The AWCI training for the Climate Change Assessment and Adaptation study (AWCI/CCAA), 11-12 March 2011, Tokyo, Japan

Department of Civil Engineering, The University of Tokyo: 9:30-18:00, 10 March 2011

Use of the WEB-DHM hydrological model for the AWCI/CCAA studies

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Section 1

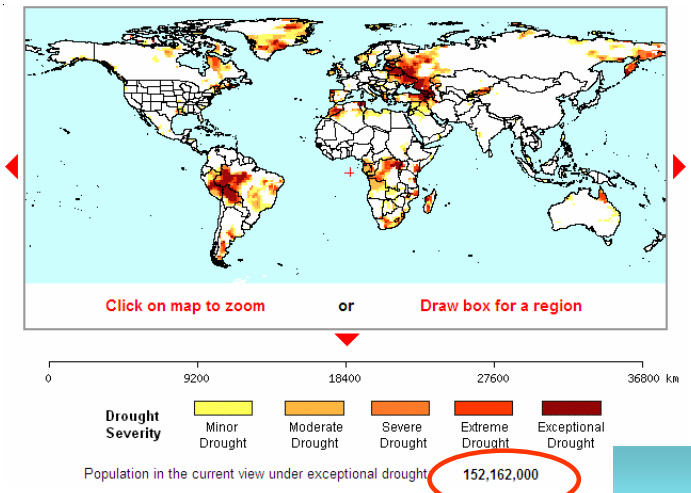
1. Introduction of the WEB-DHM hydrological model;
2. How to run the hydrological model with long-term forcing data (past and future);
3. How to analyze the simulated long-term discharge, to identify the occurrence of floods and droughts.

Section 2

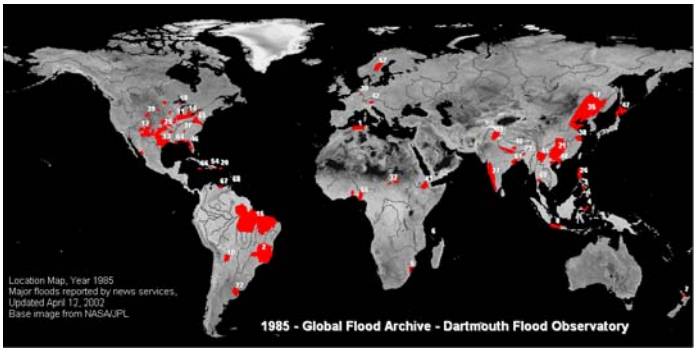
Interactive discussions between the CCAA participants with our UT team (*Wang*, *Tsujimoto*, *Patricia*, *Shrestha*, *Thanda*, *Slamet*).

Past

Global Drought (September 2010)

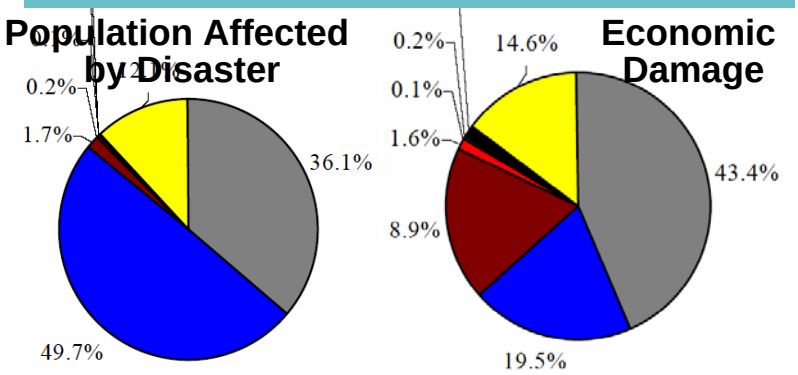


Global Flood Events (1985-2006)

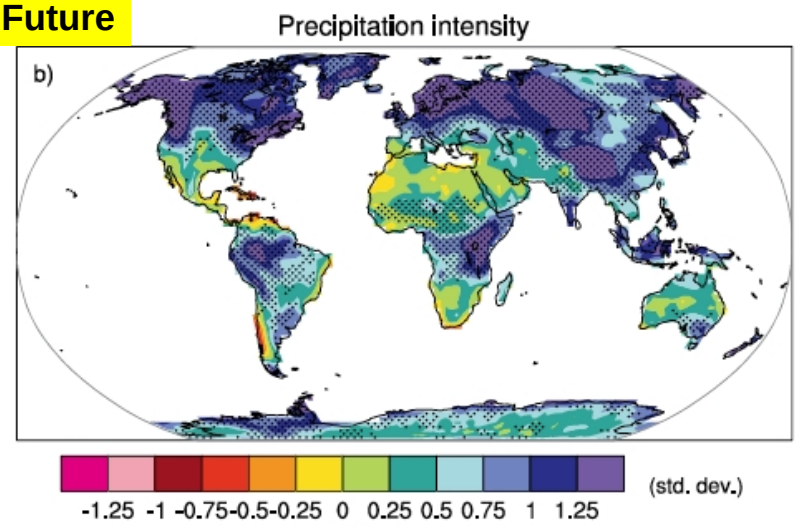


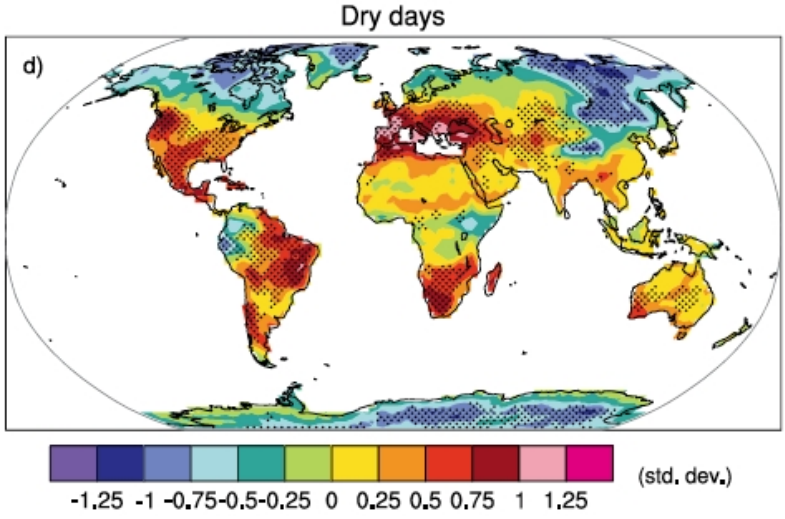
Damage by Natural Disasters around the World in Last 28 Years

- Drought
- Floods
- Earthquake
- Extreme-temperature
- Slide
- Volcano
- Wild-fire
- Windstorm



Future





IPCC AR4

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

> 90 %

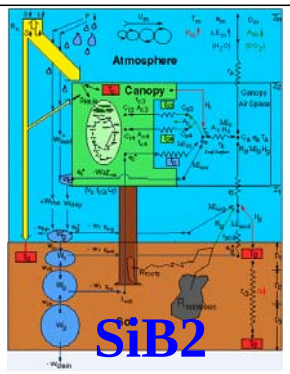
Projected changes in extremes

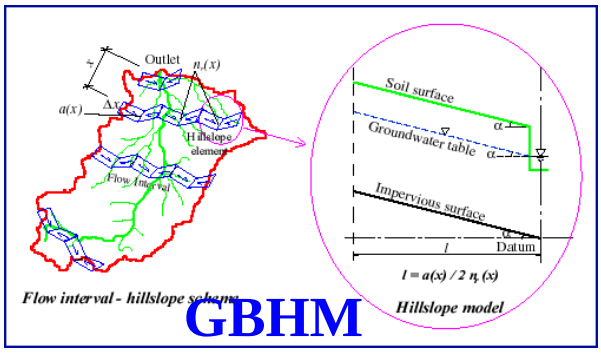
It is *likely* that area affected by drought will increase.

> 67 %

Land Surface Models Distributed Hydrological Models

Representative





Merit

- ➢Well formulate water and energy fluxes in SVAT system;
- ➢Prediction of photosynthesis and respiration.

Couple

- ➢Distributed representation of the spatial variation;
- ➢Slope-driven runoff generation and River Routing;
- ➢Groundwater dynamics.

Demerit

1-D scheme, not consider:

- ➢Sub-grid topography;
- ➢Lateral Runoff;
- ➢Groundwater dynamics.

Remove

Have large uncertainties in simulating

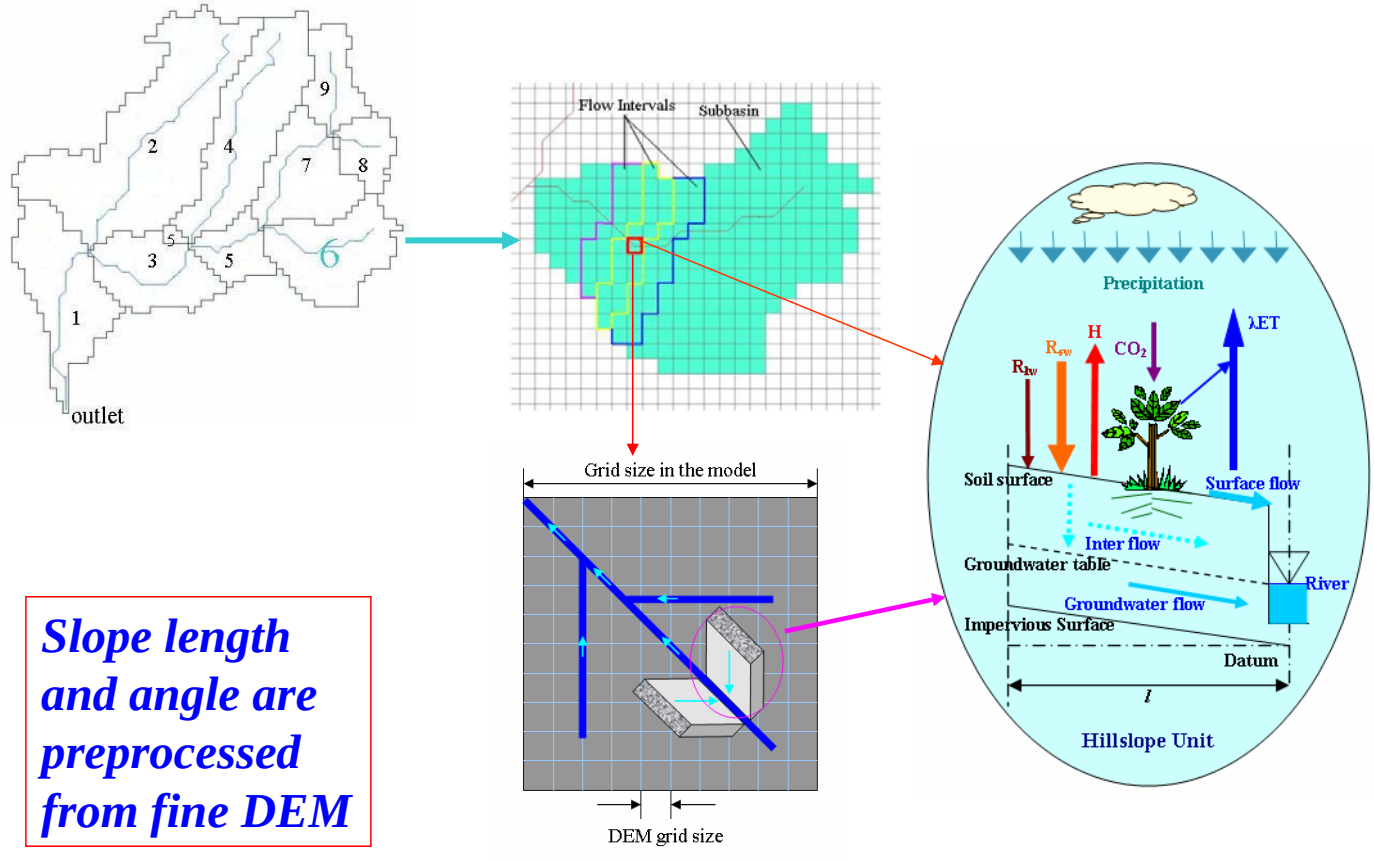
- ➢Evapotranspiration (ET);
- ➢Evolution of soil moisture.

Wang, 2007, PhD thesis

Wang, Koike et al., JGR, 2009

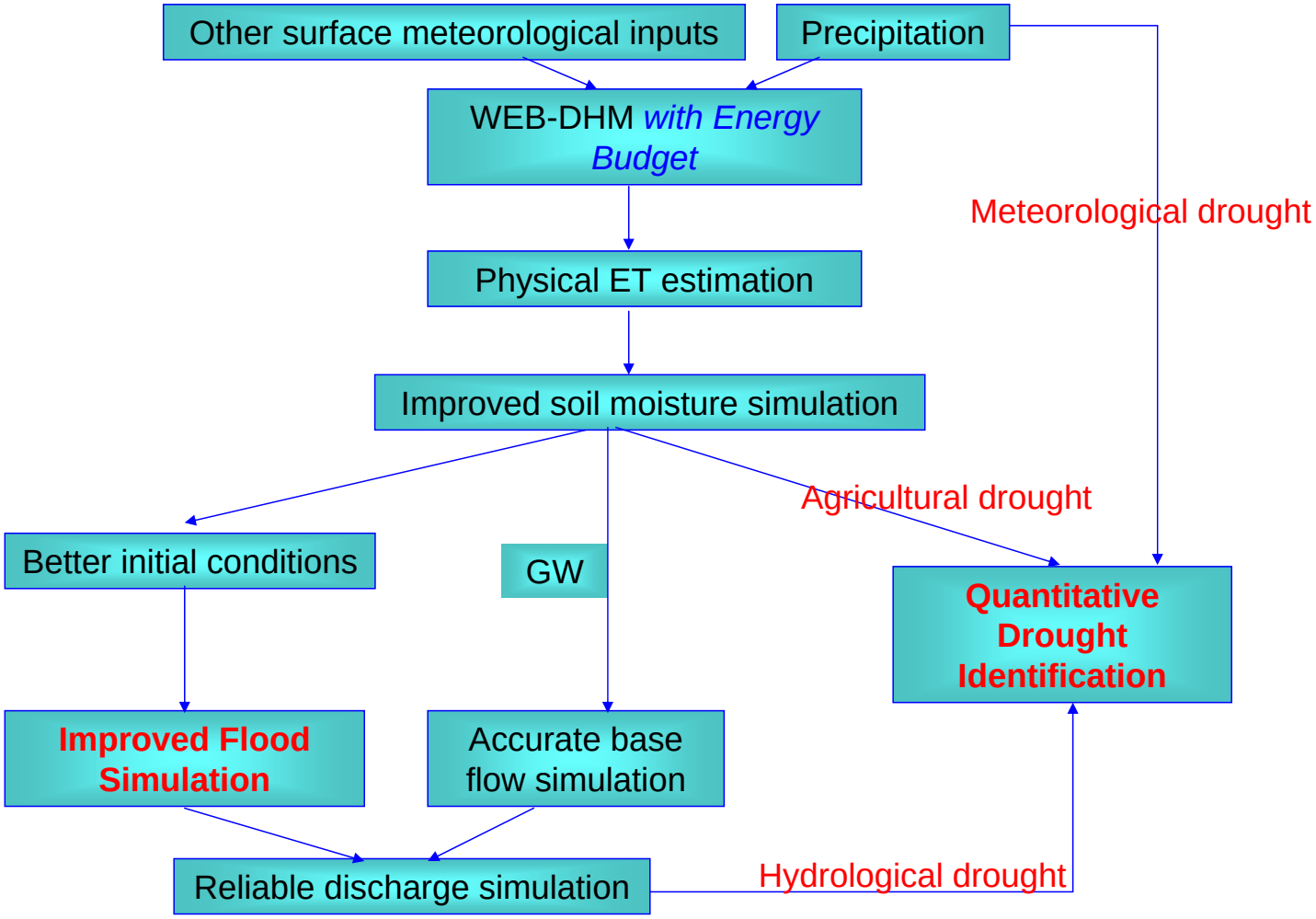
WEB-DHM

(Water and Energy Budget-based Distributed Hydrological Model)



Slope length and angle are preprocessed from fine DEM

WEB-DHM is a solution for flood and drought

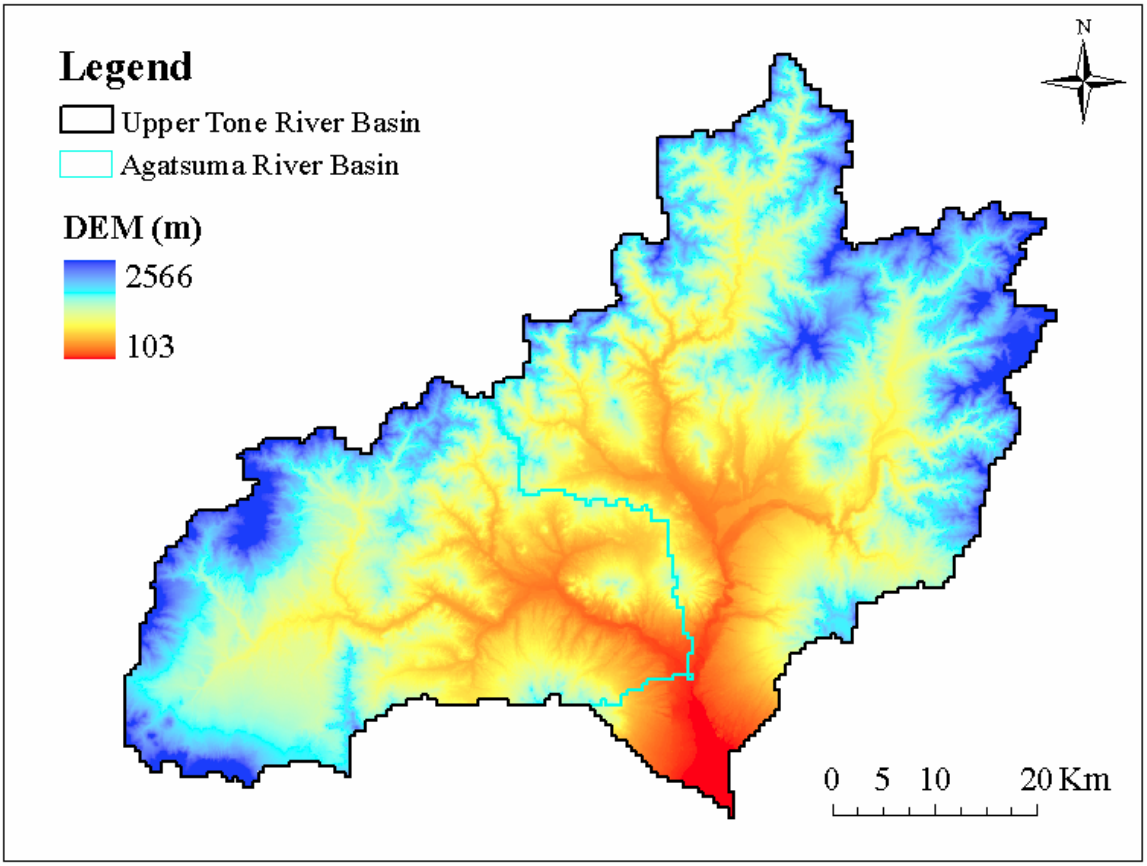


Model Inputs

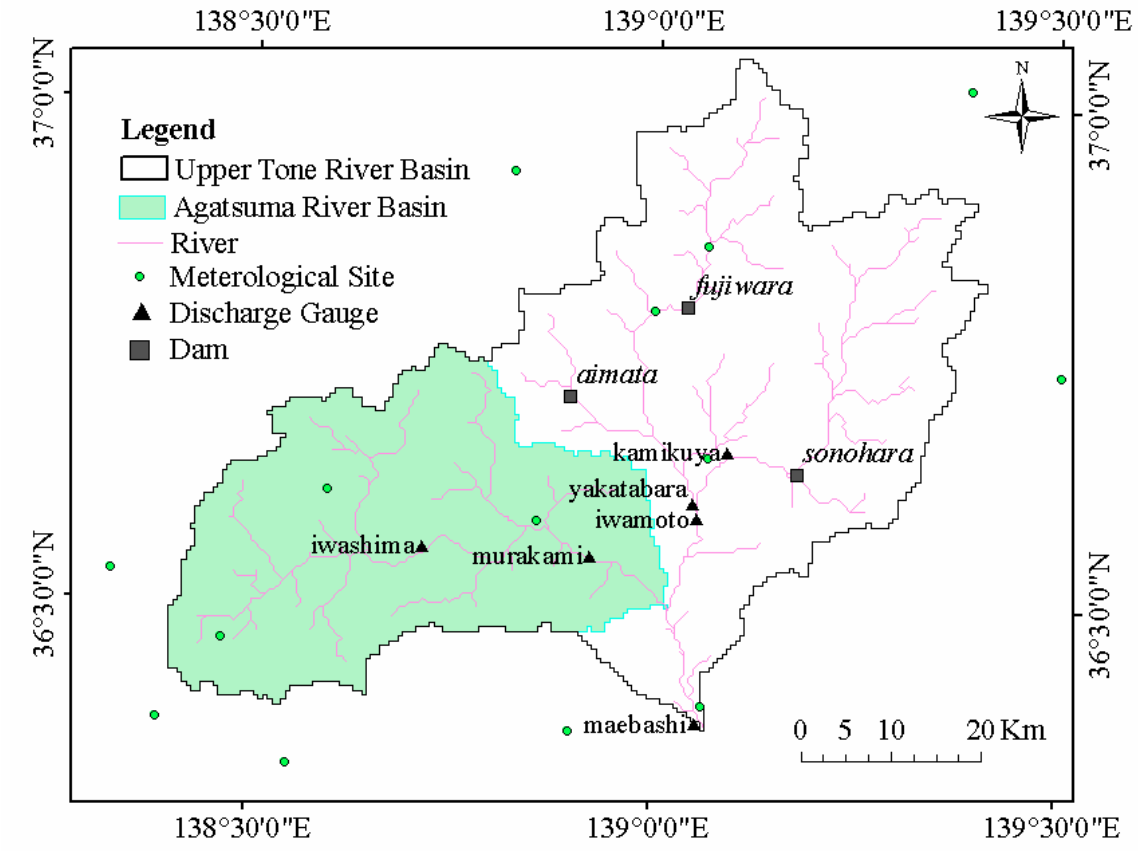
- DEM, river networks, sub-catchments with geomorphology,
- Soil map
- Land use map
- Precipitation
- Other Surface Meteorological data

  (Shortwave and longwave radiation, wind speed, humidity, air pressure, air temperature, cloud fraction)
- FPAR & LAI (satellite data)

DEM (Digital Elevation Model)

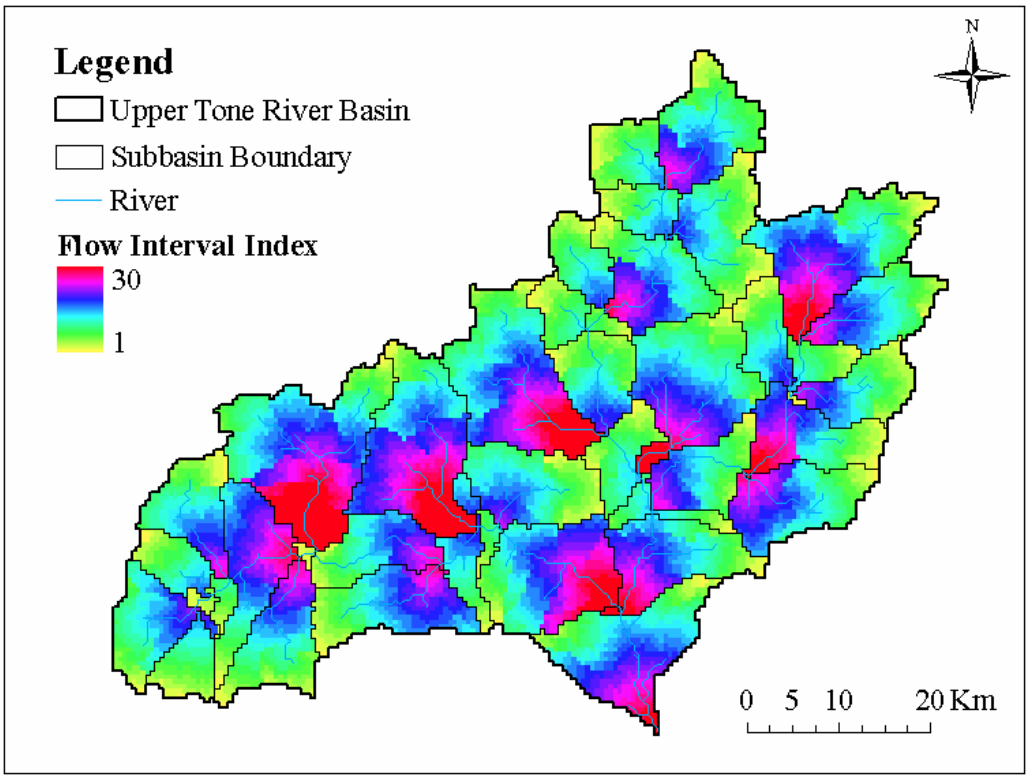


River Basin

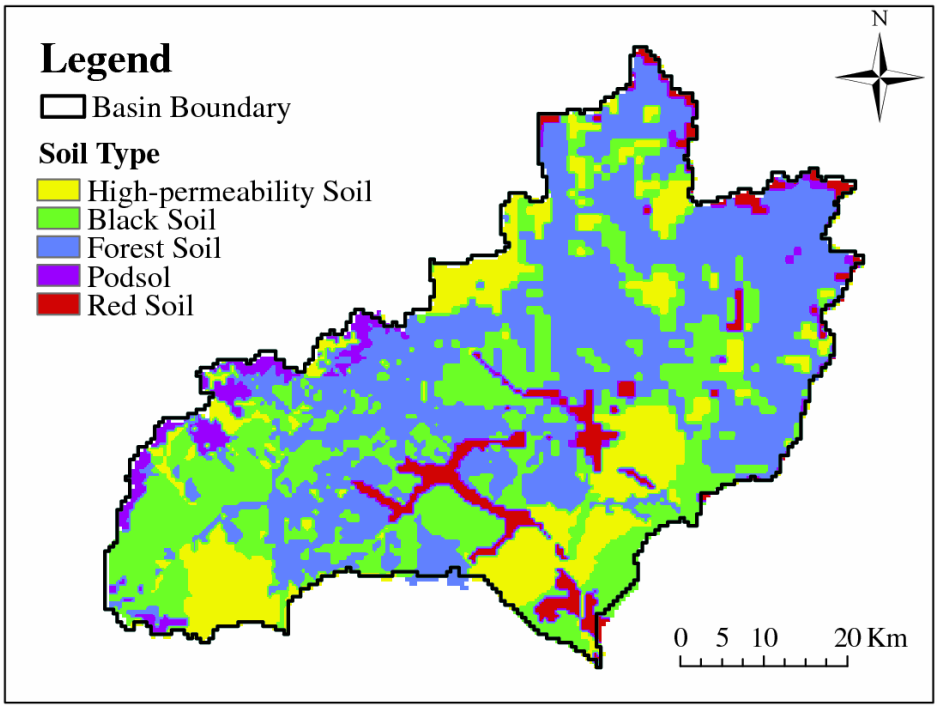


Spatial Discretization

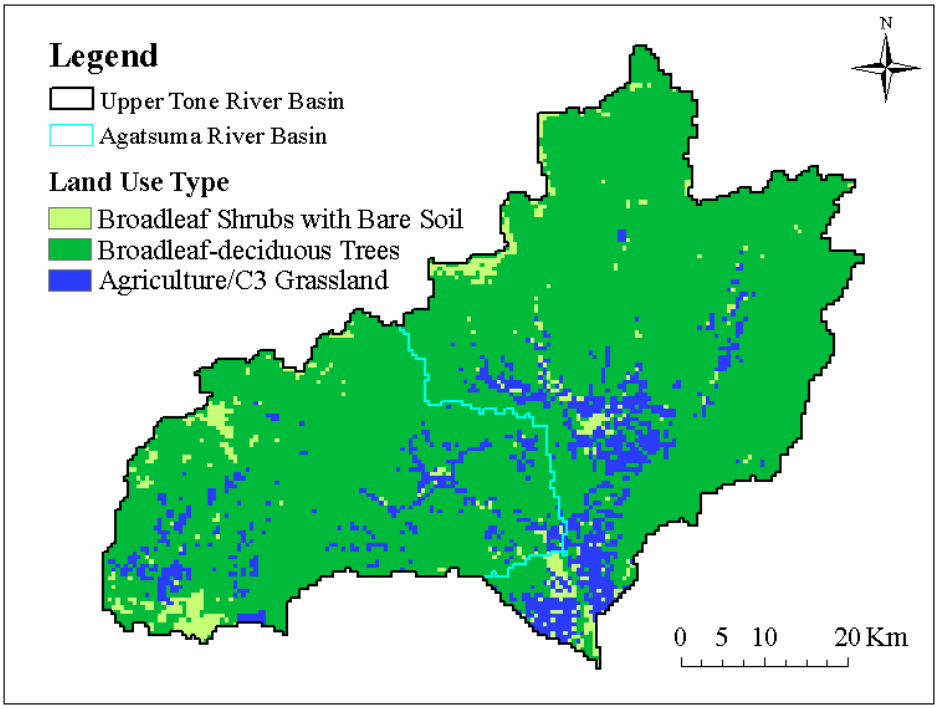
Basin-> Subbasin-> Flow intervals



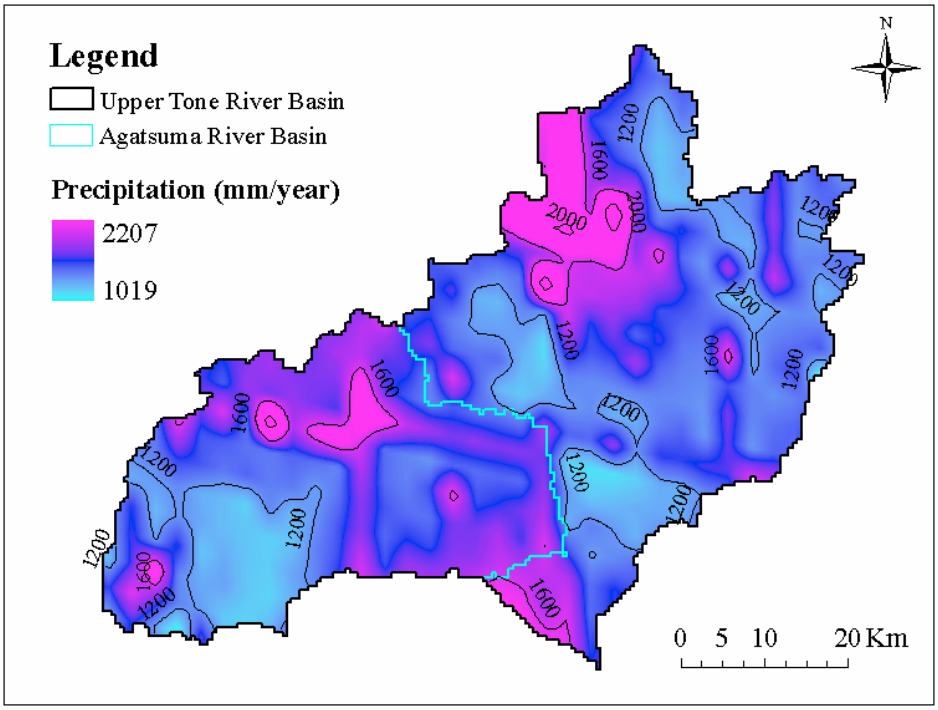
Soil Type



Land Use



An example of forcing data



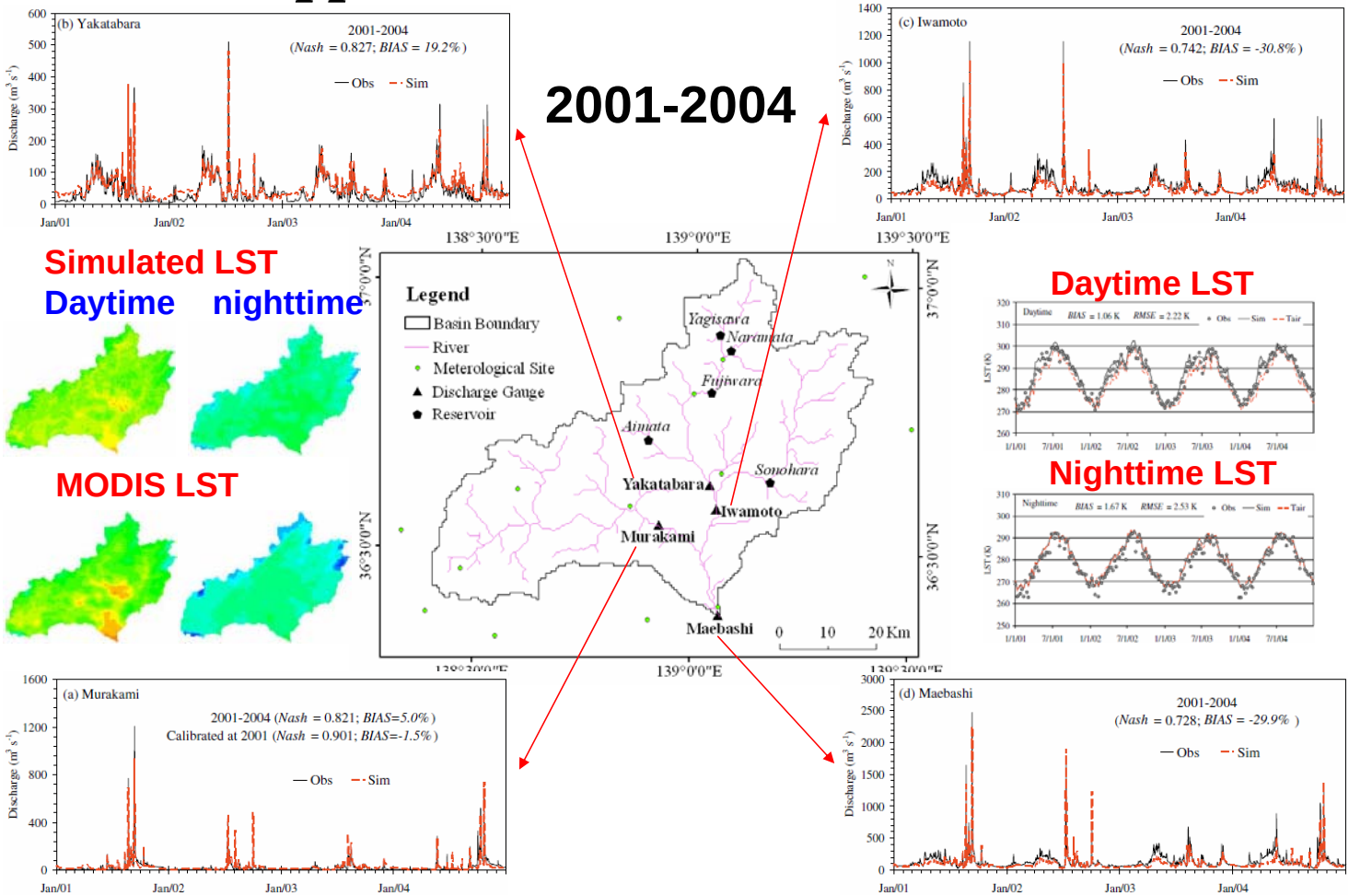
Mean precipitation for 2001 and 2002

Model outputs

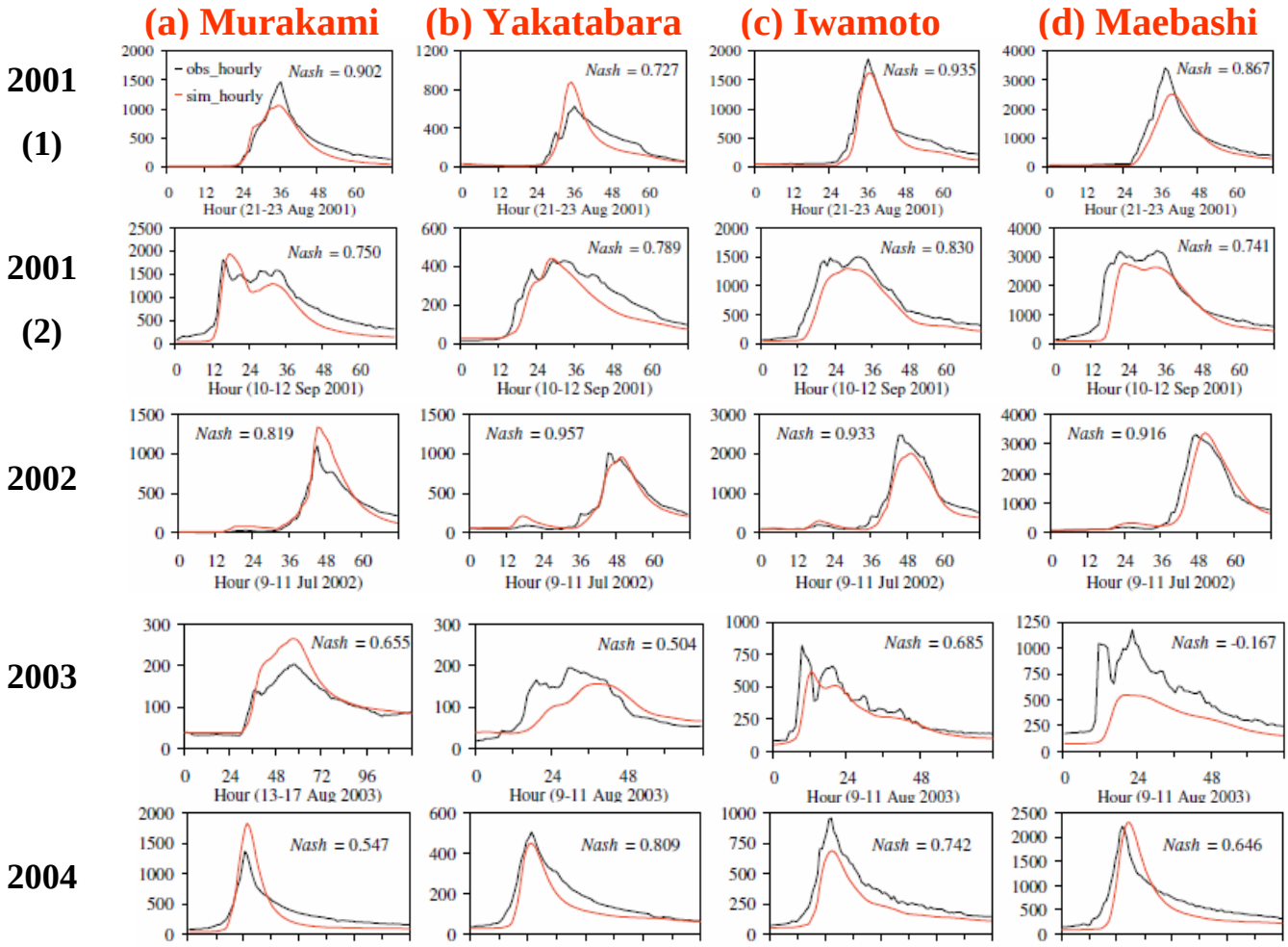
- Discharge;
- Land Surface Temperature (LST)
- Evapotranspiration;
- Soil moisture;
- Soil temperature;
- Energy and CO2 flux.

Wang, Koike et al., 2009, Journal of Hydrology

The upper Tone River Basin, Japan

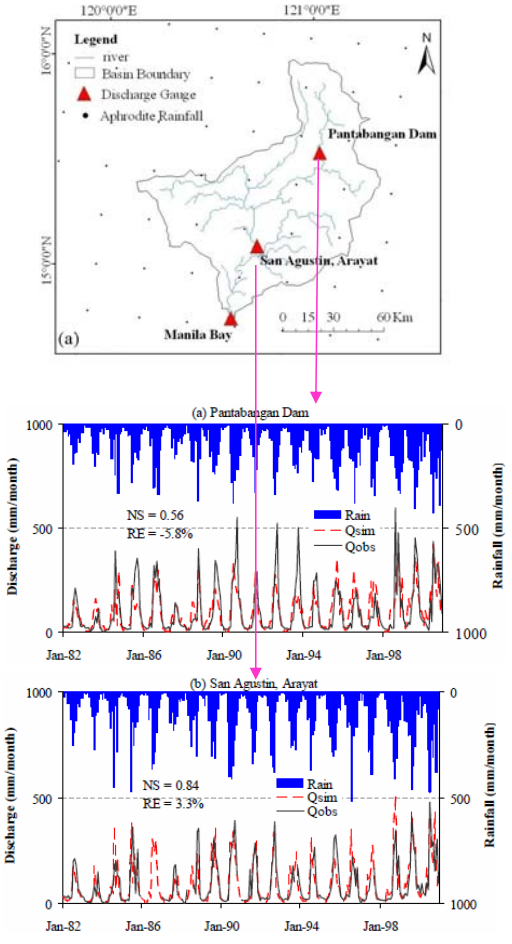


Hourly Annual Largest Flood Peak

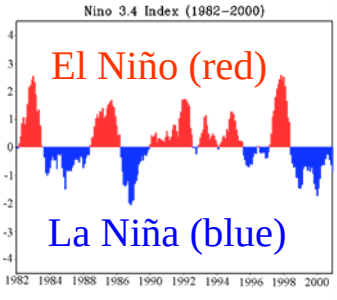


Jaranilla-Sanchez, Wang, and Koike, 2011, Water Resources Research

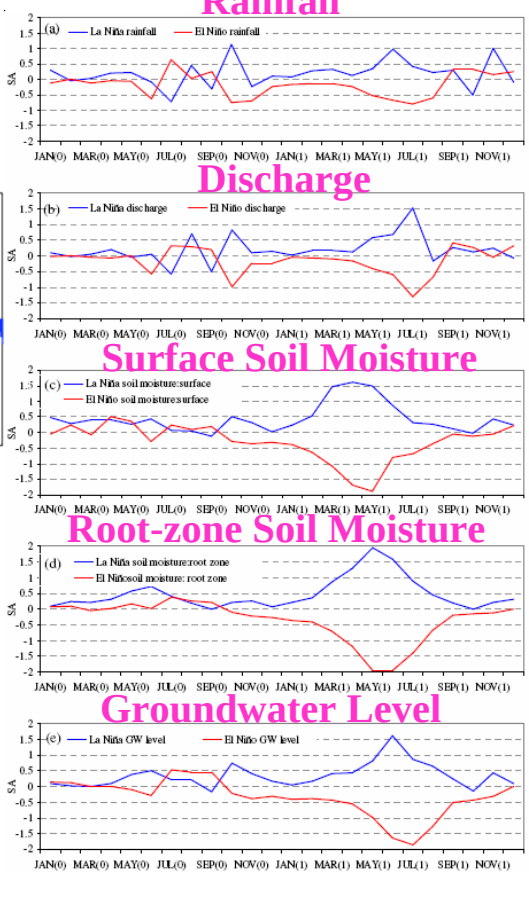
Drought study in Pampanga River Basin, Philippines



ENSO influence

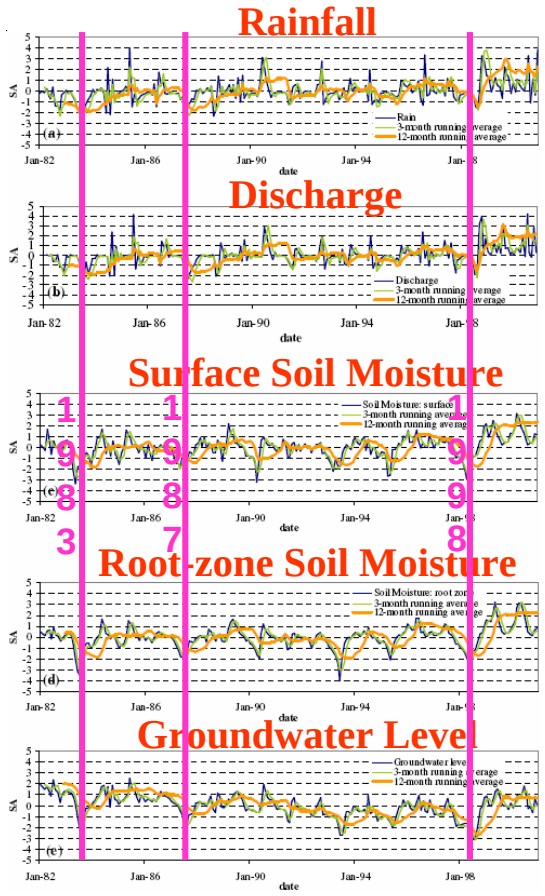


Standardized Anomaly Index

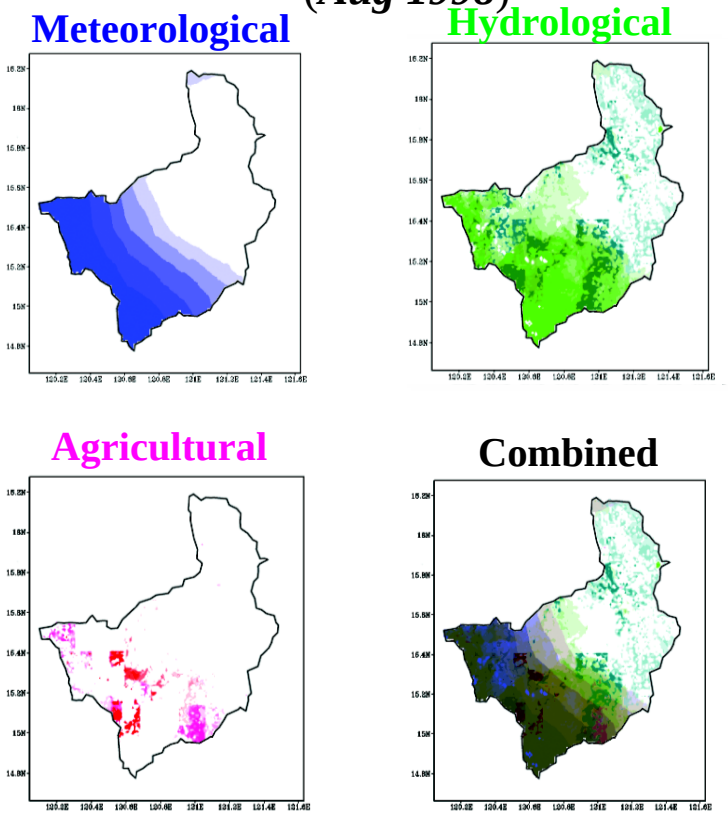


Drought identification, Pampangga River Basin, Philippines

Standardized Anomaly Index (SA)



Drought-prone areas
(***Aug 1998***)



Advantages of WEB-DHM

- A distributed biosphere hydrological model, which can give continuous, spatially-distributed descriptions of water and energy balance, as well as CO2 flux for river basins.
- More reliable estimation of ET.

  (by using a biophysical land surface scheme for simulation of heat and moisture fluxes in the SVAT processes)
- Satellite data *is used to describe the vegetation state and phenology.*
- **Couple with GCM for flood and drought prediction**
- Applicability to large river basins.

  (by simplification of a model grid to a hillslope element, and simplification of river routing process)

Section 1 (continued)

2. How to run the hydrological model with long-term forcing data (past and future);

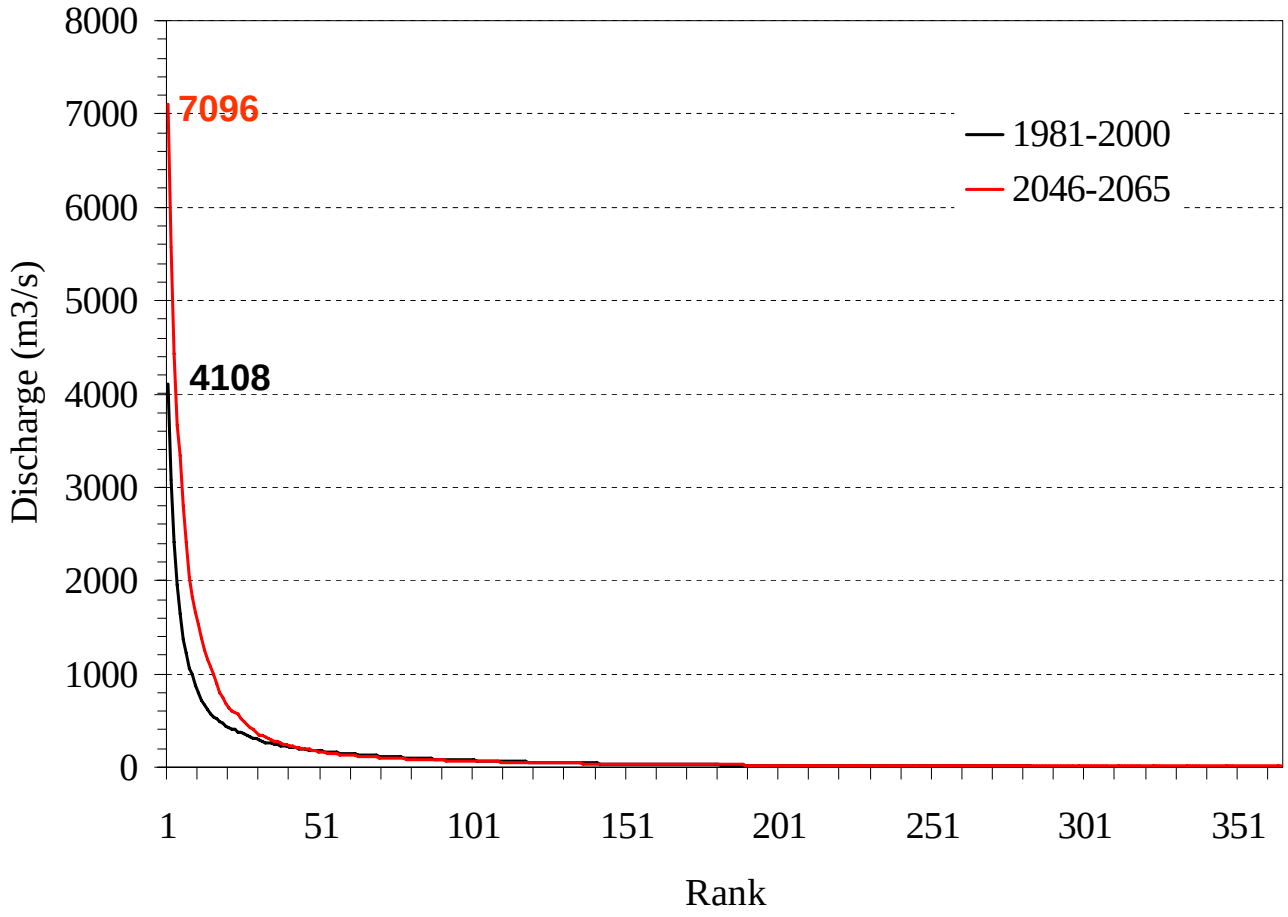
Interface: *format.f, read_rain()*, and so on

3. How to analyze the simulated long-term discharge, to identify the occurrence of floods and droughts.

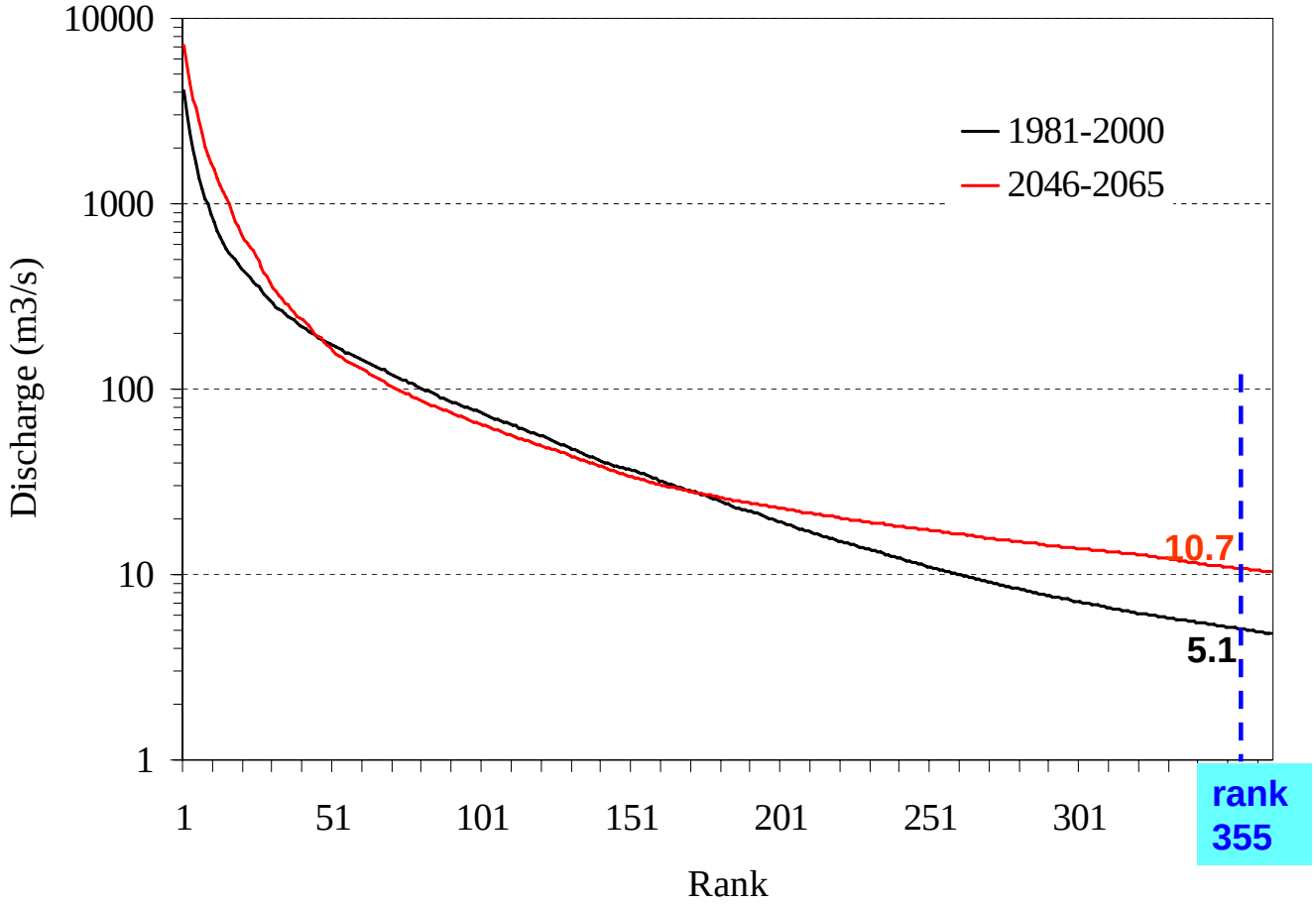
Interface: *Merge_Daily_Result.f, rank.f*

UT team member	Country
Thanda	Bangladesh
Tsujimoto	Cambodia
Slamet	Indonesia
Wang	Japan
Patricia	Malaysia
Patricia	Mongolia
Thanda	Myanmar
Shrestha	Nepal
Shrestha	Pakistan
Patricia	Philippines
Thanda	Srilanka
Patricia	Thailand
Wang	Vietnam

Vietnam_Huong: linear scale



Vietnam_Huong: logarithmic scale



Section 2

Interactive discussions between the CCAA participants with the UT team

(*Wang, Tsujimoto, Patricia, Shrestha, Thanda, Slamet*)

Any Questions and Discussions…

UT team member	Country
Thanda	Bangladesh
Tsujimoto	Cambodia
Slamet	Indonesia
Wang	Japan
Patricia	Malaysia
Patricia	Mongolia
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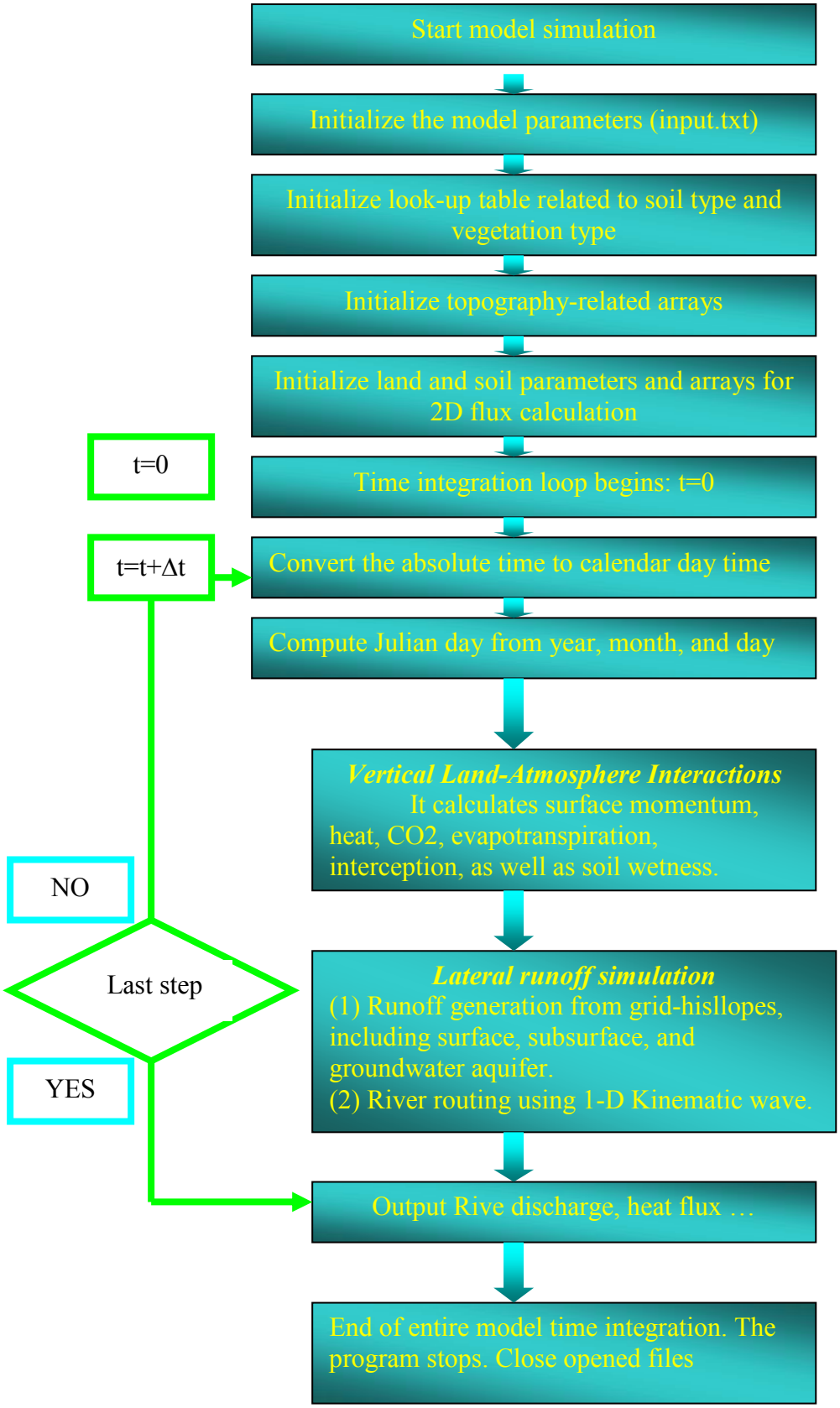

Flowchart of WEB-DHM program