FINAL REPORT for APN PROJECT
CBA2009-01CMY-Ailikun

APN
Asia-Pacific Network for Global Change Research
CAPaBLE

- Making a Difference –

Scientific Capacity Building & Enhancement for Sustainable Development in Developing Countries

The Capacity Building for Drought Monitoring and Studying in Monsoon Asia under the Framework of Asian Water Cycle Initiative (AWCI)

The following collaborators worked on this project:

Ailikun, Chinese Academy of Sciences, China, aili@mairs-essp.org

Toshio Koike, University of Tokyo, Japan, tkoike@hydra.t.u-tokyo.ac.jp

Davva Gombo, Institute of Meteorology and Hydrology, Mongolia, watersect@yahoo.com

M. RAHMAN, Bangladesh University of Engineering and Technology, Bangladesh, mafiz@agni.com

Ichirow Kaihotsu, Hiroshima University, Japan, kaihotu@hiroshima-u.ac.jp

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THE UNIVERSITY OF TOKYO

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Project Reference Number: CBA2009-01CMY-Ailikun
Final Report submitted to APN

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OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

Drought is a "creeping" hazard because droughts develop slowly and have a prolonged existence. Drought produces a complex web of impacts, which spans many sectors of the economy, especially agriculture, energy production, transportation, tourism and recreation, forest and wildland fires, urban water supply, environment and human health. There is an urgent need to create greater development of a drought monitoring and research system. Release of Satellite products provides great chance for scientists to improve the techniques and knowledge of drought study. Drought, related to the water issue in GEOSS implementing plan, is getting more and more concern from the publics and policy maker. Under the strong request of drought study and monitoring from various countries in Asia, Prof. Toshio KOIKE from University of Tokyo, promoted 3 capacity building groups under AWCI/GEOSS framework, which was drought, flood and water quality in 2008.

Through this APN project, we have set up the "AWCI drought monitoring and research working group", which includes scientists from 10 countries in Asia, and we have also built the scientific supporting team to provide advices on retrieval of remote sensing data and ground validation. We have collected the ground observation data related to drought monitoring from Mongolia, China, Bangladesh, Pakistan and Vietnam. And AMSR-E soil moisture products (from JAXA and NASA) are provided to the group members for ground validation and drought index studies. To finish the research targets in for this project, we have hosted 5 drought workgroup meetings and 1 training workshop from 2008 to 2010.

Objectives

The main objectives of the project were:

1. to set up a drought monitoring and researching network in related Asian countries;
2. to share and improve the drought monitoring capability in various Asian countries;
3. to collaborate with other disaster monitoring groups in AWCI, such as flood, water quality and GLOF (Glacial lake outburst flood);
4. to help developing the early warning system of drought hazard in related countries.

Amount received and number years supported

The Grant awarded to this project was:
US$ 39,943 for Year 1 2008/2009
US$ 37,500 for Year 2 2009/2010

Activity undertaken

Research activity:

1) We have set up the "AWCI drought monitoring and research working group", which includes about 15 participants from 10 countries in Asia.
2) We have built the scientific supporting team includes 5 scientists to provide advices on the algorithms and validation of soil moisture products retrieval from remote sensing datasets.
3) We already collected the ground observation data from Mongolia, China, Bangladesh, Pakistan and Vietnam for the year 2006-2007. Both of AMSR-E products from JAXA and NASA are used in retrieval of soil moisture and drought indices in the related countries.
4) University of Tokyo and JAXA provided the AMSR-E soil moisture products for the key areas for ground validation and long-term drought monitoring
5) We are preparing to publish a working group paper on: "Drought in Asia: monitoring and research"

Meetings and training (2008-2010):

1) The 1st drought group workshop was held in 6-8 Nov 2008 in Beijing, jointly with AWCI/GEOSS meeting. Drought working group and scientific supporting team have been built in 2008.

2) The 2nd drought working group meeting was held in Feb 2009 in Kyoto, Japan jointly with AWCI/GEOSS workshop
3) The 3rd drought group meeting was taken place in 15-16 May 2009 in Bangkok, hosted by START-Southeast Asia regional center. There were about 20 participants joined the workshop.
4) The 4th drought group meeting was in 1-3 October in 2009 in Chiang Mai hosted by Chiang Mai University. There were about 15 scientists joined this meeting
5) The 5th drought group meeting was held in 15-16 Dec 2009 in the university of Tokyo jointly with AWCI/GEOSS meeting.
6) Under the strong and main support of this project, the APN-AWCI joint training workshop was taken place in Tokyo in 17-18 Dec 2009 right after the AWCI workshop. This training course is under the strong support of JAXA (Japan Aerospace Exploration Agency), University of Tokyo (UT), Hiroshima University (HU) and Monsoon Asia Integrated Regional Study (MAIRS). About 40 participants (trainees) attended this training workshop. Trainers from JAXA, UT, HU, Chinese Academy of Sciences and Asian Institute of Technology (AIT) introduced about the missions of AMSR-E, ALOS (Daichi), Fengyun meteorological satellites, and their applications on drought and other kinds of disaster monitoring.

Results

1) From the launching of this APN project in 2008, 5 scientific workshops and 1 training workshop have been held, and all these meetings were financially supported by this APN project. 3 of them were joint workshops with AWCI/GEOSS, and 2 were independent drought group meetings, mainly discussing about the methodologies of retrieval of soil moisture products and the preparation of training workshop.
2) We have set up the "AWCI drought monitoring and research working group", which includes about 15 participant members from 10 countries in Asia, and we have built the scientific supporting team includes 5 scientists to provide advices on the algorithms and validation of soil moisture products retrieval from remote sensing datasets.
3) Through this APN project, we have already collected the ground observation datasets from China, Pakistan, Mongolia, Bangladesh and Vietnam for the year of 2006-2007. The ground observation data provided by now includes the air temperature, pressure relative, humidity, precipitation (4 times/day or daily), and soil temperature, soil moisture (according to observation).
4) The AMSR-E soil moisture products from NASA and JAXA were both tested by scientific group members. The validation with ground observations already has been done by each group from Japan, China and Thailand.

Relevance to APN's Science Agenda and objectives

Drought is a crosscutting issue which basically covers the sciences in metrology, hydrology, agriculture and water management. In many Asian counties, like Pakistan, China, Bangladesh, Vietnam and Thailand, no matter in arid or humid climate, drought is one of the most serious natural disasters that influence the social economic activities much. Drought, related to the water issue in GEOSS implementing plan, is getting more and more concern from the publics and policy makers.

This project is trying to build a network on drought monitoring and drought study in Asian countries by collecting the ground observation data sets and remote sensing products. This kind of activity will help exchanging the information on drought study and improve the capacity of drought monitoring by using latest remote sensing technology. Release of satellite products and training of the using of these products have provided great chances for scientists to improve the techniques and knowledge of drought monitoring and drought study.

Self evaluation

We already set up the drought monitoring working group and regional network in Asia, which includes about 10 countries and 15 members. The scientific supporting team also works together well. We have finished collecting the in-situ soil moisture and other metrological data sets in related countries (China, Pakistan, Mongolia and Vietnam) in 2006-2007, and we got the high resolution AMSR-E soil

moisture products which were provided by JAXA/University of Tokyo and NASA. By collaborating with Tokyo University, JAXA, Chinese Academy of Sciences and Hiroshima University, we have successfully hosted the training workshop in the end of 2009 in Tokyo.

Potential for further work

The future activity of this APN project on "drought research and monitoring in Asia" will be connected to another APN project, led by Prof. Ichiro Kaihotsu of Horoshima University, Japan, which named :" Drought monitoring system development by integrating in-situ data, satellite data and numerical model output". In this new project, we will continue improve the drought monitoring capacity and maintain the AWCI drought working group. The modeling activity will be strengthened in future after we get full establishment on human network and data resources.

Publications

Preparing to publish a working group paper on: "Drought in Asia: monitoring and research"
Lead authors: I. Kaihotsu (Horoshima University, Japan)
Jun WEN (Cold and Arid Regions Environment and Engineering Research Institute, CAS)
Jie WEI (Institute of Atmospheric Physics, CAS)
Ailikun (Institute of Atmospheric Physics, CAS)
R.B Singh (New Delhi University, India)
Rasul Ghulam (Pakistan Meteorological Department, Pakistan)
Duong Van Khanh, National Hydro-meteorological Services of MONRE VIETNAM
Davva Gombo, Institute of Meteorology and Hydrology
M. RAHMAN, Bangladesh University of Engineering and Technology

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Acknowledgments

Thanks to all the drought working group members for their good collaboration. Thanks to START Southeast Asia regional center and Chiang Mai University for their nice host of APN meetings. Special thanks to Dr. Chu ISHIDA, Dr. Takeo TADONO and Dr. Keiji IMAOKA from JAXA, Dr. Qiang FENG for CEODE-CAS (Center of Earth Observation and Digital Earth, Chinese Academy of Sciences), for their great contribution to APN-AWCI joint training workshop.

Preface

Drought is a crosscutting issue which basically covers the sciences in metrology, hydrology, agriculture and water management. There is an urgent need to create greater development of a drought monitoring and research system. Release of Satellite products provides great chance for scientists to improve the techniques and knowledge of drought study. Drought, related to the water issue in GEOSS implementing plan, is getting more and more concern from the publics and policy maker. Under the strong request of drought study and monitoring from various countries in Asia, the GEOSS/Asian Water Cycle Initiative (AWCI) led by Prof. Toshio KOIKE from University of Tokyo, promoted 3 capacity building groups under AWCI/GEOSS framework, which was drought, flood and water quality in 2008. This project is to build a network on drought monitoring and drought study in Asian region by using the satellite and ground observation.

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1. Introduction of Asian Water Cycle Initiative of GEOSS

1.1 Asian Water Cycle Initiative (AWCI) under Global Earth Observation System of Systems (GEOSS) framework

More than 60 percentages of the world population live in Asia associated with the rapid economic growth. The Asian monsoon, which is the largest water circulation system in the world, provides substantial water resources which supports to the food production, energy generation and even transportation in Asia, and causes serious water related problems due to the large seasonal and inter-annual variability of the monsoon rainfall.

Excessive water use also affects the water quality and ecosystem. Especially, severe health effects have been observed in populations drinking arsenic-rich water over long periods in some of Asian countries, including Bangladesh, China, India, and Thailand. Over the last decade, it has been recognized that healthy aquatic ecosystems provide tangible economic and social benefits. It is important to understand the drivers and status of ecosystem degradation and the need for watershed restoration in order to improve water productivity across the Asia.

The global warming is changing the water cycle. Heavier rainfall events and larger interannual variations are predicted to be likely to happen according to the “radiative-convective equilibrium”. Global warming is considered to make considerable impacts on such a vulnerable region, Asia, where the percentage of completion of river developments is still critically low compared to the high potential water-related hazards.

GEOSS/AWCI promotes observation convergence by making seamless access to the data from earth observation satellites, in-situ reference site networks, and operational observation systems, integrates the observed data, numerical weather prediction model outputs, geographical information, and socio-economic data, and disseminates usable information for sound decision making of water resources management against flood and landslide, drought and water scarcity, water pollution and ecosystem degradation, and impacts of the climate change on water.

GEOSS/AWCI enforces capacity for a broader community to generate, interpret and utilize value-added products from the observations, beyond training of qualified technical personnel to operate the observing instruments, by coordinating requests from participating countries and potential capabilities of supporting organizations and on-going and/or planed projects.

1.2 GEOSS/AWCI History and Development

At the 1st Asian Water Cycle Symposium (AWCS) in Tokyo, November, 2005, the participants recognized the common water-related issues and socio-economic needs as described above. They shared ideas on the large natural variation of the Asian monsoon and the big impacts of the human activities in Asia as their backgrounds. To address these issues, they considered that well coordinated scientific and operational challenges and efforts should be launched by making maximum use of the GEOSS, which is leading convergence and harmonization of observation activities, interoperability arrangements, and effective and comprehensive data management. Then, they agreed to establish a basic plan for “Asian Water Cycle Initiative (AWCI) contributing to GEOSS” and to organize an International Task Team (ITT) for drafting an implementation plan for demonstration projects.

Based on the discussions at the first ITT meeting and the International Workshop on Capacity Building "Earth Observations in the service of Water Management", both held in Bangkok in September 2006, a baseline implementation plan for the GEOSS/AWCI demonstration projects was proposed at the 2nd AWCS in Tokyo, in January 2007. The symposium fully approved the baseline idea and established the International Coordination Group (ICG) consisting of the national representatives and the working group co-chairs for promoting the cooperative activities.

The 1st ICG was held in Bali, in September 2007. The update of each country activity was reported and the contents and procedure of the demonstration project implementation plan were discussed, following the confirmation of the baseline implementation plan.

1.3 GEOSS/AWCI Capacity Development Framework

The goal of the capacity development program of the GEOSS/AWCI is to facilitate and develop sustainable mechanisms for the countries in Asia Pacific to use advanced earth observations systems, associated data and tools for water cycle research and water resources management under GEOSS framework.

The specific objectives of the program are to develop capacities of the Asian countries for;

1) Downscaling regional and global information to basin scale and to improve accuracy required by operational water management applications through a combination of numerical forecasting and fusion of local observations.
2) Identify reliable and efficient tools to convert the available observations and data to useful information for flood management through data transformations, interpolation, classification and estimation algorithms.
3) Conversion of information to water resources management applications, both for operational use and scenario based assessments for planning purposes.

Target groups

The program recognizes three main target groups as;

- Researchers / Scientists where the emphasize is customizing existing knowledge to suit local conditions supported by global experiences
- Professional / Practitioners which focuses on introducing new methodologies, tools and standards
- Administrative/Local governments officials to provide an over view of technology and science
- Different capacity development tools and programs will be combined to reflect the relevant emphasize and coverage for each target group.

2. GEOSS/AWCI drought working group

Explain how you carried out the project, which should follow logically from the aims. Depending on the kind of data, this section may contain subsections on experimental details, materials used, data collection/sources, analytical or statistical techniques employed, study field areas, etc. Provide sufficient detail for a technical/scientific audience to appreciate what you did. Include flowcharts, maps or tables if they aid clarity or brevity.

2.1 Importance of drought study and drought monitoring

Drought is a “Creeping” hazard because droughts develop slowly and have a prolonged existence. Drought produces a complex web of impacts, which spans many sectors of the economy, especially agriculture, energy production, transportation, tourism and recreation, forest and wildland fires, urban water supply, environment and human health. There is an urgent need to create greater development of a drought monitoring and assessment system. Release of Satellite products provides great chance for scientists to improve the techniques and knowledge of drought study. Drought, related to the water issue in GEOSS implementing plan, is getting more and more concern from the publics and policy maker

The drought study is mainly based on the observation of precipitation, temperature and soil moisture by now, such as various drought index and moisture index. The satellite products have not been widely used since lack of capacity building in many Asian countries. Under the support of JAXA and Tokyo University, the retrieved soil moisture dataset from satellite remote sensing products will be used in

these projects, and the related countries collaborators will validate this data set by using the in-situ observation of soil moisture, precipitation and temperature. The GEOSS/AWCI will be in charge of coordinate this regional activity, along with the other groups.

2.2 AWCI drought capacity building working group

GEOSS/AWCI organizes three working groups in 2008; flood, drought, and water quality. After 2009, another 2 groups "climate change" and "glacier melting" were established. Each WG covers both of "observation convergence, data integration, information sharing" and "capacity building" and address to the demonstration river basins in a strategic way.

GEOSS/AWCI is collaborating among 18 Asian countries in sharing the ground observational data, and trying to support the information exchange and improve the technology of drought monitoring and studying among these Asian countries. The main objectives of this project are:

1. To share and improve the drought monitoring capability in various Asian countries such as China, Pakistan, Thailand, Nepal and Philippines
2. To set up a drought monitoring and research network in related Asian countries.
3. To collaborate with other disaster monitoring groups in AWCI, such as flood, water quality and GLOF (Glacial lake outburst flood);
4. To help developing the early warning system of drought hazard in related countries.

2.3 State of art methodology of drought monitoring and drought study

Drought indices are wildly used in monitoring and studying the drought, such as Standardized Precipitation Index (SPI), Palmer Drought Severity Index (PDSI), Crop Moisture Index (CMI), Surface Water Supply Index (SWSI). These indices mainly based on the ground observations of precipitation, temperature and soil moisture. But the standards of definition of these indices are differed from countries and regions. In addition, the capability of monitoring the drought are various according to the spatial and temporal resolution of observation stations in different countries and regions.

Because of the complex of soil type, ground water deposit. irrigation and vegetation type in the area, soil moisture will be a key indicator of drought monitoring besides precipitation and temperature in this project. JAXA (Japan Space Agency) and University of Tokyo will help developing a set of soil moisture dataset in specific region we are interested in for related countries. Optical and microwave remote sensing datasets will be used in this project. In many studies, microwave products have many advantages in bare surface, especially in dry area. Optical products, such as NDVI and LAI are usually used for full cover vegetation area to understand the vegetation and soil processes. For partly vegetation cover area, optical and microwave products will be both used in getting the high resolution soil moisture data. The University of Tokyo and JAXA will lead in retrieving the remote sensing data. The Asian Institute of Technology, Thailand, proposed a drought index called Temperature Vegetation Dryness Index (TVDI) is calculated from satellite derived vegetation index (NDVI) and surface temperature, TVDI index will be used to monitor the drought in various countries of Asia

The participants from related Asian countries in GEOSS/AWCI will provide the ground observation dataset of temperature, precipitation and soil moisture et al. For example, Shanxi province of China is chosen as the typical research area for drought monitoring in China. Shanxi is a typical semi-arid region with average precipitation about 500mm per year, and it is influenced by drought hazard severely under the global warming and human activity (carbon emission and intensive agriculture). The summer precipitation decreased about 15% in last thirty years, There are 108 observing stations in whole area of Shanxi (150,000KM2). The meteorological observations (T,P,W,P etc) are four times per day. The soil temperature and moisture observation are taken place per ten days, and 32 stations among 108 are having soil observations per five days. We could find the dry areas are not always matches the low precipitation, the monitoring of drought severity will be more accurate if we include the information of soil moisture and temperature. It may related to other factors like topography and irrigation. Under the

framework of GEOSS/AWCI, we will choose other typical areas in Mongolia, Pakistan and Bangladesh.

2.4 Development of Drought working group in Asia

The setting of AWCI drought working group was first discussed in September 2007 in AWCS Bali workshop. The nominated members came from AWCI 18 members countries, the scientists from Japan, China, Mongolia, Pakistan, India, Nepal, Thailand, Philippines, Bangladesh and Vietnam showed big interests to be involved in this group. The membership was confirmed when this APN project was approved in the Spring the 2008. The basic members of drought working groups were:

1. Dr. I. Kaihotsu, Hiroshima University, Japan
2. Dr. Ailikun, Institute of Atmospheric Sciences, Chinese Academy of Sciences, China
3. Dr. Azzaya Dolgorsuren, Institute of Meteorology and Hydrology, Mongolia (2007-2009)
4. Dr. Gombo Dava, Institute of Meteorology and Hydrology (2009-)
5. Dr. Bashir Ahmad, National Agricultural research Center, Pakistan (2007-2009)
6. Dr. Rasul Ghulam, Pakistan Meteorological Department (2009-)
7. Dr. Madan Shrestha, Nepal Academy of Science and Technology, Nepal
8. Dr. Lai Samarakoon, Asian Institute of Technology, Thailand
9. Dr. Orn-uma Polpanich, Asian Institute of Technology, Thailand
10. Dr. Deg-hyo Bae: Sejong University, Korea
11. Dr. Flaviana Hilario, Philippine Atmospheric, Geophysical and Astronomical Services Administration, Philippines
12. Dr. Duong Van Khanh, National Hydro-meteorological Services of MONRE VIETNAM, Vietnam
13. Dr. M. RAHMAN, Bangladesh University of Engineering and Technology, Bangladesh
14. Dr. Jun WEN, Cold and Arid Regions Environment and Engineering Research Institute, Chinese Academy of Sciences, China
15. Dr. Jie WEI, Institute of Atmospheric Sciences, Chinese Academy of Sciences, China
16. Dr. Toshio Koike, University of Tokyo, Japan
17. Dr. Irina DERGACHEVA, Hydrometeorological Research Institute (NIGMI) of Uzhydromet, Uzbekistan

From 2007-2009, Dr. Ailikun from China and Dr. Azzaya from Mongolia were the co-chairs of AWCI drought working group. From 2010, Dr. Kaihotsu from Japan and Dr. Rasul Ghulam from Pakistan are the co-chairs of this group. In the same time, we also developed the scientific supporting team, The purposes of the scientific supporting team are as follows:

- ✓ To discuss and choose what kinds of RS data set can be used in the retrieval of the soil moisture, and they will give advices on the algorithms and methodology to the participant members from each county with scoping for the research improvement.
- ✓ To provide and share the soil moisture and other meteorological data of the ground-based and satellite monitoring
- ✓ To analyze the obtained soil moisture and other data from view points of drought study in climate change for supporting the demonstration projects.
- ✓ To review demonstration projects about climate change to step in their adaptation activities and organize a scientific supporting team
- ✓ To show the definitions of drought and provision of drought monitoring indices softwares
- ✓ To provide numerical model products
- ✓ To present a trial early warning system of drought hazard in related countries and numerical model products for drought assessment, climate change and forecasting.

The members of scientific supporting team are:

1) Dr. I. Kaihotsu, Hiroshima University, Japan (kaihotu@hiroshima-u.ac.jp)
2) Dr. Jun WEN, Cold and Arid Regions Environment and Engineering Research Institute, Chinese Academy of Sciences, China (jwen@lzb.ac.cn)
3) Dr. Lal Samarakoon, Asian Institute of Technology, Thailand (lal@ait.ac.th)

4) Dr. Rasul Ghulam , Pakistan Meteorological Department, Pakistan (grmet@yahoo.com, rasulpmd@gmail.com)
5) Dr. Toshio Koike, University of Tokyo (email:tkoike@hydra.t.u-tokyo.ac.jp)

2.5 Collecting of ground observation data and remote sending products from related countries

Soil moisture is an important variable in the climate system. Understanding and predicting variations of surface temperature, drought, and flood depend critically on knowledge of soil moisture variations, as do impacts of climate change and weather forecasting. The observational data set of actual in situ measurements is crucial for drought monitoring, climate analysis, for model development and evaluation, and as ground truth for remote sensing.

In this project, we collected the soil moisture, soil temperature, high resolution metrological data and remote sensing products in related countries like Mongolia, China, Pakistan and Bangladesh.

2.5.1 Soil Moisture/Soil Temperature data

- ✓ Mongolia/Japan: CEOP reference site in Mongolia: 3 stations at Mandalgobi, Deren, Bayantsaagan since 2001, A half hourly and/or hourly automatic measurement in cooperation with Institute of Meteorology and Hydrology, Mongolia
- ✓ China: Shanxi Province, 108 stations, Meteorology and Soil Temp data, SM per 10 days, 3 lays
- ✓ Pakistan: Soil moisture data available only for 4 stations (Rawalpindi, Faisalabad, Tandojam and Quetta), SM per 10 days, about 10 layers
- ✓ Bangladesh: 9 soil moisture stations, SM per 7days, 5 layers
- ✓ Vietnam: Binh Thuan Province: (10034'13"N - 11037'30"N,107023'30" E- 108052'30"E) 3 Surface Stations (Phan Thiet: 11056' - 108006', Phú Quý: 10036' - 108056', La Gi: 10040' - 107046'); P, T, R, RH, 4 times/day; 1 Soil Temp station (Phan Thiet), 4 times/day; no soil moisture

2.5.2 Metrological observing data

- ✓ air temperature: daily
- ✓ pressure: daily
- ✓ precipitation: daily
- ✓ relative humidity: daily

2.5.3 Remote sensing products of soil moisture

AMSR-E Soil Moisture products from JAXA and NASA are used, Prof. Koike and Prof. Kaihotsu are coordinating to provide the JAXA AMSR-E soil moisture products (2003-2009)

2.5.4 Data duration needed for retrieval and validation

Jan 2006-Dec 2007 for ground observation. Jan 2003-Dec 2009 for AMSR-E soil moisture

2.6 Drought monitoring and drought indices

Drought monitoring is usually taken place by direct measurements; using drought Indices; remote sensing; modeling and combination of above methods. The direct measurement can come from the observation of reservoir storage, Streamflows, soil moisture and Groundwater. The common used methods for monitoring the drought are drought indices. On the other hand, as the development of satellite technology, remote sensing and modeling of soil moisture are drawing more and more attention.

Natural drought is mainly separated into 3 types: metrological drought, hydrological drought, agriculture drought. The main indices of meteorological drought Indices are: precipitation anomalies; Deciles of Precipitation (DI); Percentage of precipitation anomalies (PI); Palmer Drought Severity Index (PDSI); Drought Area Index (DAI); Rainfall Anomaly Index (RAI); Standardized Precipitation Index (SPI). Among all these indices, SPI and PDSI are most popular in operational level.

The SPI (Standardized Precipitation Index) is an index based on the probability of precipitation for any time scale, developed by T.B. McKee et al. 1993. The SPI is a relatively new drought index based only on precipitation. The SPI can be used to monitor conditions on a variety of time scales. This temporal flexibility allows the SPI to be useful in both short-term agricultural and long-term hydrological applications.

The Palmer Drought Severity Index - PDSI (Palmer, 1965) is a soil moisture algorithm, which uses: precipitation data; temperature data; local Available Water Content (AWC) of the soil. The merit of PDSI is the calculations result in an index, which indicates standardized moisture conditions and allows comparisons to be made between locations and months (K weighting factor); Palmer Index is a comprehensive drought index. The demerit of PDSI is the values of AWC are not always available; Palmer values may lag emerging droughts by several months; Sensitive to the AWC of a soil type; It is calibrated for regions relatively homogeneous and is less well-suited for mountainous land or areas with frequent climatic extremes.

The PDSI index is not particularly suitable for droughts associated with water management systems, because they exclude water storage, snowfall, and other supplies. Human impacts on the water balance, such as irrigation, are also not considered.

The Fig. 1 shows the time series of PDSI (blue line), precipitation anomaly (Green Bar) and temperature (red line) in 2004-2009 in Taiyuan Station of Shanxi Province, China It is very clear that the PDSI index is coherent with precipitation significantly, less rain results in drought and more rain in humid PDSI. The sever drought condition is usually the combined impact of high temperature and less precipitation (by Jie WEI).

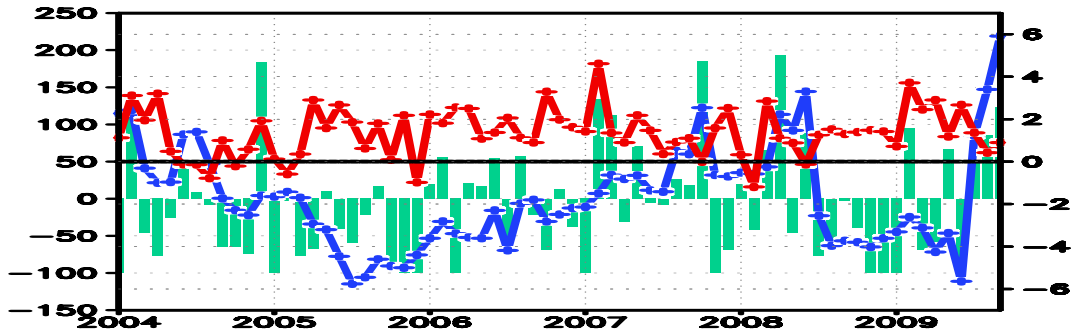

Fig. 1 show the time series of PDSI (blue line), precipitation anomaly (Green Bar) and temperature (red line) in 2004-2009 in Taiyuan Station of Shanxi Province, China

2.7 The validated AMSR-E microwave products of soil moisture (JAXA AMSR-E SM ver5)

Soil moisture remote sensing is fraught with challenges. Microwave remote sensing using satellites is an effective method for collecting global information on land surface hydrology. The moisture in the top few centimeters of soil can be detected. Algorithm development is complicated by the need for surface roughness and vegetation corrections, which are based on empirical relationships of limited breadth. Extending ground-based techniques to space-based systems requires innovative antenna technology. In spite of these challenges, recent advances in aperture synthesis and thinned array technology applied at L band have shown great promise for soil moisture mapping. Scientists that the Global Hydrology and Climate Center have been involved in experiments to address some the challenges we face in developing this technology.

The advanced Microwave Scanning Radiometers for the Earth Observing System (AMSR-E) was

developed in 2002 by National Space Development Agency of Japan (NASDA), now the JAXA. AMSR-E was launched on the Aqua satellite of NASA. The AMSR-E uses a frequency range of 6.9 to 89.0 GHz, giving a spatial resolution that varies from 70KM to 6KM. In order to estimate soil moisture by AMSR-E, it is indispensable that an algorithm be established for soil moisture observation. JAXA EORC has become the standard product for soil moisture data for AMSR-E since 2003. The quality of the soil moisture product has a significant limitation of the standard algorithm.

The validation of AMSR-E soil moisture products was taken place in Mongolia in 2000,2001 and 2007 by CEOP (Coordinated Enhanced Observation Period, now Coordinated Energy and water Cycle Observations Project), AMPEX (ADEOS-II) Mongolian Plateau Experiment for ground truth) MAVEX (Mongol AMSR/AMSR-E/ALOS validation Experiment). As shown in Fig 1, The study area for validation was 160KM by 120KM in size and consisted of terrain that was mostly flat and coved by grass and sparse shrubs with an altitude about 1300m to 1600m above sea level. 4 AWS (automatic weather station) and 12 ASSH (automatic station for soil hydrology) have been set up. And measurement elements of AWS are Temp, humidity, air pressure, net radiation, soil surface temperature, soil temperature, soil heat flux, soil moisture and wind speed/direction. The depths of SM monitoring were 3cm, 10cm, 40cm and 1m for 3 stations, and 3cm, 10cm, 20cm and 40cm for 1 station.

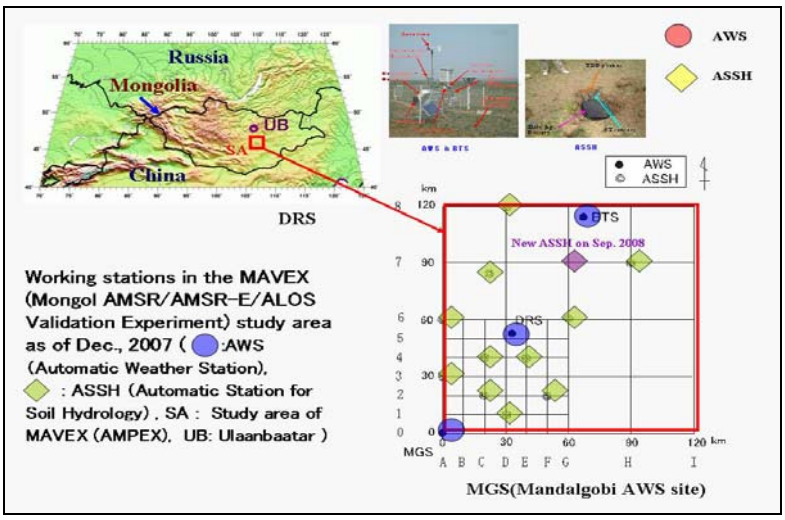

Fig 2: study area for validation of AMSR-E soil moisture product in Mongolia

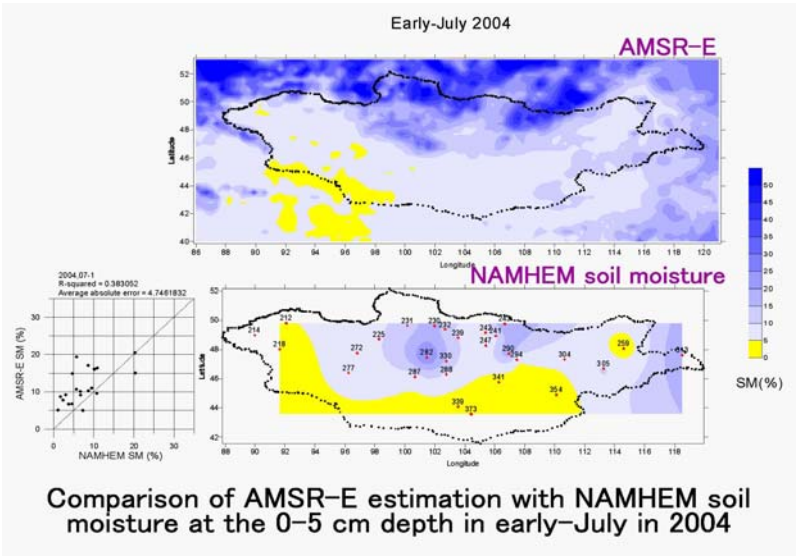

Fig 3: comparison of AMSR-E SM estimation with Soil moisture ground observation (0-5cm) in Mongolia in early July of 2004

The results of validation in Mongolia area (Kaihotsu et al2009) are:

- ✓ Although the standard product (Ver 5.0 of JAXA AMSR-E SM) using soil moisture algorithm of AMSR-E slightly over-estimated the SM, the validation results were good and there was a good correlation between AMSR-E SM product and long term ground based SM data
- ✓ The standard product of AMSR-E SM estimation gave a reasonably match between the change and distribution of soil moisture in Mongolia.

2.8 The Improvement of AMSR-E soil moisture by introducing MODIS vegetation coverage (JAXA AMSR-E SM ver 6.0)

The Koike soil moisture algorithm was applied as JAXA standard algorithm, and the validation of JAXA AMSR-E SM product was taken place in Mongolia by setting up a series of AWS and ASSH observation in the land cover of lower grass and shrubs, and with relative flat landscape. Although the fractional vegetation coverage dataset was introduced in Ver 2 of JAXA SM product, it was not fully investigated. It was ascribed as a cause of the poor accuracy of soil moisture estimation in vegetation region. In addition, the low quality of the dataset potentially resulted in poor estimation if SM even for less vegetated surface as those in semi-arid regions.

In Fujii et al (2009), he tried to solve the vegetation problem by introducing a new fractional vegetation coverage dataset by NDVI (Normalized Difference Vegetation Index) from MODIS. Vegetation parameters in the radiative transfer model were also replaced on the basis of results from ground based experiments. The soil moisture contents estimated from AMSR-E observation data were compared with in-situ data at 3 stations with different vegetation coverage conditions. Although the algorithm has a trend of over-estimated under a precipitation condition, the estimated values follow the changes in the in-situ data well for all sites. Quantitative verification using SCAN site at little river also showed improved accuracy compared with JAXA standard SM Ver 5.

3. Results & Discussion

3.1 How to retrieve soil moisture and monitor the drought

1) Choose the two typical areas (getting the algorism) in Asia: Dry climate condition: Mongolia, Pakistan; wet climate condition: Bangladesh, Vietnam and Thailand
2) AMSR-E Soil moisture products are used by Prof. Kaihotsu and Prof. Wen
3) Retrieval of SM data in two typical areas (Mongolia and Bangladeshi)
4) After the retrieval of SM data in Mongolia and Bangladesh, we will expend the SM products to Shanxi province of china and Pakistan
5) Get drought indices by using AMSR-E soil moisture products

3.2 The validation of JAXA AMSR-E soil moisture product in Shanxi Province, China

Through the relative simple comparison of differences between AMSR-E SM product and in-situ observation in Shanxi Province of China in Fig 4 and Fig 5, we fund the AMSR-E product can show the similar spatial distribution with the in-situ soil moisture, but under-estimated.

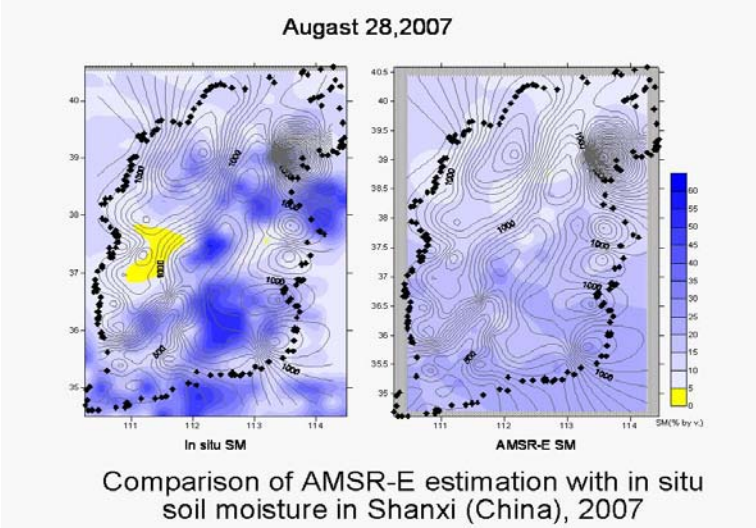

Fig 4: The comparison of AMSR-E soil moisture with in-situ observation (0-10CM) in August 2007 in Shanxi Province of China (by Kaihotsu)

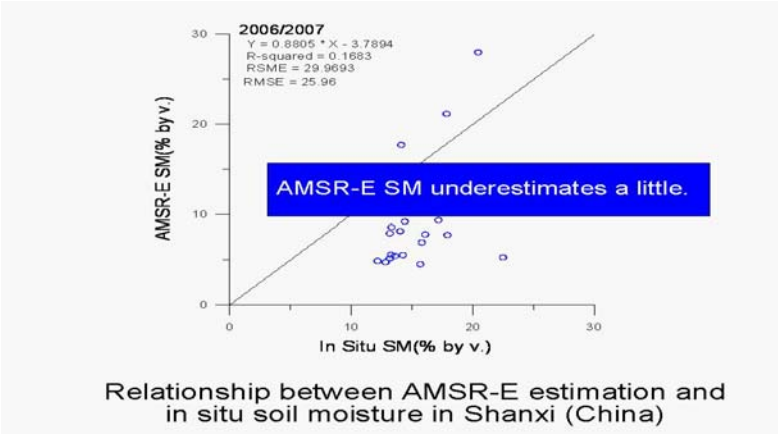

Fig 5: relationship between AMSR-E soil moisture and in-situ observation (0-10CM, 2006-2007) in Shanxi Province of China (by Kaihotsu)

3.3 The validation of JAXA AMSR-E soil moisture product in Bangladesh

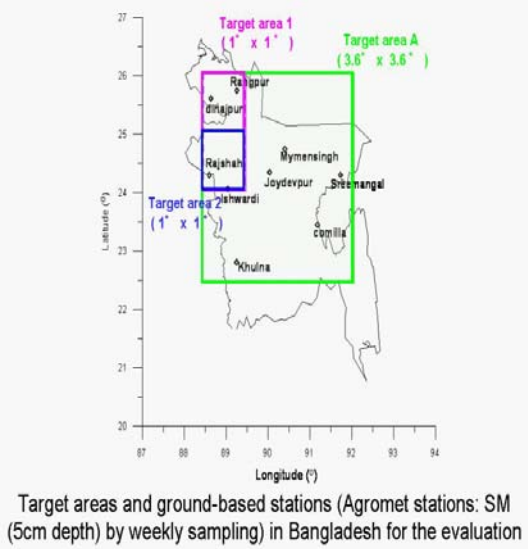

Fig. 6: the target areas for Bangladesh

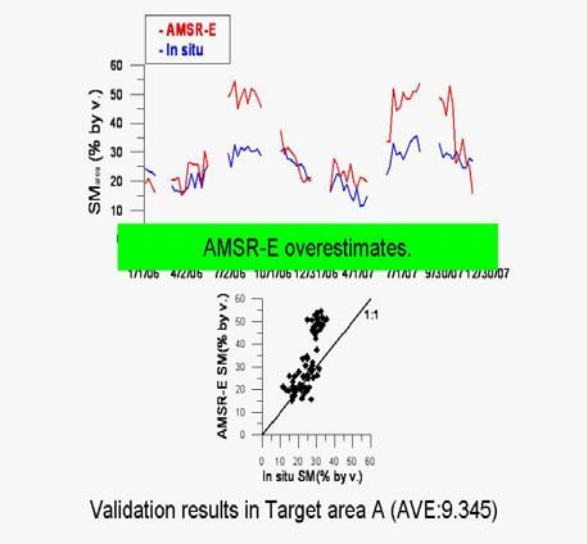

Fig. 7: validation results in Area A of Fig 5

By the comparison of differences between AMSR-E SM product and in-situ observation in Bangladeshi, we found the AMSR-E product can show the trend of increasing and decreasing of soil moisture, but over-estimated the in-situ values of soil moisture (by Kaihotsu group)

The high quality soil moisture data was retrieval by AMSR-E remote sensing product in Mongolia, It will be very helpful in setting up drought monitoring and early warning system in the place of similar climate background and landscape. For other places with different climate background, such as humid area of Bangladesh, and complex vegetation and topography in Shanxi province (lots of mountains), the applicability of AMSR-E product is still need to be investigated in future works.

4. Conclusions

- From the launching of this APN project in 2008, 5 scientific workshops and 1 training workshop have been held, and all these meetings were financially supported by this APN project. 3 of them were joint workshops with AWCI/GEOSS, and 2 were independent drought group meetings, mainly discussing about the methodologies of retrieval of soil moisture products and the preparation of training workshop.
- We have set up the "AWCI drought monitoring capacity building working group", which includes about 15 participant members from 10 countries in Asia, and we have built the scientific supporting team includes 5 scientists to provide advices on the algorithms and validation of soil moisture products retrieval from remote sensing datasets.
- Through this APN project, we have already collected the ground observation datasets from China, Pakistan, Mongolia, Bangladesh and Vietnam for the year of 2006-2007. The ground observation data provided by now includes the air temperature, pressure relative, humidity, precipitation (4 times/day or daily), and soil temperature, soil moisture (according to observation).
- The AMSR-E soil moisture products from NASA and JAXA were both tested by scientific group members. The validation with ground observations already has been done by each group from Japan, China and Thailand.
- By validation in Mongolia, we have got high quality soil moisture dataset there which can be used in monitoring the drought condition in operational level. We have already started checking the in-situ soil moisture data in Shanxi of China and Bangladesh. Although the results are not as good as it in Mongolia, the distribution pattern of high (or low) SM can be recognized in the AMSR-E SM product.

5. Future Directions

The future activity of this APN project on "drought research and monitoring in Asia" will be connected to another APN project, led by Prof. Ichiro Kaihotsu of Horoshima University, Japan, which named :" Drought monitoring system development by integrating in-situ data, satellite data and numerical model output". In this new project, we will continue improve the drought monitoring capacity and maintain the AWCI drought working group. The modeling activity will be strengthened in future after we get full establishment on human network and data resources.

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Appendix : Meetings and workshops

The 3rd International Coordination Group Meeting of the GEOSS Asian Water Cycle Initiative (AWCI)
Beijing, China, 6 November 2008

Objectives
To accelerate the GEOSS/AWCI coordination, especially on "Data Integration" and "Capacity Building", by reviewing and sharing the updated status of the GEOSS, the AWCI demonstration projects, and the related sciences.

Thursday, 6 November 2008:

9:00 – 11:00 **1. Science Presentations and Country Reports**
9:00 – 10:25 (Science presentations 9 minutes talk, 3 minutes Q&A)

0900 – 0912 Chanthachith Amphaychith (Lao PDR): *Flash Flood in the Mountainous Area of Lao PDR (the case study of Luangnamtha province)*
0912 – 0924 Irina Dergacheva (Sergey Myagkov) (Uzbekistan): *Assessment of Water Resources Change on the Aral Sea Basin under Possible Climate Change*
0924 – 0936 Dang Thi Mai (Vietnam): *Flood and Landslide in Central Part of VIETNAM*
0936 – 0948 Shiv Kumar Sharma (Nepal): *Moving Science Community to the Flood Affected Community: AWC Initiative*
0948 – 1000 Fadli Syamsudin (Indonesia): *Development of Climate Induced Flood Prediction System in Jakarta, Indonesia*
1000 – 1012 Jusoh Juhaimi (Ahmad J. Shaaban) (Malaysia): *Impact of Climate Change on the Hydrology and Water Resources of Peninsular Malaysia*

10:24 – 10:50 Country Reports: Demonstration Project Updates (1slide/2 minutes presentations)

Vietnam (Dang Ngoc Tinh)
Thailand (Thada Sukhapunnaphan)
Sri Lanka (S.B. Weerakoon)
Philippines (Flaviana Hilario)
Nepal (Shiv Sharma)
Myanmar (Tin Yi)
Malaysia (Juhaimi Jusoh)
Lao PDR (Chanthachith Amphayshicth)
Koera (Deg-Hyo Bae)
Indonesia (Joesron Loebis)
India (Rakesh Kumar/Surinder Kaur)
Bangladesh (Md. Abdul Quadir)

10:50 – 11:10 ***BREAK***

11:10 – 12:40 **2. GEOSS/AWCI Activity Reports (15min. each)**
2.1 GEOSS Current Status T. Koike
2.2 Capacity Building Activities
1) Indonesia J. Loebis
2) Bangladesh A. Quadir
2.3 WG Report
1) Floods K. Fukami
2) Droughts Ailikun
3) Water quality B. Hoque

12:40 – 13:40 ***LUNCH***

13:40 – 14:10 **3. A New WG on "Climate Change Impacts and Adaptation"**

14:10 – 15:10 **4. Meta-data and Data Archiving and Data Quality Check –demonstration**

4.1	Updated Status of Data Integration	T. Koike
4.2	Meta-data Registry	H. Kinutani
4.3	Data quality check and archiving	E. Ikoma

15:10 – 15:30 BREAK

15:30 – 17:30 **5. "Capacity Building" Implementation Plan Development**

5.1	Plenary session; Objectives and guidance	S. Herath
5.2	Breakout sessions	All

- Floods WG
- Drought WG
- Water quality WG
- Climate Change WG

5.3 Plenary session; WG reports and coordination

17:30 – 18:00 **6. Discussion Summary and Way Forward** T. Koike
18:00 ADJOURN

The 4th International Coordination Group Meeting of the GEOSS Asian Water Cycle Initiative (AWCI)
Kyoto, Japan, 6-7, February 2009
(http://www.editoria.u-tokyo.ac.jp/awci/4th/index.html)

Objectives
To accelerate the GEOSS/AWCI coordination, especially on "Data Integration" and "Capacity Building", by reviewing and sharing the updated status of the GEOSS, the AWCI demonstration projects, and the related sciences.

Friday, 6 February 2009:
12:30 – 13:30 **Registration**
13:30 – 14:00 **1. Opening by Guest Speakers** (8 min each)
1.1 *Jose Achache, Director, GEO Secretariat (TBD)*
1.2 Linda Anne Stevenson, *APN*
1.3 Hirota Tani, MEXT
1.4 Group Photo (6 min)

14:00 – 14:20 **2. GEOSS/AWCI Overview and Meeting Objectives** T. Koike
14:20 – 15:00 **3. Science Interaction Session – Land Use –**
3.1 Paddy Field Monitoring by Satellite W. Takeuchi
3.2 Global Irrigated Area Map (GIAM) and Global Map of Rainfed Cropland Areas (GMRCA) P. S. Thenkabail

15:00 – 15:20 ***Break***

15:20 – 17:30 **4. "Capacity Building" Implementation Plan Development**
4.1 Plenary session; Objectives and guidance S. Herath and C. Ishida
4.2 Breakout sessions All
- Floods WG

- Drought WG
- Water quality WG
- Climate Change WG

4.3 Plenary session; WG reports and coordination

17:30 ADJOURN

Saturday, 7 February 2009:

9:00 – 11:00 5. Data Management

5.1 GEOSS/AWCI data archiving update K. Tamagawa
5.2 Data loading and quality check E. Ikoma
5.3 Meta-data Registry H. Kinutani
5.4 Data Infrastructure – present situation and future prospects M. Kitsuregawa

11:00 – 11:20 ***Break***

11:20 – 12:00 6. Scientific Reports

6.1 Land-Lake-Atmosphere Interaction and its Effects on Local Water Use K. Tsujimoto
6.2 WEB-DHM and IWRM L. Wang

12:00 – 13:00 ***Lunch***

13:00 – 14:30 7. Panel Discussion "Promotion of Water Quality Study"
H. Furumai, and Flood/Drought/Climate Change WG Chairs

14:30 – 15:00 8. Summary and Way Forward T. Koike
15:00 ADJOURN

APN-MAIRS-ACCCA Joint Workshop on Drought Monitoring and Regional Climate Modeling
(15-16 May 2009, Bangkok)

(co-sponsored by APN CBA2008-05NMY, MAIRS, ACCCA)
(local organizer: Southeast Asia START regional center)

(Venue: Southeast Asia START regional center, Chulalongkorn University, Bangkok, Thailand)

Day 1: 15th May (Friday)

9:00-9:10
※ Welcome address by local host
※ Welcome address by Ailikun

9:10-12:00 Session I: Drought monitoring and study (Chair: Dr. Suppakorn Chinvanno)

9:10-9:30
Ailikun (MAIRS IPO, CAS): *Introduction of AWCI drought working group and APN CAPaBLE projects*

9:30-9:50
Ichiro Kaihotsu (Hiroshima University): *Soil Moisture Observations by Ground-Based Stations and Satellites in Asia*

9:50-10:10
LAI Samarakoon (AIT):

10:10-10:30 <Coffee Break>

10:30-10:50
Jun WEN (Cold and Arid Regions Environmental and Engineering Research Institute, CAS): *Soil Moisture Estimated from Satellite Microwave Remote Sensing and Its Potential in Drought Monitoring*

10:50-11:10
Azzaya D (Institute of Meteorology and Hydrology, Mongolia):

11:10-11:30
S**ARAJU KUMAR BAIDYA** (Department of Hydrology and Meteorology, Nepal) **:** *Drought over Nepal*

11:30-11:50
Jie WEI: *The Severe Drought in East China during November, December and January 2008-2009*

11:50-12:10
Duong Van Khann (Hydro-meteorological Forecasting Center of HMS, Vietnam): *The current status of drought in the Coastal Central part of Vietnam*

12:00-14:00 <Lunch>

14:00-17:00 Session II: regional climate modeling and inter-comparison (Chair: Jun WEN)

14:00-14:30
Suppakorn Chinvanno (STRAT-SEA): *Future Climate Projection for Thailand and Surrounding Countries: Climate change scenario for 21st century*

14:30-15:00
Shuyu WANG(Institute of Atmospheric Physics, CAS): *Building Asian Climate Change Scenarios by Multi-Regional Climate Models Ensemble*

15:00-15:30
Seree Supratid (Natural Disaster Research Center, Rangsit University: *Bangkok Flood Inundation under IPCC/SRES Climate Change Scenario.*

15:30-16:00
Jianping Tang (Nanjing University): *Sensitivity of a regional climate model to physis parameterizations: Simulation of summer precipitation over East Asia using MM5*

16:00-16:20 <Coffee Break>

16:20-16:50
Koji Dairaku (National Research Institute for Earth Science and Disaster Prevention, Japan): *Impacts of global warming on hydrological cycles in the Asianmonsoon region and multi-model ensembles and downscaling project in Japan*

16:50-17:20
Jiemjai Kreasuwun (Chiang Mai University): *Climate Change Simulation for Thailand Climate Change Simulation for Thailand by MM5 Regional Climate Model Regional Climate*

17:20-17:50

Rong LIU (Cold and Arid Regions Environmental and Engineering Research Institute, CAS): *Vegetation Water Content Retrieval Using MERIS and AATSR Data over the Loess Plateau*

Day 2: 16th May (Saturday)

09:00-12:00: Parallel sessions

1, Drought group discussion (Chair: Ailikun)

2, Modeling group discussion on: RCM Development, building and application of high resolution climate change scenario in Southeast Asia region (Chair: Shuyu WANG)

a) climate change hotspots in the Southeast Asia region
b) model developments and sensitivity studies; setting up regional climate change scenarios
c) application of regional climate projection: working with adaptation and assessment communities;

Draft agenda
APN workshop on "drought studying and monitoring"
Day 1， 1 Oct 2009
9:00-9:10 opening addresses by Ailikun
9:10-9:20 welcome address by local host Attachai

Morning session
9:20-10:00 Attachai: Climate change, Agriculture and Drought in Thailand
10:00-10:20 Ailikun: Introduction and Progresses of APN drought monitoring project
10:20-10:50 Ichiro Kaihotsu:
10:50-11:10 coffee break
11:10-11:40 Jun WEN: Soil Moisture Estimates from AMSR-E and Its Potential in Drought Monitoring
11:40-12:10 Orn-uma Polpanich: drought monitoring in Dryland Asia by MODIS products

Lunch (12:30-13:30)

Afternoon session
13:30-14:00 Jie WEI: Drought Indices and their Applications
Discussion on future direction of AWCI drought monitoring and study in Asia
Chair: Ailikun, Kaihotsu

Day 2, 2 Oct morning
Visiting Chiang Mai University, hosed by Prof. Attachai

Joint Training Workshop on the Application of Remote Sensing Products on Drought Monitoring in Asia
17-18 Dec. 2009, Tokyo

Backgrounds:

Asian Water Cycle Initiative (AWCI) promotes observation convergence by making seamless access to the data from earth observation satellites, in-situ reference site networks, and operational observation systems, integrates the observed data, numerical weather prediction model outputs, geographical information, and socio-economic data, and disseminates usable information for sound decision making of water resources management against flood and landslide, drought and water scarcity, water pollution and ecosystem degradation, and impacts of the climate change on water. APN (The Asia-Pacific Network for Global Change Research) CAPaBLE project (CBA2008-05NMY) "Capacity building for drought monitoring and studying in monsoon Asia under the framework of Asian Water Cycle Initiative (GEOSS/AWCI)" was formally started in 2008. The objectives of this projects are to share and improve the drought monitoring capability in various Asian countries; to set up a drought monitoring and researching network in related Asian countries; to help developing the early warning system of drought hazard in related countries.

The targets of this workshop are to grab the basic information of remote sensing technology and products on water cycle, and its application of drought monitoring and research in Asian countries. The main financial sponsors of this training workshop are APN, Tokyo University, Monsoon Asian Integrated Regional Study (MAIRS) and Japan Aerospace Exploration Agency (JAXA).

Topics of the training workshop:

1. AQUA/AMSR-E Mission
2. Advanced Land Observing Satellite (ALOS)
3. FengYun-II metrological satellite (FY-II)
4. Application of Remote Sensing Products on Drought Monitoring in Asia

Main Organizers:

Japan Aerospace Exploration Agency (JAXA)
The University of Tokyo
Hiroshima University
Institute of Atmospheric Physics, Chinese Academy of Sciences

Training Workshop Agenda

Day1 Afternoon, 17th Dec 2009 (Thursday)

13:30-18:00

13:30-14:30: Introduction of ALOS mission (Dr. Takeo Tadono、JAXA EORC)
14:30-15:30: Introduction of AQUA/AMSR-E mission (Mr. Keiji Imaoka、JAXA, EORC)

<15:30-16:00 :coffee break>

16:00-17:00: Integrated Observation and Prediction of Water Cycle Coupled with Passive and Active Microwave Sensors (Prof. Toshio Koike, U. of Tokyo)
17:00-18:00: Introduction of HY-II satellite and Data Application (Dr. Qiang FENG,, CEODE-CAS)

Day2 morning, 18th Dec 2009 (Friday)

9:00-12:30

9:00-10:30: Estimation of soil moisture by AMSR-E and its satellite algorithm basis and data assimilation (Dr. Hui Lu, U. of Tokyo)

<10:30-11:00 :coffee break>

11:00-12:00: Validation and observations of soil moisture by AMSR-E (Prof. Kaihotsu, I., Hiroshima U.)

＜12:00 – 13:30: Lunch ＞

Day2 afternoon, 18th Dec 2009 (Friday)

13:30-18:00

13:30-15:00: Principle and methodology of microwave remote sensing soil moisture measurements (Prof. Jun WEN, CAREERI-CAS)

＜15:00-15:30 coffee break＞

15:30-17:00: Retrieval of soil moisture index from MODIS in dryland areas (Dr. Orn-uma Polpanich, AIT)

17:00-18:00: Drought monitoring and drought indices in dryland of China (Dr. Jie WEI, Ailikun, IAP-CAS):

The 6th International Coordination Group (ICG) Meeting GEOSS Asian Water Cycle Initiative (AWCI)

Bali, Indonesia, 13 March 2010

(http://www.editoria.u-tokyo.ac.jp/awci/6th/index.html)

Objectives

To accelerate the GEOSS/AWCI coordination, we discuss how to promote regional cooperation and coordination on climate change adaptations.

8:30 – 9:00 Registration

9:00 – 9:20 1. Opening

Host Country

GEO Represetaive

H. Tani, Director, Ministry of Education, Culture, Sports, Science and Technology (MEXT)

Group Photo

9:20 –10:00 2. AWCI Activity Reports

2.1 Summary Report including Updates of the Demonstration Projects

2.2 Working Group Reports (Flood, Drought, Water Quality, Climate Change)

10:10 –10:25 3. Welcome a new member

Australia Dr Stuart Minchin

10:25 – 10:40 BREAK

10:40 – 11:40 3. "Capacity Building" Implementation Plan Development

S. Herath (UNU), C. Ishida (JAXA)

11:40 – 12:00 4. Socio-economic approach

S. Nasu (Kochi Univ.)

12:00 – 13:00 LUNCH

13:00 – 14:45 5. Implementation planning for climate change adaptations

- Basic Strategy
- Technical Approaches
- Political Approach

14:45 – 15:00 Break

15:00 – 16:00 6. Short Training Course 1: "Data quality check and meta data registration"

16:00 – 16:30 7. Short Training Course 2: "Flood Management"

16:30 –17:30 General Discussion

17:30 Closing

Workshop Short Reports

Report of AWCI drought working group
(update Nov 2008 by Ailikun)

This is also a rolling workplan for GEOSS/AWCI drought capacity building working group. Following are the details of structure of this group and future plans:

1. Development of Drought working group, One representative from each related country will be the contact person.
   - Japan (Dr. I. Kaihotsu, Hiroshima University, kaihotu@hiroshima-u.ac.jp)
   - China (Dr. Ailikun, Institute of Atmospheric Sciences, Chinese Academy of Sciences, aili@mairs-essp.org)
   - Mongolia (Dr. Azzaya Dolgorsuren, Institute of Meteorology and Hydrology, meteoins@magicnet.mn, azzaya23@yahoo.com)
   - Pakistan (Dr. Bashir Ahmad, National Agricultural research Center, bashirad@hotmail.com)
   - Nepal (Dr. Madan Shrestha, Nepal Academy of Science and Technology, madanls@hotmail.com)
   - Thailand (Dr. Lai Samarakoon, Asian Institute of Technology, lai@ait.ac.th)
   - Philippines (Dr. Flaviana Hilario, Philippine Atmospheric, Geophysical and Astronomical Services Administration, fhilarioph@yahoo.com, fhilario@pagasa.dost.gov.ph)
   - Vietnam (Dr. Duong Van Khanh, National Hydro-meteorological Services of MONRE VIETNAM, dvkhanh@kttv.gov.vn)
     - Bangladesh (Dr. M. RAHMAN, Bangladesh University of Engineering and Technology, mafiz@agni.com)
   - Korea (Dr. Deg-hyo Bae: Sejong University, Seoul, dhbae@sejong.ac.kr)

2. Establishing of scientific supporting team, The responsibility of the scientific supporting team is to discuss and choose what kinds of RS data set can be used in the retrieval the soil moisture, and they will give advices on the algorithms and methodology to the participant members from each county. And they will scope for the research improvement.
   - Dr. I. Kaihotsu, Hiroshima University, Japan

- Dr. Jun WEN, Cold and Arid Regions Environment and Engineering Research Institute, Chinese Academy of Sciences, China (jwen@lzb.ac.cn)
- Dr. Lai Samarakoon, Asian Institute of Technology, Thailand

3. Data information

3.1 SMST data

Japan: CEOP reference site in Mongolia: 3 stations at Mandalgovi, Deren, Bayantsaagan since 2001, A half hourly and/or hourly automatic measurement in cooperation with Dr. Azzaya and IMH (Institute of Meteorology and Hydrology, Mongolia).

China: Shanxi Province, 108 stations, Meteo and ST data 6hour, SM per 10 days

Mongolia: 3 stations at Mandalgovi, Deren, Bayantsaagan since 2001

Pakistan: 15 stations, sensor and manual

Vietnam: Binh Thuan Province: ($10^0$34'13"N - $11^0$37'30"N,$107^0$23'30" E- $108^0$52'30"E) 3 Surface Stations (Phan Thiết: 11056' - 108006', Phú Quý: 10036' - 108056', La Gi: 10040' - 107046'); P, T, R, RH, 4 times/day ; 1 Soil Temp station (Phan Thiết: 11056' - 108006'), 4 times/day ; no soil moisture

Bangladesh: 35 surface stations, P,T,RH, R, 3 hour; 12 Temp stations, 12hour; 9 soil moisture, per 7days

India:

Nepal:

Thailand:

Philippines:

3.2 Metrological observing data

air temperature: 4 times/day
pressure: 4 times/day
precipitation: daily
relative humidity: 4 times/day
soil temperature and soil moisture: /?day, ??depth (according to observation)

3.3 RS data

AMSR-E, ALOS

Prof. Koike will provide the RS soil moisture dataset retrieval by Tokyo University

3.4 Data needed for validation and retrieval

Jan 2006-Dec 2007

4. Workshops (from 2008 to 2009)

1, 1st workshop (AWCI) was held at April 2008 in Tokyo.
2, 2nd workshop (AWCI) was held in Nov 2008 in Beijing.
3, 3rd workshop (AWCI) is planed in Feb 2009 in Kyoto
4, drought group scientific meeting in Mar-April of 2009

5. Next step

In the discussion of Beijing workshop in Nov 2008, we decided to take following actions:

a. Choose the two typical areas (getting the algorism) in Asia: Mongolia represents for dry condition, and Bangladeshi for wet condition.
b. Retrieval of SM data (Dr. Kaihotsu and Dr. Wen) in two typical areas (Mongolia and Bangladeshi) by using different algorisms (AMSR-E, 2006-07). Dr. Rahman will provide the Bangladesh data to Dr. Kaihotsu and Wen, and Dr. Kaihotsu will provide the in situ data in Mongolia to Dr. Wen as soon as possible.
c. AMSR-E RS data will be provided by Dr. Kaihotsu

d. After the retrieval of SM data in Mongolia and Bangladesh, we will expend the SM products to Shanxi province of china and Pakistan. SM ground observation data in china and Pakistan will be used for validation

6) Capacity building workshop/training course of drought monitoring in summer of 2009: define the drought indices from each participating countries.

Implementing approach of drought working group (2008-2009)
(update May 2008 by Ailikun)

This is a workplan for GEOSS/AWCI drought capacity building group in following 2 years. Following are the detailed steps we will take:

1, Developing of Drought working group, One representative from each related country will be the contact person.

1, Japan (Dr. I. Kaihotsu, Hiroshima University)
2, China (Dr. Ailikun, Institute of Atmospheric Sciences, Chinese Academy of Sciences)
3, India ( ),
4, Mongolia (Dr. Azzaya Dolgorsuren, Institute of Meteorology and Hydrology)
5, Pakistan (Dr. Bashir Ahmad, National Agricultural research Center)
6, Nepal (Dr. Madan Shrestha, Nepal Academy of Science and Technology)
7, Thailand (Dr. Lai Samarakoon, Asian Institute of Technology)
8, Philippines (Dr. Flaviana Hilario, Philippine Atmospheric, Geophysical and Astronomical Services Administration)
9, Vietnam (Dr. Duong Van Khanh, National Hydro-meteorological Services of MONRE VIETNAM)
10, Bangladesh (Dr. M. RAHMAN, Bangladesh University of Engineering and Technology)

2, Establishing of scientific supporting team, The responsibility of the scientific supporting team is to discuss and choose what kinds of RS data set can be used in the retrieval the soil moisture, and they will give advices on the algorithms and methodology to the participant members from each county. And they will scope for the research improvement.

1, Dr. I. Kaihotsu, Hiroshima University, Japan
2, Dr. Jun WEN, Cold and Arid Regions Environment and Engineering Research Institute, Chinese Academy of Sciences
3, Dr. Krishna Murty, Indian Space Research Organization (ISRO)
4, Dr. Lai Samarakoon, Asian Institute of Technology, Thailand

3, The representatives will choose a specific area in their country

Japan: ?
China: Shanxi Province, 108 stations, STSM per 10 days
India:
Mongolia: Mandalgovi, 5 stations, STSM per 10 days
Pakistan:
Nepal:
Thailand:
Philippines:
Vietnam: Binh Thuan Province: ($10^0$34'13"N - $11^0$37'30"N,$107^0$23'30" E- $108^0$52'30"E)
3 Surface Stations (Phan Thiết: 11056' - 108006', Phú Quý: 10036' - 108056', La Gi: 10040' - 107046'); P, T, R, RH, 4 times/day ; 1 Soil Temp station (Phan Thiết: 11056' - 108006'), 4 times/day ; no soil moisture
Bangladesh: 35 surface stations, P,T,RH, R, 3 hour; 12 Temp stations, 12hour; 9 soil moisture, per 7days

4, ground observing data needed

air temperature: 4 times/day
pressure: 4 times/day
precipitation: daily
relative humidity: 4 times/day
soil temperature: /?day, ?? depth (according to observation)
soil moisture: /?day, ??depth (according to observation)

5, RS data needed

ALOS. AMSR, ASTER, others?
Prof. Koike will provide the RS soil moisture dataset retrieval by Tokyo University

6, Data preparation period

Every country representative should provide the ground observing data in Jan1-Dec31, 2006 before 1Jun 2008. The RS data of 2006 will be provided to the scientific group members and country representatives (if needed) will be provided in the same time.

7, Data integration period:

Jun-Dec 2008

8, workshop

A workshop is planned for drought group at March 2008, the scientific group and country participants will discuss about the meta data, data submission, algothrism and methodology

9, relation with other groups

CEOP
GEOSS/AWCI
GEOSS global drought monitoring system

Report of AWCI drought working group
(update May 2009 by Ailikun)

This is also a rolling workplan for GEOSS/AWCI drought capacity building working group. Following are the details of structure of this group and future plans:

1, Development of Drought working group, One representative from each related country will be the contact person.

1, Japan (Dr. I. Kaihotsu, Hiroshima University, kaihotu@hiroshima-u.ac.jp)
2, China (Dr. Ailikun, Institute of Atmospheric Sciences, Chinese Academy of Sciences, aili@mairs-essp.org, Dr. Jie WEI, wjie@mail.iap.ac.cn)
3, Mongolia (Dr. Azzaya Dolgorsuren, Institute of Meteorology and Hydrology, meteoins@magicnet.mn, azzaya23@yahoo.com)
4, Pakistan (Dr. Muhammad Munir Sheikh, Climatology Section, Global Change Impact Studies Centre (GCISC), munir.sheikh@gcisc.org.pk)
5, Nepal (Dr. Madan Shrestha, Nepal Academy of Science and Technology, madanls@hotmail.com; Dr. SARAJU KUMAR BAIDYA, Department of Hydrology and Meteorology, sarajubaidya@yahoo.com)
6, Thailand (Dr. Lal Samarakoon, Asian Institute of Technology, lai@ait.ac.th; Dr. Syams Nashrrullah, syams@ait.ac.th)
7, Philippines (Dr. Flaviana Hilario, Philippine Atmospheric, Geophysical and Astronomical Services Administration, fhilarioph@yahoo.com, fhilario@pagasa.dost.gov.ph)
8, Vietnam (Dr. Duong Van Khanh, National Hydro-meteorological Services of MONRE VIETNAM, dvkhanh@monre.gov.vn,)

9, Bangladesh (Dr. M. RAHMAN, Bangladesh University of Engineering and Technology, mafiz@agni.com)
10, Korea (Dr. Deg-hyo Bae: Sejong University, Seoul, dhbae@sejong.ac.kr)

2, Establishing of scientific supporting team, The responsibility of the scientific supporting team is to discuss and choose what kinds of RS data set can be used in the retrieval the soil moisture, and they will give advices on the algorithms and methodology to the participant members from each county. And they will scope for the research improvement.

1, Dr. I. Kaihotsu, Hiroshima University, Japan (kaihotu@hiroshima-u.ac.jp)
2, Dr. Jun WEN, Cold and Arid Regions Environment and Engineering Research Institute, Chinese Academy of Sciences, China (jwen@lzb.ac.cn)
3, Dr. Lal Samarakoon, Asian Institute of Technology, Thailand (lal@ait.ac.th)

3, Data information

3.1 SM/ST data

Mongolia/Japan: CEOP reference site in Mongolia: 3 stations at Mandalgovi, Deren, Bayantsaagan since 2001, A half hourly and/or hourly automatic measurement in cooperation with Dr. Azzaya and IMH (Institute of Meteorology and Hydrology, Mongolia).
China: Shanxi Province, 108 stations, Meteo and ST data 6hour, SM per 10 days
Pakistan: Soil moisture data available only for 4 stations (Rawalpindi, Faisalabad, Tandojam and Quetta), Soil temperature data for some stations, Daily temperature and precipitation data for a good number of stations.
Vietnam: Binh Thuan Province: ($10^0$34'13"N - $11^0$37'30"N,$107^0$23'30" E- $108^0$52'30"E)
3 Surface Stations (Phan Thiet: 11056' - 108006', Phú Quý: 10036' - 108056', La Gi: 10040' - 107046'); P, T, R, RH, 4 times/day ; 1 Soil Temp station (Phan Thiet), 4 times/day ; no soil moisture
Bangladesh: 35 surface stations, P,T,RH, R, 3 hour; 12 Temp stations, 12hour; 9 soil moisture, per 7days
Nepal: (Dr. Saraju Kumar BAIDYA provides the information)
Thailand: (Dr. Syams Nashrrullah provides the infromation)

3.2 Metrological observing data

air temperature: 4 times/day
pressure: 4 times/day
precipitation: daily
relative humidity: 4 times/day
soil temperature and soil moisture: /?day, ??depth (according to observation)

1) Dr. Saraju Kumar BAIDYA will provide the data from Nepal
2) Prof. Munir Sheikh from Pakistan agreed to provide the SM/ST and metrological data in Pakistan
3) Dr. Syams Nashrrullah will check the SM/ST data in Thailand

3.3 RS data

Microwave: AMSR-E, ALOS (Dr. Kaihitsu and Dr. Wen)
Optical: MODIS (Dr. Syams Nashrrullah)
Prof. Koike will provide the RS soil moisture dataset retrieval by Tokyo University

3.4 Data duration needed for retrieval and validation

Jan 2006-Dec 2007

4, Workshops (from 2008 to 2009)

1, 1st workshop (AWCI) was held at April 2008 in Tokyo.
2, 2nd workshop (AWCI) was held in Nov 2008 in Beijing.
3, 3rd workshop (AWCI) in Feb 2009 in Kyoto
4, drought group scientific meeting in 15-16 May 2009 in Bangkok

5, how to retrieving soil moisture

1) Choose the two typical areas (getting the algorism) in Asia: Dry climate condition: Mongolia, Pakistan, Nepal (winter drought); wet climate condition: Bangladesh, Vietnam and Thailand
2) Besides the AMSR-E data used by Prof. Kaihotsu and Prof. Wen, MODIS data will also be used by Dr. Syams Nashrrullah from AIT.
3) Retrieval of SM data (Dr. Kaihotsu, Dr. Wen and Dr. Syams) in two typical areas (Mongolia and Bangladeshi) by using different algorisms (AMSR-E, MODIS, 2006-07)
4) The ground observation data in Mongolia, China and Bangladesh will be provided to Dr. Syams Nashrrullah,
5) After the retrieval of SM data in Mongolia and Bangladesh, we will expend the SM products to Shanxi province of china and Pakistan. SM ground observation data in china and Pakistan will be used for validation

6, next steps

1) We will mainly focus on the Agriculture drought in each area. Meteorological drought should also be considered.
2) The soil moisture products will be made in 3-5 months after the Bangkok meeting, 3 kinds of soil moisture data sets (Kaihotsu (AMSR-E), Wen (AMSR-E) and Syams (MODIS) will be compared). A small group meeting will be held in Beijing in August-Sep 2009.
3) There is an agreement Among Prof. Wen, Ailikun and BAIDYA, that a young scientist from Nepal will visit CAREER/CAS for 3 months to study the methods of retrieving soil moisture data by RS microwave products.
4) After we get the retrieved soil moisture data, developing a drought index for each related country is necessary. Drought index should be prepared by and category made by the local people. Some research is already on the way to combine soil moisture with the meteorological data (precipitation, Daily maximum and minimum temperature).
5) Capacity building workshop/training course on drought monitoring is planned in Autumn of 2009, which might conjunct with AWCI core meeting.

Report of APN-AWCI Joint Training Workshop on the Application of Remote Sensing Products on Drought Monitoring in Asia
17-18 Dec. 2009, Tokyo

The objectives of APN CAPaBLE project (CBA2009-01CMY-Ailikun) "Capacity Building for Drought Monitoring and Studying in Monsoon Asia under the Framework of Asian Water Cycle Initiative (GEOSS/AWCI)" are to share and improve the drought monitoring capability in various Asian countries; to set up a drought monitoring and researching network in related Asian countries; to help developing the early warning system of drought hazard in related countries. Asian Water Cycle Initiative (AWCI/GEOSS) promotes observation convergence by making seamless access to the data from earth observation satellites, in-situ reference site networks, and operational observation systems, integrates the observed data, numerical weather prediction model outputs, geographical information, and socio-economic data, and disseminates usable information for sound decision making of water resources management against flood and landslide, drought and water scarcity, water pollution and ecosystem degradation, and impacts of the climate change on water.

By now, AWCI drought working group has 18 members from 11 countries. And the scientific supporting team plays the key role in retrieval of soil moisture dataset from remote sensing products. From the beginning of 2009, AWCI drought working group tried to hold a training workshop based on the activities in last 3 years by collaborating with other AWCI working groups. Under the strong support of APN, Japan Aerospace Exploration Agency (JAXA), Tokyo University, Hiroshima University and Monsoon Asia Integrated Regional Study (MAIRS), an APN-AWCI joint training workshop was held in 17-18 Dec 2009 at Tokyo University. The topics of this training workshop cover the: AQUA/AMSR-E Mission; the Advanced Land Observing Satellite (ALOS); Chinese FengYun-II metrological satellite (FY-II); and the application of Remote Sensing Products on Drought Monitoring in Asia. About 40 trainers attended this joint workshop.

The trainers showed high interests in application of new remote sensing products on drought and other disaster monitoring in their own countries. They would like to know and master more techniques and methodology in using the AMSR-E, ALOS and FY-II products, and transfer this information to more scientists. Most of the training materials will be summarized in the AWCI drought working group report in near future.

Training Workshop Agenda

Day1 Afternoon, 17th Dec 2009 (Thursday)

13:30-14:30: Introduction of ALOS mission (Dr. Takeo Tadono、JAXA EORC)
14:30-15:30: Introduction of AQUA/AMSR-E mission (Mr. Keiji Imaoka、JAXA, EORC)
<15:30-16:00 :coffee break>
16:00-17:00: Integrated Observation and Prediction of Water Cycle Coupled with Passive and Active Microwave Sensors (Prof. Toshio Koike, U. of Tokyo)
17:00-18:00: Introduction of HY-II satellite and Data Application (Dr. Qiang FENG,, CEODE-CAS)

Day2 morning, 18th Dec 2009 (Friday)

9:00-10:30: Estimation of soil moisture by AMSR-E and its satellite algorithm basis and data assimilation (Dr. Hui Lu, U. of Tokyo)
<10:30-11:00 :coffee break>
11:00-12:00: Validation and observations of soil moisture by AMSR-E (Prof. Kaihotsu, I., Hiroshima U.)
＜12:00 – 13:30: Lunch ＞

Day2 afternoon, 18th Dec 2009 (Friday)

13:30-15:00: Principle and methodology of microwave remote sensing soil moisture measurements (Prof. Jun WEN, CAREERI-CAS)

＜15:00-15:30 coffee break＞

15:30-17:00: Retrieval of soil moisture index from MODIS in dryland areas (Dr. Orn-uma Polpanich, AIT)

17:00-18:00: Drought monitoring and drought indices in dryland of China (Dr. Ailikun, Jie WEI, IAP-CAS)

Report of AWCI drought working group
(last updated Jan 2010 by Ailikun, Kaihotsu, Rasul)

This is also a rolling workplan for GEOSS/AWCI drought capacity building working group. Following are the details of structure of this group and future plans:

1, The objectives of AWCI drought working group

P1: to build a drought monitoring and researching network of member Asian countries
P2: to share and improve the drought monitoring data/capability in various Asian countries
P3: To make a stronger collaboration with the AWCI demonstration projects
P4: To help developing the early warning system of drought hazard in member countries

Present situation:
P1: making efforts to build DATA bank
P2: providing the routine soil moisture data (filling the data gaps)
P3: planning to move forward with practical approach
P4: making efforts to show the system

2, Members of Drought working group

Co-chairs: Dr. I. Kaihotsu and Dr. Rasul Ghulam
National representatives of drought group:

1, Japan (Dr. I. Kaihotsu, Hiroshima University, kaihotu@hiroshima-u.ac.jp)
2, China (Dr. Ailikun, Institute of Atmospheric Sciences, Chinese Academy of Sciences, aili@mairs-essp.org)
3, Mongolia (Dr. Davva Gombo, Institute of Meteorology and Hydrology, watersect@yahoo.com)
4, Pakistan (Dr. Rasul Ghulam， Pakistan Meteorological Department, grmet@yahoo.com, rasulpmd@gmail.com)
5, Nepal (Dr. Madan Shrestha, Nepal Academy of Science and Technology, madanls@hotmail.com)
6, Thailand (Dr. Lal Samarakoon, Asian Institute of Technology, lai@ait.ac.th; Dr. Orn-uma Polpanich, o_polpanich@ait.ac.th)
7, Philippines (Dr. Flaviana Hilario, Philippine Atmospheric, Geophysical and Astronomical Services Administration, fhilarioph@yahoo.com, fhilario@pagasa.dost.gov.ph)
8, Vietnam (Dr. Duong Van Khanh, National Hydro-meteorological Services of MONRE VIETNAM, dvkhanh@monre.gov.vn, Dr. Dang Ngoc Tinh, tinhdangngoc@fpt.vn)
9, Bangladesh (Dr. M. RAHMAN, Bangladesh University of Engineering and Technology, mafiz@agni.com)
10, Korea (Dr. Deg-hyo Bae: Sejong University, Seoul, dhbae@sejong.ac.kr)
11, Uzbekistan (Dr. Irina DERGACHEVA, Hydrometeorological Research Institute (NIGMI) of Uzhydromet, NIGMI@albatros.uz)

Other members:

Dr. Jie WEI (IAP-CAS, wjie@mail.iap.ac.cn)
Dr. Bilqis Hoque (Bangaladesh, bilqisdhaka@yahoo.com)
Dr. Muhammad Munir Sheikh (Pakistan, munir.sheikh@gcisc.org.pk, mmunirsheikh@yahoo.com)
Dr. Le Bac Huynh (Vietnam, lbhuynh@yahoo.com, lebachuynh@fpt.vn)
Dr. Edna JUANILLO (Philippine, ejuanillo@yahoo.com)
Dr. Qiang FENG (China, CEODE-CAS, qfeng@ceode.ac.cn)

3, Scientific supporting team, The responsibility of the scientific supporting team is to discuss and choose what kinds of RS data set can be used in the retrieval the soil moisture, and they will give advices on the algorithms and methodology to the participant members from each county. And they will scope for the research improvement.

1, Dr. I. Kaihotsu, Hiroshima University, Japan (kaihotu@hiroshima-u.ac.jp)

2, Dr. Jun WEN, Cold and Arid Regions Environment and Engineering Research Institute, Chinese Academy of Sciences, China (jwen@lzb.ac.cn)
3, Dr. Lal Samarakoon, Asian Institute of Technology, Thailand (lal@ait.ac.th)
??

3, Data information

3.1 SM/ST data

Mongolia/Japan: CEOP reference site in Mongolia: 3 stations at Mandalgovi, Deren, Bayantsaagan since 2001, A half hourly and/or hourly automatic measurement in cooperation with Institute of Meteorology and Hydrology, Mongolia

China: Shanxi Province, 108 stations, Meteo and ST data 6hour, SM per 10 days, 3 lays

Pakistan: Soil moisture data available only for 4 stations (Rawalpindi, Faisalabad, Tandojam and Quetta), SM per 10 days, about 10 layers

Bangladesh: 9 soil moisture stations, SM per 7days, 5 layers

Vietnam: Binh Thuan Province: ($10^0$34'13"N - $11^0$37'30"N,$107^0$23'30" E- $108^0$52'30"E)
3 Surface Stations (Phan Thiet: 11056' - 108006', Phú Quý: 10036' - 108056', La Gi: 10040' - 107046'); P, T, R, RH, 4 times/day ; 1 Soil Temp station (Phan Thiet), 4 times/day ; no soil moisture

3.2 Metrological observing data needed

air temperature: daily
pressure: daily
precipitation: daily
relative humidity: daily
soil temperature and soil moisture: /?day, ??depth (according to observation)

By now, we got the metrological data from China, Mongolia and Vietnam, no meteoro. data from Pakistan and Bangladesh

3.3 RS data

Microwave: AMSR-E (Dr. Kaihitsu and Dr. Wen), AMSR-E SM products from JAXA and NASA are used
Optical: MODIS (Dr. Orn-uma Polpanich)

3.4 Data duration needed for retrieval and validation

Jan 2006-Dec 2007

3.4, Information of soil physical parameters

Soil texture, soil color, ??

4, Workshops (from 2008 to 2009)

1, 2nd workshop (AWCI) was held at April 2008 in Tokyo.
2, 3rd workshop (AWCI) was held in Nov 2008 in Beijing.
3, 4th workshop (AWCI) in Feb 2009 in Kyoto
4, drought group scientific meeting in 15-16 May 2009 in Bangkok
5, drought group scientific meeting in 1-2 Oct 2009 in Chiang Mai
6, 5th workshop (AWCI) in 15-17 Dec 2009 in Tokyo
7, joint drought training workshop in 17-18 Dec 2009 in Tokyo

5, how to retrieving soil moisture and monitoring the drought

1) Choose the two typical areas (getting the algorism) in Asia: Dry climate condition: Mongolia, Pakistan; wet climate condition: Bangladesh, Vietnam and Thailand
2) Besides the AMSR-E data used by Prof. Kaihotsu and Prof. Wen, MODIS data is used by AIT group.
3) Retrieval of SM data in two typical areas (Mongolia and Bangladeshi)

4) After the retrieval of SM data in Mongolia and Bangladesh, we will expend the SM products to Shanxi province of china and Pakistan
5) Dr. Jie WEI and Ailikun are trying to get drought indices by using AMSR-E soil moisture products

6, next steps

Workplan in 2010

1) Keep building the drought monitoring and researching network of member Asian countries for AWCI
2) continue providing and sharing the soil moisture and other metrological data of the ground-based and satellite monitoring.
3) building a closer collaboration with other AWCI groups, reviewing demonstration projects to step in their adaptation activities
4) preparation of call for papers for the drought working group report.

Workplan in 2011

1) provide and share the soil moisture dada of the ground-based, satellite and modeling products
2) collaborating with Demonstration Projects to hold seminars and workshops in member countries to develop capacity and exchanging the experience and expertise
3) improving of standard drought outlook and foresting
4) analyzing the obtained soil moisture dada from the view point of climate change
5) providing the trial early warning system for drought hazard in related countries and numerical products for drought assessment, climate change and forecasting.
6) Publication of drought working group report.

7, submission of APN CAPaBLE proposal in 2009

Proposal title: Drought monitoring system development by integrating in-situ data, satellite data and numerical output

Proponent's name: Ichiro Kaihotsu

Main use for APN funding:

Workshops
Networking
Training courses
Report and publications
Data sharing, programming, software

Contact:

Prof. Ichiro Kaihotsu
Graduate school of integrated arts and sciences, Hiroshima University
Kagamiyama 1-7-1, Higashihiroshima, 739-8521, Japan
Phone: +81-82-424-6497/6495, FAX: +81-82-424-0758
Email: kaihotu@hiroshima-u.ac.jp

Funding sources outside the APN

University of Tokyo: 20,000 USD
JAXA (Japan Aerospace Exploration Agency): 10,000 USD
MAIRS (Monsoon Asia Integrated Regional Study): 10,000 USD

List of Young Scientists

(This is the list of young scientists supported by APN funding to attend the workshops and training course

Dr. Rong LIU
Cold and Arid Regions Environmental and Engineering Research Institute,
Chinese Academy of Sciences
Lanzhou, 730000
Tel: +86-931-4967076
Email: rliu@lzb.ac.cn

Dr. Saraju Kumar Baidya
Department of Hydrology and Meteorology, Nepal
P.O. Box: 8332, Kathmandu, Nepal
Tel: 977 1 4255920 (o)
Email: sarajubaidya@yahoo.com, sarju@dhm.gov.np

Dr. Jianping TANG
School of Atmospheric Sciences (SAS)
Nanjing University
22 Hankou Road, Nanjing, Jiangsu ,210093, P.R. China
Tel : 86-25-83597253
Fax: 86-25-83592575
Email: jptang@nju.edu.cn

Dr. Jie WEI
Institute of Atmospheric Physics(IAP), Chinese Academy of Sciences(CAS),
Qijiahuozi Huayanli 40#, Chaoyang District,
P.O.Box 9804,
Beijing 100029, China
Tel:86-10-82995094
Email: wjie@mail.iap.ac.cn

Dr. Deming ZHAO
Institute of Atmospheric Physics(IAP), Chinese Academy of Sciences(CAS),
Qijiahuozi Huayanli 40#, Chaoyang District,
P.O.Box 9804,
Beijing 100029,China
Tel:86-10-82995111
Fax:86-10-82995161
Email: zhaodm@tea.ac.cn

Dr. Koji DAIRAKU
Storm, Flood, and Landslide Research Department,
National Research Institute for Earth Science and Disaster Prevention,
3-1 Tennodai Tsukuba Ibaraki 305-0006 Japan
Tel: 81(29)-863-7512,
Fax: 81(29)-863-7510
E-mail: dairaku@bosai.go.jp

Ms. Mega Octaviani
Joint Graduate School of Energy and Environment (JGSEE)
King Mongkut's University of Technology Thonburi (KMUTT)
126 Prachauthit Rd., Bangmod, Tungkru, Bangkok, 10140, Thailand
Tel: 66 2 470 7332, Fax: 66 2 470 7337
Mobile: 66 8 3292 1547
E-mail: megabintihasan@gmail.com

Mr. Kritanai Torsri
Joint Graduate School of Energy and Environment (JGSEE)
King Mongkut's University of Technology Thonburi (KMUTT)
126 Prachauthit Rd., Bangmod, Tungkru, Bangkok, 10140, Thailand
Tel: 66 2 470 7332, Fax: 66 2 470 7337
Mobile: 66 8 1587 9549
E-mail: kritanai_ts@yahoo.co.th

Dr. Kansri BoonPrakob
Department of Biology, Faculty of Science,
Ramkhamhaeng University, Bangkok 10240,
Thailand
Tel: 6623108395
Fax: 6623108416
Email: kansri@ru.ac.th
Email: bkansri@hotmail.com

Syams Nashrrullah
Project Researcher
Geoinformatics Center
School of Engineering and Technology
Asian Institute of Technology (AIT)
Km. 42 Paholyothin Highway

Klong Luang Pathumthani 12120,
Thailand
Tel: 6625246485
Fax: 6625246147
Email: syams@ait.ac.th

He CHEN
Department of Hydraulic Engineering
Tsinghua University
Beijing 100084, China
Tel: +86-10-62773729（314）
Fax: +86-10-62796971
E-mail: chenhe08@mails.tsinghua.edu.cn

Dr. Qiang FENG
Division of Digital Ocean and Atmosphere, Lab. of Digital Earth Sciences,
Center for Earth Observation and Digital Earth
Chinese Academy of Sciences
P.O. Box 9718, 20A Datun Road,
Chaoyang District, Beijing, 100101,P.R. China
Fax:86-10-64807826
Tel:86-10-64807838
Email: qfeng@ceode.ac.cn

Dr. Li ZHANG
Division of Digital Land, Lab. of Digital Earth Sciences,
Center for Earth Observation and Digital Earth,
P.O. Box 9718, 20A Datun Road,
Chaoyang District, Beijing, 100101,P.R. China
Fax:86-10-64807826,
Tel:86-10-64807838,
Email: lizhang@ceode.ac.cn

Xin WANG
Cold and Arid Regions Environmental and Engineering Research Institute,
Chinese Academy of Sciences
Lanzhou, 730000
Tel: +86-931-4967046
Email: xinwang@lzb.ac.cn

Le Bac Huynh
Vietnam Association for Conservation of Nature and Environment
Add. 9th floor , Vietnamese Trade Union Hotel
(Khach san Cong doan Viet Nam)
14 Tran Binh Trong Str.
Hanoi, Vietnam.
Email: lbhuynh@yahoo.com; lebachuynh@fpt.vn;

Orn-uma Polpanich
Project researcher
Geoinformatics Center, School of Engineering and Technology
Asian Institute of Technology
P.O. Box 4, Klong Luang
Pathumthani 12120, Thailand
Tel. 66 2 524 6485
Fax. 66 2 527 6147
Email: o_polpanich@ait.ac.th
http://www.geoinfo.ait.ac.th/

Thaworn Onpraphai
Assistant Professor,
Crop Sciences and Natural Resources
Faculty of Agriculture, Chiang Mai University
Chiang Mai, 50200
Thailand
Email: thaworn@chiangmai.ac.th