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# The role of climate forecast in water resources management - Case studies in Southeast Asia -

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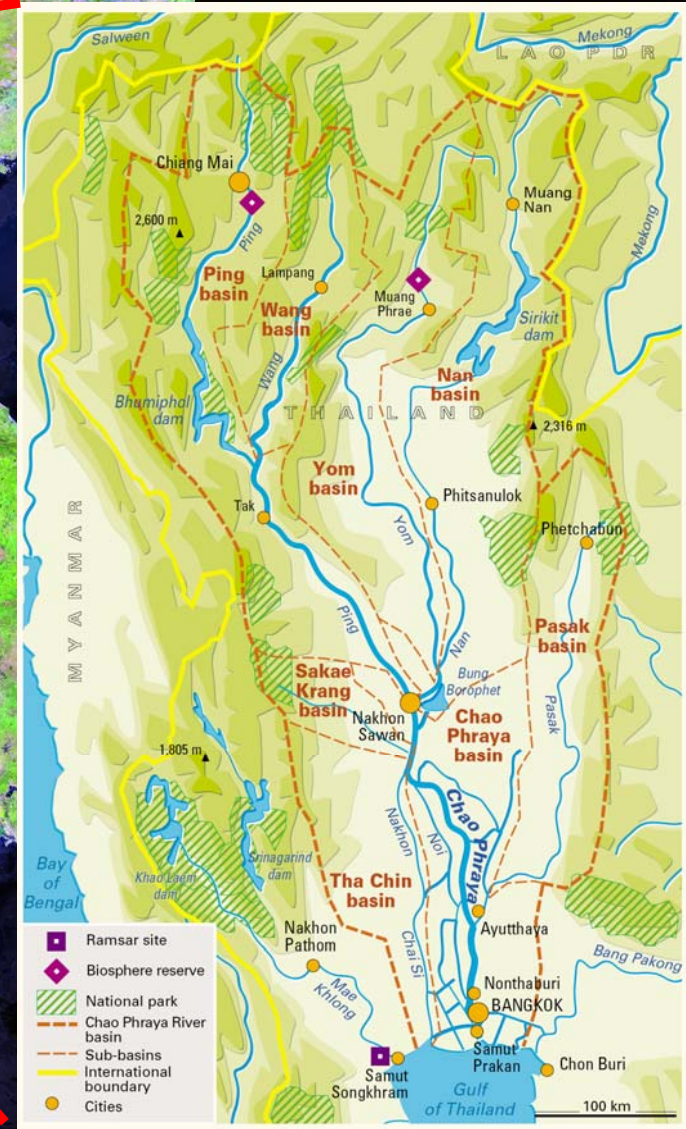
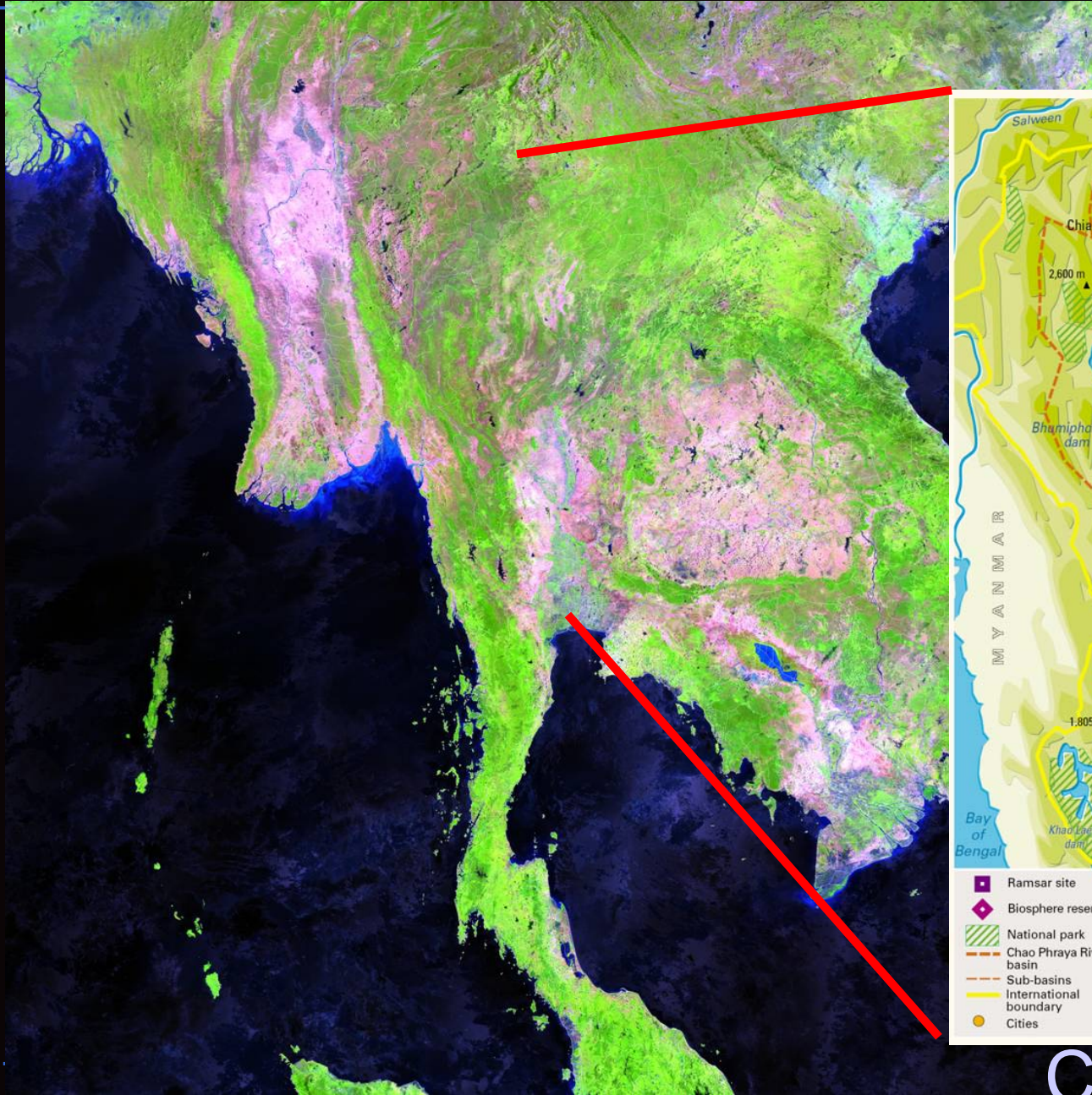
# Acknowledgement to

- Staff and students of IIS, University of Tokyo  
(= Taikan Oki and his group)
- Staff and students of University of Yamanashi  
(= Yukiko Hirabayashi and her group)
- Staff of JMA (Mr. Yamada, Mr. Maeda, ....)
- Staff of RIHN
- Dr. Jun Matsumoto, Dr. Akiyo Yatagai.
- Many colleagues in agencies in Southeast Asia (e.g. TMD, RID, ...)

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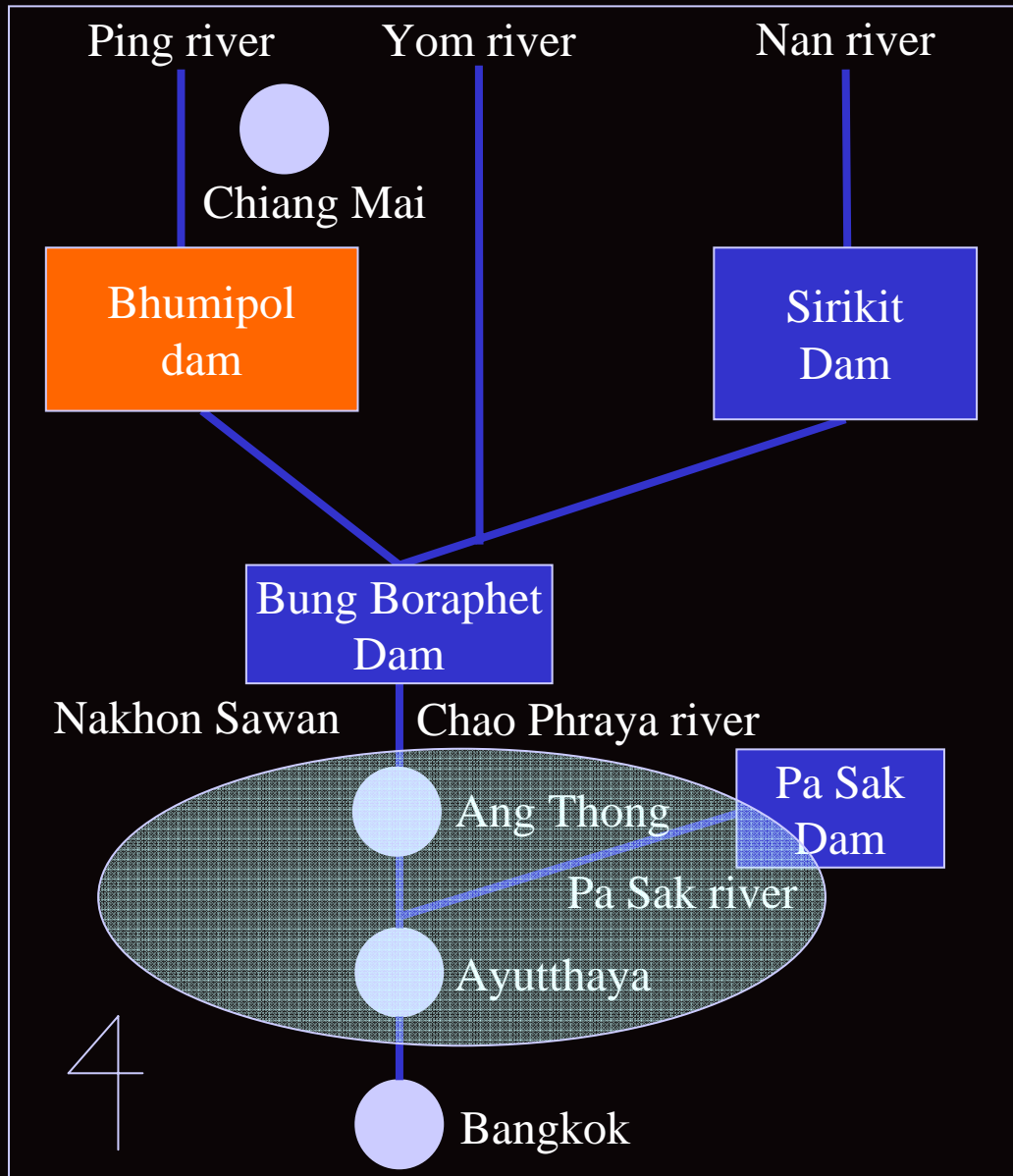
# Contents

- 2006 Floods in the Chao Phraya River
  - One-month climate forecast for Mekong flood.
  - A new gridded precipitation dataset for validation of climate forecast.
-



Chao Phraya

# Introduction: many floods in 2006



*Aug. ~ the beginning of Oct.*

- Floods 5 times
- The death 104
- The completely destroyed 51
- The partially destroyed 8779
- The amount of damage 17 billion B
- The damaged farmland 3856 km<sup>2</sup>
- Compensation to farmer  
 (Mr. Chatchai) 2000 B/rai  
 (Mr. Panya) 500 B/rai

<http://www.business-i.jp/news/world-page/news/200610250026a.nwc>

1rai = 1600 m<sup>2</sup>



18<sup>th</sup> October 2006







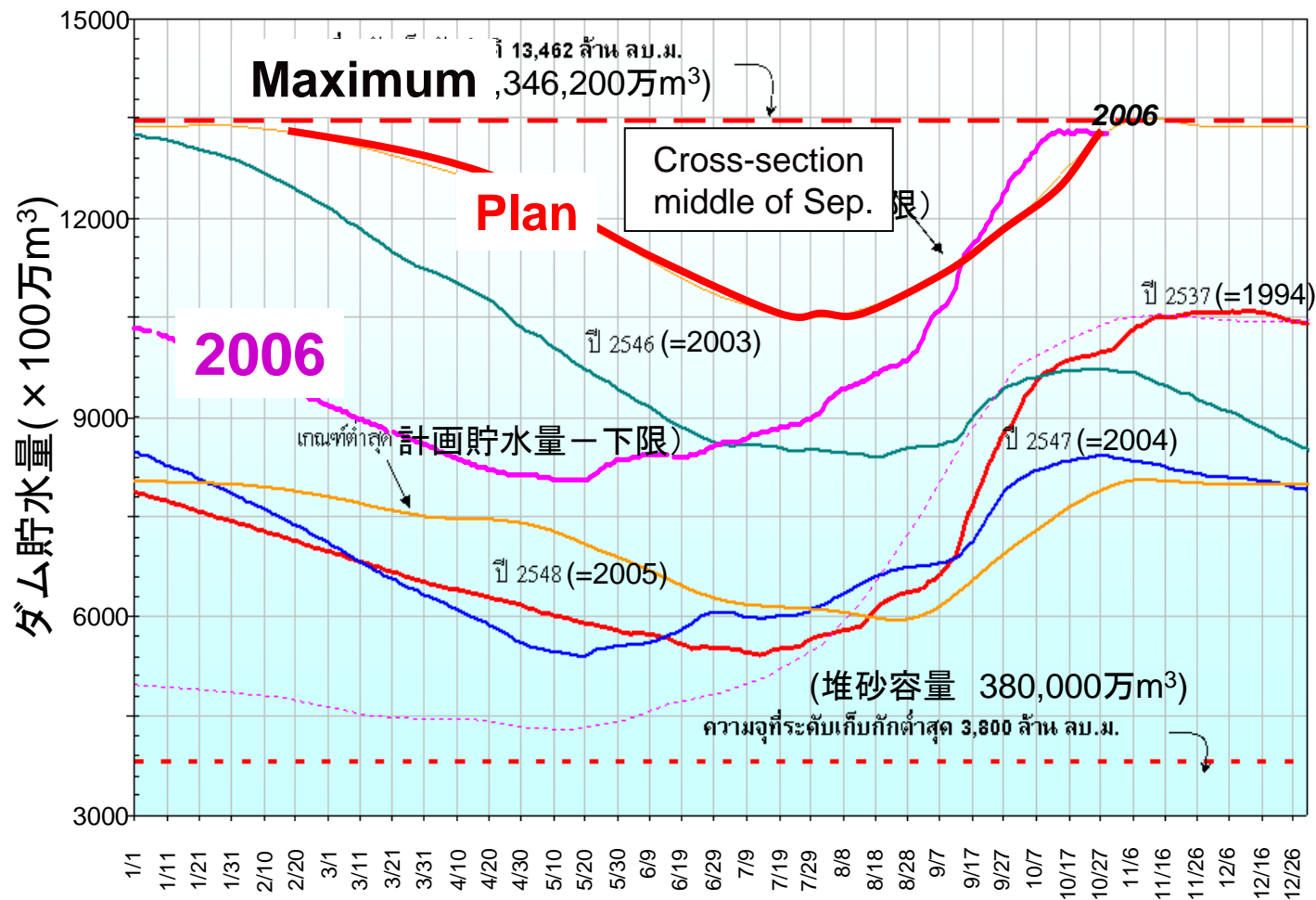




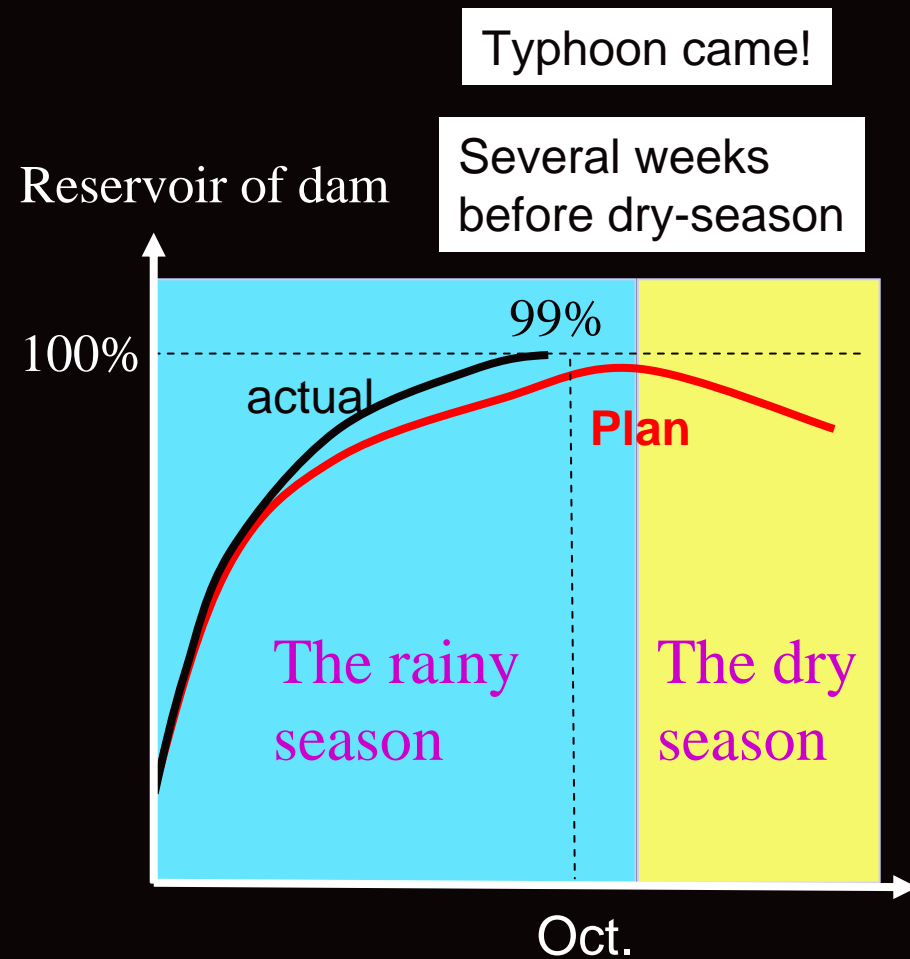
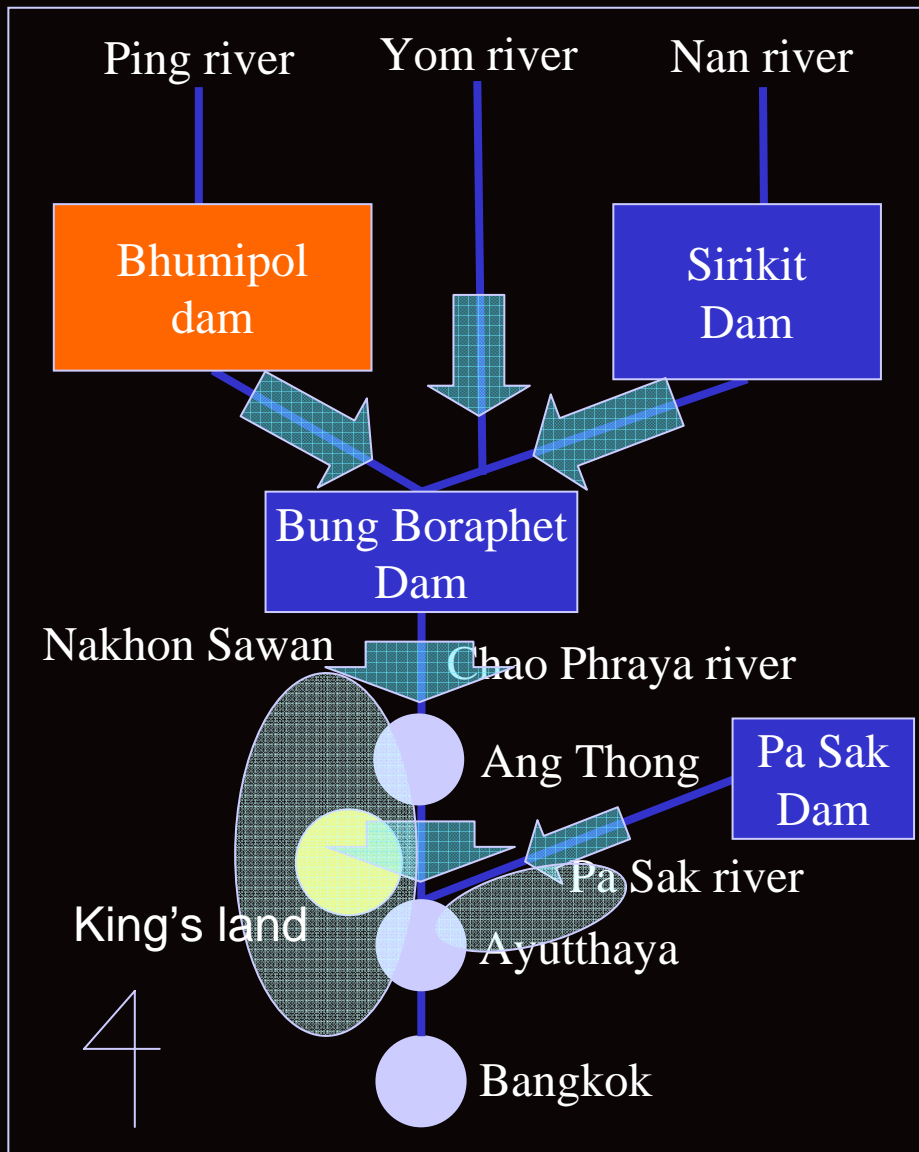


# Rule curve of a dam-reservoir

## Bhumipol Dam-reservoir



# Flood in Ayutthaya and Ang Thong



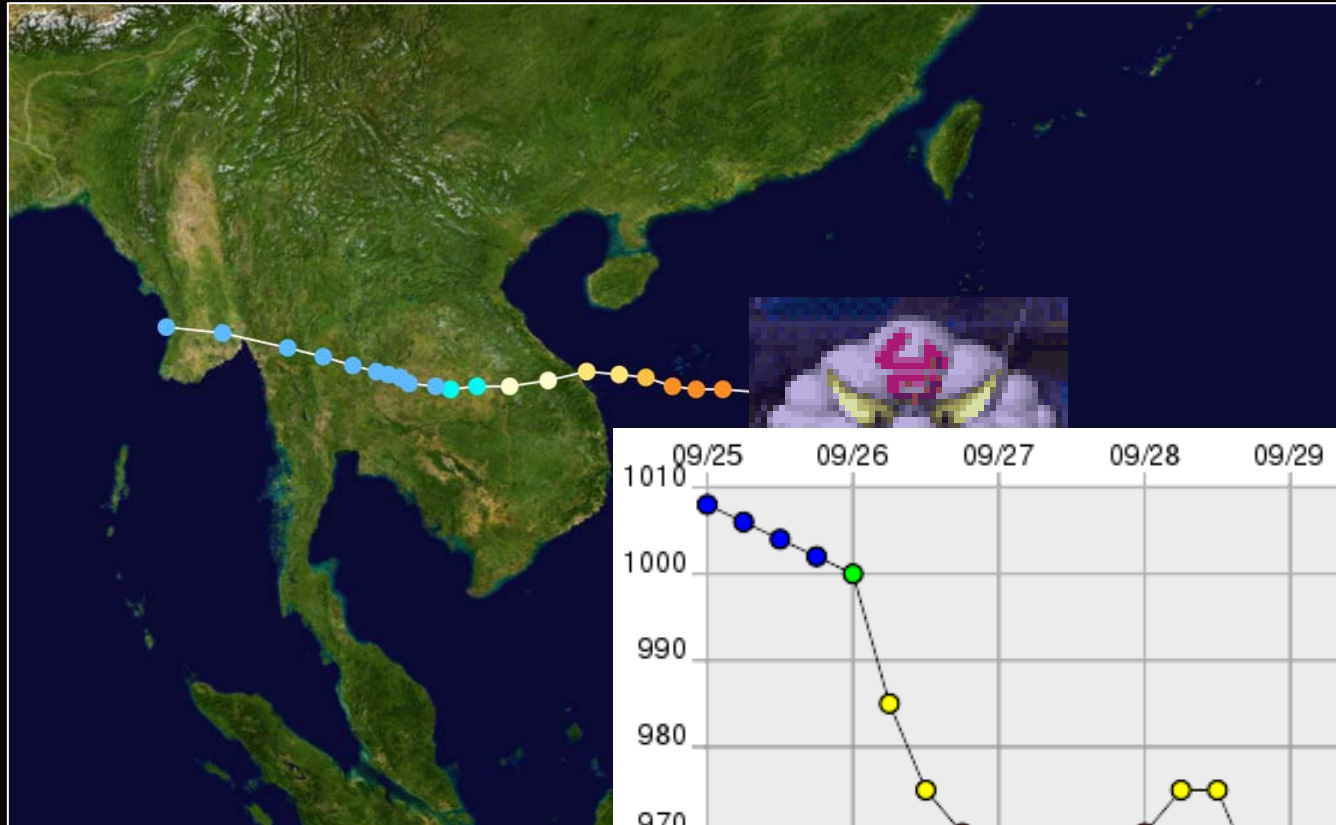
# Interview in Ang Thong -1



- Worse than 1995, 2001 floods
- 20-30 cm/day increase
- Information by TV  
(3 wks prior to flood)
- Temporary walls made about 3 days before flood (concrete)
- Most trouble : toilet

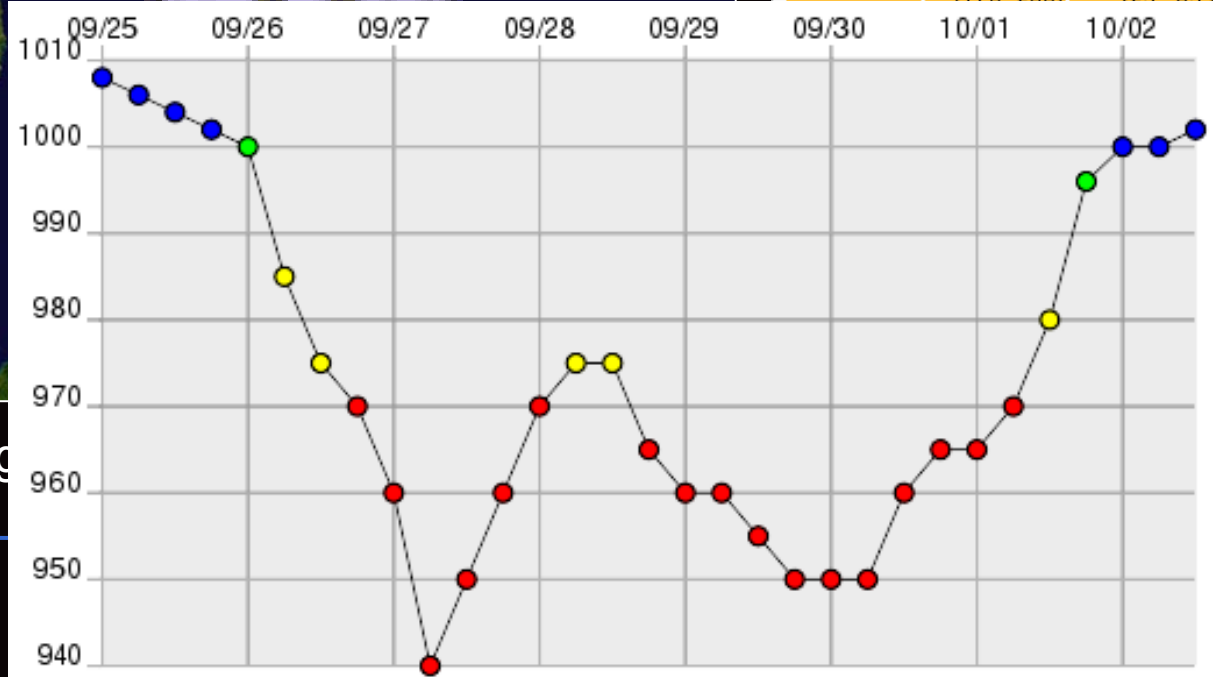
Sex distinction	Female
Estimated age	40-50s
Occupation	Shop owner
Lives in	area along the main road of Ang Thong

# Typhoon "Xangsane" arrived ...



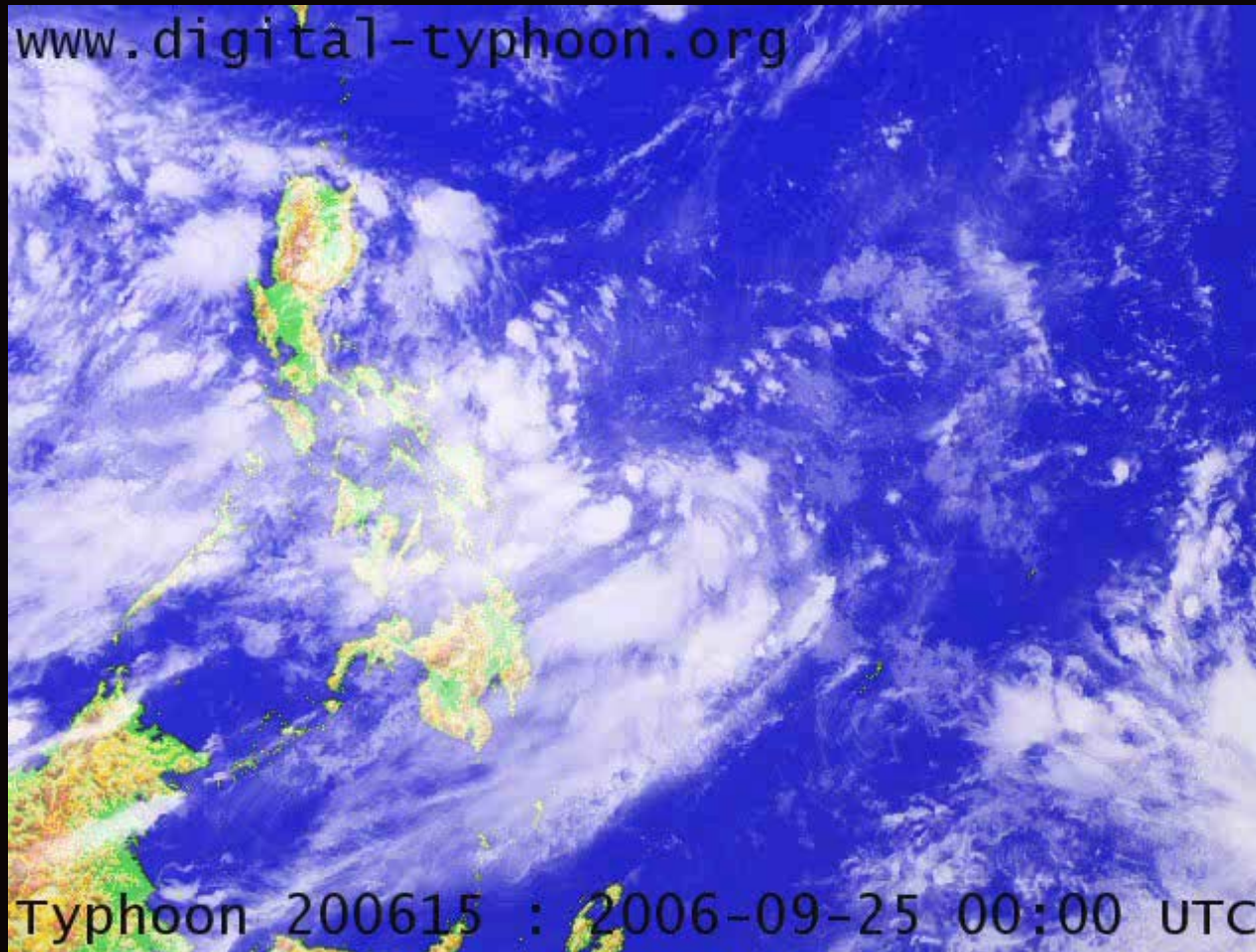
**Saffir-Simpson Hurricane Scale**

Category	Wind speed	Storm surge
	mph (km/h)	ft (m)
5	≥156 (≥250)	>18 (>5.5)
4	131–155 (210–249)	13–18 (4.0–5.5)
3	111–130 (178–209)	9–12 (2.7–3.7)



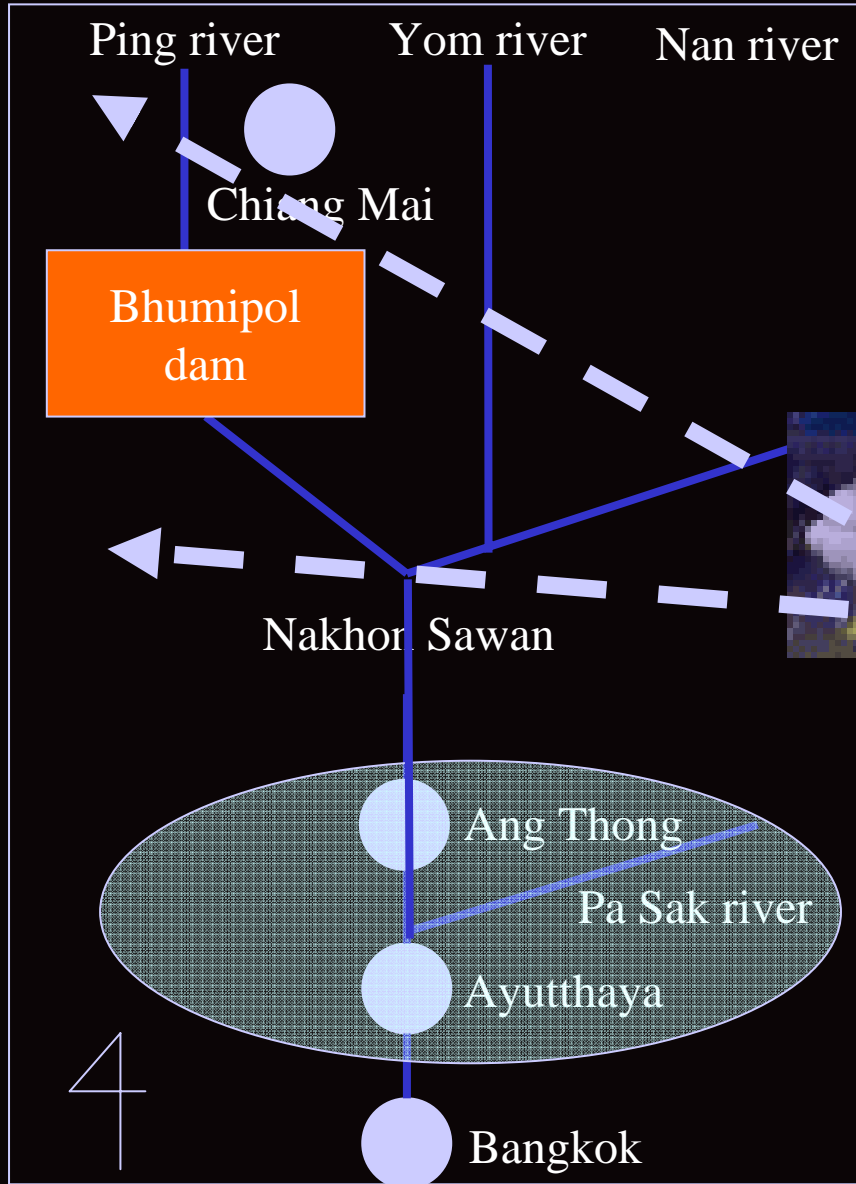
2<sup>nd</sup> Oct., in early dawn, Xangsane

# Typhoon Track

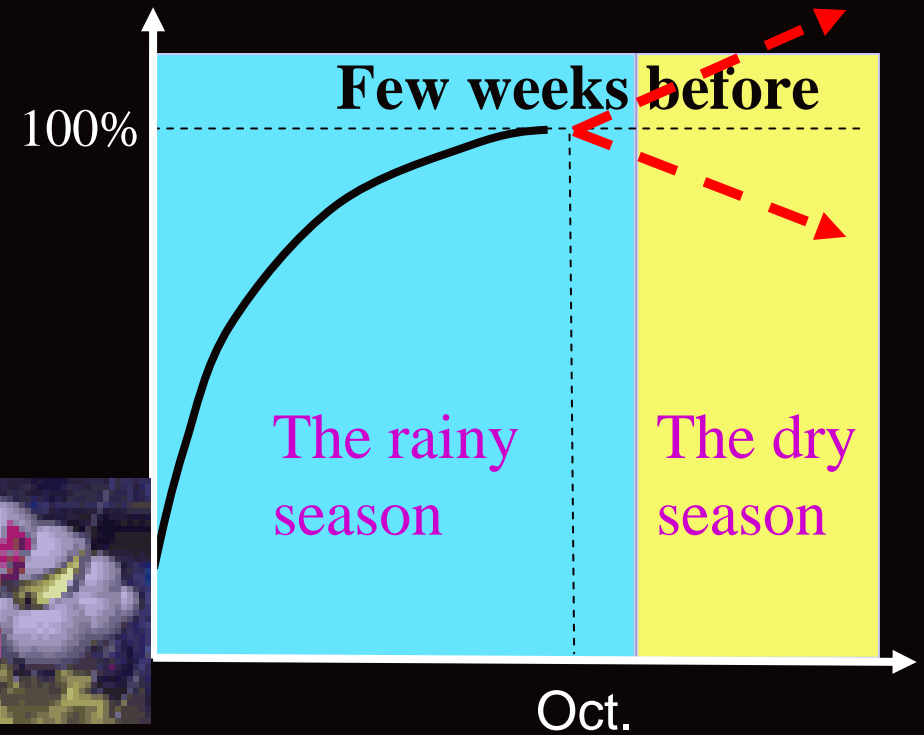




# Introduction



Reservoir of dam



One month forecast.  
Few days forecast.  
both are important !

# Summary up to here

- Numerical climate forecast data is probably not used for actual purpose in many countries.
- Information is useful, both for “few weeks beforehand” (← climate) and “few days beforehand” (← weather).
- We should study:
  - Current accuracy of few weeks climate forecast.
  - How to use “non-perfect” climate forecast for water management.

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## Current accuracy and uncertainty of one-month rainfall forecast

- Target basin is the Mekong.
  - JMA one-month forecast (hindcast) for 1992-2001.
  - Spatial resolution is 2.5 degree.
  - Evaluation is based on one-month rainfall.  
(basically 10day-forecast\*3 =30day is used.)  
(sometimes 30day-forecast is used.)
  - Observed precipitation data is collected mostly as a part of GAME/MAHASRI.
-

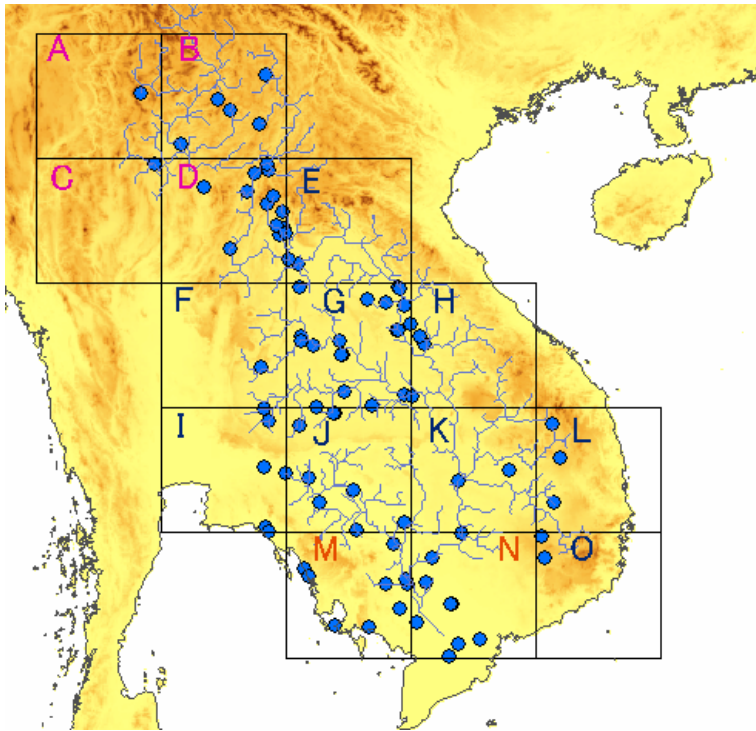


# 0.25-degree grid and observation stations

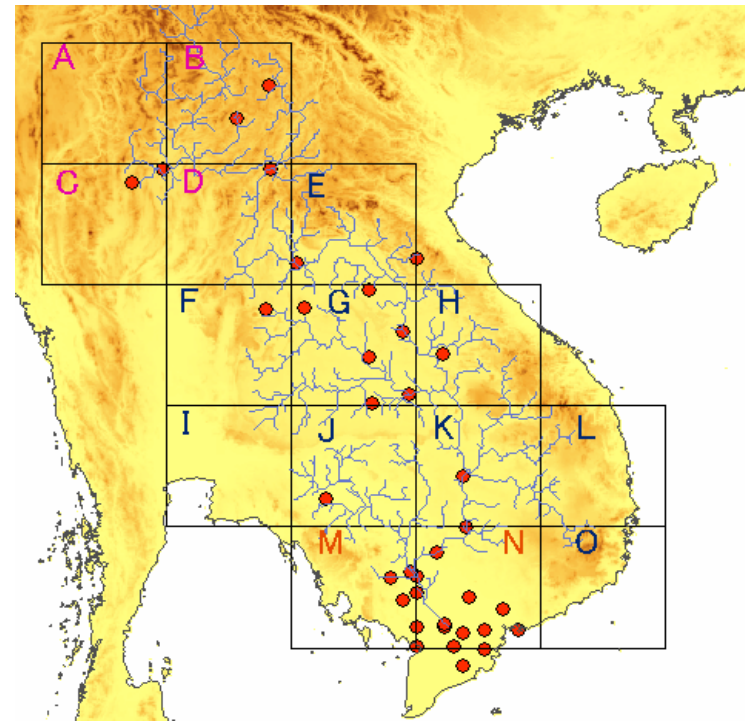
上流域···格子A、B、C、D

中流域···格子E、F、G、H、I、J、K、L、O

下流域···格子M、N

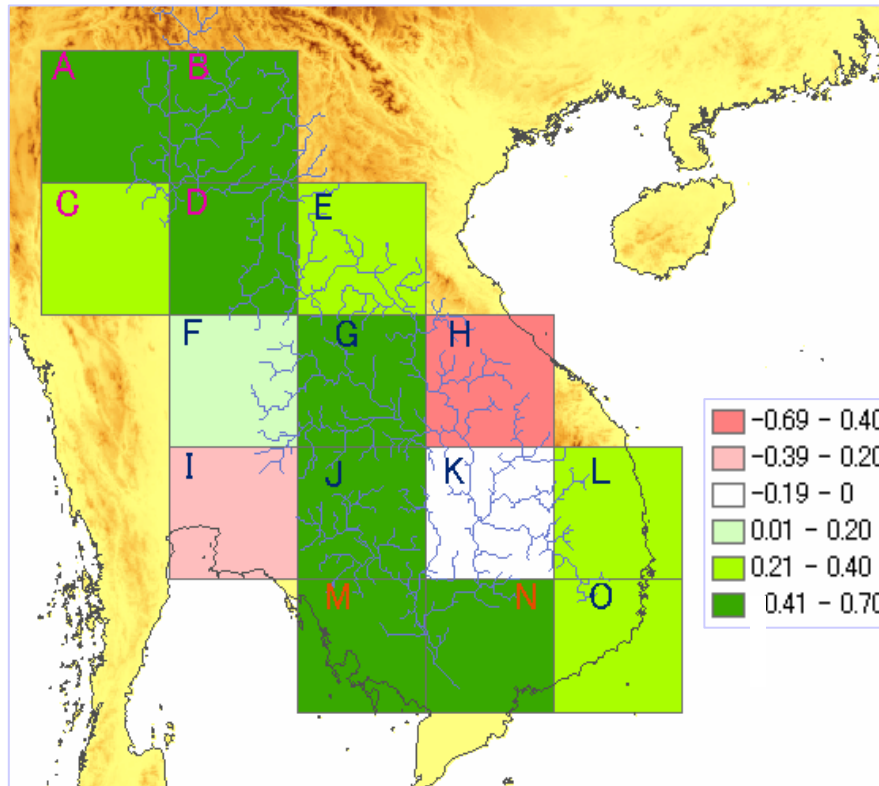


Observation stations

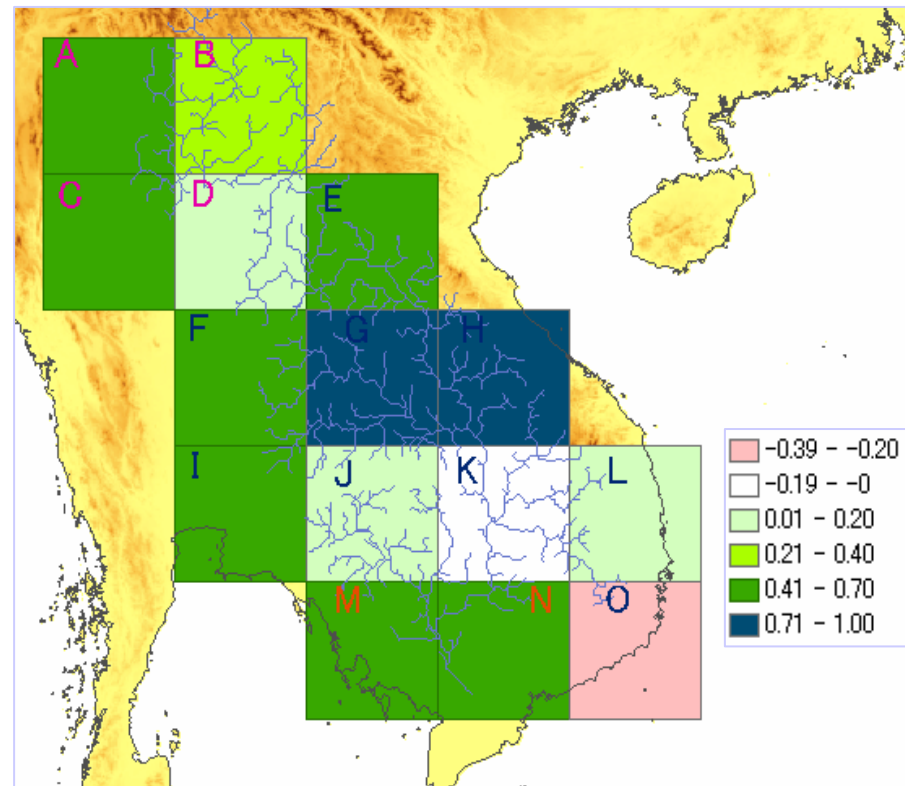


Flooded points

# Correlation between observation and forecast (Precipitation)

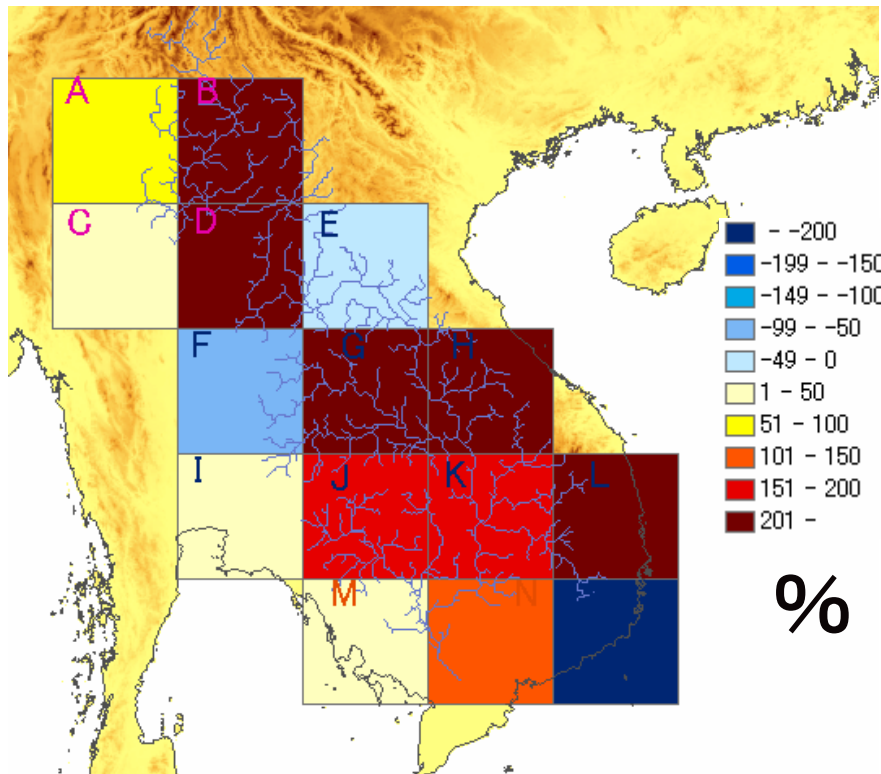


August



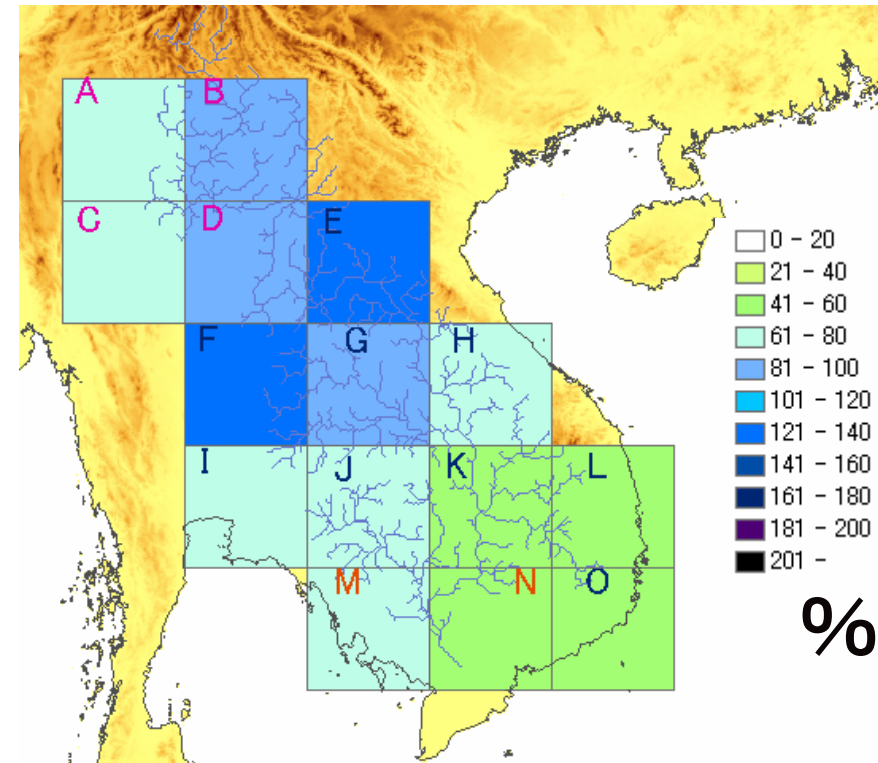
September

# Flood of 2000 July 7th: Forecast error and Ensemble uncertainty



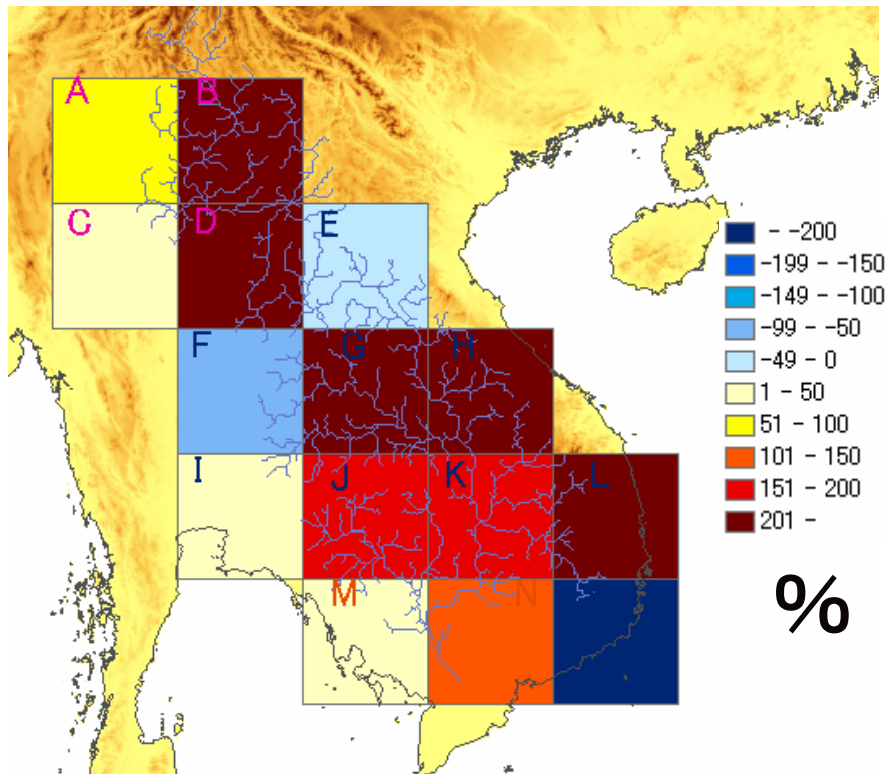
Forecast Error

(anomaly is compared)

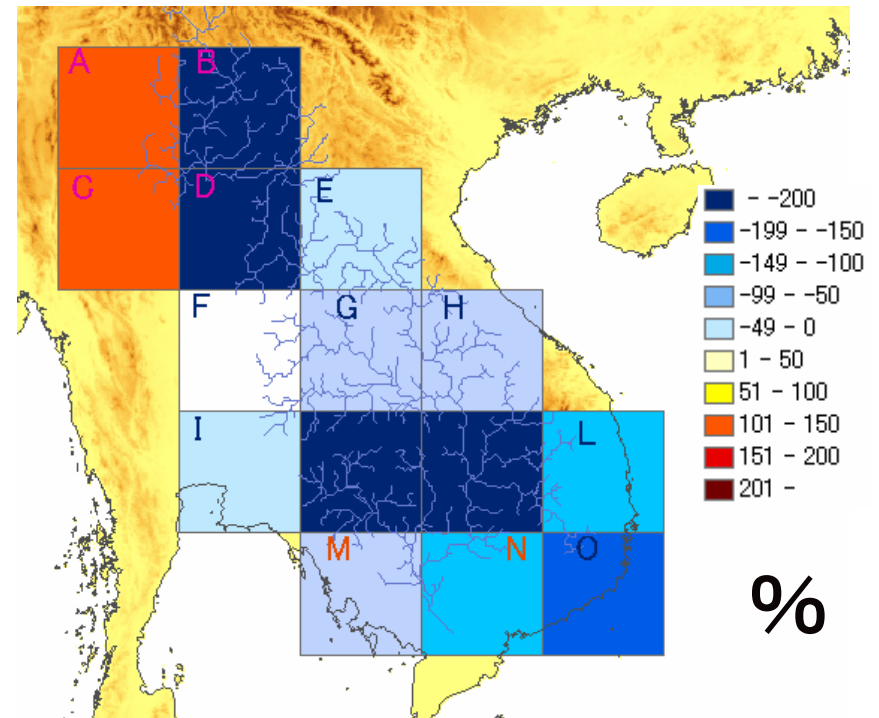


Ensemble Uncertainty

# Flood of 2000 July 7th: Forecast error based on 10-day forecast and 30-day f



Error by 10-day\*3

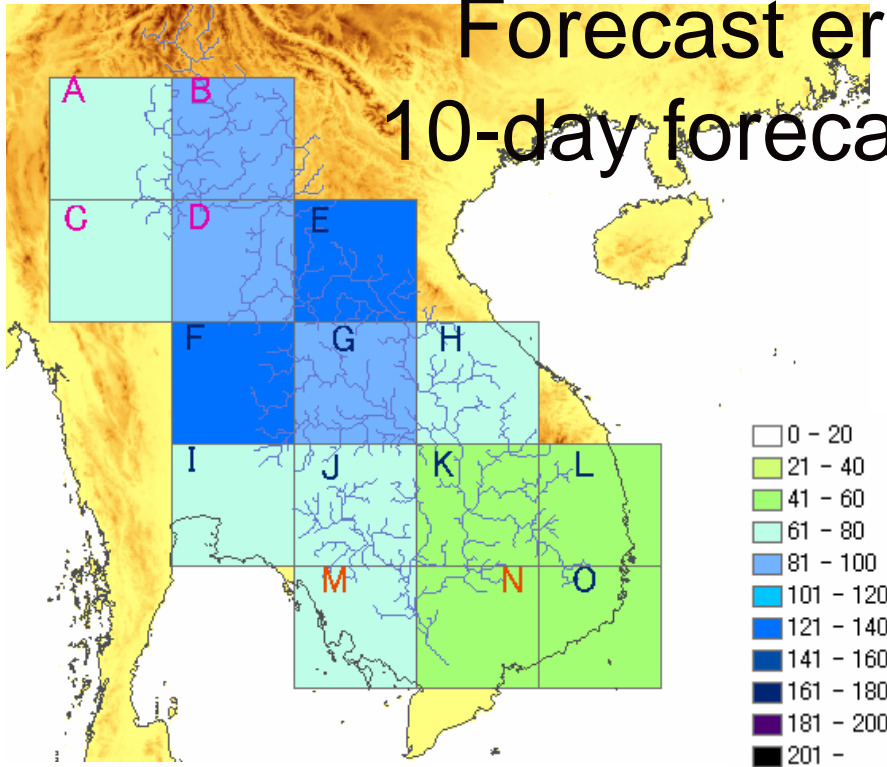


Error by 30-day

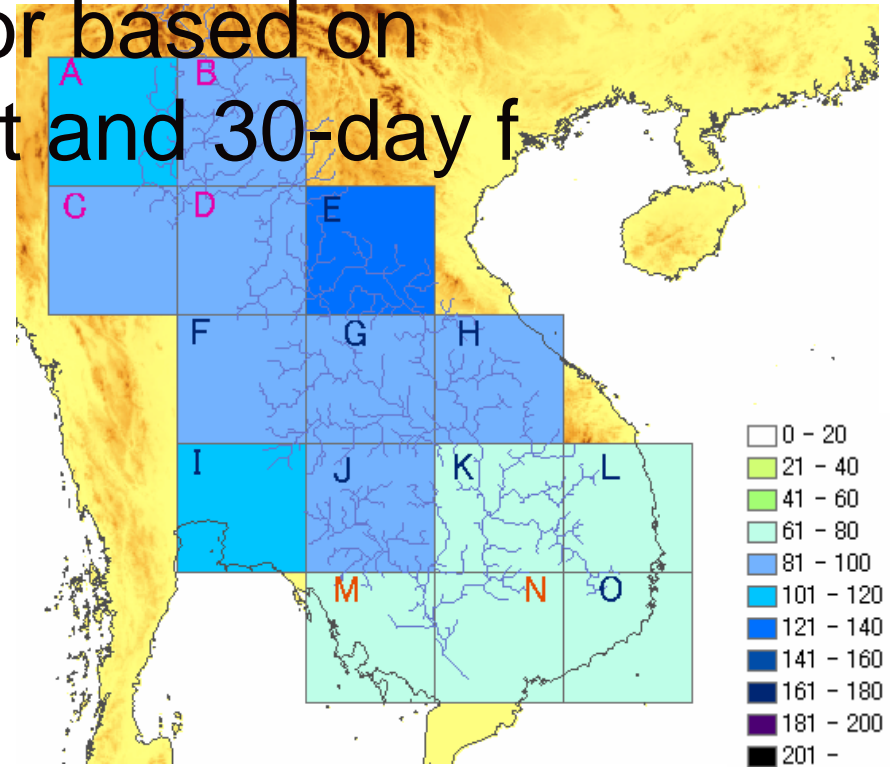


# Flood of 2000 July 7th:

## Forecast error based on 10-day forecast and 30-day f



Ensemble uncertainty<sup>%</sup>  
by 10-day\*3



Ensemble uncertainty<sup>%</sup>  
by 30-day

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For the validation of forecast,  
observed precipitation dataset is very  
important!!

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# APHRODITE's Water Resources

**(Asian Precipitation – Highly-Resolved  
Observational Data Integration Towards  
Evaluation of the Water Resources)**

**Global Environmental Research Fund by the Ministry of Environment,  
Japan** (Project B062 Approved as a three year project; May 2006 –  
March 2009)

**Principal Investigator: Dr. Akiyo Yatagai (RIHN)**

Research Institute for Humanity and Nature (RIHN)

**Co-PI:** Dr. Akio Kitoh, Meteorological Research Institute (MRI)/  
Japan Meteorological Agency (JMA)

**Members:** Akiyo YATAGAI, Shinjiro KANAE, Tsugihiko WATANABE,  
Jumpei KUBOTA, Itsuki HANDOH (RIHN)

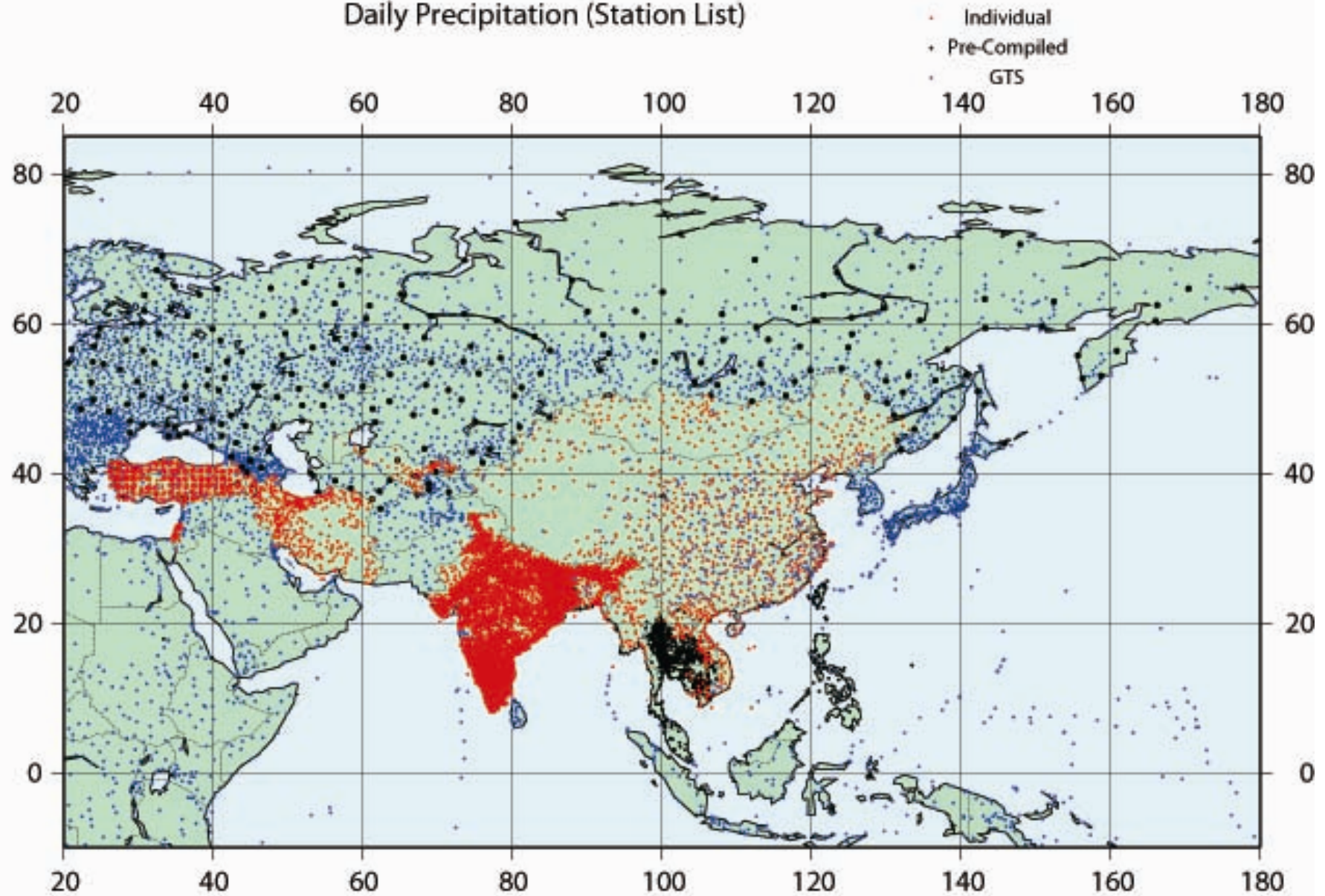
Akio KITO, Kenji KAMIGUCHI, Osamu ARAKAWA (MRI/JMA)

**Project Home Page:** <http://www.chikyu.ac.jp/precip/aphrodite.htm>

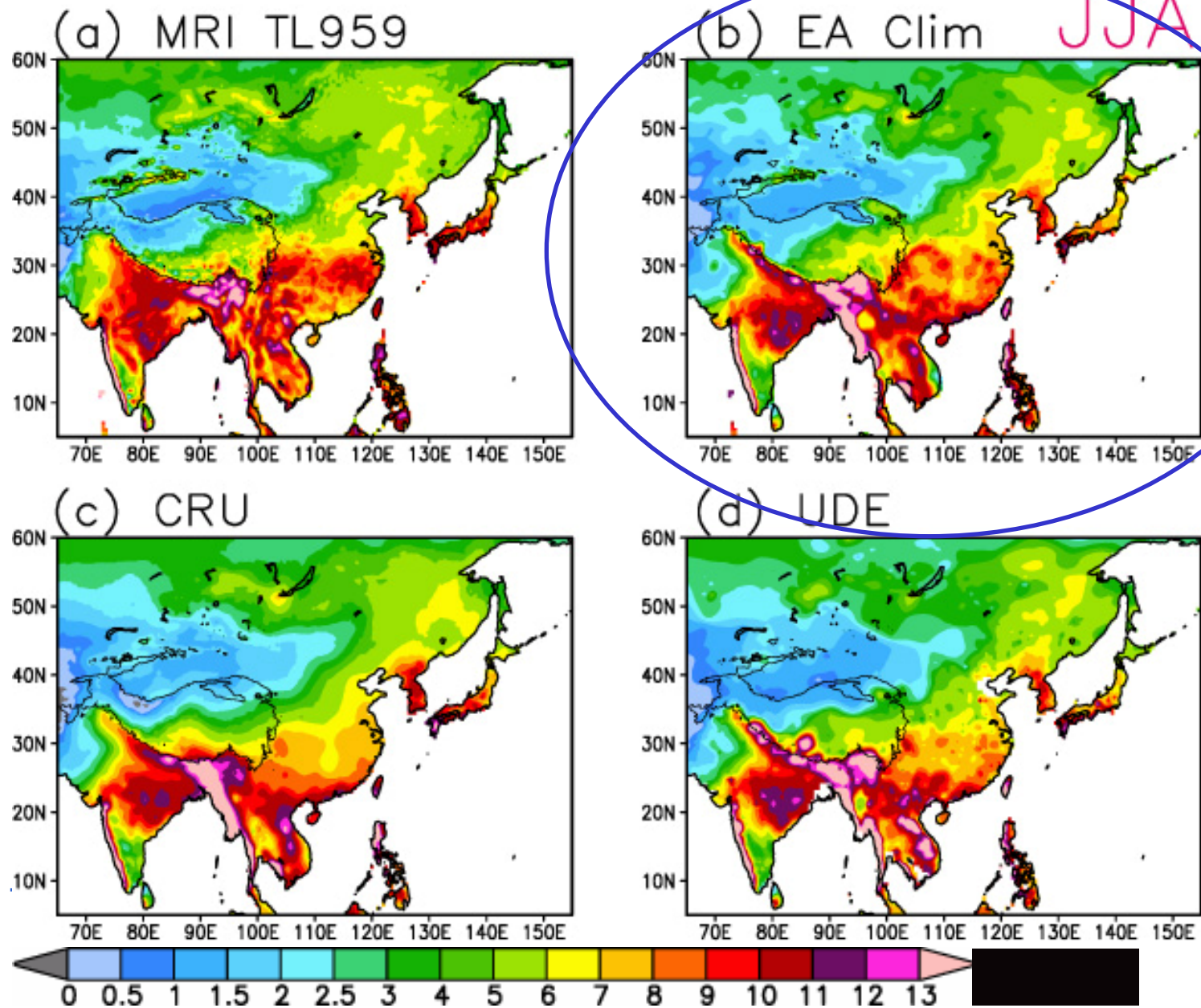
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# APHRODITE precipitation data collection

## Daily Precipitation (Station List)

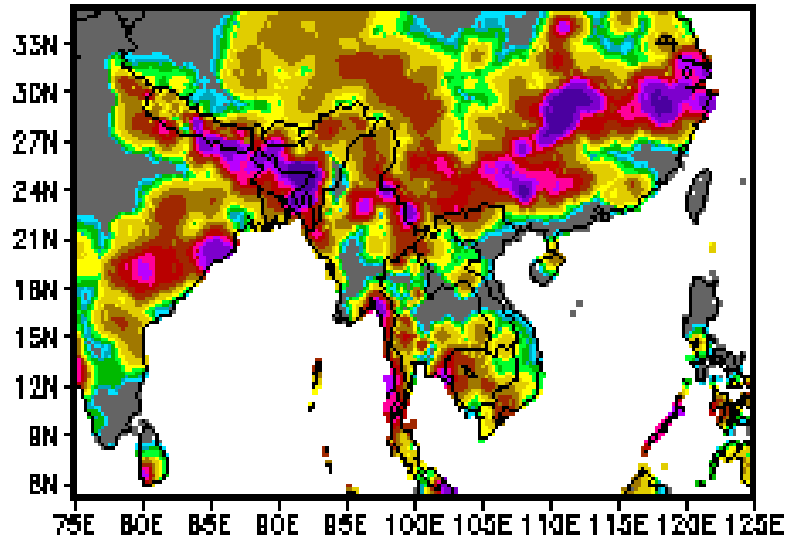


# East Asia Gauge-Based Daily Precipitation Analysis Climatology (Xie et al. 2004)

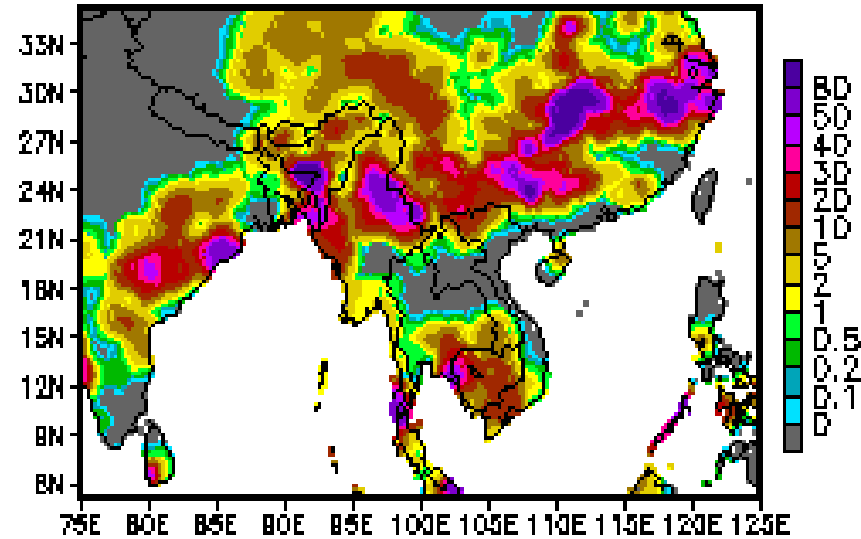


Yatagai et al. (2005)

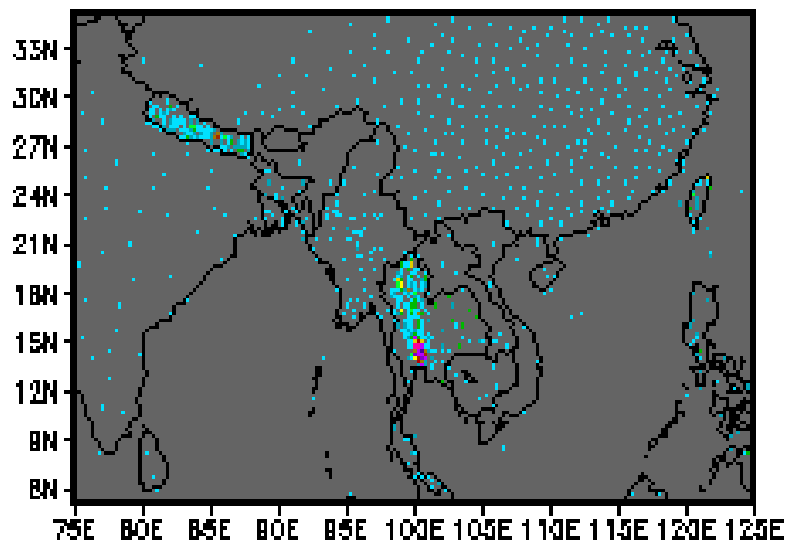
### With GAME Data



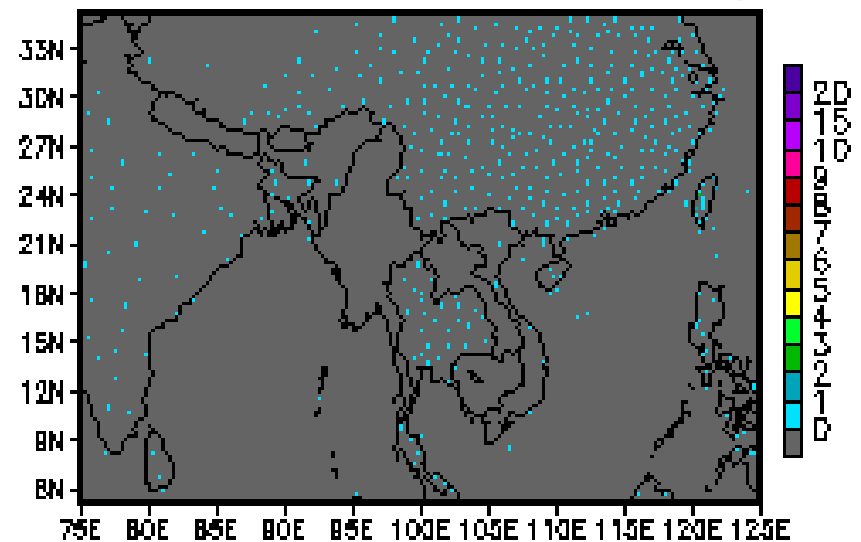
### Without GAME Data



### Number of Gauges



### Number of Gauges



In each 0.5 deg. box

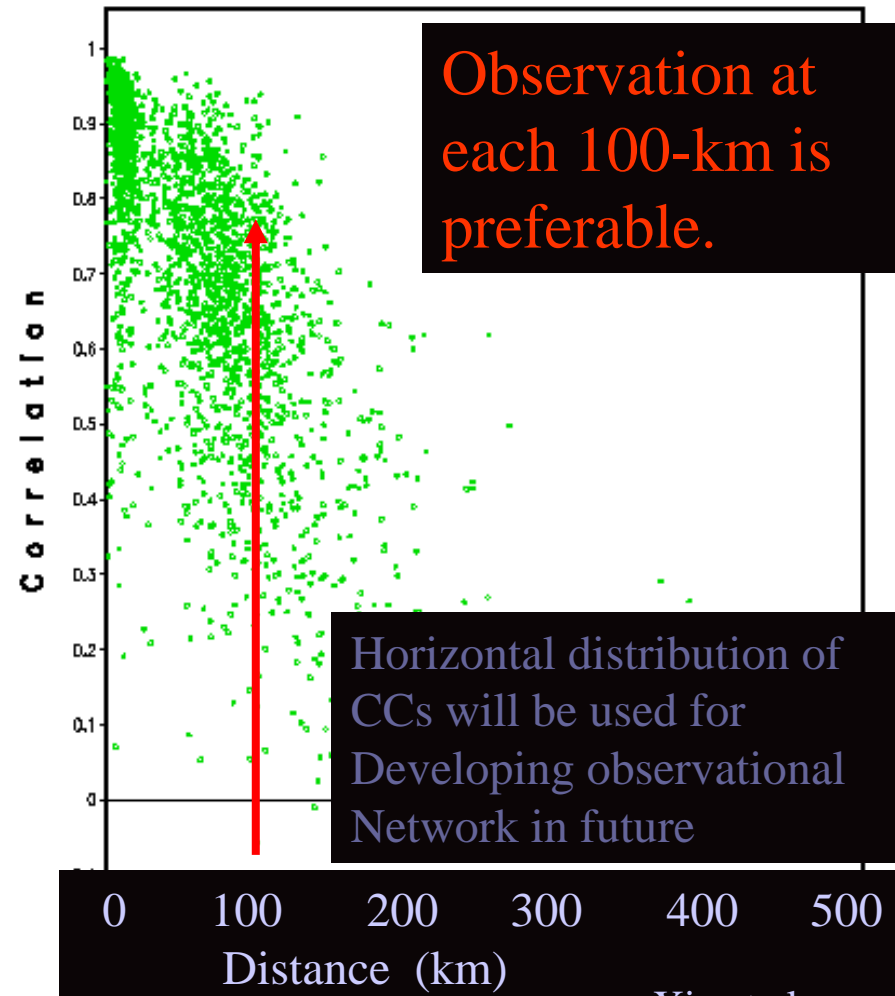
Xie et al. (2004)

# Cross Validation Tests

- Cross validation tests are conducted for 365 days of 1997;
- Each time, daily precipitation observations at 10% randomly selected stations are withdrawn and data at the remaining 90% stations are used to define the daily analyses at  $0.05^\circ$  lat/lon grid resolution;
- This is repeated for 10 time so that each station is dropped once;
- Withdrawn station observations are compared to analyzed values at the gauge location to examine the accuracy of the daily analyses;

# Accuracy – Gauge Network Density

- Analyses were made without 10% stations (10 times);
- Correlation between the withdrawn station observations and the analysis is calculated for each station;
- Scatter plots between correlation and the distance to the closest station are examined;





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## My analysis is preliminary. Your help is necessary.

- Let's share climate-forecast dataset. (database for everyone is preferable.)
  - Let's make a good observation dataset of precipitation over Asia. (Gridded data is easy to use!)
  - Let's investigate from the viewpoint of
    - current accuracy
    - required accuracy for application
    - remove bias, and consider ensemble-uncertainty
    - importance of time-scale for application (several weeks? several days? hours?)
-

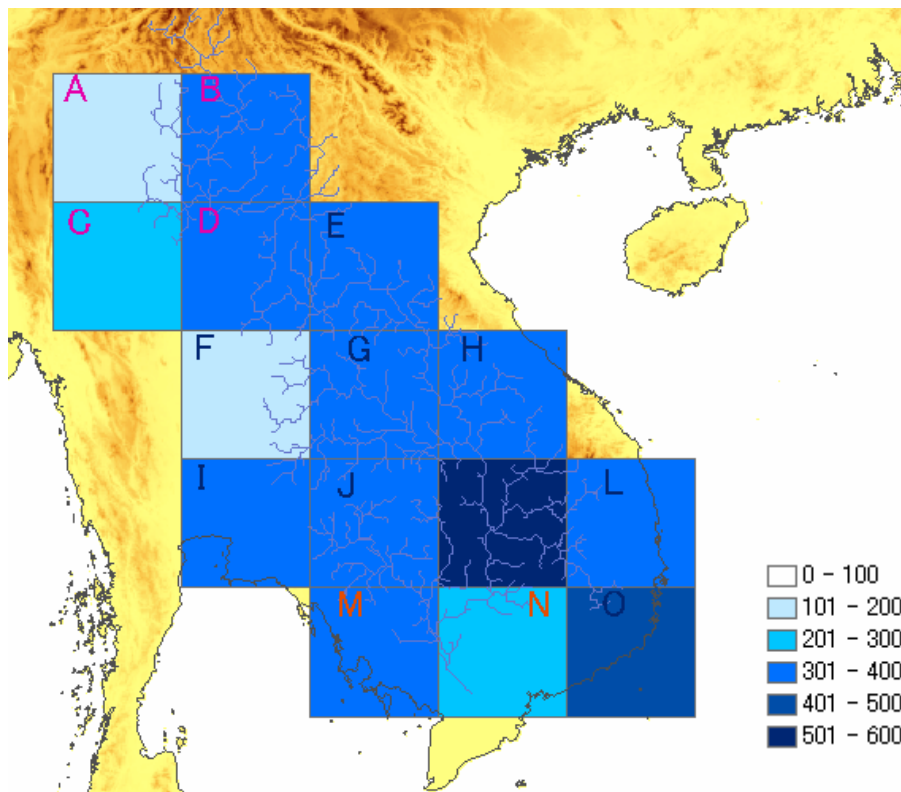
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Thank you very much

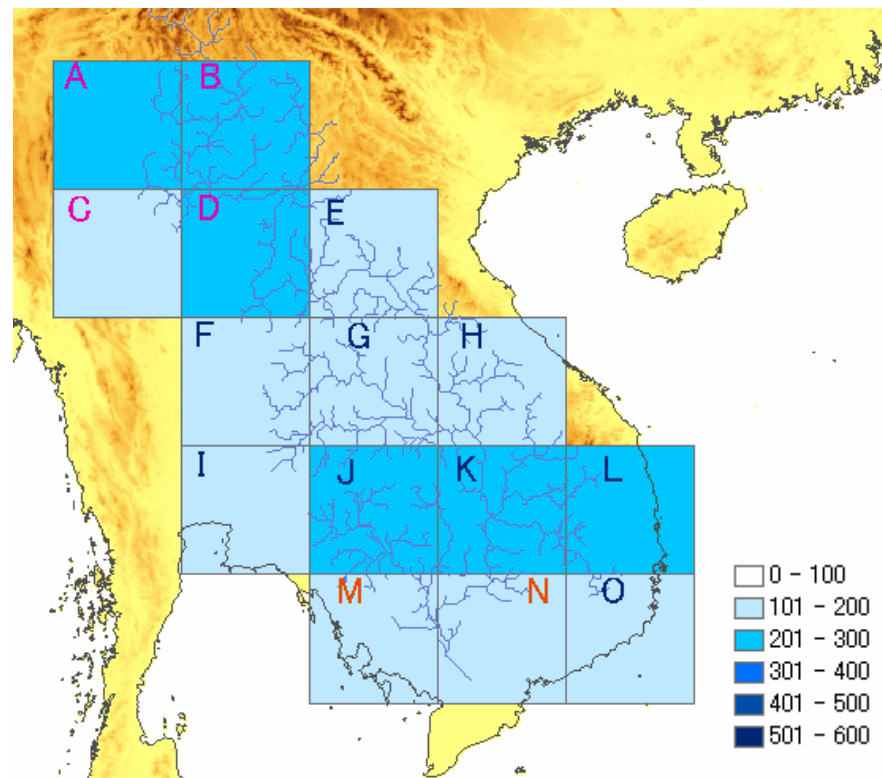
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○アンサンブル予報のばらつき

2000年7月7日の洪水 …… (2000/6/8-2000/7/7の30日積算降水量の比較)



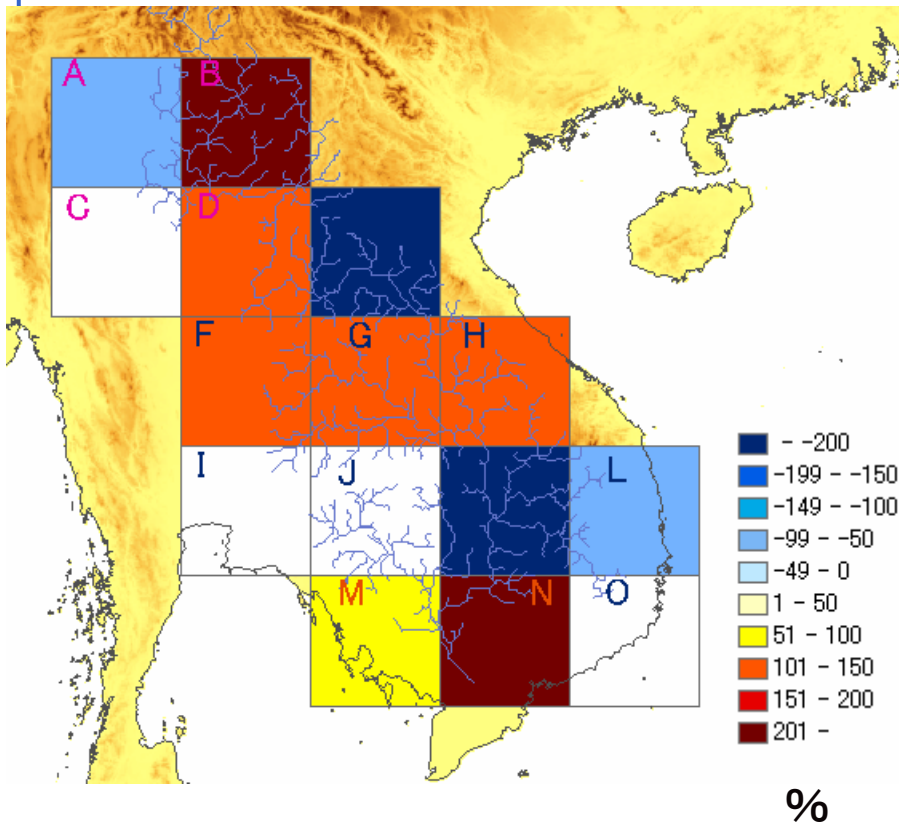
観測



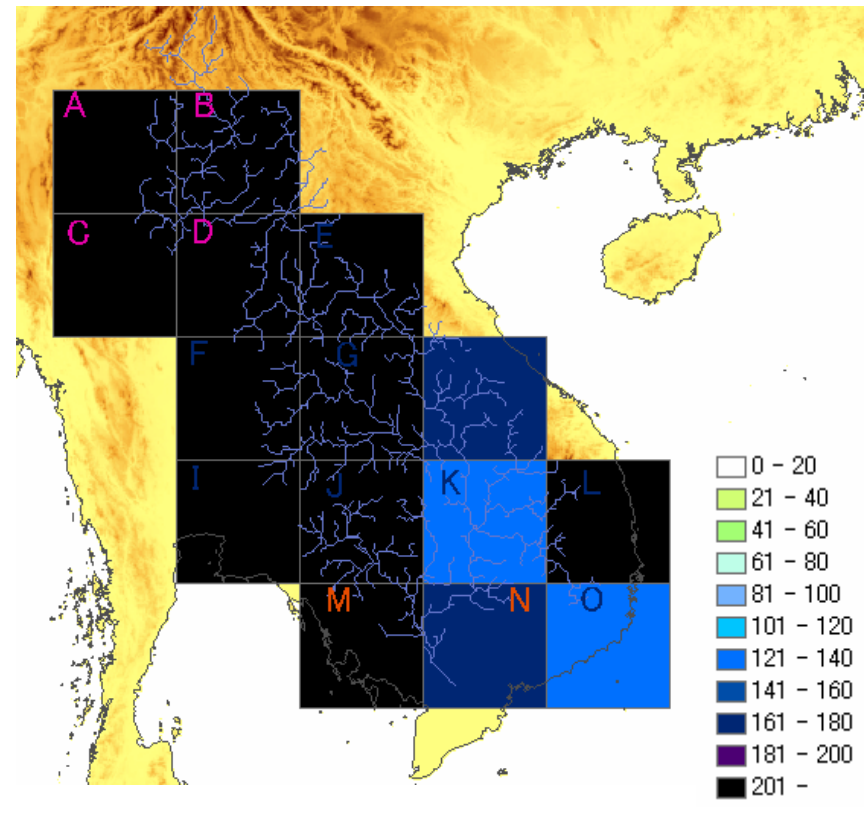
予測  
約10日先の予測

予測降水量は観測降水量の半分程度と過小評価気味

2000年7月7日の洪水 …… (2000/6/8-2000/7/7の30日積算降水量の比較)



予測スコア  
30日先の予測



アンサンブルのばらつき  
30日先の予測

予測スコアは概ね-20.0~20.0の範囲  
 予測スコアの増大に偏りはない  
 変動係数は一様にととても大きい ⇒ 降水量予測のしにくかった状態