

# **GAME-T and the Future Hydro-Meteorological Research in Thailand**



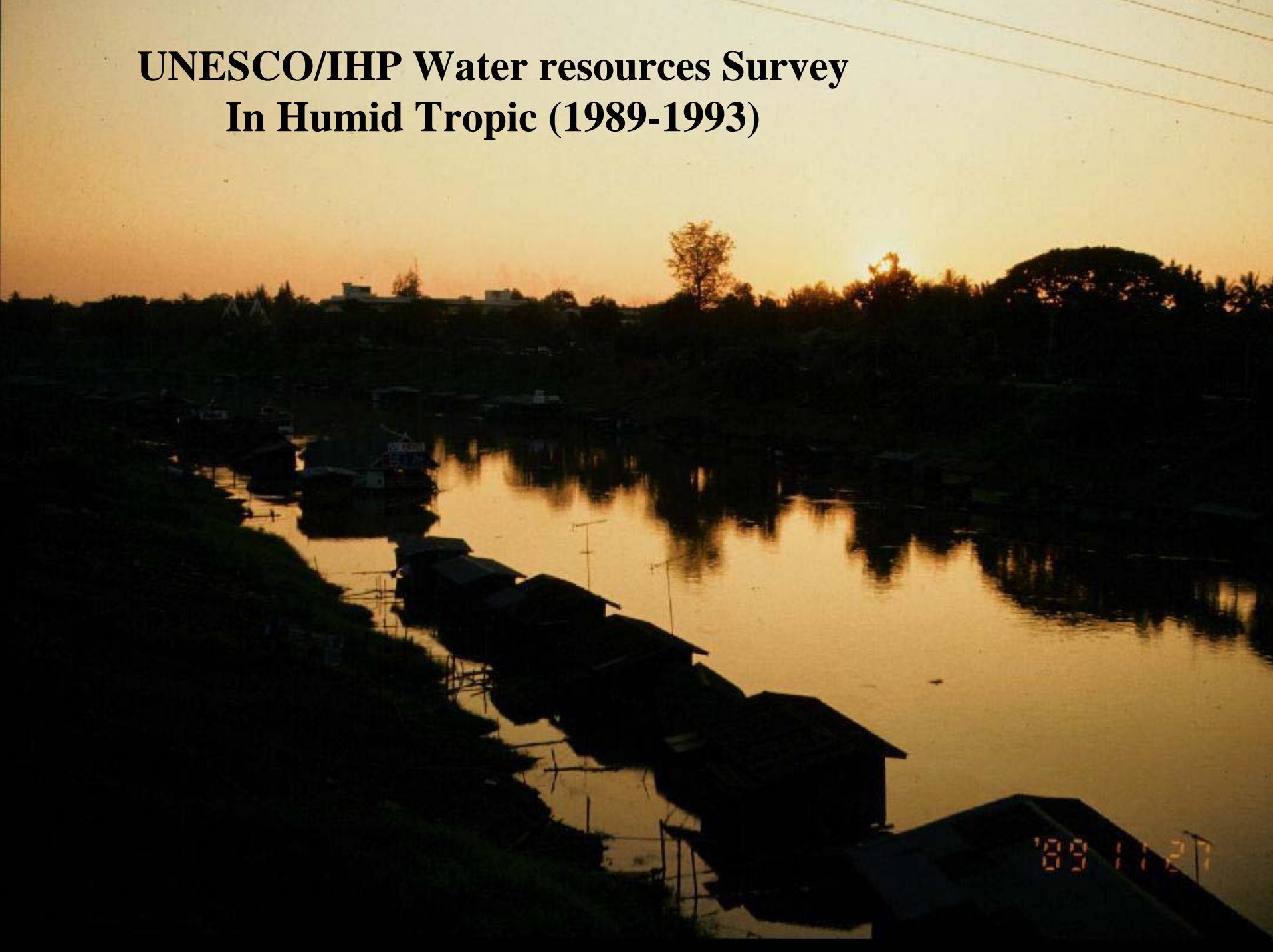
**Research Inst. for Humanity and Nature**

<http://www.chikyu.ac.jp>

**IIS, University of Tokyo**

**Taikan Oki**

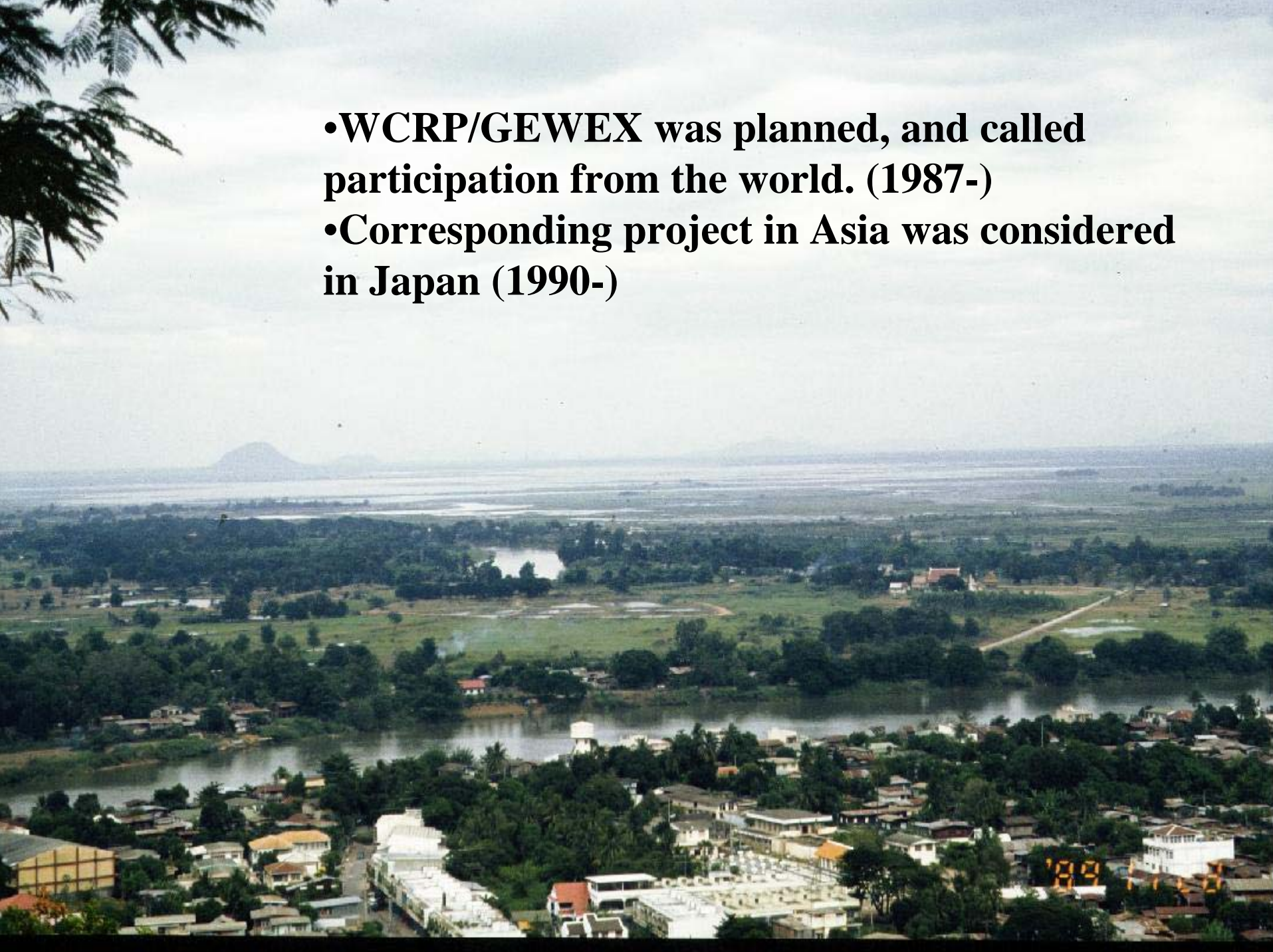
**UNESCO/IHP Water resources Survey  
In Humid Tropic (1989-1993)**





**Prof. Musiake visited all over Thailand.**

- **WCRP/GEWEX** was planned, and called participation from the world. (1987-)
- Corresponding project in Asia was considered in Japan (1990-)



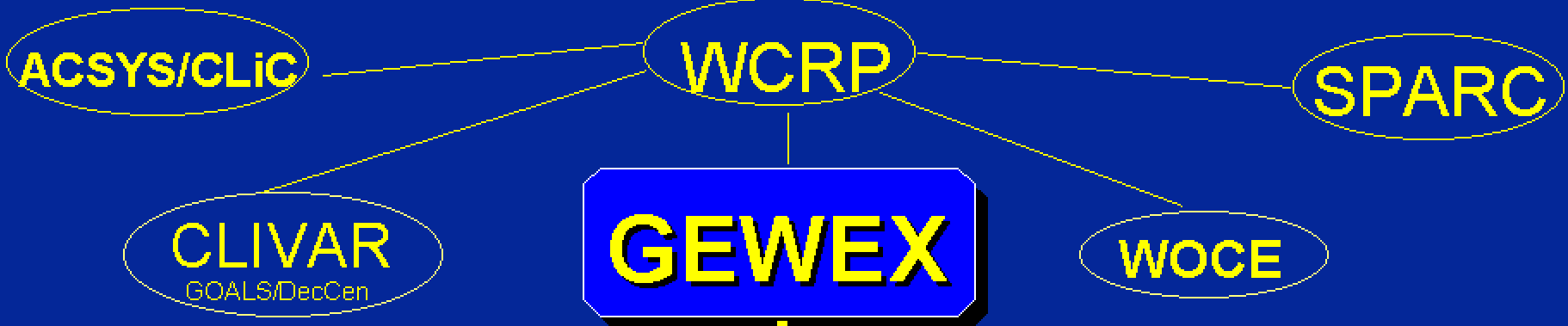
# GEWEX

- The **Global Energy and Water Cycle Experiment** is a program initiated by the **World Climate Research Programme (WCRP)** to observe, understand and model the hydrological cycle and energy fluxes in the atmosphere, at land surface and in the upper oceans. GEWEX is an integrated program of research, observations, and science activities ultimately leading to the prediction of global and regional climate change.
- <http://www.gewex.org/>

ICSU

WMO

IOC



**HYDROMETEOROLOGY**  
(GEWEX Hydromet Panel)

**MODELLING**  
(GMPP - WGNE)

**RADIATION**  
(GEWEX Radiation Panel)

GAPP / ISLSCP  
GAME / GRDC  
BALTEX / (IAHS)  
LBA / MAGS

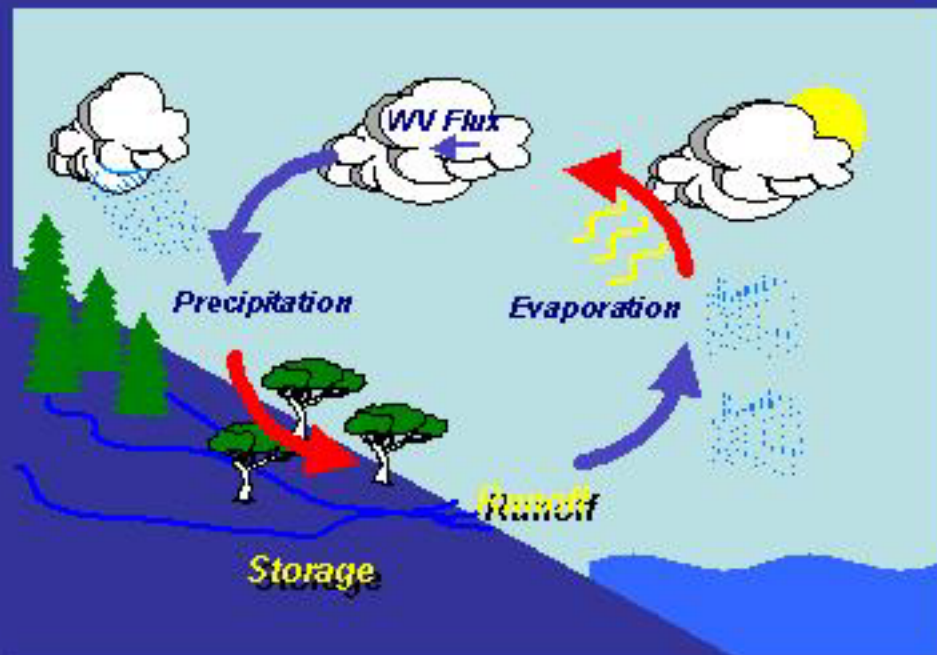
GCSS  
GLASS  
GABLS

ISCCP / SRB  
BSRN  
GVaP / GPCP  
GACP

# Objectives

- **Determine the hydrological cycle and energy fluxes by means of global measurements of atmospheric and surface properties.**
- **Model the global hydrological cycle and its impact on the atmosphere, oceans and land surfaces.**
- **Develop the ability to predict the variations of global and regional hydrological processes and water resources, and their response to environmental change.**
- **Advance the development of observing techniques, data management, and assimilation systems for operational application to long-range weather forecasts, hydrology, and climate predictions.**

- **Determine the Hydrological Cycle by Global Measurements**



## Energy and Water Cycle

- **Model the Hydrological Cycle and its Effects**
- **Predict Response to Environmental Change**
- **Improve Observing Techniques and Data Assimilation Systems**



# GEWEX PROJECTS

## Hydrometeorology Projects

- GEWEX Americas Prediction Project (GAPP)
- Baltic Sea Experiment (BALTEX)
- GEWEX Asian Monsoon Experiment (GAME)
- Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA)
- Mackenzie GEWEX Study (MAGS)
- International Satellite Land-Surface Climatology Project (ISLSCP)
- Global Runoff Data Centre (GRDC)

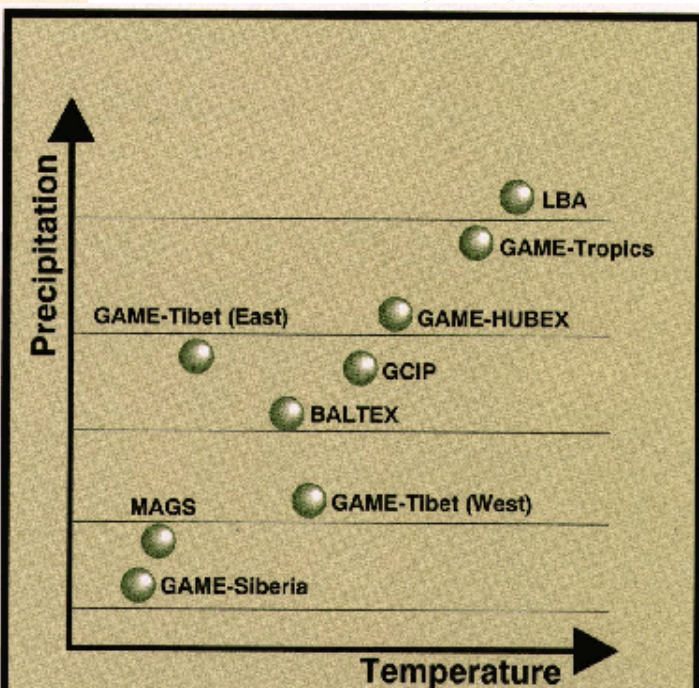
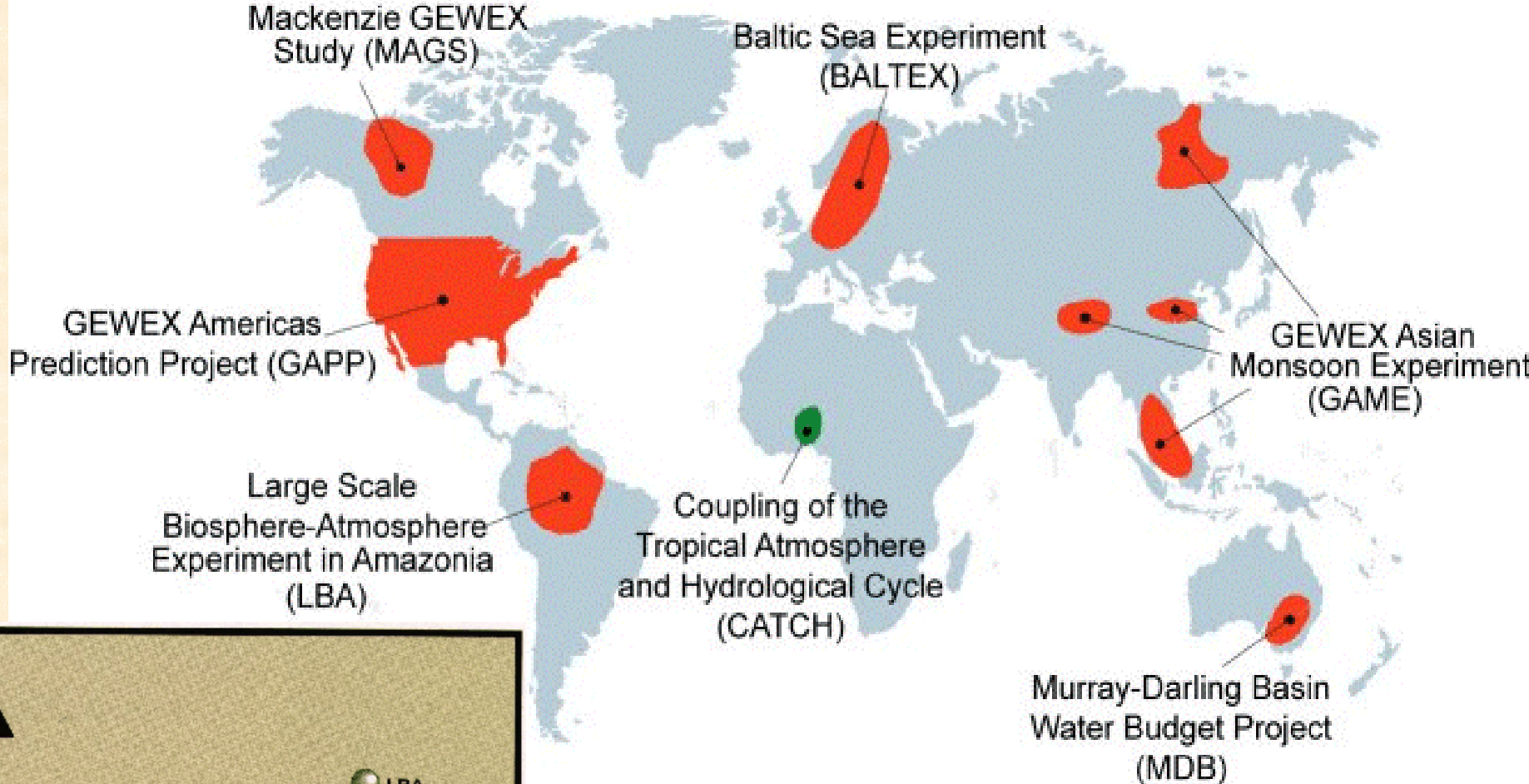
## Modeling and Prediction Projects

- GEWEX Cloud System Study (GCSS)
- GEWEX Global Land/Atmosphere System Study (GLASS)
- GEWEX Atmosphere Boundary Layer Study (GABLS)

## Radiation Projects

- International Satellite Cloud Climatology Project (ISCCP)
- Surface Radiation Budget (SRB) Project
- Global Water Vapor Project (GVaP)
- Global Precipitation Climatology Project (GPCP)
- Global Aerosol Climatology Project (GACP)
- Baseline Surface Radiation Network (BSRN)





- **GEWEX HYDROMETEOROLOGY PANEL (GHP)**

<http://www.usask.ca/geography/MAGS/GHP/ghp.html>

- **Continental Scale Experiments (CSEs)**

# GAME

- As a part of the **Global Energy and Water cycle EXperiment (GEWEX)**, the **GEWEX Asian Monsoon Experiment (GAME)** is being implemented to understand the role of the Asian monsoon in the global energy and water cycle and to improve the simulation and seasonal prediction of Asian monsoon patterns and regional water resources.

<http://www.ihas.nagoya-u.ac.jp/game/index.html>

To understand the role of Asian monsoon in the global energy and water cycle

The seasonal forecasting of monsoon rainfall and water resources in monsoon Asia

GAME Archive Information Network (GAIN)

4DDA

Advanced data assimilation scheme combined with numerical weather prediction models including macro-scale hydrological models

Process Study  
- Tropical monsoon region  
- Tibetan Plateau  
- Huai-He River  
- Siberia

Satellite Observing System

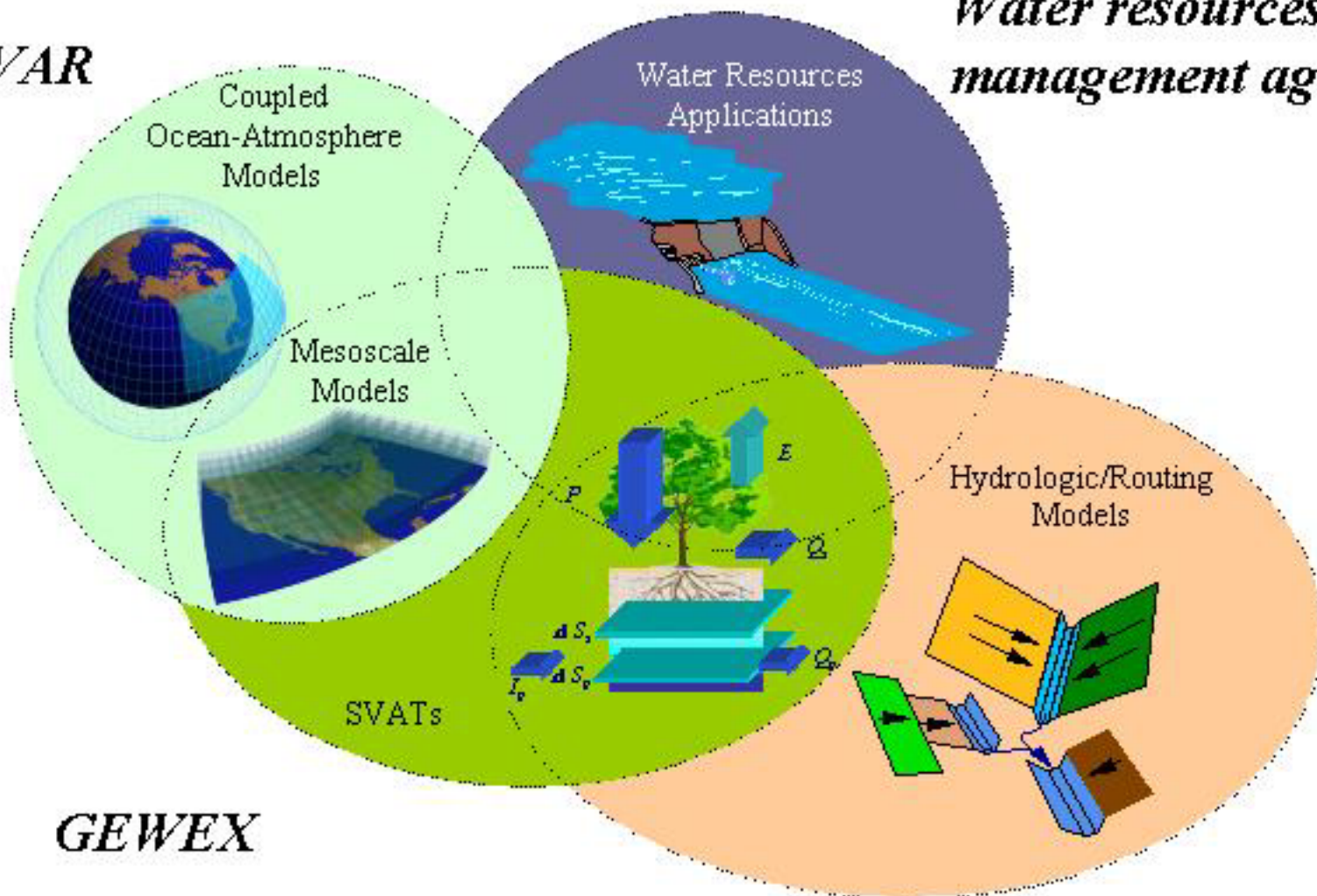
Asian Automatic weather stations Network (AAN)

Operational Met. & Hydrol. Data

Monitoring & Observation



*CLIVAR*



*Water resources  
management agencies*

*GEWEX*

*Hydrologic Services*

# Why do we need meteorological forecasting for water resources?

$$T_{LH} > T_D + T_C + T_U$$

- $T_{LH}$  : leading time by hydrological forecast
- $T_D$  : time for data collection
- $T_C$  : time for calculating forecast
- $T_U$  : time for utilization of the forecast

$T_{LH} < \text{Propagation/Travel Time of Water}$

$$\rightarrow T_{LH} + T_{LM} > T_D + T_C + T_U$$

- $T_{LM}$  : leading time by meteorological forecast

# How much time do we need to utilize the forecast information?

$$T_{LH} > T_D + T_C + T_U$$

- for storm drainage in cities: 30 minutes?
- for flash flood warning: 3 hours?
  - → Nowcast
- for reservoir operation for flood: 24 hours?
  - → Weather forecast
- for reservoir operation for drought: 3 months?
  - → Seasonal forecast
- for planning of infrastructure: 30 years?
  - → Climate simulation considering global warming

## GAME-T Workshop in Thailand (Bangkok, 1998)

96 Workshop on GAME-T in Thailand  
The National Research Council of Thailand  
Bangkok, Thailand  
22-25 June 1998





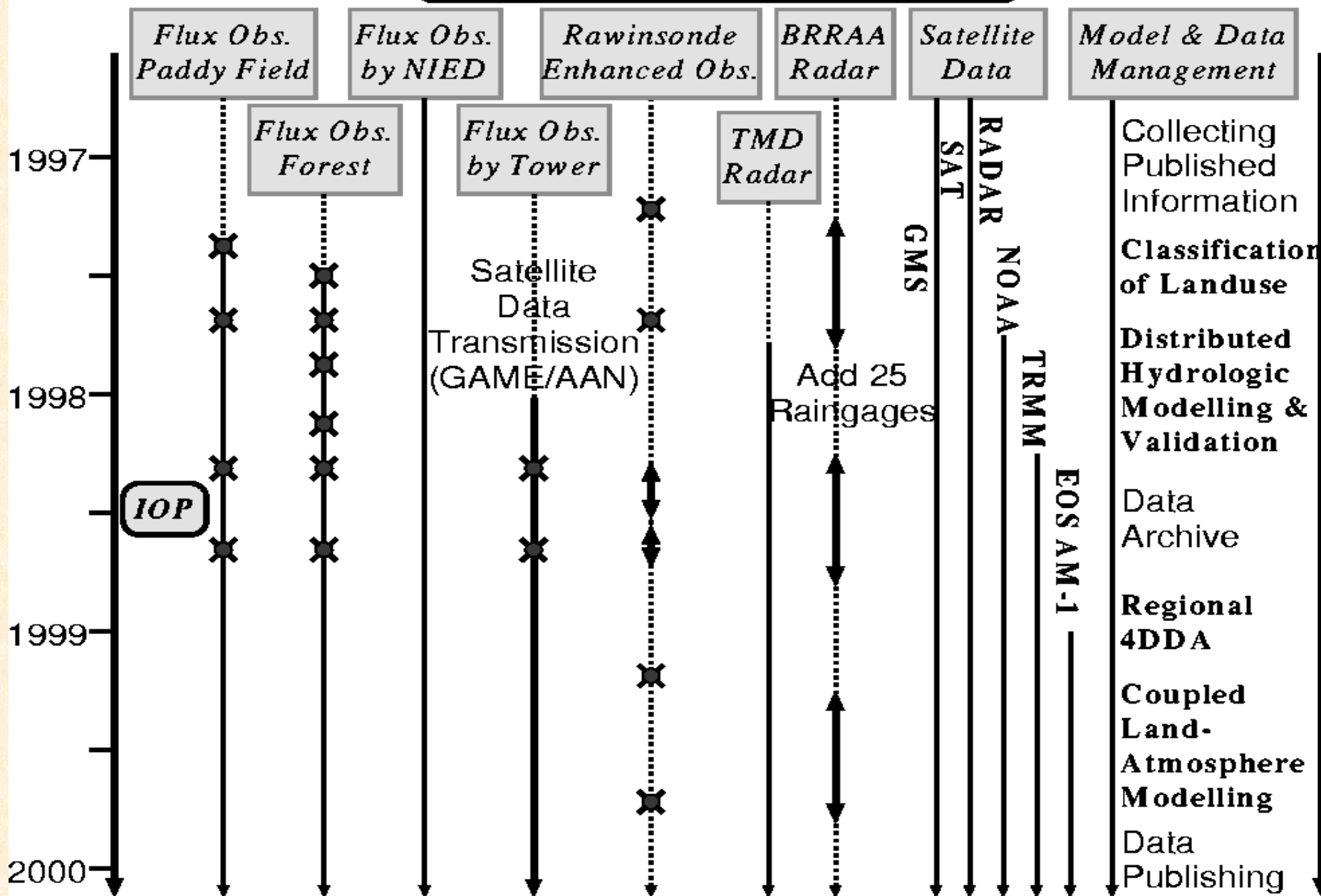




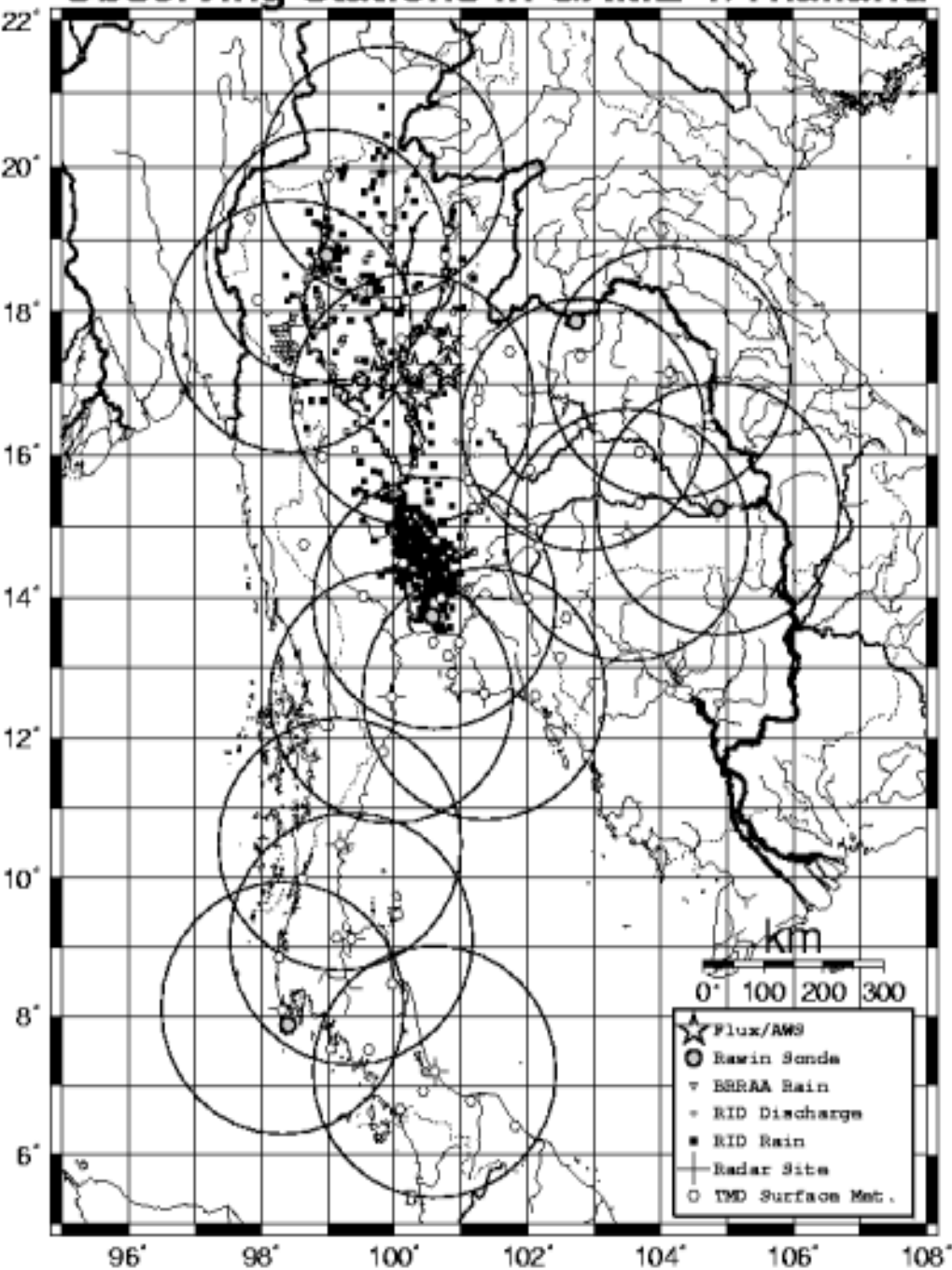
(as of May, 1997)

# GAME-T Chao Phraya Time Table

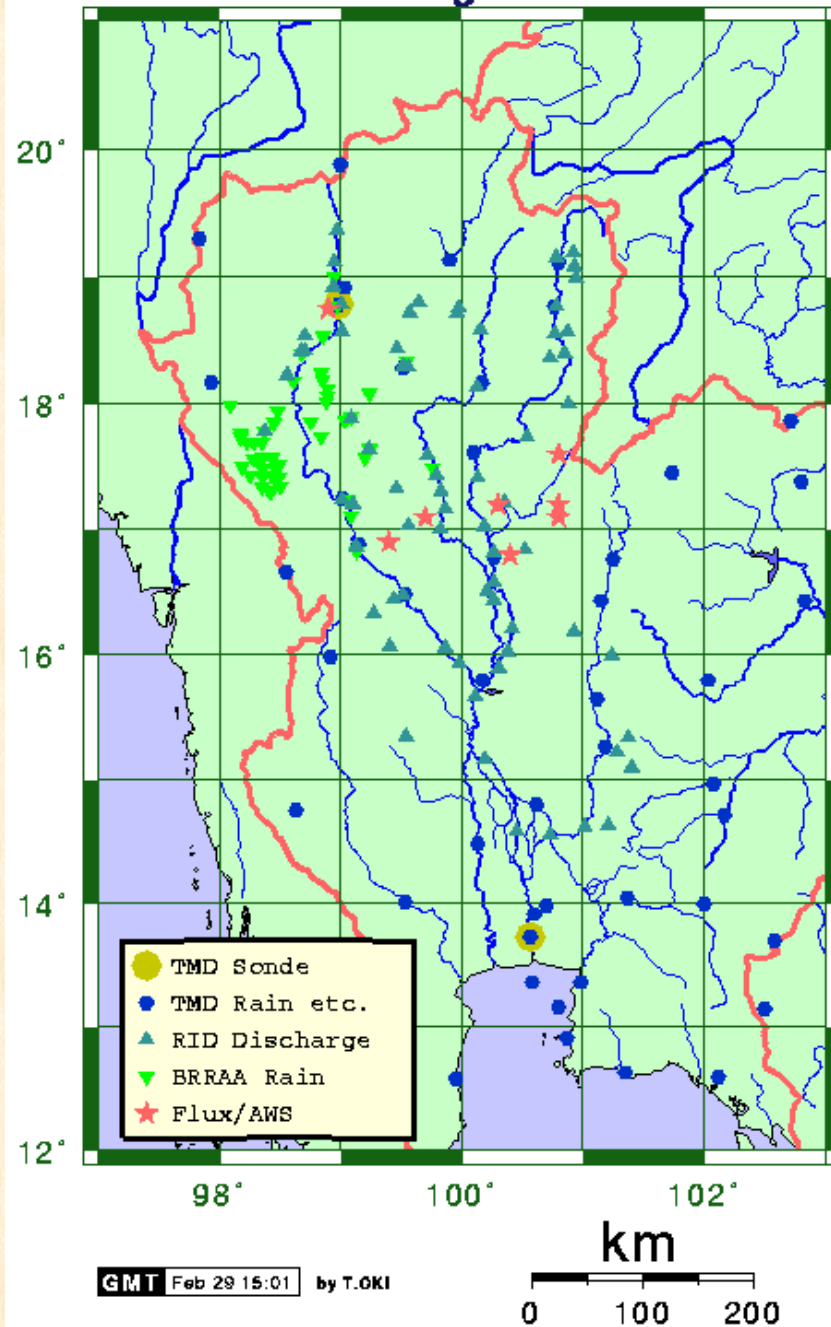
by T. OKI



# Observing Stations in GAME-T/Thailand



# GAME-T/Thailand/Chao Phraya Observing Stations





WEATHER RADAR WSR 74 C

OPERATE ON 25 FEB 1982

TYPE OF RADAR

FREQUENCY 5600 MHz

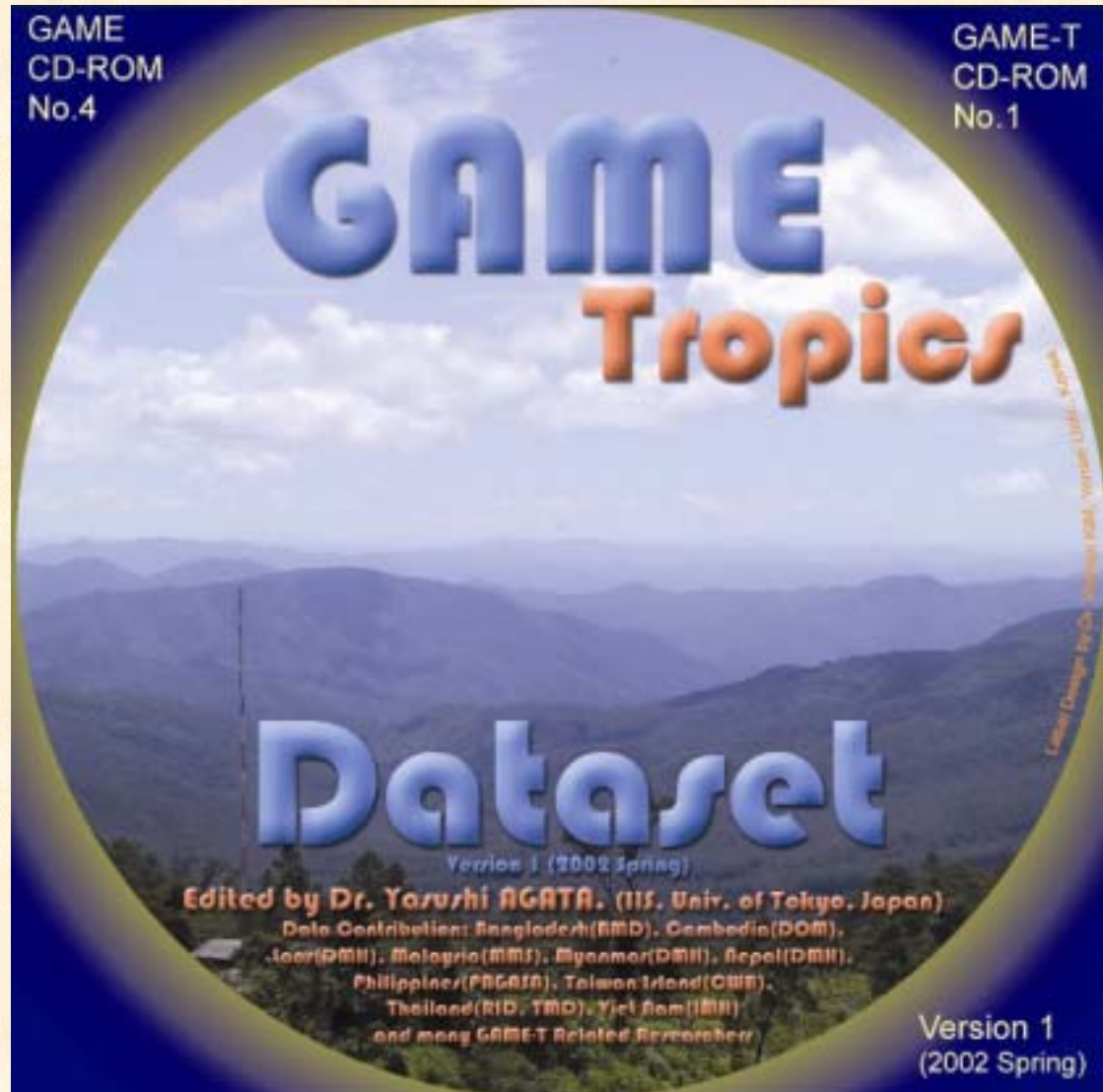
WAVELENGTH 5.3

RESOLUTION 1.5



# Recent Achievement [1]

- CD-ROM published
  - Complete ‘Snapshot’ of GAME-T database at June 2002.
  - Contains more than 8000 files (620MB)
  - Please take one!



# GAME-T Dataset



## DataCenter Top Page

GAME-T  
DataCenter

[GAME-T](#) >> [DataCenter](#) (Current Position)

### Navigation

Choose Link!

- [GAME-T TOP](#)
- [Documents](#)
- [DATA](#)
  - [Field](#)
  - [Sonde](#)
  - [Routine](#)
  - [R/S](#)
  - [Satellite Data](#)
- [Related Links](#)
- [Maps](#)
- [Obs. List](#)
- [Contact Persons](#)
- [Original Data Files](#) (GAME-T

### Data Contents

#### [Field Observations](#)

Flux observations at paddy field and forest, Experimental Basin Observation and Soil Moisture Measurement

#### [Sonde Observations](#)

Rawinsonde enhanced observation etc.

#### [Routine \(Station\) Observations](#)

Routine Obs. Data (Rainfall, Air Temp., Wind Velocity, River Discharge etc.) by local authorities, including both routine and radar observation.

**2002 Aug. 8-9 RID daily river discharge 1980-1994**

#### [Remote Sensing](#)

Remote sensing activities other than satellite observation.

**2002 Jun. 10-11 : GPS Observation datacenter opened**

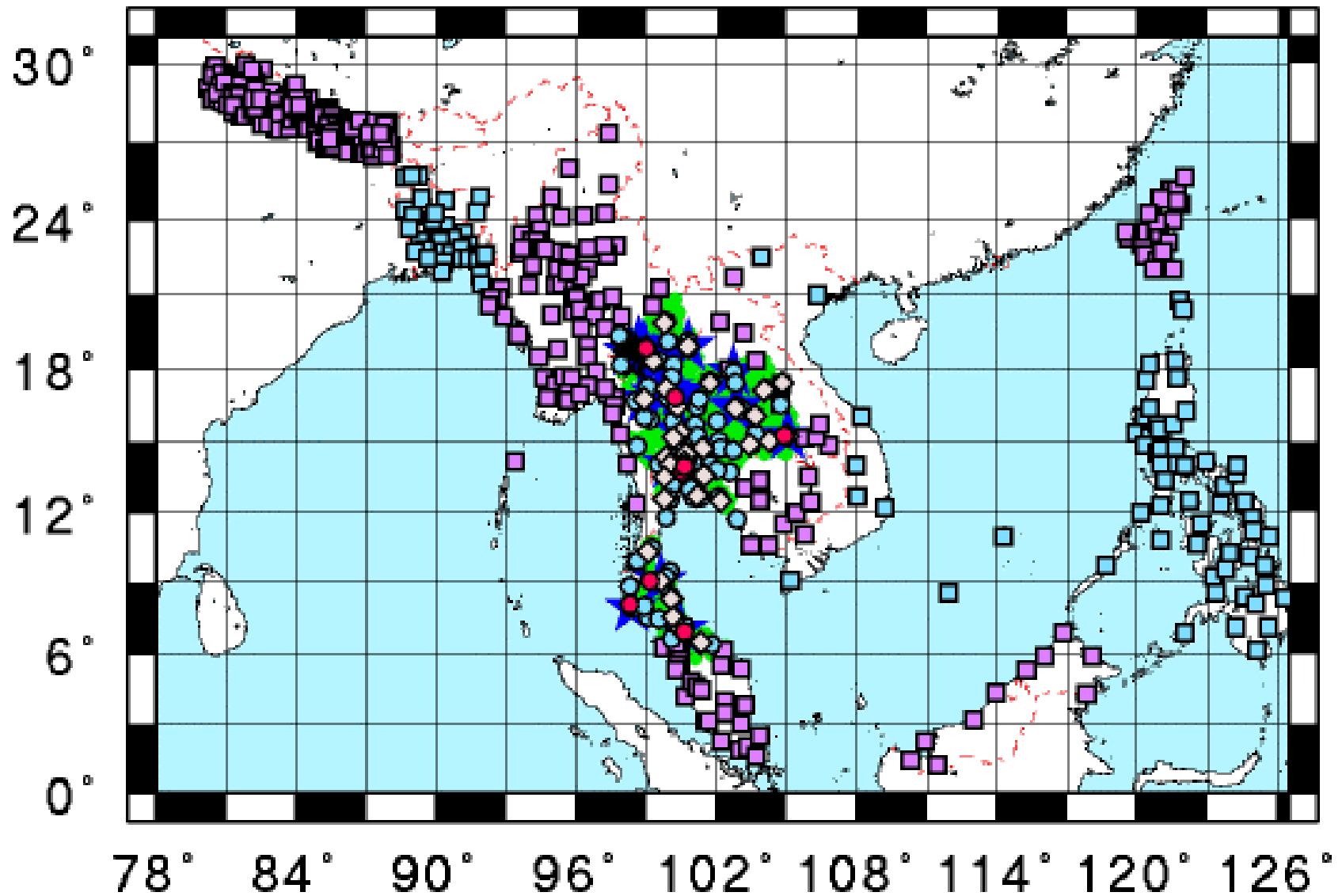
### What's New

Oct. 8, 2002  
New Item :  
[Original data files](#) provided by each organization and/or researchers.  
Opened only for GAME-T members.

Oct. 7, 2002  
**Errata**  
**Correction** :  
The zipped archive of daily discharge file



# Routine Obs. Stations



# Recent Achievement [2]

- **New DB Server** was installed in NRCT, Thailand
  - Maintained by NRCT's staff
  - Contents are the same as that of Univ. of Tokyo's Server (rsync)



**<http://game-t.nrct.go.th/GAME-T/>**

# Discussions for GAME-T2

- 
- The background image shows a workshop event. A table covered with a pink cloth is in the foreground, adorned with a large bouquet of purple and white flowers. Two people are seated at the table. A banner in the background reads "2000 Workshop on GAME-T in Thailand during 6-7 March 2000". Another banner below it says "THE LONG BEACH - AM HOTEL PETCHABURI, THAILAND".
- **GAME-T Workshop in Petchaburi (Mar. 2000)**
  - **GISP in Tokyo (June 2000)**
  - **Omkoï meeting (August 2000)**
  - **GAME-T Workshop in Phuket (March 2001)**
  - **GAME Conference in Nagoya (October 2001)**
  - **GAME-T Workshop in Chiang Rai (Oct. 2002)**
  - **.... and other domestic meetings**

# GAME-T2

- **Program-project framework (multi-funding) from a few countries will be implemented.**
  - **Japan: MEXT/RIHN, JST/CREST, JAMSTEC, NASDA, JICA, Thai: MOAC, NRTC, USA: NSF...**
- **Related programs:**
  - **CEOP (IGOS)**
  - **GLASS, GCSS, WRAP (GEWEX)**
  - **WWDR, WWAP, HELP, IHP, PUBs(UNESCO)**
  - **IGBP?**
- **Time frame:**
  - **ITP 2 years, Apr 2002-Mar 2004 (GAME-2)**
  - **+ 3 years, Apr 2005-Mar 2008 (GAME is over)**

# Scientific Objectives of GAME-T2

- **Promote hydrometeorological science in Tropical Southeast Asia**
  - Numerical modelings
  - Satellite data assimilations
  - Data sharing and communications
- **Social application of the latest scientific achievements**
  - Advanced hydrometeorological monitorings
  - Comprehensive water resources assessments
  - Integrated water resources management



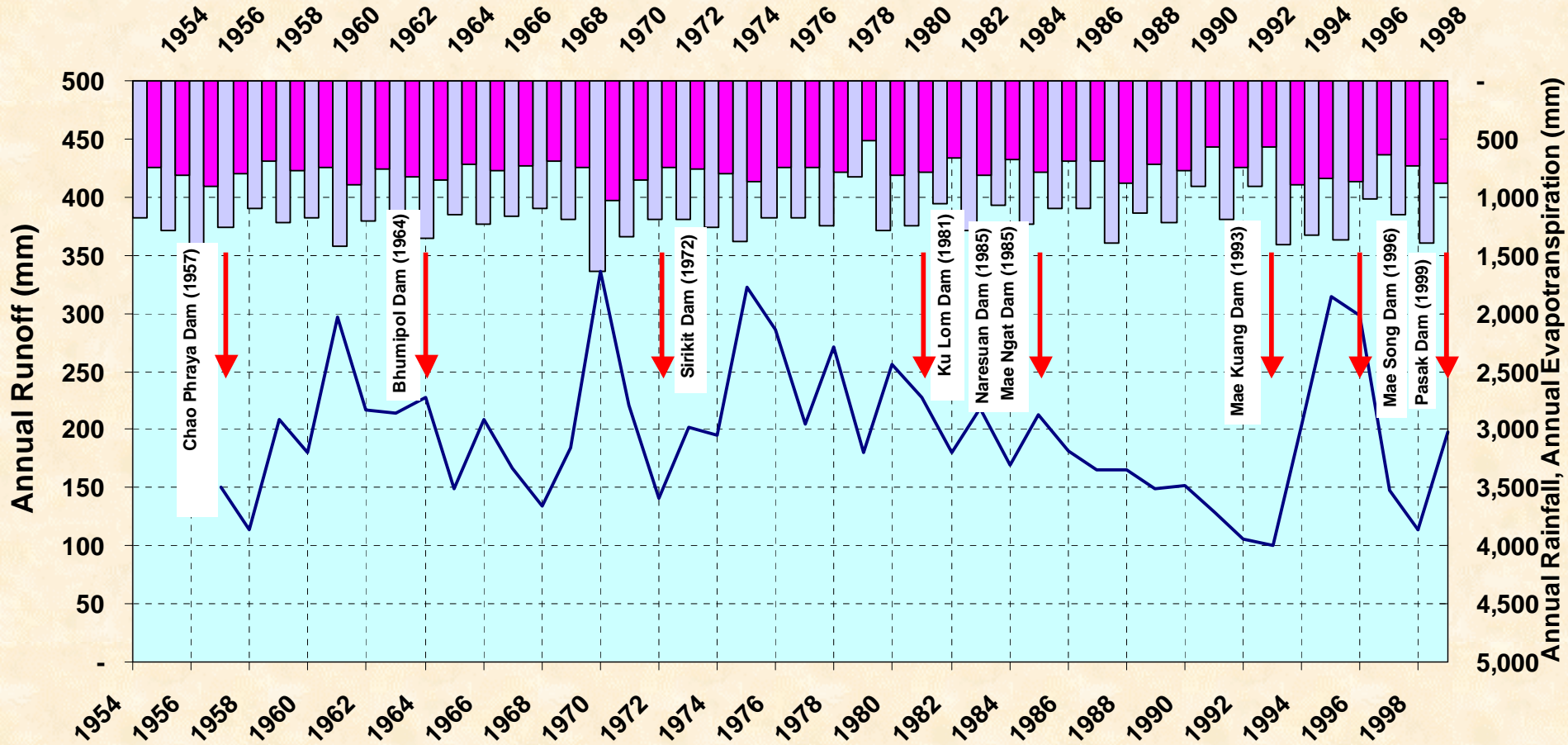
# Continuation from GAME-T

- **GAME-T Workshop once a year**
- **Flux measurements at: Kog-Ma, Pan Khum Watershed, SiSamrong, Shkhothai paddy field, teak forest, cassava, and EGAT tower**
- **Raingauge network in MaeCham river basin**
- **Radar observations**
- **Radiometers**
- **GPS stations**
- **Royal Projects and new Thai project**
- **AVHRR & MODIS data receiving**
- **+CEOP rawinsonde & wind profiler**

# Research Topics [I]

- **Comprehensive study on the decrease of discharge in the Chao Phraya river basin**
- **Impact of rainmaking on regional hydrological cycles**
- **Irrigation control/integrated water resources management**
- **Seasonal forecasting of Asian Monsoon rainfall**
- **Future projection on the water demand**

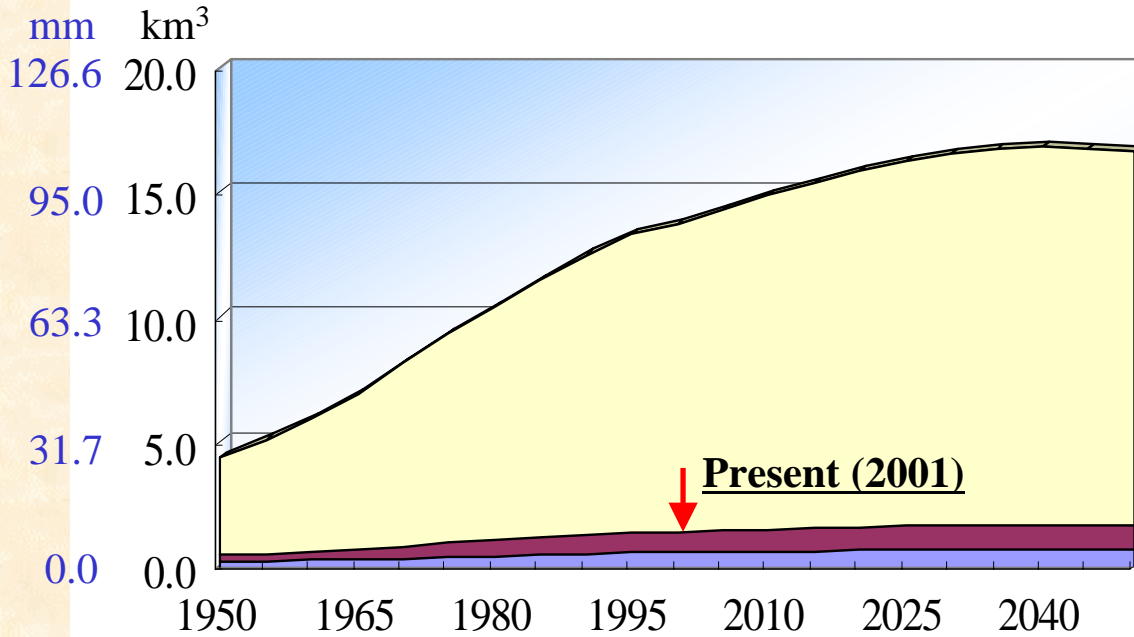
# Water Balance in Chao Phraya River Basin



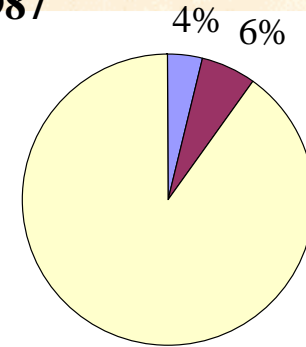
- : Annual Rainfall (average of 9 rainfall stations)
- : Annual Evapotranspiration
- : Annual Runoff at Nakhon Sawan (C2)



# Water withdrawals by each sector in Chao Phraya River Basin



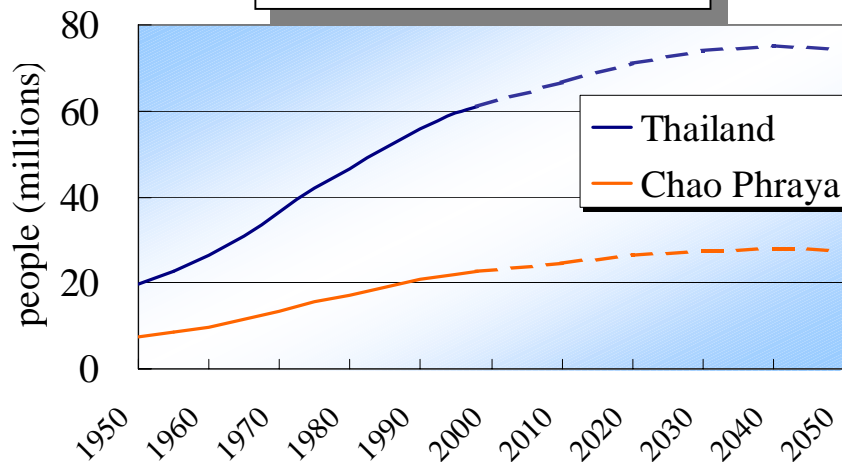
Distribution of water withdrawals in 1987



Source : WRI, 1998

- : Agricultural
- : Industrial
- : Domestic

Population projections

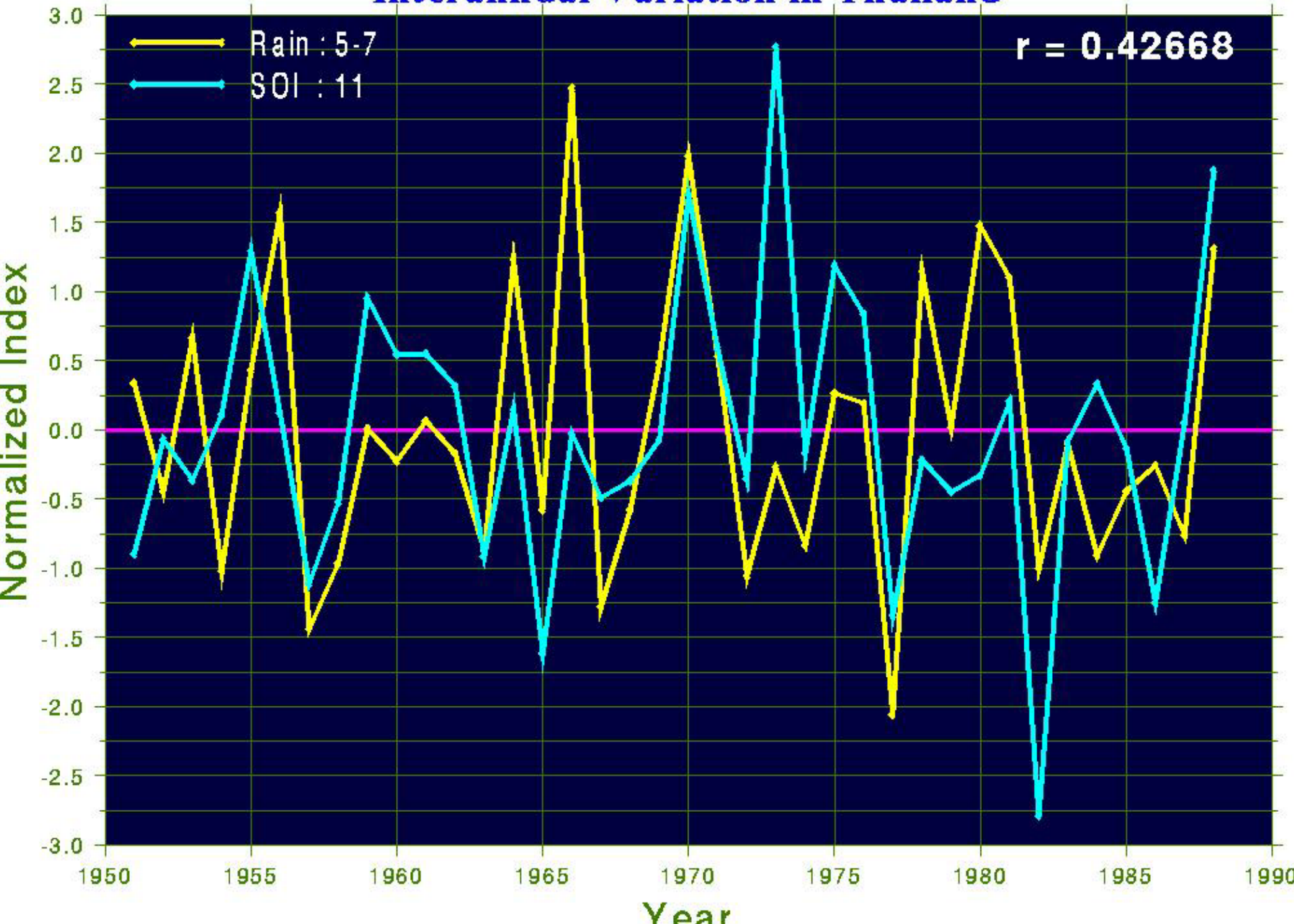


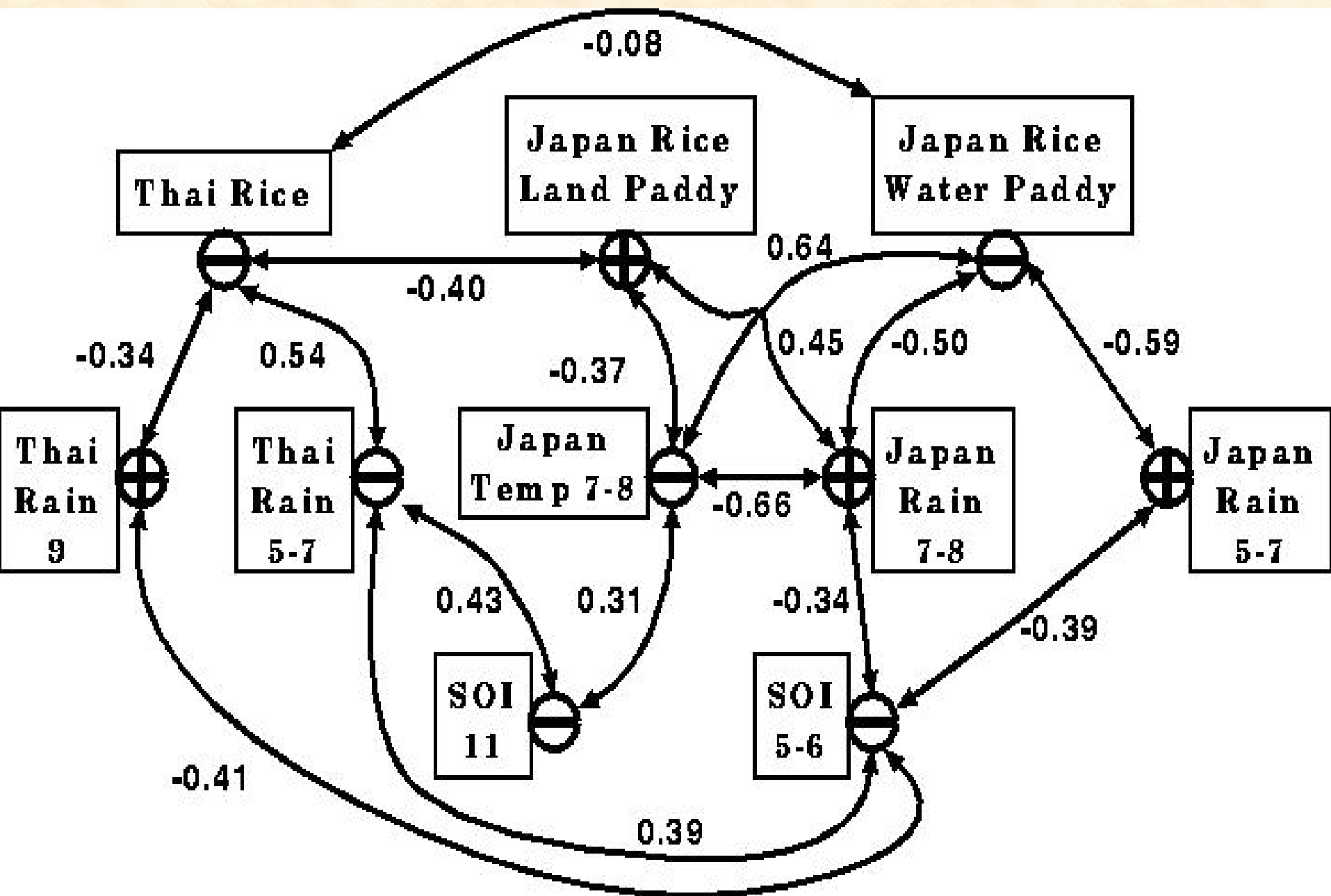
Source : UN, 1998, World Population Prospects

# Research Topics [II]

- **Flood forecasting**
  - **Telemetry, telecommunication and hydrological modeling**
  - **Typhoon and tropical cyclones**
  - **ENSO effect**
  - **Torrential rainfall, ex., Hay Yai in every 12 years?**
  - **Urbanization and deforestation**
  - **Associated with global change**

# Interannual Variation in Thailand

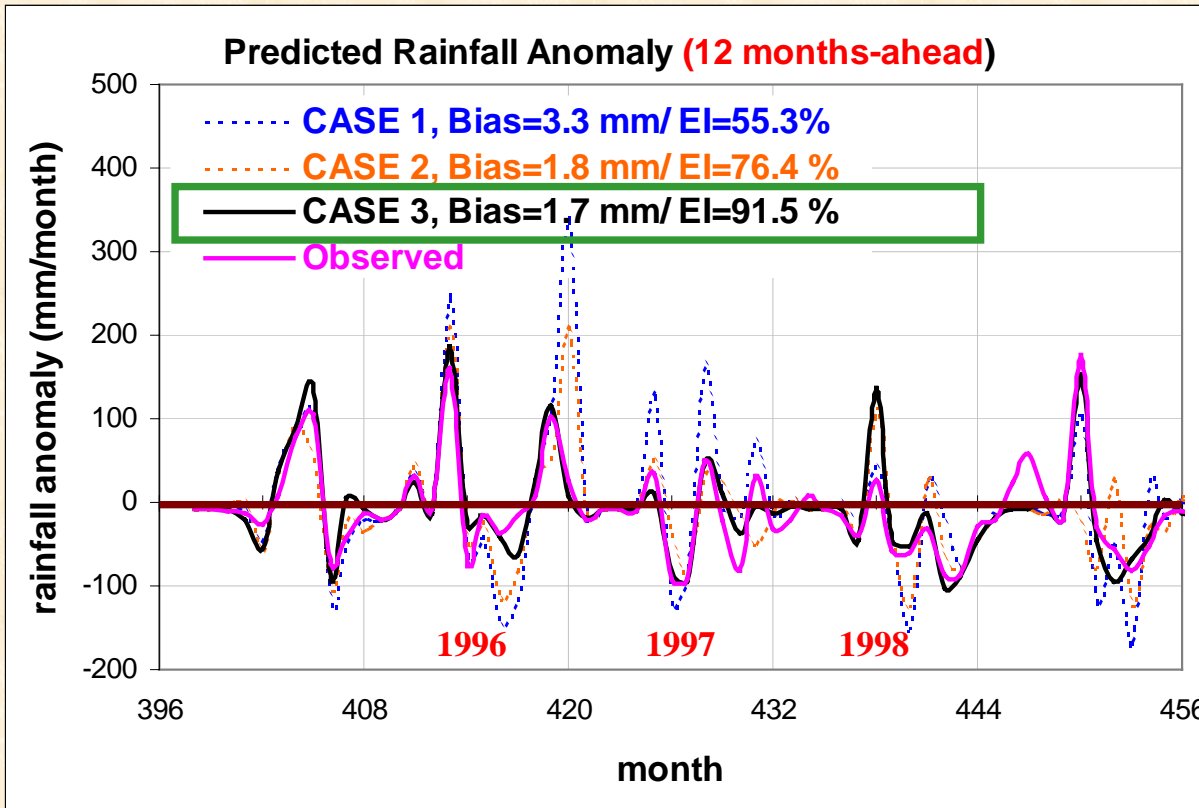




# Rainfall Anomaly Prediction

12 months ahead

3 areas-SST



### Case 1:

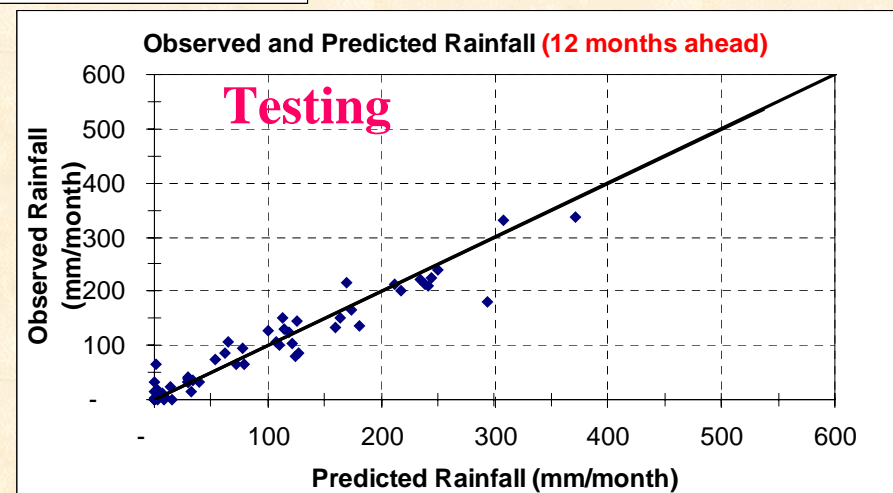
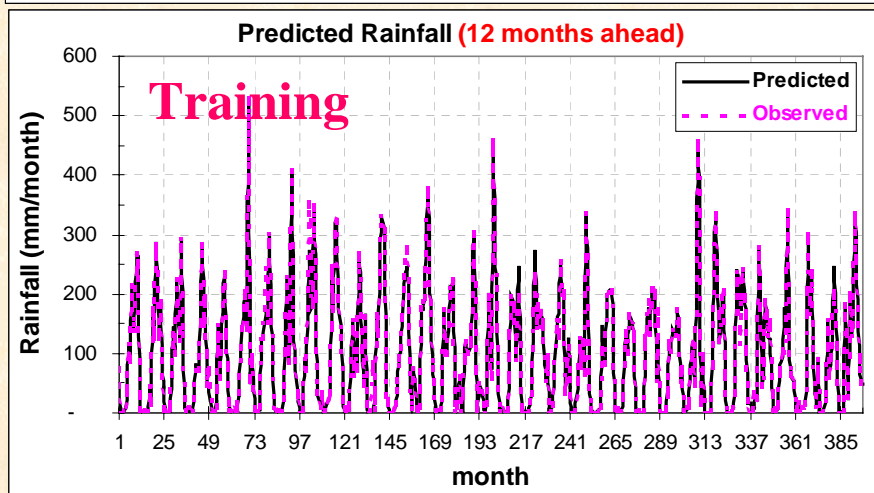
Train (1962-1979, 18 yrs),  
Test (1980-1999, 20 yrs)

### Case 2:

Train (1962-1989, 28 yrs),  
Test (1990-1999, 10 yrs)

### Case 3:

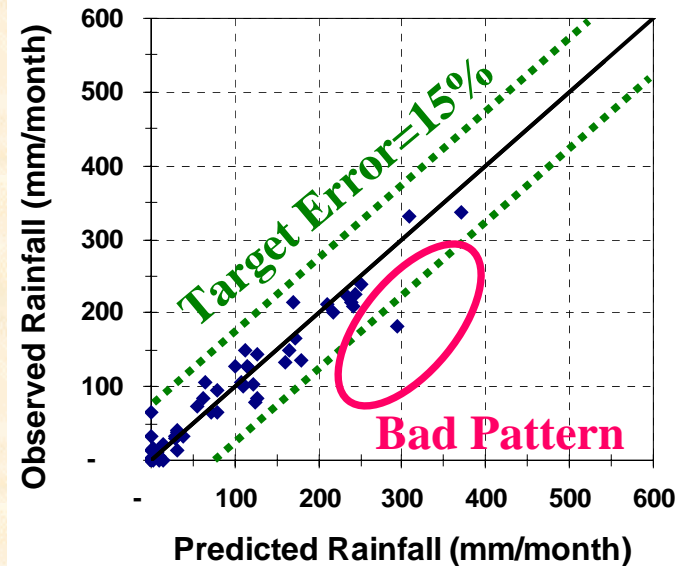
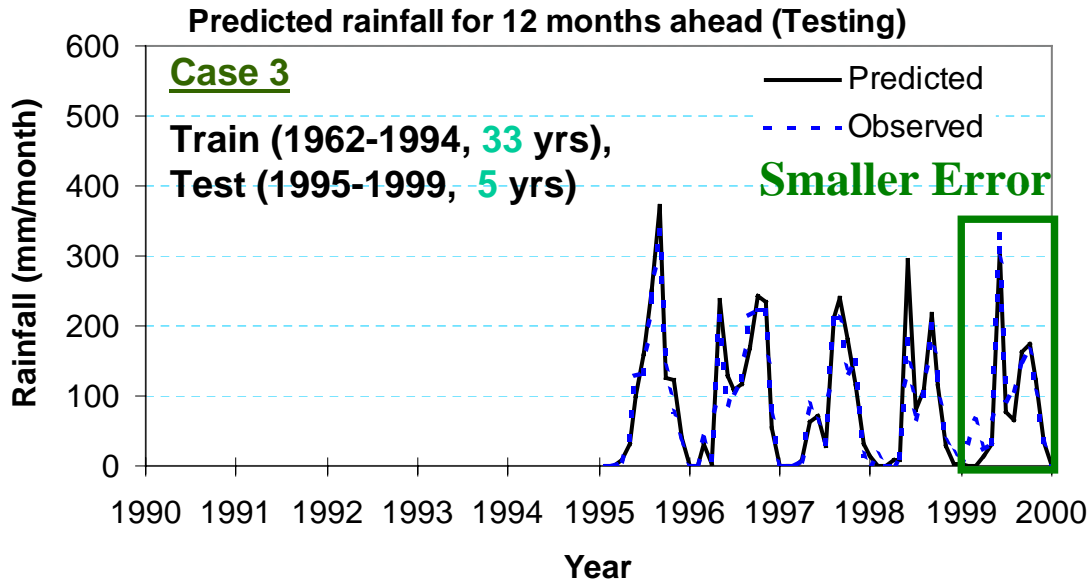
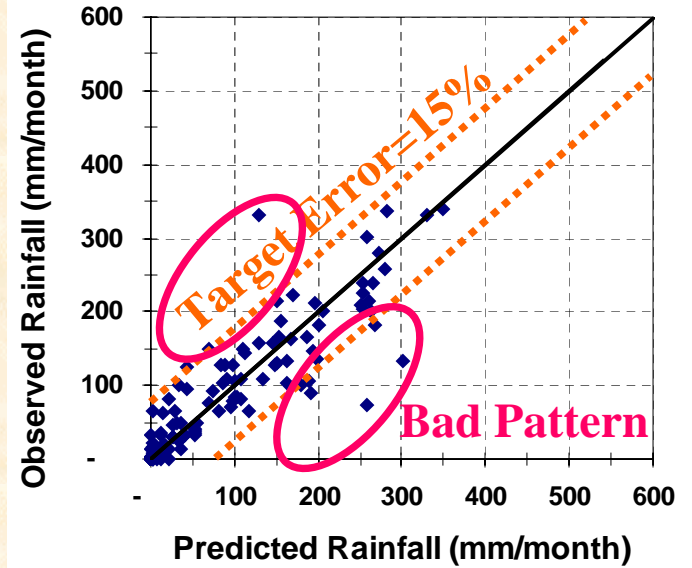
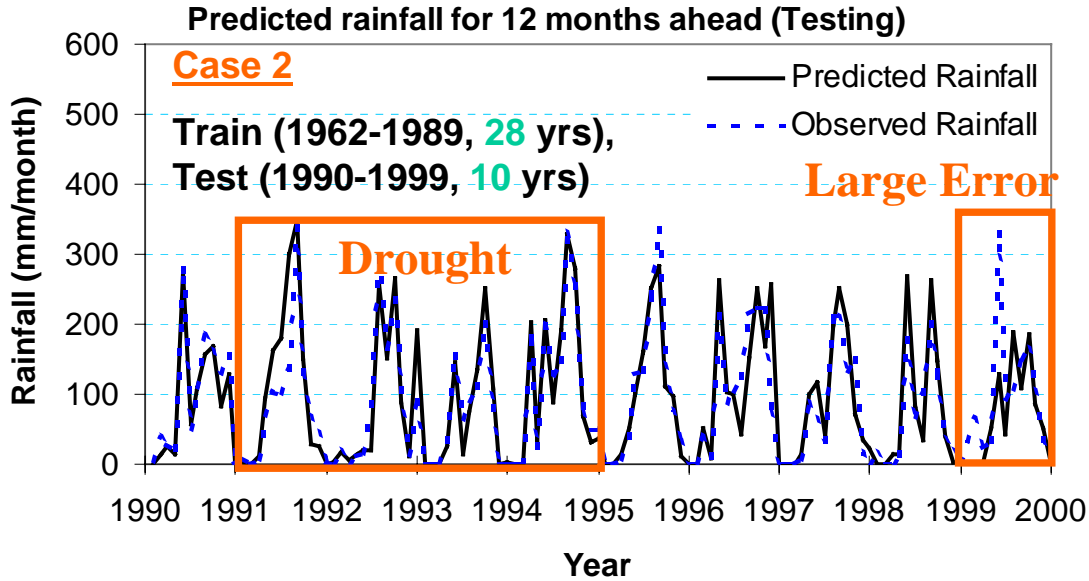
Train (1962-1994, 33 yrs),  
Test (1995-1999, 5 yrs)



# Rainfall Prediction

12 months ahead

3 areas-SST



2002 Workshop on GAME-T and Hydrometeorological Studies  
in Thailand and Southeast Asia

Organized by  
National Research Council of Thailand  
Japan Sub-Committee for GAME-Tropics  
29-31 October 2002  
Dusit Grand Resort Hotel, Chiangrai, Thailand



# Recommendations (1)

- **Capacity building in scientific research is one of the most important aspects of the project. More opportunities should be given for not too old (young) researchers in Thai, Japan, and other participating countries; opportunities such as exchange scholar, visiting program, participation to scientific conferences, and field survey.**
- **The formation of a new research group consists of not too old (young) scholars in Thailand with strong leadership is required.**



# Recommendations (2)

- **Further exchange of data and sharing information & idea should be promoted.**
- **Publication of a textbook summarizing the latest knowledge about the hydro-climatology in the South-East Asia will contribute for it.**
- **Existing facilities, such as GAME-T or monsoon study related mailing list both in Thai and Japan, should be utilized wisely.**

# Recommendations (3)

- Application of the latest scientific knowledge to human dimension should be encouraged.
- One possible target could be the investigation of the “**Scientific Basis for Hydro-meteorological Warning System**” in short, medium, and long ranges for flood and drought management with the basic understanding of Asian Monsoon System and the latest technology of monitoring and modeling.

# Summary

- **GAME-T Database is there:**

**<http://game-t.nrct.go.th/GAME-T/>**

- **How to utilize the data should be described through this seminar:**
  - theory
  - observation and data
  - analysis and phenomena
  - modeling and prediction
- **New research opportunities under GAME-Tropics/Phase II!**

ขอบคุณ ครับ

THANK YOU!



2002/10/30 19:42