Implementation Plan for Asian Monsoon Years (2007-2012)

(Version 1, June 8 2008)

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1. Introduction

As stated in Science Plan for Asian Monsoon years (2007-2012), a number of monsoon research activities and field projects are being planned in the time frame of 2008-2010 in China, Japan, India, Korea and many other countries. All funding supporting these projects comes from the individual nations. The Asian Monsoon Years 2007-2012 (AMY2007-2012) will coordinate these national level projects into international monsoon research for the benefit of all interested parties.

AMY integrates existing national and international research programs in the Asian monsoon regions. Currently, AMY has involved 24 national and multi-national projects and a total of 24 participating organizations as listed below:

- Australia: BMRC
- China: IAP/CAS, ITP/CAS, CAMS/CMA, NCC/CMA, SCSIO/CAS, Nanjing Univ. of Information Science and Technology
- Chinese Taipei: NTU, CWB, NCU
- India: IITM, CAOS/IISc, ESSD/DST, IMD, NCMRWF, IIT
- Indonesia: BPPT, BMG
- Japan: IORGC/JAMSTEC, FRCGC/JAMSTEC, JMA, MRI, Univ. Tokyo, Tokyo Metrop. Univ., Tsukuba Univ., Nagoya Univ., Chiba Univ., Kyoto Univ.
- Korea: APCC, Seoul National Univ., Pukyong National Univ.
- Malaysia: MMD, National University of Malaysia
- Mongolia: IMH
- Nepal: DHM
- Philippine: PAGASA
- Thailand: TMD, Kasetsart University, Chulalongkorn University, RID, RFD, BRRAA
- USA: Univ. Hawai, GSFC/NASA, Naval Postgraduate School, COLA, NCAR, George Mason Univ./IGES, Univ. Maryland
- Vietnam: NHMS, Hanoi Univ.

Hydrometeorological agencies in other counties in Asia will also participate.

In addition, the following international projects and the activities of the APEC Climate Center (APCC) provide a wider geographical and international perspective:

- GEWEX- CEOP, MAHASRI, GaME-T
- CLIVAR- AMMP, IOP, POP
- ESSP- MAIRS
- WWRP-TMR- TCS08

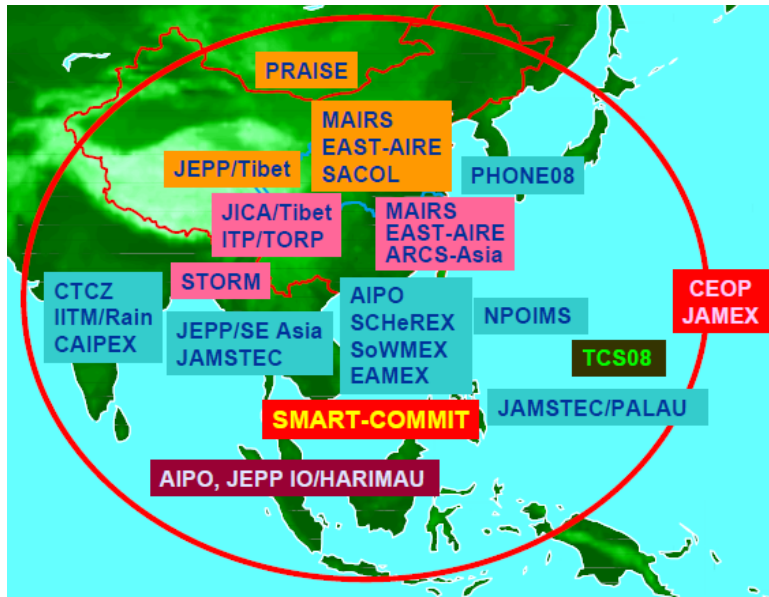The approximate regional extent of these projects is shown in Fig. 1.

Fig. 1 Participating national/regional projects contributing to AMY.

To meet the AMY overarching goal **"**To improve **Asian monsoon predictions on intraseasonal and seasonal time scales** for societal benefits by advancing our understanding of the **physical processes determining the Asian monsoon variability and predictability"**, the following research strategy will be taken. Namely, AMY will seek to take a balanced approach that integrates observations, modeling, and understanding components. Observations provide data for validation of model physics, initial conditions for predictive models and ground truth for gauging satellite measurements. Modeling provides the basis for prediction, helped through assimilation of data into the prediction systems themselves to provide initial conditions; it also acts as a tool to help better understand of the complex interaction processes which take place in the monsoon environment. Improved understanding feeds into the representation of physical processes in models, provides guidance for setting priority for future field studies and to provide insights to help develop the observing and monitoring strategy for monsoon systems.

In order to address the overarching goal, a science steering committee has been formed. The AMY Science Steering Committee is a coordination body, with representatives from different panels or groups, to provide guidance for the program. An AMY project office is also established at Institute of Atmospheric Physics (IAP), Beijing, China. AMY has established three complimentary science working groups focusing on, respectively, the field experiments and observation coordination, central data archiving and management, and coordination of

monsoon modelling and prediction. The Chairs and members of the SSC and those of the working groups are listed as follows:

AMY Organization:
Scientific Steering Committee
      Co-Chairs: Bin Wang and Jun Matsumoto
      Members: C.-P. Chang, Y. Ding, C. Fu, S. Gadgil, T. Koike, W. Lau, J.
         Shukla, D. R. Sikka, T. Yao, T. Yasunari, G. Wu, R. Zhang
AMY Program Office at Beijing: Director Jianping Li
Observation Coordination Working Group:
      Co-Chairs: Dongxiao Wang and Manabu D. Yamanaka
      Members: Zhanqing Li, Yaoming Ma, Yunqi Ni, Ben Jou, P. S. Rao, R.C.
         Bhatia, Xiangde Xu, Tsay, Jianping Huang, Hongbin Chen,
         AtsushiHiguchi, TeruyukiNakajima, C. Hsu, B. Holben, Somchai
         Baimoung, Nguyen Thi Tan Thanh, Yap Kok Seng, Fadli Syamsudin,
         Azzaya Dolgorsuren, Samarendra Karmakar, Madan, L. Shrestha
Data Archiving and Management Working Group:
      Co-Chairs: Kooiti Masuda, Guangqing Zhou
      Members: Tsay, Preveen, Chi-yung Francis Tam, Mei Gao, M. Rajeevan
Modeling and Prediction Working Group:
      Co-Chairs: Harry Hendon, Takehiko Satomura, Akio Kitoh
      Members: B. N. Goswami, Kun Yang, Xueshun Shen, Johnny Chan,
         Yongqiang Yu, Dehui Chen, Ailikun, In-Sik Kang, Jinghai He, Edvin
         Aldrian, Weijing Li, U. C. Mohanty

The SSC and working groups intend to work together to develop the implementation plan of AMY. The head quarter for the intensive field observations listed in 2.1 is indispensable for our well coordinated observations. The South China Sea Institute of Oceanology (SCSIO), Guanzhou, China will take this role. Another important organization is data management center. As described in 2.2, we basically adopt data sharing system among major data centers that manage the data obtained by the participating projects in each country. JAMSTEC/FRCGC, Japan will take responsibility for the coordination of these data centers.

2. Observations
2.1 Field observations

One of the purposes of the field campaigns is to provide observations that are useful for validating and improving numerical models. Field campaigns also provide valuable ground truth data for calibration of satellite measurements and

parameterizations. Improvement of initial conditions for coupled climate models is possible only when satellite data are fully utilized. Another important aspect of the field observations is to find out the unknown physical processes/phenomena related to monsoon variability which has not been accounted for in the models but which is crucial for better representation of monsoons by the models. Combination of in-situ observations with satellite observations is essential for understanding the large-scale processes. Since AMY targets land-ocean-atmospheric interactions and aerosol-monsoon interactions under the Asian monsoon system, well coordinated ocean, land, aerosol and atmospheric observations should be conducted including intensive field observation campaigns. Since AMY also targets high impact weather, special meso-scale observations will be conducted in collaboration with THORPEX and WWRP of WMO.

One of the main targets of the AMY should be study of the dynamics and predictability of intraseasonal variability (ISV) of both 30-60 days and biweekly period through new observations and modeling. Land-atmosphere and ocean-atmosphere interactions should be re-examined through intensive observations focusing on their roles in the ISVs. The time-space structures of the ISVs seem to have been changing during the past several decades, which may, at least partly, be related to the anthropogenic forcings including the impact of aerosols etc.

AMY coordinated field experiments are classified into three categories: ocean observations, land observations and special process observations. Special process observations include meso-scale experiments for observing heavy rainfall and tropical cyclones, and aerosol-cloud-radiation experiment.

AMY will seek to coordinate field campaigns in various individual research projects. Indeed the coordination of these observations is essential for the success of AMY. The major targeting period of these observations can be classified into (1) pre-monsoon period in March-May; (2) monsoon onset phase in May-June; (3) monsoon mature phase in July-August; (4) winter monsoon in December. Some projects will target specific weather events. In such cases, the coordination of simultaneous observations in different regions by different projects will be a key role for the observation center, SCSIO.

a. Ocean observations

Ocean observations should include the sustained array that is being developed under CLIVAR's IOP, POP and those are being planned in both the Indian Ocean by JAMSTEC/IORGC, JEPP/IO, AIPO/IO, CTCZ/IO and the western Pacific by AIPO/SCS-Philippine Sea, JAMSTEC/PALAU, TiMREX,

SoWMEX, NPOIMS, EAMEX. The planned intensive ocean observations are listed in Table 2-1.

Table 2-1 List of planned intensive ocean observations

Project Name	Intensive observation period	Observation region	Observation items /frequency
JEPP/IO	2008-2009	Eastern equatorial Indian Ocean	T, S from the sea surface down to 750m depth Meteorological variables at the sea surface Upper-ocean current at 10m depth.
AIPO/IO	2008-2009	Karimata Strait and Java coast	Long-term submersible mooring system
CTCZ/IO	2009-2010 (?)	Bay of Bengal	ORV Sagar Kanya (35day Cruise) Buoys, Argos
AIPO/SCS-PS	Nov. 2007-Nov. 2008 (Kalimata strait & Java coast)	East Luzon Island Karimata strait Off Java coast Xi-Sha Island Northern SCS Off Luzon	Surface mooring Subsurface mooring Submersible mooring Air-sea flux tower Intensive RV cruise
JAMSTEC/PALAU	Jun.-Aug. 2008	Western Tropical Pacific	RV(Mirai): May 30-June 4: ARGO float 5 points daily sounding along 130E from 20N to 5N down to 500 m depth June 4-28: 8 times/day sonde launch at 12N, 135E July 3-Aug.6: 2-times sonde launch in 145-156E, 2S-20N
SoWMEX/TiMREX	May.15-Jun. 25, 2008	Northern South China Sea and southern Taiwan	RV (Da_Kwan), upper air sounding, 4 per day, temp, water vapor, pressure, and horizontal winds

NPOIMS	2008-2009	Luzon Strait, West of the Luzon Island (18N), East China Sea, and North-East SCS, Western Pacific and East China Sea Cruises	Surface mooring at two stns, ADCP, RV cruises
EAMEX	May 15-Jun. 30 2008 (Summer), Oct. 2008 to Feb. 2009 (Winter)	Northern SCS (Summer) East China Sea east of Taiwan (Winter)	3RVs for summer (u,v,T,Z,q,precip.) sonde: 4 times/day in SCS area 1RVs for winter(u,v,T,Z,q,precip) sonde: 4 times/day in SCS and ECS areas (for 4-5 events when major rainfall systems are forecasted)

b. Land observations

Land based observations will be enhanced in the following specific regions through coordinated field experiments: (a) Tibet: MAHASRI (JEEP/ Tibet), JICA/ Tibet, WEBS, TORP; (b) China/Mongolia: SACOL, MAIRS, PRAISE; (d) South China: SCHeREX, AIPO; (e) Chinese Taipei: SoWMEX, TiMREX, EAMEX, (f) South East Asia: MAHASRI (JEPP/SEA, JEPP/Thailand, GaME-T, CREST-SEA), JAMSTEC/IORGC, EAMEX; (g) Maritime continent: MAHASRI (JEPP/HARIMAU) and , (h) India: STORM, CTCZ. The planned intensive land observations are listed in Table 2-2.

Table 2-2 List of planned intensive land observations

Project Name	Intensive observation period	Observation region	Observation items /frequency
TORP	2008-2009	Tibetan Plateau	3 Key PBL stations (Surface layer and Boundary layer, surface radiations, surface fluxes, soil parameters, temperature and water vapor vertical profiles), isotope, glacier, POPs, permafrost, dust storm, ecosystem, water vapor channel

JICA-TIBET	Feb.-Jul., 2008	Tibetan Plateau	GPS (24), Boundary layer tower (3), AWSs, Radio sonde (P1: Feb.-Mar. & P2: Apr.-May: 4-6 times/day at 6 stations, P3:Jun.-Jul.: 4 times/day at approx. 20 stations)
JEPP-TIBET	Jan.-Mar. 2008 (data may be available in 2008 by automated observations)	Tibetan Plateau	Surface Flux (1-turbulence, 6-profile), Soil moisture (7)
MAIRS	Mar-Sep, 2008	Semi arid Northern China.	AWS, PBL tower, SMTM, radiation flux, soil temp and moisture
SACOL	2008-2009	Lanzhou, central China	Boundary layer, Surface radiation, Surface fluxes, Soil parameters, Temperature and water vapor vertical profiles, Sky condition
PRAISE	2008-2009	Mongolia	Two flux sites in the Taiga forest and steppe grassland measures surface fluxes of momentum, heat and water, radiation components, surface meteorology, and profiles of soil temperature and moisture, and biophysical parameters. Four AWSs measures surface meteorology, radiations, and soil temperature and moisture.
SCHeREX	May-July, 2008 (maybe in 2009)	South China	Doppler radar (9), Surface station (169), Upper sounding (10) AWS (600), GPS (12), Wind profiler (4)

SoWMEX/ TiMREX	May 15-June 25, 2008	Southern Taiwan, Northern South China Sea	Rawinsonde (9 stations, 6 in Taiwan Island and 3 off coast), whole troposphere observations: temp, water vapor, pressure, and horizontal winds; Mesonet (26 stations), surface observations: station pressure, temp, dew point, and horizontal winds. Rain gauges (115 stations): rainfall rates; Doppler radars (4 radars, 2 S-bands, 1 C-band, and 1 X-band), 3-D reflectivity and Doppler winds with an area of 120kmx60km; Polarimetric radars (2 radars, 1 S-band and 1 X-band), differential reflectivity, hydrometeor classification, and rain DSD in clouds); disdrometer network (6 disdrometers), rain DSD at the surface
EAMEX	May 15-June 30 2008 (Summer), Dec 2008 to Feburary 2009 (Winter)	Northern SCS (Summer) East China Sea east of Taiwan (Winter)	Upper-air sounding (sonde), radar, tower, surface AWSs
JEPP-SEA	Jan.-Mar. 2008 (data may be available in 2008)	Indochina, Bangladesh, NE India	AWS(5), automatic Rain Gauges (approx. 50), operational radars (3)
JEPP-Thailand (GaME-T)	Jan.-Mar. 2008 (data may be available in 2008)	Central and northern Thailand	Surface Flux (2), Rain-gauge (16) Rain-gauge-Radar combination, AWS(14) Soil moisture (4), Hydrological Data,

CREST-SEA	Jan.-Sept. 2008	Indochina and Borneo, Malaysia	Surface flux towers in the forests in northern Thailand and Borneo (meteorological variables, surface flux, and soil moisture and temperature profiles), automatic rain gauge network at 18N over Indochina, operational radar at Vientiane, Laos
JEPP-HARIMAU	2008-2009	Indonesia	Radar-Windprofiler Network (2-radars, 3 windprofilers), Radio Sonde
JAMSTEC/IORGC	Dec. 2008-Jan. 2009	Kalimantan, Indonesia, Indochina along SCS	GPS (3), Sonde 4-times/day (several stations), daily rain water isotope (3-4)
CTCZ	2009 (Pilot) 2010 (?)	Northern India	Surface, Upper air, Radiation, PBL-Flux Towers, Doppler Radars, Wind Profilers.Watershed
STORM	April-May 2009-2010	Easteran and NE India	Seven upper air radiosonde stations, Doppler Weather Radar, weather radars, Mobile Doppler Radar, Wind Profilers, AWS

c. Special processes studies
(1) Meso-scale experiments related with heavy rainfalls, tropical cyclones

Special observations related with heavy rainfalls and/or tropical cyclones will be provided by the following projects: (a) Meso-scale field experiments: STORM, SCHeREX, TiMREX, SoWMEX, PHONE08-09, and (b) Monsoon-Tropical cyclone interaction: TCS08, T-PARC, DOTSTAR. The planned intensive special observations are listed in Table 3-3.

Table 2-3 List of planned intensive meso-scale observations

Project Name	Intensive observation period	Observation region	Observation items /frequency
IITM/rain	?	Pune, west/east-coast of India	Multi-parameter dual polarization Doppler radar, GPS Radiosonde, Dual polarization Micro Pulsed LIDAR

CAIPEX	May-Oct., 2008-2009		Multi-parameter dual polarization Doppler radar, Cloud seeding, CCN and the natural droplet spectra, ice nuclei and ice formation, cloud droplet spectra by aircraft
MAIRS	Mar.-Sep., 2008	Semi arid Northern China.	Aerosol: surface meteorological parameters, physical/chemical components.
STORM	Apr.-May 2009-2010	Easteran and NE India	Seven upper air radiosonde stations, Doppler Weather Radar, weather radars, Mobile Doppler Radar, Wind Profilers, AWS
SCHeREX	May-Jul., 2008 (maybe in 2009)	South China	Doppler radar (9), Surface station (169), Upper sounding (10) AWS (600), GPS (12), Wind profiler (4)
SoWMEX/ TiMREX	May.15-Jun. 25, 2008	Northern South China Sea and southern Taiwan	Dropsonde (45 flight hours and 200 dropsondes), upper air sounding (9 stations), 30 ground GPS stations, 26 surface stations, 115 rain gauges, 2 NEXRAD, 1 C-Dop and 1 X-Dop radar, 4 Ku- and 1 X-band rain profiler, 940 MHz wind profiler, Mobile X-pol radar, US/NCAR S-pol, COSMIC/FORMOSATIII GPS sounding, 6 disdrometers
PHONE08 -09	Jun. –Jul., 2008	East China Sea	4 S-band Doppler radars, 5 Radiosonde stations (4 per day?), and ocean site for radiosonde and surface observation in East China Sea

TCS08	Aug.-Sept., 2008	Tropical western North Pacific	Airborne Doppler wind Lidar, airborne ELDORA dual X-band Doppler radars, flight level data, and dropsondes. NRL P-3 250 dropsondes in 100 hours flight, approx 10 flights with 100 km spacing. Equal number available for T-PARC WC-130J 750 dropsondes in 200-250 h, approx 20 flights with 100 km spacing near TC
T-PARC	TC season in 2008 (Aug.-Sept. ?)	East Asia, East China Sea	Aircrafts, Vessels (How many?), Upper Soundings, Wind form MTSAT, etc.
DOTSTAR	TC season in 2008 (Aug.-Sept. ?)	Western North Pacific between about 15-30N and 118-133E	GPS dropwindsonde sounding data, available through GTS

(2) Aerosol and radiation, clouds

Special observations on aerosol and its relationship with radiation and/or clouds in particular study areas will be provided by the following projects: (a) Monsoon-Aerosol interaction: JAMEX, East-AIRE, AAF/SMART-COMMITRajo-Megha, SACOL, ARCS-Asia, TGERZ, Rajo-Megha, CTCZ; (b) Cloud-Radiation interaction: IITM/Rain, CAIPEX; (c) Monsoon-Human interaction: MAIRS. The planned intensive special process study observations in these aspects are listed in Table 2-4.

Table 2-4 List of planned intensive special process study observations

Project Name	Intensive observation period	Observation region	Observation items /frequency
JAMEX	EOP-1: Apr.-Dec. 2008	China, India and Indo-China, Himalaya	Aerosol properties from AERONET observation in China, India and Indo-China (planned); high altitude surface meteorological observations in Pyramid site at Mt. Everest.

EAST-AIRE	Mar.-Dec., 2008	Tahu, Xianghe (China)	Active/Passive Cloud Remote Sensors, Narrowband and Broadband Radiometers, Wind Profiler, AERI, Aerosol and CCN
AAF/SMART-COMMIT	Feb.-Nov. 2008	Vicinity of Lanzhou and Beijing area (China)	Measuring surface & aerosol/precursor properties and boundary-layer atmospheric parameters
SACOL	2008-2009	Lanzhou, central China	Aerosol optical properties, Aerosol vertical profile
ARCS-Asia	2008-2009	Beijing, PRD (near Hong Kong), Bangkok, Mt. Happo (1850m asl, central Japan)	In-situ and semi-continuous measurements of carbonaceous (BC and CO) aerosols at the ground sites (source regions and background regions). Aircraft observations of size distribution of aerosol and mixing state of BC in the outflow from the Asian continent will be also conducted in spring 2008.
TIGERZ	2008-2009	Indo-Gangetic Plain	Aerosol (AERONET)
Rajo-Megha	2009	Central India	Aerosol
CTCZ	2008 (Pilot) 2009	Northern India	Airborne cloud and aerosol measurements
IITM/rain	?	Pune, west/east-coast of India	Multi-parameter dual polarization Doppler radar, GPS Radiosonde, Dual polarization Micro Pulsed LIDAR
CAIPEX	May-Oct., 2008-2009	?	Multi-parameter dual polarization Doppler radar, Cloud seeding, CCN and the natural droplet spectra, ice nuclei and ice formation, cloud droplet spectra by aircraft
MAIRS	Mar.-Sep., 2008	Semi arid Northern China.	Aerosol: surface meteorological parameters, physical/chemical components.

STORM	Apr.-May 2009-2010	Easteran and NE India	Seven upper air radiosonde stations, Doppler Weather Radar, weather radars, Mobile Doppler Radar, Wind Profilers, AWS

2.2 Satellite observations

Since the 1990's, the availability and use of multi-decadal merged satellite-gauge precipitation datasets from the Global Precipitation Climatology Project (GPCP) and the CPC Merged Analysis Precipitation (CMAP) have greatly advanced our understanding of monsoon variability in providing better spatial and temporal descriptions of monsoon rain systems, and better validation of atmospheric general circulation models.

More recently, high-resolution data products from TRMM which include surface rainfall, water vapor, cloud liquid water, storm cloud heights, convective-stratiform rain ratio, vertical profile of hydrometers and others have provided unprecedented information for studies of the physical characteristics of clouds and precipitation systems in monsoon regions, as well as for improving physics in models of the Asian monsoon. TRMM has also produced three-hourly, $1^{o}x1^{o}$ degree global rainfall data that are essential for the validation of model simulations of the diurnal cycle.

These high-resolution data will also be useful in the studies of flash flood and high impact weather associated with monsoon depressions and *Mei-Y*u fronts, and in dissecting the fine structures of latent heating processes associated with these extreme events. Furthermore, daily data of sea surface temperature derived from the TRMM microwave instrument, and oceanic surface winds and flux data from QuikScat have provided new insights on high-frequency monsoonal air-sea interactions over the Indian Ocean, the South China Sea, and the western Pacific. TRMM is expected to continue to operate into the late 2000's or the early 2010's, and is scheduled to be continued by the Global Precipitation Mission (GPM). The continuation of TRMM/GPM data will be highly desirable for AMY. These high-resolution SST and surface wind datasets are extremely important for studies of diurnal, intraseasonal variability, and multi-scale interactions under AMY.

In addition to these new satellites, conventional geostationary satellite data are also important, since they provide high time resolution cloud and cloud derived wind data that are indispensable for the study of diurnal variations. Two unique activities are planned; one is the merged product of Japanese MTSAT centered at 140°E and Chinese FY-2 centered at 105°E covering whole Asian monsoon region in one image. This product will be archived by the CEReS

(Center for Environmental Remote Sensing), Chiba University, Japan in collaboration with DPRI (Disaster Prevention Research Institute), Kyoto University, Japan from April 2008. Another activity is the rapid scan of these geostationary satellites, normally operated hourly, to be operated with time intervals of 15 or 30 minutes. These high time interval data will be useful for the severe weather events like heavy rainfalls due to typhoon or activated Bai-u/Mei-yu/Chang-ma front.

A critical contribution to AMY aerosol-monsoon interaction studies will be the satellite data products from the NASA A-Train series of satellites, including Cloudsat-Calipso, MODIS, CERES, AIRS/Aqua, OMI/Aura, which take near-simultaneous measurements of aerosol properties, vertical structure, cloud properties, temperature and water vapor profiles. These satellite data are vital for the Joint Aerosol-Monsoon Experiment (JAMEX). They will be used to provide inputs to aerosol forcing functions in GCMs and regional climate models, and for validating model simulations. Aerosol studies in AMY will rely on improved satellite algorithms for retrieving aerosol properties over highly reflecting land surface over deserts and semi-arid regions. The development of multi-sensor algorithms to distinguish aerosols, clouds and surface reflectance will be a critical component of JAMEX. By combining CERES top-of-the-atmosphere fluxes, aerosol/cloud properties retrieved from MODIS, vertical distributions of aerosols and clouds from Calipso and CloudSat, as well as measurements from aircraft and surface networks over the Asian continent, planned under AMY, radiative transfer models can be used to determine reliably the variation of radiative forcing efficiency of mineral dusts as they move from desert source regions to the mixed polluted industrial regions.

During AMY, land surface vegetation, and ocean bio-productivity data from MODIS and Seawifs will be used to supplement *in-s*itu observations for atmosphere-ocean-land-cryosphere-biosphere interaction studies over the Asian continent and the coastal regions. Because of the need to calibrate satellite observations and to better define the aerosol forcing functions, *in-situ* observations of aerosols such as from AERONET and surface radiation observations are essential. The large number of observational sites and platforms in the Indo-Pacific and Asian regions from the various projects under AMY will play invaluable roles for satellite data calibration and validation.

3 Data management and assimilation

To achieve the goals of AMY, data obtained by its observational, modeling and data assimilation components should be shared among the participants of AMY. They should also eventually be open to the wider (global) community. Because of the diversity of AMY and lack of central funding, a large

part of data management of AMY needs to be conducted in a distributed manner. Thus, data policy and data management are crucial for the success of AMY.

3.1 Data archiving and dissemination

To achieve the goals of AMY, data obtained by the observational, modeling and data assimilation components of AMY should be shared among the participants of AMY, and also they should be eventually open to the world in the same sense as "the free and unrestricted international exchange of data and products" as mentioned in WMO Resolution 40 (Cg-XII, 1995; PDF file at WMO: http://www.wmo.int/pages/prog/www/ois/Operational_Information/AdditionalData Products/02_Resolution%2040.pdf).

Observational components will make data from their regular observations either open or available to AMY participants by 1 year after the observation. They will make data from their all observations open by 2 years after the observation. Modeling and data assimilation components will share the same spirit of data sharing and dissemination.

Because of the diversity of AMY and lack of central funding, large part of data management of AMY need to be conducted in a distributed manner. Each component of AMY will assign its primary data depository. The primary data depository should continue to be available even after AMY has officially ended. In the case of difficulty, the Data Management Working Group for AMY (DMWG) will help to find a depository.

With coordination by the DMWG, data depositories will maintain a common data catalog, and links to depositories of all components on the Internet. The design of the catalog will initially follow the Global Change Master Directory (http://gcmd.nasa.gov/), but it will grow in more detail as the actual data accumulate.

Though it does not seem feasible to consolidate all data of AMY, we will pursue possibility of consolidated management of parts of them. It is encouraged that components of AMY which use data from various components together (e.g. for data assimilation) provide their quality-checked input data together with their output product in an integrated manner.

In addition to the experimental data conducted under AMY, routine observation data in Asian monsoon countries are also needed for various research purposes, such as synoptic condition analysis, detailed rainfall situations, model validation, etc, since GTS based information is not always enough and accurate, in particular, precipitation data. Special effort should be devoted to collect and archive routine observation data observed by each country's operational meteorological agency, in particular, hourly and/or 3-hourly surface meteorological data in order to analyze diurnal cycle.

The detailed guideline for the data management in AMY is attached in the Appendix 2.

3.2 Data assimilation

Regional atmospheric reanalysis with high-resolution models, regional ocean data assimilation over the monsoon oceans and warm pool oceans, and land surface assimilation, especially over the Tibetan Plateau, are planned as follows..

a. Ocean data assimilation

The AIPO ocean data assimilation activity aims at improving ocean data assimilation techniques and to deliver high resolution ocean state estimation via reanalysis for AIPO area. AIPO plans (1) to generate a high resolution remote-sensing sea surface data set by merging multi-source remote sensing observations. (2) to develop a new background error covariance model which can describe more accurately the properties in the Indian Ocean, South China Sea and west Pacific Ocean by ensemble methods. (3) to generate an at least 15 year (1991-2005) high resolution (0.25° grid size both in latitude and longitude expected) oceanic reanalysis product for AIPO area (25°S-40°N, 30°E-180°E). (4) to analyze the oceanic circulations in AIPO area, with particular attention to the connections between the east Indian Ocean, South China Sea and west Pacific.

b. Plateau data assimilation

CEOP/WEBS plans a four-step activity. (1) Validation of the land data assimilation system at The University of Tokyo (LDAS-UT), which is to be used to produce a surface water and energy budget. The LDAS-UT was developed to assimilate satellite microwave brightness temperature (Yang et al. 2007). The microwave signal can penetrate cloud layers and thus be used for all-sky retrieval of surface status. The microwave sensor can also "see" near-surface soil moisture, which reduces the sensitivity of the system output to errors in precipitation. The core of this system is a unique dual-pass assimilation technique, which optimizes model parameter values with a long-term window and estimates soil moisture and energy budget with a short-window. The system has been validated for the CEOP-Tibet mesoscale area which is affluent in situ data. More validation will be conducted based on CEOP data. (2) Analysis and correction of LDAS forcing data: The LDAS-UT is driven by precipitation, radiation, wind, air temperature and humidity. These data can be provided by GCMs, reanalysis, or satellite retrievals. (3) Production of surface water and energy data sets: After additional validation of the LDAS-UT, it will be applied to establishing a 10-year data set covering the plateau with a spatial resolution of 0.5 degree, and a temporal resolution of 1 hour.

(4) Analysis of water and energy cycles on plateau surface and in the atmosphere, with particular attention to their climatology and temporal variability.

4 Modeling and prediction

The objectives of AMY require coordinated efforts on modelling and prediction experiments. The objectives include: (1) determining the predictability of the Asian monsoon on intraseasonal and seasonal time scales; (2) determining the roles of land initialization in prediction of warm season precipitation especially over the land; (3) development of a hydro-meteorological prediction system (with lead time up to a season) in Southeast Asia and (4) coordinated regional modeling, modeling of aerosol impacts and exploration of decadal monsoon variability and its prediction. The AMY modeling activity will seek to fulfill these objectives. CLIVAR/AAMP and the APCC are expected to play a leading role in organization and coordination of these modeling activities. In particular, AMY encourages the following activities.

a. Analysis of operational numerical weather prediction (NWP) products

AMY strongly encourages scientists working in monsoon countries to engage in analysis of the NWP products produced at major operational centers worldwide. These include analysis of the predictability of the monsoon onset, predictability of the monsoon disturbances (heat lows, monsoon depressions, cyclones), and case studies made by cloud-resolving global models (ex. NICAM).

b. Analysis of operational and research monthly and seasonal to interannual prediction

AMY should consider making an organized analysis of existing hindcast datasets through APCC/CliPAS project and the planned WCRP Task Force on Seasonal Prediction (TFSP) Climate-system Historical Forecast Project (CHFP), identifying a range of suitable metrics relating to the AAM for application to the outputs, to (1) assess seasonal to interannual prediction skills and identify common weakness of the current dynamic predictions of the Asian monsoon, (2) determine the predictability of Indian Ocean Dipole which is an objective of the CLIVAR/GOOS Indian Ocean Panel, and (3) study the role of the MJO in the onset of the (1997) El Niño.

c. Coordinated AGCM/CGCM experimental prediction of the monsoon ISO

The aim of this activity is to better understand the cause of monsoon ISVs, determine their intraseasonal predictability, and overcome major difficulties in modeling and predicting MISO. AMY should focus on improved representation of convection in models (seeking commitment of resources to model development), design diagnostic studies for the behavior of convection in models, and make appropriate observations to support improved model representaion of convection. The MJO WG has also attempted to predict the lifecycle of MJO at several

operational centers worldwide. AMY should encourage an organized effort to pursue predictions of monsoon ISOs. The main focus of AMY should be placed on boreal summer and winter monsoon onset, active/break phases and retreat. Both AGCMs and coupled GCMs can be used. Both hindcast and real time prediction are encouraged.

d. Coordinated seasonal monsoon prediction experiments with CGCMs

For seasonal prediction, the importance of data assimilation and initialization for climate models cannot be overemphasized. The AMY implementation plan needs to consider how to: (1) enhance the atmospheric and oceanic observing system, especially in the Indian Ocean; (2) improve atmosphere-ocean initial conditions and develop coupled ocean-atmosphere-land data assimilation; (3) examine impact of land-ocean initialization on monthly to seasonal prediction. This is of particular importance. To determine the roles of land initialization in continental seasonal rainfall prediction, AMY should consider proposing a coordinated hindcast experiment within the Asian monsoon community on the impact of land surface initialization and land-atmosphere interaction on the prediction of Asian summer monsoon rainfall in the continental regions in collaboration with GEWEX and CLIVAR's WGSIP and the TFSP CHFP. (4) using CGCMs, to explore the predictability of coupled variability in Indian Ocean (including IOD, oceanic ENSO teleconnections, and monsoon/ENSO interaction). Its sensitivity to ocean and land initial conditions should be determined.

e. High resolution modeling and development of a hydro-meteorological prediction system

It is recommended that coordinated multi-high resolution model ensemble experiments be organized to investigate sub-seasonal to interannual factors that influence extreme events, such as tropical cyclones, severe droughts, devastating floods. The coordinated high resolution modeling proposed by Sieg Schubert at NASA has been endorsed by CLIVAR/AAMP and APCC, and forms a very useful starting point for developing a high resolution modeling activity. AMY is strongly urged to use this proposed study as a framework. It is also strongly recommend that the global cloud-resolving models developed or developing at FRCGC (NICAM) and other institutes will be used to carry out short-term simulations of up to a year to understand the predictability of the monsoon onset and hydro-meteorological systems.

f. Regional modeling

AMY has noted the utility of regional climate models in generating local information from seasonal prediction and climate change projection products of global coarse-resolution models for use in impact assessment. Such regional modeling activities may also focus on, for example, monsoon variability over

Vietnam, Malaysia, Indonesian maritime continent, Southeastern India and Sri Lanka, which are areas of significant local impacts. MAHASRI aims at development of a hydro-meteorological prediction system over the Southeast Asia. Over SE-Asia including the Maritime Continent, diurnal cycles, land-sea breezes, 2-3 day westerly or easterly events and intraseasonal oscillations are vigorously interactive. The MJO intraseasonal variability over the tropics tends to break up within the maritime continent due to the land topography and complexities of land-sea interaction. Since high time/space resolution radar and wind profiler data are extremely useful to validate fine mesh models and will provide a good opportunity for coordinated observation and modeling studies, it is strongly recommended that these observational data are obtained continuously under MAHASRI/JEPP HARIMAU project and other related projects.

g. Aerosol impacts

Possible impacts of aerosols on the radiation budget and on regional climate should be studied using regional models within the ARCS-Asia framework. A smoke haze model for the Asian monsoon region should be developed. The development of such a model involves emission inventory and smoke haze trace modeling. The implementation of smoke haze modeling within a regional model means that it can be used for operational forest fire smoke warnings. In these modeling efforts, temporal and spatial variations of aerosols observed over Asia will be studied, and the direct and indirect effects of aerosols on Asian monsoon will be evaluated.

h. Coordinated decadal monsoon predictability experiments

In order to determine importance of internal climate dynamics versus increasing greenhouse gas forcing, coordinated decadal monsoon predictability experiments is encouraged. In addition, AMY calls for more analysis of the IPCC AR4 and future such CMIP model outputs. The following items are being proposed as specific modeling activities.

a. Coordinated AGCM/CGCM experimental prediction of the monsoon ISO

Current models have great difficulty in modeling and predicting monsoon intraseasonal variations. Understanding the cause of monsoon ISVs, determining the intraseasonal predictability, and overcoming major difficulties in modeling and predicting MISO remain urgent needs. AMY should focus on improved representation of convection in models (committing resources to model development), design diagnostic studies for the behavior of convection in models, and make appropriate observations to support model improvement of convection.

In order to determine predictability and predictive skills of the Asian monsoon on intraseasonal time scales, monitoring and assessment of real time medium/extended range (1-30 days) predictions of the MJO using CGCM will be

continued. Short-term simulations up to seasonal change using a global cloud resolving model will be accomplished and help understanding roles of convection in monsoon ISO including MJO and tropical cyclogenesis. Through these research activities, the behavior of convections in models will be better understood and the representation of convections in models will be improved. The US-CLIVAR MJO working group has designed metrics for evaluation of model simulations and measure of ISO prediction skill. AMY should take advantage of these metrics for diagnostic analysis. The MJO WG has also attempted to predict the lifecycle of MJO at several operational centers worldwide. AMY should encourage an organized effort to pursue prediction of monsoon ISO. The main focus of AMY should be placed on boreal summer and winter monsoon onset, active/break phases and retreat. Both AGCMs and coupled GCMs can be used. Both hindcast and real time prediction are encouraged.

Considering that cooperation with operational centers are very important, efforts to encourage operation centers doing organized prediction experiments of MJO and MISO.

b. Seasonal prediction experiments

For seasonal prediction, the importance of data assimilation and initialization for climate models cannot be overemphasized. The AMY implementation plan needs to consider how to: (1) enhance the atmospheric and oceanic observing system, especially in the Indian Ocean; (2) improve atmosphere-ocean initial conditions and develop coupled ocean-atmosphere-land data assimilation; (3) improve and develop new reanalysis datasets that use new satellite observations and Argo observations; (4) promote model and observation studies for understanding of predictability of monsoon. Of particular importance is to examine impact of land-ocean initialization on monthly to seasonal prediction.

AMY should consider making an organized analysis of existing hindcast datasets through APCC/CliPAS project and the planned WCRP Task Force on Seasonal Prediction (TFSP) Climate-system Historical Forecast Project (CHFP), identifying a range of suitable metrics relating to the AAM for application to the outputs, to (a) assess seasonal prediction skills and identify common weakness of the current dynamic predictions of the Asian monsoon, (b) determine the predictability of Indian Ocean Dipole which is an objective of the Indian Ocean Panel, and (c) study the role of the MJO in the onset of the (1997) El Niño, which is a joint effort between AAMP and Pacific Panel (PP).

To determine the roles of land initialization in continental seasonal rainfall prediction, AMY should consider proposing a coordinated hindcast experiment within the Asian monsoon community on the impact of land surface initialization and land-atmosphere interaction on the prediction of Asian summer monsoon

rainfall in the continental regions in collaboration with CLIVAR's WGSIP and the TFSP CHFP.

Using CGCMs, predictability of coupled variability in Indian Ocean (including IOD, oceanic ENSO teleconnections, and monsoon/ENSO interaction) and its sensitivity to ocean and land initial conditions will be determined. Impact of ocean assimilation system on prediction of ENSO, IOD, ENSO-monsoon interaction and monsoon onset will be also studied. The engaged models in this direction are POAMA, MRI-CGCM and so on. Regional modeling activity in the same direction will be also continued.

c. High resolution modeling and development of a hydro-meteorological prediction system

Process studies on geographical variation of monsoon rainfall in time scales from diurnal to intraseasonal ranges. These studies include mechanisms and processes for the onset and maintenance of the summer monsoon, diurnal variations of summer convection short-term climate simulation of summer rainfall, climate change scenarios for summer rainfall, and mechanisms and processes for the winter monsoon over South China, South Asia and Southeast Asia. Local climate and its connections to ENSO and Indian Dipole mode will be also studied and assessed.

In addition to regional mode studies, global high-resolution modeling activities will contribute this objective. By using very high resolution AGCMs, extreme event projection and evaluation and reduction of uncertainty in global warming projection, to predict and evaluate disaster environment and to assess climate-change impacts on flood risk and its reduction measures on global and local scales will be studied. Using a global cloud-resolving model, short-term simulations up to season will be accomplished to understand hydro-meteorological systems.

It is recommended that coordinated multi-high resolution model ensemble experiments be organized to investigate sub-seasonal to interannual factors that influence extreme events, such as tropical cyclones, severe droughts, devastating floods. The coordinated high resolution modeling proposed by Sieg Schubert at NASA has been endorsed by CLIVAR/AAMP and APCC, and forms a very useful starting point for developing high resolution modeling activity. AMY is strongly urged to use this proposed study as a framework..

AAMP and MAHASRI encourage application of regional models to sensitivity studies of parameterization schemes and to the monsoon prediction problem and monsoon climate change issues. AMY has noted the utility of regional climate models in generating local information from seasonal prediction and climate change projection products of global coarse-resolution models for use

in impact assessment. Such regional modeling activities may also focus on, for example, the northeast monsoon variability over Vietnam, Malaysia, Indonesian maritime continent, Southeastern India and Sri Lanka, which are areas of significant local impacts. MAHASRI aims at development of a hydro-meteorological prediction system over the Southeast Asia.

Possible impacts of aerosols on radiation budget and regional climate will be studied using regional models within the ARCS-Asia framework. Smoke haze model for Asian monsoon region will be developed. The development of model involves emission inventory and smoke haze trace modeling. The implementation of smoke haze modeling within a regional model that will be used for operational forest fire smoke warning. In these modeling efforts, temporal and spatial variations of aerosols observed over Asia will be studied, and direct and indirect effects of aerosols on Asian monsoon will be evaluated.

d. The use of regional climate model for the maritime continent

The maritime continent consists of many small islands that act as a single heat engine source over the tropics. These small islands could not be represented well by the global climate model for atmosphere (AGCM) nor for ocean (OGCM). For many studies, the missing heat engine is the source of discrepancies between model result and observation. In many climate model studies, this area is modeled through either global climate model or merely a regional model. For the AMY research study, a combination of global climate model and regional climate model is the most appropriate method to simulate climate over the region. Although many still argue that the simultaneous use of regional and global model with different parameterization method many inflict more biases to the model results, however combination of both modeling technique shall give better representation on land sea interaction and sea air interaction. For example the diurnal cycle that is important for land sea breeze and 2-3 days of westerly variability is mainly depend on the land sea distribution.

The MJO intraseasonal variability over the tropics will breaks up within the maritime continent due to the land topography and complexity of land sea interaction. The asymmetry of the onset and retreat of Asian monsoon over the maritime continent accounts for the land sea distribution as well. Aldrian et al (2005) has shown contrasts of land sea rainfall pattern that pretty much related to the distribution of the land sea mask. Ideally, the 20km resolution or at 0.2 degree shall be adequate to represent sub grid convection processes over the tropics. Arakawa and Kitoh (2005) has shown that precipitation distribution over the maritime continent area is well simulated in the MRI 20-km mesh GCM. A regional model up to 1/6 degree or 18km has shown a pretty well performance (Aldrian et al 2004). However, with 0.5 degree model resolution, the regional model could

justify the land sea process over the tropics. Wu et al. (2008) has also noted the minute precipitation distribution related with topography and land/sea configuration in the maritime continent islands is not very realistic even in 20-km GCM result by Arakawa and Kitoh (2005) and regional model with 4-km resolution can simulate better results. Unless the AGCM has reached such a resolution between 0.2 - 0.5 degree, there is a need to include down scaling method of combination between AGCM and regional climate model.

In the AMY, since high time/space resolution radar and wind profiler observation data will be obtained under MAHASRI/JEPP HARIMAU project, the use of these data for using validation of these fine mesh models will provide a good opportunity for coordinated observation and modeling studies.

5. Time table

The important time table of related international meetings and expected AMY Workshop is as follows. Basically, AMY will organize a session in AOGS annual meeting and AMY Workshop will also be held during the meeting. Presentation in AGU, EGU, IAMAS, IUGG as well as WCRP GEWEX and CLIVAR, and WMO related meetings are encouraged.

<2008>

June 18-19	The 5th Asian Oceania Geosciences Society Annual Meeting Session: AMY – A New Coordinated Asian Monsoon Experiment at Busan, Korea
June 19	The 4th AMY Workshop at Busan, Korea
October 20-25	IMW-IV, CLIVAR/AMMP, Pan-WCRP Monsoon Workshop The 5th AMY Workshop (?) at Beijing China

<2009>

July 19-29	IAMAS at Montreal, Canada
August 11-15	The 6th Asian Oceania Geosciences Society Annual Meeting at Singapore The 6th AMY Workshop (?)
August 24-28	The 6th International Scientific Conference on the Global Energy and Water Cycle Experiment and 2nd iLEAPS Science Conference, Melbourne, Australia

Appendix 1 Acronyms

AAF	Aerosol Air-Quality Facility
AAMP	Asian-Australian Monsoon Panel
ADCP	Acoustic Doppler Current Profiler
AERONET	Aerosol Robotic Network
AGCMs	Atmospheric General Circulation Model
AIPO	Ocean-Atmosphere Interaction over the Joining Area of Asia and Indian-Pacific Ocean and Its Impact on the Short-Term Climate Variation in China
AMF	Deployment of the Atmospheric Radiation Measurement Mobile Facility
AMIP	Atmospheric Model Intercomparison Projects
AMY	Asian Monsoon Years
AOGS	Asia Oceania Geosciences Society
APCC	APEC Climate Center
APEC	Asia-Pacific Economic Cooperation
ARCS	Aerosol and Regional Climate Studies
BMG	Meteorological and Geophysical Agency (Indonesia)
BMRC	Bureau of Meteorology Research Centre
BPPT	Agency for the Assessment and Application of Technology (Indonesia)
BRRAA	Bureau of Royal Rainmaking and Agriculture Aviation
CAIPEX	CAMS Chinese Academy of Meteorological Sciences
CAMS	Chinese Academy of Meteorological Sciences
CAOS	
CAS	Chinese Academy of Sciences
CCN	Cloud Condensation Nuclei
CEReS	Center for Environmental Remote Sensing
CEOP	Coordinated Energy and water cycle Observation Project
CGCM	Coupled With Ocean-Atmosphere General Circulation Model
CHFP	Climate-system Historical Forecast Project
CliPAS	Climate Prediction and Its Application to Society
CLIVAR	Climate Variability and Predictability
CMA	China Meteorological Administration
COLA	Center for Ocean-Land-Atmosphere Studies
COMMIT	Chemical, Optical, and Microphysical Measurements of In-situ Troposphere
CREST	Core Research for Evolutional Science and Technology

CTCZ	Continental Tropical Convergence Zone as a component of coupled Land-Ocean-Biosphere-Atmosphere System
DMH	Depertment of Meteorology and Hydrology
DPRI	Disaster Prevention Research Institute
EAST-AIRE	East Asia Study of Tropospheric Aerosol: an International Regional Experiment
EAMEX	East Asian Monsoon Experiment
ESSD	
ENSO	El Niño-Southern oscillation
ESSP	Earth System Science Partnership
FRCGC	Frontier Research Center for Global Change
GAME	GEWEX Asian Monson Experiment
GaME-T	GEOSS and MAHASRI Experiment in the Tropics
GCM	General Circulation Model
GEOSS	Global Earth Observation System of Systems
GEWEX	Global Energy and Water Cycle Experiments
GPS	Global Positioning System
HARIMAU	Hydrometeorological Array for Iintraseasonal-Monsoon Automonitoring
HyARC	Hydroshperic Atmospheric Research Center
LASG	State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics
IAP	Institute of Atmospheric Physics
IGBP	International Geosphere-Biosphere Programme
IIT	Indian Institute of Technology
IITM	Indian Institute of Tropical Meteorology
IMD	India Meteorological Depertment
IMH	Institute of Meteorology and Hydrology
IOD	Indian-Ocean dipole
IOP	Indian Ocean Panel
IORGC	Institute of Observational Research for Global Change
IPCC	Intergovernmental Panel on Climate Change
ISO	Intraseasonal Oscillation
ISV	Intraseasonal Variability
ITCZ	Intertropical Convergence Zone
ITF	Indonesian Throughflow
ITP	Institute of Tibetan Plateau Research
IUGG	International Union of Geodesy and Geophysics
JAMEX	Joint Aerosol-Monsoon Experiment
JAMSTEC	Japan Agency for Marine-Earth Science and Technology

JEPP	Japan EOS Promotion Program
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
JSC	Joint Scientific Committee
LDAS-UT	Validation of the land data assimilation system at The University of Tokyo
MAHASRI	Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative
MAIRS	Monsoon Asia Integrated Regional Study
MIPs	Model Intercomparison Programs
MISO	Monsoon Intraseasonal Oscillation
MJO	Madden-Julian Oscillation
MMD	Malaysian Meteorological Department
MME	Multi-Model Ensemble
MRI	Meteorological Research Institute
MODIS	Moderate Resolution Imaging Spectroradiometer
NAME	North American Monsoon Experiment
NASA	National Aeronautics and Space Administration
NCC	National Climate Center
NCEP	National Centers for Environmental Prediction
NCMRWF	National Centre for Medium Range Weather Forecasting
NEC	North Equatorial Current
NHMS	National Hydrometeorological Service
NICAM	Numerical experiments with global cloud-system resolving model
NPOIMS	Variability of the Subtropical North Pacific Ocean Circulation and its Impacts on the Dynamic Environment of the Marginal Seas
OMI	Ozone Monitoring Instrument
PACDEX	Pacific Aerosol-Cloud-Dust Experiment
PAGASA	Phillipine Atmospheric, Geophysical and Astronomical Services Administration
PHONE	Pukyong National University and HyARC, Nagoya University Observation Network (for GRL) over East China Sea
POAMA	Predictive Ocean Atmosphere Model for Australia
POP	Pacific Ocean Panel
PRAISE	Pacific Regional Aquaculture Information Service for Education
RAISE	Rangelands Atmosphere-Hydrosphere-Biosphere Interaction Study Experiment in Northeastern Asia
Rajo-Megha	Radiation Aerosol Joint Observations – Monsoon Experiments over the Gangetic Himalayas Area
RCM	Regional Climate Model

RFD	Royal Forest Department
RID	Royal Irrigation Department
SACOL	Semi-Arid Climate and Environment Observatory of Lanzhou University
SCS	South China Sea
SEA	Southeast Asia
SoWMEX	Southwest Monsoon Experiment
SCHeREX	Southern China Heavy Rainfall Experiment
SCSIO	South China Sea Institute of Oceanology
SPICE	Southwest Pacific Ocean Circulation and Climate Experiment
START	SysTem for Analysis Research and Training
SMART	Surface-sensing Measurements for Atmospheric Radiative Transfer
STORM	Severe Thunderstorms – Observations & Regional Modeling
TC	Tropical Cyclone
TFSP	Task Force on Seasonal Prediction
TiMREX	Terrain-influenced Monsoon Rainfall Experiment
TCS08	Tropical Cyclone Structure 2008
TCZ	Tropical Convergence Zone
THORPEX	The Observing-System Research and Predictability Experiment
TiMREX	Terrain-influenced Monsoon Rainfall Experiment
TMD	Thailand Meteorological Department
TORP	Tibetan Observation and Research Platform
T-PARC	THORPEX Pacific Asian Regional Campaign
TRMM	Tropical Rainfall Measuring Mission
UTWV	Upper tropospheric water vapor
WCRP	World Climate Research Programme
WEBS	Water and Energy Budget Study
WGSIP	Working Group on Seasonal to Interannual Prediction
WMO	World Meteorological Organization
WNP	Western North Pacific
WPSH	Western Pacific subtropical high
WWRP	World Weather Research Programme
YOTC	Year of Tropical Convection

Appendix 2 Guideline for data management in AMY

1. Principle

Each participant of the Asian Monsoon Years (AMY) will make its data products eventually "open". The meaning of "open" here is essentially the same as "the free and unrestricted international exchange of data and products" as mentioned

in and (see Section 2).

Observational research projects will make data from their regular observations available either "open" or as "AMY internal data sets" (see Section 3) by 1 year after the observation, and data from their all observations "open" by 2 years after the observation.

While consolidated data management of some part of AMY data is desirable (see section 6), large part of data management of AMY will be conducted in a distributed manner. Each project participating in AMY should assign its data depository (Section 4). The Data Management Working Group for AMY (DMWG) will make efforts of coordination, including compilation of a common data catalog (Section 5).

2. Condition on use and distribution

2.1 AMY data products

AMY data products should be "open". That is, they may be accessed by anyone, not limited to the participants of AMY, for non-commercial purpose. (However, those who have violated the condition of use and distribution may be excluded from access, as sanction.)

Users should acknowledge the originating project when they publish the results which utilize the data products. The documentation of the data should contain the identification of the products that can be used for citation.

The depository should make the condition readily visible to the users, and the users should respect the condition.

2.2 AMY internal data sets

Some data sets may be put in the state where only the participants of AMY can access them. This condition is applied only temporarily.

If a depository has data of this category, it should check identification of the user to make sure that the user is a participant of AMY.

2.3 Special data sets

It may happen that some data sets cannot be made "open" because of issues such as privacy, national security or intellectual property rights, but that they may be shared with limited members of collaborative research. Such data are not considered AMY data products, but information about such data may be included in the common catalog if the originating project as well as the DMWG consider it appropriate.

3. Time frame

This section refers to observational research projects only, but other participants will share the same spirit.

Data from regular observations should be brought either to the "open" state or to the state of "AMY internal data set" by **1 year** after the observation. By "regular", we mean that the stations are monitored regularly, and that the work flow of observations and data management has been established when the activities of AMY start.

Every project participating in AMY, including the above cases, should make its data products "open" by **2 years** after the observation.

It is encouraged to make data available earlier than these time limits.

Also it is encouraged to make data available in real-time, either through the operational telecommunication channel or the Internet. It will be helpful to both real forecasts and operations of observational research projects. Copies of the data which has been transmitted in real-time should also be included in the depository, preferably with better quality checking.

4. Distributed data management

Each project will assign a primary depository which is responsible for making its data product publicly available.

DMWG will help to find a depository when the originating project cannot find by itself.

By agreement with the originating project, the dataset may also be made publicly available from secondary depositories.

If the primary depository is going to disappear, it should be made sure that its role will be taken over by another institution.

The depository should make the data products available either by placing them on the Internet either permanently or responding to users' requests. (Sometimes the depository may need to deliver the data products off-line, but this may be limited to the cases when the user has little Internet access.)

The depository may modify the data format or add some quality checks, but it should also retain the original version which they have received.

5. Common data catalog

DMWG will organize AMY Data Management Mailing List (Data-ML) which includes representatives of all depositories.

With contributions by Data-ML members, DMWG will make a catalog of provisional data products, and continuously revise it. Eventually the catalog will contain information of actual data products with links to depositories. The editors of the catalog, assigned by DMWG, will frequently contact individual members of Data-ML to keep the catalog current.

The catalog will contain such information as, at least,
- broad category (e.g. AWS, flux tower, radar, radiosonde, river discharge),
- elements (physical variables) of observational data records,
- locations of stations,
- term and frequency of observations,
- primary depository.

It is desirable that it also contains more detailed information about instrumentation and surrounding condition of the stations.

6. Prospects of consolidated data management

It is desirable to have various data in the same archive where a user can use them in an integrated manner. It requires, however, huge effort to unify the format of data as well as metadata (information of data). At the present stage, there is no concrete plan for consolidated data management. With a good focus of research, consolidation of data related to that theme will be fruitful. AMY will encourage such initiatives. In particular,
- When multiple projects participating AMY have a coordination for their common Intensive Observing Period, it is desirable that their data are also available together.
- When data assimilation is conducted, it is desirable that observational data used as its input can be found together with its output products.

In order to make data available from the consolidated data depository to users, agreements between the depository and the originating project. DMWG will help achieving such agreements when requested.

Even in distributed data management, standardization of data formats and metadata is desirable. This subject will be coordinated in Data-ML.

References
- World Meteorological Organization, Resolution 40 (Cg-XII, 1995): WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities. (PDF file at WMO: http://www.wmo.int/pages/prog/www/ois/Operational_Information/AdditionalDataProducts/02_Resolution%2040.pdf)
- World Meteorological Organization, Resolution 25 (Cg-XIII, 1999): Exchange of hydrological data and products. (Web page at Global Runoff Data Centre: http://grdc.bafg.de/servlet/is/1653/?lang=en)
- Coordinate Enhanced Observing Period (CEOP Phase 1) Reference Sites Data Release Guidelines (http://www.eol.ucar.edu/projects/ceop/dm/documents/ceop_policy.html)

- GAME (GEWEX Asian Monsoon Experiment) Data Management: Guideline for Data Exchange and Dissemination (http://gain-hub.mri-jma.go.jp/gain_intro.html)

Appendix 3 Funding and sponsors

AMF: Funded by the US Department of Energy and the Chinese Academy of Sciences.

CTCZ: Individual project mode support to participating Indian scientists is being provided by the Department of Science and Technology and Ministry of Earth Sciences, Government of India as part of the ICRP. It is expected that financial support for the planned observational programme and the modeling studies of the CTCZ programme will also be provided by these and other ministries in Gov. of India involved in climate research.

EAST-AIRE: Funded by NASA and China's Ministry of Science and Technology

JEPP: Funded by the Ministry of Education, Culture, Sports, Science and Technology, Japan related with GEOSS.

MAHASRI: Funded by the Ministry of Education, Culture, Sports, Science and Technology and Ministry of Environments, Japan

MAIRS: China National Key project: aridity in northern China and human adaptation (2006-2010), 30 million Yuan for 5 years. CAS Key project: The characteristics of changes of climate and hydrological cycle and its interaction over northwest China (2006-2008), 2 million for 3 years.

SACOL: Sponsored by Lanzhou University through 985 Program; the National Basic Research Program of China under grant of 2006CB400501, the National Science Foundation of China under grants of 4063301.

SCHeREX: China National Key project: Theories and Methods for Monitoring and Predicting Heavy Rainfall in South China (2004-2009), 30 million Yuan for 5 years. State Key Laboratory of Severe Weather (LaSW), CAMS.

SoWMEX: Funded by NSC and CWB of Chinese Taipei

STORM: Special funding for additional observational systems, other than routine operational observational systems of India Meteorological Department and other government agencies, implementation of multi-year field phases and follow-on research studies are being provided by the Department of Science and Technology, Government of India.

TiMREX: Funded by NSF with field phase facility support from NCAR

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