GEWEX Asian Monsoon Experiment

GAME Letter

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A New Phase of GAME

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The Intensive Observing Period (IOP) for the four regional experiments have finished successfully, including the GAME-Siberia region, where the IOP was implemented in spring through summer of 2000. The data sets obtained through these experiments are being released through GAIN, as is reported by K. Takahashi in this issue. The objectively-analyzed GAME reanalysis data are also being released (as described in this issue by N. Yamazaki). The 5th session of the GAME International Science Panel (GISP) was held in June in Tokyo, and we discussed further cooperation and cooperation of the overall activities of GAME. The agreement was met on the need for promoting cooperative research, including monitoring, data analyses and modeling. GAME-AAN, as reported in this issue, needs further continuous monitoring of surface radiation, energy and water fluxes, to reveal seasonal and interannual variations of surface radiation, and energy balances on various surface climatological conditions of monsoon Asia. The regional modeling of climate and hydrological processes in the four regional experiments has started based on the data sets of the IOPs and other related hydro-meteorological data archived as part of the regional experiments. These activities need further involvement of scientists and engineers of the regional and local institutions who worked together in the data collections during the IOPs.

Though the first phase of GAME (FY1996 to FY2000) is being over, GISP agreed to extend this phase, or to build up the second phase, particularly for promoting the cooperative research activity based on the data obtained through the first phase. The important task of the second phase should be to further understand physical processes, particulary land surface hydrological processes, cloud/precipitation processes, and related atmospheric boundary layer processes, and to improve model parameterizations of these processes which are essential for improving seasonal forecast of Asian monsoon and regional hydrological cycle in each part of the Monsoon Asia. As a step for this research phase, we are currently editing GAME Special Issue of the Journal of the Meteorological Society of Japan, which will be published in February of 2001.

I also believe that this new research phase of GAME should be actively utilized as a bridge to the new WCRP/GEWEX initiative of the global-scale study of the Coordinated Enhanced Observing Period (CEOP), which is scheduled in a time-frame of 2002-2003. The current status of CEOP is briefly reported in this issue by T. Koike.

I do hope that the second phase of GAME would be a good step-up for developing the cooperation and coordination in the studies of climate and water problem of monsoon Asia under the changing earth environment within the Asian countries and the international science community.

Contents

Application of GAME-T in Thailand

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1. Background

In most region of the world the water resources reflect the climate with the influence modified by the surface topography, soils and geology. Climate is particularly critical to Thailand since surface water is the prevalent source of water used. Hence, rainfall is critical in terms of both timing and distribution.

Thailand has a advanced agricultural system and generally well operated water management system: yet the growing need for water appears most heavily related to the needs of an expanding of population and Thai economy, which requires more water to meet its expanding agricultural energy demands as well as an industrial use.

Natural disasters caused by flood and drought occur more frequently and tend to be more severe than before, possibly resulting from inadvertent weather modification and another unsolved development problems such as deforestation, changing of land uses and increasing of environmental pollution. Development patterns in Thailand that ignore sustainable water management are exposing communities to greater risks to those disasters.

It is quite clear that increasing national water management efficiency requires knowledge and understanding of various characteristic of weather patterns and their impacts on water resources focusing on both regional and local scales.

Recognizing the need for the development and implementation of a more comprehensive scientific approach to the design, operation and evaluation of the national water resources management, Thailand has been involved with the series of data observation and experimental activities related to the atmosphere and hydrological cycle in tropic region under the GEWEX/ GAME-T since 1995.

GAME-T can be defined as a regional study of Tropical Monsoon Regions under GAME.

The major objectives for Phase I of GAME-T are:

1) To investigate the global energy and water cycle, which is the objectives of GEWEX, in a local scale.
2) To establish and improve surface hydrological model for the global scale land-atmosphere interactions.
3) To evaluate the effect of the variation of the global energy and water cycle to the human society, especially in southeast Asia region.
4) To build up comprehensive hydro-meteorological data set in the southeast monsoon Asian region, from Japan, China, Philippines, Vietnam, Thailand, Malaysia, Indonesia, and Australia.

2. Future Plan for GAME-T

Scientific researches based on various observation and experiments under GAME-T are undergoing, and basically successful. Data is now being organized and will be released for worldwide benefit.

Future research programs would be based on experiences gained from GAME. The multi-disciplinary approach program would be conducted through the National Research Council of Thailand as a key coordinating body for various Thai Institutions and Japanese researchers.

Thai researchers proposed more research topics focusing on water resources and agriculture management issues. These include the followings:

- Social and economic problems on water resources, land use and water management
- Hydro-meteorological radar network program for reservoir and irrigation management
- Monsoon forecasting and long range weather prediction
- Flood and drought forecasting and warning systems
- Upgraded utilization of satellites and GIS
- Impact of population, land use and industrial growths on the environment and natural water cycle in national and regional scales

To response to the rising interest for GAME-T project, the Japanese and Thai researchers are pleased

to continue sharing their skill in more comprehensive research studies. Detail planning for GAME-T Phase II are under preparation. The provision of GAME-T Phase II are listed below.

GAME-T Phase II

Motivations:

- More scientific approach is required to understand the global energy and water cycle
- Further research focusing on application of research results to benefit the water resource management
- Maintain friendship in international research community

Objectives:

- Similar to Phase I -more focusing on the above motivations

Some related programs:

- CEOP (Coordinated Enhanced Observing Period)
- GLASS (Global Land-Atmosphere System Study)
- WWAP (World Water Assessment Program)

Continued observations are crucially important:

- Three sites of surface fluxes in Thailand (KogMa forest, Sukhothai paddy field and EGAT tower)
- Intensive observational site in Sri Samrong
- GPS measurements in Bangkok, Chiangmai
- Rain gage network
- Wind profiler at KMITL
- Satellite data receiving at AIT

New observations:

- Wind profiler and other additional instruments at Sri Samrong
- Hourly rainfall network
- Water sampling for chemical and stable isotope measurements: rain, stream, soil moisture, and ground water

3. Special Remarks

Thailand is initially classified hydrologically into 25 river basins. These basins can be further aggregated into 5 regions, namely, North, Central, Northeast, East, and South. There are three main sources of fresh water available in any river basins, namely, rainfall, stream flow and ground water. Water demand can be classified into non-consumptive and consumptive. Typical non-consumptive uses are hydropower, navigation and environmental requirement, while consumptive uses are agriculture, municipality or domestic and household and industrial water supply.

All river basins in Thailand are likely subject to flood every rainy season. Degree of damage depends upon various measures, flood warning, flood forecasting and flood protection included flood zoning. Floods can occur at any time, but weather patterns have a strong influence on when and where floods happen. Typhoon, or storms can cause floods in the rainy season in the northeast and especially in the south during the late rainy season. Thunderstorms are relatively small but intense storms that can cause flash floods in smaller streams in late summer in the east coast. Frontal storm form can cause floods in the central plain of Thailand during rainy season.

Drought is another seasonal phenomenon where rain does not fall or fall in insufficient amount. Without storage, surface or ground water, people tend to suffer from lack of water that could lead to other socio-economic damage.

Millions of dollar and countless lives can be saved each year from timely and accurate predictions of both floods and droughts including early warning well-trained mitigation action. These tasks fall into the subject of national water resources management.

Understanding of the whole process of global energy and water cycle system that leads to better explanation for regional and local scale weather phenomena will be useful to improve accuracy of weather prediction and proper water management strategy for Thailand. Therefore, maintaining international research and experimental cooperation under the GAME-T is a great benefit to alleviate not only national disasters for the Thai people but also for the world community.

Progress of Siberia Regional Project in 1999/2000

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The followings are the progress of Siberia regional project.

1). *Continuation and extension of observation of variety of land surfaces in Yakutsk area*

At Spasskaya tower site, heat/water exchange and vegetation condition, ground surface layer conditions at a larch forest site was continued in 1999 which had wet climate, and 2000. The second tower was built at a pine forest, and the third 24 m tower was built in the larch but less dense younger forest, and other systems were built at grass surfaces.

2). *Third year observation at Tiksi tundra site:*

Third year meteo/hydrological observation has been made at two drainages (5 and 40 km^2). There, ACOS meteorological measurement systems was operated and good quality year round data was obtained. Detail studies of heat/water exchange, vegetation and soil textures were done including measurement of uneven snow cover. Also, aerial observation method using a helicopter was newly introduced in 1999-2000, measuring surface spectral radiance (visible range), surface temperature and surface conditions by a video camera.

3). *Observational work at other area:*

Drainage water budget study at Mogot experimental site in southern part of Lena (north of Tynda) started in July 2000, which was postponed due to permission and logistic problems.

4). *Modeling and satellite analysis:*

Simulation of Lena River out flow was made. A regional circulation model was tested against the Yakutsk area, and NDVI analysis and snow cover estimation by microwave were continued.

Russian Group tested global climatic model MSU and LAMBLS, and the model of water cycle of small and medium watersheds, ECOMAG and a model of monthly water balance were adapted to permafrost conditions.

5). Implementation of IOP 2000 atmosphere-land surface interaction:

The target study area was north of the Yakutsk 80 x 40 km area connecting the Spasskaya Pad area and the Tungulu area (alas developing area), and the period was from April to June 2000. Observation equipments employed were :

1. Surface observation
   Left bank (Spasskaya): 2 forest towers (larch, pine)
   Right bank (Tunguru): 1 forest tower, 2-3 grass land masts
2. Atmosphere
   Aircraft: Mean meteor. values, flux (fast response wind, temp., and humidity). Isotope and CO_2. 9 days from April 24 to June 18
   Enhanced Radio-sonde soundings: 4 sites. 1 at Spasskaya, 4 times a day at 3 aerological station (Hydromet Service) piball measurements
3. Surface observation network within the study area for data sets driving models

6). Future planned activities:

Analysis of observed results and integration of results obtained by various methods will be made. For presentation and discussion of analysis and publication of the results, “The 3rd International Workshop on Water and Energy Cycle in Siberia and GAME” is planned for March 15-16, 2001 in Tokyo.

Upper Air Characteristic Features Over Indian Stations During GAME 1998

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1. Introduction

India being an agricultural country the economy mainly depends on the monsoon rainfall and its variability. The long range forecasting of monsoon rainfall is a matter of great concern for the people. The GEWEX Asian Monsoon Experiment (GAME) was started in 1996 as part of GEWEX (Global Energy and Water Cycle Experiment) under WCRP (World Climate Research Programme). In 1998, GAME Intensive Observing Period (IOP) was implemented and India Meteorological Department being a member of GAME collected intensive radiosonde data during this period by taking additional ascents. The upper air data were collected for nine stations viz. Patiala, Delhi, Mohanbari, Lucknow, Gorakhpur, Guwahati, Patna, Ranchi and Calcutta for 00, 06, 12 and 18 UTC in two phases. The first phase of observations were taken from 15th May to 15th June and the second phase from 1st July to 31st July, 1998, covering the onset and active phases of the summer Indian monsoon. We have analysed these observational data to examine the characteristics of tropopause and freezing level heights during the two phases.

2. Data

Data collected during IOP for the two phases were scrutinized, processed, quality controlled and archived at National Data Centre, Pune. This archived data were utilized for the study. Figure 1 shows the radiosonde stations where enhanced observations were taken during IOP.

3. Advancement of southwest monsoon during the IOP

Southwest monsoon was set in over Kerala on 2nd June. By 15th June it had covered Madhya Maharashtra, Marathwada, Vidharbha, parts of Madhya Pradesh, West Bengal and parts of east Bihar. By 17th June it had covered Delhi, Gujarat, East Rajasthan, Himachal Pradesh and Punjab. By 30th June it has covered the whole country. The progress of southwest monsoon is shown in Fig. 1.

Two systems crossed during this period one each along west coast (Arabian Sea) and east coast (Bay of Bengal) during the onset phase of monsoon. A severe cyclonic storm crossed the Gujarat coast on 9th June and a deep depression crossed east coast near Visakhapatnam on 14th June.

4. Freezing Level Heights

Figure 2 shows mean freezing level heights for 00, 06, 12 and 18 UTC during phase 1 and phase 2. In general (except Patna), the freezing level heights are between 5000 and 5500 gpm during phase 1 and between 5500 and 6000 gpm during phase 2. It means that freezing level heights occur at higher altitudes when the monsoon is fully established over the country. Before the onset of monsoon, continental air mass (Tc) prevails over Northern India, while the main characteristic of the southwest monsoon period is the prevalence of a highly warm moist air in great depth over most parts of India and represents maritime air mass (Tm). Due to the differences in the air mass characteristics the differences in the freezing level heights are seen. Diurnal variation is also seen in the freezing heights with maximum occuring at 06 UTC. The differences in the tropopause heights during the two phases are increasing from east to west with Lucknow, Delhi and Patiala showing more differences.

Figure 3 shows the percentage frequencies of freezing level heights over Calcutta during phase 1 and phase 2. Before the onset of monsoon (i.e. phase 1) around 65% of occasions the heights are between 4500 and 5500 gpm at 00 and 18 UTC and more than 75% of occasions the heights are between 5000 and 6000 gpm at 06 and 12 UTC. During phase 2 around 85% times the freezing level heights are between 5000 and 6000 gpm at 00 and 18 UTC and between 5500 to 6500 gpm at 06 and 12 UTC.

5. Tropopause Heights

Figure 4 shows the mean tropopause heights for both the phases for all 9 stations. The tropopause heights are lower during phase 2 compared to phase 1 for 00, 06, 12 and 18 UTC for stations east of 85 deg E i.e. Calcutta, Mohanbari, Ranchi, Patna and Guwahati. For stations west of 85 deg E (New Delhi, Lucknow Patiala and Gorakhpur) the tropopause heights for 06 and 12 UTC are higher than phase 1. After the onset of monsoon the lapse rates are nearly saturated adiabatic.

6. Conclusions

From the discussions the following observations can be made:

a) After the onset of monsoon mean freezing level heights for all the stations have increased. Diurnal and longitudinal variations are also present in freezing level heights.

b) During phase 2, tropopause heights are lower than phase 1 for stations located east of 85 deg E for all four hours. For stations west of 85 deg E this phenomenon is observed for 06 and 12 UTC only.

Further studies on tropopause and freezing level heights and their role in atmospheric convection are in progress.

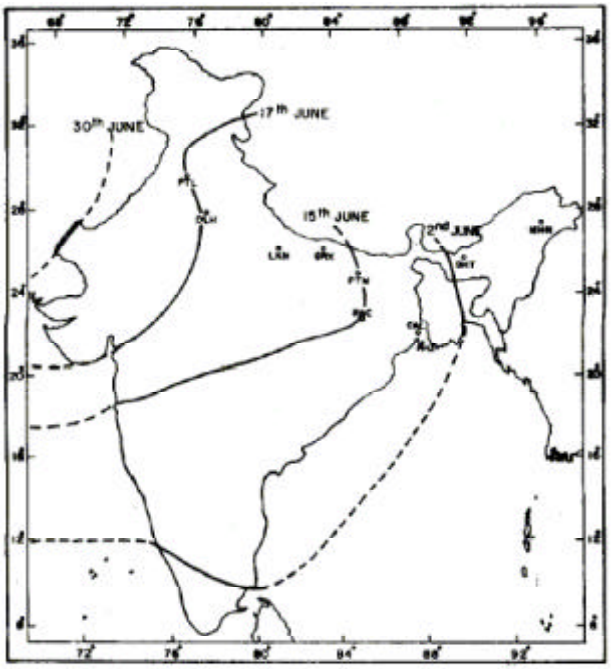

Fig. 1 List of radiosonde/radiowind stations during GEWEX IOP (15th May - 15th June and 1st July - 31st July).

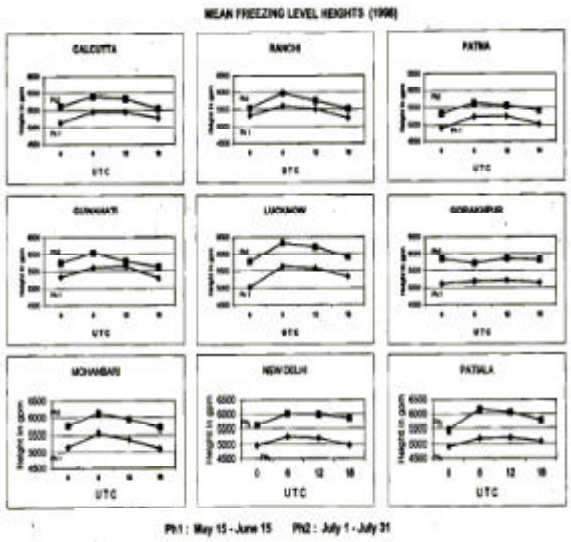

Fig. 2 Mean freezing level heights for 00, 06, 12 and 18 UTC during phase 1 and phase 2.

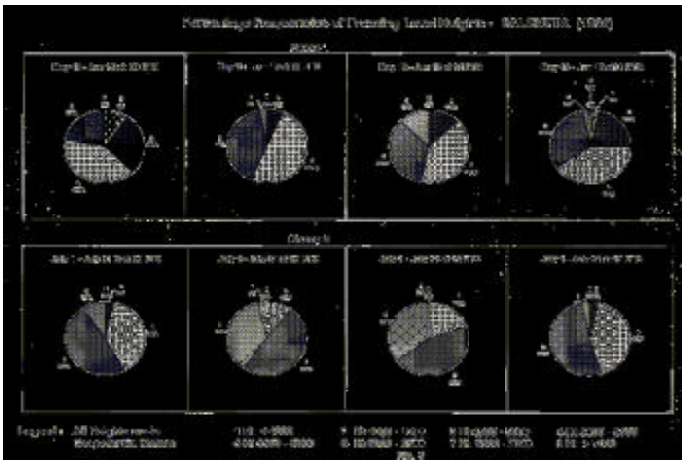

Fig. 3 Percentage frequencies of freezing level heights over Calcutta during phase 1 and 2.

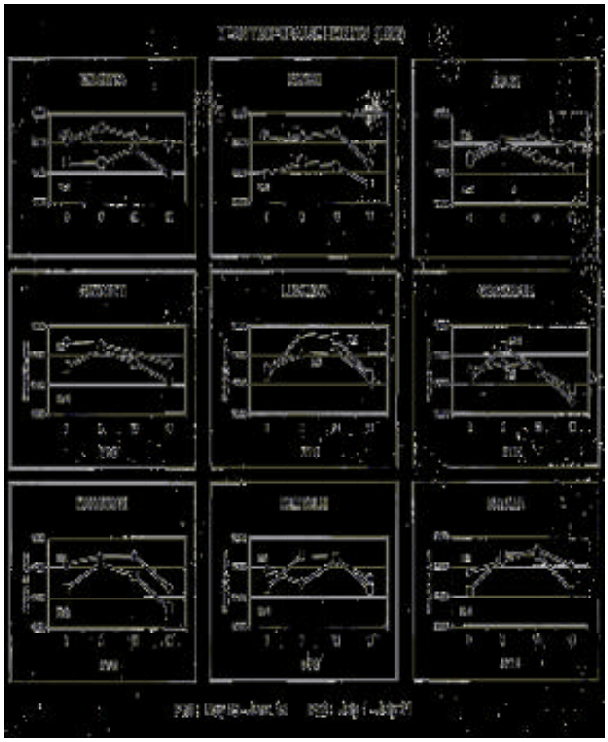

Fig. 4 Mean tropopause heights for both the phases for all 9 stations.

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Current status of GAME reanalysis

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1. Introduction

GAME reanalysis project in Japan started last year with a joint effort of the Meteorological Research Institute, Numerical Prediction Division/Japan Meteorological Agency (JMA), and the Earth Observation Research Center. The Object of the GAME reanalysis is to collect off-line data during the GAME IOP period and to obtain reanalysis of higher quality using the most updated assimilation system and the off-line data as well as on-line data through the GTS. The target period is from April to October, 1998.

Most of collected off-line data shown in Table 1 are located between 25 N and 40 N in China. The assimilation system used is almost the same as the current operational JMA system: 3 dimensional optimum interpolation scheme and forecast model with 0.5625 degree horizontal resolution, 30 vertical layers and prognostic Arakawa-Schubert convective scheme.

2. Comparison of GAME reanalysis product with ECMWF and NCEP

Figure 1 shows 850 hPa wind fields of GAME reanalysis (top), 850 hPa wind difference of GAME reanalysis from ECMWF analysis (middle) and difference of NCEP analysis from ECMWF reanalysis (bottom), averaged over July 1998. Differences are small over regions with many sonde-observation sites, but differences are large over the Indian Ocean, where satellite is only observational data source except very few sonde observations. Compared with ECMWF, the GAME reanalysis is somewhat similar to the NCEP analysis around the Indian Ocean.

3. Impact of four times a day sonde observation on diurnal variation of precipitable water

Incorporation of intensive sonde observations (4 times a day) during the GAME IOP is expected to improve diurnal variations of the analyzed fields, especially in China. Impact of the off-line intensive observation was examined by comparing two reanalysis with and without the IOP data.

Precipitable water difference between at 12 UTC (20 o'clock in Beijing Standard Time [BST]) and 00 UTC (8 BST) averaged over July 1998 with and without the IOP data was examined. No significant impact in the difference was found, although incorporation of the IOP data slightly enhances diurnal amplitude. This is probably because enough observations are already made at 00 and 12 UTC. The difference at 18 UTC (2 BST) and 06 UTC (14 BST) with and without the IOP data are seen in both the amplitude and the phase. Regions with more precipitable water at 02 BST than at 14 BST expand in the reanalysis with the IOP data in the eastern China.

4. Summary

GAME reanalysis product ver. 1.1 will be released in this September. Parameters to be released are shown in Table 2. We will distribute these data by CD-ROM (2.5-degree horizontal distribution), 8-mm tapes and Internet. Web site of game reanalysis is

http://gain-hub.mri-jma.go.jp

Table1 Off-line data incorporated in GAME reanalysis

	Place	No. of Stations	Period (1998)
Sonde	HUBEX *1)	21	5 Jun, 1-23 Jul
	A-region*1) *2)	15	5 Jun-22 Jul
	TIPEX *1)	11	9 May-9 Aug
	Ozon-sonde	3	
	Watukosek		9,23,29,30 Sep, 6,7,23 Oct
	Kototabang		29,30 Sep, 2,5-7 Oct
	Pontianak		16,23,27,29,30 Sep, 2,6,7,9 Oct
	Myanmar *3)	1	1-31 Aug
	Okhotsuku *1)	1	8-25 Jul
Profiler	Bangkok *1)	1	4 Jan-27 Oct
	Indonesia *1)	2	
	Bukit		23 Aug-31 Oct
	Serpong		30 Jun-31 Oct
	India Gadanki *3) Profiler	1	14 May-24 Aug
	India Gadanki *3) MST radar	1	2-4,11,13-18,20,22,25,27-30 Apr
			1-4,6,8,9,12,13,15-20,22,23,26,27,29,30 Jun
			1-4,6-10,13-18,20-25,27,30,31 Jul
			3-5,7-8,10,11,18-22,25-31 Aug
			1,8,9,11,22,24,25 Sep
Airplane	Indonesia	1	21,24-27,29,30 Sep,2,6,7,9,10 Oct

*1) Sonde observation at 4 times a day
*2) The region between the Tibet and HUBEX target area
*3) Once or twice daily observation

Table 2 GAME reanalysis product ver.1.1 released in September 2000

	Analysis over the Asian region	Global analysis		Global physical monitor	
Region	30E-180, 30S-90N	Whole Globe (0-358.75, 90N-90S)	Whole globe (0-357.5, 90N-90S)	Whole globe (0-358.75, 90N-90S)	Whole globe (0-357.5, 90N-90S)
Horizontal resolution (in degree)	0.5 x 0.5	1.25 x 1.25	2.5 x 2.5	1.25 x 1.25	2.5 x 2.5
Media	8mm tapes	Anonymous ftp & 8 mm tapes	Anonymous ftp & CD-ROM	Anonymous ftp & 8 mm tapes	Anonymous ftp & CD-ROM
Period, Time resolution	April-October in 1998 4 times a day, 6 hourly				
Vertical levels	17 layers (1000 925 850 700 600 500 400 300 250 200 150 100 70 50 30 20 10 hPa) and the surface(the model bottom layer)			Two-dimensional physical monitor (at the surface or vertically integration)	
Quantities	Geopotential height, horizontal wind, temperature, specific humidity at the mandatory levels Pressure, horizontal wind, temperature, specific humidity the surface at the model bottom layer Sea level pressure			runoff, transpiration, interception, convective precipitation, large-scale precipitation, precipitable water(instant), vertically integrated water vapor flux and the divergence, latent and sensible heat flux at the surface, radiative flux at the surface and the top of the atmosphere (downward shortwave, upwards shortwave, downward longwave, upward longwave), total cloudiness, cloud radiative forcing (shortwave, longwave)	

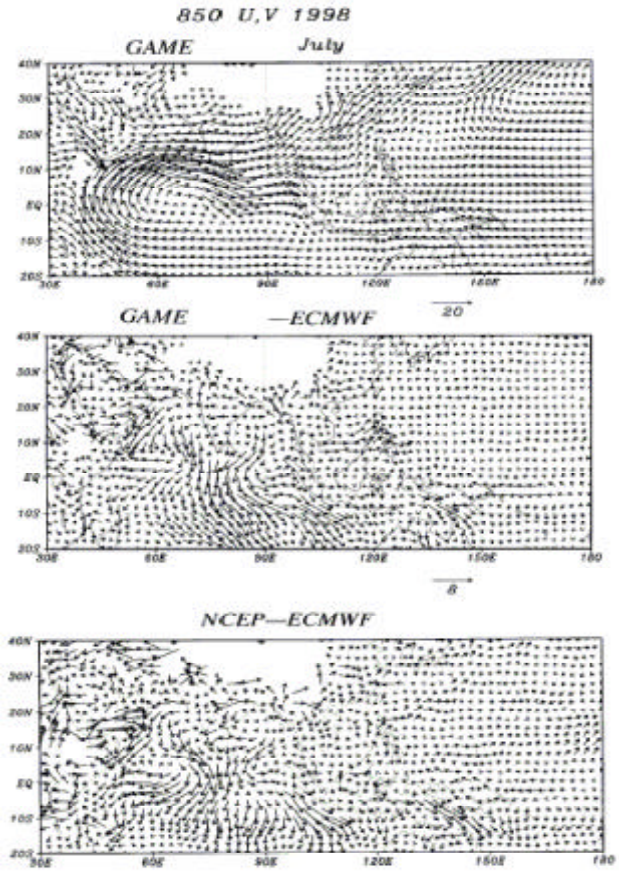

Fig. 1 Horizontal distribution of 850 hPa wind fields of GAME reanalysis (top), 850hPa wind difference of GAME reanalysis from ECMWF analysis (middle), and difference of NCEP analysis from GAME reanalysis (bottom), averaged over July 1998.

GAME-AAN: Current Status and Future Plan

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The main activities of GAME-AAN in year 2000 consist of (i) maintenance/improvement of deployed AWSs (Automatic Weather Station), (ii) on-going data acquisition/data quality check and preparation for the data archiving and distribution, and (iii) the planing of future activities.

As of summer of 2000, 15 AWSs are listed as GAME-AAN stations (see Fig. 1 and also AAN web site at http://www.suiri.tsukuba.ac.jp/Project/aan/aan.html). Among them, some stations have experienced technical problems for a continuous measurement. In order to remedy this and also to enhance the reliability of AWSs for a long term measurement for phase II (see below), a site visit and system improvement by a manufacturer's engineer was carried out in the spring of 2000. In addition, a backup data acquisition system has been implemented to some of the AWSs.

Even though the several problems exist, each station has provided us with new interesting observations and findings. They indicate wide variations of surface conditions over the GAME experiment areas, which were expected, but were not confirmed through actual data before. One clear result from these stations are on the role of soil wetness on the surface flux distribution and its variation through the season. Increase of the surface soil moisture, which for some regions comes from thawing of the frozen soil and for some regions is the results of the onset of the monsoon season, dramatically increases the latent heat fluxes while the sensible heat fluxes decreases accordingly (see Figs. 2a and 2b from the Mongolia station, for example). The timing at which such a change takes place is quite different from one area to another. A mapping of such

information over the continent, through the use of models and satellite data, should clearly be the next step to achieve our goals of the GAME-AAN project.

The data have been checked and processed for archiving at the AAN data center. Each station has four types of data set within the data center. They include (i) station documentation, (ii) data set documentation, (iii) data inventory and (iv) actual data set. At the moment, (i)-(iii) are available (see Fig. 3 for example) and are open to the public through the AAN web site. The actual data are distributed within the GAME community first, and will then be open to a wider scientific communities.

Besides the data archiving and station operations, there are other on-going activities for the future of the AAN project. One such activity is the proposal and preparation for the phase II activity of AAN. The phase II was originally planned to start in 2000 and was designated as the period for a long-term monitoring to determine mean, seasonal and annual variations of surface variables. This has again been proposed and approved at the GAME International Scientific Panel meeting held in June 2000. In short, the phase II should include such activities as the continued operation of AWSs and the data analysis to achieve scientific objectives of GAME-AAN. Currently, 10 AAN stations are planned to keep measurements for phase II (see Fig. 1). To enhance data analysis through discussions and collaborations among the GAME scientists, the first International GAME-AAN Scientific Workshop will be held on March 7-9 in Thailand. Presentations of initial results from AAN data sets are expected. However, since surface flux measurements involves not only wide ranges of science disciplines but also varieties of technological issues, presentations from outside of GAME-AAN project, which may have different objectives from those of AAN, are welcome for possible future collaborations and improvement of our knowledge on these issues.

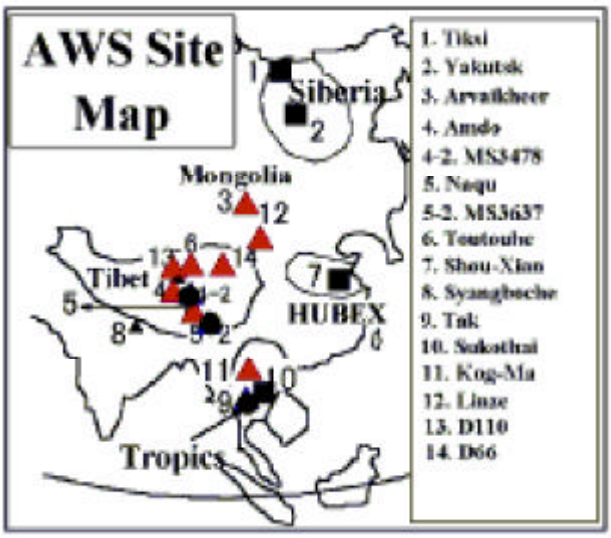

Fig. 1 A map showing the location of GAME-AAN flux stations currently in operation. Triangles indicate those stations expected to operate through phase II of GAME-AAN, while circles represent those that will operate only during phase I.

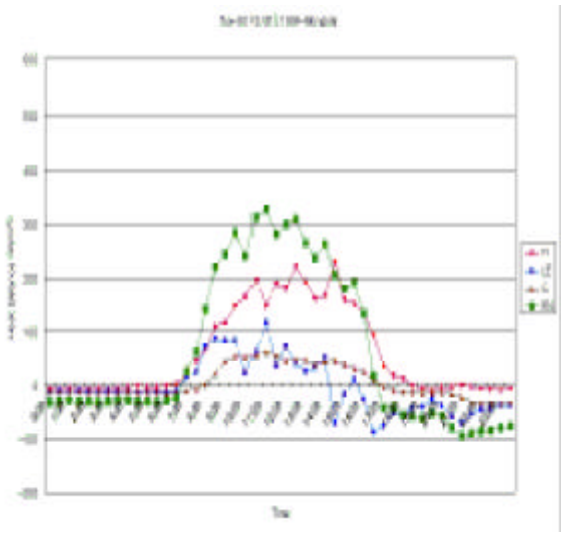

Fig. 2a An example of diurnal variation of energy balance components when the soil moisture is very low. (Early spring, when surface soil water content is around 5 %)

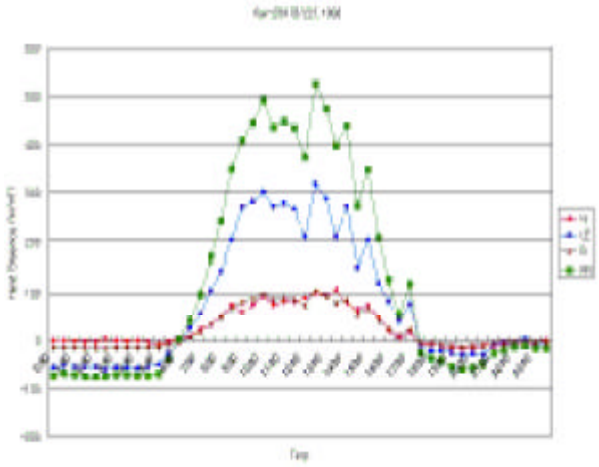

Fig. 2b Same as Fig. 2a but when there is plenty of soil moisture. (Summer, when surface soil water content is around 16 %)

Fig. 3 An example of the GAME-AAN data inventory list as seen on the AAN web site.

Current Status of GAIN (GAME Archive & Information Network)

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Nearly two years have passed since the GAME IOP, 1998 summer. GAME data basically became open to international research communities after June, 2000 according to the agreement in the GAME data management although some exceptional cases still remain.

In the GAME project, main mean for data provision is the on-line access via Internet, and each subproject group has its own responsibility in data provision. So most of subgroups started to operate ftp or web sites for data dissemination. Their functions and information they offered might seem to be insufficient. But such situation will be improved soon.

In the following we will introduce some topics concerning GAIN.

HUBEX group will start their data center web page in October, 2000. In the beginning, accessing HUBEX data will be restricted by user authentication with password. But such restriction will be loosened gradually in the near future.

GAME-Tibet also started their web page in this June. You can access data obtained through GAME-Tibet. In IOP other observational research programs were conducted in Tibetan region cooperatively with GAME-Tibet. Their data will also be open internationally one more year later.

Now GAME reanalysis project is being conducted under the cooperation of JMA/NWP, MRI, NASDA/EORC and University of Tsukuba. Experimental version (June-July, 1998) was already released only for the internal evaluation at the end of June, 2000. Release schedule of the formal version of reanalysis data is as follows.

First version of the formal reanalysis product will be released at the end of September, 2000, and then

the second version will be released in the next spring. Planned methods of data publication for reanalysis data are summarized in the following table.

You can get more detailed and the latest information including URLs for sub-groups' sites by accessing to the gain-hub (http://gain-hub.mri-jma.go.jp).

Table Distribution methods of reanalysis data

Resolution	2.5x2.5°	1.25x1.25°	0.5x0.5° (Asia only)
Data type	Analysis and physical monitor		Analysis only
CD-ROM	From gain-hub(MRI)		
On-line access	gain-hub page	IIS,Tokyo univ.(via gain-hub)	
8mm tape	From gain-hub(MRI)		

Current status of GAIN DAAC

DAAC	Data	Method & *Contact person*
Siberia	(1)Hydrological data (2)Surface meteorological data (3)Land-atmosphere boundary data in forest (4)Land-atmosphere boundary data in tundra	Anonymous ftp at Tsukuba and Nagoya universities etc. http://www.ihas.nagoya-u.ac.jp/game/siberia/(index.html, dataset1.html) (1),(2) *Rikte Suzuki (IGCR/FRSGC-Tsukuba)* *E-mail: suzuki@frontier.bosai.go.jp, Tel/Fax: +81-298-53-4400/51-9764* (3) *Takeshi Ohta (Iwate University)* *E-mail: takeshi@iwate-u.ac.jp, Tel(Fax): 019-621-6137* (4) *Y. Kodama (Inst. of Low Temperature/Univ. of Hokkaido)* *E-mail: kod@pop.lowtem.hokudai.ac.jp, Tel: 011-706-5509*
HUBEX	・Intensified radio-sonde observation data ・Regional-scale four dimensional assimilation data ・Conventional radar reflectivity data, raingauge data ・Doppler radar data.	All data will be provided through the internet, 4 & 8 mm tape (restricted) http://www.ihas.nagoya-u.ac.jp/game/GAME-HUBEX.html http://ruin.ihas.nagoya-u.ac.jp/data_center *Ding Yihui (National Climate Center, CMA) at Chinese side* *E-mail: yhding@public.bta.net.cn, Tel/fax: +86-10-6275-2903/1615* *Kazuhisa Tsuboki (IHAS, Nagoya University) at Japanese side* *E-mail: tsuboki@ihas.nagoya-u.ac.jp, Tel/Fax: +81-52-789-3493/3436*
4DDA	(1)Objective analysis data & 2-D physical monitor data (2)Reanalysis data for April-October,1998	(1)8 mm tape (from GAIN-Hub) *Ken-ichi Kuma, Toshikazu Nishio (Numerical Prediction Division, JMA)* *Kumaken@naps.kishou.go.jp, nishio@naps.kishou.go.jp* *Tel/Fax: 03-3212-8341(Ext.3315)/3211-8407* (2)8mm tape, CD-ROM, http://gain-hub.mri-jma.go.jp *Nobuo Yamazaki (Climate Res. Dept./MRI/JMA)* *E-mail nyamazak@mri-jma.go.jp, Tel/Fax: +81-298-53-8668/55-2683*
Satellite	・Snow water equivalent on the Eurasian continent derived from SSM/I ・Surface wetness on the Eurasian continent derived from SSM/I-every 5 days average	http://monsoon.t.u-tokyo.ac.jp/satellite/index.html Basically 8mm tape. *Toshio Koike (Univ. of Tokyo) E-mail: tkoike@hydra.t.u-tokyo.ac.jp*
Radiation	(1) one minute mean and sigma for short/long up/downward (2) radiation at Si-Samrong(Thailand) and Shou-Xian(China) (3) one minute mean profile of atmospheric extinction coefficient (/m) at Si-Samrong (Thailand)	ftp://atmos.cr.chiba-u.ac.jp/pub/gamc (1) *Tadahiro Hayasaka (Tohoku Univ.) E-mail: hayasaka@mail.cc.tohoku.ac.jp* (2) *Teruyuki Nakajima (CCSR/Univ. of Tokyo) E-mail: teruyuki@ccsr.u-tokyo.ac.jp* (3) *Nobuo Takeuchi (Chiba University) E-mail: takeuchi@cr.chiba-u.ac.jp*
AAN	Hydro-meteorological quantities from automatic weather stations at Tiksi, Yakutsk (Russia), Arvaikheer (Mongolia), Amdo, Naqu, Toutouhe, D66, D110, Linze-Dunhuang, Shou-Xian (China), Syangboche (Nepal), Tak, Sukhotai, KogMa (Thailand)	http://www.suiri.tsukuba.ac.jp/Project/aan/aan.html *Shin Miyazaki (University of Tsukuba) E-mail: shin@erc2.suiri.tsukuba.ac.jp* *Michiaki Sugita (University of Tsukuba) Email: sugita@atm.geo.tsukuba.ac.jp*
Kormex	・Upper-air soundings ・radar data ・Meteorological synoptic sfc data ・Buoy & aerological data(AMOS)	CD-ROM for KORMEX data, http://www.metri.re.kr/frlweb/kormex/english/index *Won-Tae Kwon, Seung-On Hwang (Meteorological Research Institute, KMA)* *E-mail: wontk@irts.metri.re.kr, hwangso@irts.metri.re.kr* *Tel/Fax: +82-2-846-2852/2853*

DAAC	Data	Method & *Contact person*
GAIN-Hub	・GAME Data Catalogue Information ・4DDA data (Objective analysis data & 2-D physical monitor data) ・Linkage to other DAAC for data provision	http://gain-hub.mri-jma.go.jp (GAIN Home Page) *Kiyotoshi Takahashi (MRI/JMA)* *E-mail: ktakaha@mri-jma.go.jp, Tel/Fax: +81-298-53-8670/55-2683* *5th Research Lab./Climate Research Dep./Meteorological Research Institute* *Nagamine 1-1, Tsukuba, Ibaraki 305-0052*
Tropics	Intensive Radio-sonde data	http://hydro.iis.u-tokyo.ac.jp/GAME-T/GAIN-T/sonde/ ftp://ftp.kurase.kyoto-u.ac.jp/pub/private/game-t/sonde (not yet available) *Akira Watanabe (Faculty of Education, Fukushima University)* *E-mail: may@ah2.educ.fukushima-u.ac.jp, Tel/Fax: +81-24-548-8203*
	Radar data at Chiang Mai, Phitsanulok, Khon Kaen	8mm/DLT, IIS, university of Tokyo *Taikan Oki (Institute of Industrial Science, University of Tokyo)* *E-mail: taikan@iis.u-tokyo.ac.jp, Tel/Fax: +81-3-3402-6231(ext.2528)/2597*
	Hydrological and meteorological routine data	http://hydro.iis.u-tokyo.ac.jp/~GAME-T/Data/hydro http://rdp.dpri.kyoto-u.ac.jp/hydrodata/thailand.html (not yet available) ftp://hydro.iis.u-tokyo.ac.jp/~GAME-T/Data/hydro (not yet available) *Shinjiro KANAE (Institute of Industrial Science, University of Tokyo)* *E-mail : kanae@iis.u-tokyo.ac.jp, Tel/Fax : +81-3-3402-6231(ext.2527)/2597*
	Micro meteorological observation data (a) Flux observation at sukhothai paddy field (b) Solar radiation at 11 TMD agrometeorological stations (c) Flux observation at kog-Ma (hill evergreen forest) (d) Flux observation at EGAT Tower (GAME-AAN/AWS,Flux-PAM data)	http://www.suiri.tsukuba.ac.jp/Project/aan/aan.html ftp://erc2.suiri.tsukuba.ac.jp/pub/GAIN/ 8mm/DLT, ERC., Tsukuba university Faculty of Agriculture, University of Tokyo, for SAT raw data *(a),(b) Masatoshi Aoki (Tokyo University of Agriculture and Technology)* *E-mail: aoki.mas@cc.tuat.ac.jp, Tel/Fax: +81-42-367-5727/6078* *(c) Masakazu Suzuki (School of Agricultural and Life Science, Univ. of Tokyo)* *E-mail:suzuki@fr.a.u-tokyo.ac.jp,Tel/Fax: +81-3-3812-2111(ext.5234)/5802-2930* *(d) Noba Ohte (School of Agricultural Sciences, Kyoto University)* *Tel/Fax: +81-75-753-6093/6088*
	・Satellite data ・GPS data at 5 stations in Thailand	8mm/DLT, IIS., university of Tokyo *Toshiyuki Nakaegawa (MRI/JMA)* *E-mail: tnakaegawa@mri-jma.go.jp, Tel/Fax: +81-298-53-8601/55-2552*
	Wind profile observed by KMITL wind profiler	http://www.crl.go.jp/ck/ck121/windprof/wp-data.html *Yuichi Ohno (Communication Research Laboratory)* *E-mail: ohno@crl.go.jp, Tel/Fax: +81-42-327-6946/6666*
	Rainfall measurement with 12 gauges in a mountainous river basin (Mae Chaem river basin)	*Koichiro Kuraji (Tokyo Institute of Technology)* *E-mail: kuraji@depe.titech.ac.jp, Tel/Fax: +81-45-924-5548/5519*
	Radio sonde observation at EGAT-Tower	ftp://erc2.suiri.tsukuba.ac.jp/pub/GAME-T/ *Michiaki Sugita (University of Tsukuba) E-mail: sugita@atm.geo.tsukuba.ac.jp*

DAAC	Data	Method & *Contact person*
GAME-Tibet	(1) Land-surface - atmosphere interaction a. 5 AWSs along the Tibetan highway b. 2 AWSs in the west (by JEXAM) c. PBL Tower at Amdo d. Turbulent flux measurement at Amdo and Korean sites e. Intensive radio-sonde observation at Amdo f. Barometer network (2) Precipitation and cloud studies a. 3-D Doppler radar: 4 months, 10 minutes interval b. Rain gauges c. Microwave radiometer at Naqu d. GPS at Amdo (3) Land surface monitoring by satellite RS Ground truth data (4) Cold region hydrology including permafrost study a. Soil moisture/temperature at the 8 sites along the Tibetan highway b. Evaporation c. Slope hydrology d. River discharge (5) Isotope Study on Precipitation and Surface Water Isotope sampling: precipitation, river water, soil water	CD-ROM (by the end of June, 1999) **http://monsoon.t.u-tokyo.ac.jp/tibet/index.html** *Toshio Koike (University of Tokyo.)* *E-mail: tkoike@hydra.t.u-tokyo.ac.jp*
TRMM (NASDA)	TRMM PR(2A25) for GAME IOP over the Asian monsoon region	**http://www.eorc.nasda.go.jp/TRMM/TSD/index.htm** *Riko Oki (EORC/NASDA), E-mail: trmmcont@eorc.nasda.go.jp*
India	* radio-sonde (Surface, rainfall, radiation, marine data)	FD, MT, Cartridge tape or from **GAIN-hub** *Dr. U.S.De (Additional Director General of Meteorology (Research), IMD)* *E-mail: imdpune@gn3.vsnl.net.in, Fax: 091 0212 323201*
China	(1) TIPEX Sonde observation PBL tower, etc. (2) HUBEX	CD-ROM HUBEX Data Center (1) *Xu Xiangde (CAMS, CMA)* (2) *Ding Yihui (National Climate Center, CMA)*

*Bold face indicates that the address is already available. As of September 19,2000

CEOP as a GAME Follow-on

Toshio Koike
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The Coordinated Enhanced Observing Period (CEOP) from July 2001 to September 2003, which is built as the foundations of the World Climate Research Programme (WCRP)/Global Energy and Water Cycle Experiment (GEWEX), seeks to provide an initial step for establishing an integrated global observing system for the water cycle which responds to both scientific requirements and societal needs. The connections between water and energy cycle variations are essential for understanding the global water and energy cycle and its connection with water resources. CEOP has as its guiding goal:

"To understand and model the influence of continental hydroclimate processes on the predictability of global atmospheric circulation and changes in water resources, with a particular focus on the heat source and sink regions that drive and modify the climate system and anomalies."

One of the key CEOP objectives is to make maximum use of the new generation satellites through a global-scale and comprehensive validation of the whole water and energy cycle. During this unique period, various new-generation satellites are scheduled to be available to monitor the entire water cycle from a local to the global scale by providing unpreceded enhancement of observing capabilities to quantify critical atmospheric, surface, hydrological and oceanographical data. Each space agency will implement sensor calibration and algorithm/product validation as its own responsibility. A CEOP validation task force is currently addressing validation from the point of view of the whole water and energy cycle.

The overall modeling objective is to advance our capabilities to simulate water and energy processes and to close water and energy budgets, over land areas and over associated ocean areas. Model transferability and predictability for water and energy fluxes and budgets over land areas will be assessed by better understanding of the response to and the role of land areas on the larger scale environment. A new set of local and regional data which covers global climate variation during coordinated period will be provided to regional and global modeling communities to evaluate global models over many diverse climate regions in order to understand the limitations of parameters.

A new framework based on the cooperation between GEWEX and the Climate Variability and Predictability (CLIVAR), which is one of the other WCRP projects, covers spatially and temporally wider climate issues. In particular, studies of monsoonal circulations, CLIVAR will join with efforts under GEWEX to address land-ocean-atmosphere interactions. In Asia, a coordinated research activity among the three spheres (atmosphere, hydrosphere and lithosphere), CEOP Asia-Australia Monsoon Project (CAMP), is now under planning as shown in Fig.1. The CAMP objectives are to understand the mechanisms of the intra-seasonal to interannual variations induced by the land-atmosphere-ocean interactions and to improve the accuracy of the seasonal prediction of monsoon rainfall. A science plan will be discussed by the CAMP working group which was established at the GAME International Science Panel meeting in June, 2000.

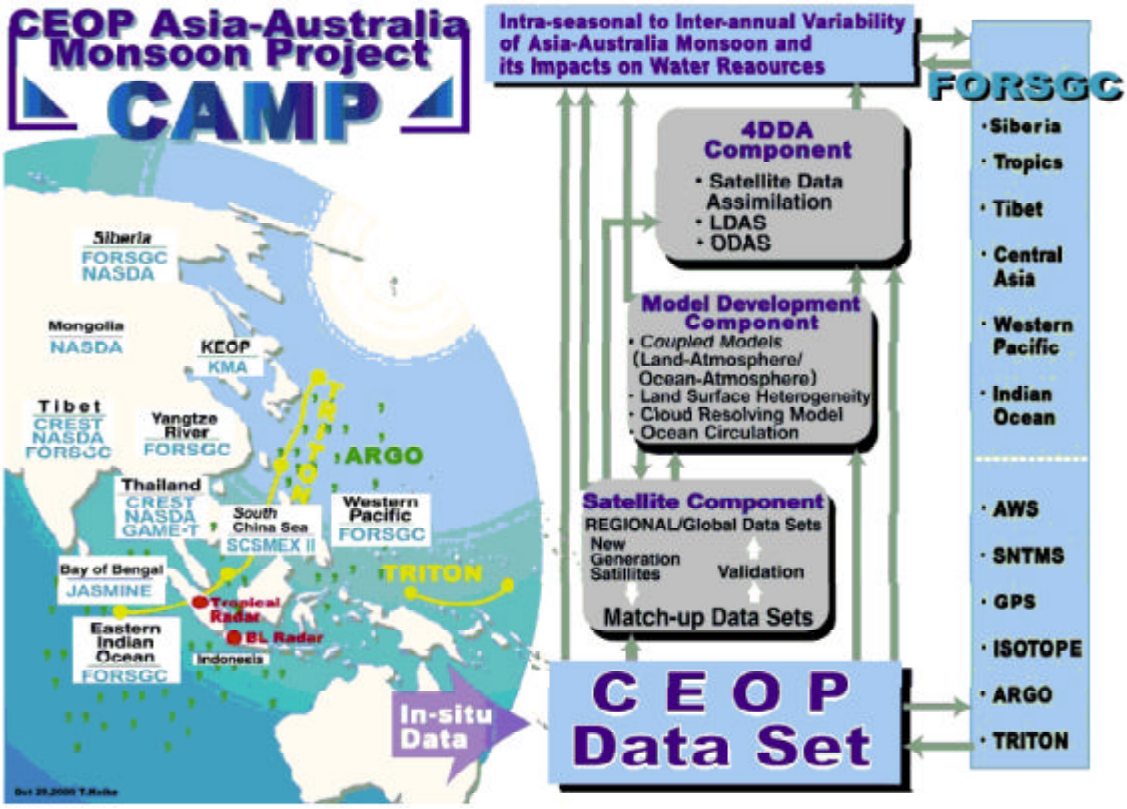

Fig. 1 Schematic diagram of CAMP (CEOP Asia-Australia Monsoon Project).

Attention!

The 5th International Study Conference on GEWEX in Asia and GAME will be held at Aichi Trade Center, Nagoya, Japan, in 3-5 October 2001. This conference will be organized by the GAME International Science Panel. Please notice important dates:

Deadline for the submission of abstract: **31 May, 2001**, Acceptance notice: **30 June, 2001**

Deadline for a paper of conference proceedings: **10 August, 2001**

Deadline for the early registration: **20 August, 2001**

Please visit the site, **http://www.ihas.nagoya-u.ac.jp/game/info/call4paper5thconf.html**

Summary of the 5th GAME International Sicence Panel Meeting

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The Fifth GAME International Science Panel (GISP) meeting was held for 26 and 27 June, 2000 at Seavans, Tokyo Japan with kind supports of the National Space Development Agency of Japan (NASDA), the Ministry of Education, Science, Sports and Culture (MESSC), the Frontier Research System for Global Change (FRSGC). Participants in GISP meeting were: one from Bangladesh, four from China, two from India, twenty-eight from Japan, four from Korea, two from Malaysia, two from Mongolia, one from Myanmar, one from Nepal, two from Russia, one from Singapore, one from Sri Lanka, eleven from Thailand, and two participants came from USA. Thus, total participants are sixty-two (GAME-ISP members are twenty-eight, observers/experts are thirty-four).

After the opening addresses from Prof. T. Yasunari, Chairperson of GISP, Dr. Y. Furuhama, Executive Director, NASDA and a congratulatory message from Mr. K. Yoshio, MESSC, the panel discussion started. First, current status of international activities closely related to GAME, such as GEWEX/GAME, WCRP and GHP were presented including an introduction of FRSGC activity and future plan. After those, current activities and results of each component of GAME were reported. In addition to them, GAME-related experiments such as KORMEX and SCSMEX, etc. were introduced. The activity reports continued until second day morning.

Generally speaking, each component of GAME did not have any serious problems, and many workshops are planned to be held, such as, GAME-HUBEX workshop in September 2000, and GAME-Siberia Workshop in March 2001. The data opening policy was reconfirmed and data will be opened to communities nearly on schedule. Data analyses of each component are going well and several interesting results have been shown, but we are not yet in the phase to link each analyzed results. Some issues have come out from the observation. One of them is the so-called imbalance problem in the surface flux measurement. This problem is crucial to understand the land-atmosphere interaction. Model studies and reanalysis data set including the GAME enhanced observations are essential, and they are now going on. It is, however, too early to obtain full results from the model studies and reanalysis data set. Thus, it is recognized that the main objectives of GAME below has not yet achieved.

A) to understand the role of Asian monsoon in the global energy and water cycle and
B) to improve the simulation and seasonal prediction of Asian monsoon and regional water resources.

Future of GAME was the biggest subject of this GISP. One big international Plan is CEOP (Coordinated Enhanced Observing Period)/CAMP (CEOP Asia Australia Monsoon Project). CEOP is a two or three year project based on the well-established Earth observing satellites, such as US's Aqua, Japan's ADEOS-II and French ENVISAT. Ocean component will also be included and CLIVAR will also support CEOP. CEOP observation will utilize the heritage of GEWEX projects including GAME. CAMP is the Asian and Australian part of CEOP. Everybody recognized that CEOP is a timely project and a good one as a GAME follow-on. However, the objective of CEOP is different from that of GAME, and it was agreed that GAME would support a part of CEOP which relates to GAME.

As a summary, GISP considered that:

1) According to the GAME Implementation Plan, the period of 1996-2001 is dedicated for data collections including IOP's.
2) The GAME was/would be well conducted,
3) The objective of GAME has not yet achieved, though many interesting observational results have come out,
4) CEOP which is for a study of the interannual varia-

tions of land-atmosphere-ocean interactions under a framework of GEWEX/GHP, in corporation with CLIVAR and CLIC has been proposed.

and, GISP recommended that:

1) GAME Phase II (2002-2003/4) should be started in 2002 after reviewing Phase I activities. The reviewing results will be reported in the next ISP in 2001,
2) GAME Phase II should be concentrate on deeper data analysis including modeling studies for the primary goal of GAME,
3) CEOP/CAMP working sub-committee under led by Prof. Koike GISP should be established.
4) The progress of GAME and its future plan including the initiation of CEOP/CAMP project 2001-2003 should be presented in the forthcoming WMO Regional Association II 12th session in 19th-27th Sep., 2000 at Soul, Korea.

Other business included:

1) The Fifth International Study Conference on GEWEX in Asia and GAME will be held in Nagoya, Japan in October 2001 along with the Sixth GAME International Science Panel meeting.
2) GISP memberships at least until 2001 were reconfirmed.
3) After confirming that every member has a good access to e-mail system, GISP mailing list (GAME-ISP e-mail service) was decided to be made.

GAME MEETINGS SCHEDULE

3-5 March 2001

2001 International Workshop on GAME-T in Thailand, Phuket, Thailand. The 1st Circular will be avaliable on http://hydro.iis.u-tokyo.ac.jp/GAME-T from the middle of November 2000. Contact: Dr. S. Kanae: kanae@iis.u-tokyo.ac.jp

7-9 March 2001

International Workshop on GAME-AAN (Asian Automatic Weather Station (AWS) Network)/Radiation, Phuket, Thailand. The 1st Circular is also now available at http://erc2.suiri.tsukuba.ac.jp/Project/aan/aan.html. Contact: Dr. S. Miyazaki: shin @erc2.suiri.tsukuba.ac.jp

15-16 March 2001

The 3rd International Workshop on Energy and Water Cycle in GAME-Siberia, Fronteir Research System for Global Change, Tokyo, Japan. Contact: Prof. T. Ohata, ohata@pop. lowtem. hokudai.ac.jp

1-2 October 2001

The 6th GAME International Science Panel meeting, Aichi Trade Center, Nagoya, Japan. Contact: GAME International Project Office, gio@ihas.nagoya-u.ac.jp

3-5 October 2001

The 5th International Study Conference on GEWEX in Asia and GAME, Aichi Trade Center, Nagoya, Japan. Contact: GAME International Project Office, gio@ihas.nagoya-u.ac.jp

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