliPAS projects and GLACE-2, provide potential resources. The upcoming JSC TFSP pan-WCRP Seasonal Prediction Experiment to explore the overall predictability of the climate system on the seasonal timescale will provide another important opportunity for analysis and experimentation. In addition the present WCRP CMIP AR4 archive allows the systematic exploration of the potential response of the monsoon

systems to global change. Other global (but also regionally-linked) issues include, for example the multiscale interactions extending from the convective- to the large-scale, the role of tropical modes of variability on the monsoon systems including the role of ENSO, the Indian Ocean Dipole and tropical Atlantic variability, and the overall role of the monsoons in the global climate system, including the descending branches of monsoon circulations.

It is recommended that the JSC:

- (a) Carry out an assessment, initially through the current TFSP activity in collaboration with other WCRP monsoon and modelling activities, of present capabilities in monsoon prediction**
- (b) Request CLIVAR and GEWEX to develop an overall implementation plan for WCRP activity aimed at more reliable predictions of the monsoon systems of the world. Particular attention to be given to coordinating these activities with the YOTC.**
- (c) Request CLIVAR to develop a more global focus to its regional monsoon activities overall, with particular attention to the role of the oceans for the monsoon systems of the world; CLIVAR should also continue to encourage its regional monsoon panels to organise activities to analyse the available global datasets from a regional perspective with feedback to global modelling groups.**
- (d) Confirm their request to GEWEX and CLIVAR to organise a further pan-WCRP monsoon workshop with foci on (a) to (c) above and building on the outcomes of the 1st pan-WCRP Workshop. The lead for the science program will be T Yasunari.**
- (e) JSC form a task force to coordinate the IMY related international and national efforts (TF-IMY), consisting of relevant JSC members, monsoon experts, and CLIVAR and GEWEX contacts.**

4. Visibility and Communication:

Monsoons are well known phenomena on a regional scale where the value of CLIVAR-GEWEX collaboration have been demonstrated. *The current successes and efforts by GEWEX and CLIVAR in this area provide an excellent basis for WCRP to demonstrate its contributions to issues that are of great concern to society.* WCRP needs to mobilize its public information capabilities to communicate this message to its stakeholders and to highlight its future plans and successes in this area.

5. Interaction with Other Bodies:

Through their monsoon research GEWEX and CLIVAR are building bridges with the Earth System Science Partnership (ESSP) Monsoon Asia Integrated Regional Study (MAIRS) program and SysTem for Analysis Research and Training (START). MAIRS and MAHASRI share a number of investigators and scientists. A number of the monsoon studies (MAHASRI, AMMA, NAME, MESA, etc) include application projects that bring the scientific understanding and predictions to decision makers primarily in the field of hydrology.

6. Capacity Building in/by WCRP:

The monsoons offer many opportunities for capacity building because a number of the countries affected by monsoons need enhanced capacity. CLIVAR is developing experience in capacity building through its VACS Panel and through the workshops of the joint CLIVAR/CCI Expert Team on Climate Change Detection, Monitoring and Indices. Leverage of CLIVAR and GEWEX research was a component in the successful bid in 2003 for GEF funds for planning and implementation of strategic actions to be taken by the governments in LPB countries for the environmental and socially sustainable economic development of the basin. GEWEX through the Integrated Global Water Cycle Observations (IGWCO) theme and the Group on Earth Observations (GEO) Capacity Building efforts has gained considerable insight into the needs for capacity building in monsoon areas. GEWEX collaborated with IGWCO and GEO in a workshop in Southeast Asia in 2006 that addressed

the opportunities to build capacity in analysis and prediction in support of monsoon floods. GEWEX and particularly CEOP activities in the Asian region are being coordinated through the Asian Water Cycle Initiative while GEWEX Capacity Building activities in the Americas are being developed under a GEO task concerned with the development and implementation of a Capacity Building process for Latin America.

AMMA has successfully developed capacity in national weather services through augmentations to observing systems and by building the skill levels in local forecast offices. In particular AMMA has recently included African partners in the AMMA-EU consortium and is funding research to assess the effects of the West African Monsoon (WAM) on agriculture and food productivity, land use, water resources, health and food security. AMMA is also working with operational centres to enable them to forecast seasonal variations in the WAM. *From the perspective of the Asian Monsoon, capacity building activities, it will be important to integrate with the ESSP- MAIRS (Monsoon Asia Integrated Regional Study) activity in particular.* Integration with the WCP, in particular CLIPS, and the applications of monsoon predictions to issues of health, agriculture and water supply. MAIRS works closely with START, the capacity building arm of the WCRP.

It is recommended that the JSC request that CLIVAR and GEWEX to develop a joint plan for capacity building activities for the application of observations and predictions in monsoon regions for societal benefit.

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Annex A Year of Tropical Convection – Summary Current Status and Plans

1. Summary

WCRP and THORPEX are proposing a Year of coordinated observing, modelling and forecasting of organized tropical convection and its influences on predictability as a contribution to the United Nations Year of Planet Earth to compliment the International Polar Year (IPY). This effort will exploit the recent investments in Earth Science infrastructure, specifically the vast amounts of existing and emerging observations (both satellite and in-situ) and computational resources, in conjunction with the development of new, high-resolution modelling frameworks to address the following science questions:

- What are the most crucial elements of the large-scale circulation that influence the development, organization and maintenance of tropical convection?
- Under what circumstances and with what mechanisms is energy and momentum transferred between the convective, mesoscale, synoptic scale, and the large/planetary scale?
- How does organized tropical convection interact with the extra-tropical circulation?

This activity and its ultimate success will be based on the coordination and leveraging of a wide range of ongoing and planned international programmatic activities (e.g., GEWEX/CEOP, THORPEX/TIGGE, EOS, GOOS, AMY/IMY 2008). The goals of the program are to achieve significant gains in forecast skill by 2010 in:

1. Medium-range tropical weather forecasts, particularly disturbed conditions associated with organized convection,
2. Extended-range/subseasonal forecasts of the MJO, and
3. Medium-to-extended range extratropical forecasts derived from improved tropical weather/climate and tropical-extratropical interactions,

through better understanding and improved data assimilation techniques/resources and modeling capabilities.

2. Current Status

Since the conceptualization of YOTC at the WCRP-THORPEX workshop in March 2006 on the "Organization and Maintenance of Tropical Convection and the Madden Julian Oscillation", presentations on YOTC have been made at the CLIVAR SSG (Apr 06) and US CLIVAR Summit (Jul 06), the Second THORPEX International Science Symposium (Dec 06), the Pan-GEWEX (Oct 06) and GEWEX SSG (Jan 07) meetings, the joint WGNE/WMP meeting (Oct 06), the 3rd WIS Enhancement meeting (Aug 06), THORPEX/NCAR/NSF TIIMES Retreat on Convection (Jul 06), and the so-called White Paper meetings in Reading, UK (Oct 06). In addition to connections with WIS, there have also been discussions with NASA data services, NOAA/EOL (formerly JOSS), and TIGGE to lay groundwork for data support issues associated with YOTC. A draft science plan has been developed

(hydro.jpl.nasa.gov/tmp/WCRP.THORPEX.YOTC.draft.pdf) and been in circulation since Oct 06 that outlines the motivation, general science questions, and overarching strategy.

Requests have been made to WCRP and THORPEX, both from WGNE (letter dated 2/2/07) as well as from the instigating science community (letter dated 1/19/07) to consider more formal recognition and the formation of a science steering group (SSG) that would finalize the science plan and draft formal implementation plans.

3. Plans

Albeit the need for more formal recognition and an associated scientific body to develop, sanction and guide the proposed initiative, as presently envisioned the activity calls for a "year" of "intensive observations" and real-time/subsequent modelling activities. Nominally, this "year" would probably extend for about 15 months and possibly begin in May 2008 and extend through August 2009. The focus area would be the global tropics, although the two-way interactions with key mid-latitude regions are of high interest and priority to address. Specific target phenomena within the tropics include the diurnal cycle, easterly waves/hurricanes, convectively-coupled equatorially waves and the MJO, the monsoons and the ITCZ. These target phenomena would be addressed through the establishment of focused working groups underlying the activity's SSG. Together the SSG and the working groups, within the context of a series of both focused and international workshops, would identify the most pressing and

tractable problems from the target Year, design and coordinate activities, share modeling strategies and successes, report results, and iterate on additional problems or future Years. Observation resources will be based on the traditional network, the wide array of new, research oriented satellite missions (e.g. EOS, A-Train, Envisat), time-scale relevant aspects of the global ocean observing system (GOOS; e.g. buoys, drifters and floats), a number of enhanced in-situ programs (e.g., ARM, CEOP) and opportune IOPs (e.g., AMMA, VOCALS, T-PARC). The TIGGE data set represents a keystone of the modeling component along with a variety of research-oriented multi-scale simulation/hindcast components (e.g., global and regional CRMs, MMFs, NCAR channel model, GCMs). Funding opportunities are now starting to arise and organizational infrastructure needs to be put in place to begin taking advantage of these opportunities.

Annex B: Emerging activities in the Asian-Australian Monsoon region

B2.1 The Asian Monsoon Year (AMY):

The Asian Monsoon Year (AMY) was proposed as an important element in improving observations, analyses and modelling in the monsoon regions jointly with GEWEX and CLIVAR, as well as CliC and SPARC. The time period for the AMY 2008 will be from April 2008 until March 2009 to cover the full annual cycle of boreal summer monsoon. It will link across to and contribute from plans for the Year of Tropical Convection initiative. The idea of extending this effort to the global perspective of an International Monsoon Year is being explored. The initiative will bring together the GEWEX and CLIVAR monsoon efforts in the austral Asian region, **in particular the Monsoon Asian Hydro-Atmosphere Scientific Research and the prediction Initiative (MAHASRI)**. An Asian Monsoon Year (AMY08) International Workshop is currently being planned to be held in Beijing, China from 23-25 April 2008.

B2.2 MAHASRI

MAHASRI is a GEWEX initiative that has the goal of improving the prediction of the Asian monsoon and its hydrological cycle. It is a 10-year program for the period 2006-2015, focusing on establishing a scientific basis for predicting the hydroclimate monsoon system intraseasonal to seasonal time-scale, including developing prediction systems for droughts and flood conditions of regional river basins and similar areas in Asia. MAHASRI will address issues of diurnal cycles, intraseasonal, interannual, and decadal scale variability and their multi-scale interactions with convection and precipitation processes, and, boundary layer processes, low level jets, and interaction with complex terrains, and the warm water pool. It will target processes in both the Asian summer and winter monsoons. Its spatial coverage will include the tropics from the maritime continent to the South and Southeast Asia, Tibet/Himalaya, East Asia, and Northeast Asia. Special emphasis will be placed on the air-land-ocean interactions, the role of aerosols on monsoons, monsoon predictability, and flood/drought predictions. MAHASRI is part of CEOP, and will play an essential role in the WCRP strategic framework. It will contribute to IMY through a special observing period that is planned for 2008 and 2009 (Lead/POC: Jun Matsumoto, Tokyo Metrop. U., Japan)

B2.3 Impact on the Short-Term Climate Variation in China: (AIPO) Program (China)

China's strong and active monsoon studies supported by the Chinese Academy of Sciences (CAS), and by the Chinese Meteorological Administration (CMA) are associated with both CLIVAR and GEWEX. Recently the Chinese Ministry of Science and Technology (MOST) has approved a 5-year (2007-2011) national program, which was jointly proposed by CAS, CMA, Chinese National Natural Science Foundation (NSFC) and the Chinese State Oceanographic Administration (SOA), to study the monsoon coupled ocean-atmosphere-land interaction over the Asia, and Indian and Pacific Oceans, focusing on the dynamical effects of heating contrast between the Indo-Pacific warm pool and the Asian continent. The project will include a special observing period, tentatively planned for 2008 to 2009, that includes measurements of atmosphere and ocean from ships, buoys and moorings over the South China Sea, Eastern equatorial Indian Ocean and western equatorial Pacific Ocean.

(Lead/ Point of Contact (POC): Guoxiong Wu, LASG, Institute of Atmospheric Physics, CAS).

B2.4 South China Heavy Rainfall Experiment (SCHeREX)

SCHeREX is aimed at better understanding the mechanism of formation and development of meso-scale strong convective systems under Asian summer monsoon background and improving its prediction, as well as the study of advanced characteristics of the Asian summer monsoon and its relation with activities of meso-scale heavy rainfall systems. The period of SCHeREX is three years from 2007 to 2009. This project is focusing on establishing a meso-scale observing network including over 600 surface automatic stations, over 20 sounding stations, 9 Doppler radars with four movable Doppler radars comprised of four pairs of dual-Doppler radar nets, airborne dropsonde, 3 wind profiles and others in Southern China and a lot of operational observation stations and equipments in the areas of down and middle stream of Yangtze River. (Lead/ Point of Contact (POC): Renghe Zhang, CAMS, CMA, China).

China is also supporting several other projects that will be part of IMY including: 1) Drought trends in Northern China and human adaptation, 2) Environmental change over the Tibetan Plateau, its response to global change and the adaptation counter measures, and 3) Aerosols over China and their climatic impacts.

A2.5 Monsoon Research Program (India)

Particularly relevant to the AMY are two planned field campaigns: Severe Thunderstorms: Observations and Regional Modeling (STORM) 2006-09, and Continental Tropical Convergence Zone (CTCZ) 2007-2010. The science focus of STORM is in heavy rainfall, lightning, and severe weather. Mesonet (25 km resolution) observation networks will be set up in target regions to monitor, heavy rain, wind, lightning, aerosols, and other atmospheric parameters during various phases of the monsoon. In CTCZ, the scientific objective is to unravel the relative roles of internal dynamics and the boundary layer forcing of the intraseasonal oscillations in affecting the northward movement of the monsoon from northern India Ocean to the Indo-Gangetic Plain and the foothills of the Himalayas, and their possible relationship to interannual and decadal scale climate variability and change. The possible impacts of aerosol forcings during the pre-monsoon period, as well as during the monsoon breaks, aerosol-cloud rainfall interaction over the Indo-Gangetic Plain and elsewhere there are additional factors that may affect monsoon predictability. (Lead/POC: D.R. Sikka/ Rao, Science and Technology Agency, India)

A2.6 Japan EOS Promotion Program (JEPP) (Japan)

As a contribution of Japan to GEOSS, five research projects have been selected that relate to the establishment of hydrometeorological observations in the Asian monsoon region. These include: Observation network in the Indian Ocean (Lead: Mizuno, JAMSTEC/IORGC) and Maritime Continent (Lead: M.D. Yamanaka, JAMSTEC/IORGC), over the Tibetan Plateau (Lead: H. Ishikawa, Kyoto Univ., Japan); in Southeast Asia (Lead: J. Matsumoto, Tokyo Metrop. U., Japan) and in Thailand (Lead: T. Oki, Univ. Tokyo, Japan).

A2.7 Monsoon Asia Integrated Regional Study (MAIRS)

MAIRS is an Earth System Science Partnership (ESSP) initiative sponsored by the World Climate Research Programme (WCRP), the International Geosphere Biosphere Programme (IGBP) and being implemented by START. MAIRS has the objective of better understanding the role of human activities in affecting and interacting with the changing atmospheric, terrestrial, and marine environments in the Asian monsoon regions, and to develop institutional capacity to improve forecasts and to mitigate adverse impacts. Monitoring stations for aerosol, agriculture, biodiversity will be set up in coastal zones, high mountains, semi-arid regions, and urban areas in the Southeast and East Asian regions. (Lead/POC: C. B. Fu, Institute of Atmospheric Physics, CAS, China).

A2.8 Joint Aerosol-Monsoon Experiment (JAMEX)

The objective of the Joint Aerosol-Monsoon Experiment (JAMEX) is to unravel the physical mechanisms and multi-scale interactions associated with aerosol-monsoon water cycle in the Asian Indo-Pacific region towards improved prediction of rainfall in land regions of the Asian monsoon. JAMEX will be planned as a five-year (2007-2011) multi-national aerosol-monsoon research project, aimed at promoting collaboration, partnership and alignment of ongoing and planned national and international programs. Two coordinated special observing periods (SOP), covering the pre-monsoon (April-May) and the monsoon (June-August) periods is tentatively targeted for 2008 and 2009. One of the unique aspects of JAMEX is that it stems from grass-root scientific and societal imperatives, and it bridges a gap between aerosol and monsoon dynamics research in existing national and international programs. Currently we have identified 10 major national and international projects/programs separately for aerosols and monsoon research planned in the next five years in China, India, Japan, Italy, and the US, that could be potential contributors or partners with JAMEX. These include the AIPO, MAHASRI, CTCS/STORM, SHARE-Asia ABC, PACDEX, East-AIRE, MAIRS and others. (Lead/POC, W. Lau, V. Ramanathan).