

**GEOSS Joint Asia-Africa Water Cycle Symposium**

**GEOSS**  
**Water Cycle Integrator**

**Toshio Koike**  
**The Univeristy of Tokyo**

Ito International Research Center, Ito Hall, University of Tokyo, Hongo Campus  
25 – 27 November 2013

**Climate  
System**

Extremes

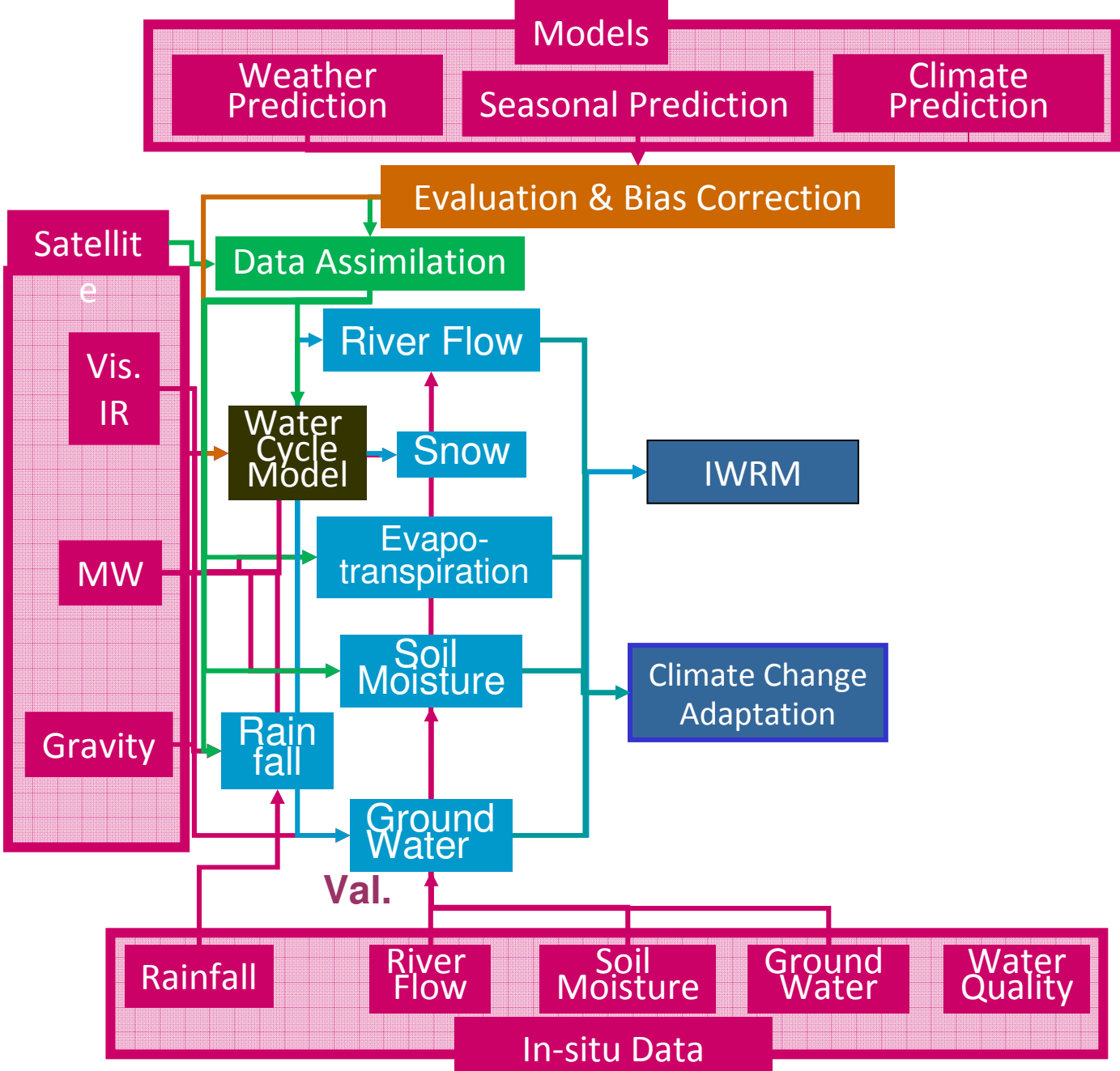
Regime Shift

**Water  
Cycle**

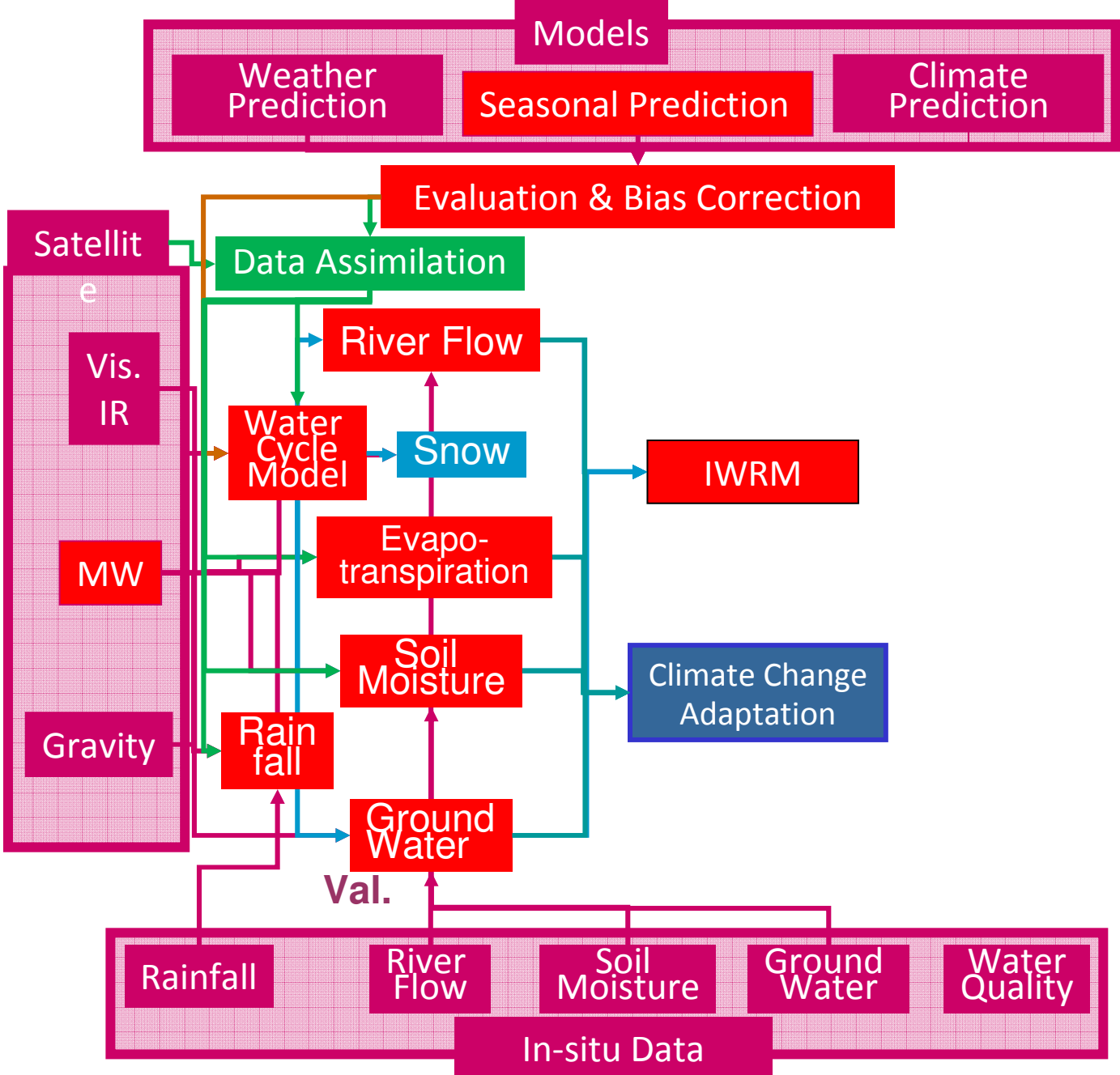
Flood/Drought

**Water  
Resources  
Management  
System**

# Water Cycle Integrator



# Water Cycle Integrator



# Drought Quantification: The Standard Anomaly Index

1) Transform the best-fit distribution pattern into a standardized distribution

$$x_{transformed} = \frac{x - \mu}{\sigma}$$

2) Normalize by calculating SA

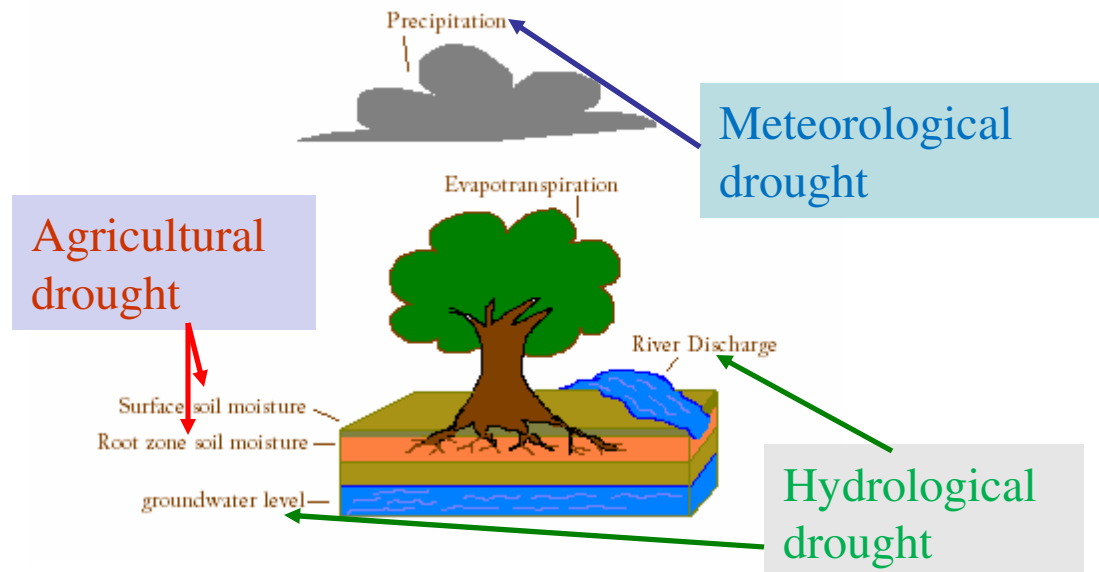
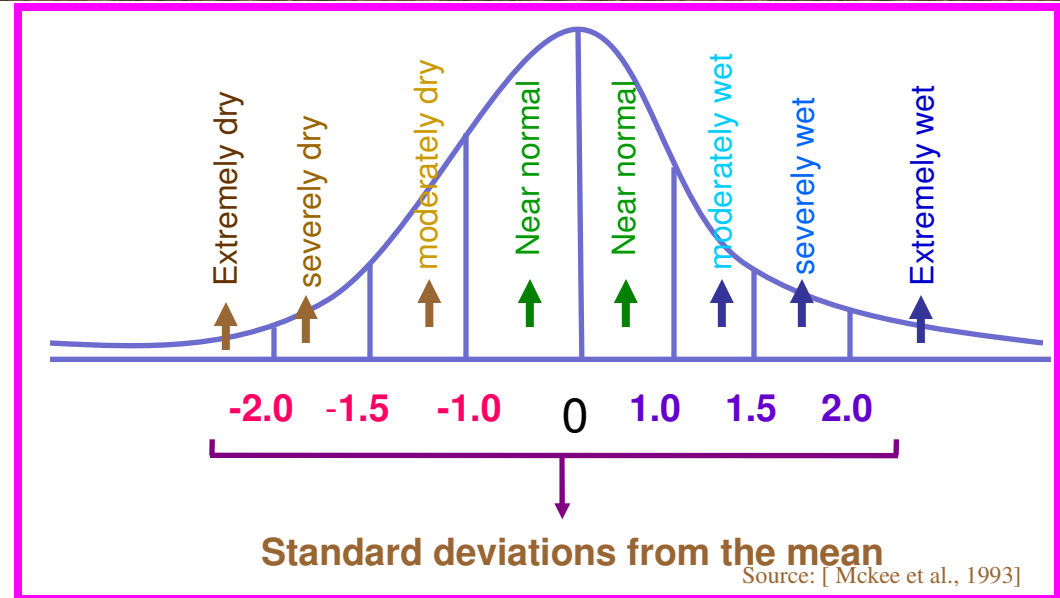
$$SA = Z = \frac{x_{transformed} - \bar{x}_{transformed}}{\sigma_{transformed}}$$

$$\sigma = \sqrt{\text{var}(x)}$$

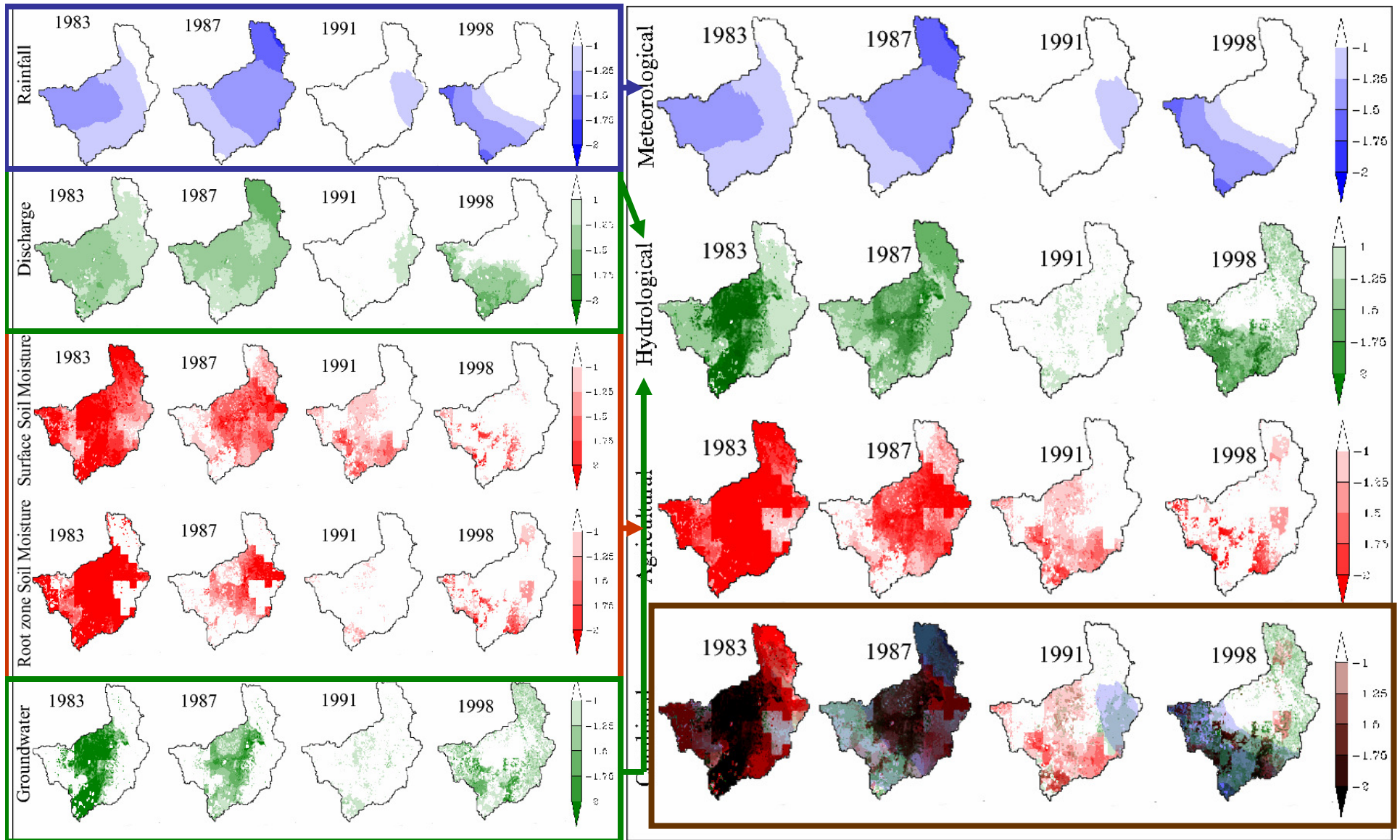
$$\text{var}(x) = \int (x - \mu)^2 f(x) dx$$

$$\mu = \int xf(x) dx$$

Jaranilla-Sanchez, P. A., et al. (2011),  
*Water Resour. Res.*, in press.



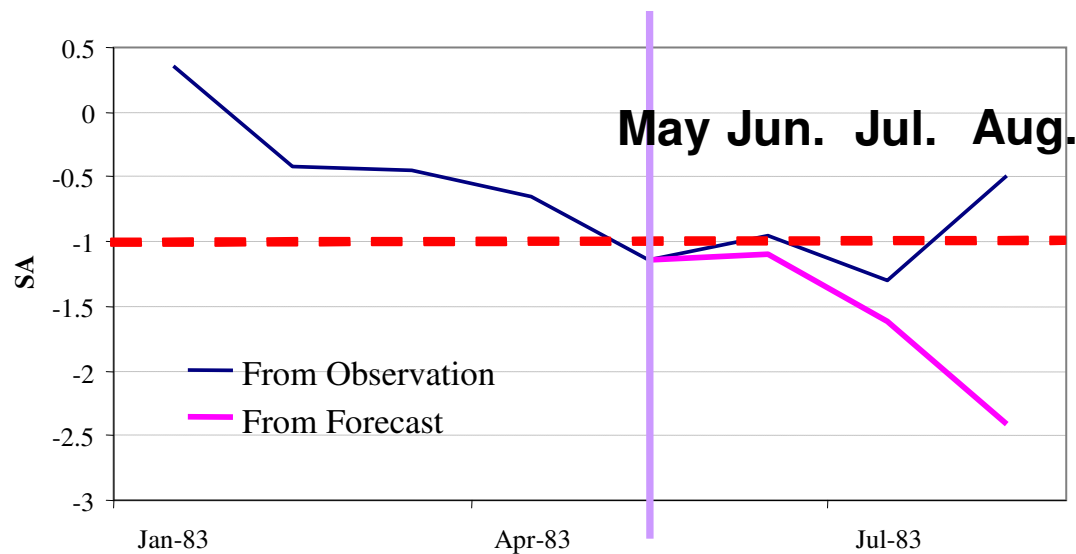
# Spatial SA: Philippines



# Seasonal Drought Prediction

Month	SA FROM OBSERVED DISCHARGE	SA FROM FORECAST DISCHARGE
June	-0.954	-1.010455
July	-1.30505	-1.61425
August	-0.4937	-2.41276

} Close enough, drought conditions can be forecasted



# Seasonal Drought Prediction

Months	1 <sup>st</sup>		2 <sup>nd</sup>		3 <sup>rd</sup>	
Year	Observed	SFC	Observed	SCF	Observed	SCF
1983						
1991						
1997						
1999-2000						

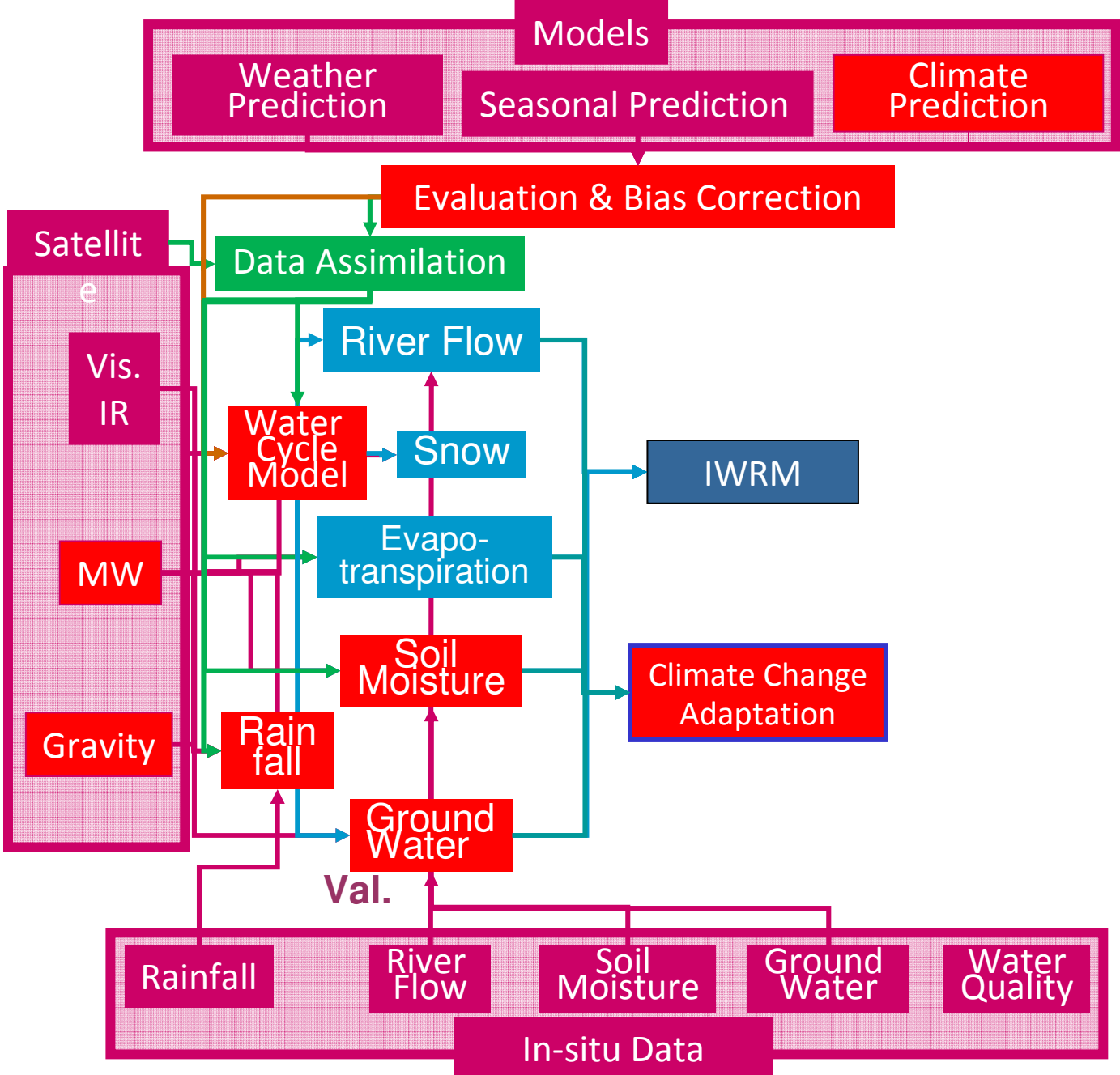
ARROW Legends: **red**= drought; **green**=normal; **blue**=wet

e.g. increase towards drought conditions

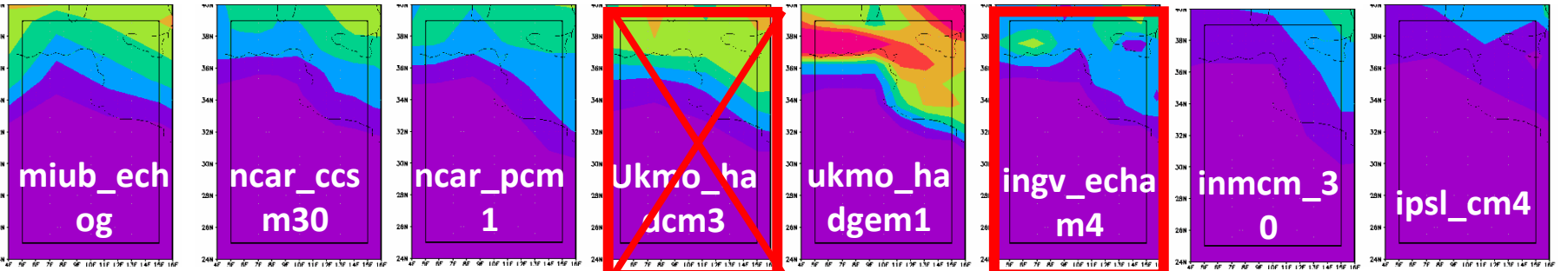
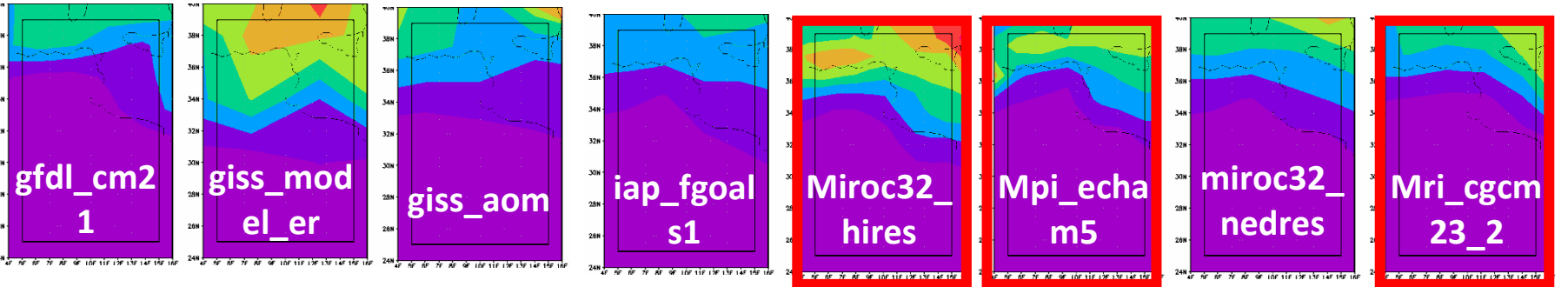
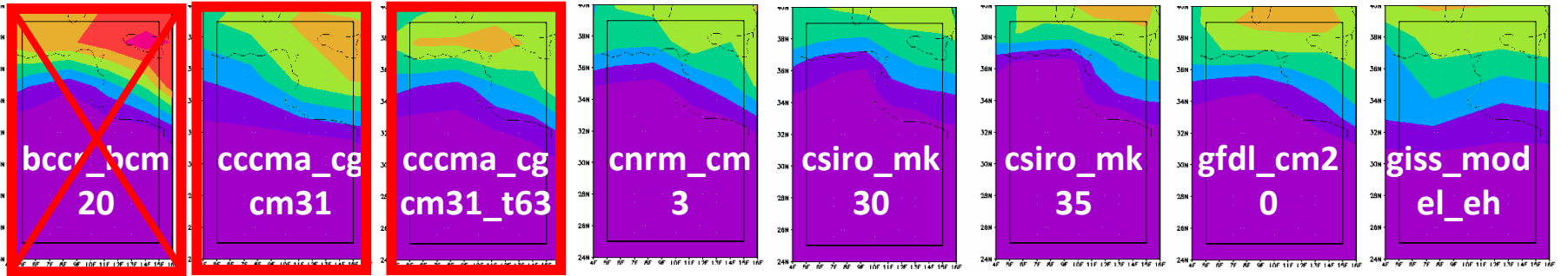
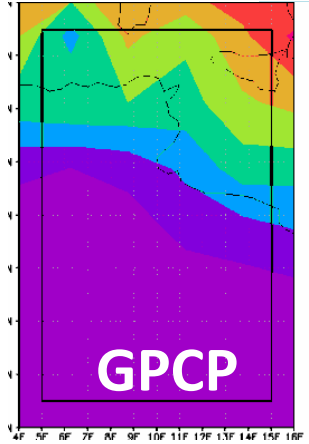




# Water Cycle Integrator

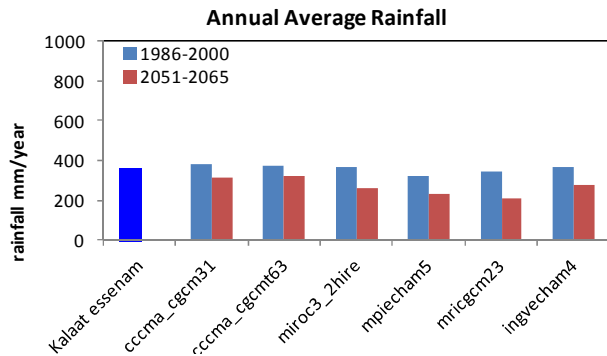


# Mejerda River Precipitation Oct – Jan (1981-2000)

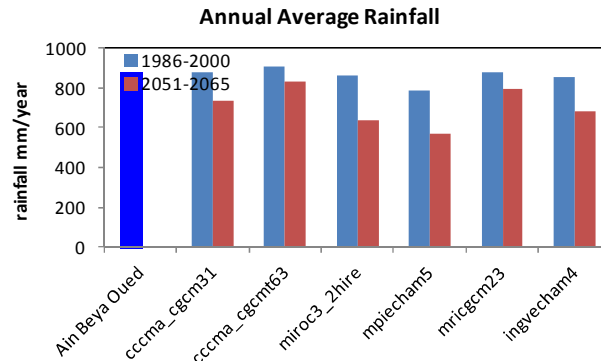


# Mejerda River

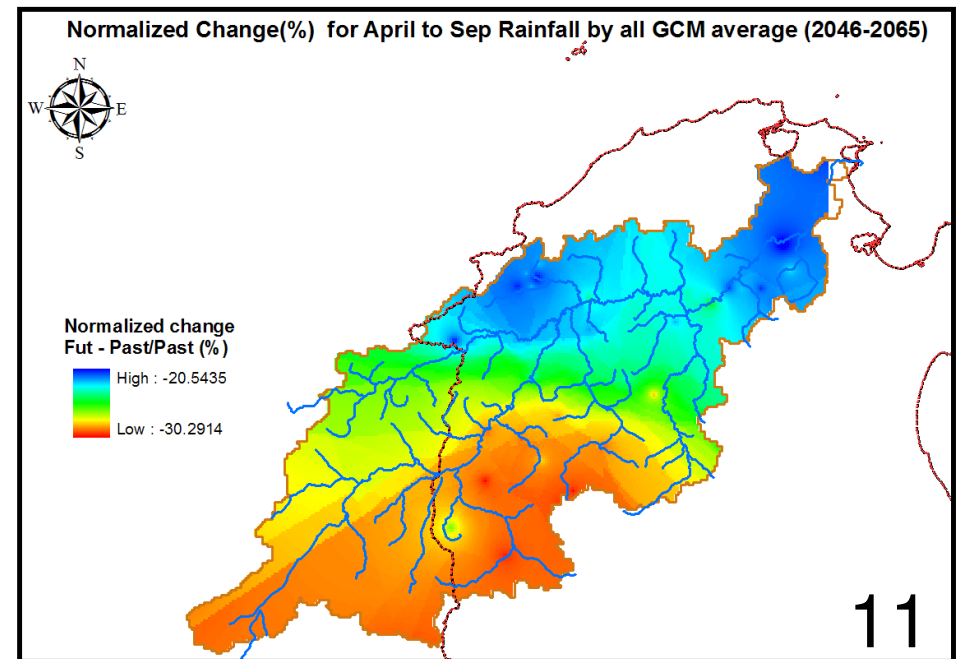
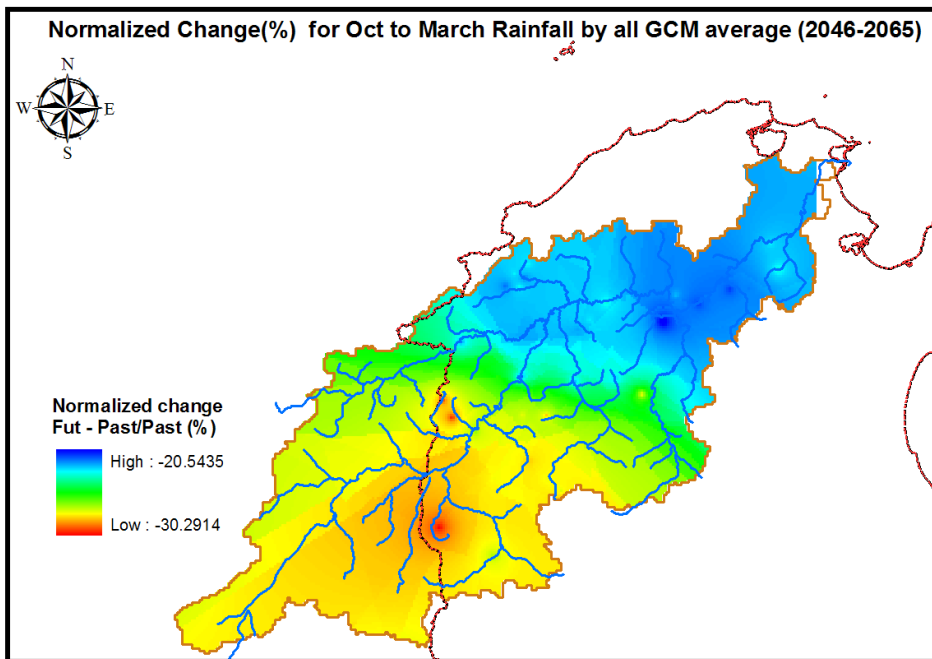
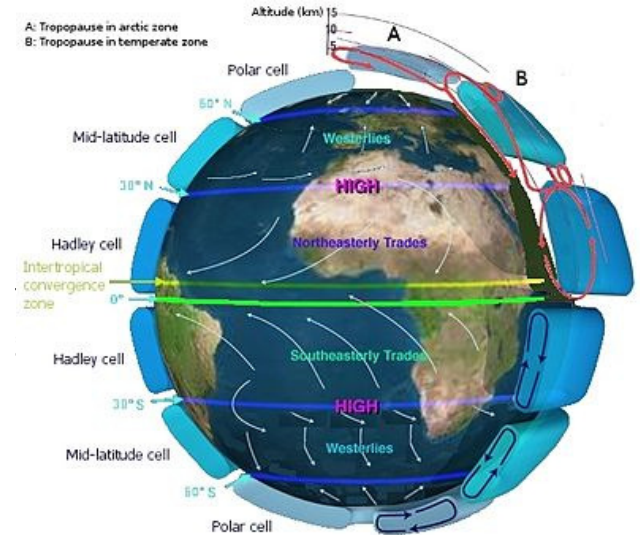
It is virtually certain that drought will become more severe.

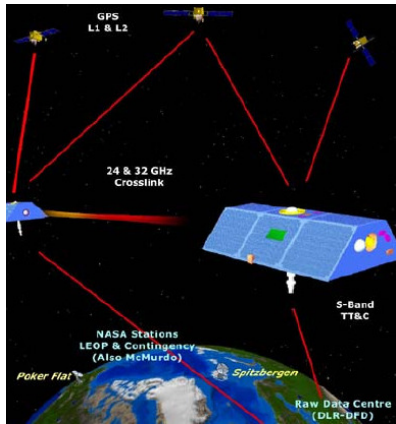


**KALAAT ESSENAM**

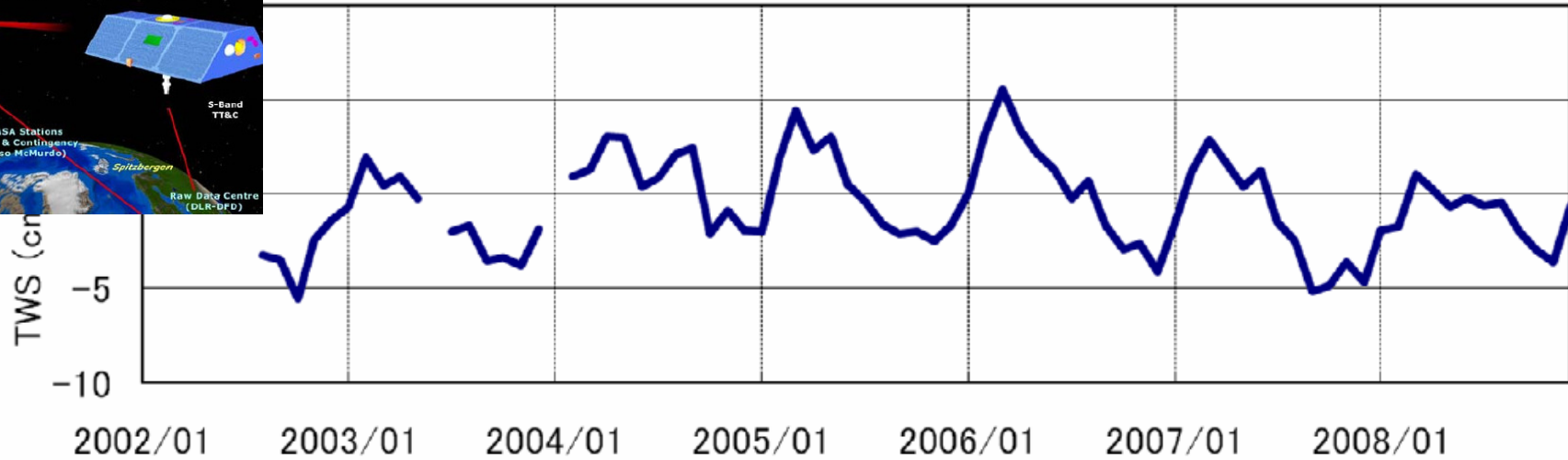


**AIN BEYA OUÉD**

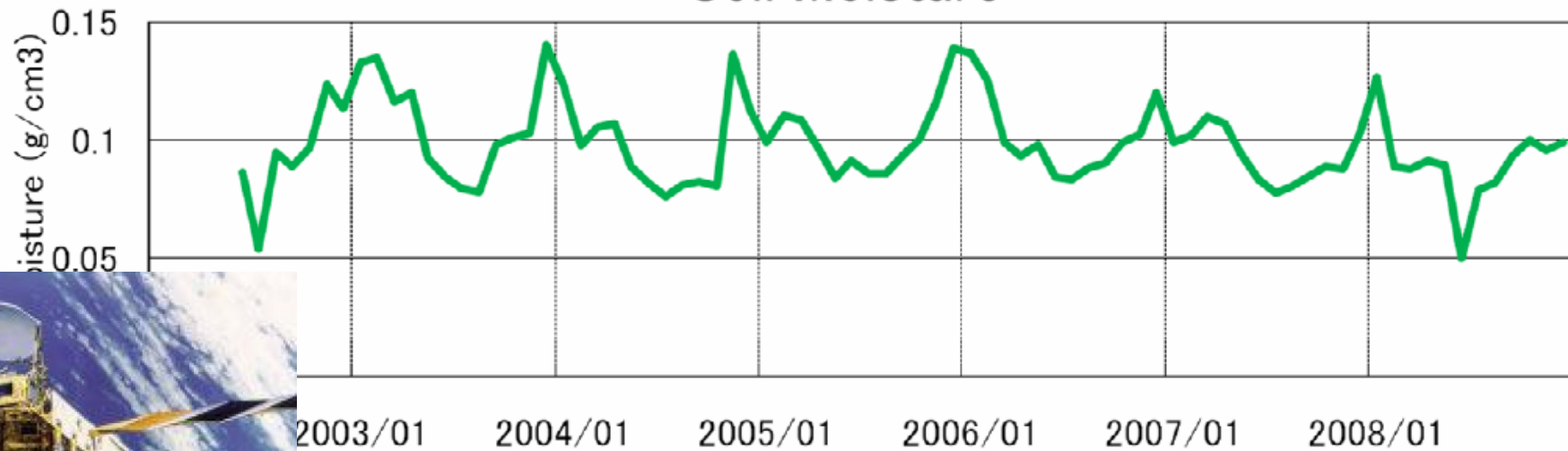


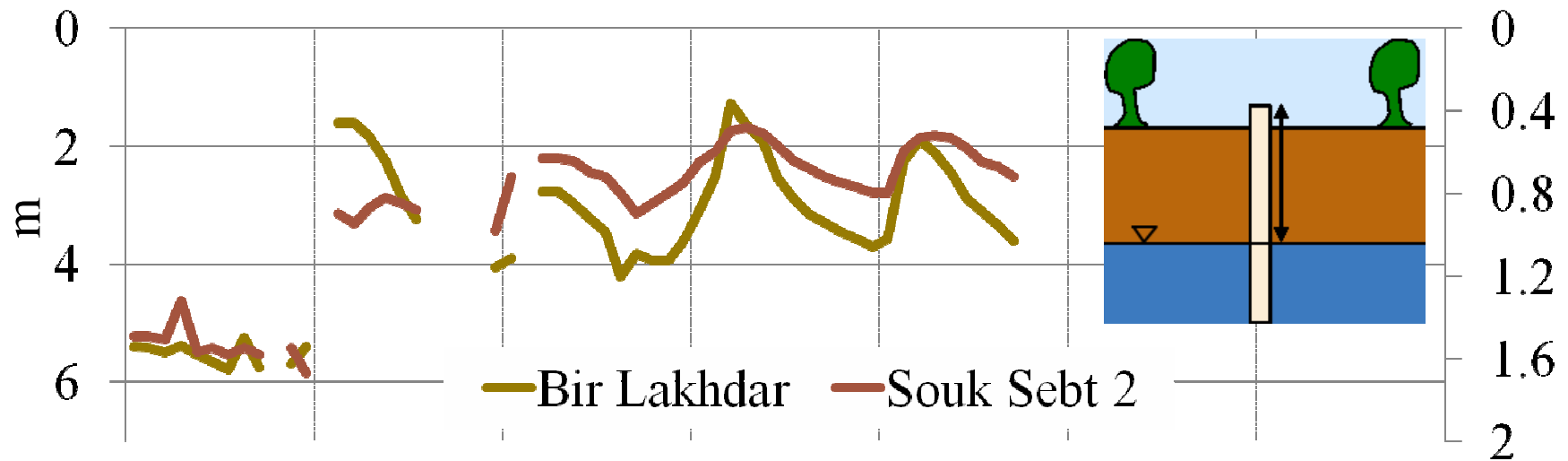
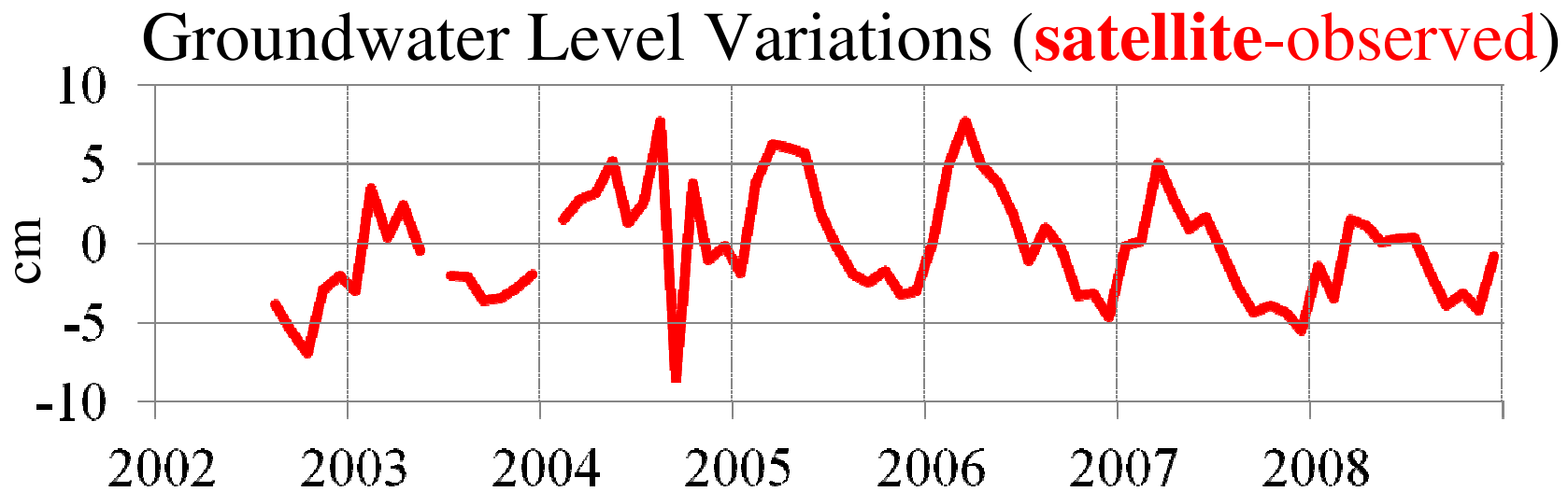


## Terrestrial Water Storage Change

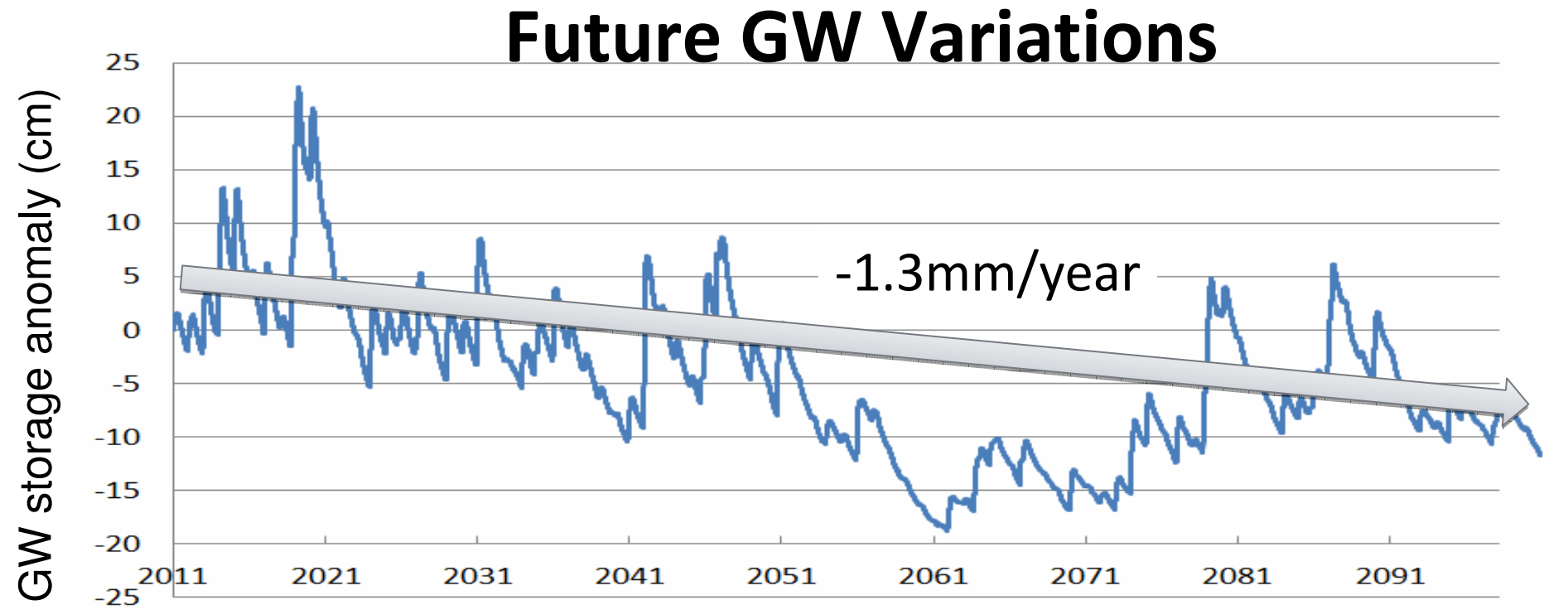
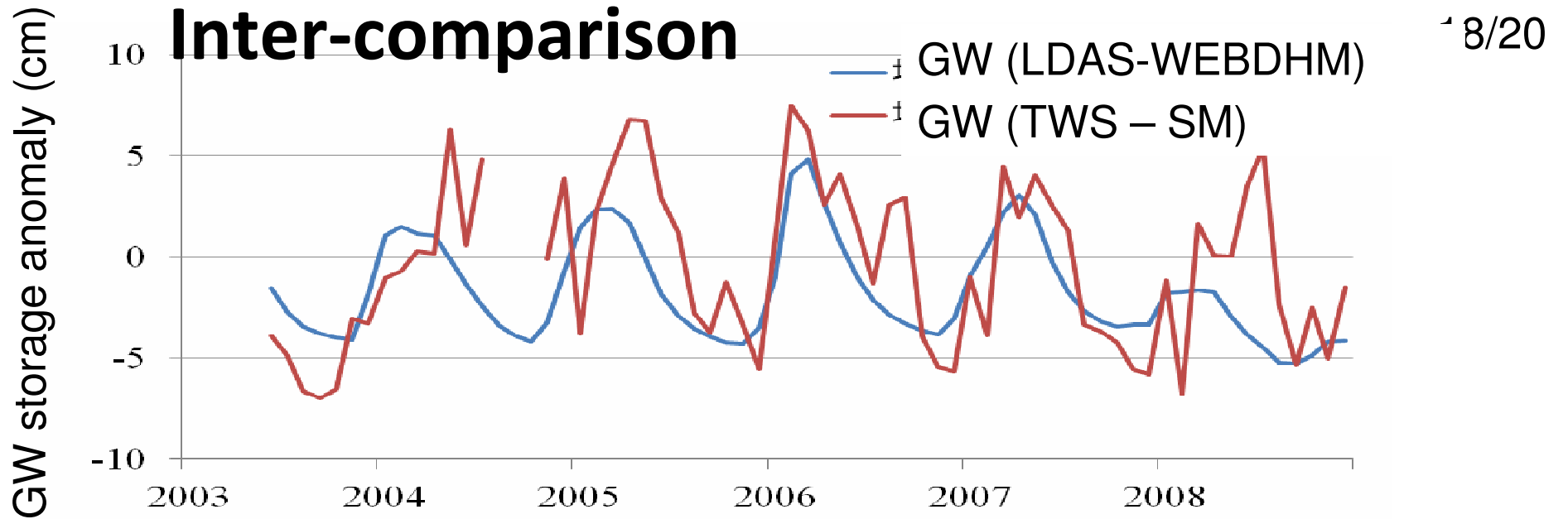


## Soil Moisture

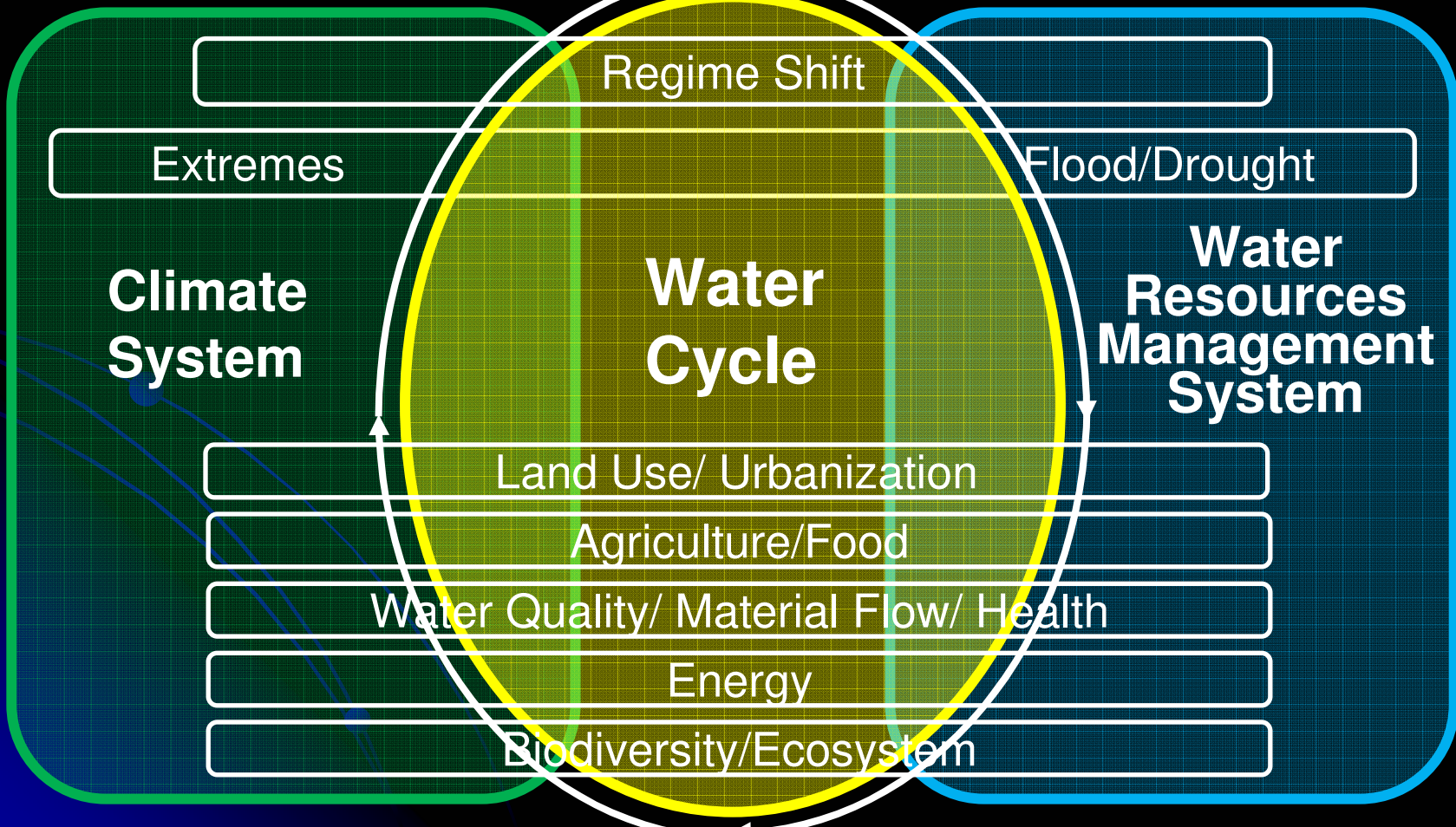




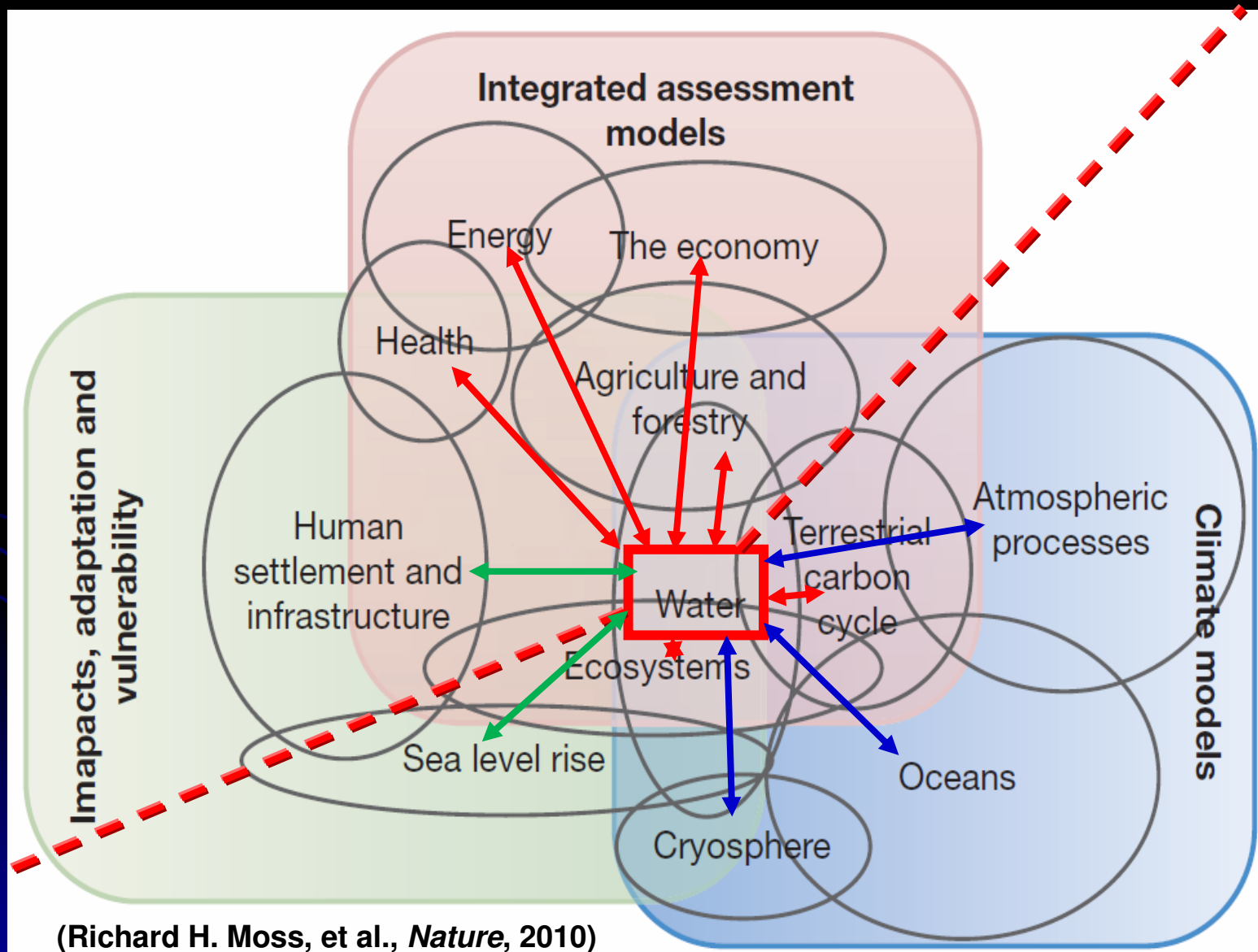
Groundwater Level Variations (**ground-observed**)



# Coordinated and Integrated Efforts for Working Together



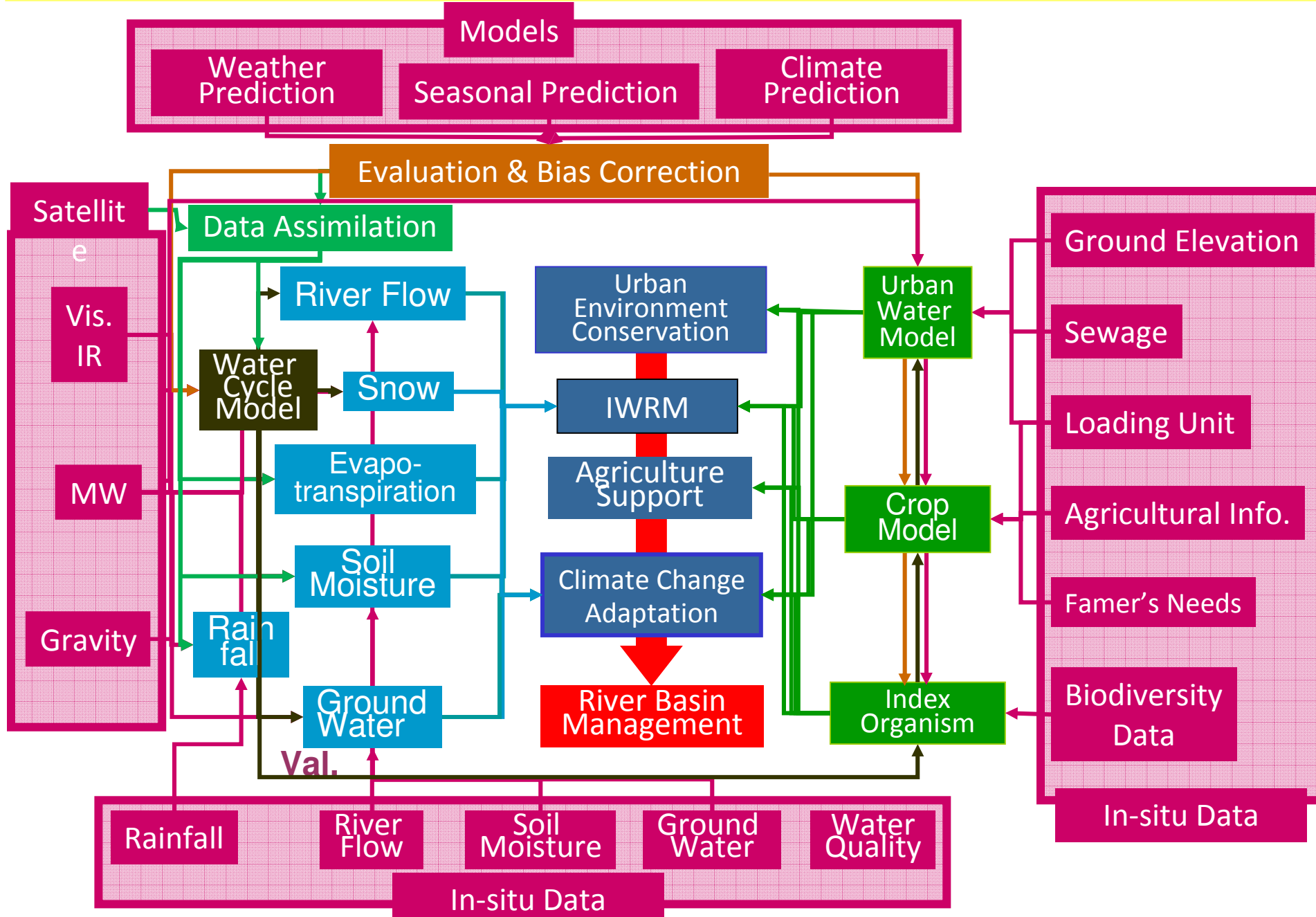
# Water is a Key bridging between climate processes and societal benefits.

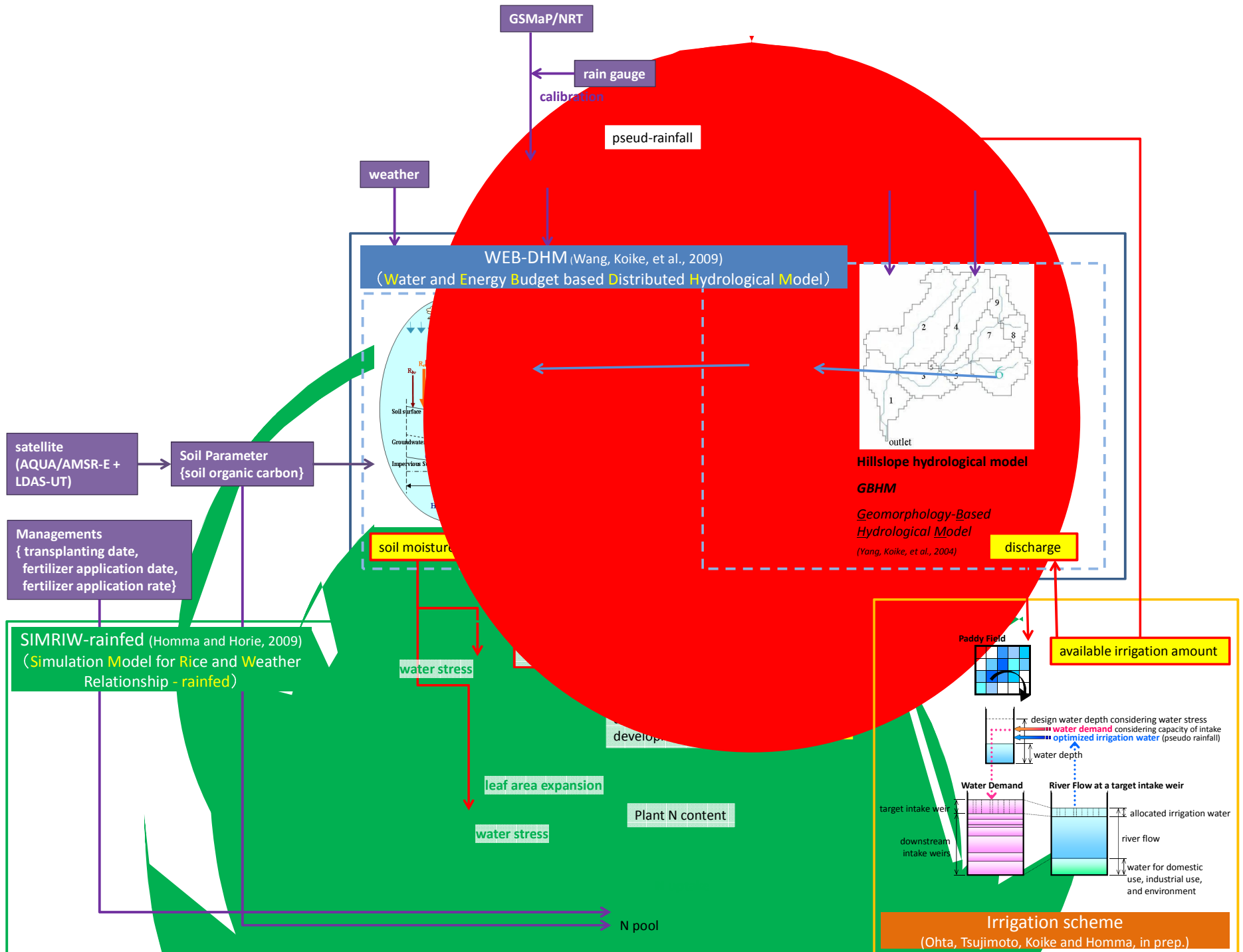


(Richard H. Moss, et al., *Nature*, 2010)



# Water Cycle Integrator





# Cambodia CROP & WATER Watch

Farmer

Province

Village

## CROP DATA

- soil moisture
- irrigation
- discharge
- plant date
- yield simulation

Field#  LAT   
LON

Field#  LAT   
LON

type

type

planting  /  /

planting  /  /

Irrigation1  /  /

Irrigation1  /  /

Irrigation2  /  /

Irrigation2  /  /

Fertilixzation1  /  /

Fertilixzation1  /  /

Fertilixzation2  /  /

Fertilixzation2  /  /

## RAIN MAP

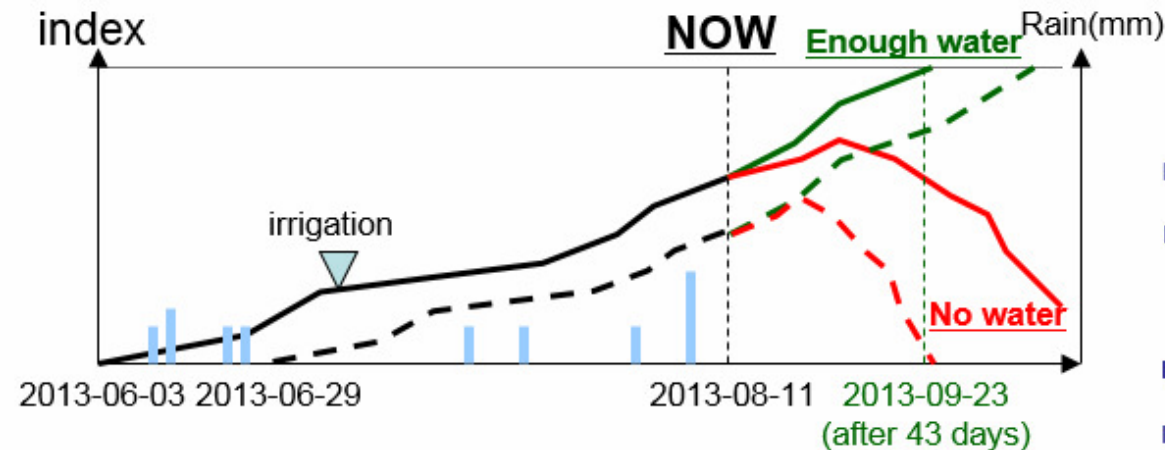
- raw data
- corrected data

## METEO. DATA

- latest data
- past data
- stats data
- station

## SATELLITE

- soil moisture map
- 10km scale
- 10-100m scale
- flooding area



## Production

### Enough water

Field 1

Field 2

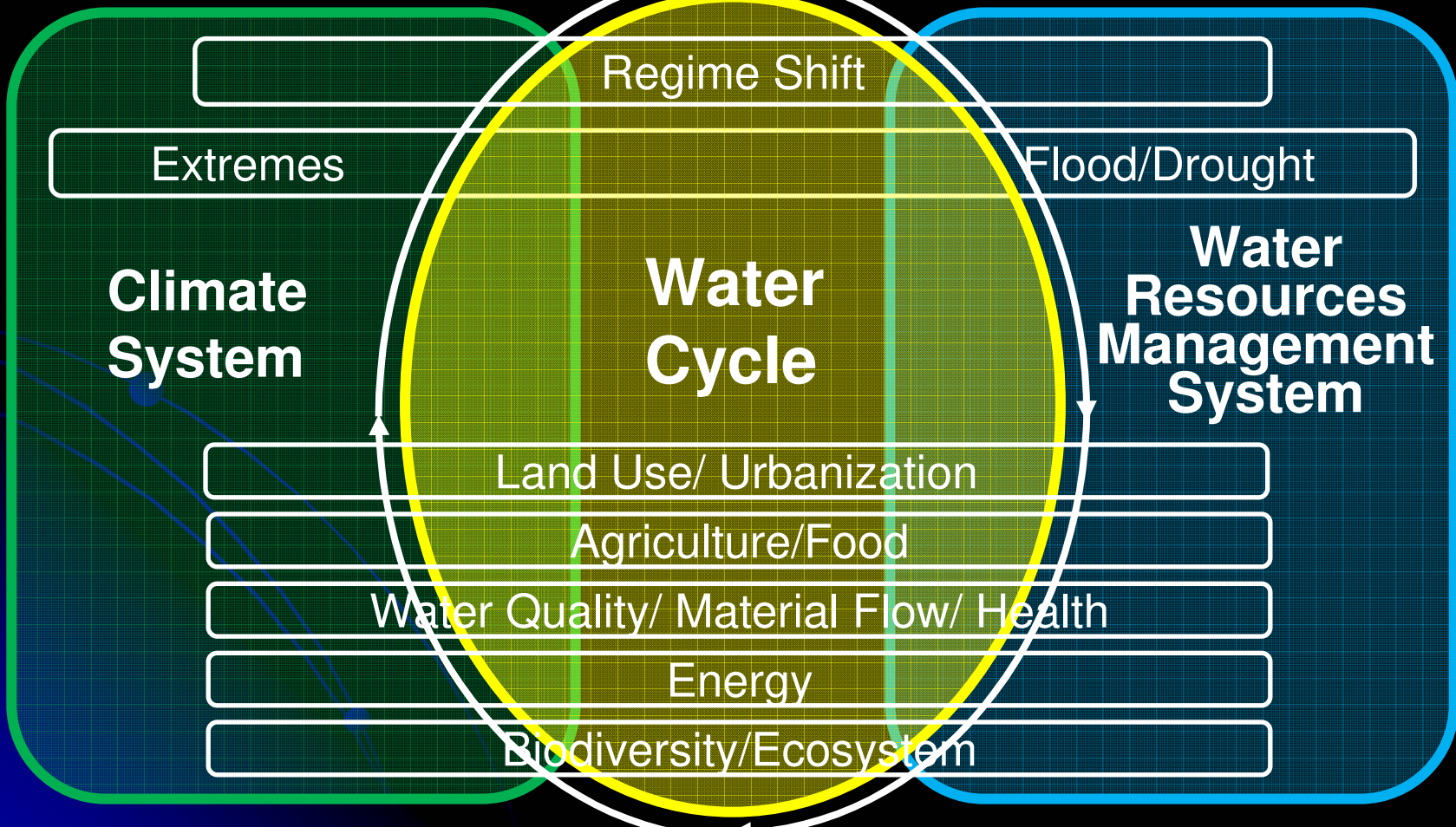
### No water

Field 1

Field 2

# Sustainable Development

Coordinated and Integrated Efforts for Working Together



# **GEOSS Asian Water Cycle Initiative (AWCI)**

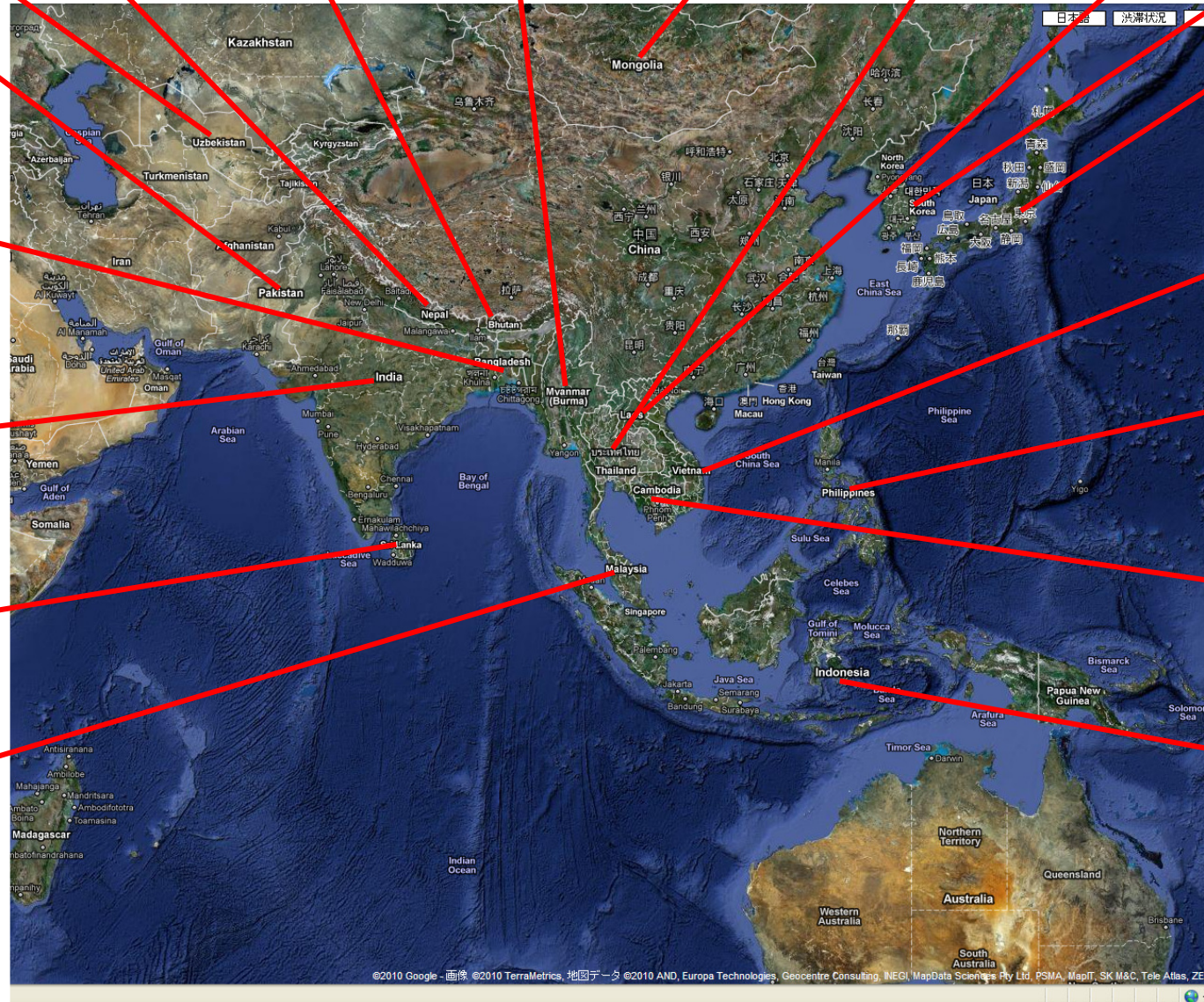
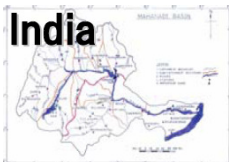
**To promote integrated water resources management by making usable information from GEOSS, for addressing the common water-related problems in Asia.**

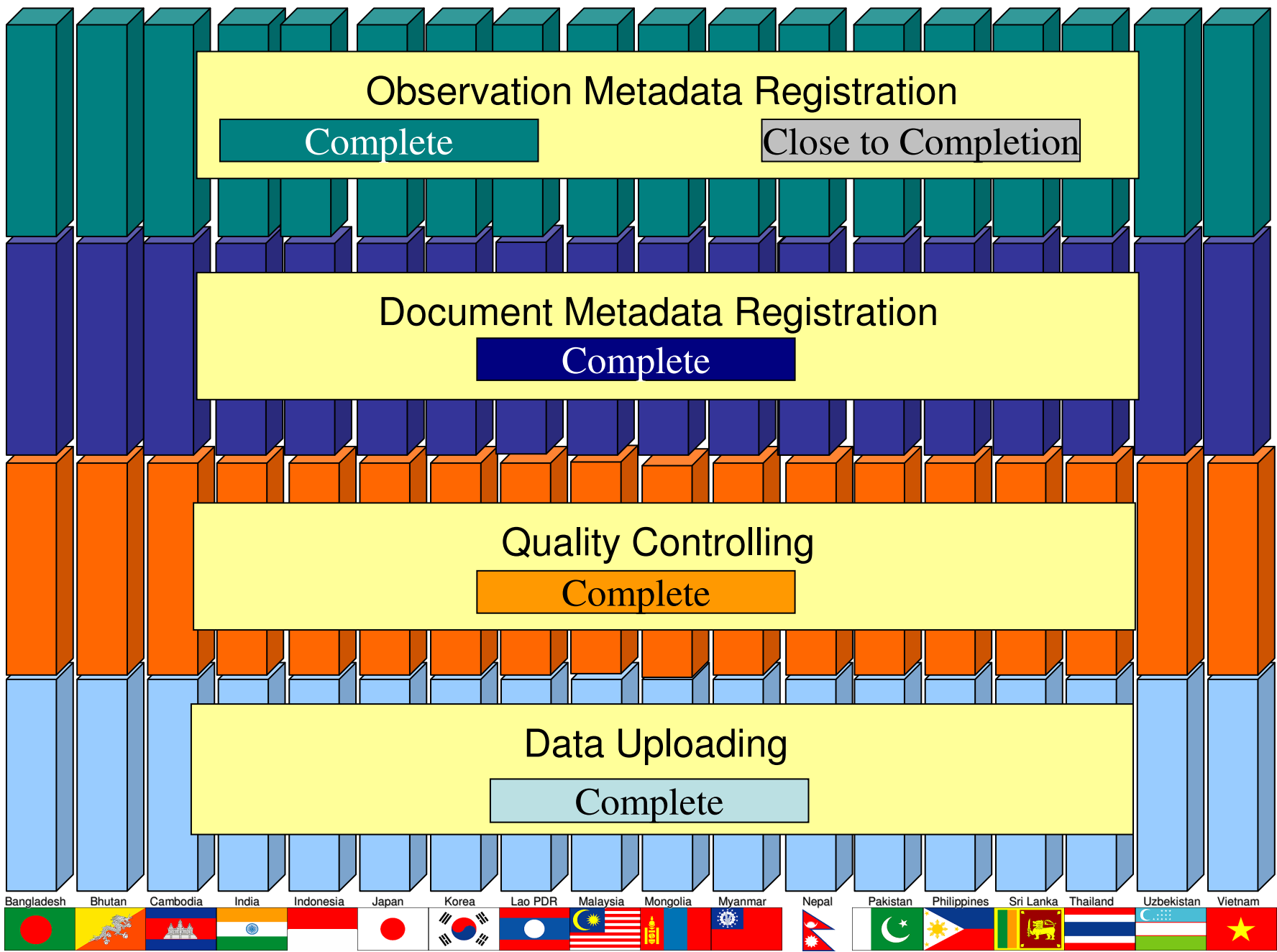
## **Uniqueness**

- A River Basin of Each Country**
- Observation Convergence**
- Interoperability Arrangement**
- Data Integration**
- Open Data & Source Policies**
- Capacity Building**
- Early Achievements**



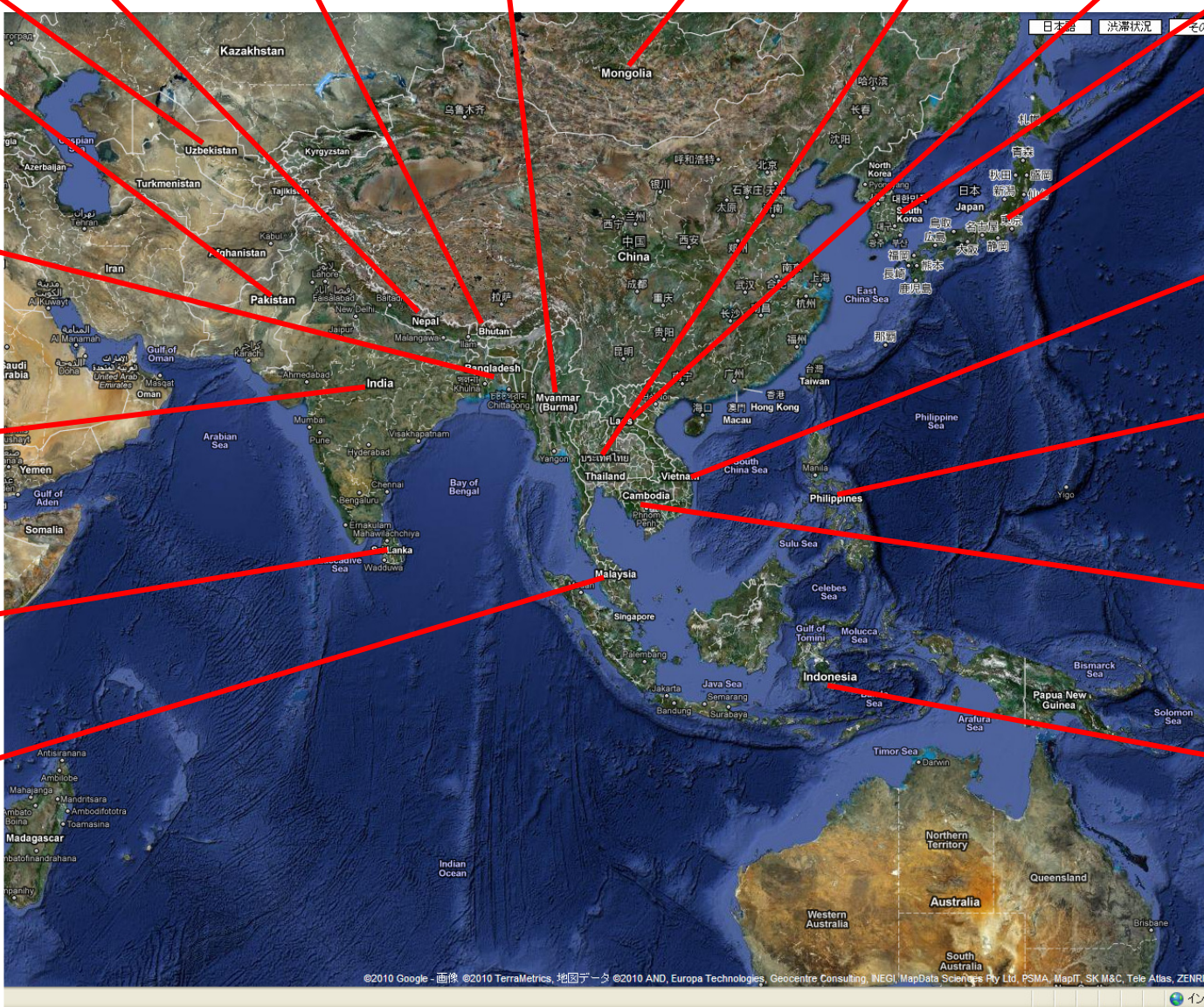
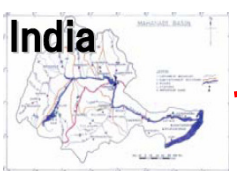
# Demonstration River Basins





- Bangladesh
- Bhutan
- Cambodia
- India
- Indonesia
- Japan
- Korea
- Lao PDR
- Malaysia
- Mongolia
- Myanmar
- Nepal
- Pakistan
- Philippines
- Sri Lanka
- Thailand
- Uzbekistan
- Vietnam

# Demonstration River Basins





# Pakistan Flood Information in 2010

Pakistan PALSAR Flood - Windows Internet Explorer  
 http://monsoon.t.u-tokyo.ac.jp/AWCI/doc/Pakistan/index.htm

Monitoring Flooding in Pakistan Using ALOS PALSAR Data Provided by JAXA

Brief Summary of Pakistan Flooding Monitoring (CEOP-Vol.20\_No.3\_07\_p08.pdf) [0.4MB]

PALSAR Images:

	PALSAR_Flood + Road (Please click left mouse then high resolution image appear in new window. Please click right mouse button there and select "save image as" to save high resolution image.)	GDEM + PALSAR_Flood + Road (Please click left mouse then high resolution image appear in new window. Please click right mouse button there and select "save image as" to save high resolution image.)	On the Google Earth (Please click "open" when you asked on your computer). Or please download "kmz" file on your computer then double click it. You can see the flood area on the google earth.)
2010/08/05 (Thu.)			 <a href="#">20100805_pakistanflood_palsar_wb1_ge.kmz</a>
2010/08/19 (Thu.)			 <a href="#">20100819_pakistanflood_palsar_fhd_ge.kmz</a>
2010/08/22 (Sun.)			 <a href="#">20100822_pakistanflood_palsar_wb1_ge2.kmz</a>
2010/08/27 (Fri.)			 <a href="#">20100827_pakistanflood_palsar_wb1_ge.kmz</a>
2010/08/29 (Sat.)			 <a href="#">20100829_pakistanflood_palsar_wb1_ge.kmz</a>
2010/09/13 (Mon.)			 <a href="#">20100913_pakistanflood_palsar_wb1_ge.kmz</a>

GEOSS/AWCI Website:  
<http://monsoon.t.u-tokyo.ac.jp/AWCI/doc/Pakistan/index.htm>

GEWEX

Monitoring Flooding in Pakistan Using ALOS & GSMaP Data Provided by JAXA

Takeo Tadono<sup>1</sup>, Masanobu Shimada<sup>1</sup>, Kentaro Aida<sup>2</sup>, Katsunori Tamagawa<sup>1</sup>, Toshio Koike<sup>1</sup>, Kazuhiko Fukami<sup>3</sup> and Takahiro Kawakami<sup>3</sup>  
<sup>1</sup>Earth Observation Research Center, JAXA; <sup>2</sup>Department of Civil Engineering, The University of Tokyo; <sup>3</sup>International Centre for Water Hazard and Risk Management under the auspices of UNESCO (ICHARM)

Serious damage has occurred in Pakistan recently due to floods and mudslides caused by heavy rain, which occurred continuously since July 29, 2010. The flood damage has spread from north to south in Pakistan. The Japan Aerospace Exploration Agency (JAXA) has made observations using the Advanced Land Observing Satellite (ALOS, 'Daichi') to monitor the state of the damage.

Figure 1 shows images of Hyderabad, 1,200 km south-southwest from Islamabad, which were taken after the disaster on August 23, 2010 (left) and before the disaster on March 23, 2010 (right). It is obvious that the flooded area along the Indus river basin has greatly expanded.

Figure 2 shows the inundation area image obtained from data acquired with the Phased Array type L-band Synthetic Aperture Radar (PALSAR) onboard ALOS on August 19, 2010. The data was acquired using the ScanSAR observing mode (WB1); therefore it covered an approximately 350 km wide strip at 100 m spatial resolution. The blue color on the topographical map derived from the ASTER Global Digital Elevation Model (ASTER GDEM) shows the inundation area, which was identified by analyzing the backscattering coefficients observed before and after the flood.

Figure 3: Comparison of preliminary IFAS-PDHM simulations using the corrected GSMaP data with the observed in-situ river discharge data at Nowshera, Kabul River from July 25, 0:00 to August 6, 0:00 GMT

A preliminary runoff analysis was done at the Nowshera hydrological station of the Kabul River, which is one of the major tributaries of the Indus River, using the Integrated Flood Analysis System (IFAS) - Public Work Research Institute (PWRI) Distributed-parameter Hydrologic Model (PDHM), grid-size 4 km and the Global Satellite Mapping of Precipitation (GSMaP) as shown in Figure 3. The GSMaP data corrected by the ICHARM's correction method based solely on rainfall-area moment information, without regarding ground-based rainfall data, was used as the input to the IFAS-PDHM. According to the estimation of this preliminary simulation, the flash-flood runoff peak at the Nowshera point (watershed area approximately 92,000 km<sup>2</sup>) appeared to be over 16,000 m<sup>3</sup>/s near the time of 0:00 (GMT) on July 31, but in reality, most of the high-flow discharge must have been inundating the floodplains (valley plains) along the Kabul River.

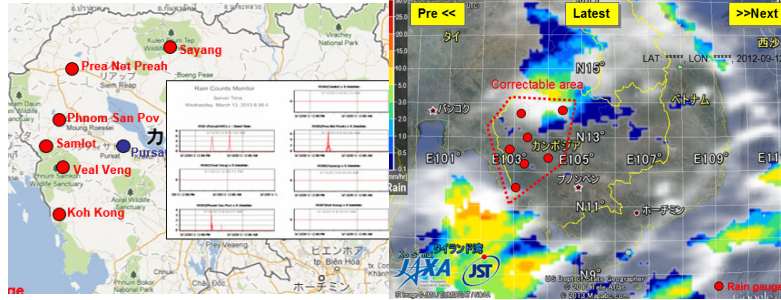
August 2010

Takeo Tadono et al., "Monitoring Flooding in Pakistan Using ALOS & GSMaP Provided by JAXA" GEWEX Newsletter, Special CEOP Issue, Vol. 20, No. 3, p. 8, August 2010.

# Water-Climate-Agriculture Workbench in Cambodia



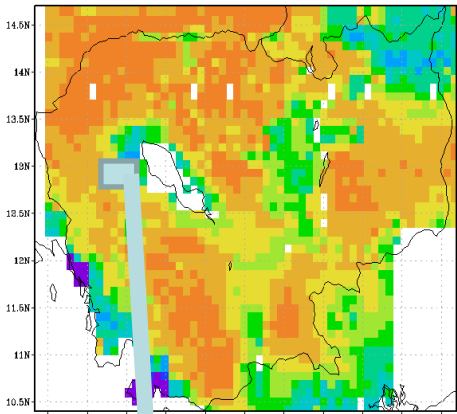
Stakeholder Meeting



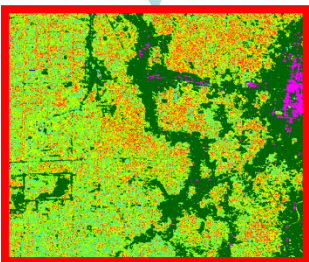
Real-time Rain Gauge → Satellite Data Correction  
→ Wide Data Dissemination



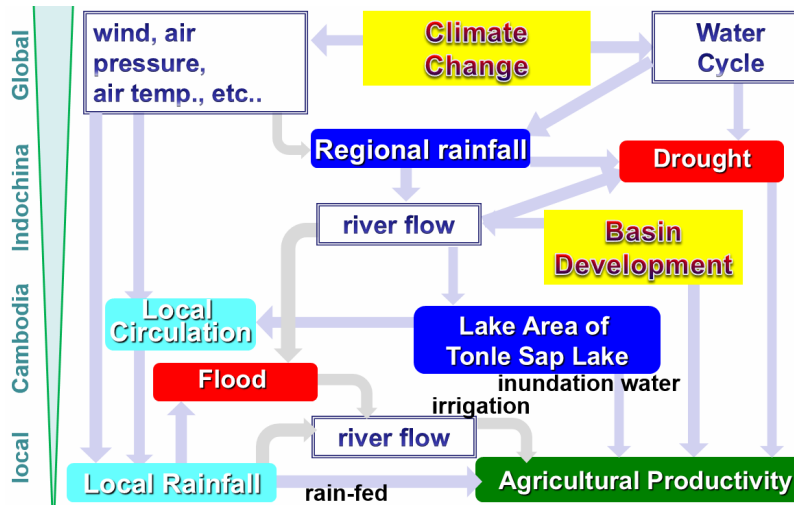
Farmers' Needs & Experiences



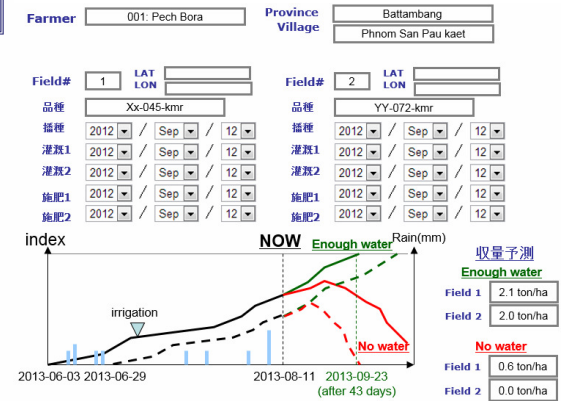
Nation-wide Daily Soil Moisture from Satellite



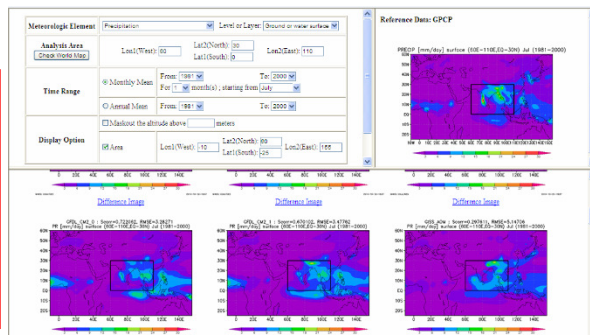
Local Information



Holistic View of Water-Climate-Agriculture Problems



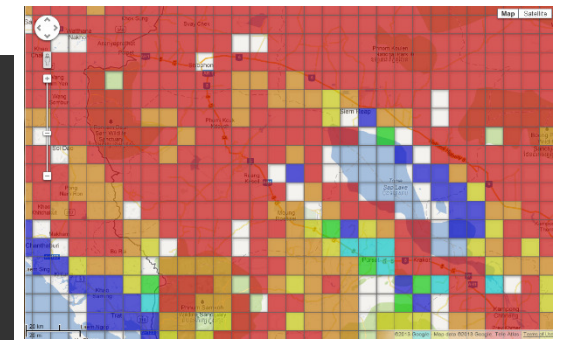
Water Cycle-Rice Production Coupled Model



Climate Change Analysis Tools



OJT for Local Practitioners



Rice Production Monitoring

Jan. 2009

1<sup>st</sup> GEOSS African Water Cycle Symposium in Tunis, *Water-related Issues & Roles of EO*

Sept. 2009



1<sup>st</sup> Task Team Meeting in Geneva, *Strategy for Coordinated EO and CB*



Feb. 2011

2<sup>nd</sup> African Water Cycle Symposium in Addis Ababa *Planning for Demonstration*



GEO-UNESCO Joint Workshop in Nairobi *Report on Demonstrations and IWRM CB Program*

Jan. 2012

Feb. 2012

3<sup>rd</sup> African Water Cycle Symposium in Libreville *Basic Idea of Implementation, Statement to Rio+20*



3<sup>rd</sup> African Water Cycle Coordination Initiative Workshop in El Jadida, *Draft Implementation Plan*

Feb. 2013

Nov. 2013

1<sup>st</sup> GEOSS Africa & Asia Joint Water Cycle Symposium in Tokyo *1<sup>st</sup> AfWCCI Implementation Plan and 2<sup>nd</sup> AWCI Implementation Plan*

# GEOSS African Water Cycle Coordination Initiative (AfWCCI)

Based on a collaboration between the **Group on Earth Observations (GEO)** and RBOs in Africa, **Global Earth Observation System of Systems (GEOSS)** supports application of coordinated, comprehensive and sustained Earth Observations and information across trans-boundary river basins in Africa, particularly focusing on:

● Observation and data management

● Capacity development on:

- observation
- data archiving
- Modeling
- Prediction
- climate change impact assessment
- data integration

Improvement of the water resources management capacity

*Participating  
Medjerda, Niger, Nile, L/Victoria, L/Chad, Okavango,  
Orange-Senqu, Senegal, Zambezi, Oum Er-Rabia,  
L'Ogooue*

**Goal : To facilitate better management in trans-boundary rivers in Africa**

# Sustainable Development

Coordinated and Integrated Efforts for Working Together

