Data Integration and Analysis System (DIAS)

Toshio Koike
The University of Tokyo

GEO Alliances and Harmonization Workshop
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Earth Observation and Ocean Exploration System

National Key Technologies
The 3rd Basic Program for Science and Technology of Jap

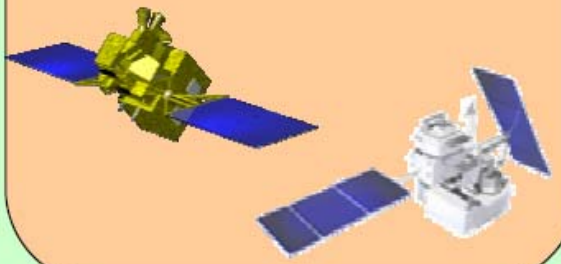
Objectives

The system contributes to national security in a broad sense by coping with global environmental and energy problems such as:

- monitoring of global warming and natural disasters
- exploration of energy resources

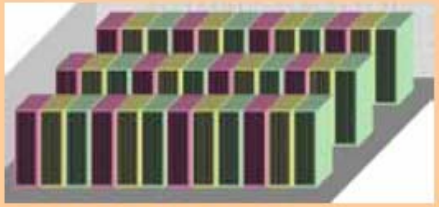
Components of the System

Satellite Observation & Monitoring System



Advanced Ocean Exploration Technology

Data Integration and Analysis System (DIAS)



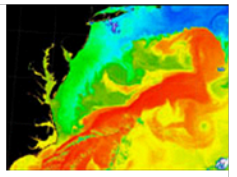
The Mission of DIAS

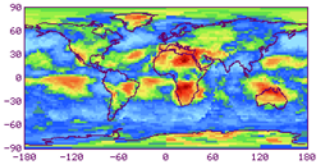
- to coordinate the cutting-edge information science and technology and the various research fields addressing the earth environment;
- to construct data infrastructure that can integrate earth observation data, numerical model outputs, and socio-economic data effectively;
- to create knowledge enabling us to solve the earth environment problems; and
- to generate socio-economic benefits.

DIAS
Data Integration & Analysis System

Computational Modeling in Two Stages; Driving Evolution & Enabling Revolution

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



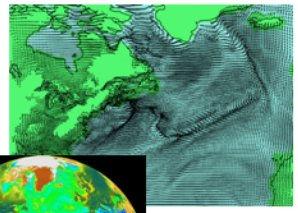


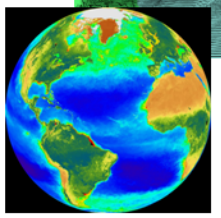
.25°x .25° resolution; add cloud, chemistry, & radiation effects

2015

2020

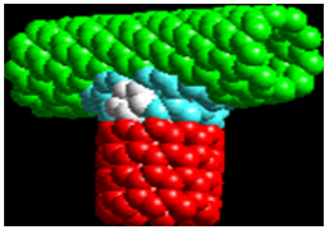
2010





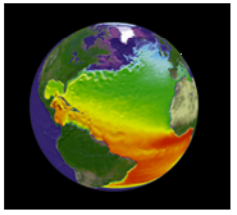
.25°x .25° resolution; hurricanes, storm fronts

2005



Nanotechnology

2°x 2° resolution; synoptic scales



Interactive physics, biology, chemistry; assimilation of satellite data

Revolutionary

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, tackling a large increase in volume of the earth observation data

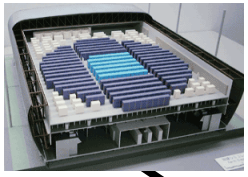
DIAS is developing a core system
for data integration and analysis
that includes the supporting functions of
life cycle data management,
data search,
information exploration,
scientific analysis,
and partial data down-loading.

DIAS
Data Integration & Analysis System

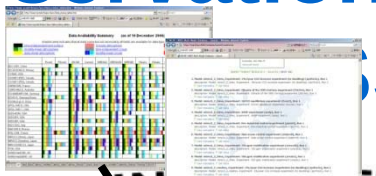
Global Earth Observation System of Systems

satellite

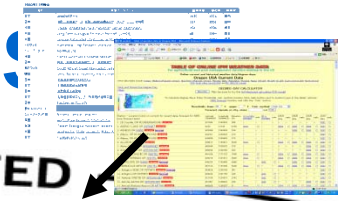
simulation



WCRP CMIP3



MetBroker



In-situ

ocean

INTEGRATED

A Prototype of Data Integration and Analysis

Application Layer

User Apps. | User Apps. | User Apps. | User Apps. | User Apps.

Common Software

- •Visualizer(w display wall)
- •Discovery Work Flow Assist
- •Data Quality Manager
- •Data Transformer
- •Data Crawler
- •ETL
- •Data Manager
- •Data Navigator
- •Meta Data Manger

Data Management Layer

•DBMS

File System Layer

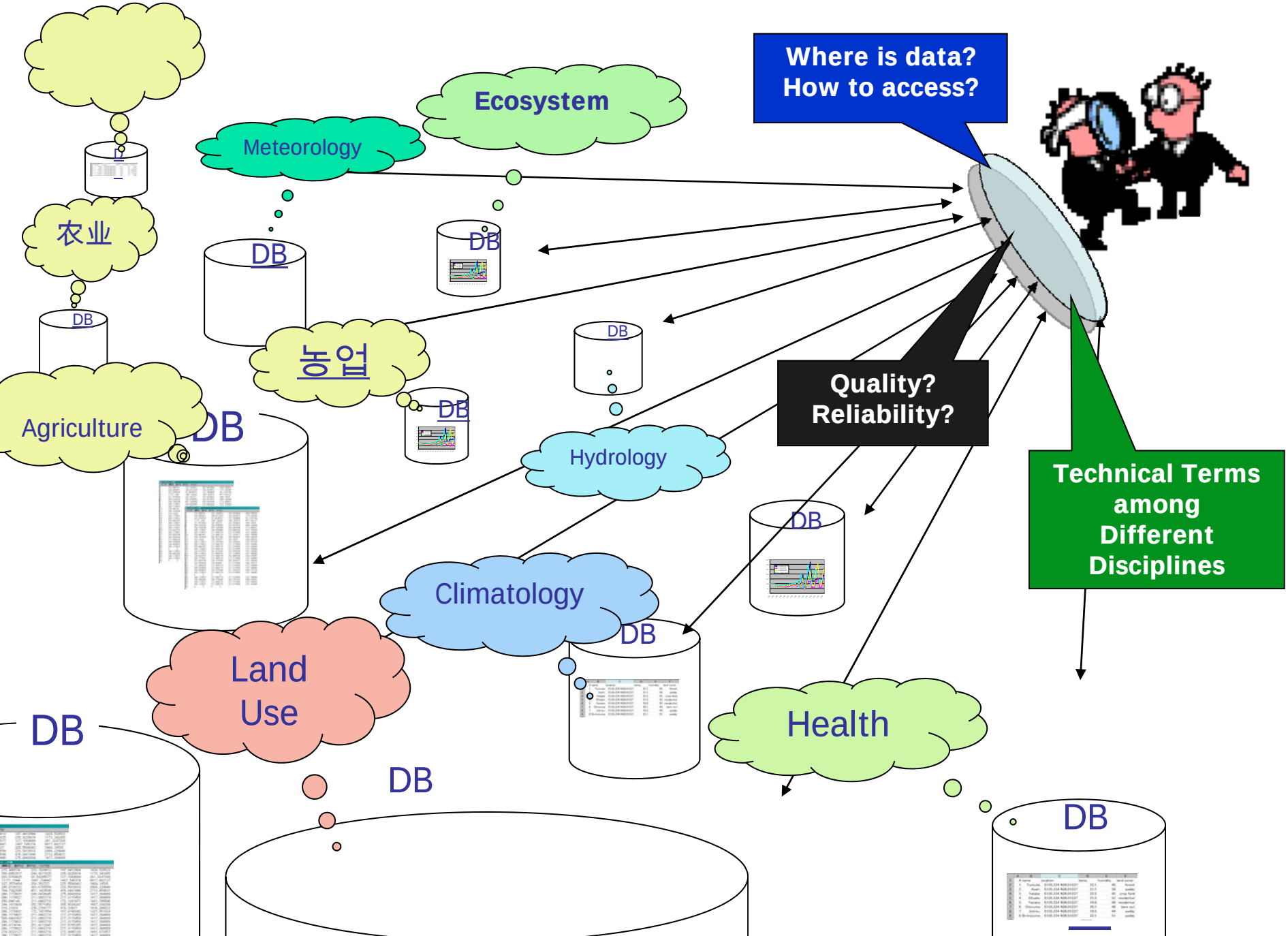
- •Storage Management System
- •Power management System

Storage Layer

Disk Array

Human Health & Well-Being | Natural & Human Induced Disasters | Weather Information, Forecasting & Warning | Energy Resources | Water Resources | Climate Variability & Change | Sustainable Agriculture & Desertification | Ecosystems | Oceans

DIAS
Data Integration & Analysis System


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

DIAS, tackling a large increase in diversity of the earth observation data

For improving data interoperability,
DIAS is developing a system
for identifying the relationship between data
by using ontology
on technical terms and ideas, and geography.
DIAS also is acquiring data base information
from various sources
by developing a cross-sectoral search engine
for various data bases.

DIAS
Data Integration & Analysis System

Group on Earth Observations

Land cover data schema

Climate Data Schema

Land Use Model

Socio-economic Data Schema

Agricultural Economy Model

Water Cycle Data Schema

Crop Growth Model

Sanitation Data Schema

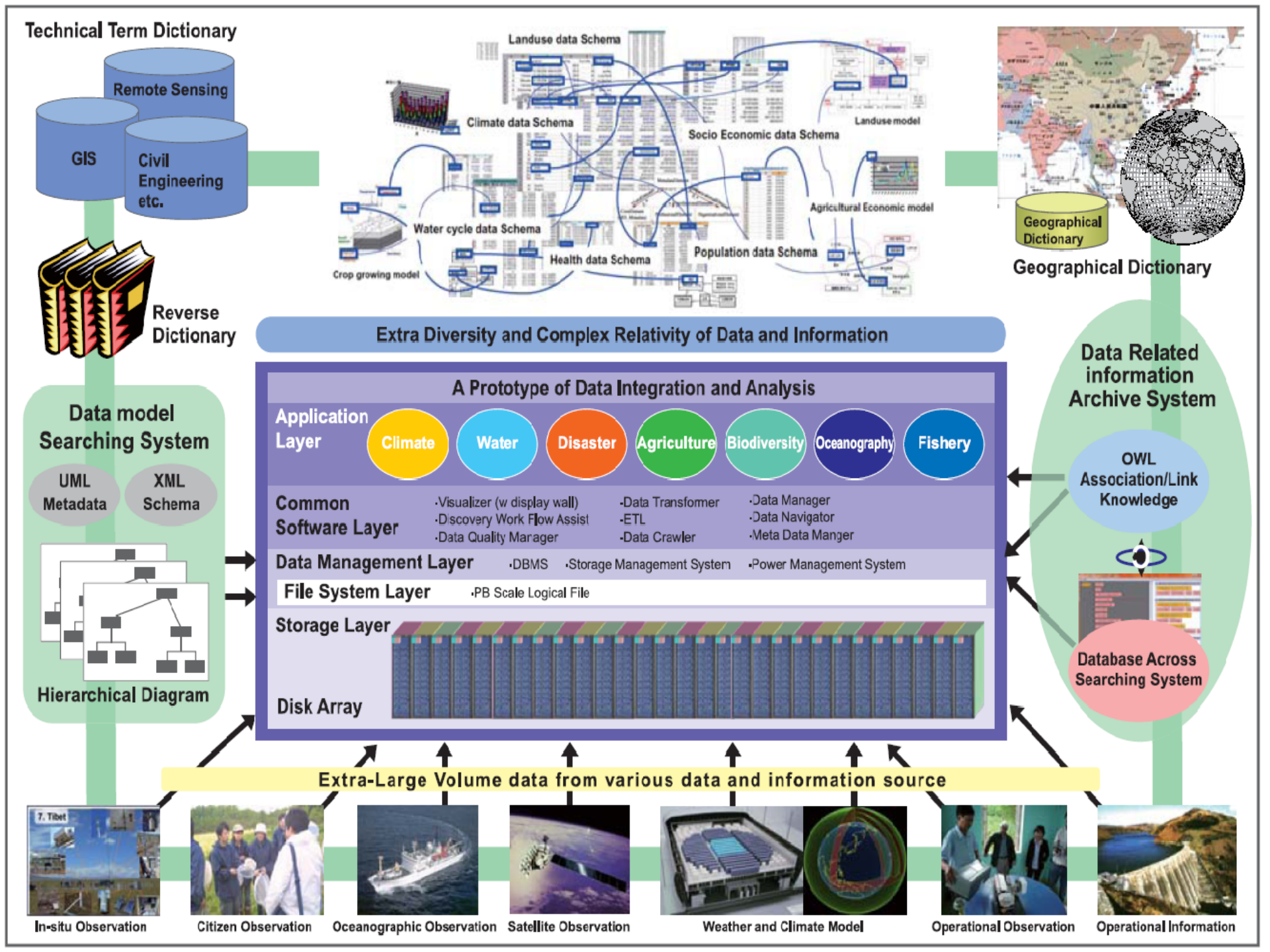
Population Data Schema

Making Connection among Disciplines through Ontology

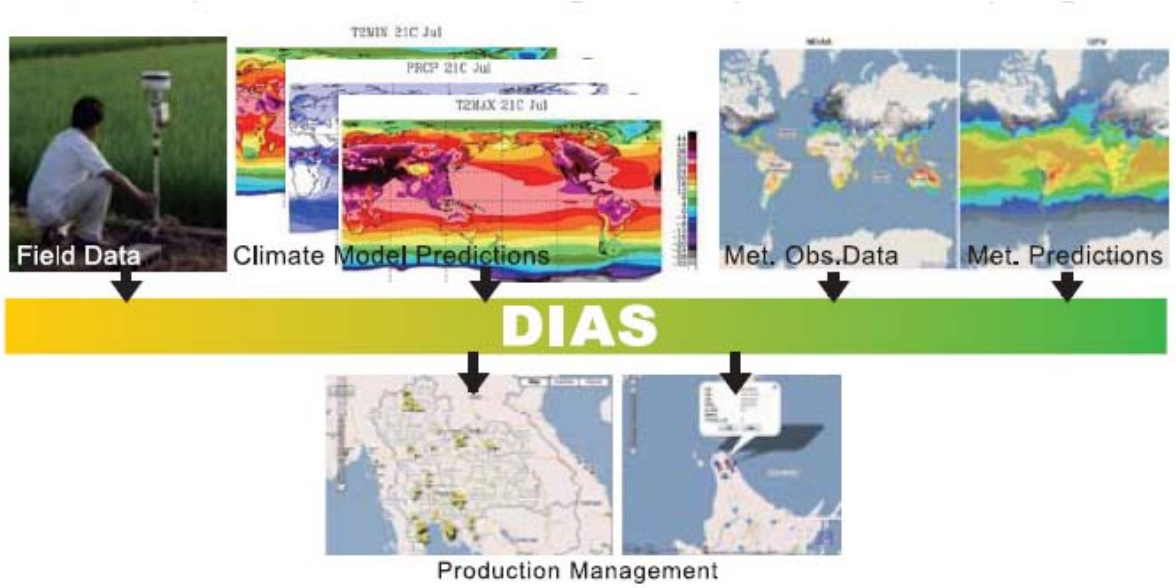
Dictionary to Ontology

Geographical Ontology

DIAS Data Integration & Analysis System


Technical Term Dictionary
Remote Sensing
GIS
Civil Engineering etc.
Reverse Dictionary
Landuse data Schema
Climate data Schema
Socio Economic data Schema
Landuse model
Agricultural Economic model
Water cycle data Schema
Health data Schema
Population data Schema
Crop growing model
Geographical Dictionary
Geographical Dictionary
Extra Diversity and Complex Relativity of Data and Information
Data model Searching System
UML Metadata
XML Schema
Hierarchical Diagram
A Prototype of Data Integration and Analysis
Application Layer
Climate
Water
Disaster
Agriculture
Biodiversity
Oceanography
Fishery
Common Software Layer
·Visualizer (w display wall)
·Discovery Work Flow Assist
·Data Quality Manager
·Data Transformer
·ETL
·Data Crawler
·Data Manager
·Data Navigator
·Meta Data Manger
Data Management Layer
·DBMS
·Storage Management System
·Power Management System
File System Layer
·PB Scale Logical File
Storage Layer
Disk Array
Data Related information Archive System
OWL Association/Link Knowledge
Database Across Searching System
Extra-Large Volume data from various data and information source
In-situ Observation
Citizen Observation
Oceanographic Observation
Satellite Observation
Weather and Climate Model
Operational Observation
Operational Information

Agricultural Production Management



DIAS develops an information system for agricultural production management by integrating the real-time monitoring data of farmland, the growing condition of each crop cultivar, meteorological data, numerical weather predictions, and climate model predictions. This system will be usable by the farming community, enabling them to make improved management decisions especially in regions which are susceptible to global warming impacts.

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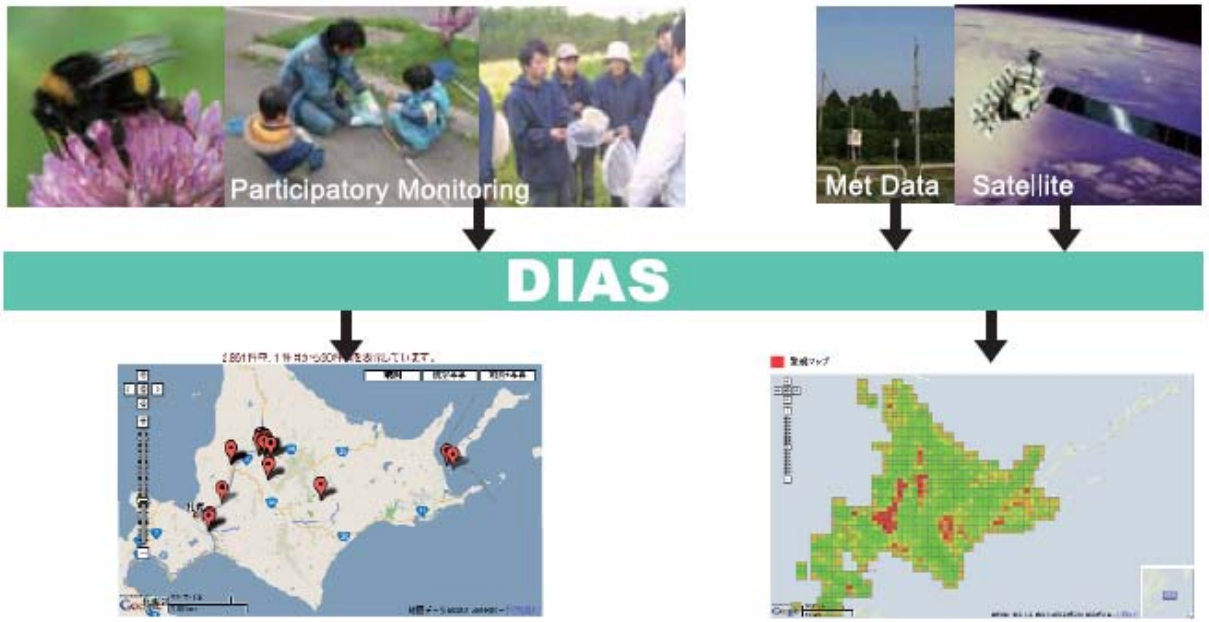
Ecosystem Conservation and Participatory Monitoring Program



DIAS compiles data bases of a number of important indices of biodiversity, including invasive alien species and endangered species through participatory monitoring programs, integrates to analyze the data with other earth observation data, and disseminates the products in a form to be easily used for decision making related to biodiversity conservation..

DIAS
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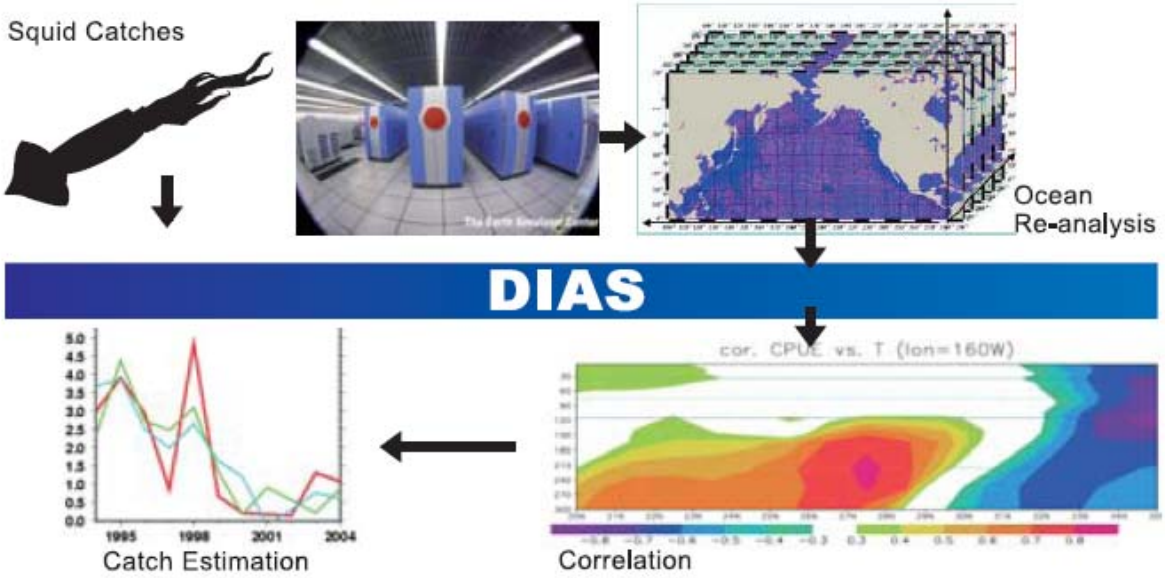
Ocean Circulation and Fishery Resources Management



DIAS provides usable information for a sustainable fishery resources management by constructing an oceanography- fishery cooperative platform that enables resource managers to investigate relationships between fluctuations in the fishery resources and the seasonal to decadal ocean variations derived from an ocean re-analysis based on the data assimilation by applying the four dimensional variational assimilation methods.

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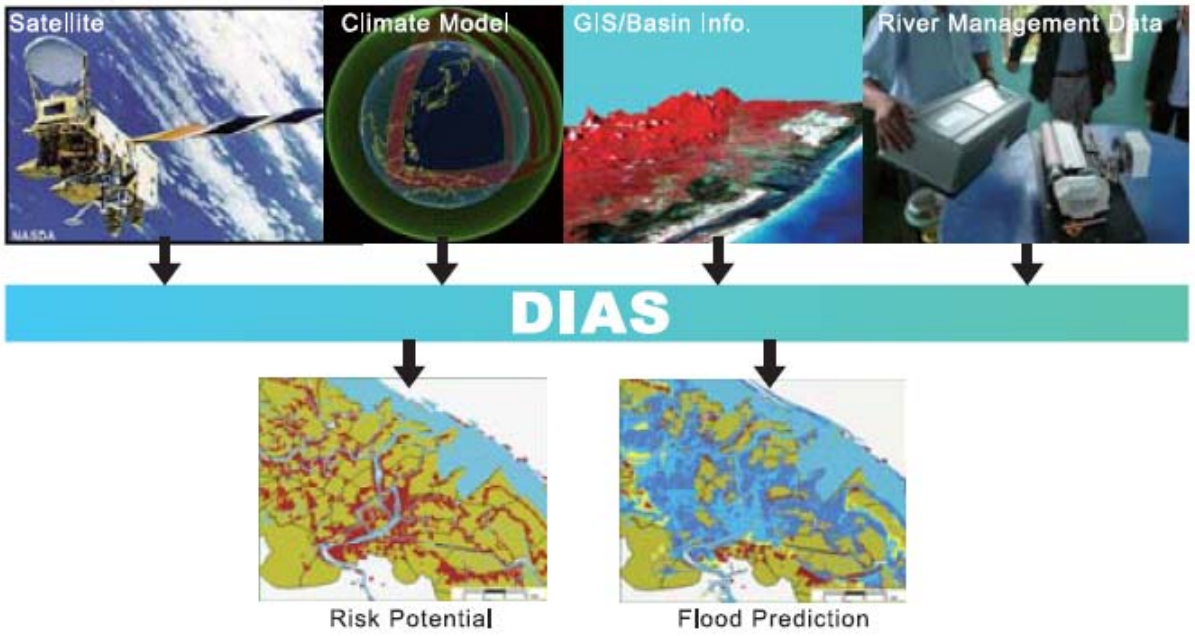
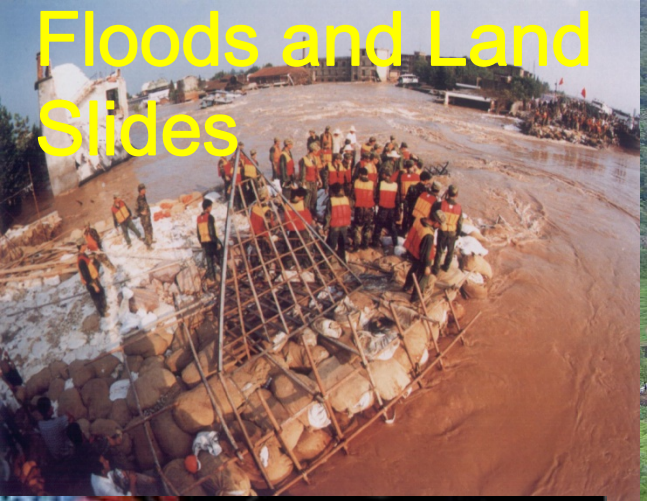
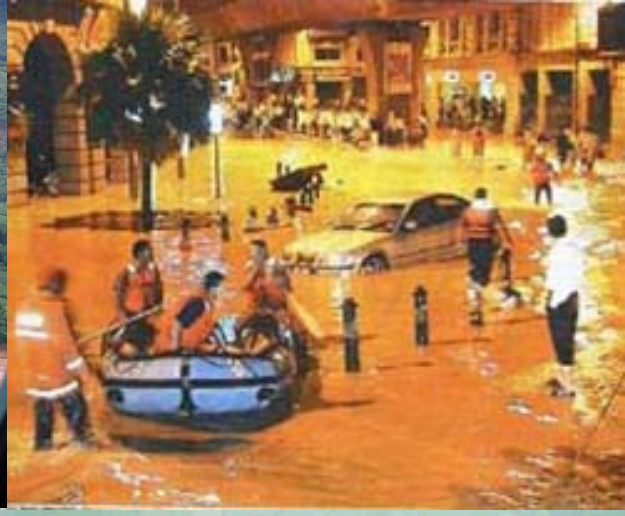
Integrated Water Resources Management



The Asian countries cooperatively integrate data from earth observation satellites and in-situ networks with other types of data, including numerical weather prediction model outputs, geographical information, and socio-economic data, to generate information for making sound water resources management decisions.

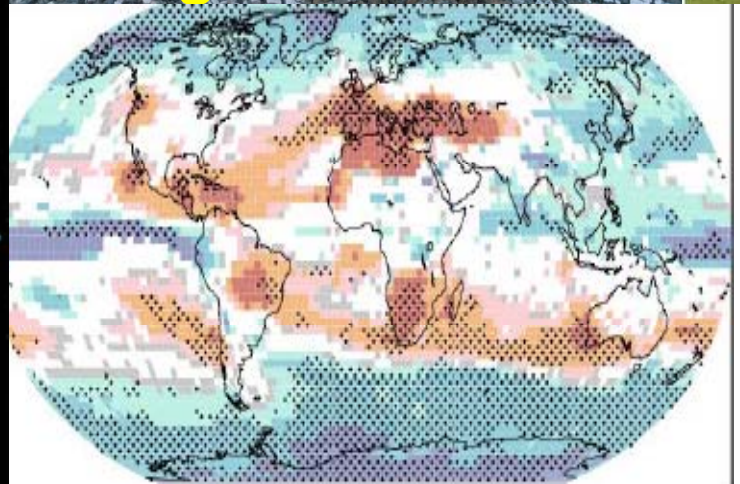
DIAS
Data Integration & Analysis System

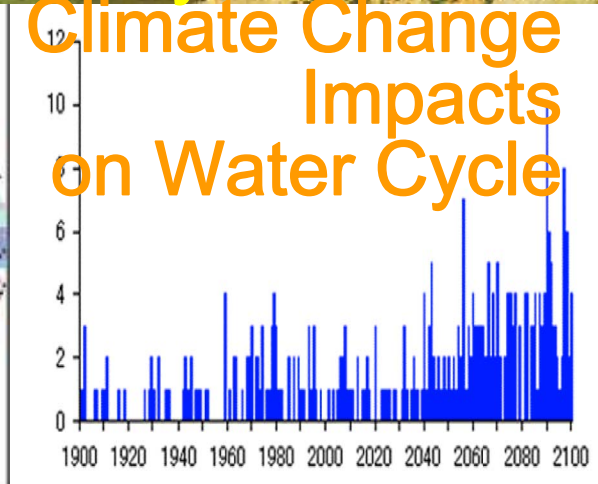

Floods and Land Slides




Water Pollution and Ecosystem Degradation


Drought and Water Scarcity




Climate Change Impacts on Water Cycle
12
10
6
4
2
0
1900 1920 1940 1960 1980 2000 2020 2040 2060 2080 2100


1st Asian Water Cycle Symposium, Tokyo, Nov. 2005


1st Task Team Meeting, Bangkok, Sep. 2006


1st Capacity Building Workshop, Sep. 2006


2nd Asian Water Cycle Symposium, Tokyo, Jan. 2007


1st GEOSS AP Symposium, Tokyo, Jan. 2007


1st International Coordination Group Meeting, Bali, Sep. 2007


3rd Asian Water Cycle Symposium, Beppu, Dec. 2007

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

GEOSS Asian Water Cycle Initiative (AWCI)

19 Member Countries

"Recent Signs of Water-related Disasters"

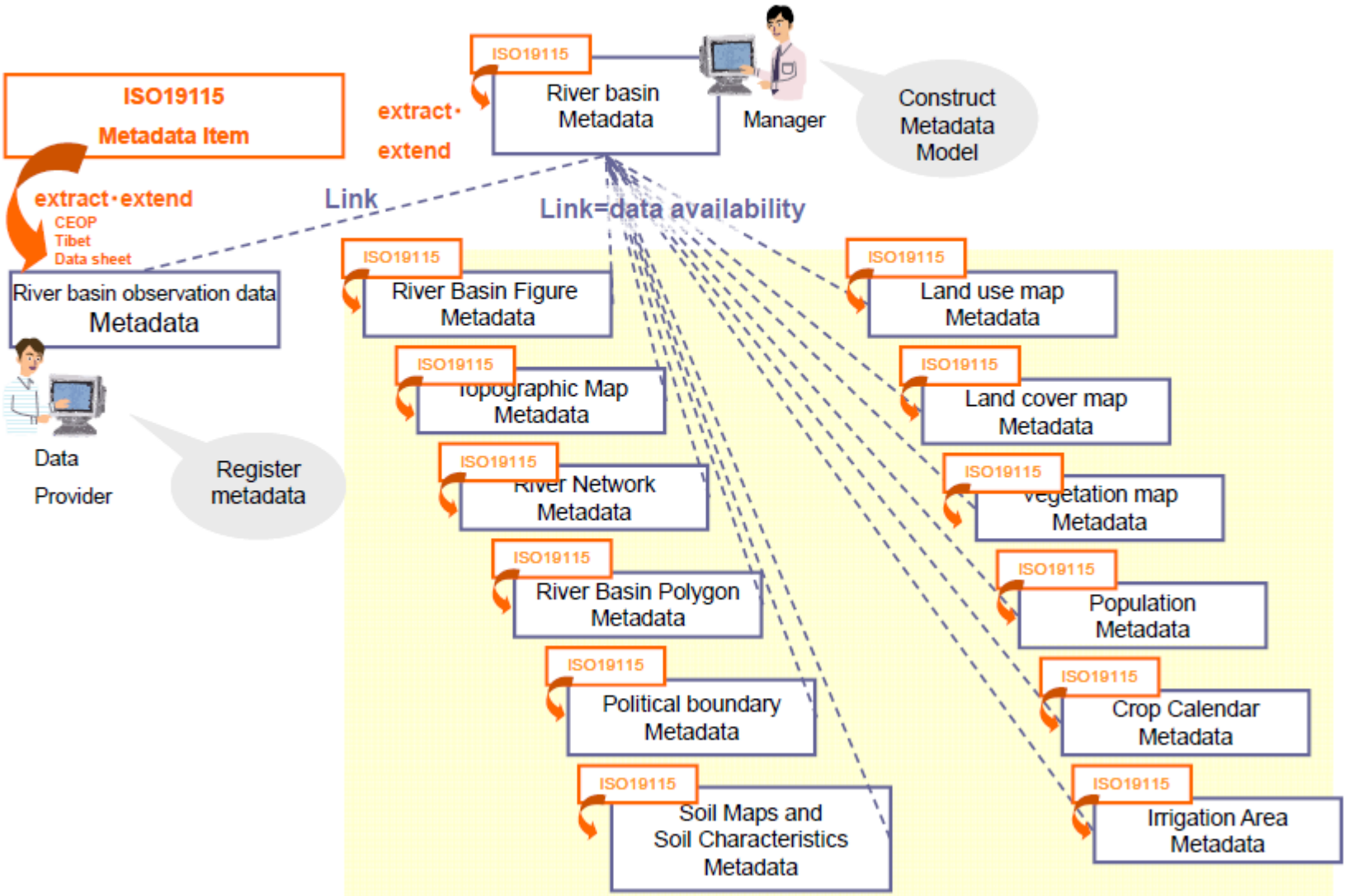
		BD	BT	CB	IN	ID	JP	MY	MM	MN	NP	PK	PH	CE	TH	UZ	VT
Flood	13	■			■	■	■	■	■	■	■	■	■	■	■		■
Typhoon/Cyclone	5	■			■							■	■				■
Localized torrential rainfall	3						■					■					■
GLOF	1											■					
Snowmelt Flood	1											■					
Avalanche	1				■												
Glacier	3										■	■				■	
Landslide/Mudflow	6	■			■								■	■	■	■	
Bank Erosion	2	■									■						
Tsunami	3	■			■									■			
Drought	5	■			■							■	■	■			
Water Logging	1	■															
Cold Wave	1	■															
Climate Change	8	■					■	■	■		■	■			■	■	

GEOSS Asian Water Cycle Initiative (AWCI)

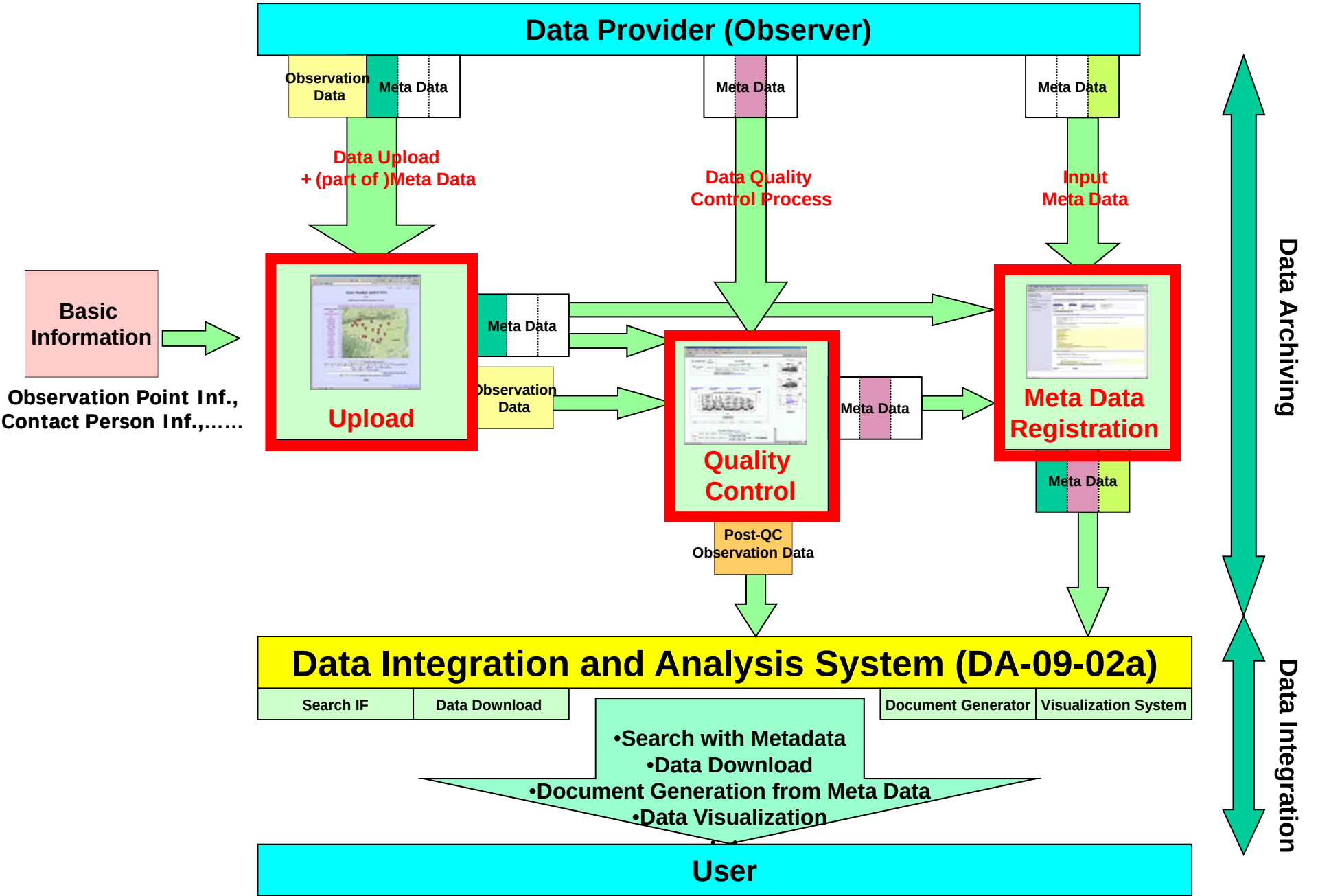
19 Member Countries

18 River Basins for Initial Demonstration

River Basin Metadata Structure



Web-based Data Archiving & Integration System



Data status as of 2009/04/10

	Country	Basin Name	Basic Info.	Raw DataUpload		Quality Control		Metadata Initial Registration		Metadata Update	Remarks
			Complete	Ready	Complete	Ready	Complete	Ready	Complete	Complete	
1	Bangladesh	Meghna	09/01/20	09/01/20 09/04/02							Number of Station were changed (09/04/02)
2	Bhutan	Punatsangchhu	09/01/20	09/01/22	09/02/03	09/02/05	△	09/02/05			
3	Cambodia	Sangker	08/10/30	09/02/06	△			08/11/04			
4	India	Seonath	08/07/22	08/08/22	○						
5	Indonesia	Mamberamo	09/01/20	09/01/20	○						
6	Japan	Tone	08/10/30	08/12/26	08/12/26	09/01/18	△	08/12/26			
7	Korea	Upper Chungju-dam	08/08/05	08/08/05	08/10/02	08/11/02		08/11/04			
8	Lao PDR	Sebangfai									
9	Malaysia	Langat	09/02/06	09/02/06 09/02/11							Station location changed (09/02/11)
10	Mongolia	Selbe	08/07/22	08/08/22							
11	Myanmar	Shwegyin	09/01/22	09/01/22	09/03/05						
12	Nepal	Bagmati	08/11/10	08/11/12	09/01/17						
13	Pakistan	Swat	08/07/22 09/04/01	08/08/22 09/04/02							Basin Name/ location was changed (09/04/02)
14	Philippines	Pampanga	08/08/05	08/08/22	○						
15	Sri Lanka	Kalu Ganga	08/08/05	08/08/22	09/01/20						
16	Thailand	Mae Wang	08/08/05	08/09/01	09/01/31						
17	Uzbekistan	Chirchik-Okhangaran	08/08/05	08/09/01 09/04/02	○						Number of Station were changed (09/04/02)
18	Vietnam	Huong	08/07/22	08/09/04	○						

YY/MM/DD : Handling Date
○ : Full Data provided by offline
△ : Partial Data provided by offline

Completely Finished

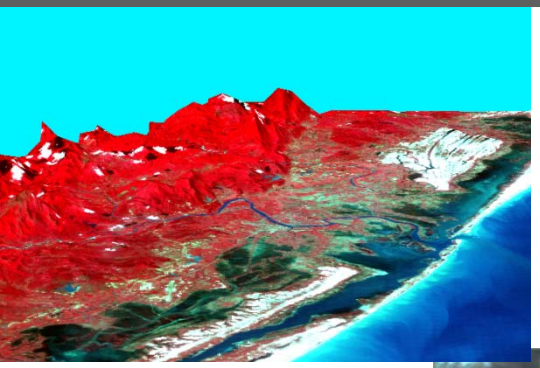
Partially Finished

GEOSS Asian Water Cycle Initiative (AWCI)

19 Member Countries

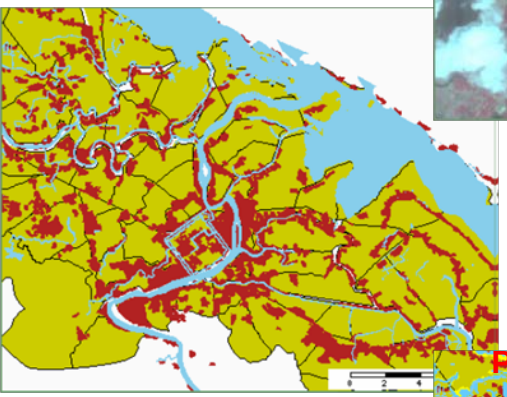
18 River Basins for Initial Demonstration

GEOSS/AWCI Flood Evacuation Instruction System in Vietnam



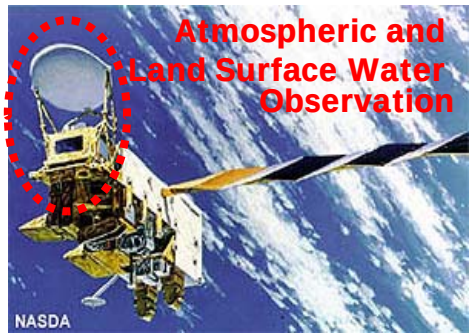
Topography and River Channel Network

Land-use

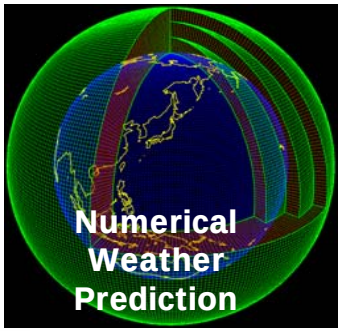


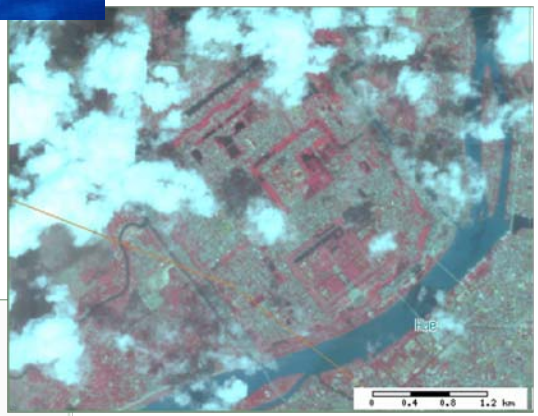
Socio-Economic Data

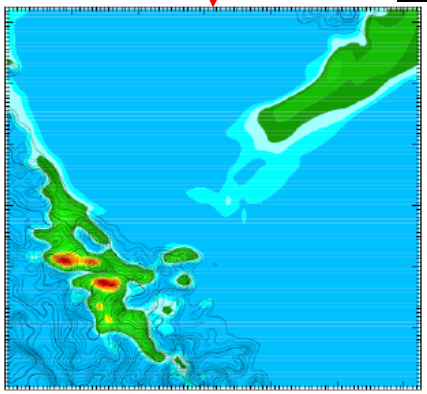
Evacuation Instruction



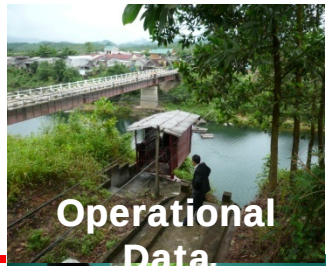
Heavy Rainfall Prediction Coupled with Satellite Data Assimilation



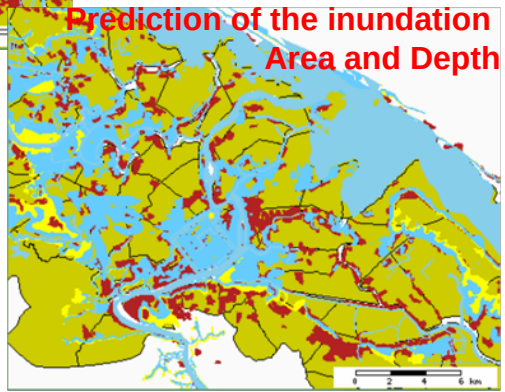




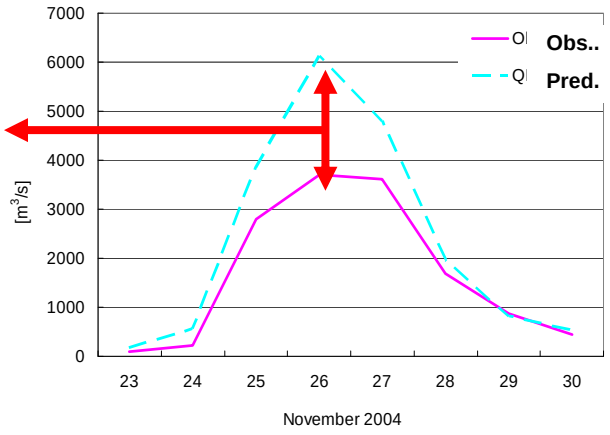
Heavy Rainfall Prediction



Prediction of the inundation Area and Depth

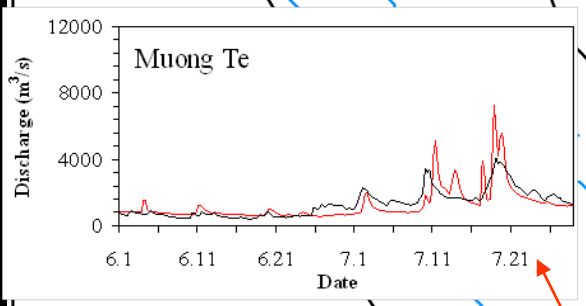


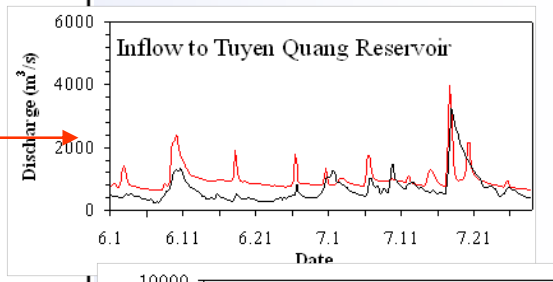
Flood Prediction

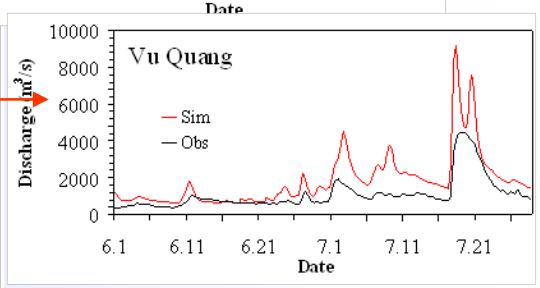


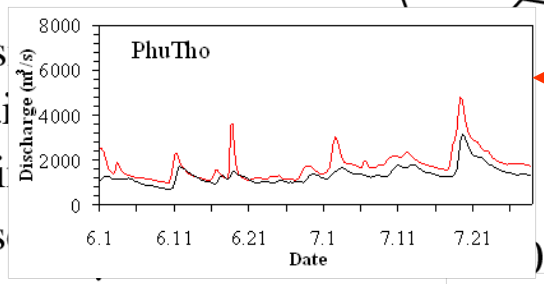
Asian Water Cycle Initiative

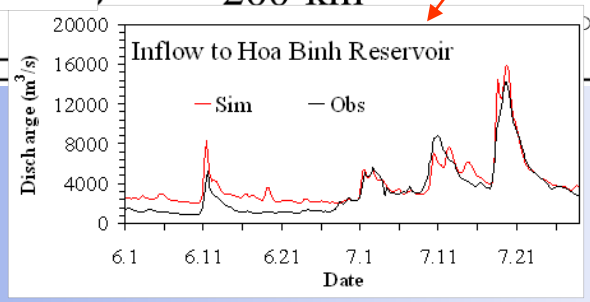
The outflow from *LaoCai* is taken as inflow from its upper region.

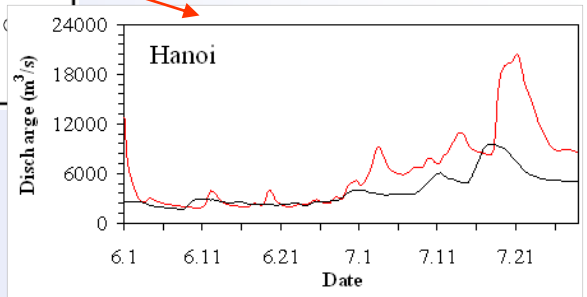








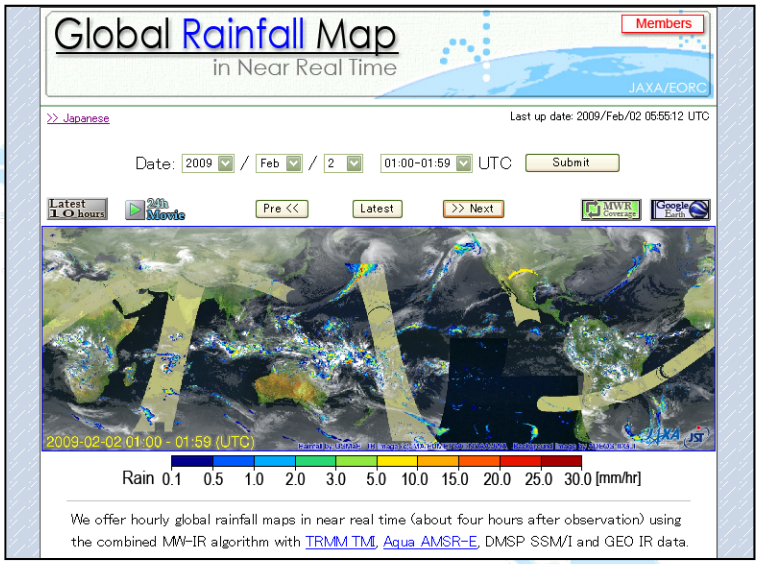


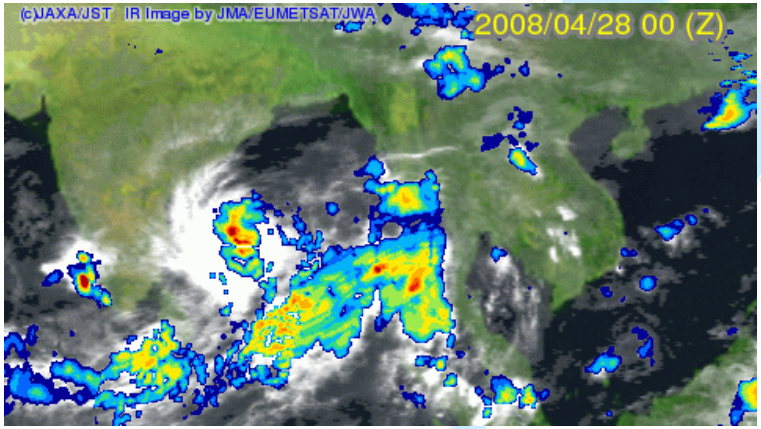


2006 simulation

Global Rainfall Map in near-real-time (GSMaP_NRT)

- GSMaP (Global Satellite Mapping for Precipitation) is originally funded by JST/CREST during 2002-2007.
  - Development of reliable MWR algorithm consistent with TRMM/PR and precipitation physical model developed by using PR (Aonashi et al., 2009).
  - Combination of microwave radiometer retrievals with GEO IR by the moving vector (like CMORPH) and new Kalman filtering method (Ushio et al., 2009).
- JAXA/EORC began to provide near-real-time version data of GSMaP (GSMaP_NRT) about 4-hour after observation via password protected ftp site since October 2008.
- Hourly browse images, kmz files for GoogleEarth, and 24-hour movies are also available from Web server.

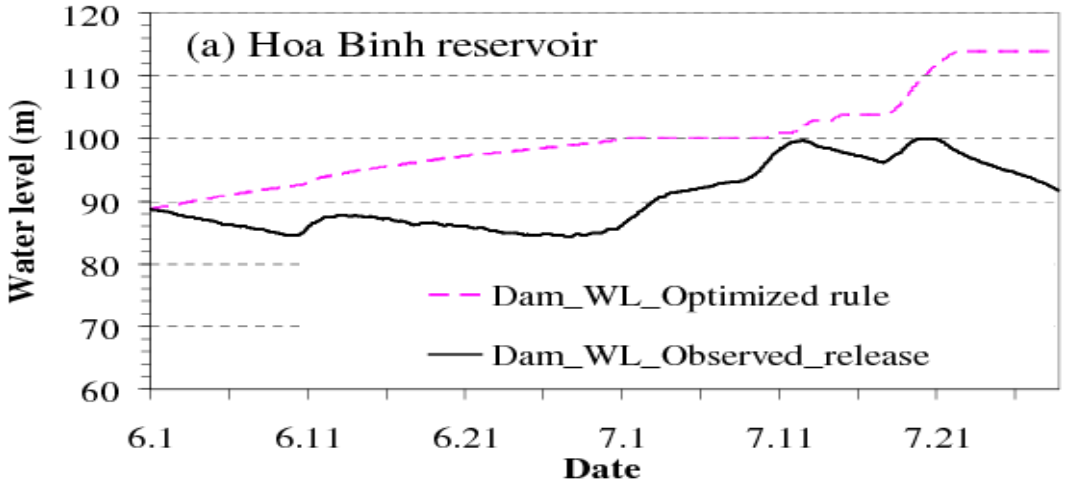


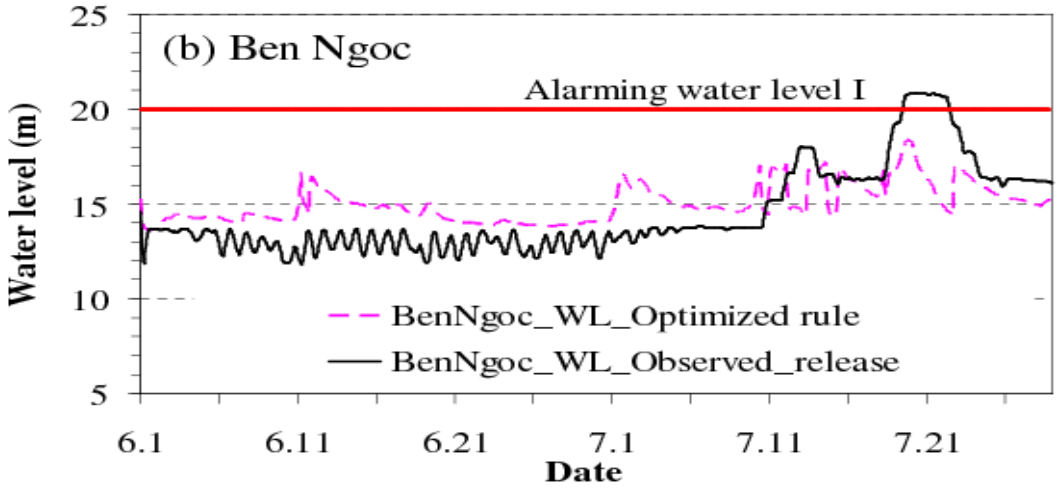


Cyclone "NARGIS" attacked Myanmar

Global Rainfall Map in near-real-time -- http://sharaku.eorc.jaxa.jp/GSMaP/

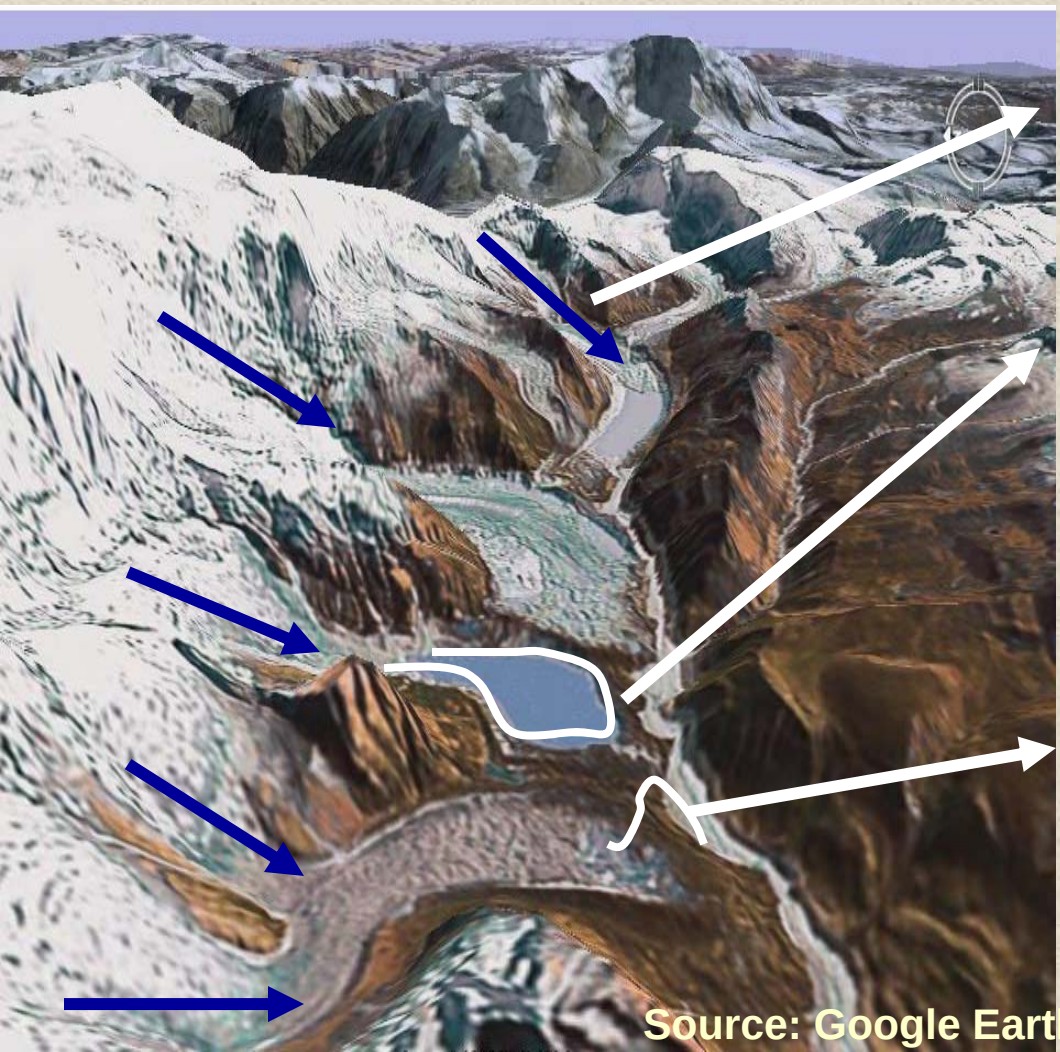
Optimized reservoir operation (2006)

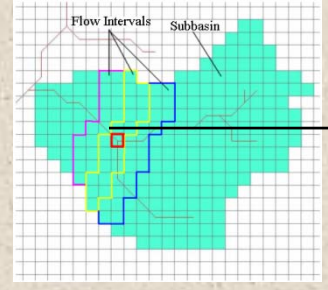


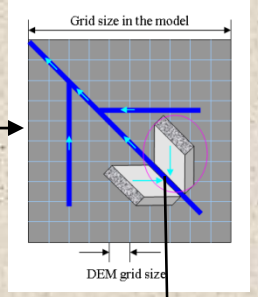


Ben Ngoc is in the 1 km downstream of the Hoa Binh reservoir.

Glacier Lake Outburst Floods (GLOFs)

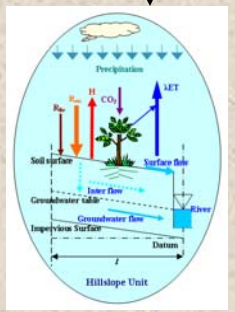






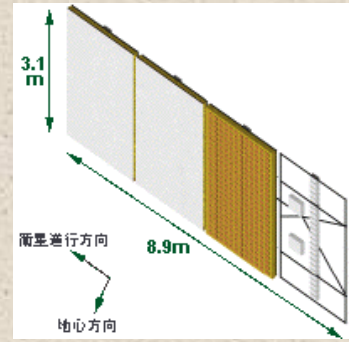
Lake area expantion

Water and energy budget distributed hydrological model (WEB-DHM) coupled with climate models



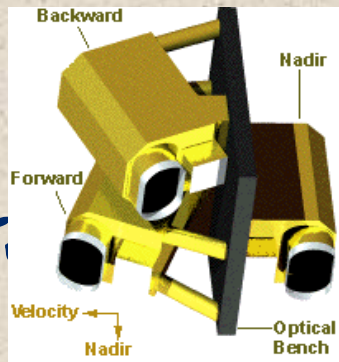
Lake area expantion

Daichi/PALSAR Synthetic aperture Radar for identifying water surface

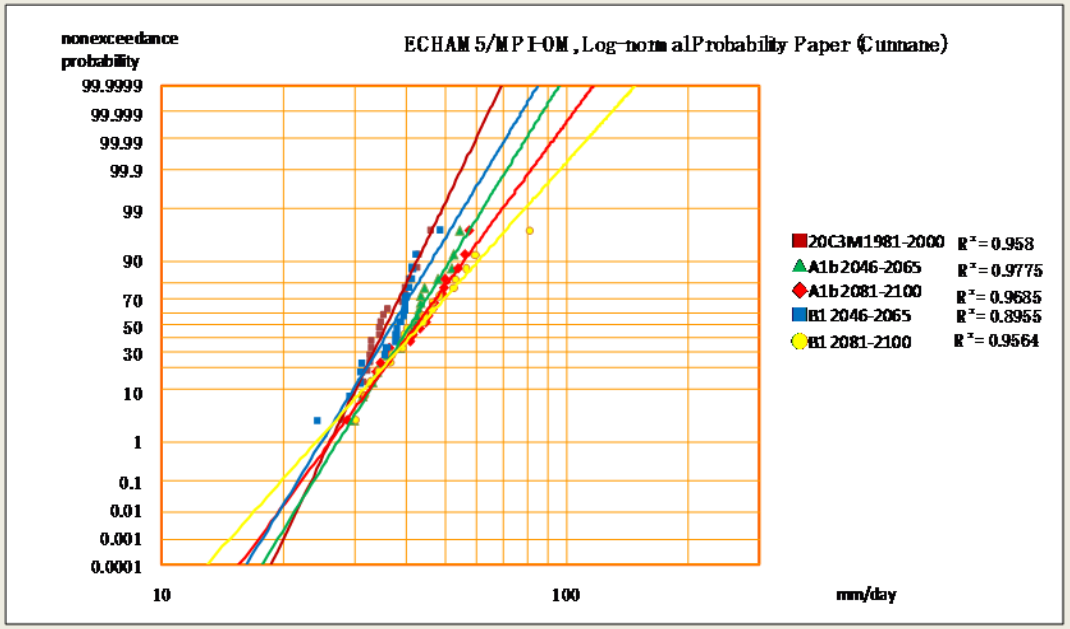


Moraine topography

Daichi/PRISM: three independent optical systems for digital elevation data



Climate Change Impacts on Heavy Rainfall in Indonesia



	A1B		B1	
	2046-2065	2081-2100	2046-2065	2081-2100
Number of models which show more severe distribution than now	82% 14(/17)	94% 16(/17)	76% 13(/17)	53% 9(/17)
5-year probable rainfall	1.18	1.31	1.14	1.18
10-year probable rainfall	1.20	1.35	1.15	1.2
100-year probable rainfall	1.20	1.36	1.17	1.18

Asian Water Cycle Initiative

Design Rainfall

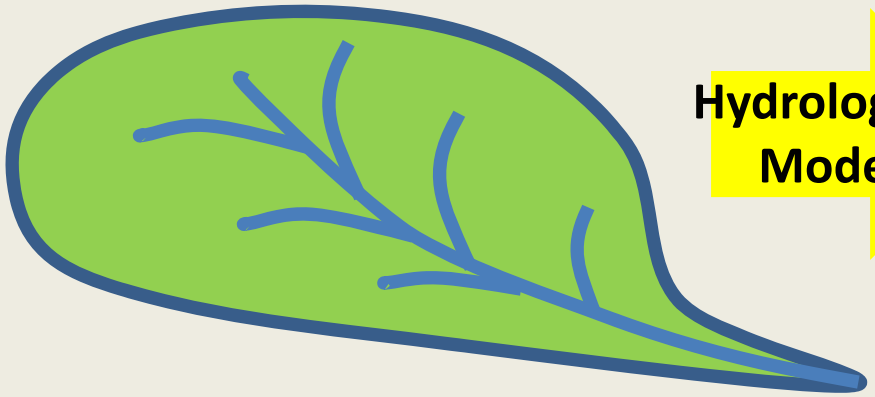
Design Hydrograph

Current Design Rainfall

Future Design Rainfall under Climate Change

1

1.2



Hydrological Model

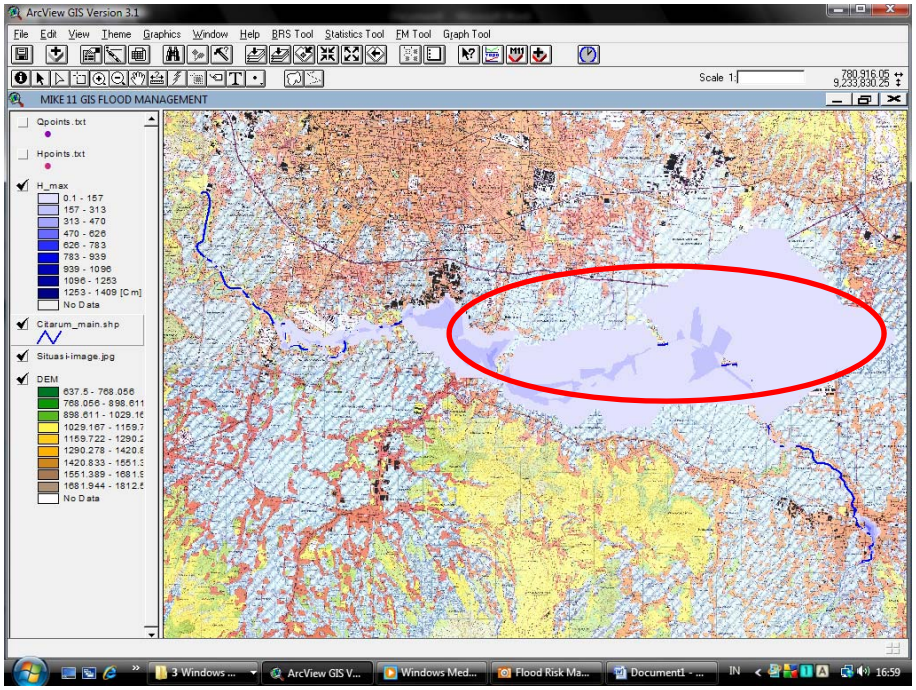
Discharge (m^3/s)

Climate Change

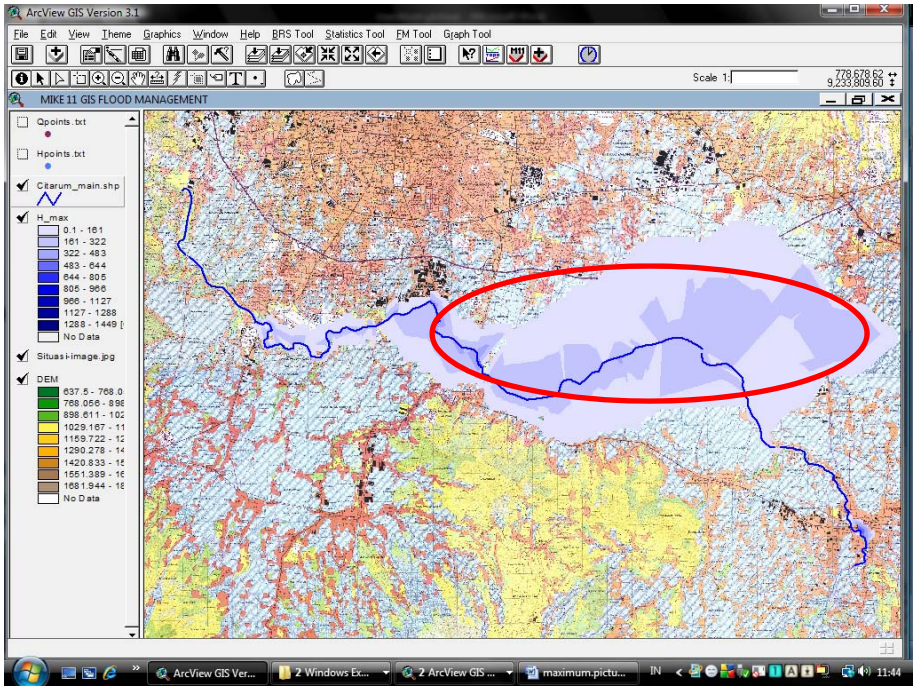
Current Climate

T

Climate Change Impacts on Flood Control Plan in Indonesia



Probable flood (10year)
Current Climate



Probable flood (10year)
50 years later

Asian Water Cycle Initiative

End to End Approach on Climate Change Adaptation