Country report
Some achievements under the framework of AWCI activity.

Reporter: DUONG VAN KHANH
Country : Vietnam

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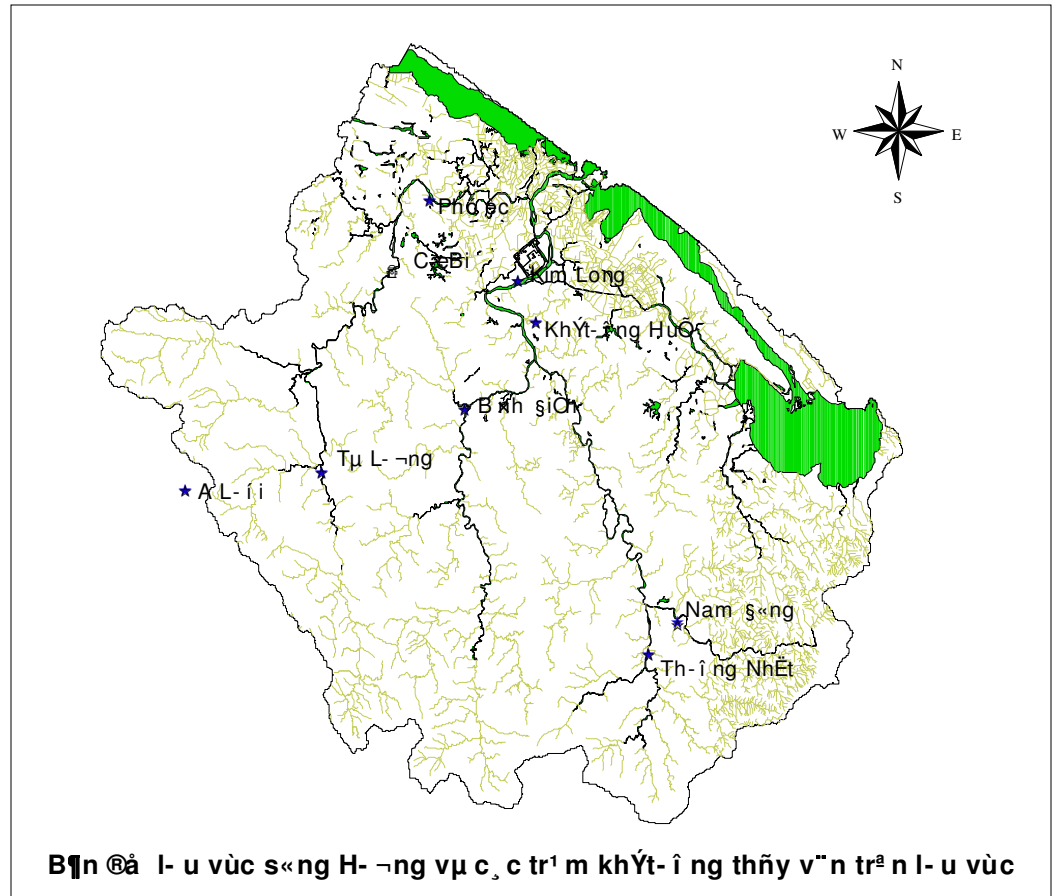g
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Nominated River: Huong River

Area of Huong river basin is 2830 km2 belong to Thua Thiên Hue Province.
Huong river system. It is located in latitude 16-170N, longitude 107-1080E.
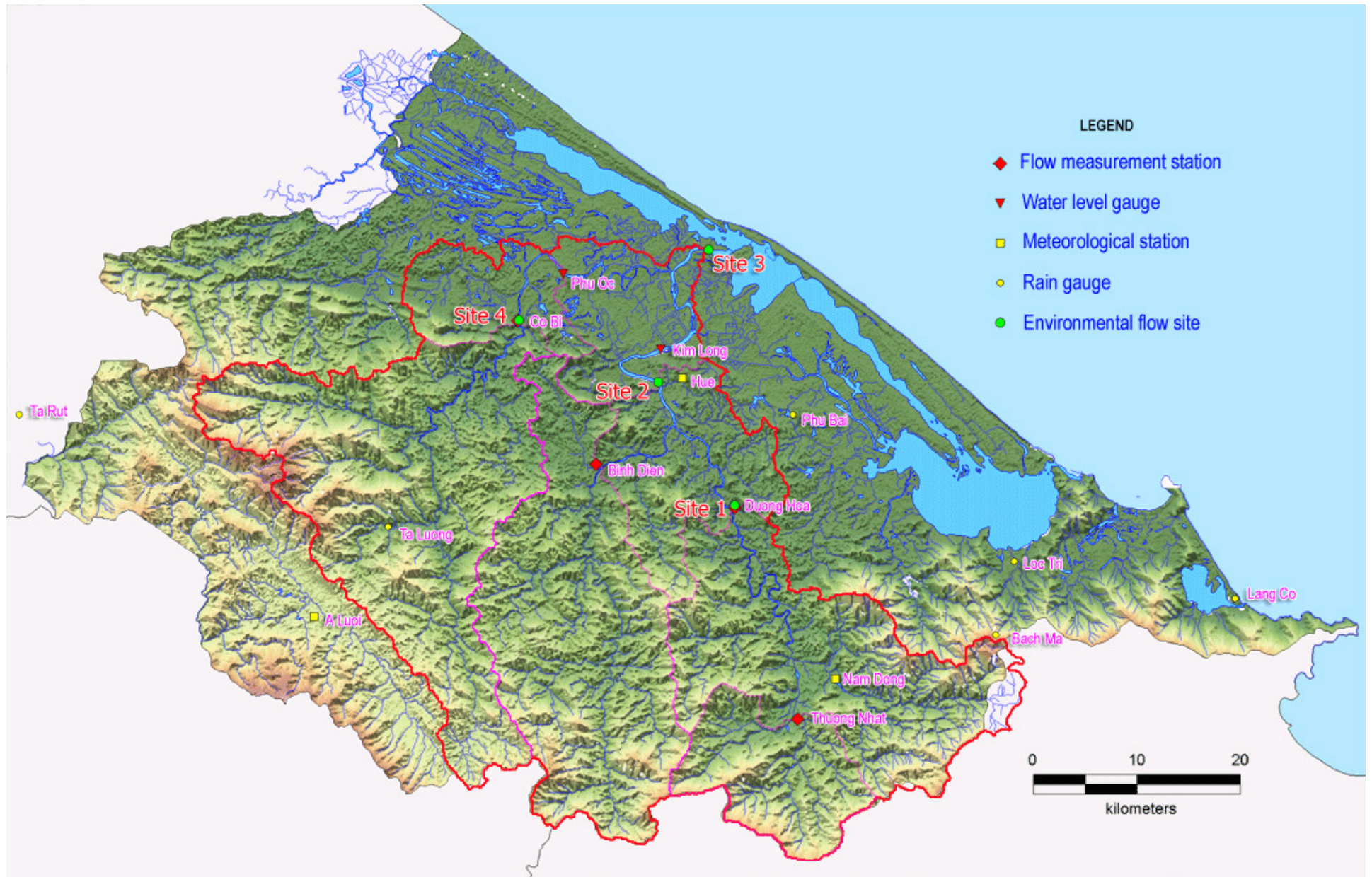There are Truong Son mountain range and Bach Ma with tops about of 1000m in the West and the South-West.
 East Sea **is** in the East. This is transitional climate region.
contain 3 main river: Ta Trach, Huu Trach and Bo river. In whichTa Trach river is upper stream of Huong river

B¶n ®å l- u vùc s«ng H- ¬ng vµ c¸c tr¹m khÝt- î ng thñy v¨n trª n l- u vùc

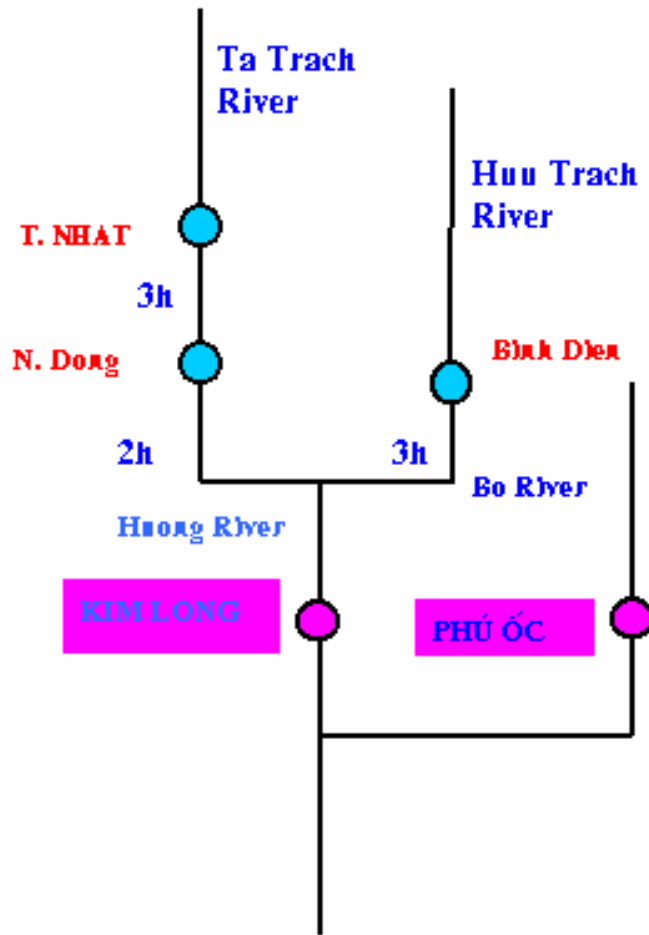# Hydro-meteorological station network

Schematic Diagram Huong System

RIVER	Water level station	Rainfall Station	Forecast Lead Time
HUONG	Thuong Nhat	A Luoi, Thuong Nhat	0 hr
	Nam Dong	Thuong nhat, Nam Dong	3 hrs
	Binh Dien	A Luoi, Binh Dien	3 hrs
	Kim Long	A Luoi, Thuong Nhat, Nam Dong, Binh Dien, Kim Long	6 hrs
BO	PHU OC	Ta Luong, Phu Oc	3 hrs

- *Rainfall-runoff models, method of corresponding stage and multivariable regression have been used to produce short-term river forecasts.*

-*In recent years, different models like TANK, NAM,* MIKE 11 GIS , *MARINE have been applied in flood forecasting for Huong river.*

-*Forecasting accuracy is 75-80% for short-term forecasts respectively*

Hydro – Meteorological station network in Huong Rives basin

- 3 Meteorological stations:

  Hue station (1915 up to now);

  Nam Dong (1973 up to now);

  Aluoi (1976 up to now).

- 4 hydrological stations in upstream, measuring rainfall (X), water level (H) and water discharge (Q):

  Thuong Nhat on Ta Trach River (1979 up to now) with the drainage area of 208 km^2;

  Binh Dien on Huu Trach River with the drainage area of 570 km^2 Co Bi on Bo River with the drainage area of 720 km^2 (1979-1985), Duong Hoa with the drainage area of 686 km^2 (1986-1987).

- 2 Water level stations in downstream (observing X, H) are Kim Long (Hue) on Huong Rives and Phu Oc on Bo River (1979 up to now).

Hydro – Meteorological station network in Huong Rives basin

| N.	HydroMeteorological station	observed Parameters	obser. method		Iquipment
			Water level	Rainfall	
1	Thuong Nhat (78 H, 81 Q)	H, Q, R	Automatic	Manual	Automatic
2	Kim Long (1976)	H,R	Automatic	Manual	Automatic
3	Binh Thanh (99)	H,R	Manual	Manual	Manual
4	Ta luong (84)	R		Manual	
5	Nam §ong (73 to now)	Meteo.		Automatic	Manual
6	Binh §ien (78 - 85; 2000)	H	Automatic		Automatic
7	Phu Oc (1976- 93)	H,R	Automatic	Manual	Automatic
8	Co Bi (**79 -85**)	H	Manual	Automatic	Manual
9	Hue	Meteo.			
10	A Luoi	Meteo.		Automatic	Manual

- Some projects is peformed for strengthening (improving) of timeliness and accuracy of the forecasts related to flood conditions at provinces in Central part of Viet Nam to the degree necessary to allow for an efficient flooding warning system and for effective natural disaster preparedness, prevention measures and reduce he losses of properties and human lives
- *2003-2004, VIE-97-02 project, Huong river was installed 4 automatic water level equipments (float stirling well with Steven equipment, workng by 2 type: mechnic and automatic record to data logger) ; data was transmited by Motorola equipment system and 04 ADPC to measure the water discharge.*
- *2007-2010, ODA, Italy for* improving the capability of observation, collection, processing, modeling, warning and forecasting hydro-meteorology.

Application on Huong River
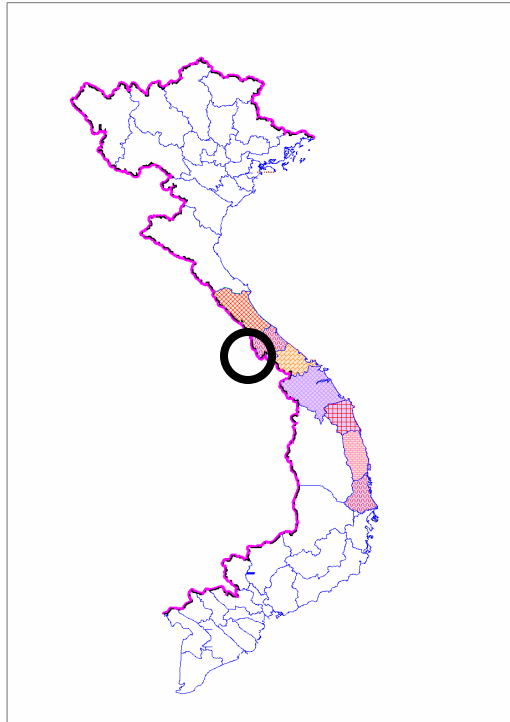
(Area:2.830km2)
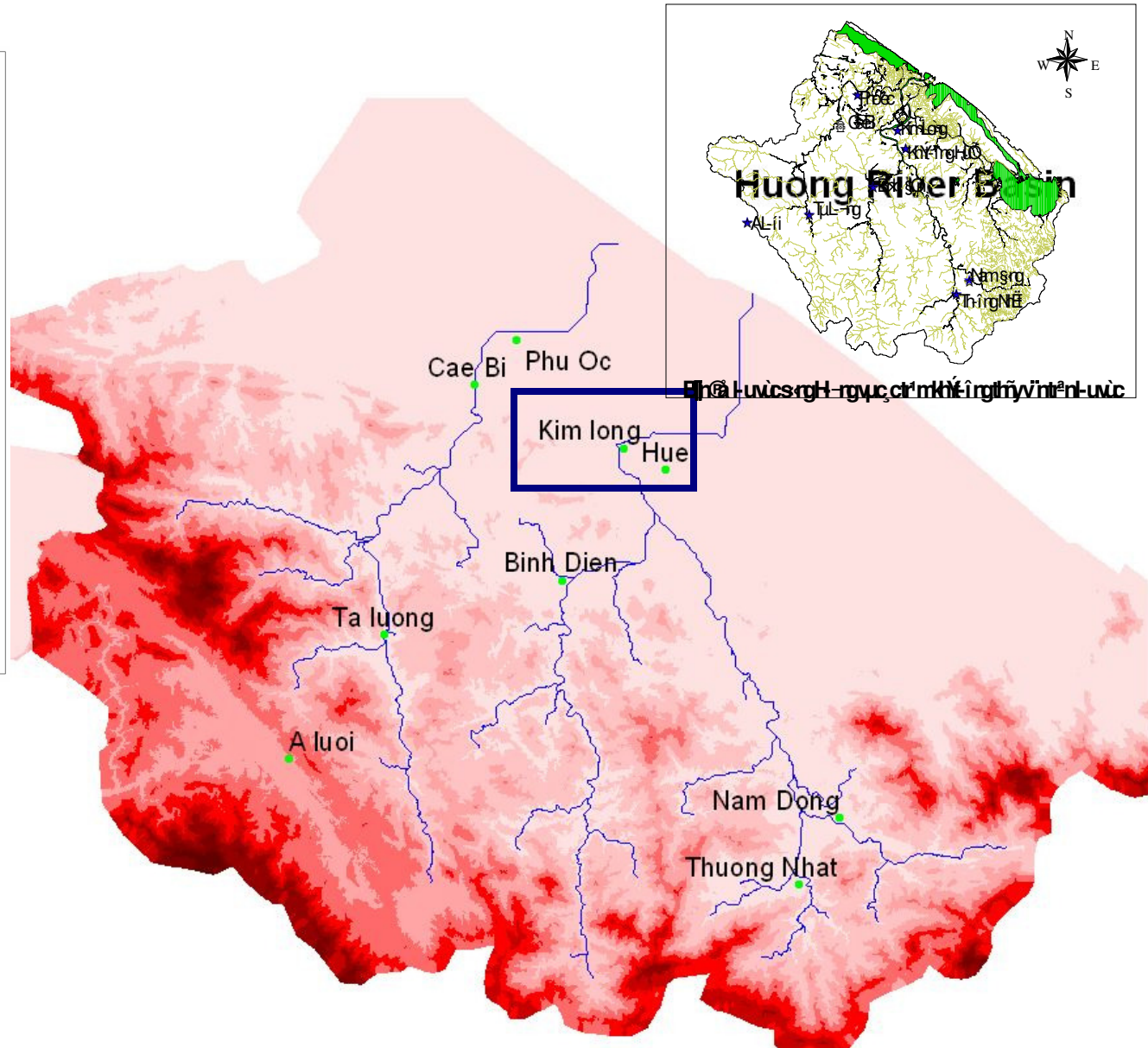
- **From 4 - 8th, April, 2007, The delegation contain of 04 men:**

  1. Prof. Dr. Toshio Koike, The University of Tokyo

  2. Dr. Oliver Saavedra, The University of Tokyo

  3. Mr. Kengo Aizawa, Japan Aerospace Exploitation Agency (JAXA)

  4. Mr. Ben Burford, Remote Sensing Technology Center (RESTEC)

The meeting on 4th for introducing to GEO, GEOSS and AWCI, flood forecasting, river management system, satellite observations to Huong River; introduce the sytem and available satellite data.
HMS (Vietnam) introduce about the characteristics of Huong river basin, the available data, the floods in past, and the current observation and forecasting systems.

- And then, 5th April we visited the Huong River basin;

- Working group visited the Trung Trung Bo Central Regional Hydro-meteorological Forecasting Center at Da Nang city;

- And the go to Hue city. Working at Hydro-meteorological Forecasting Center of Hue city of Thua Thien Hue Provice (Trung Trung Bo Central Regional Hydro-meteorological Forecasting Center)

- Visited some hydro-meteorological stations in the Huong river basin under control of Hydro-meteorological Forecasting Center of Hue city:

  Hydrological stations: Thuong Nhat, Phu Oc, Binh Dien, Kim Long station.

  Meteorological stations: Nam Dong, Hue station.

Discuss about capabilities : Observation, transmission data of hydro-meteorological stations in the Huong river basin, capability of hydro-meteorological of Hue Center.

Vietnam have supplied about rainfall data, water level, discharge data of Thượng Nhat, Kim Long and rainfall data of some other local point in flood in November, 1999 in Huong river basin, GIS data of Huong river basin.

Thuong Nhat Hydrological station
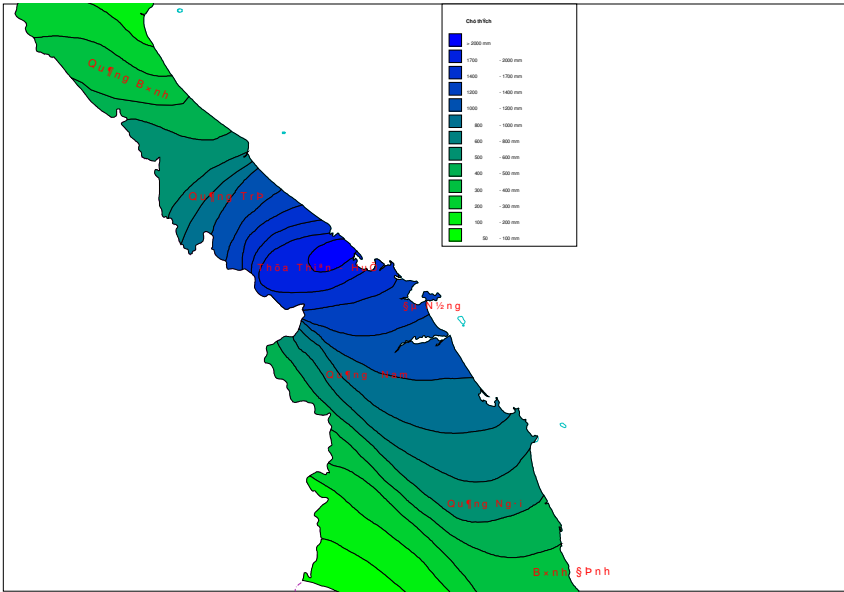
Rainfall and flood occur in the Huong River basin in 11/1999

Flood trace on flood happen November, 1999 at Kim Long Hydrological Station

Flood trace in 1999

2006 10 3

Kim Long Water level
station at 4,28m .

Flood trace in 1999 at Huong
Van in Bo river basin

The flood caused by Sangsan typhoon in 2006 in Huynh Thuc Khang str. (Hue city)

Phu Oc Station in Bo river basin in flood caused by Sangsan typhoon in 2006

- **From 22nd – 27th, May, 2007, Prof. Koike and Dr. Oliver visited Hanoi for the second time under GEOSS/AWCI to update Huong model and define strategy for future steps.**

- **We visited the Hoa Binh Dam on the Red river system**

Catchment area: 169,000 km2

Mean annual rainfall: 1200 – 5000 mm

80% of annual rainfall in May-Oct

Average discharge at Hanoi: 3700 m3/s

Maximum discharge at Hanoi (1971): 38,000 m3/s

2006/1/1 0:01

2006/1/1 0:01

Giờ	Ht	Hh	Qra
1	9148	1448	1730
4	9140	1400	1365
7	9135	1378	580
10			
13			
TB	91.92	1457	1894
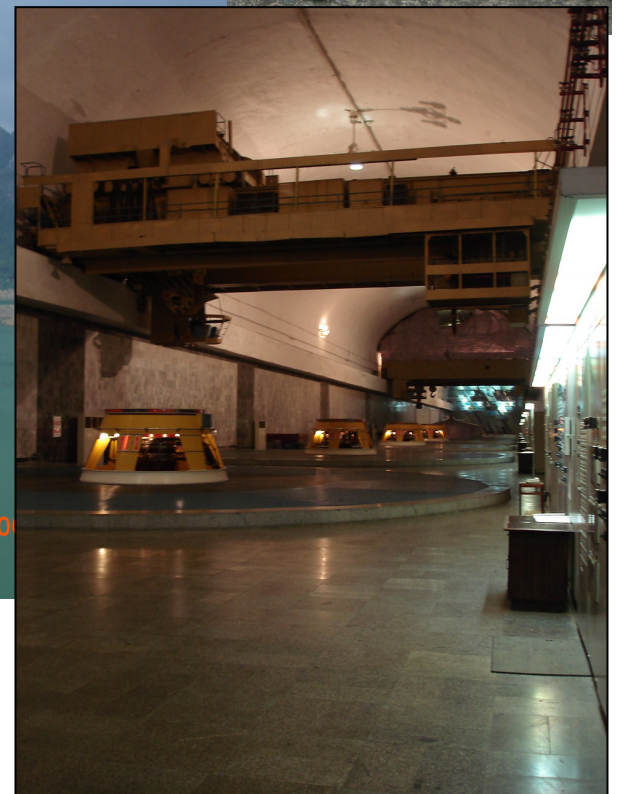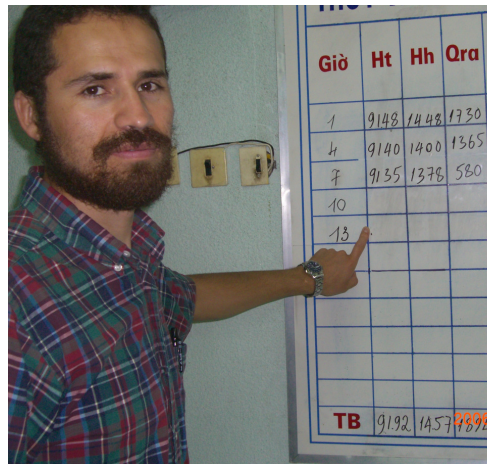
- **Total storage capacity: 9.5 billion m^3**
- **Flood control storage: 5.6 billion m^3**
- **Crest level of dam: 123 m**
- **8 turbines of 240 MW each**
- **Hydropower generating capacity: 1920 MW**
- **Average production: 7.8 billion kWh/year**
- **12 bottom sluice gates and 6 spillways**

Dr. Oliver visited and discuss at Mechanic
Institute of MOST-Vietnam - On 25th, May, 2007

- Results for application Distributed Hydrological Model for Huong river basin

- Location: 107.5-107.75E 16.0-16.5 N
- Simulated area: 1500 km^2 down to Kim Long
- Computing Grid: 500 m
- Target event: 22-26 Nov 2004
- Input Rainfall:
  - Observed
    - Rain gauge network (daily)
    - Global Satellite TRRM, 3hr, 0.25°
  - Forecast
    - Meso- scale HRM: at hydro-met. stations (24 hr lead time)
    - Global JMA/GPV, 24 hr lead time issued every 12 hours
    - NWPO: UKMO, NCEP
  - Assimilated
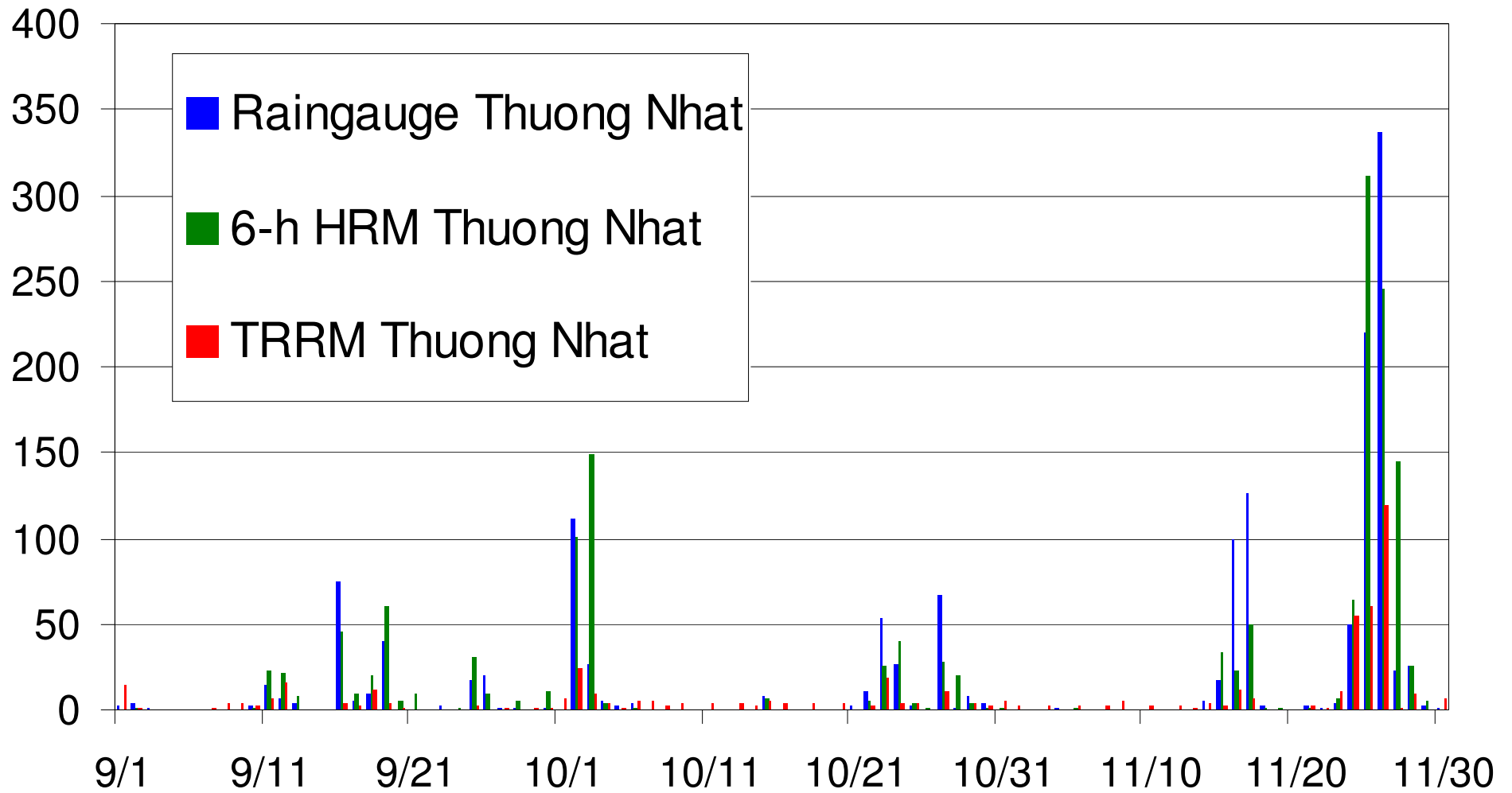   - Clouds microphysics ARPS, IMDAS
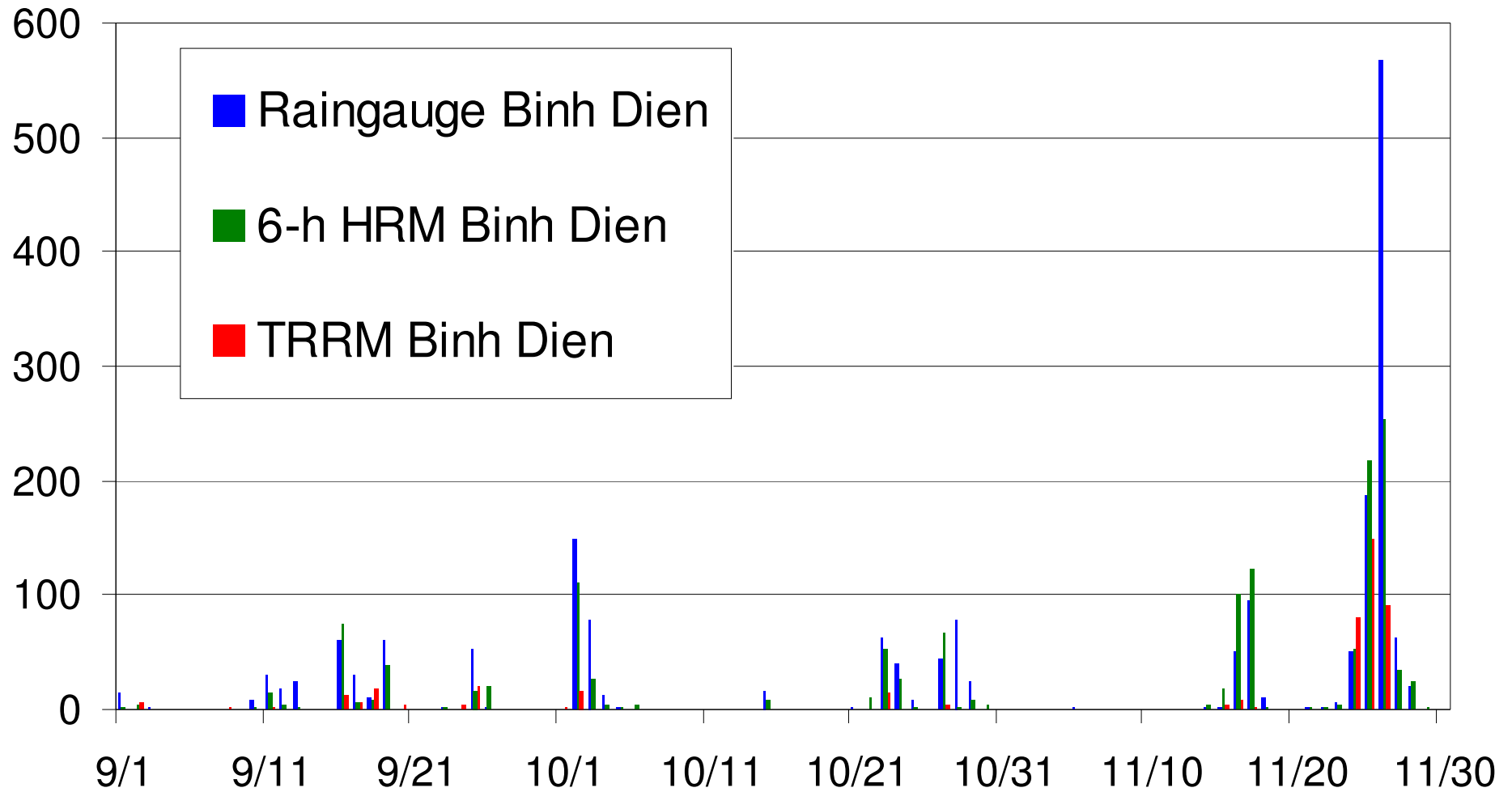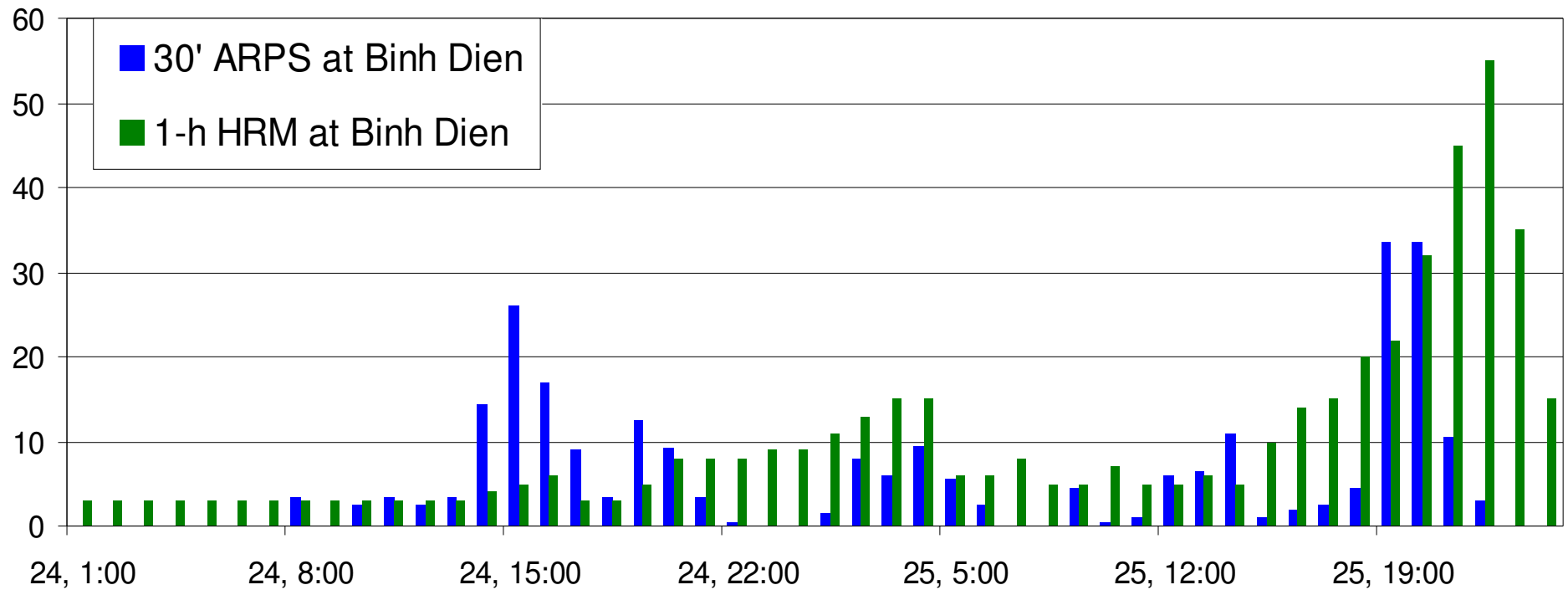
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Huong River Basin
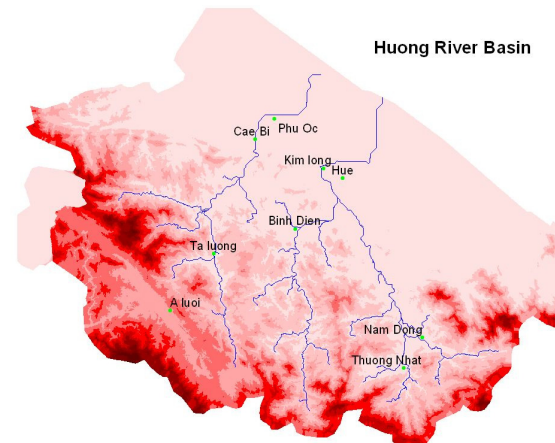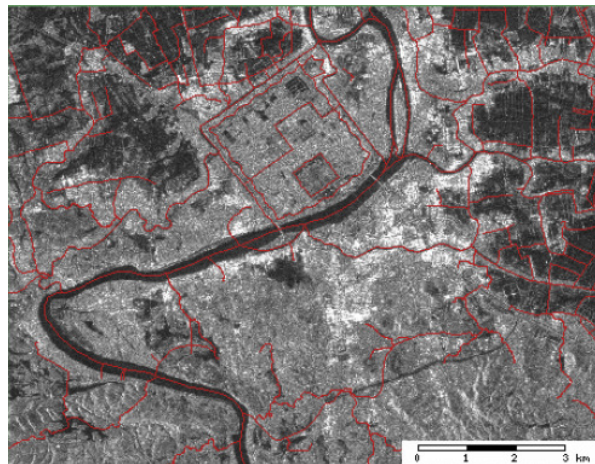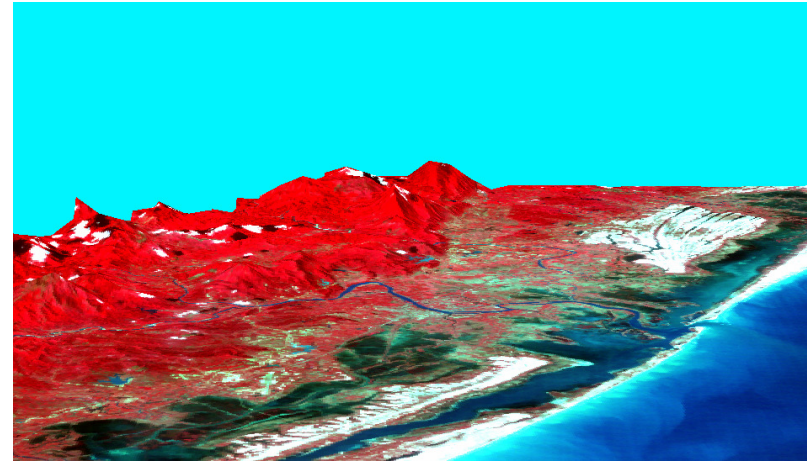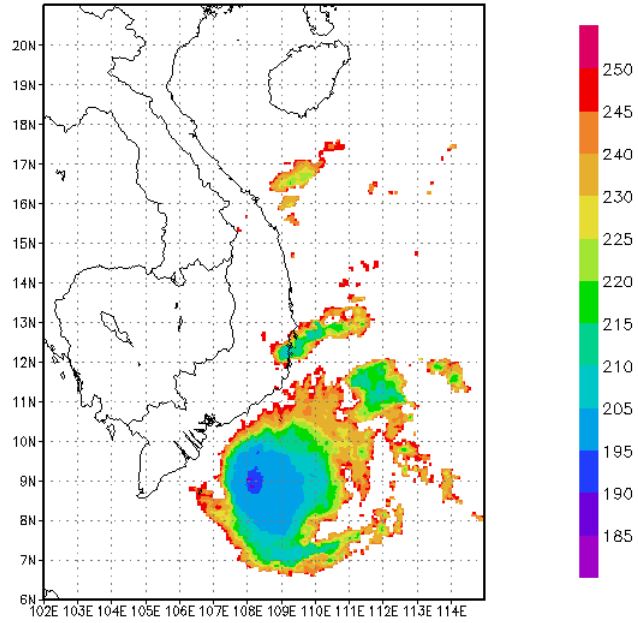
Daily rainfall comparison at Thuong Nhat

Daily rainfall comparison
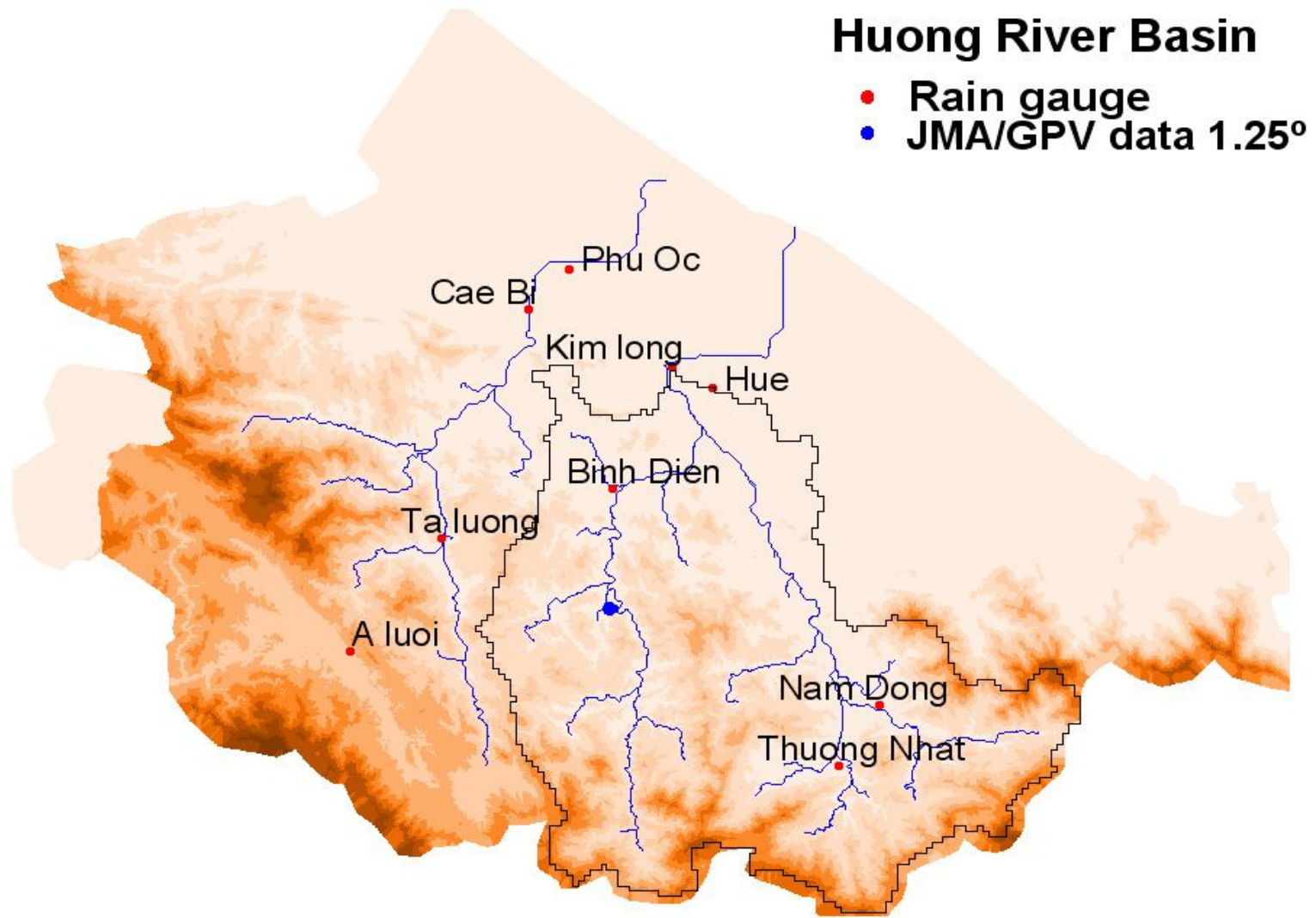at Binh Dien

Hourly rainfall comparison at Binh Dien

- 30' ARPS at Binh Dien
- 1-h HRM at Binh Dien

Spatial distribution of TRRM

Huong River Basin
- Rain gauge
- TRRM data 0.25°

Phu Oc
Cae Bi
Kim long
Hue
Binh Dien
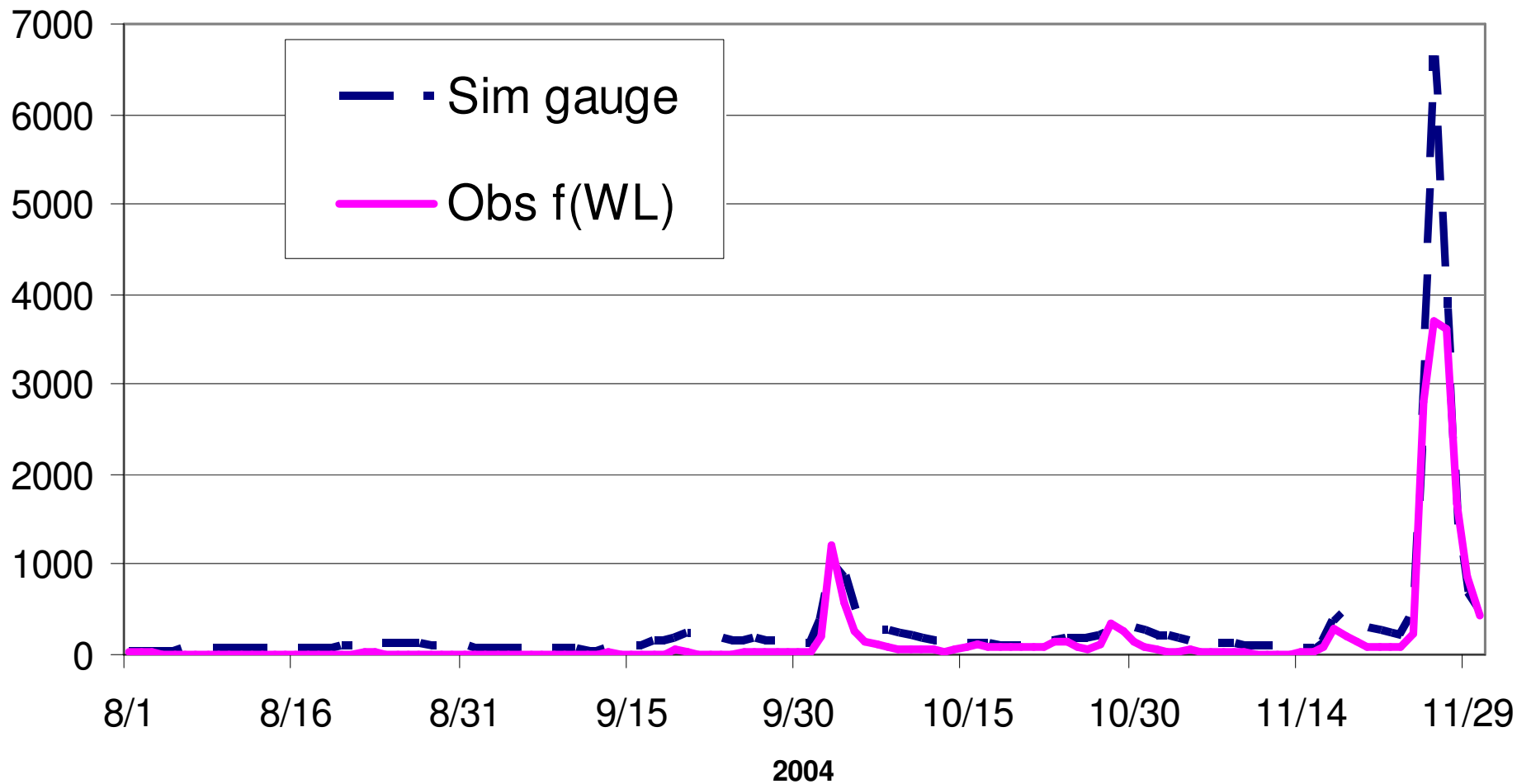Ta luong
A luoi
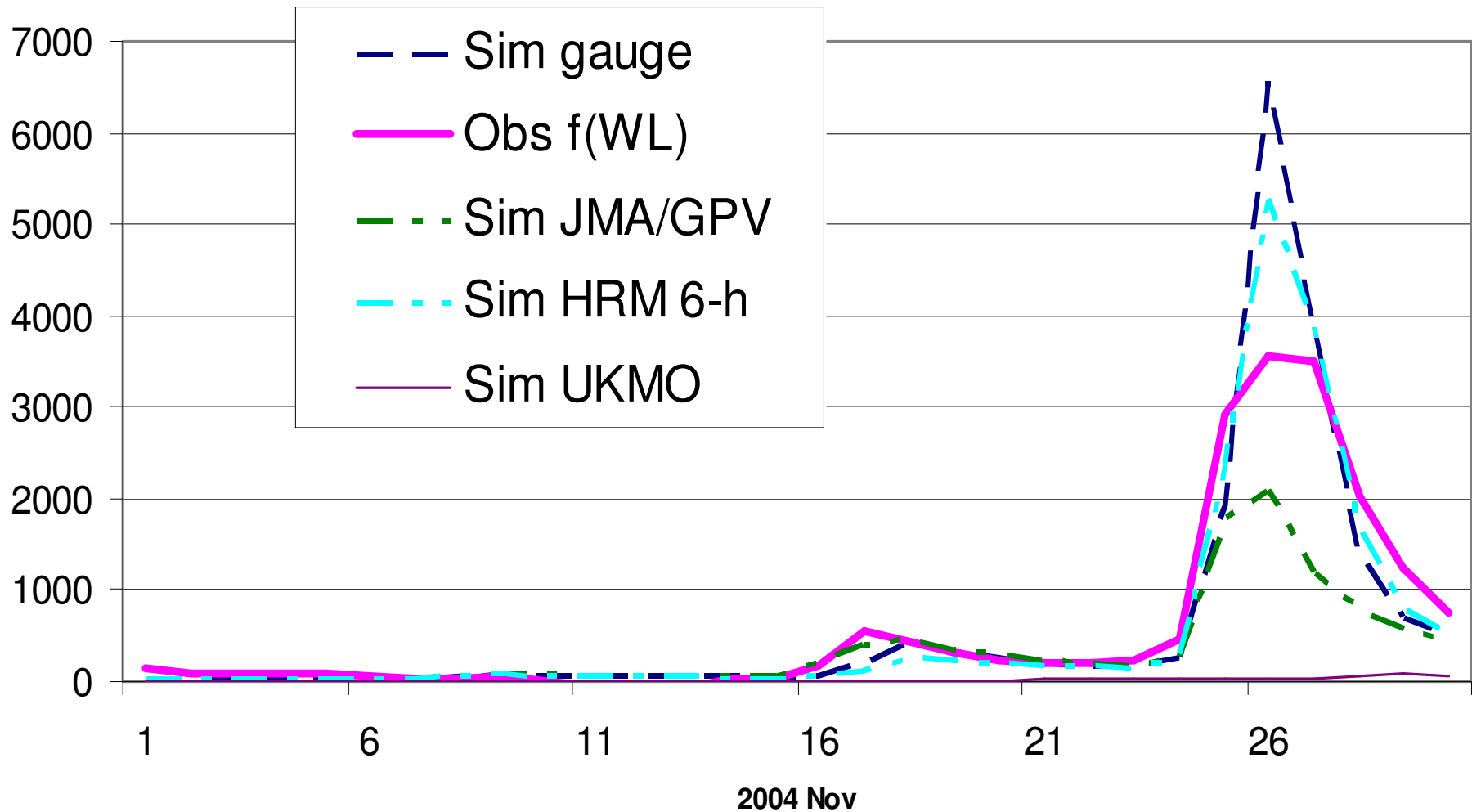Nam Dong
Thuong Nhat
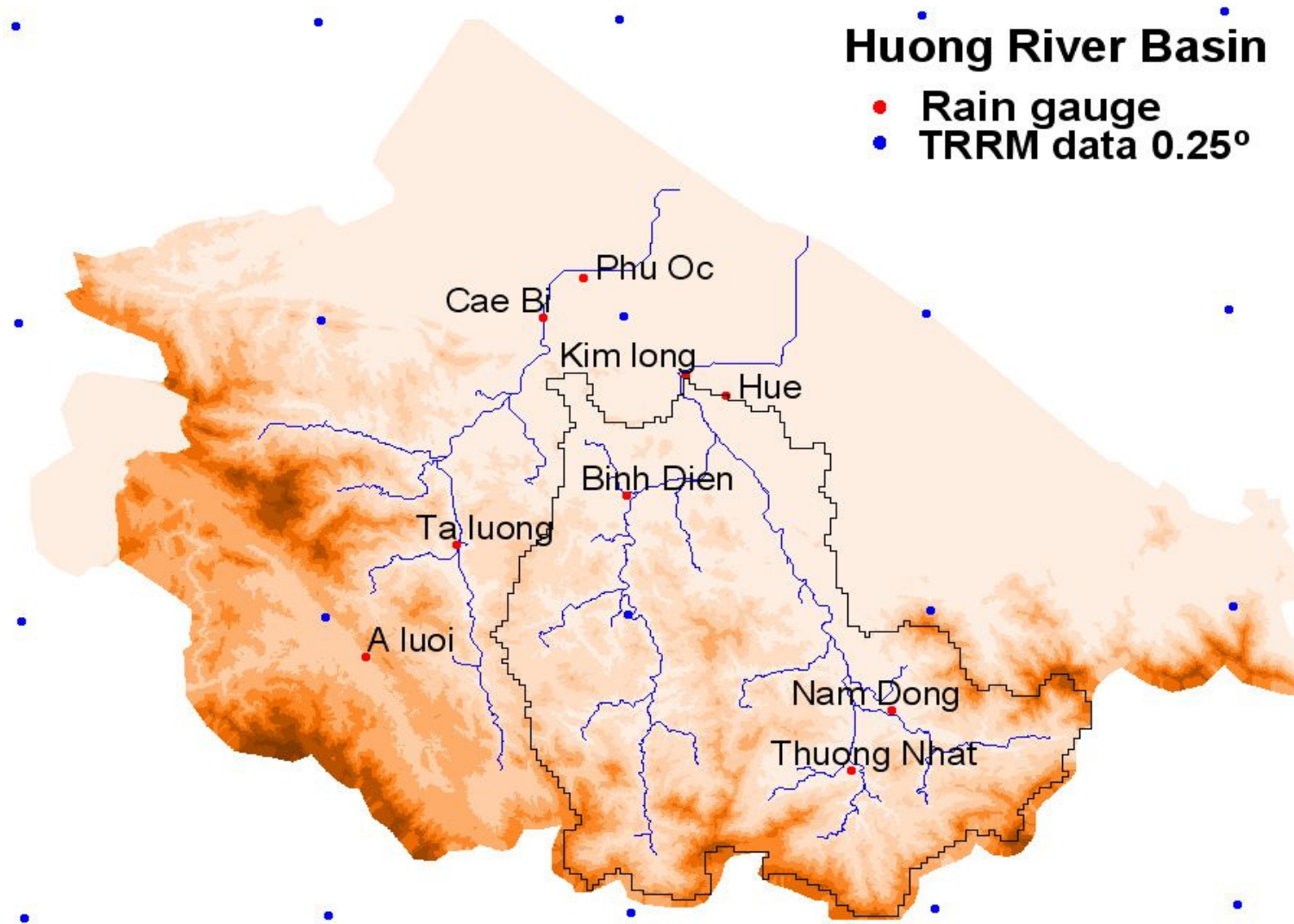
Spatial distribution of JMA/GPV

August to November Simulation

Daily simulation at Kim Long

November Simulation

Daily simulation at Kim Long

24-30 November Simulation

Daily simulation at Kim Long

Legend:
- Sim gauge
- Obs f(WL)
- Sim JMA/GPV
- Sim HRM 6-h
- Sim UKMO

2004 Nov
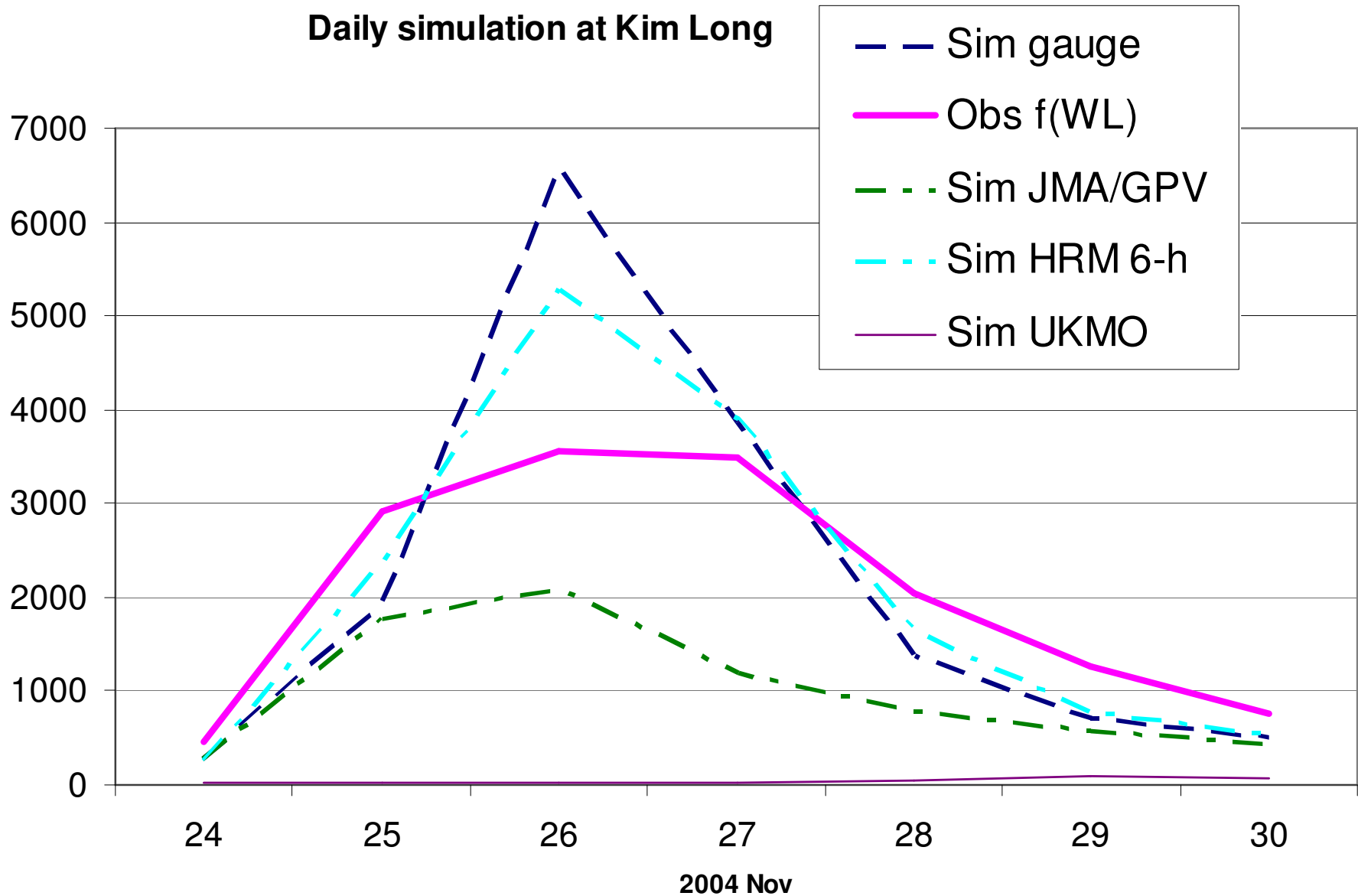
Some proposals

- Calibration of DHM using observed rainfall at flood events with peaks around 4000m^3/s

- Spatial correlation of overflow to water level inundation

- Couple DHM with optimization scheme for Flood warning levels

- Include hourly radar data for calibration with rain gauge

In AWCI framework, It is very necessary to Organize GBHM training course in Vietnam for improvement the skill, Knowledge in building the input data for modeling:

The content of the training course: How to apply the GBHM for any river basin: skill, Knowledge in building the input data for modeling: DEM, land use, soil type, geological maps, how to delineate the watershed, divide the basin to sub-basins, set-up spatial distribution of study area, prepare time series data: rain gauge and interpreted radar products.

Need to modify, simplify and build the menu of GBHM for model application easily

- **Need to develop the capacity on data acquisition, information extraction and end user product generation for flood analyses and risk reduction for all of the developing countries in Asia.**

- **High resolution satellite data are important for flood damage reduction and risk management, need to make such basic data easily accessible and available on a basin scale . These data can be utilized for disaster management purposes especially rainfall and flood inundation in real time, for preparing existing infrastructures inventories, especially, in high risk areas, for the implementation of flood forecasting and warning system in ungauged or poorly-gauged river basins.**