Seminar on
Resilience under climate change:
perspectives for Water, Energy and Food Security

Climate Change Impacts on Water and Society and Adaptation Strategy in Africa

- Climate and Water Changes, *unequivocal and uncertain*
- Date Integration, *a science and technology challenge*
- GEOSS, *a coordination mechanism for working together*

Toshio Koike
The University of Tokyo

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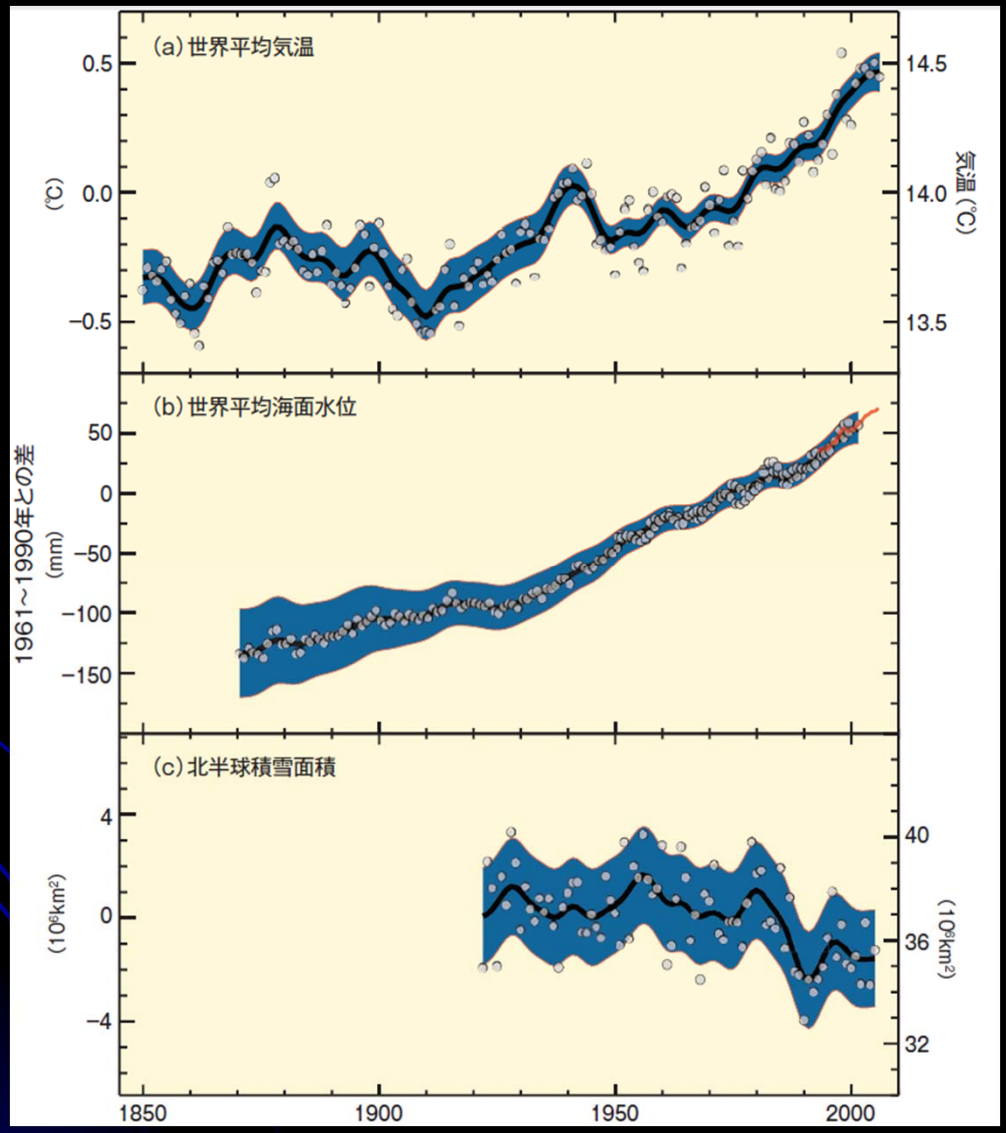
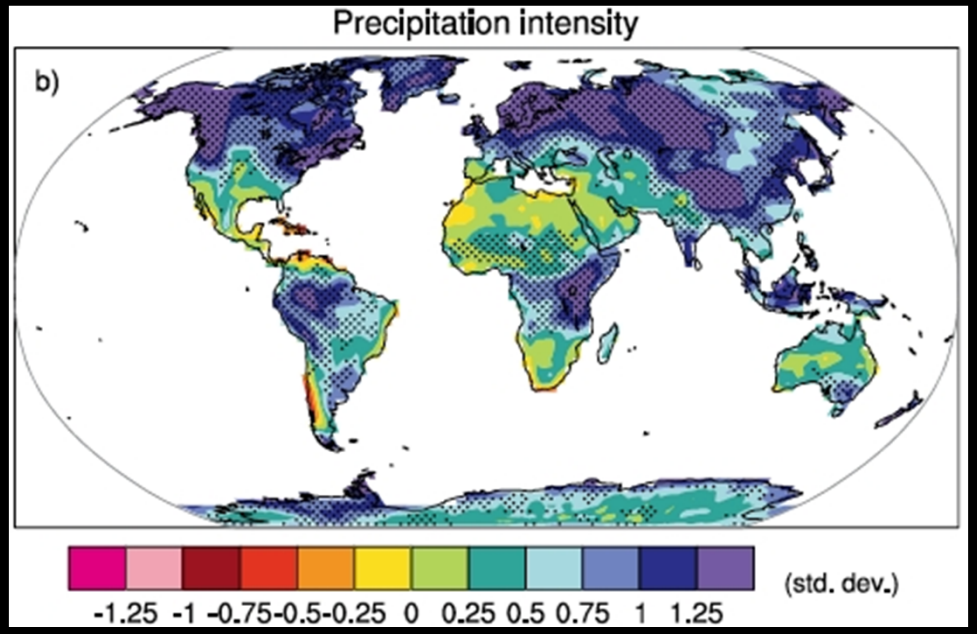
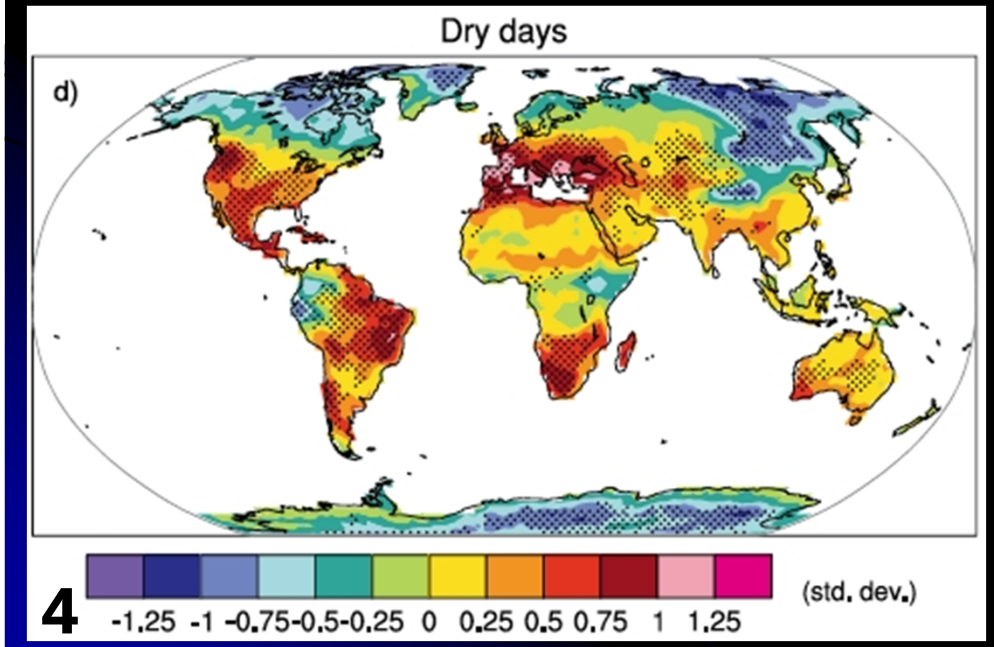
Warming of the climate system is unequivocal.

(IPCC AR4, 2007)







IPCC AR4

Projected changes in extremes

It is *very likely* that heavy precipitation events will continue to become more frequent.

It is *likely* that area affected by drought increases.

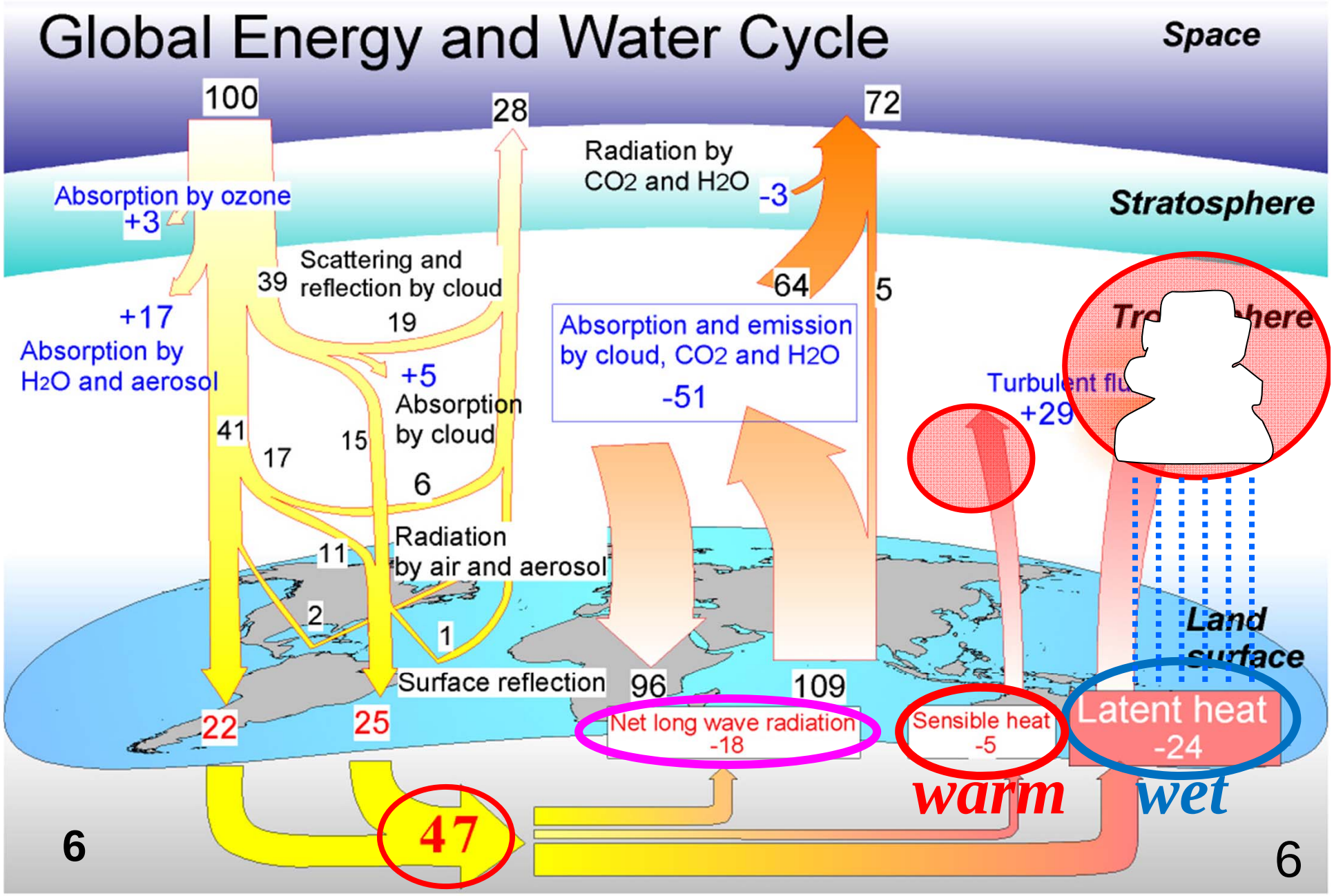
Table 4. Likelihood Scale.

Terminology	Likelihood of the occurrence/ outcome
Virtually certain	> 99% probability of occurrence
Very likely	> 90% probability
Likely	> 66% probability
About as likely as not	33 to 66% probability
Unlikely	< 33% probability
Very unlikely	< 10% probability
Exceptionally unlikely	< 1% probability

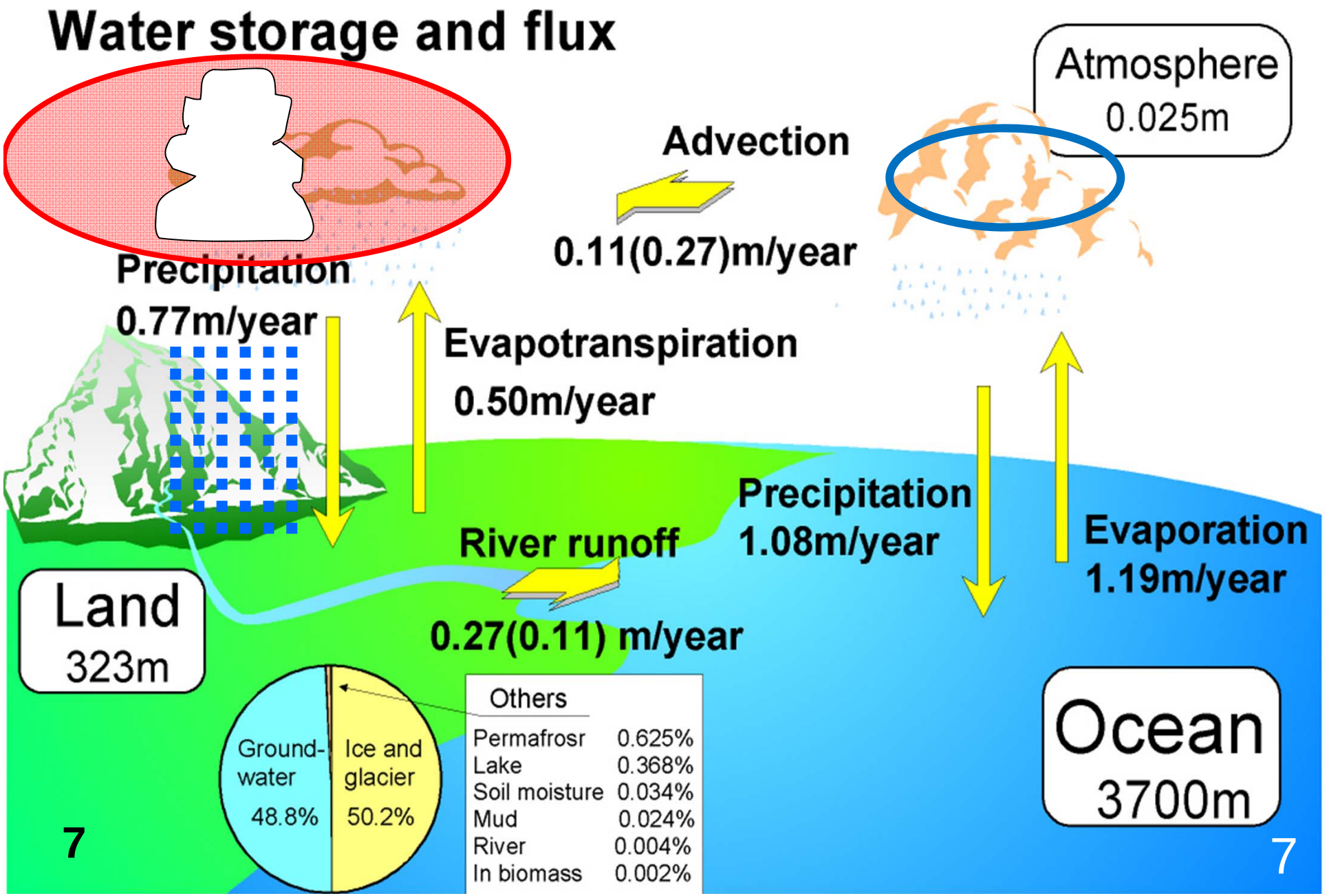
Recent trends, assessment of human influence on the trend and projections for extreme weather events for which there is an observed late-20th century trend.

Phenomenon[a] and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend[b]	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	*Very likely*[c]	*Likely*[d]	*Virtually certain*[d]
Warmer and more frequent hot days and nights over most land areas	*Very likely*[e]	*Likely (nights)*[d]	*Virtually certain*[d]
Warm spells/heat waves. Frequency increases over most land areas	*Likely*	*More likely than not*[f]	*Very likely*
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	*Likely*	*More likely than not*[f]	*Very likely*
Area affected by droughts increases	*Likely* in many regions since 1970s	*More likely than not*	*Likely*
Intense tropical cyclone activity increases	*Likely* in some regions since 1970	*More likely than not*[f]	*Likely*
Increased incidence of extreme high sea level (excludes tsunamis)[g]	*Likely*	*More likely than not*[f,h]	*Likely*[i]

Variability of Climate and Water Cycle: Unique Roles of Water

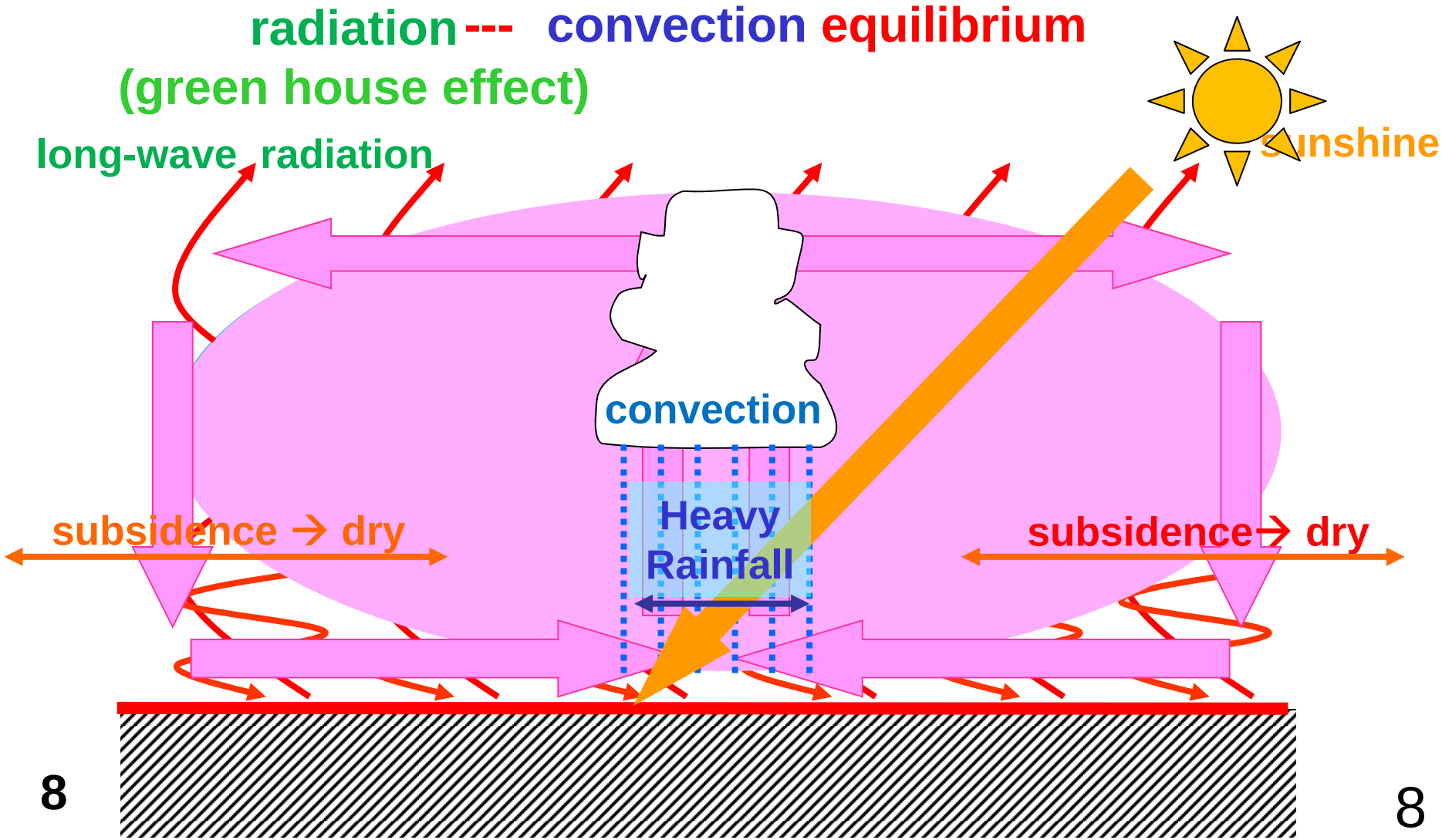


Variability of Climate and Water Cycle: Unique Roles of Water

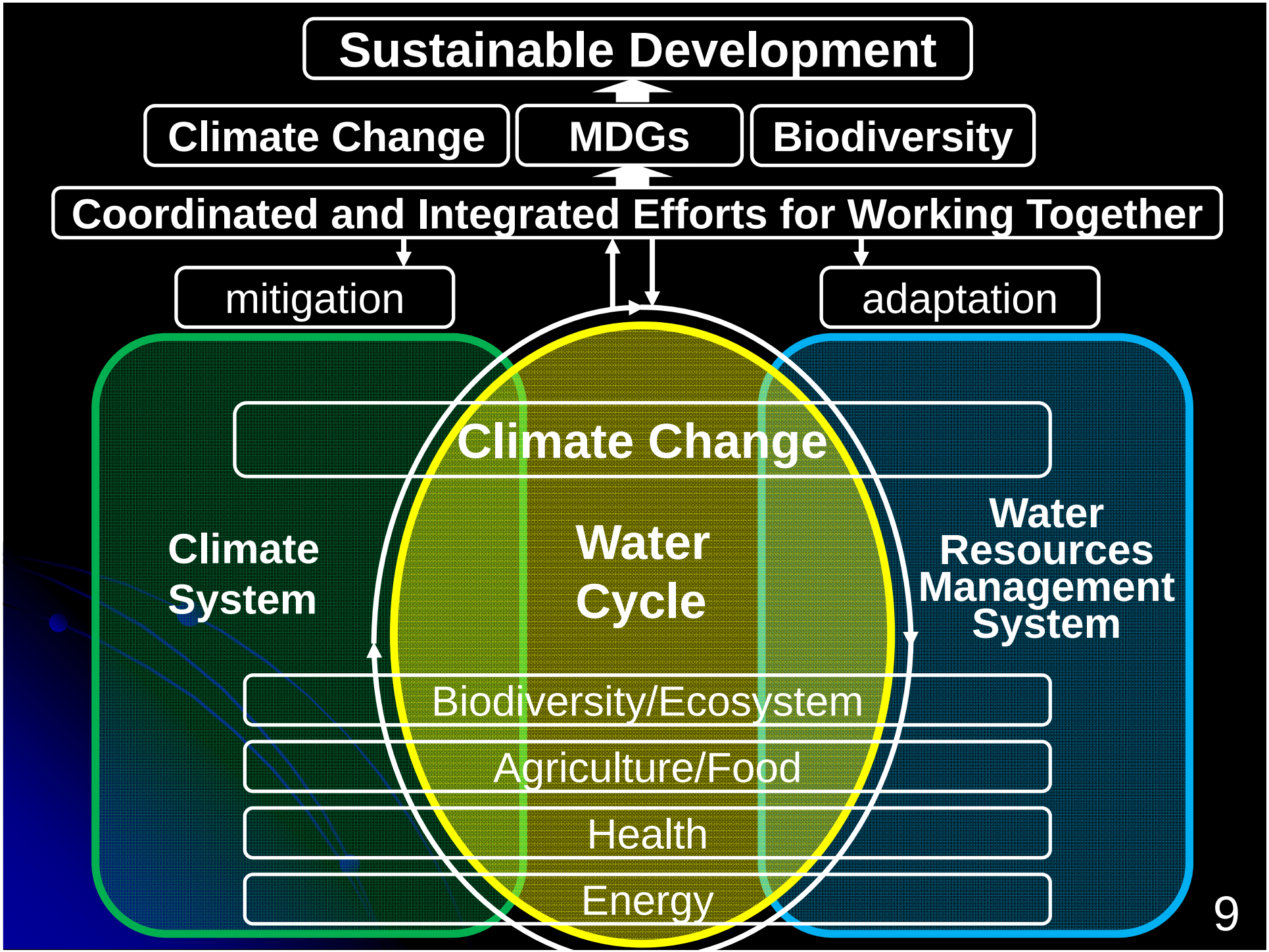


Variability of Climate and Water Cycle: Unique Roles of Water

Temperature ⇧ → Saturated Water Vapor Pressure ⇧ → Cloud Formation ⇩



8


Sustainable Development
Climate Change
MDGs
Biodiversity
Coordinated and Integrated Efforts for Working Together
mitigation
adaptation
Climate Change
Climate System
Water Cycle
Water Resources Management System
Biodiversity/Ecosystem
Agriculture/Food
Health
Energy

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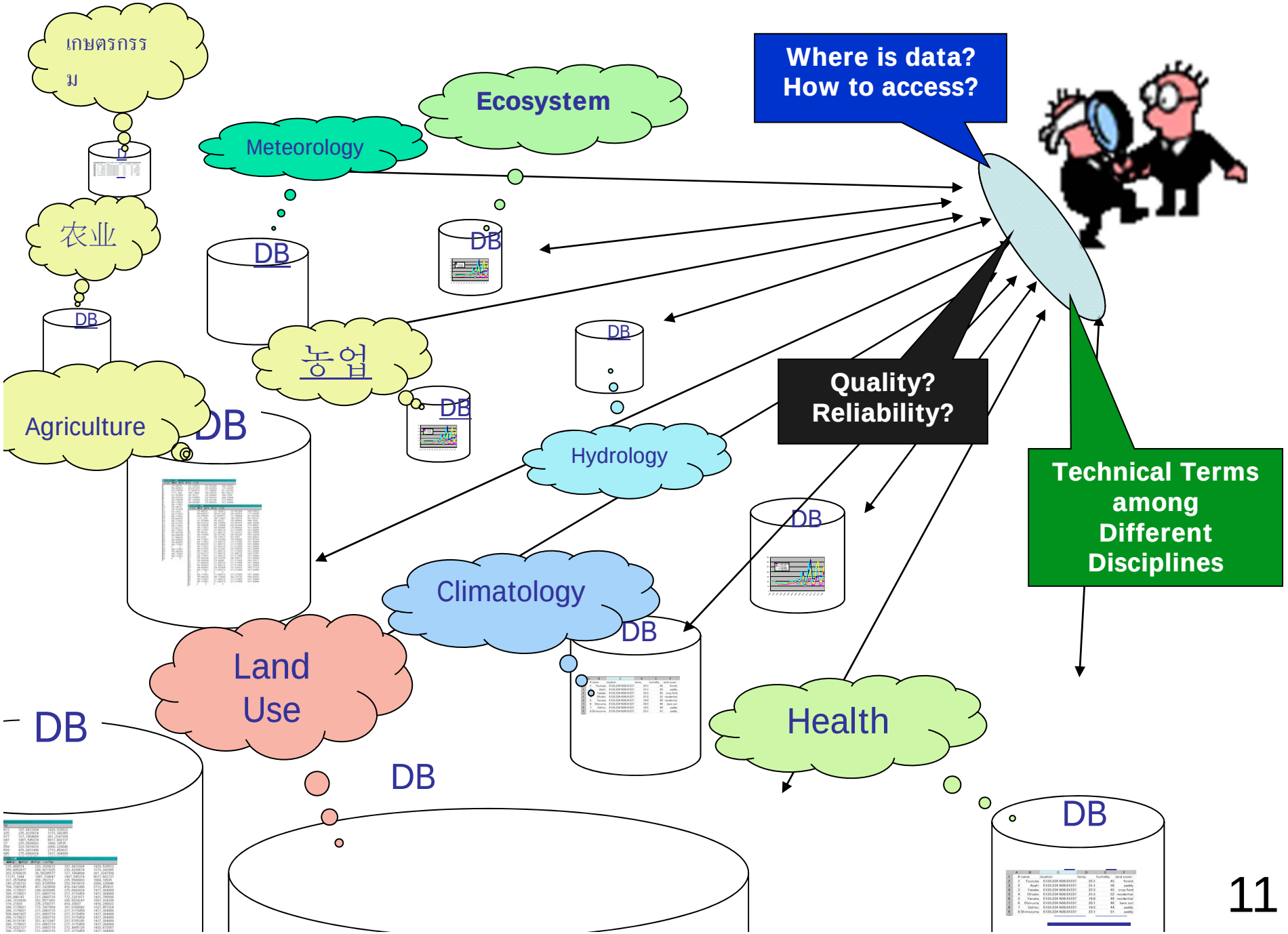
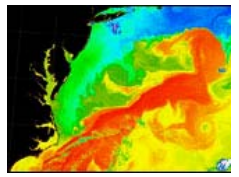
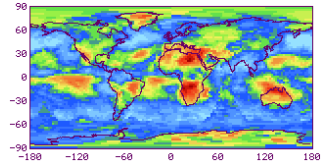

เกษตรกรรม
Ecosystem
Where is data?
How to access?
Meteorology
DB
DB
DB
농업
DB
DB
Agriculture
DB
Hydrology
Quality?
Reliability?
Technical Terms among Different Disciplines
DB
Climatology
DB
Land Use
Health
DB
DB
DB

Computational Modeling in Two Stages; Driving Evolution & Enabling Revolution

Fully interactive (biology, chemistry, physics) ensemble simulations in an operational mode

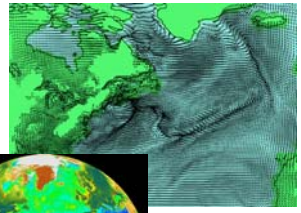




.25°x .25° resolution; add cloud, chemistry, & radiation effects

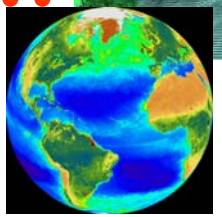
2015

2020

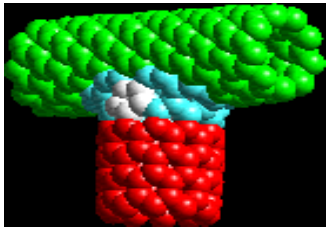


2010

.25°x .25° resolution; hurricanes, storm fronts



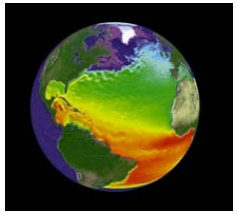
2005



Nanotechnology

2°x 2° resolution; synoptic scales

Interactive physics, biology, chemistry; assimilation of satellite data



Revolutionary

IPCC AR4 (2007): 40TB

→ AR5 (2012): 2.6PB

2001

Homogeneous Cluster

Heterogeneous Cluster

Information Power Grid

Evolutionary

Data Size, Bytes

10^{16} 10^{15} 10^{14} 10^{13} 10^{12} 10^{11} 10^{10} 10^{9}

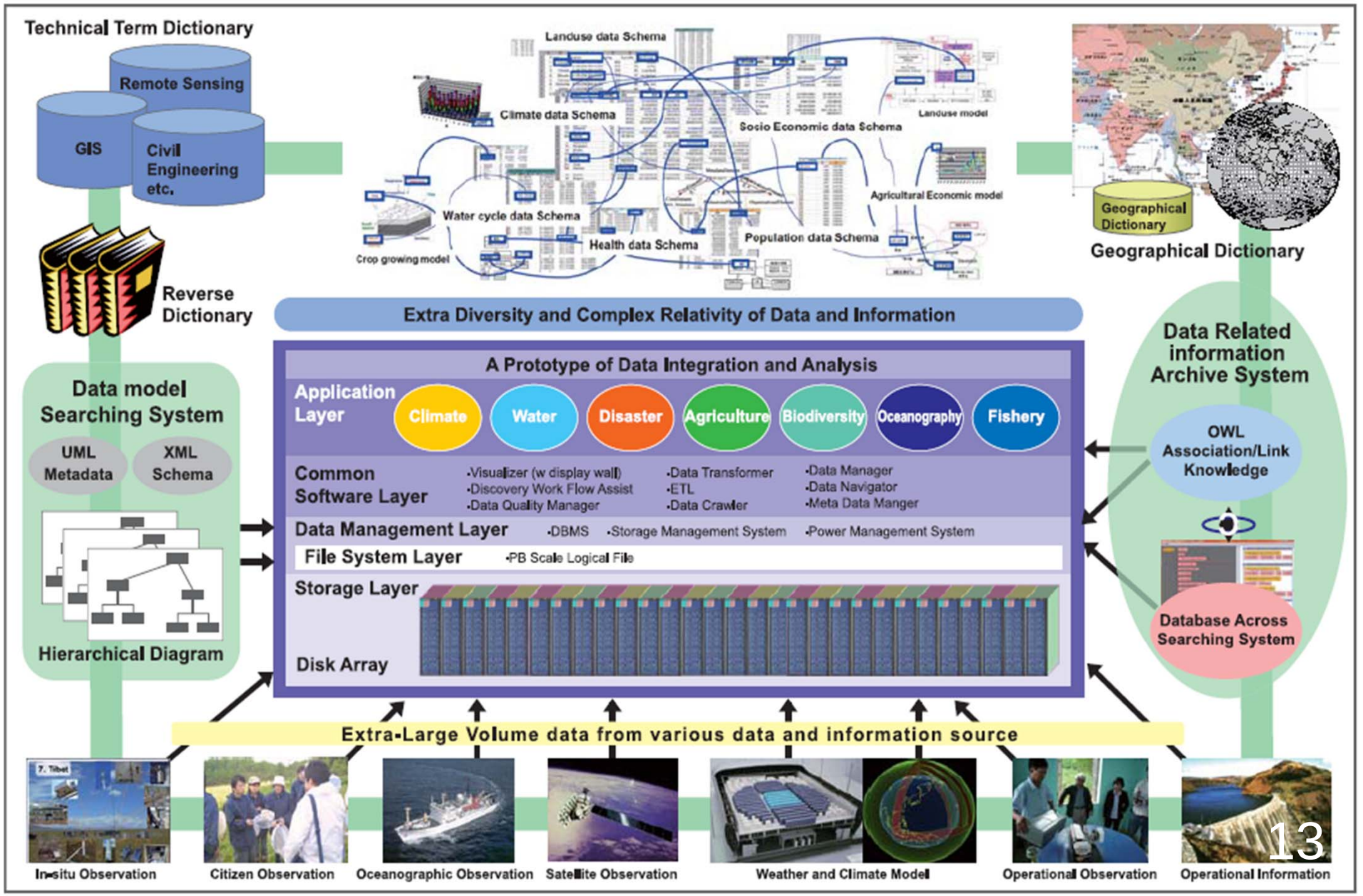
GigaFLOPS TeraFLOPS PetaFLOPS ExaFLOPS

10^{9} 10^{10} 10^{11} 10^{12} 10^{13} 10^{14} 10^{15} 10^{16} 10^{17} 10^{18}

Compute Speed, FLOPS

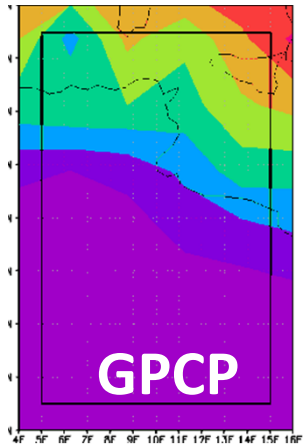
Real Demonstrated Performance doing useful Science

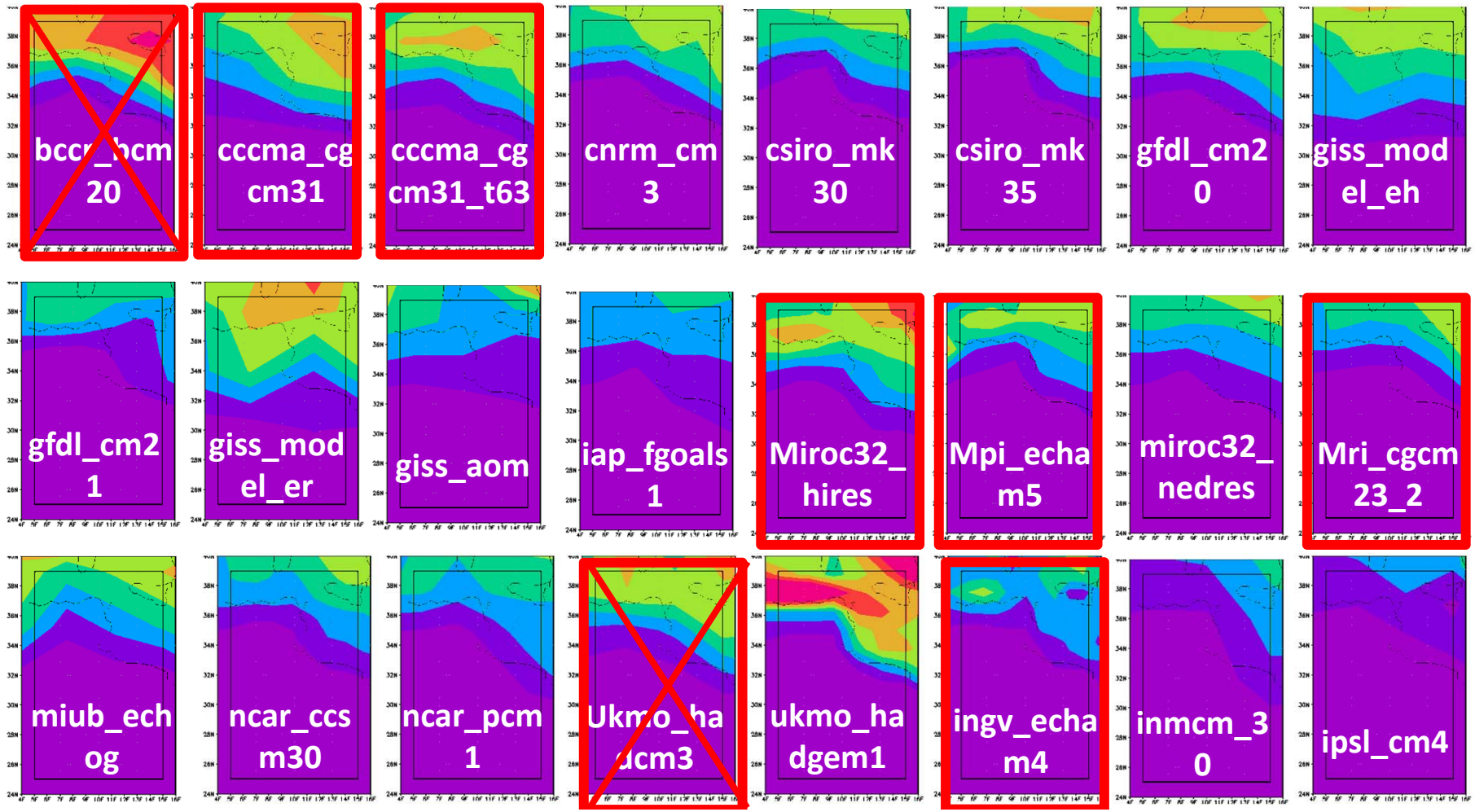
DIAS
Data Integration & Analysis System



Mejerda River

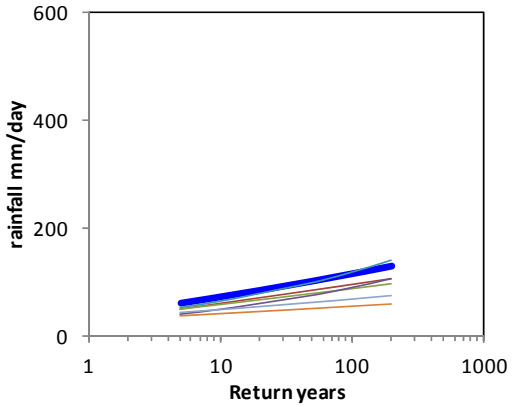
Precipitation Oct – Jan (1981-2000)

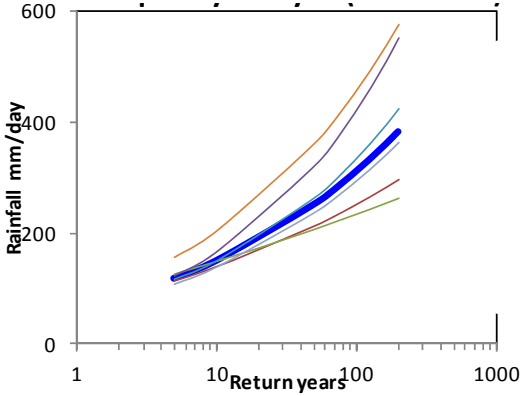


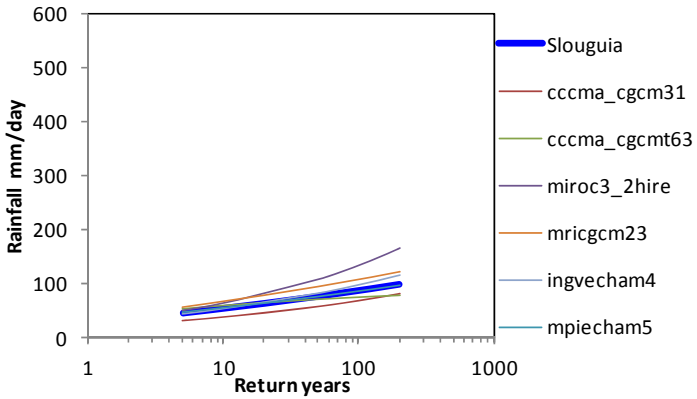


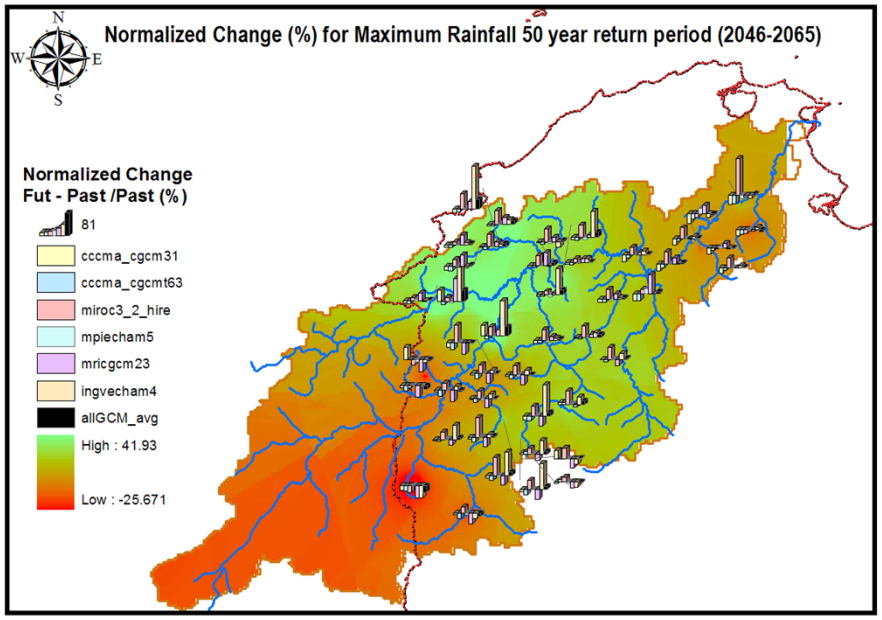
Mejerda River

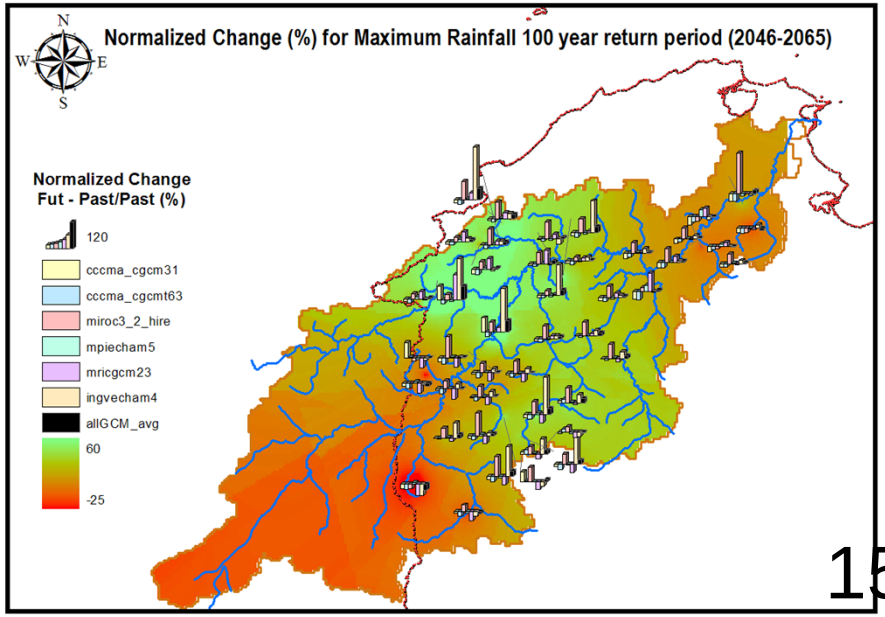
Heavy rainfall will increase in the middle of the basin and decrease in the upstream, in average.





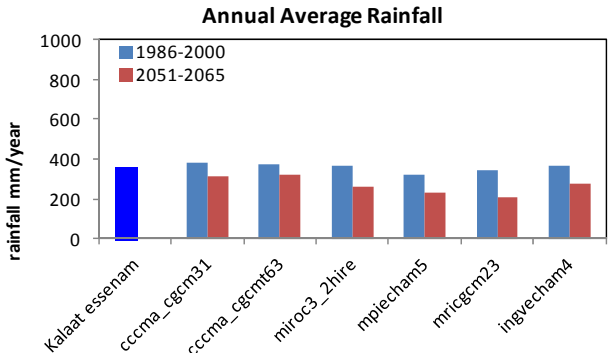




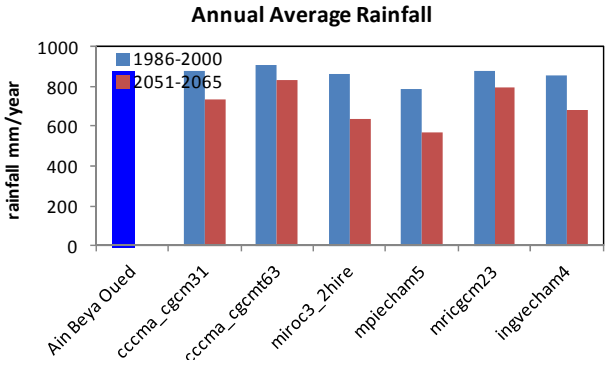


Mejerda River

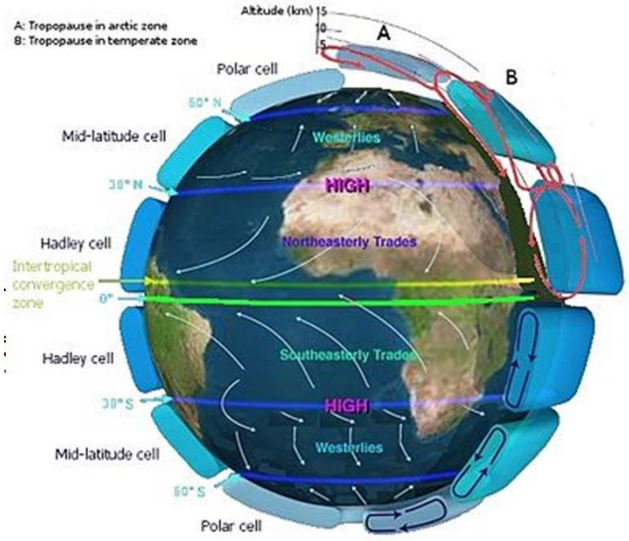
It is virtually certain that drought will become more severe.

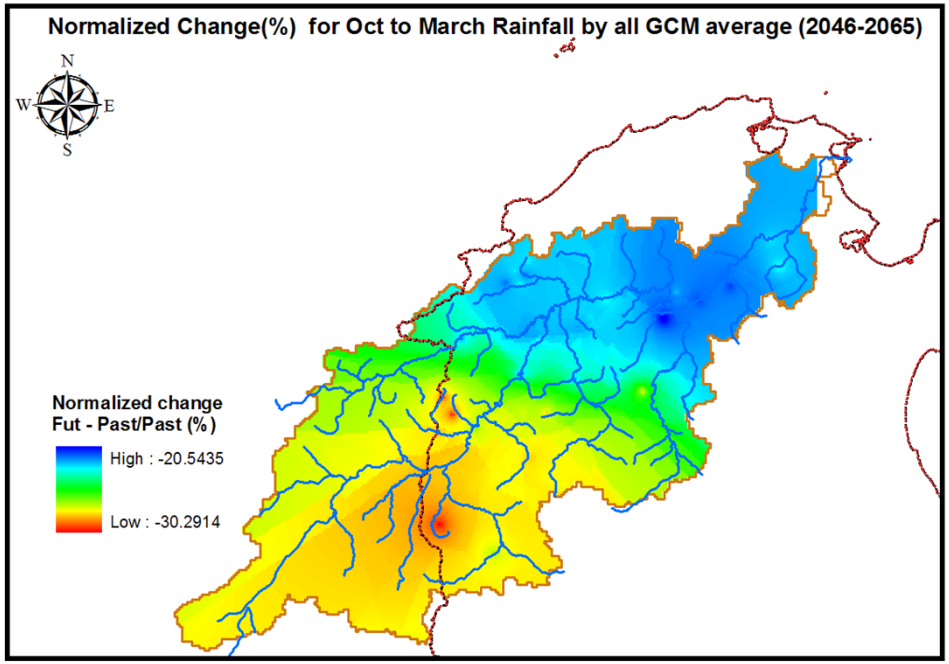


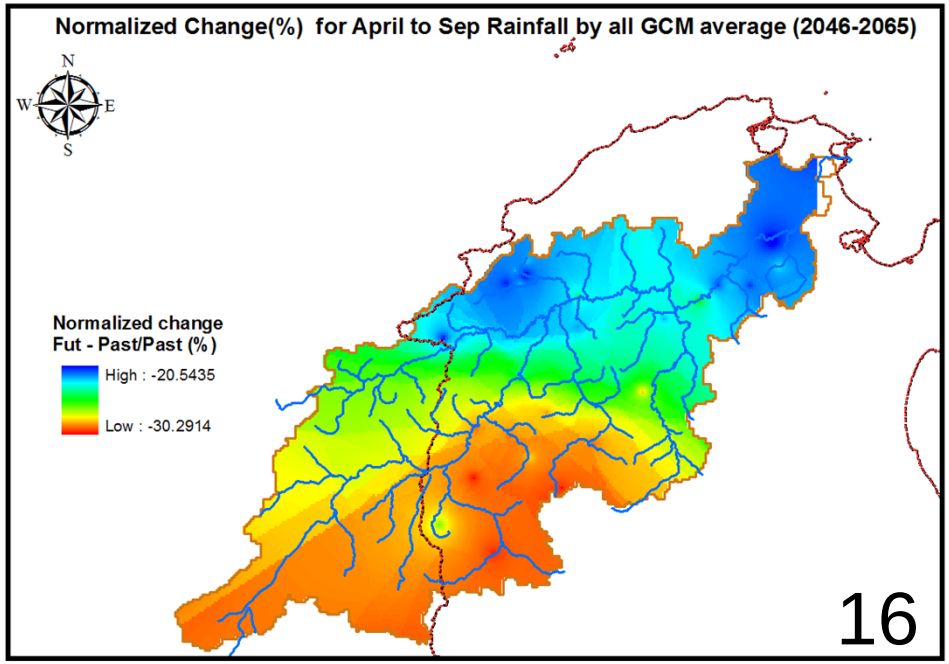
KALAAT ESSENAM



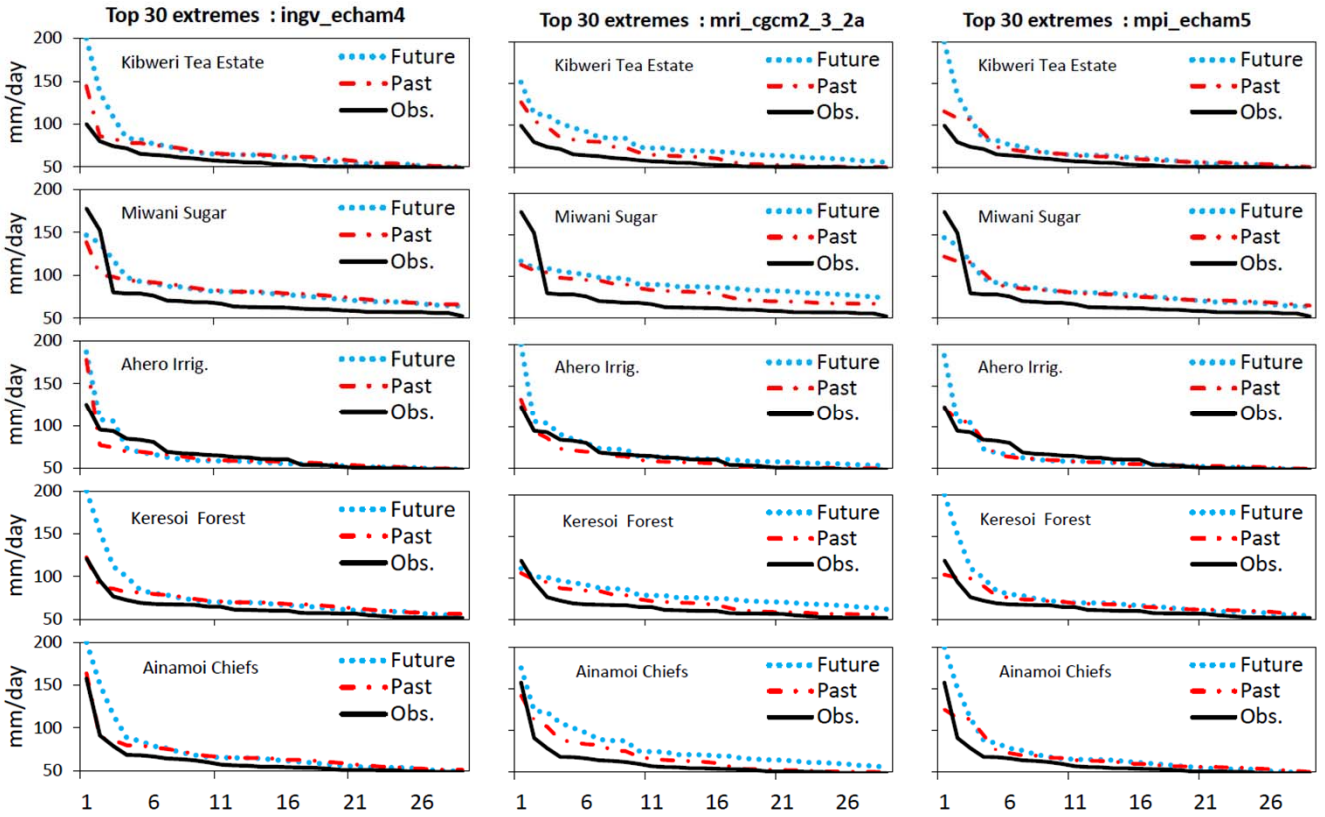
AIN BEYA OUED



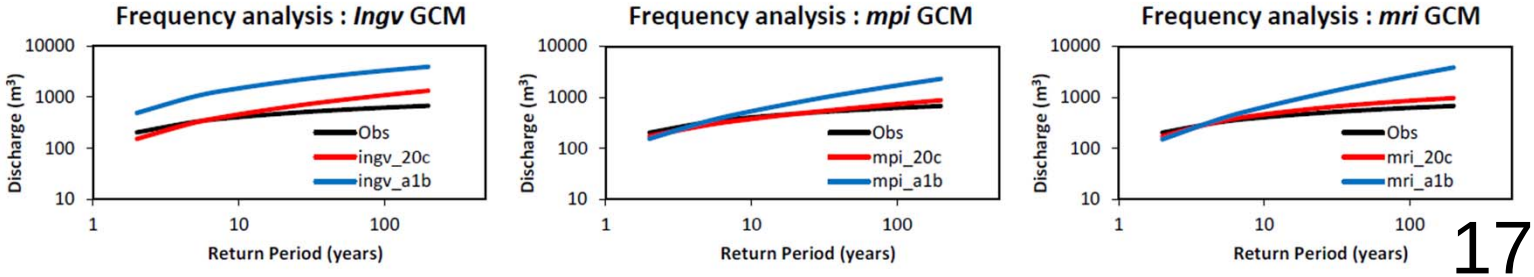


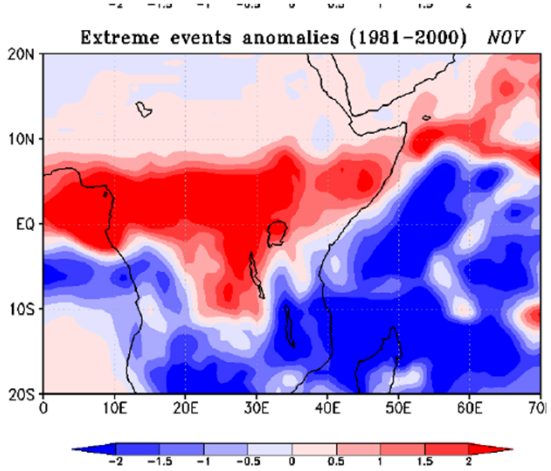


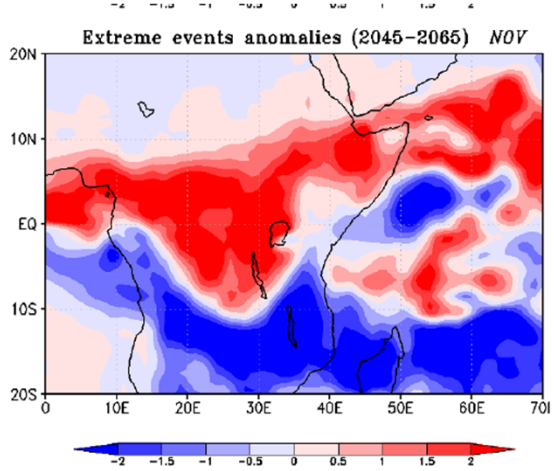
It is virtually certain that heavy rainfall will occur more often.

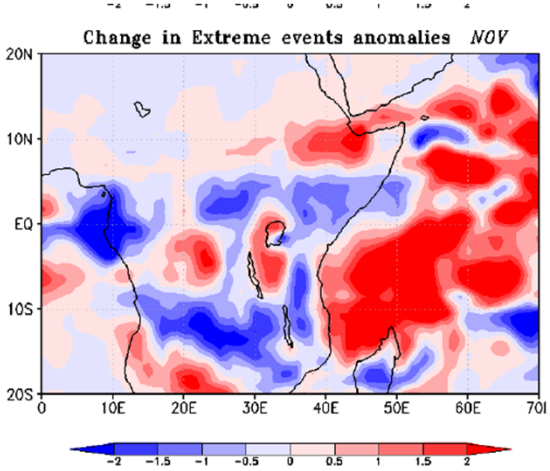


It is virtually certain that flood will become more severe.

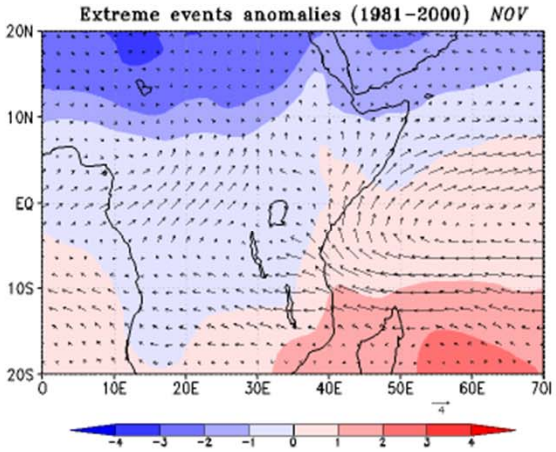


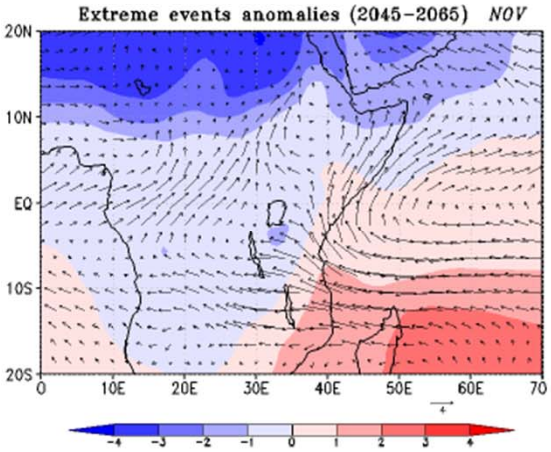


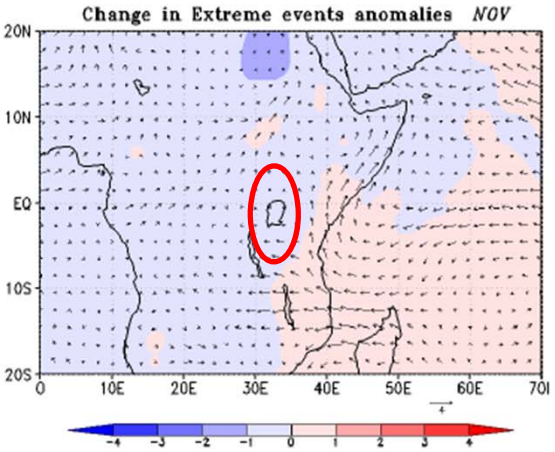




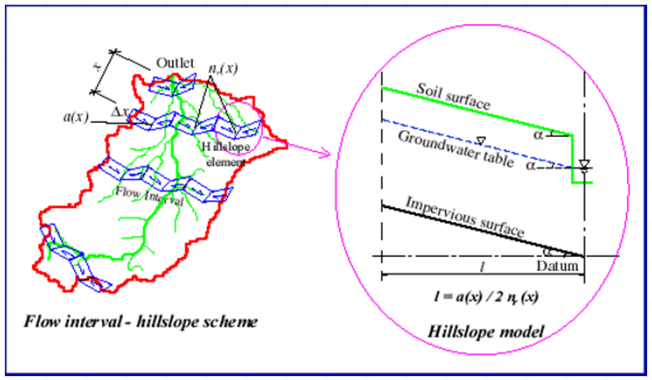
Heavy rainfall will occur more often regionally,
closely related with the change of the general circulation







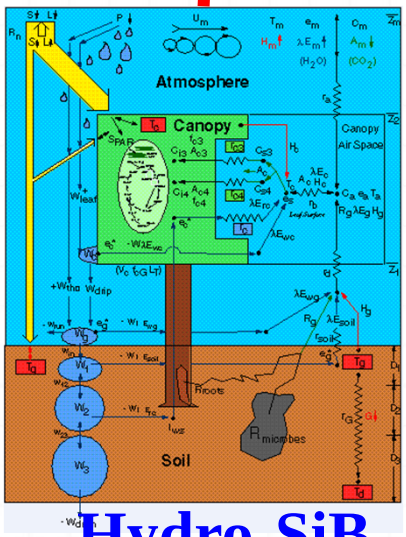
A eco-hydrological model: WEB-DHM + DVM



GBHM(river model)

⇒ WEB-DHM + DVM can simultaneously reproduce river discharge and vegetation growth.

Coupling



Hydro-SiB

+

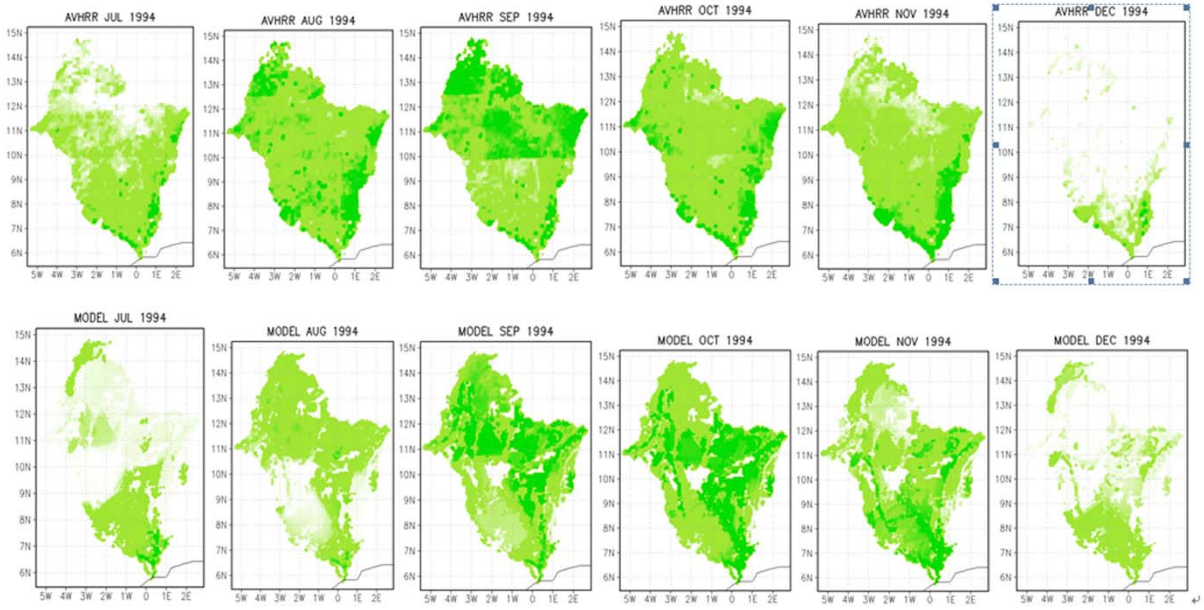
Dynamic Vegetation Model

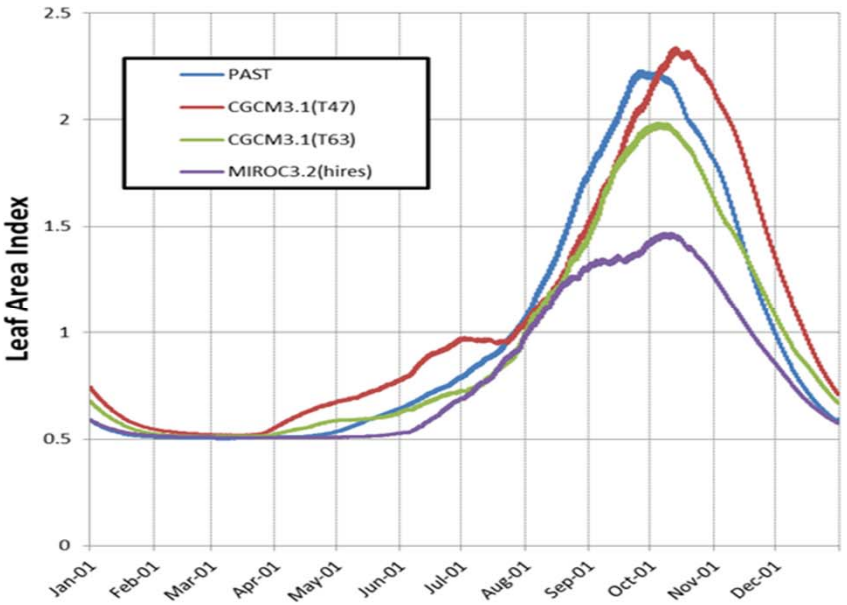
- Carbon Allocation Model
- Carbon-Pool Update Model
- Carbon-LAI Conversion Model

AVHRR LAI

Volta River

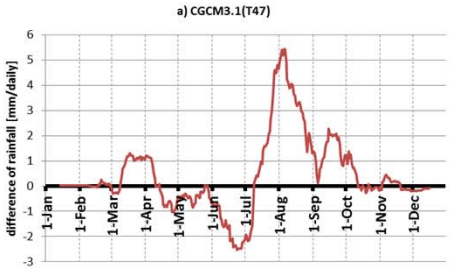
Simulated LAI



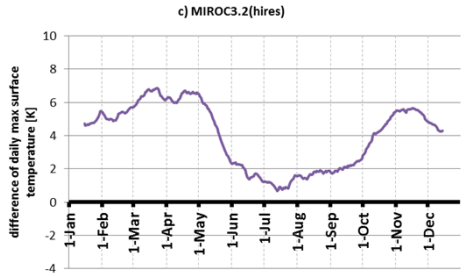


Climate Change
Impact Assessment
of Biomass Production
in the Volta River Basin

Precipitation



Air Temperature



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GROUP ON EARTH OBSERVATIONS

GEO, the Group on Earth Observations

An Intergovernmental Body
with 89 Members & 64 Participating Organizations

- ***Earth Observation Summit I (July 2003: Washington DC)***
- ***EO Summit II (April 2004: Tokyo)***
- ***EO Summit III (February 2005: Brussels)***
- ***EO Summit IV (November 2007: Cape Town)***
- ***EO Summit V (November 2010: Beijing)***

GROUP ON EARTH OBSERVATIONS

GEOSS

Global Earth Observation System of Systems

Vision for GEOSS

The vision for GEOSS is to realize a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information.

A Global, Coordinated, Comprehensive and Sustained System of Observing Systems

GROUP ON EARTH OBSERVATIONS

GEO Worldwide

89 Members
64 Participating Organizations

African Participation in GEO

Member Nations (22):

- Algeria
- Burkina Faso
- Cameroon
- Central African Republic
- Congo, Republic of the
- Egypt
- Ethiopia
- Gabon
- Ghana
- Guinea-Bissau
- Guinea, Republic of
- Mali
- Mauritius
- Morocco
- Niger
- Nigeria
- South Africa
- Sudan
- Tunisia
- Uganda
- Cote d'Ivoire

Participating Organizations:

- AARSE
- ACMAD
- EIS-Africa
- RCMRD
- UNECA

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