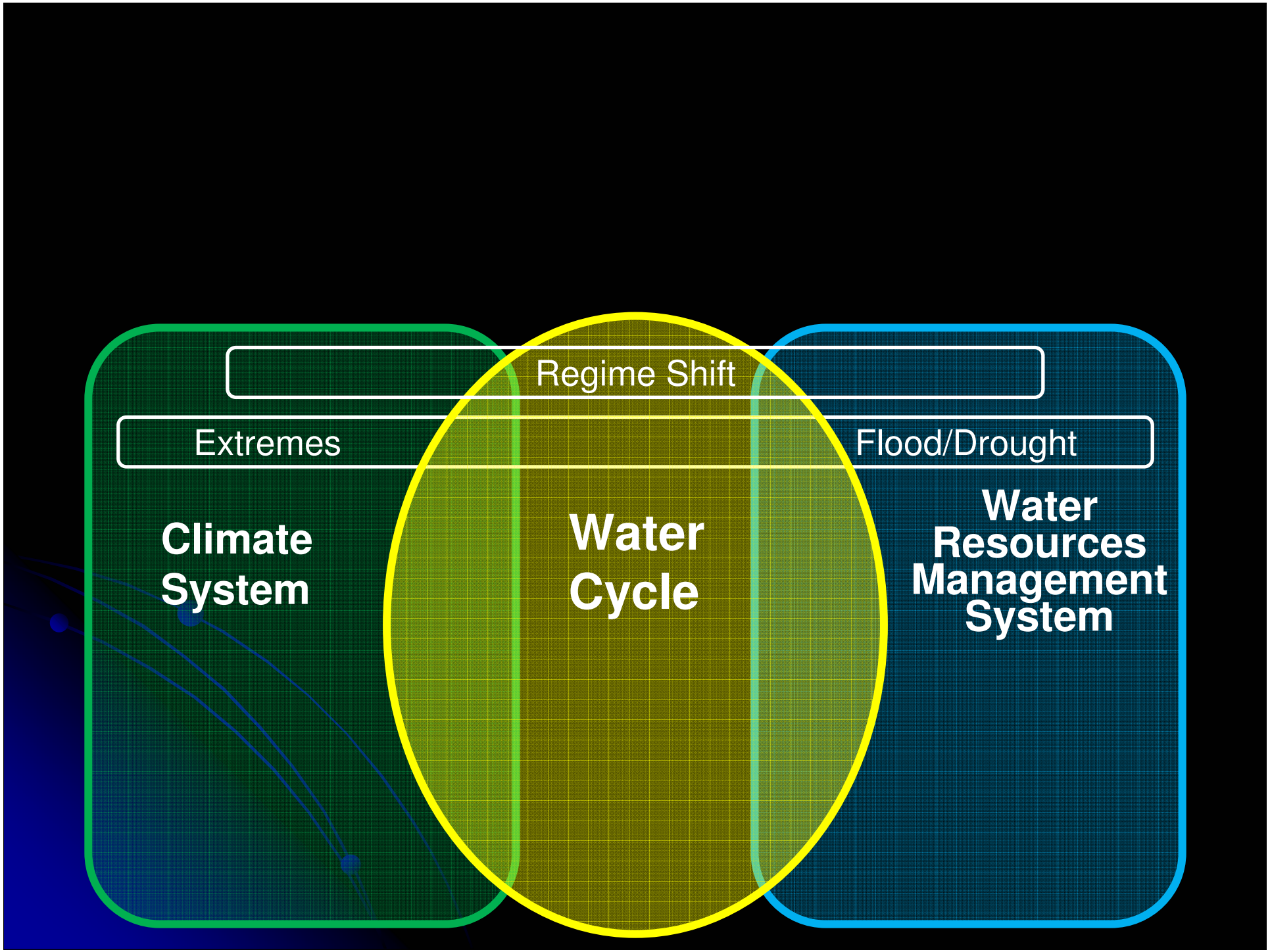
GEOSS Joint Asia-Africa Water Cycle Symposium

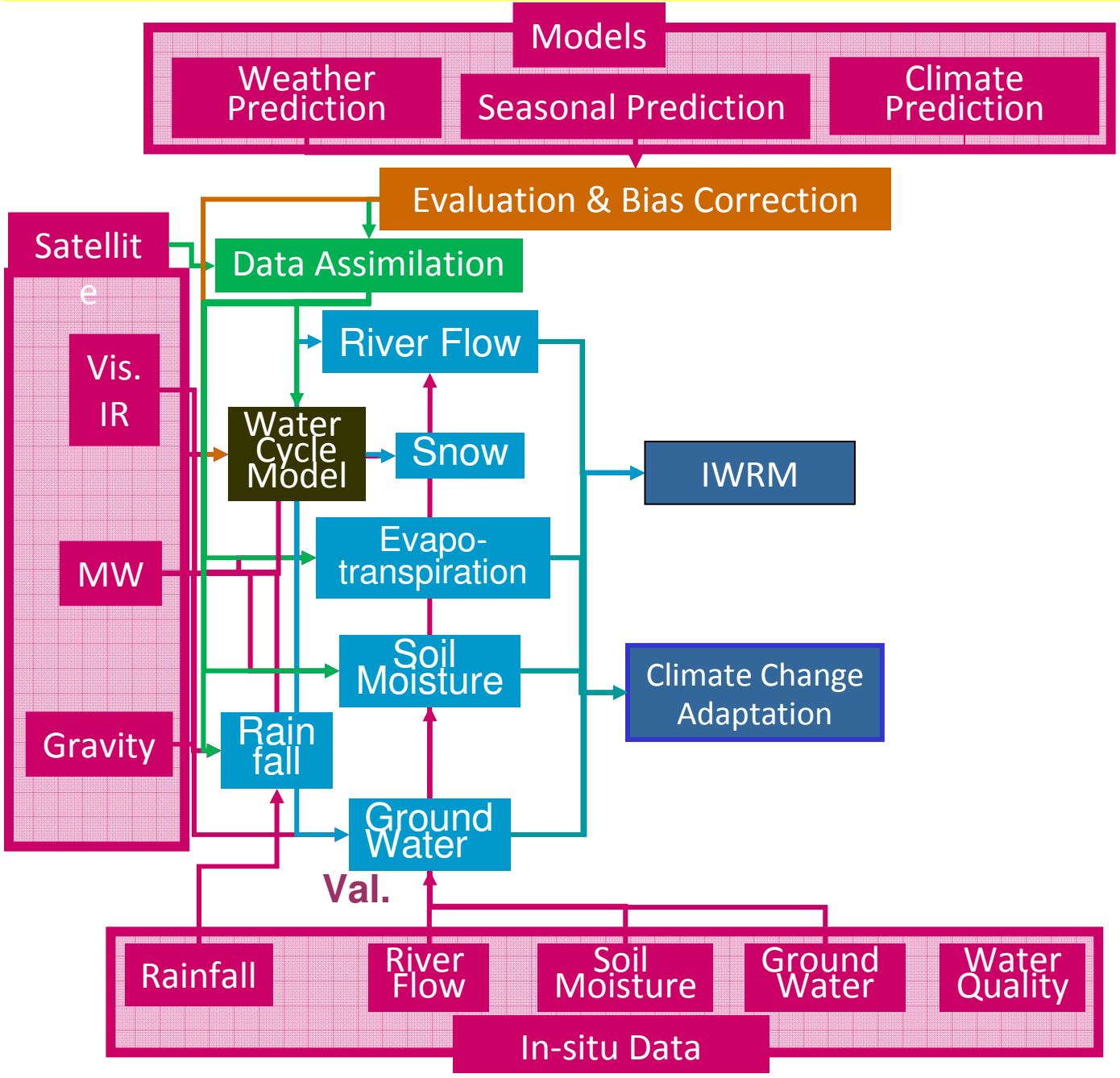
GEOSS
Water Cycle Integrator

Toshio Koike
The Univeristy of Tokyo

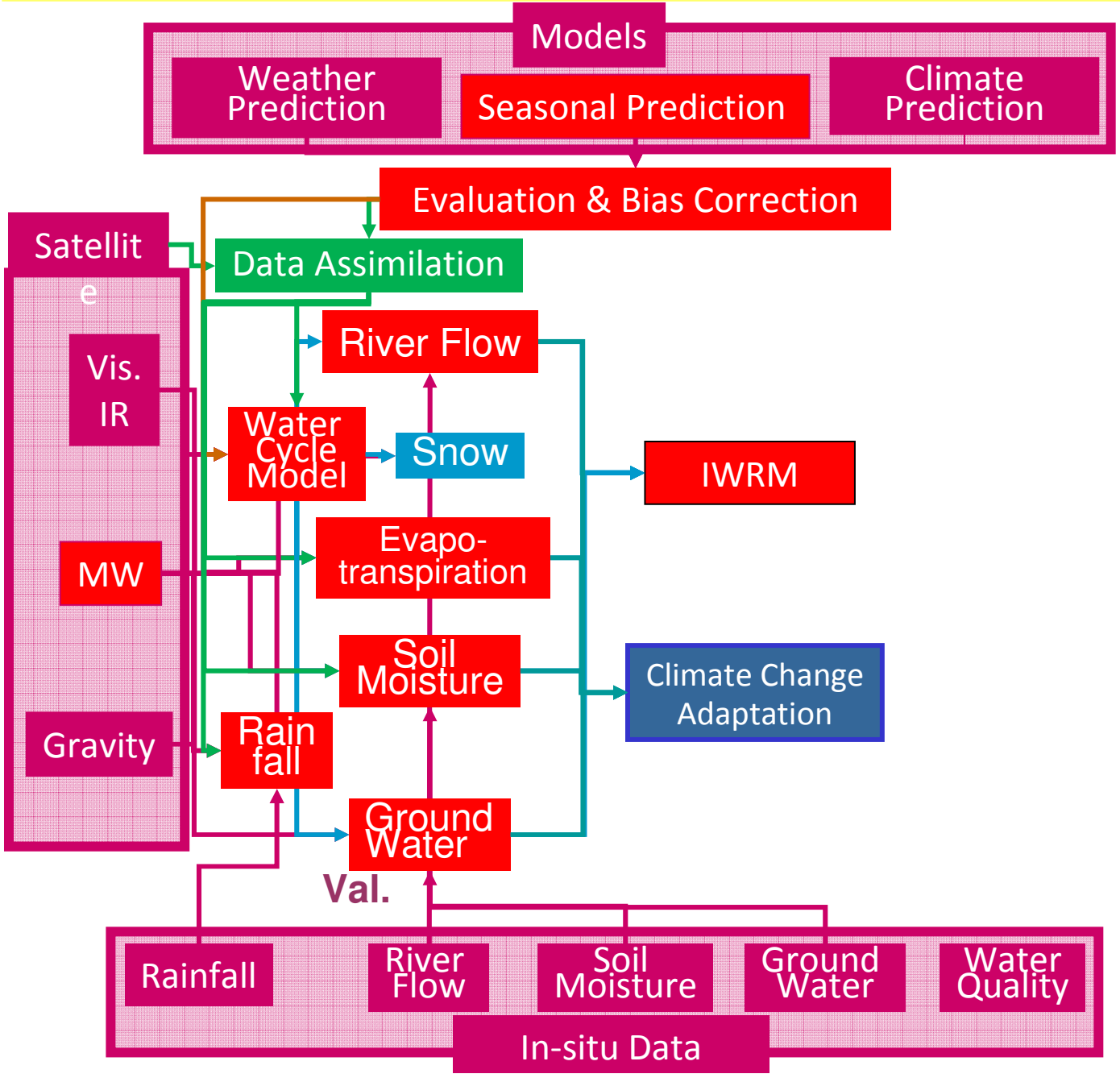
Ito International Research Center, Ito Hall, University of Tokyo, Hongo Campus
25 – 27 November 2013


Regime Shift
Extremes
Flood/Drought
Climate System
Water Cycle
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

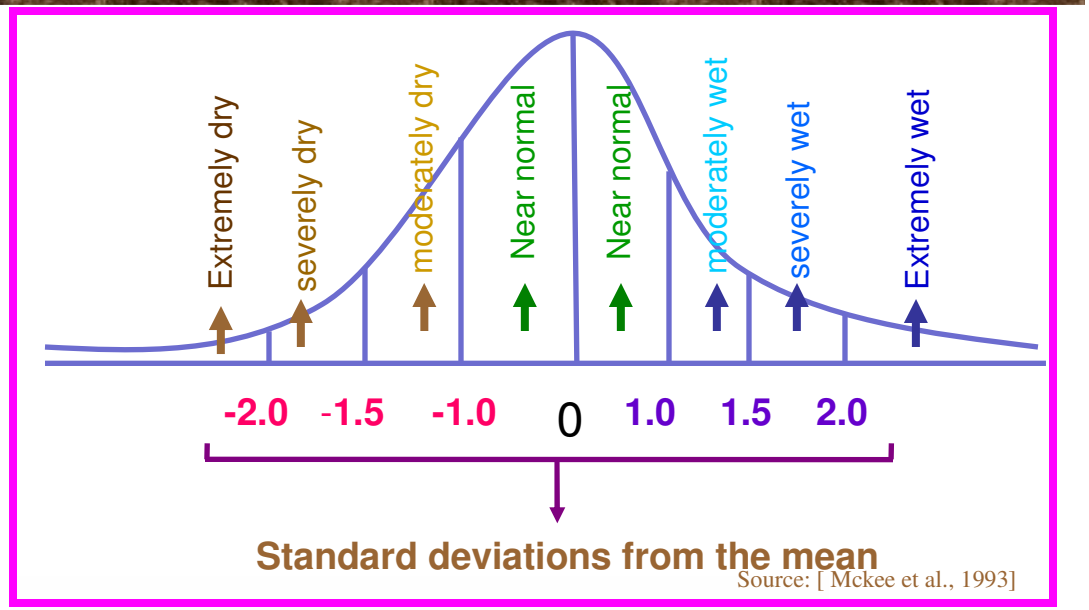
$$SA = Z = \frac{x_{transformed} - \bar{x}_{transformed}}{\sigma_{transformed}}$$

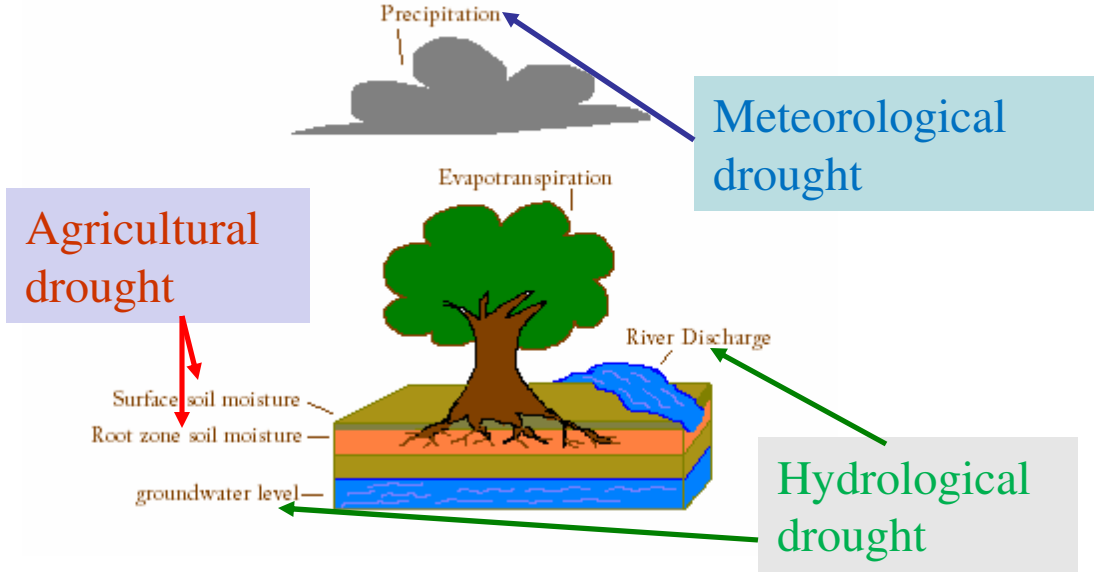
$$\sigma = \sqrt{\mathrm{var}(x)}$$

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

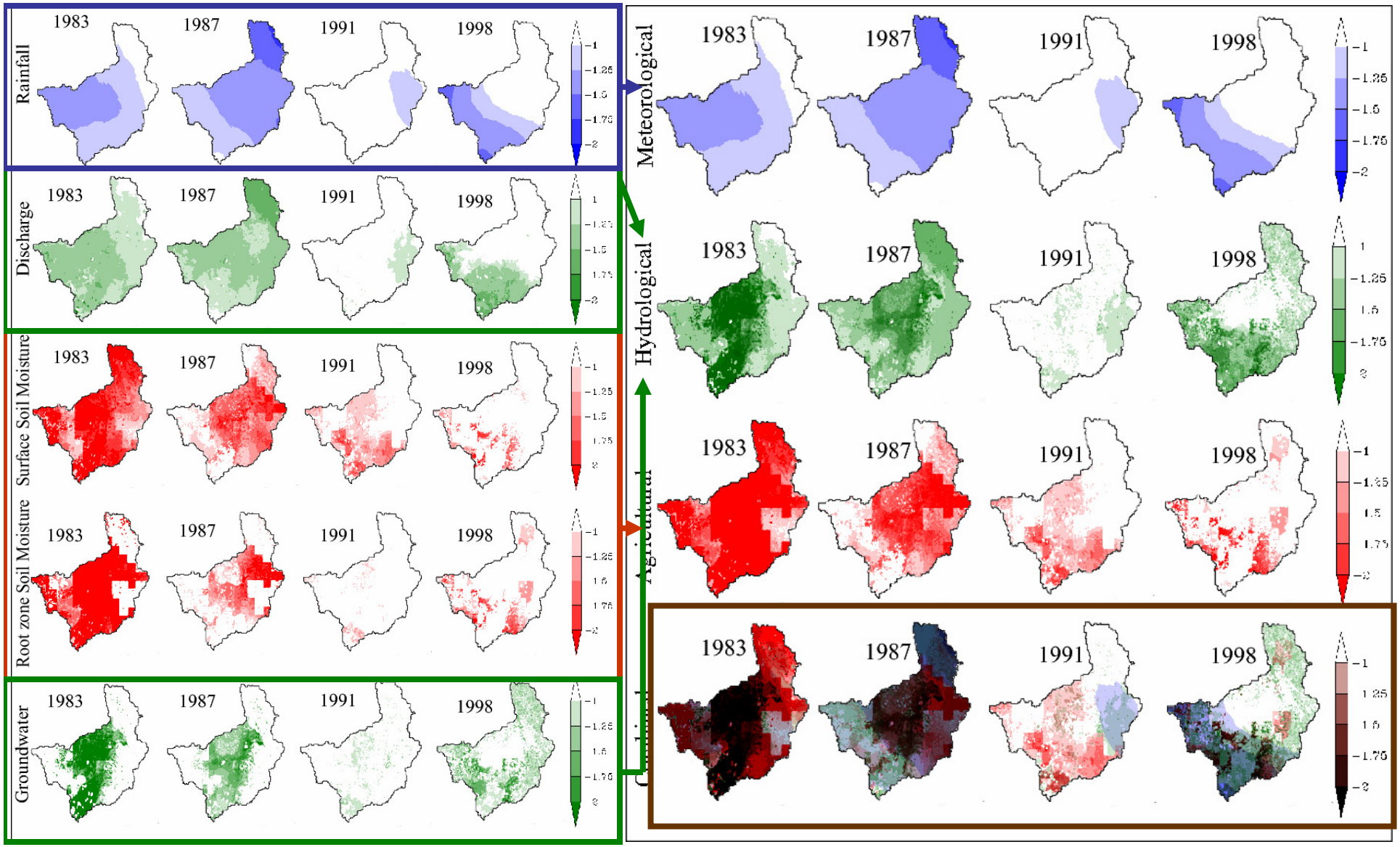
$$\mu = \int x f(x)dx$$

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





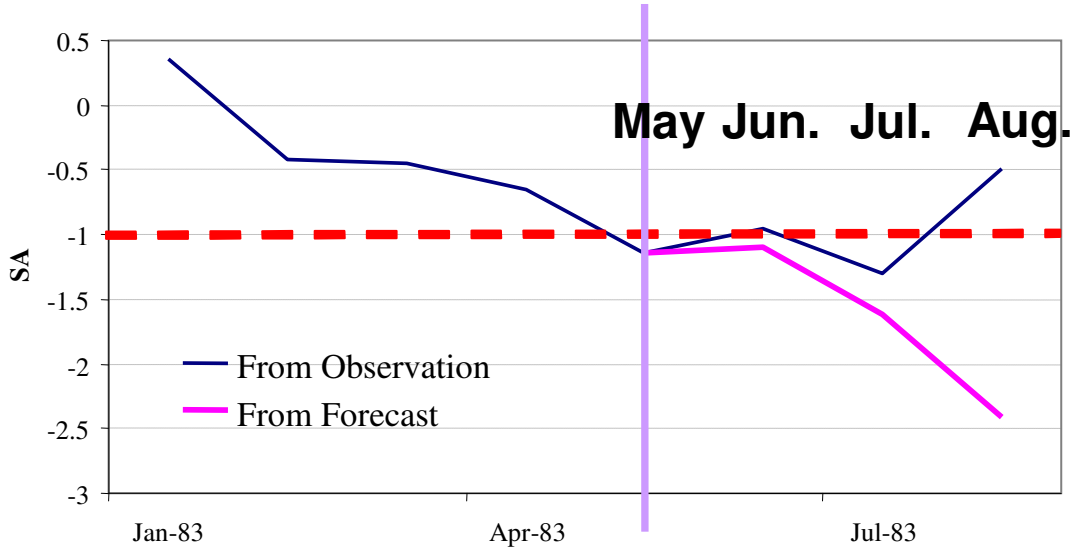
Spatial SA: Philippines



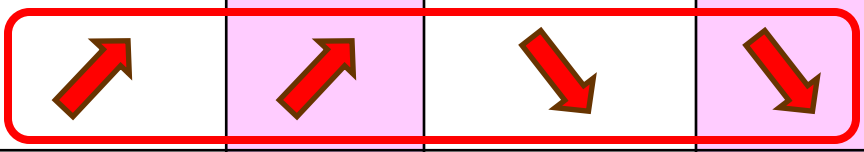
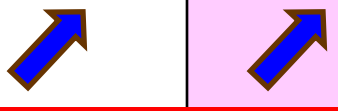
Seasonal Drought Prediction

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



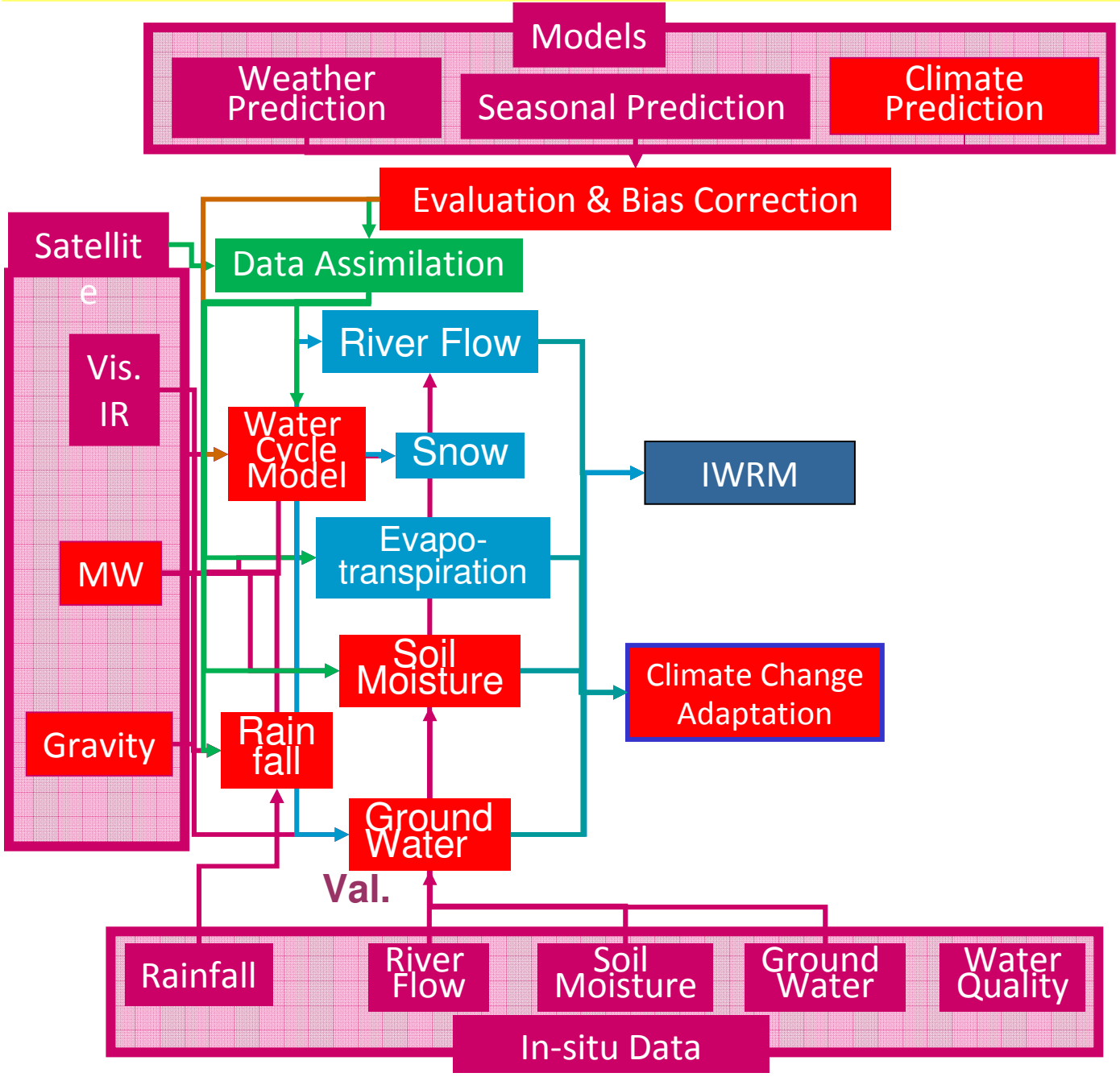
Seasonal Drought Prediction

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

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

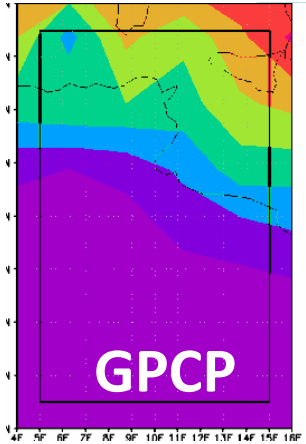
e.g. increase towards drought conditions 

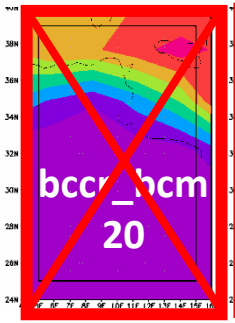
Water Cycle Integrator

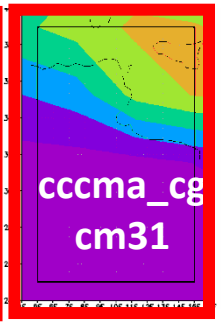


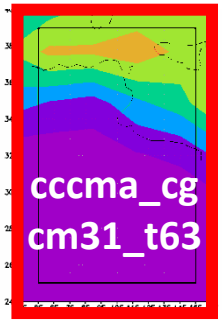
Mejerda River

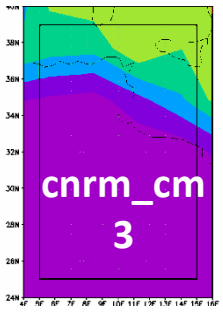
Precipitation Oct – Jan (1981-2000)

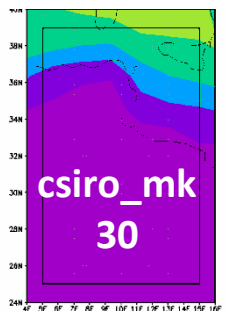


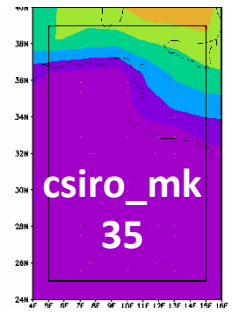


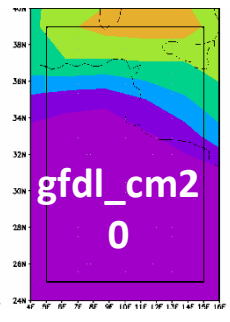


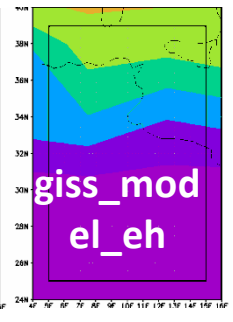


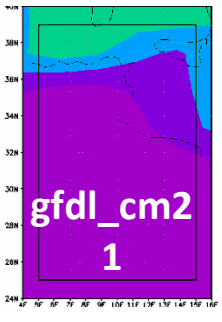


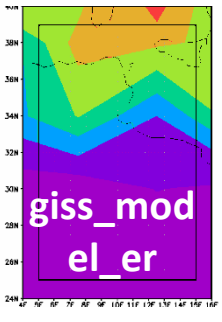


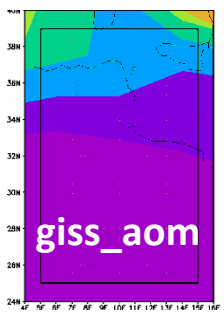


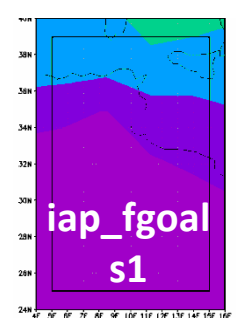


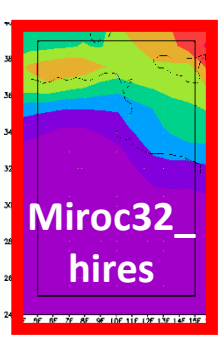


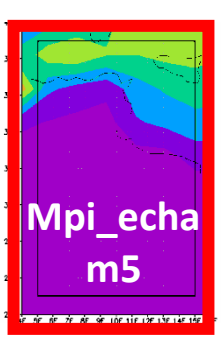


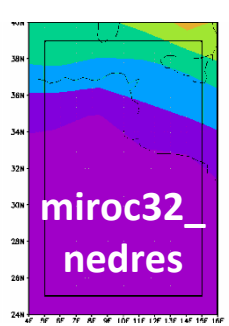


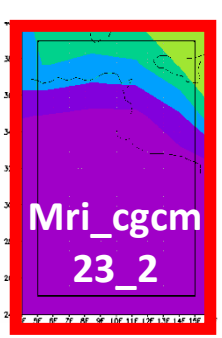


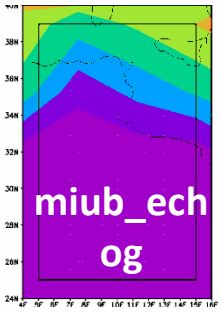


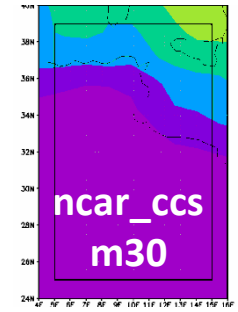


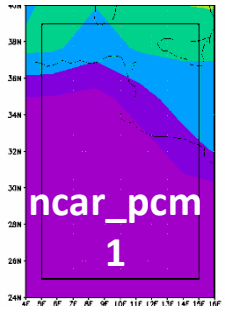


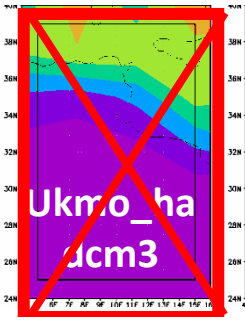


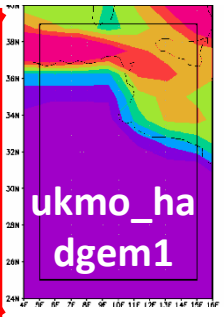


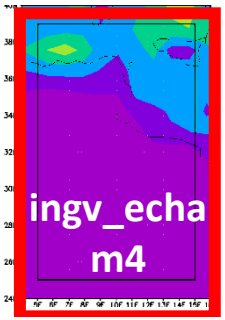


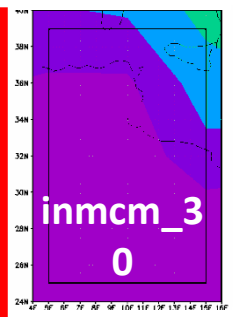


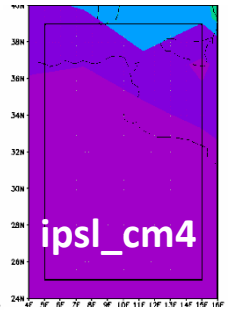






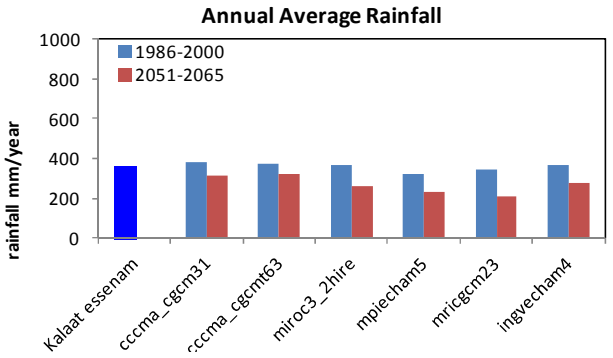




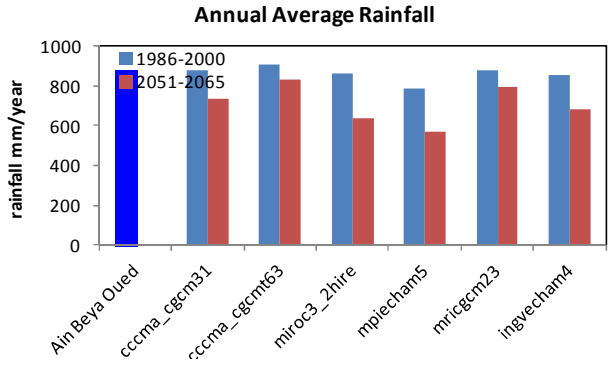


Mejerda River

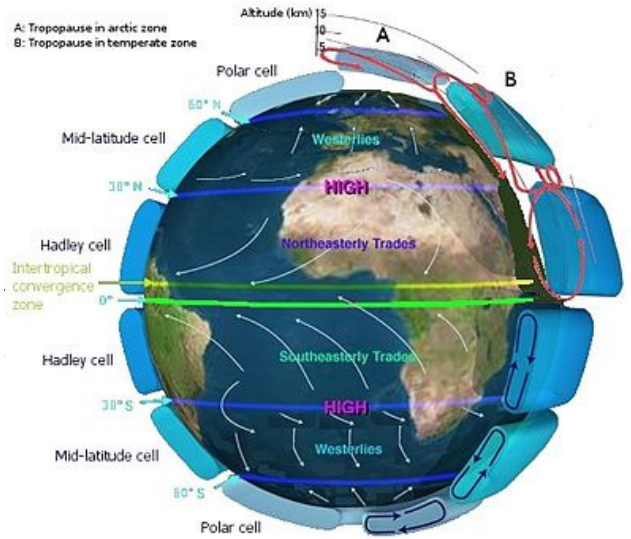
It is virtually certain that drought will become more severe.

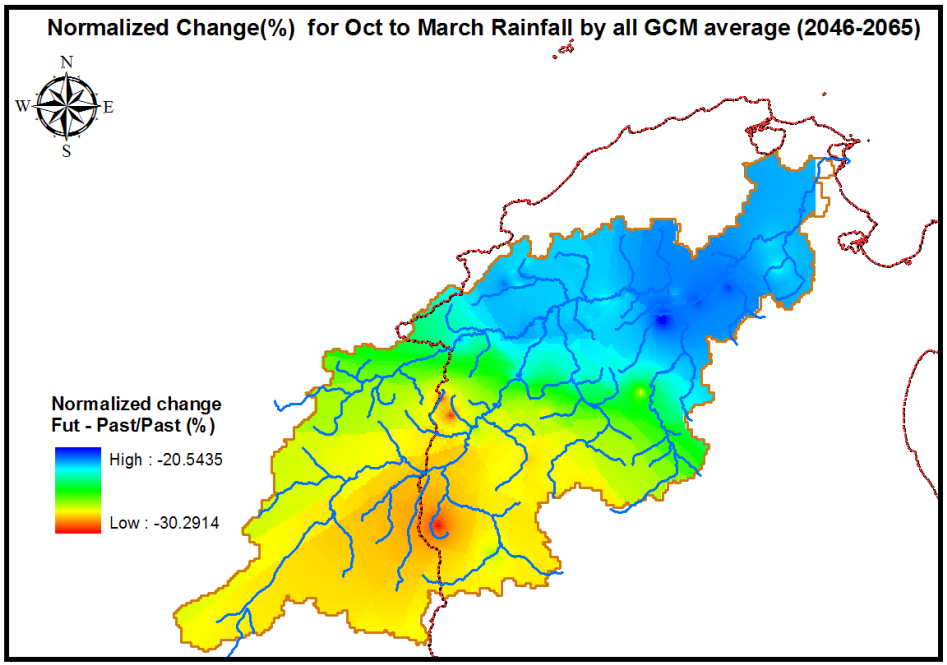


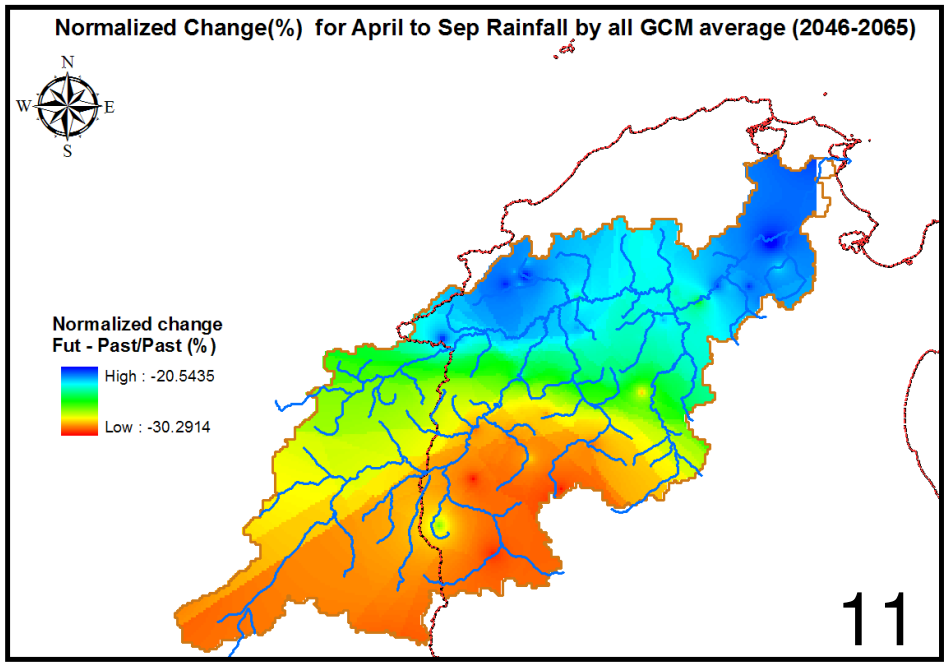
KALAAT ESSENAM

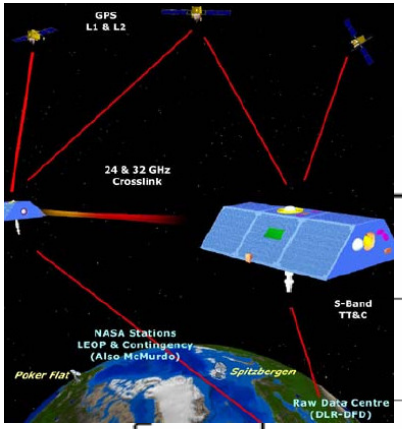


AIN BEYA OUED

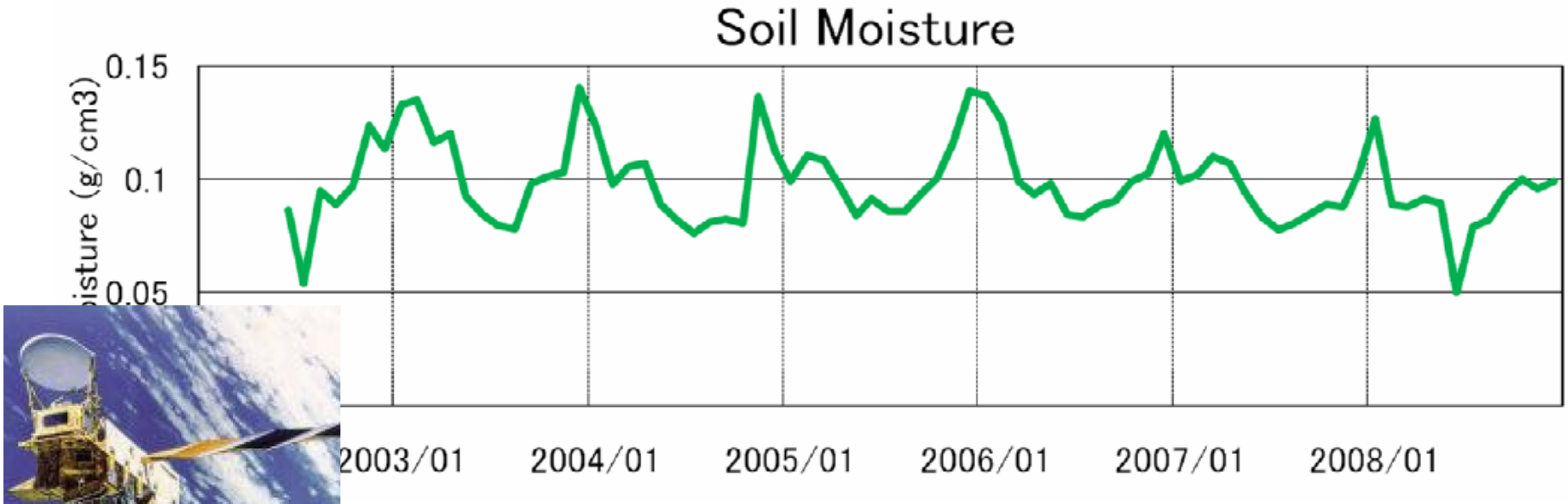




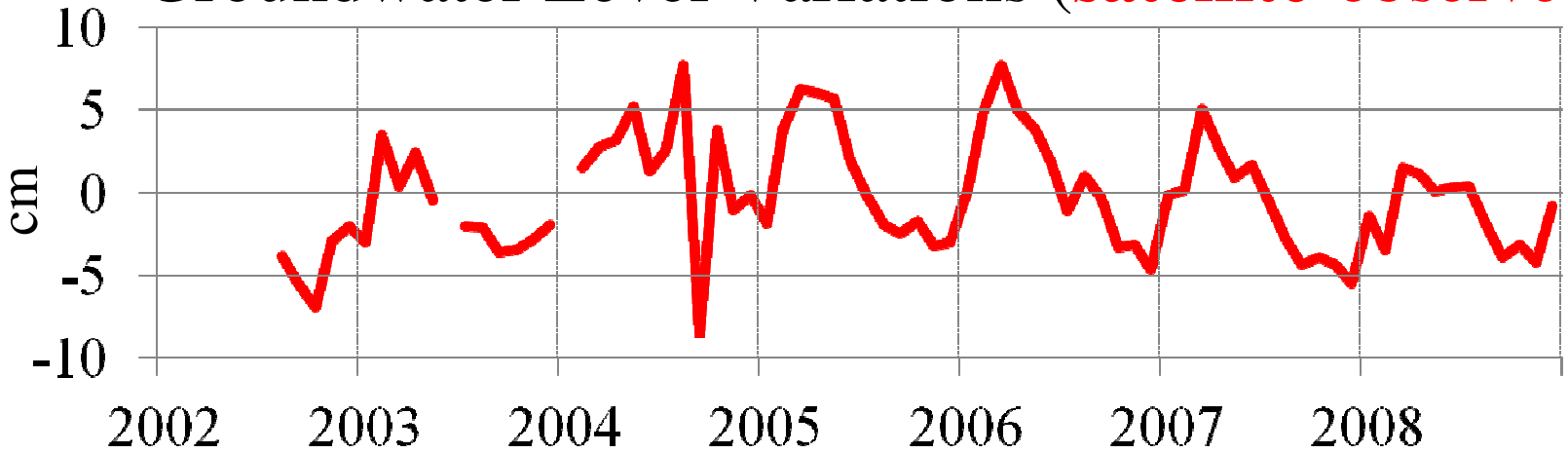


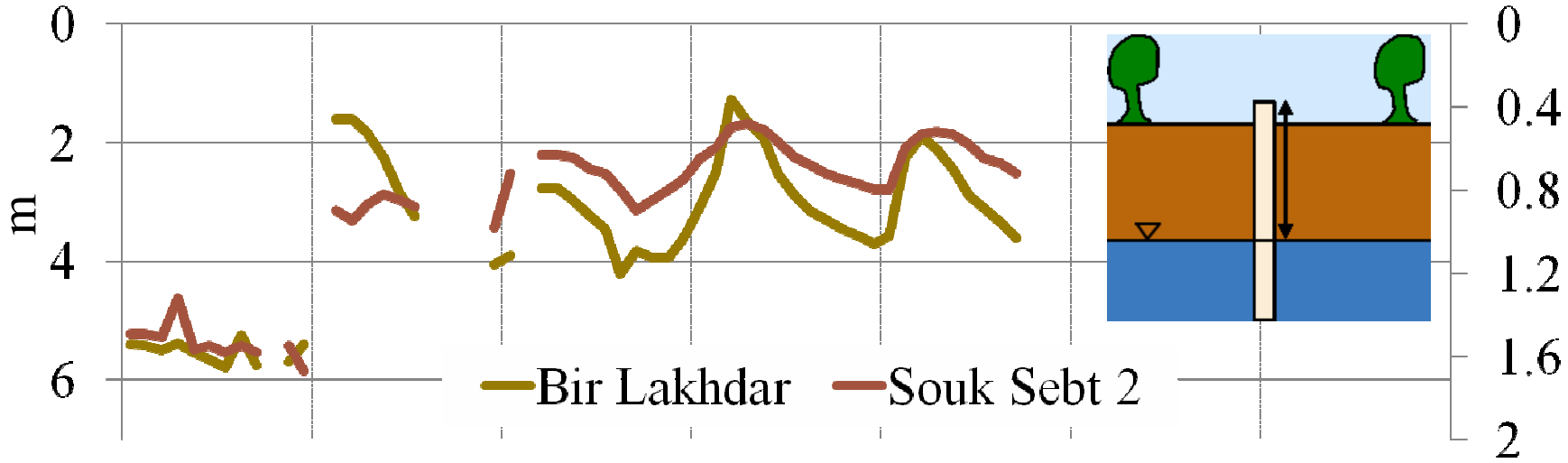

GPS
L1 & L2
24 & 32 GHz
Crosslink
S-Band
TT&C
NASA Stations
LEOP & Contingency
(Also McMurdo)
Poker Flat
Spitzbergen
Raw Data Centre
(DLR-DFD)

Terrestrial Water Storage Change
TWS (cm
−5
−10
2002/01
2003/01
2004/01
2005/01
2006/01
2007/01
2008/01


Soil Moisture
0.15
0.1
0.05
(g/cm3)
2003/01
2004/01
2005/01
2006/01
2007/01
2008/01

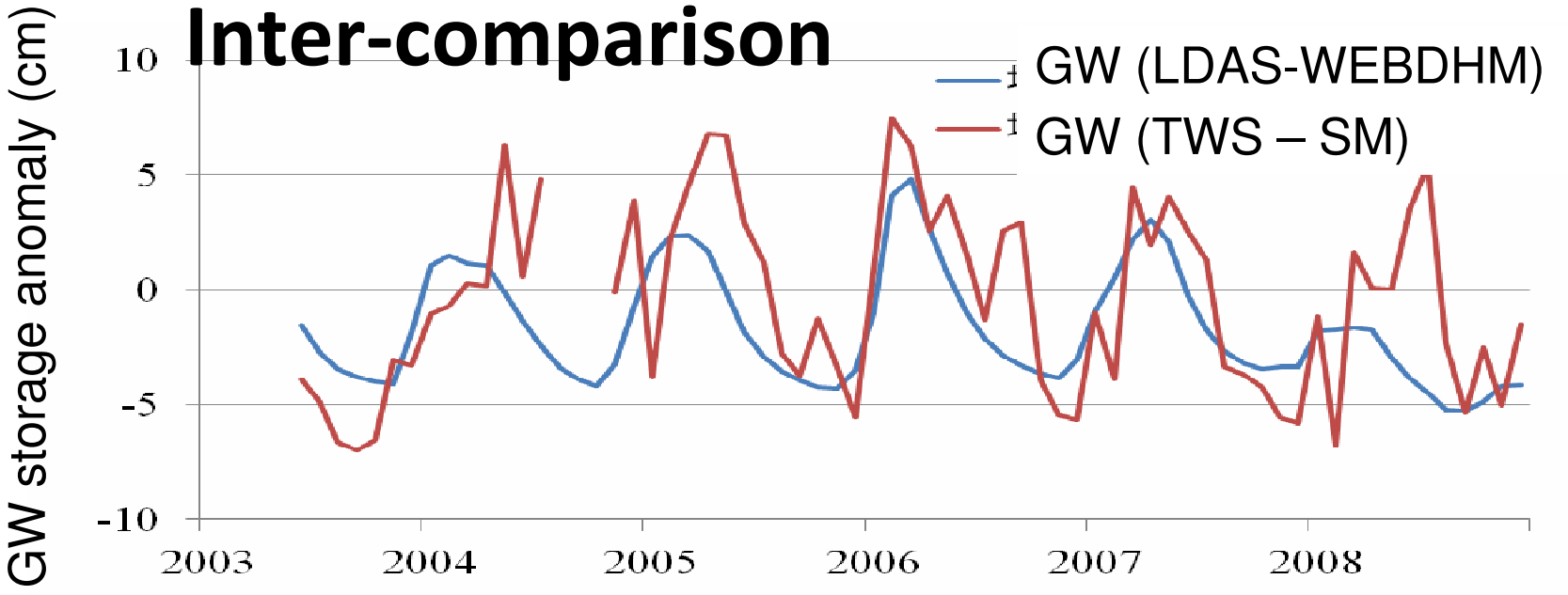
Groundwater Level Variations (**satellite**-observed)



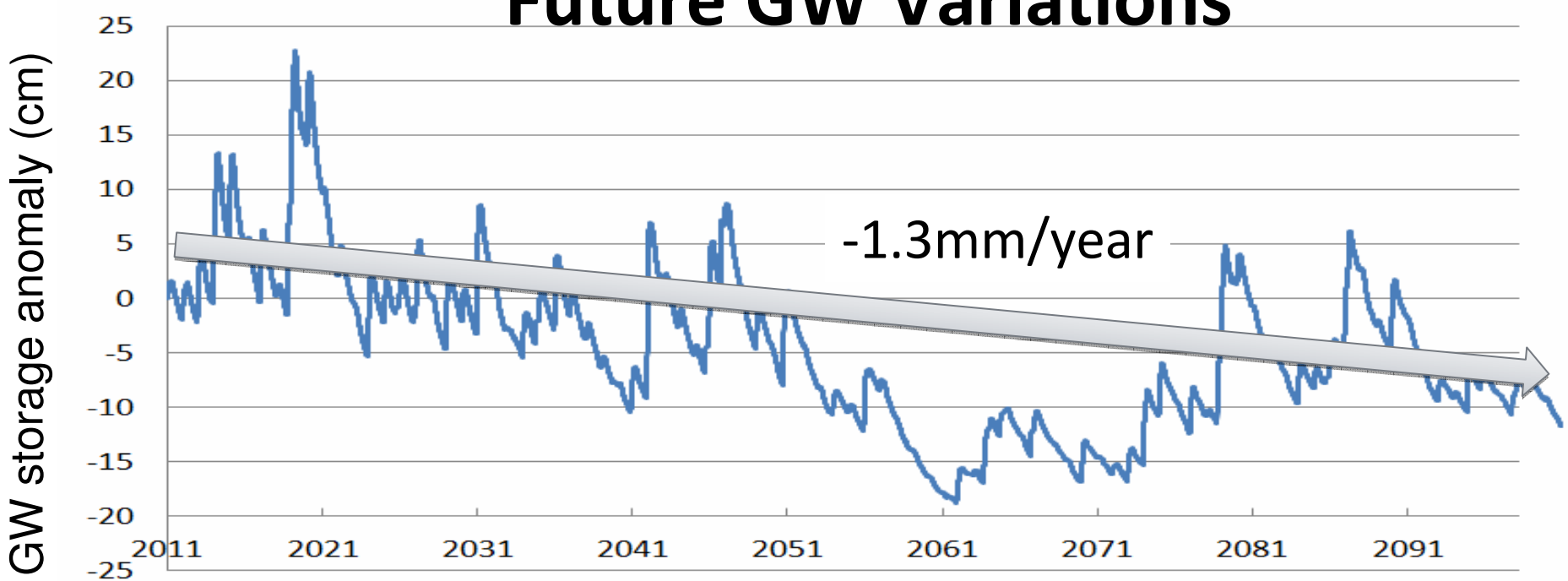


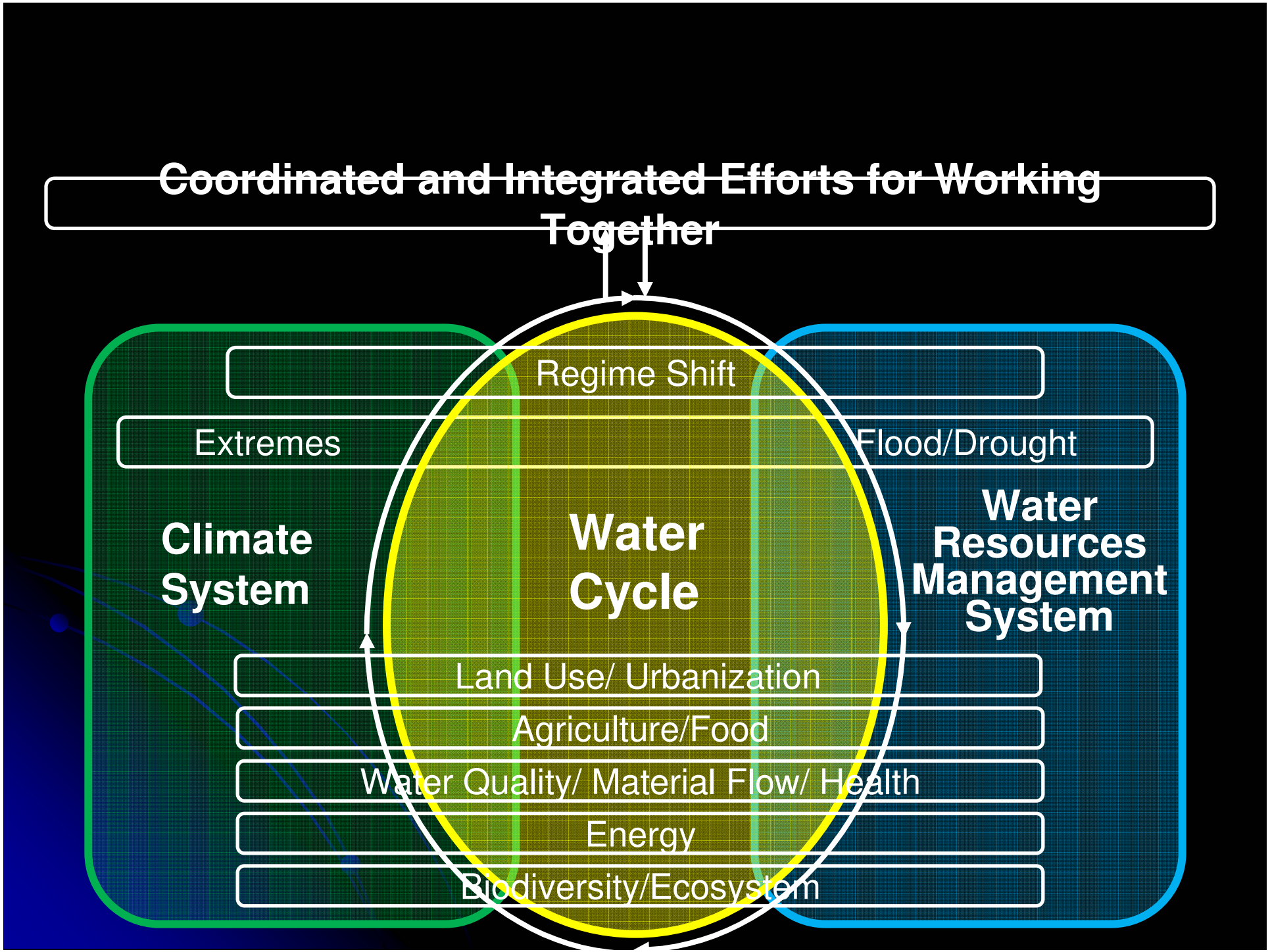
Groundwater Level Variations (**ground**-observed)

Inter-comparison

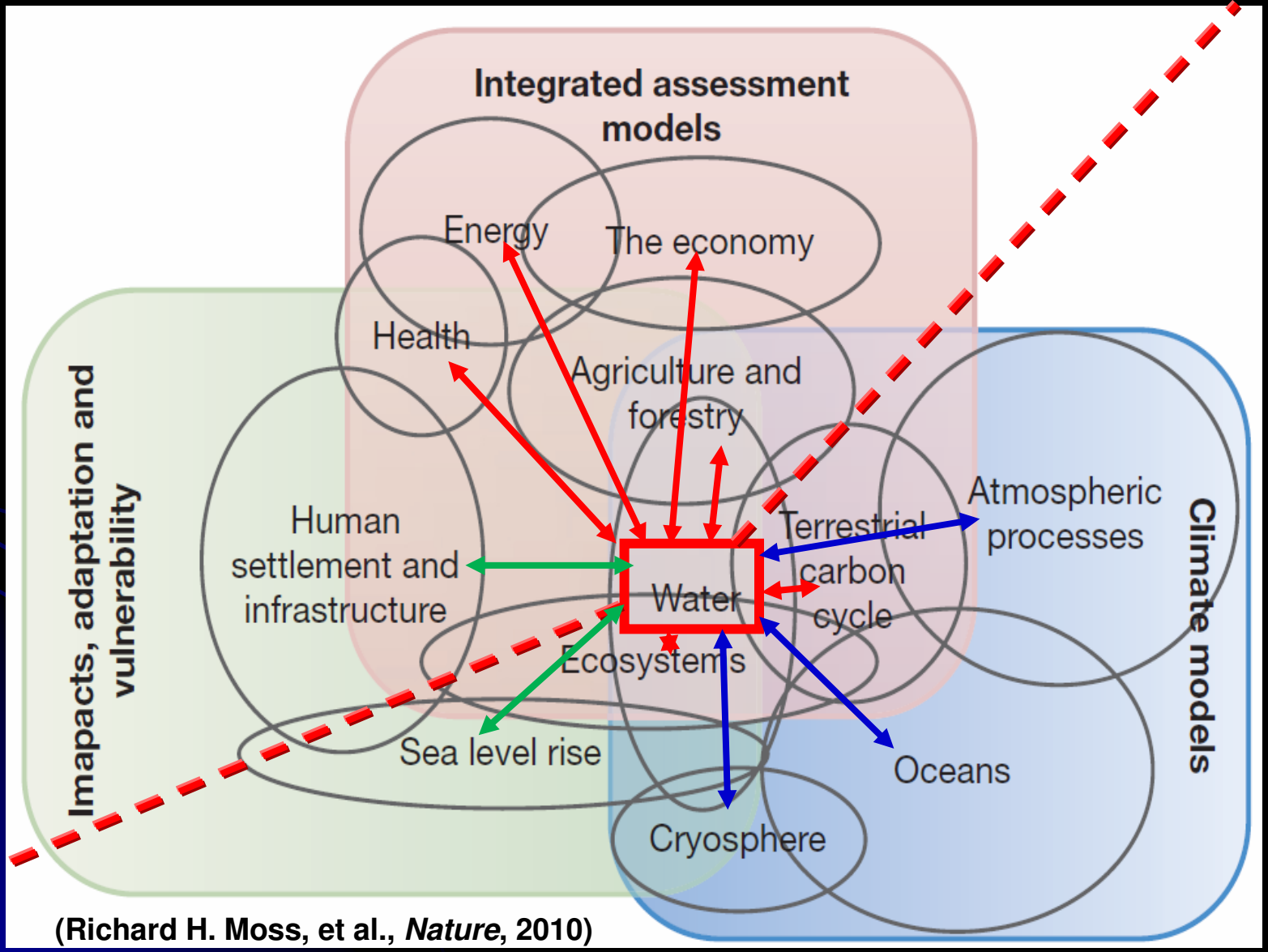


Future GW Variations



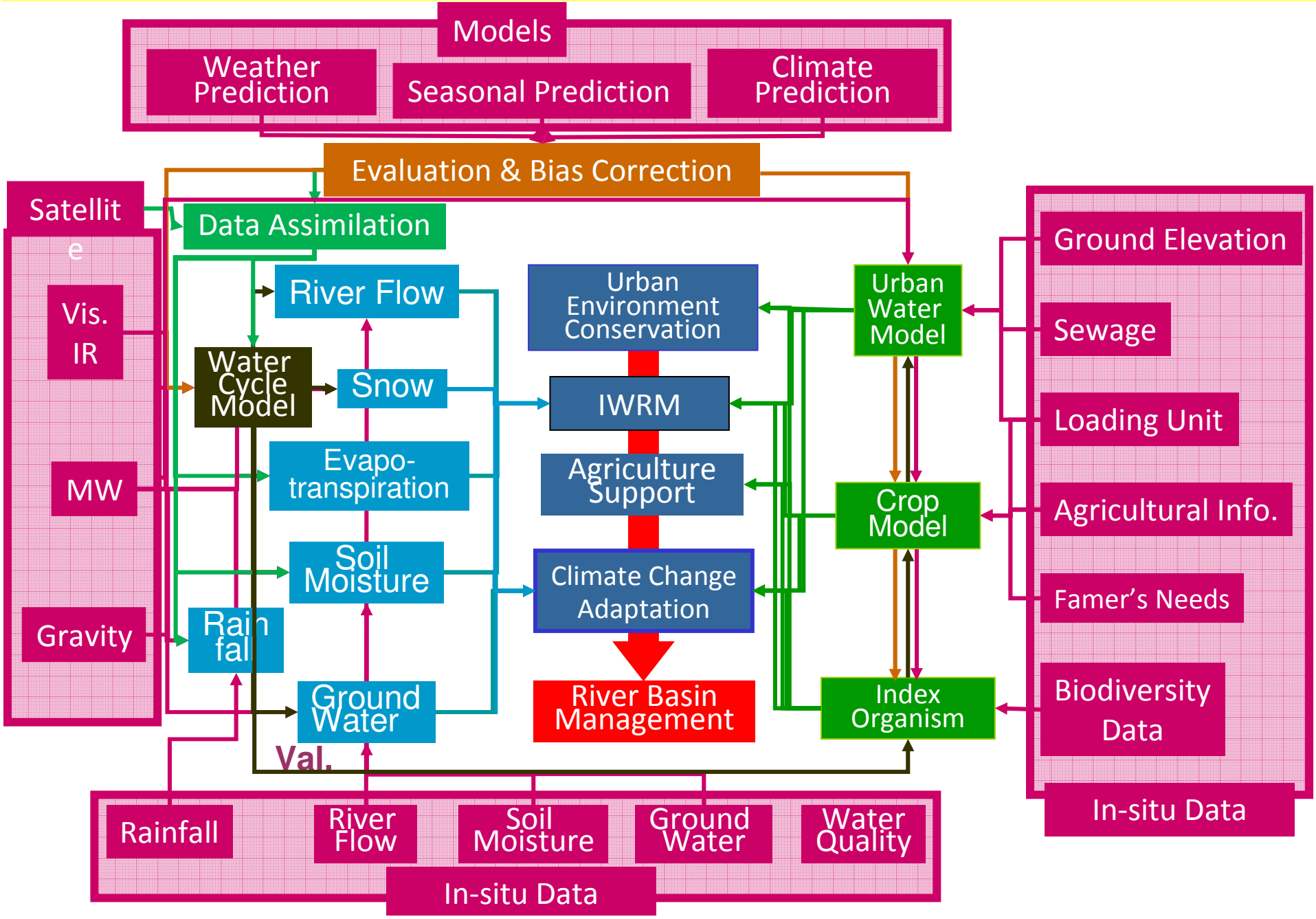

Coordinated and Integrated Efforts for Working Together
Regime Shift
Extremes
Flood/Drought
Climate System
Water Cycle
Water Resources Management System
Land Use/ Urbanization
Agriculture/Food
Water Quality/ Material Flow/ Health
Energy
Biodiversity/Ecosystem

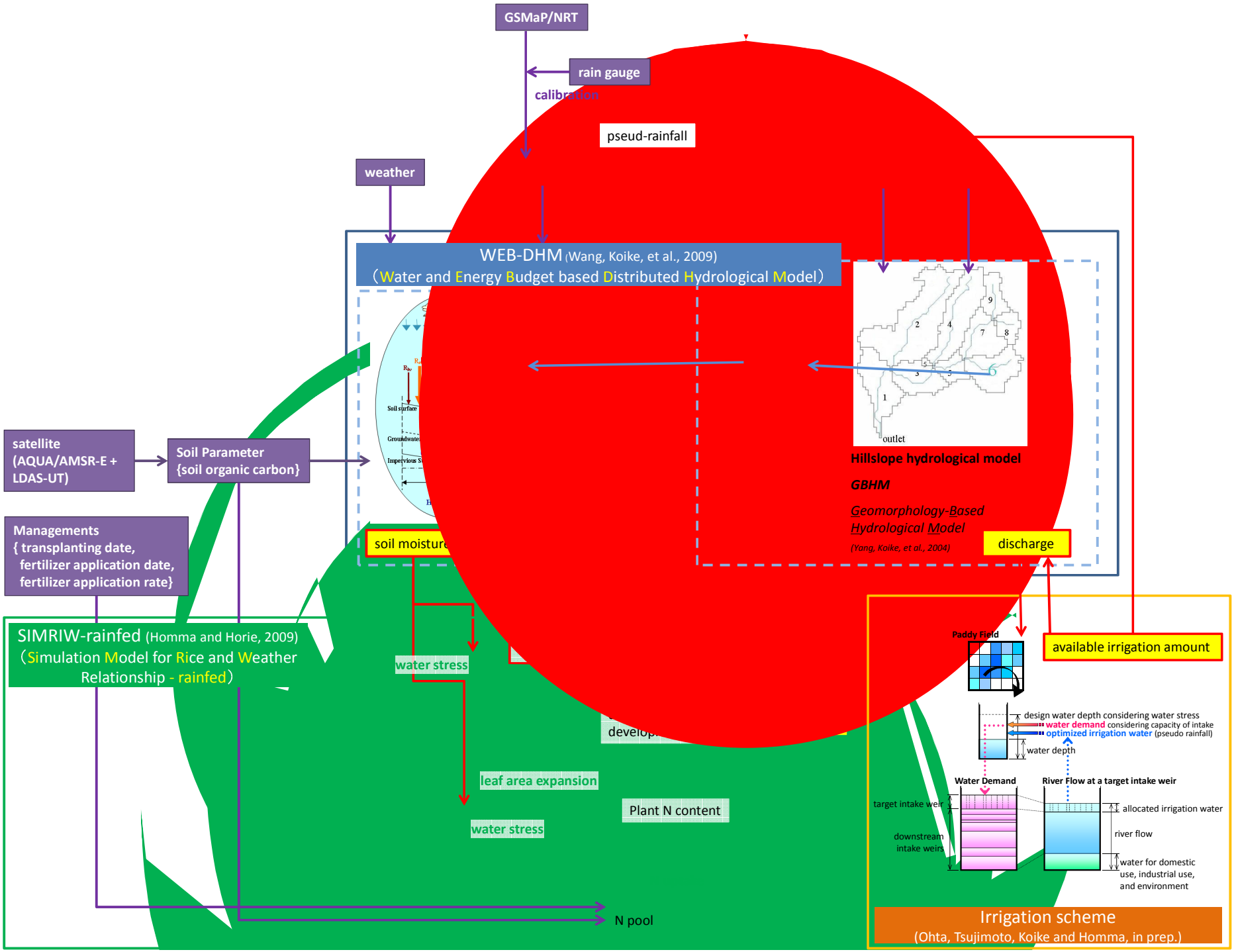
Water is a Key
bridging between climate processes and societal benefits.



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

Water Cycle Integrator




GSMaP/NRT
rain gauge
calibration
pseud-rainfall
weather
WEB-DHM (Wang, Koike, et al., 2009)
(Water and Energy Budget based Distributed Hydrological Model)
satellite
(AQUA/AMSR-E +
LDAS-UT)
Soil Parameter
{soil organic carbon}
Managements
{ transplanting date,
fertilizer application date,
fertilizer application rate}
soil moisture
discharge
Hillslope hydrological model
GBHM
Geomorphology-Based
Hydrological Model
(Yang, Koike, et al., 2004)
outlet
SIMRIW-rainfed (Homma and Horie, 2009)
(Simulation Model for Rice and Weather
Relationship - rainfed)
water stress
leaf area expansion
water stress
Plant N content
N pool
available irrigation amount
Paddy Field
design water depth considering water stress
water demand considering capacity of intake
optimized irrigation water (pseudo rainfall)
water depth
Water Demand
River Flow at a target intake weir
target intake weir
downstream
intake weirs
allocated irrigation water
river flow
water for domestic
use, industrial use,
and environment
Irrigation scheme
(Ohta, Tsujimoto, Koike and Homma, in prep.)

Cambodia CROP & WATER Watch

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

RAIN MAP
- -- raw data
- -- corrected data

METEO. DATA
- -- latest data
- -- past data
- -- stats data
- -- station

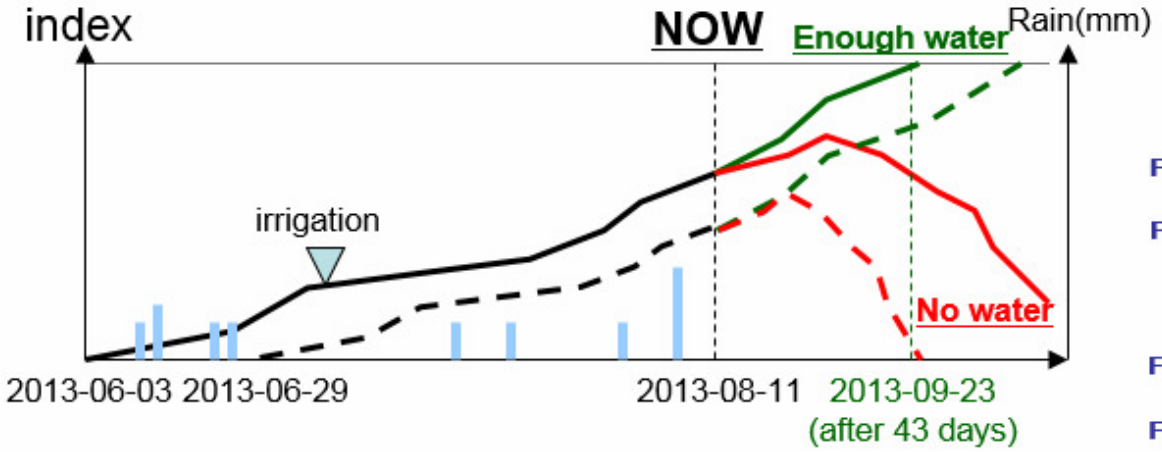
SATELLITE
- -- soil moisture map
  - -- 10km scale
  - -- 10-100m scale
- -- flooding area

Farmer 001: Pech Bora

Province Battambang

Village Phnom San Pau kaet

	Field# 1	Field# 2
LAT / LON		
type	Xx-045-kmr	YY-072-kmr
planting	2012 / Sep / 12	2012 / Sep / 12
Irrigation1	2012 / Sep / 12	2012 / Sep / 12
Irrigation2	2012 / Sep / 12	2012 / Sep / 12
Fertilixzation1	2012 / Sep / 12	2012 / Sep / 12
Fertilixzation2	2012 / Sep / 12	2012 / Sep / 12



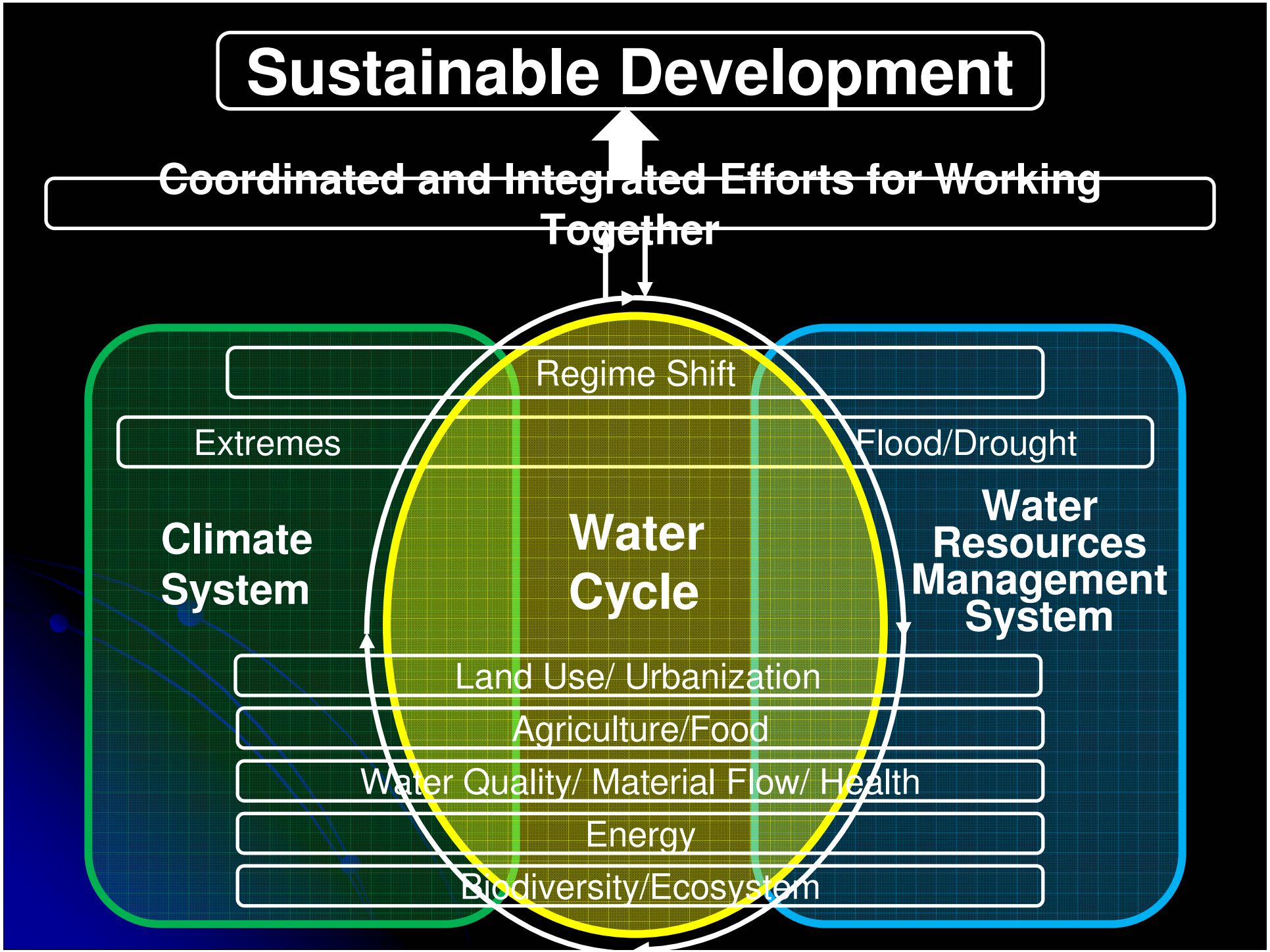
Production

Enough water

Field 1	2.1 ton/ha
Field 2	2.0 ton/ha

No water

Field 1	0.6 ton/ha
Field 2	0.0 ton/ha


Sustainable Development
Coordinated and Integrated Efforts for Working Together
Regime Shift
Extremes
Flood/Drought
Climate System
Water Cycle
Water Resources Management System
Land Use/ Urbanization
Agriculture/Food
Water Quality/ Material Flow/ Health
Energy
Biodiversity/Ecosystem

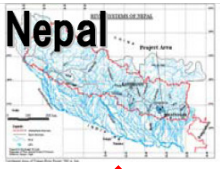
GEOSS
Asian Water Cycle Initiative (AWCI)

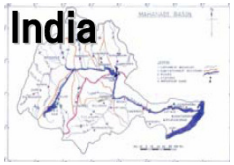
To promote integrated water resources management by making usable information from GEOSS, for addressing the common water-related problems in Asia.

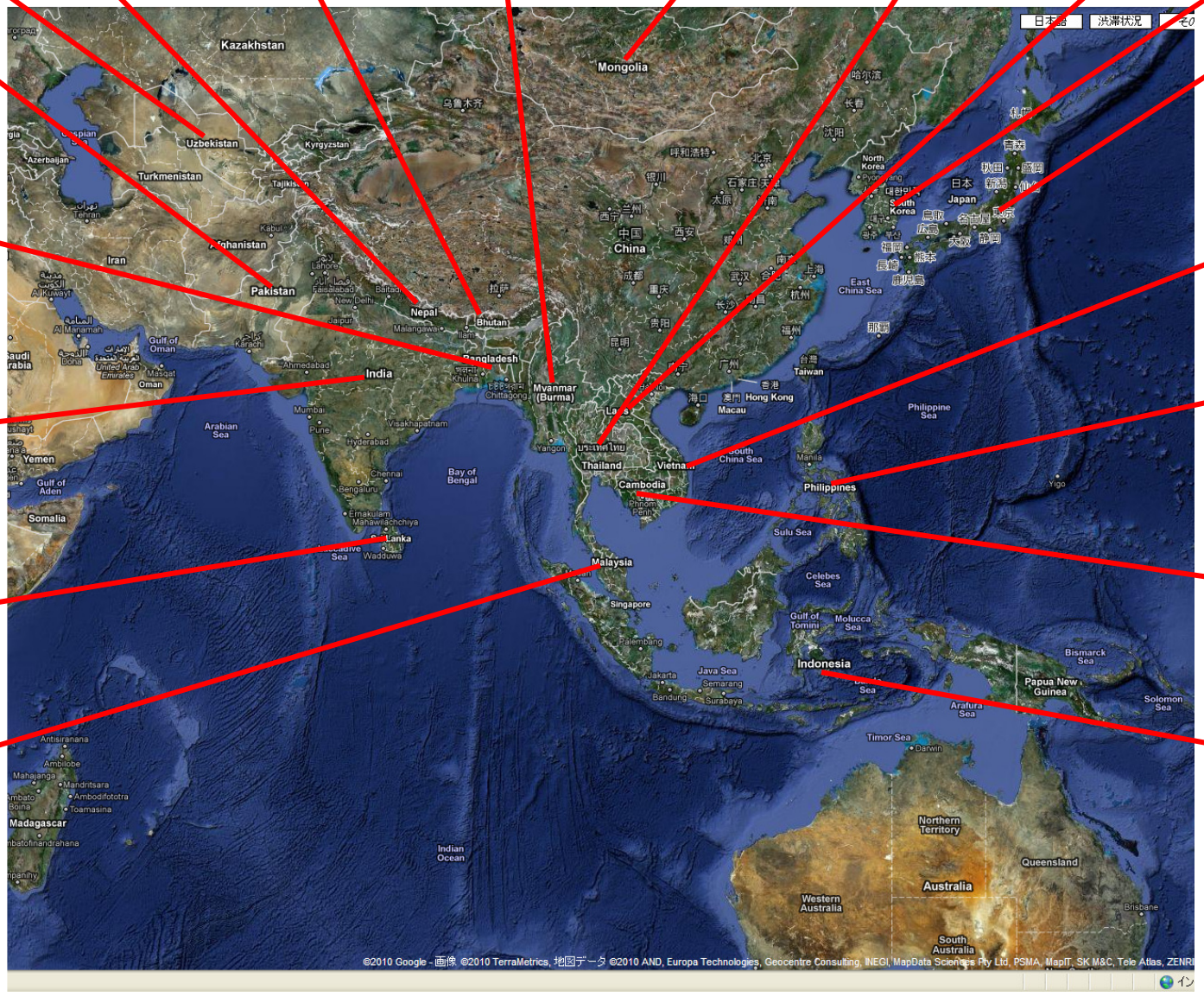
Uniqueness

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

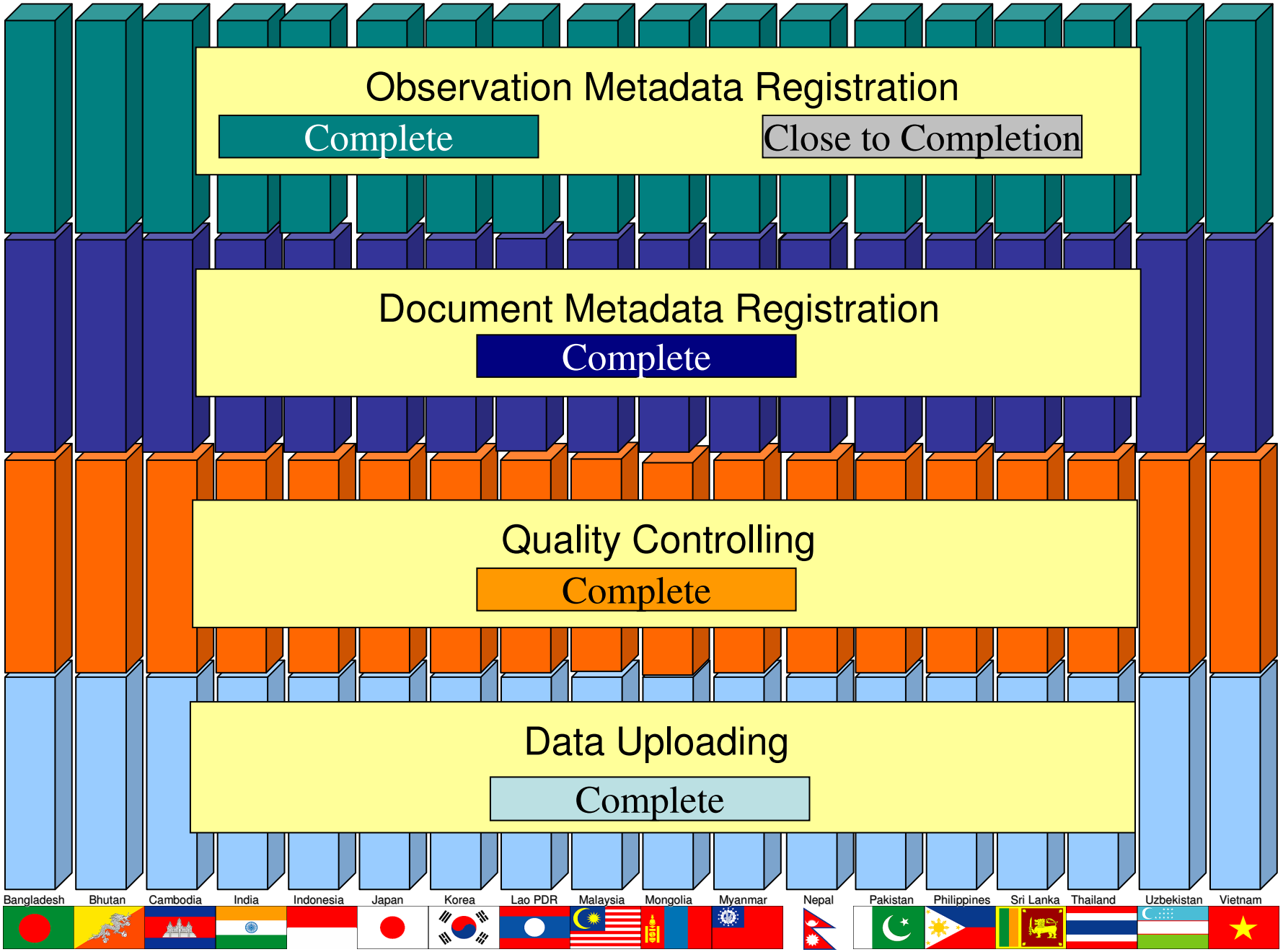
Demonstration River Basins



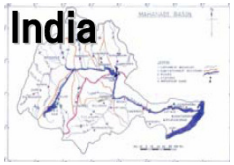


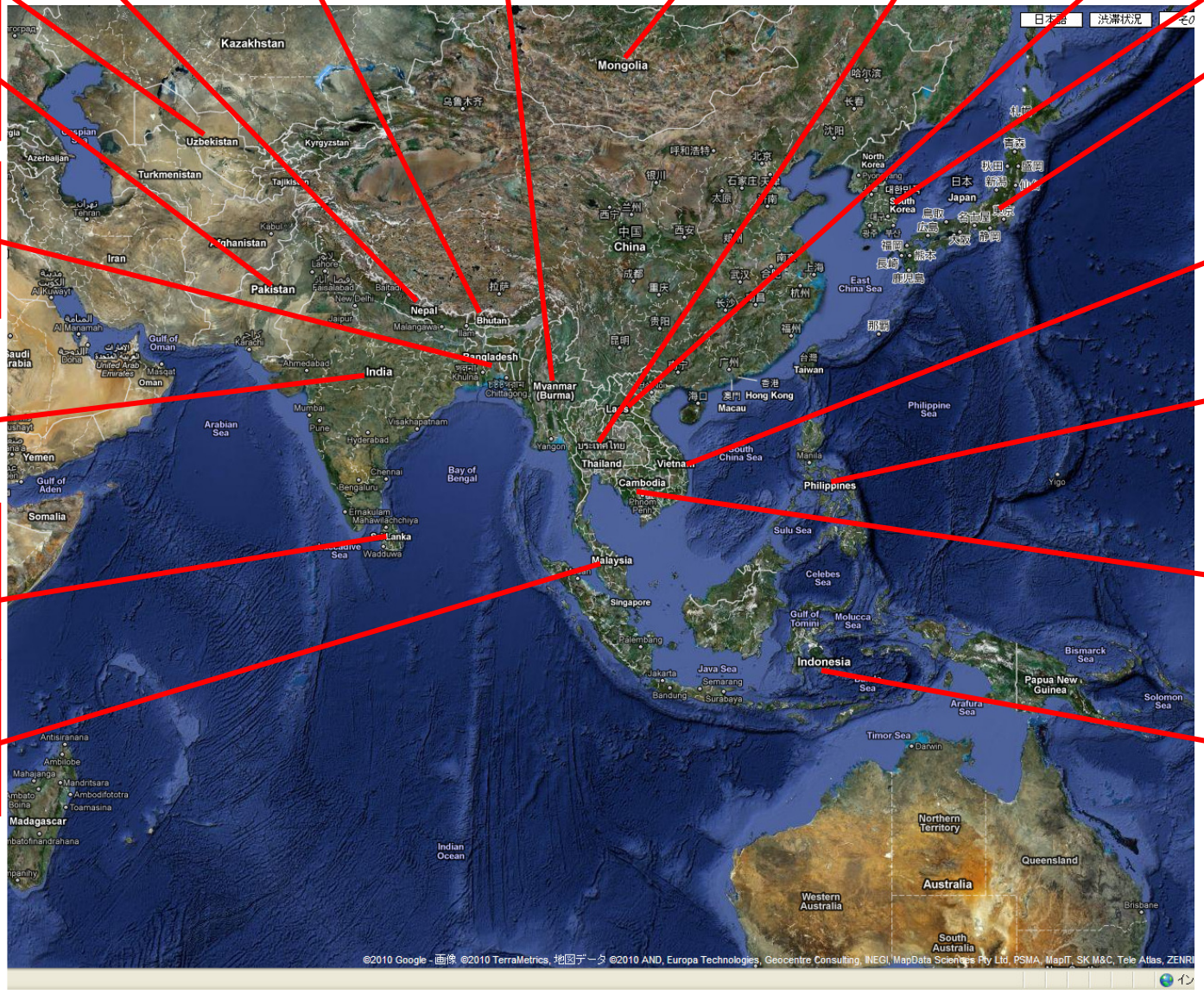


Asian Water Cycle Initiative


Observation Metadata Registration
Complete
Close to Completion
Document Metadata Registration
Complete
Quality Controlling
Complete
Data Uploading
Complete
Bangladesh
Bhutan
Cambodia
India
Indonesia
Japan
Korea
Lao PDR
Malaysia
Mongolia
Myanmar
Nepal
Pakistan
Philippines
Sri Lanka
Thailand
Uzbekistan
Vietnam

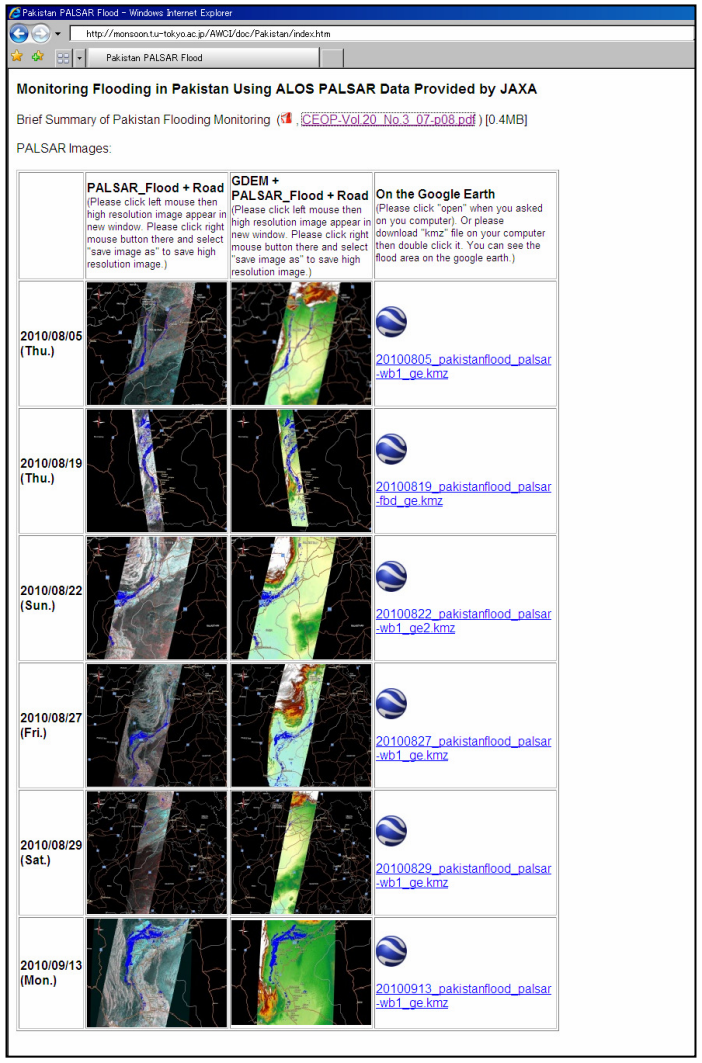
Demonstration River Basins



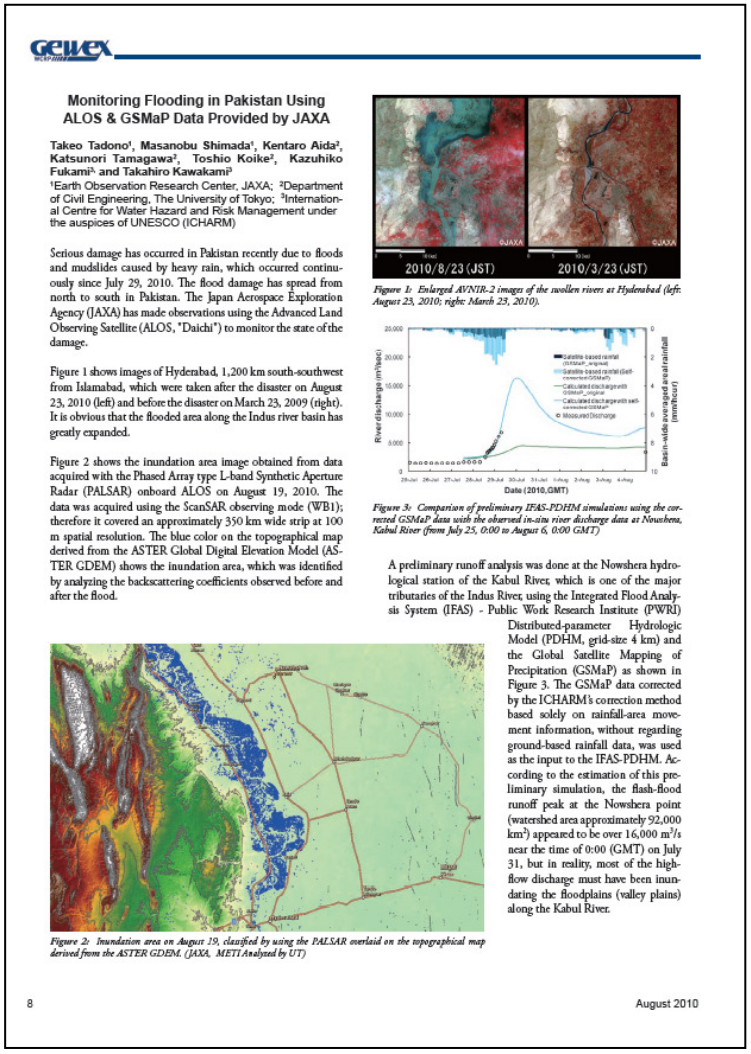


Asian Water Cycle Initiative

Pakistan Flood Information in 2010



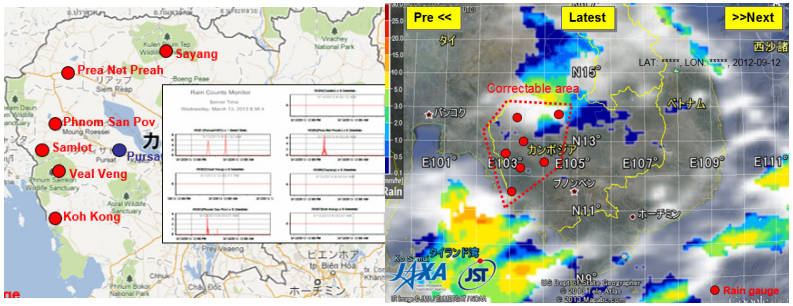
GEOSS/AWCI Website:
http://monsoon.t.u-tokyo.ac.jp/AWCI/doc/Pakistan/index.htm



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.

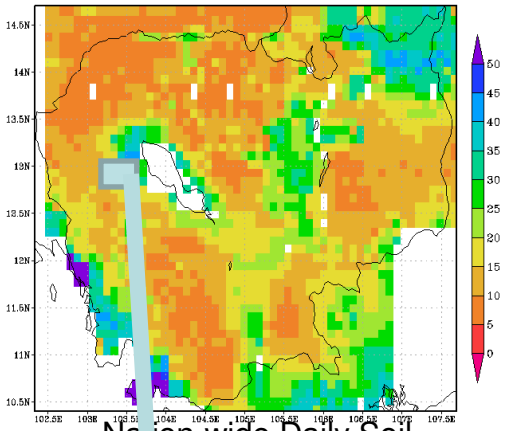
Water-Climate-Agriculture Workbench in Cambodia

Stakeholder Meeting

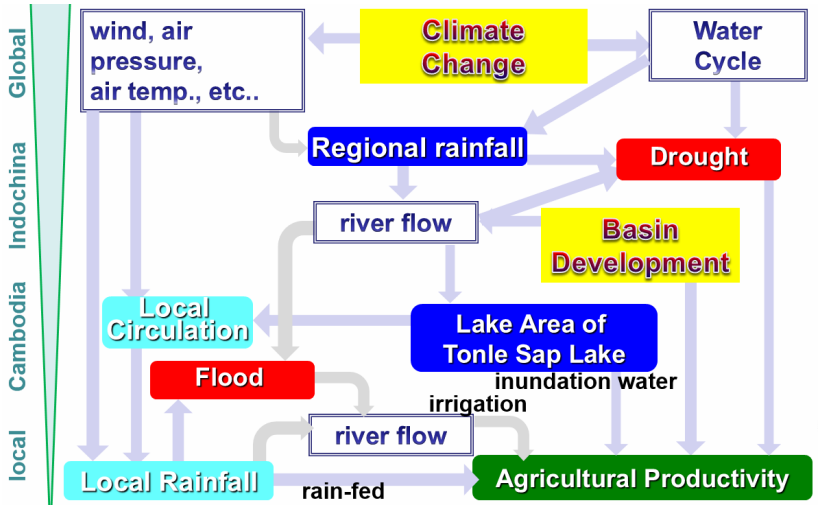


Real-time Rain Gauge → Satellite Data Correction → Wide Data Dissemination

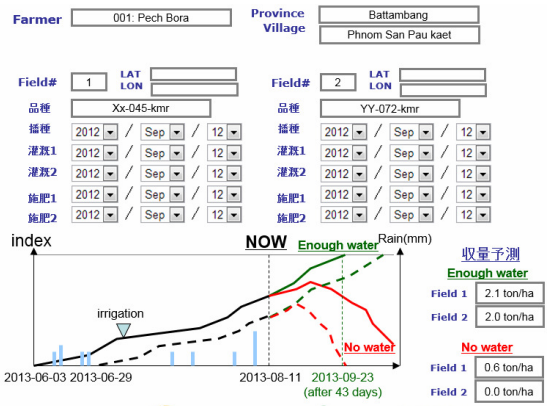
Famers' Needs & Experiences



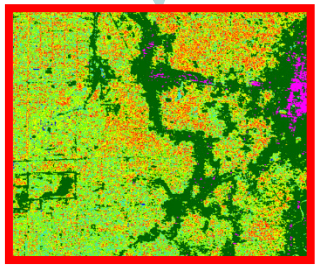
Nation-wide Daily Soil Moisture from Satellite



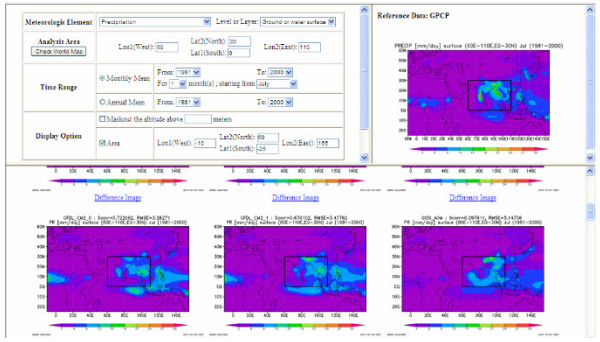
Holistic View of Water-Climate-Agriculture Problems



Water Cycle-Rice Production Coupled Model

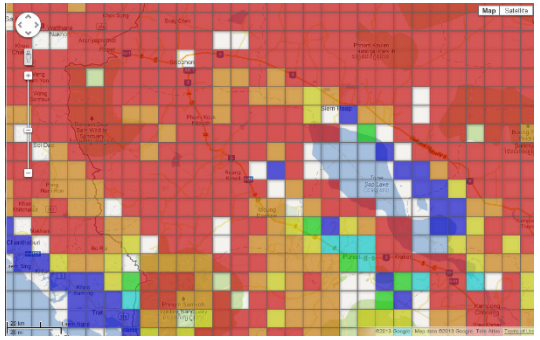


Local Information



Climate Change Analysis Tools

OJT for Local Practitioners



Rice Production Monitoring

Jan. 2009

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

Sept. 2009

1st Task Team Meeting in Geneva, *Strategy for Coordinated EO and CB*

Feb. 2011

2nd African Water Cycle Symposium in Addis Ababa
Planning for Demonstration

Jan. 2012

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

Feb. 2012

3rd African Water Cycle Symposium in Libreville
Basic Idea of Implementation, Statement to Rio+20

Feb. 2013

3rd African Water Cycle Coordination Initiative Workshop in El Jadida, Draft Implementation Plar

Nov. 2013

1st GEOSS Africa & Asia Joint Water Cycle Symposium in Tokyo
1st AfWCCI Implementation Plan and 2nd AWCI Implementation Plan

GEOSS African Water Cycle Coordination Initiative (AfWCCI)

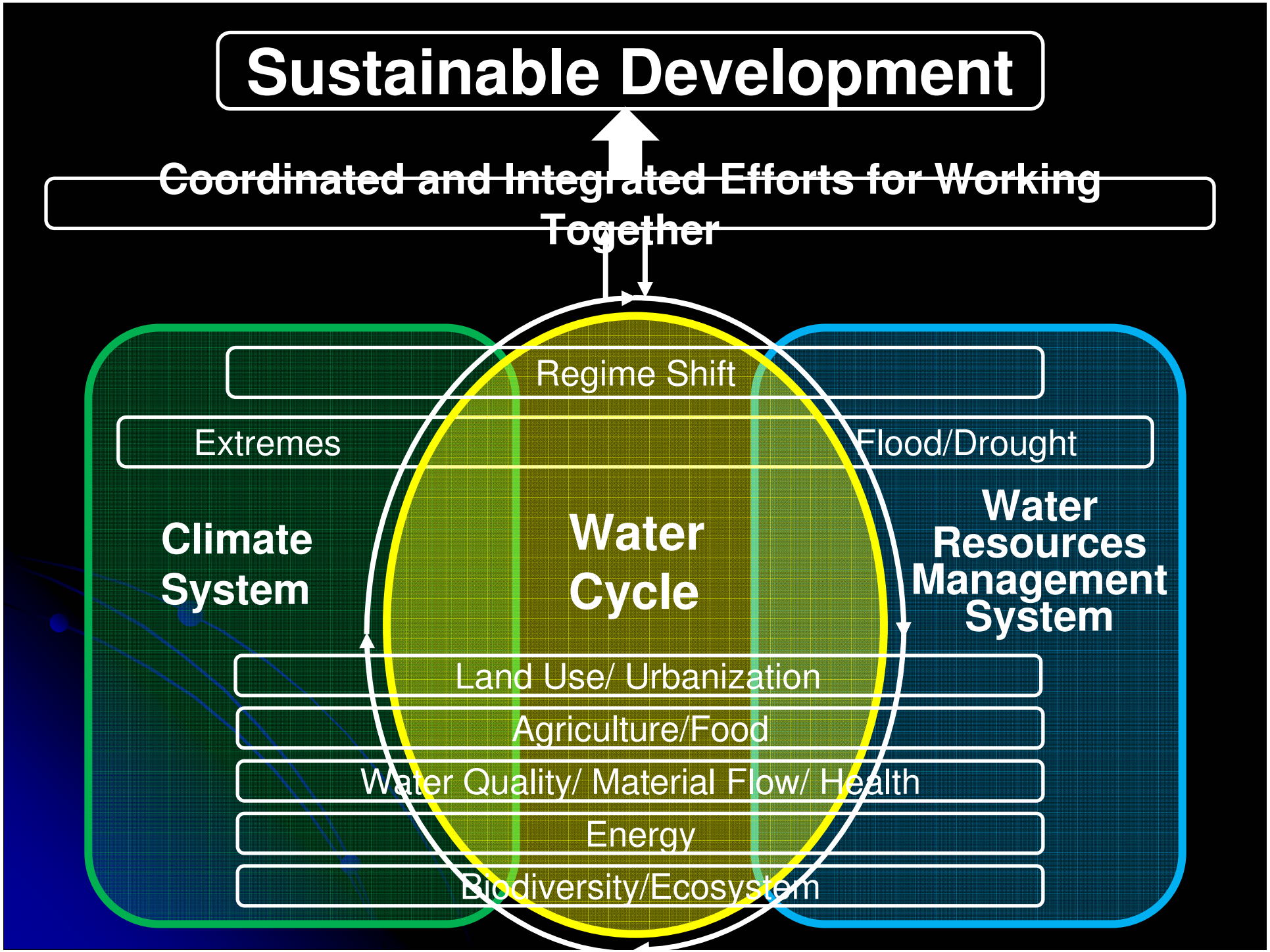
Based on a collaboration between the **Group on Earth Observations** (GEO) and RBOs in Africa, **Global Earth Observation System of Systems** (GEOSS) supports application of coordinated, comprehensive and sustained Earth Observations and information across trans-boundary river basins in Africa, particularly 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
Regime Shift
Extremes
Flood/Drought
Climate System
Water Cycle
Water Resources Management System
Land Use/ Urbanization
Agriculture/Food
Water Quality/ Material Flow/ Health
Energy
Biodiversity/Ecosystem