FY2013 Precipitation Measuring Mission (PMM) Meeting
January 16, 2014, at Tokyo

Validation and application of GSMaP and GPM data for mitigating impact of water related disasters in Vietnam

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Project Background

Vietnam is stretching north-south elongated direction over the Indochina Peninsular facing the South China Sea to the east with rather complicated topography in the west. These geographical conditions generate unique climatic characteristics, for example, heavy rainfall in late autumn to early winter related with the Asian winter monsoon. The research interest for the winter monsoon related rainfall has been increased recently, specifically in Central Vietnam where severe flood disasters frequently occur due to heavy rainfall events. Under the future climate changes, it is expected that heavy rainfall events will be increased in term of intensity and frequency. In order to mitigate induced disasters, accurate prediction/projection of heavy rainfall is strongly requested from Vietnamese society.

Precipitation in NE monsoon season

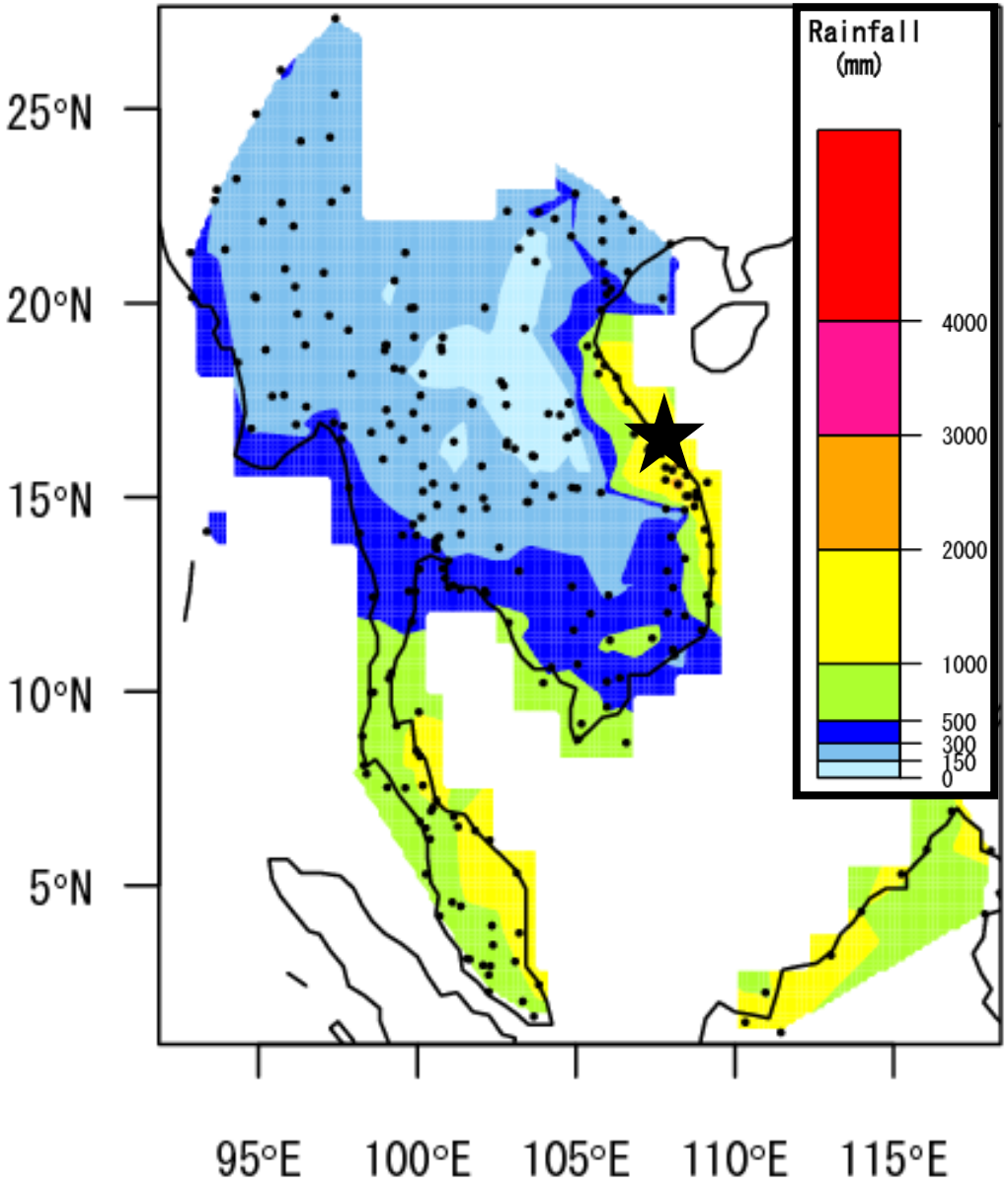


Fig. 1 Mean precipitation distribution in the Indochina Peninsula (9/28-12/31)

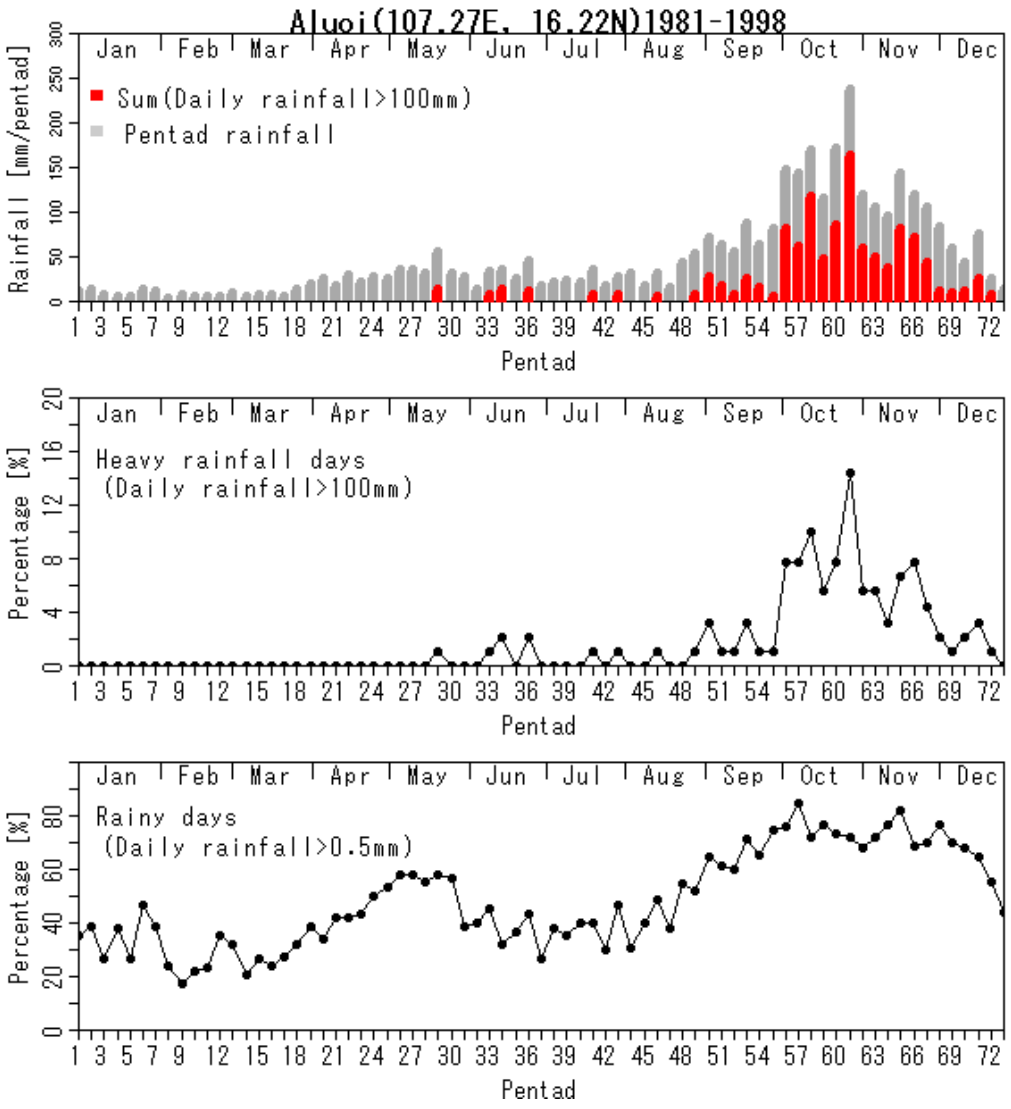
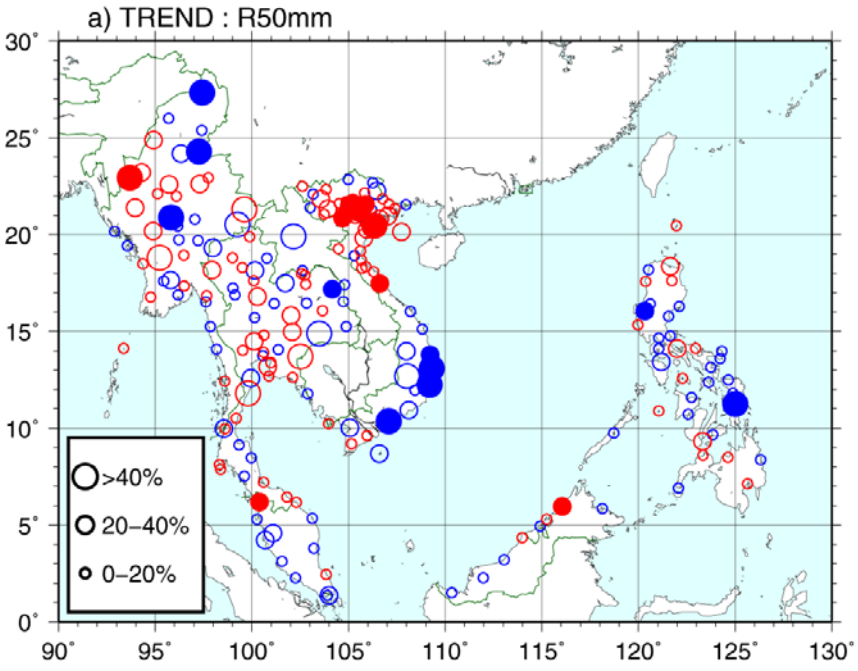
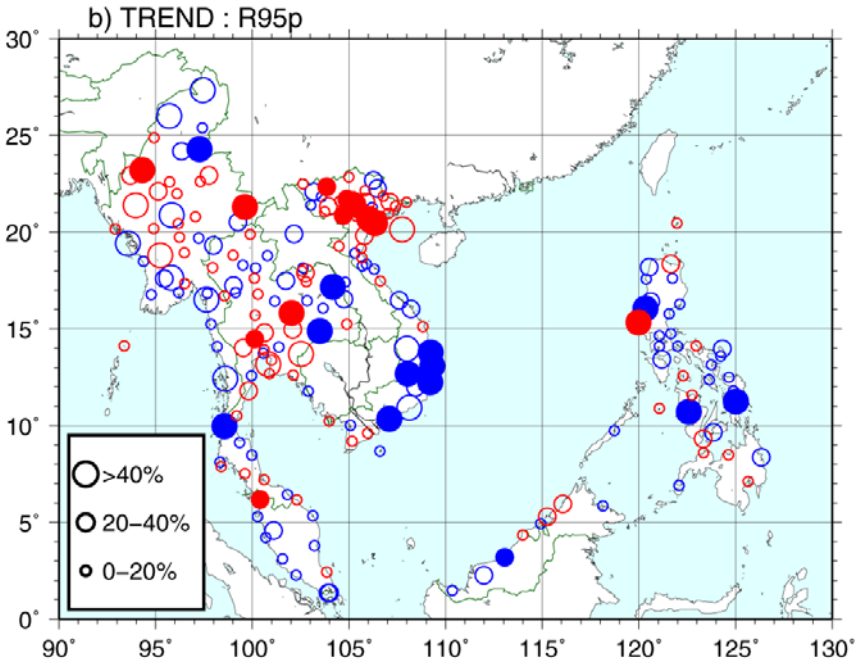
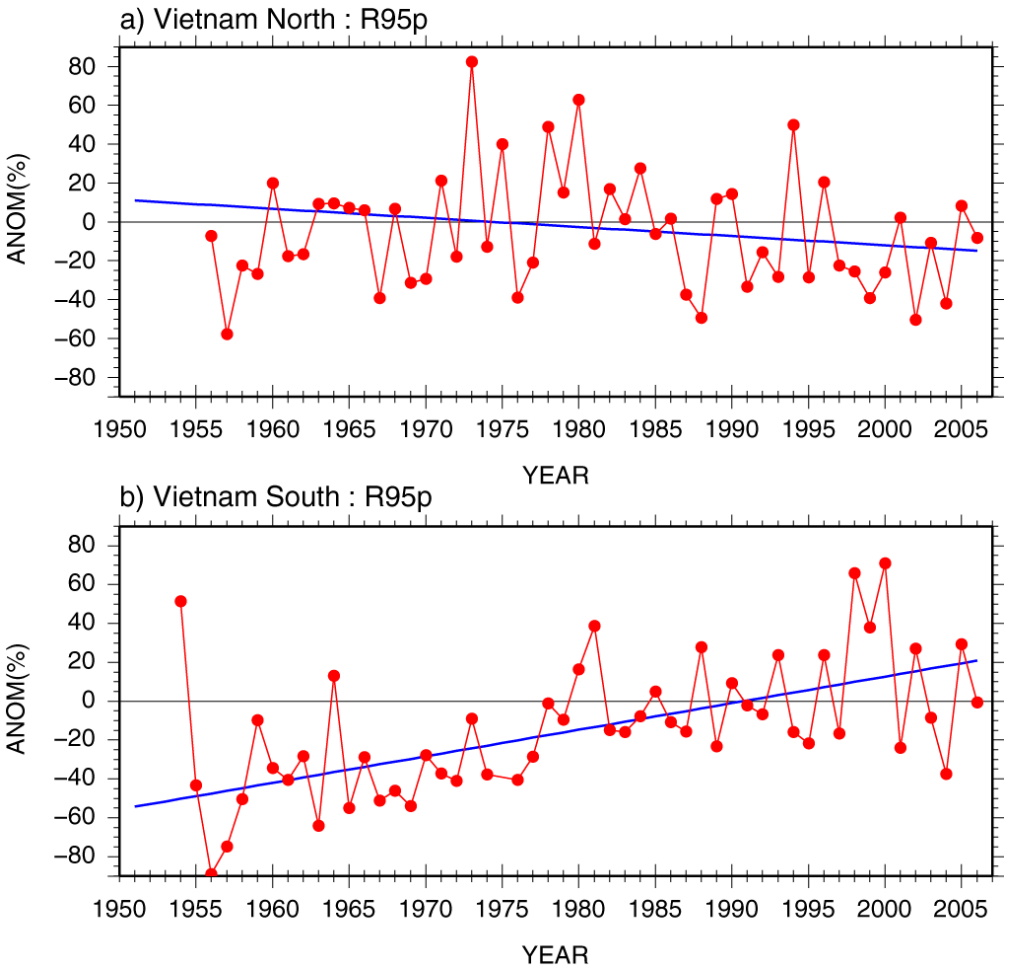


Fig. 2 Pentad mean precipitation (top), heavy rainfall days (daily rainfall > 100 mm, middle) and number of rainy days (daily precip. > 0.5 mm, bottom) at Aluoi in central Vietnam

Our previous study using rain-gauge information in Vietnam







Decreasing trend in North Vietnam
Increasing trend in South Vietnam

❖ **57 stations in Vietnam**

Endo et al. (2009: SOLA)

Objectives

Collaborative researches will be conducted with the Vietnamese National Hydrometeorological Service (VNHMS) and National Hanoi Science University (HUS) in order to better understand the precipitation characteristics by utilizing both satellite and ground based data. The goal of the project is to adjust and apply satellite rainfall data for operational hydrological purposes in order to forecast and mitigate the impact of water related disasters in Vietnam.

Methods

1. First, rainfall distribution by GSMaP and GPM datasets will be validated in Vietnam by comparing them with surface raingauge data and radar data, and the problem of these dataset will be detected. In particular, North and Central Vietnam will be targeted for the detailed study.
2. Second, the satellite rainfall data will be adjusted in order to properly use for other purposes such as operational-hydrological forecasting. A bias correction method will be developed at basin scale and independent validations of the method will be conducted.
3. Finally, an operational system for hydrological forecasting purposes will be developed. Adjusted satellite rainfall will be used as input for hydrological models in near real-time basis.

Hydrological Research Letters **7**(4), 85–90 (2013)
Published online in J-STAGE (www.jstage.jst.go.jp/browse/hrl). doi: 10.3178/hrl.7.85

Monthly adjustment of Global Satellite Mapping of Precipitation (GSMaP) data over the VuGia–ThuBon River Basin in Central Vietnam using an artificial neural network

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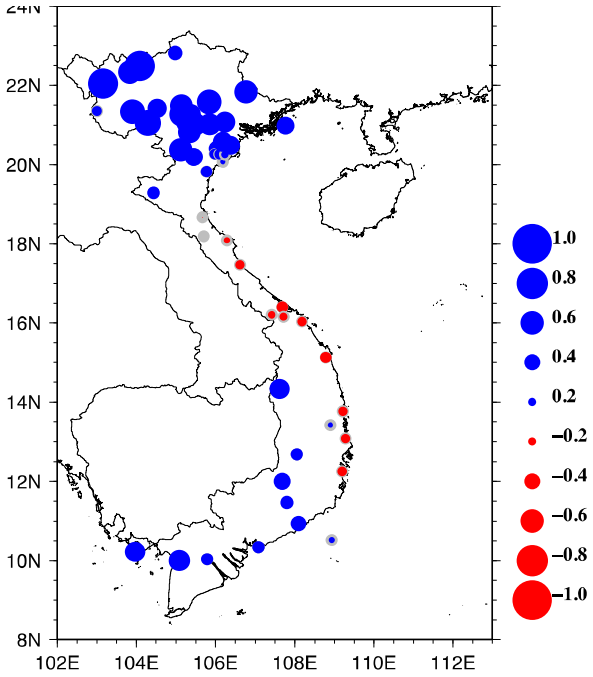
[4]*International Centre for Water Hazard and Risk Management (ICHARM), Japan*

- **GSMaP_MVK** data, version 5.222.1, available in August 2012, **0.1 degree** and a temporal resolution of **1 hour** (8N-24N, 102E-112E)

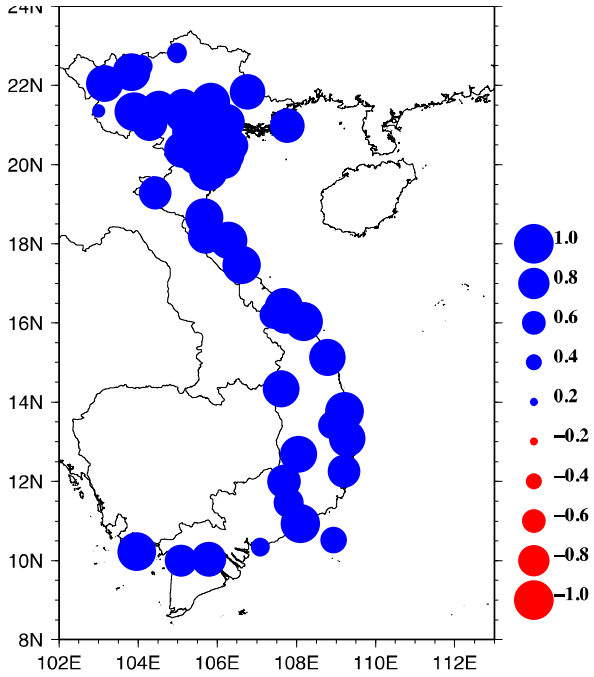
- **For validation and comparison with APHRODITE (2001-2007)**

Correlation of the 2001-2007 monthly data

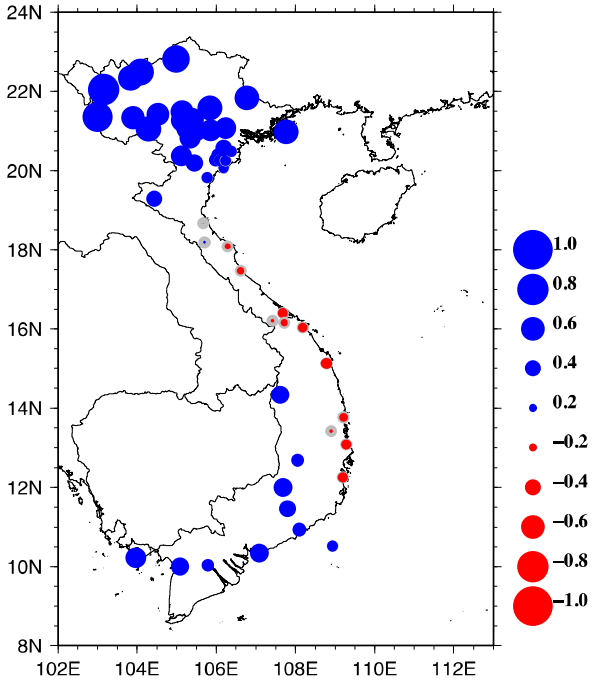
GSMaP & OBS



APHRO & OBS

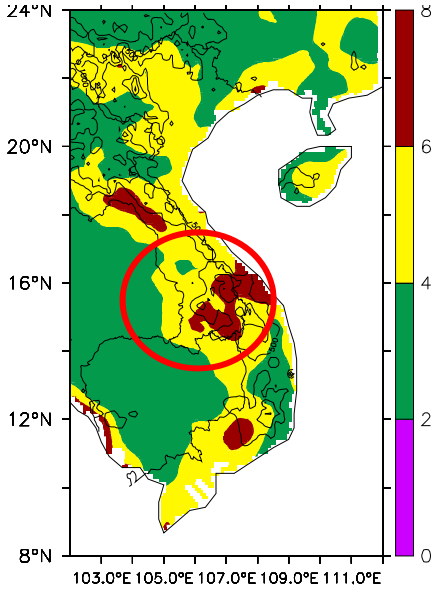


GSMaP & APHRO

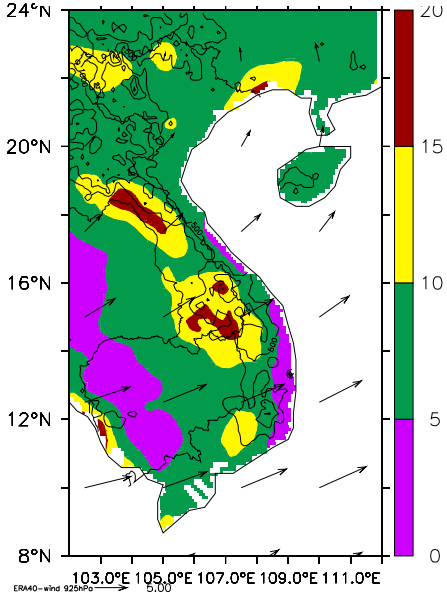


- the correlation between GSMaP and OBS is ~[-0.3,0.6], which is significantly lower than [0.7,0.9] of APHRODITE
- low quality of GSMaP in the coastal zone of the Central Vietnam

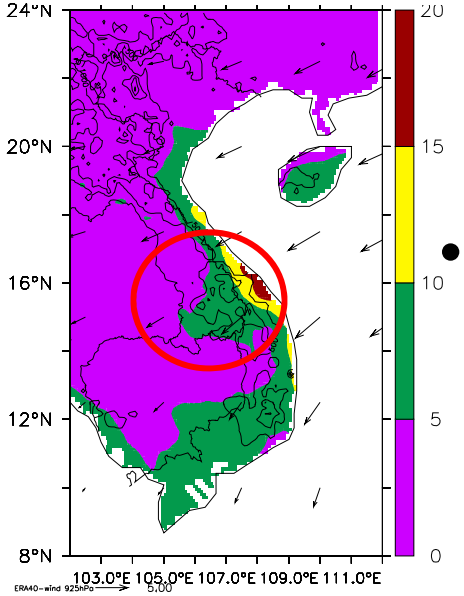
APHRO, annual



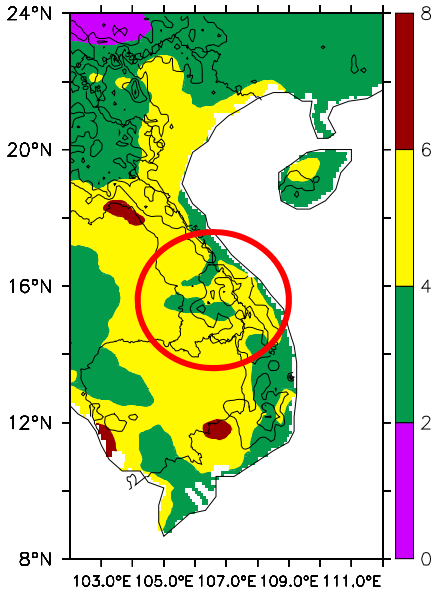
APHRO, JJA



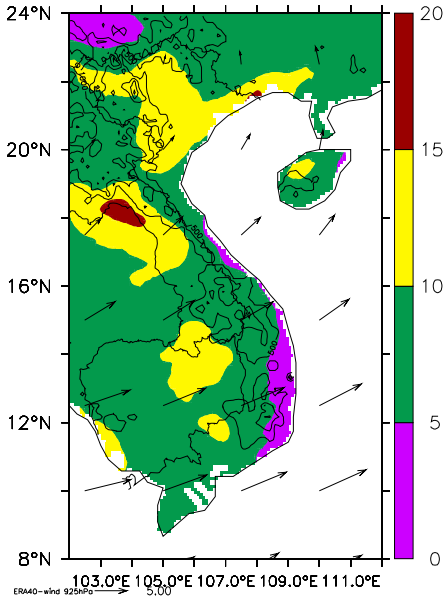
APHRO, SON



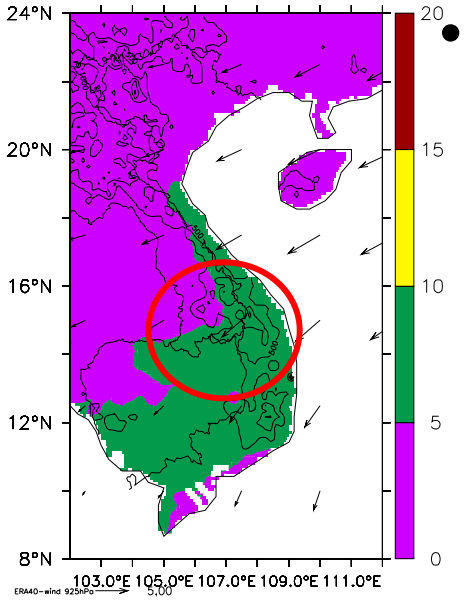
GSMAP, annual



GSMAP, JJA



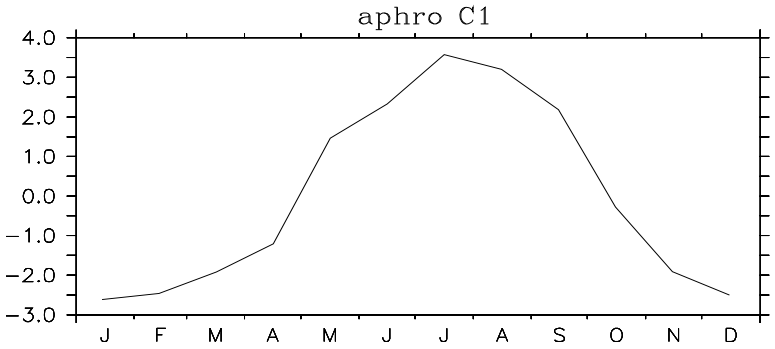
GSMAP, SON

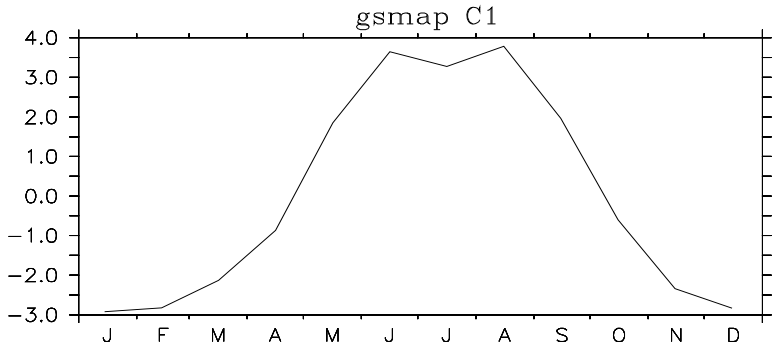


2001-2007 average

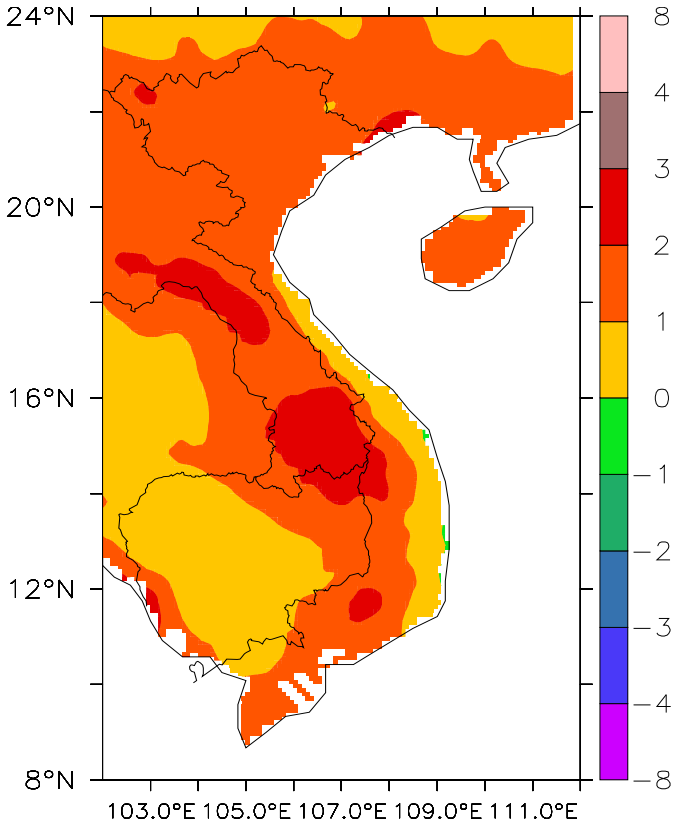
- Topographic effects: more precipitation in the windward side of the mountain range
- Large difference over **the VuGia-ThuBon River basin**

EOF analysis of land-rainfall for the 2001-2007 monthly climatology

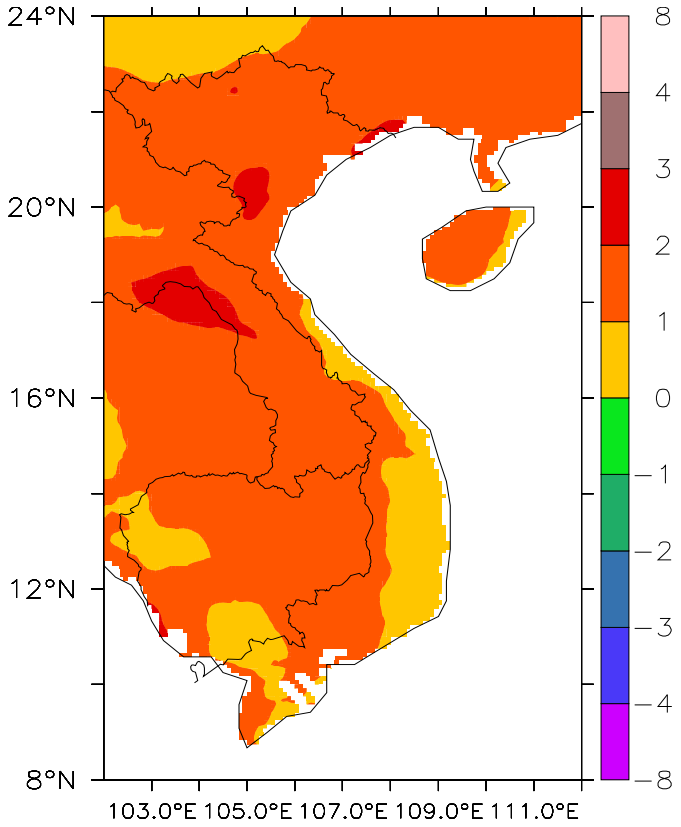




APHRODITE EOF1, 79.1%



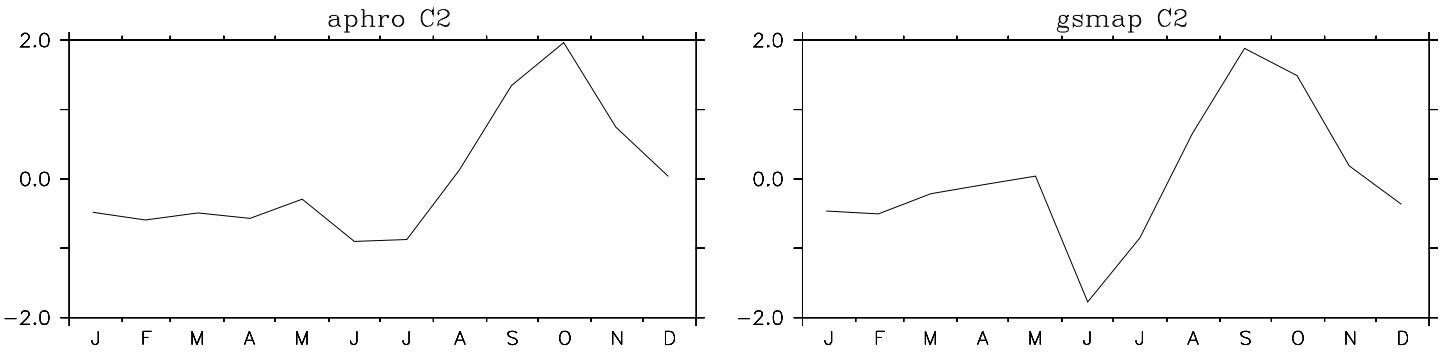
GSMaP EOF1, 83.95%



May-October regime (summer monsoon) in northern and southern Vietnam

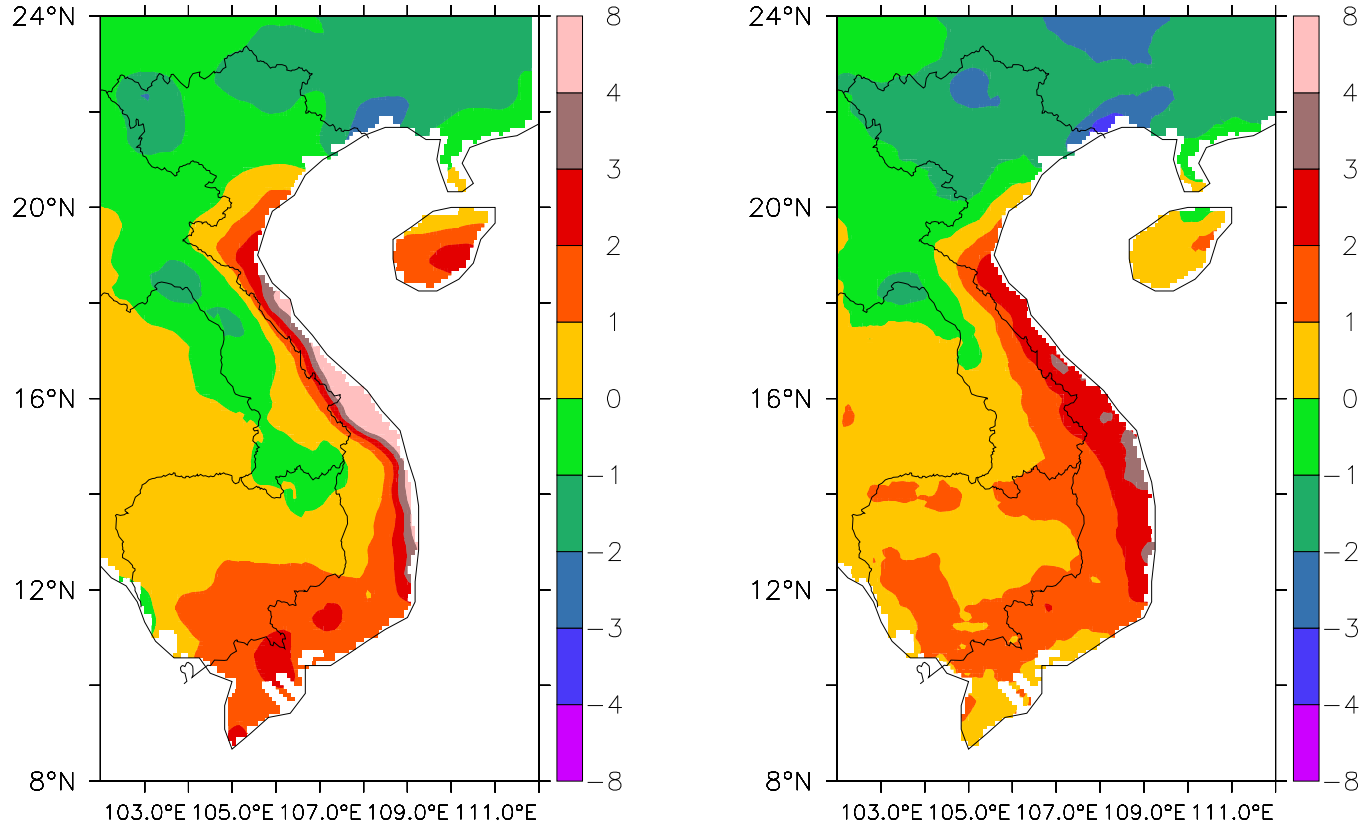
In agreement with Yen et al., 2011

EOF analysis of land-rainfall for the 2001-2007 monthly climatology



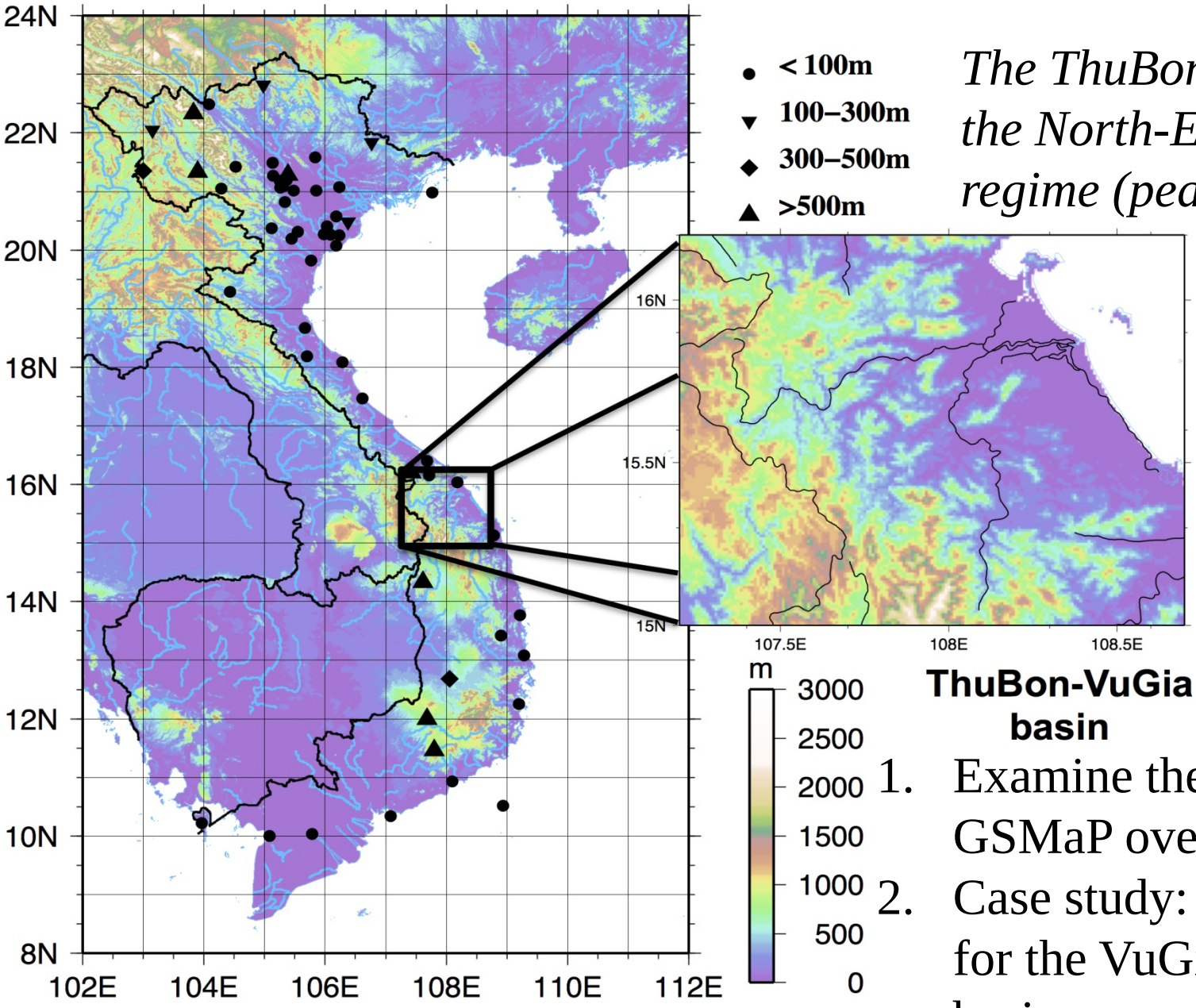
APHRODITE EOF2, 11.31%

GSMaP EOF2, 11.12%



September-November regime (winter monsoon) in Central Vietnam

Region of interest

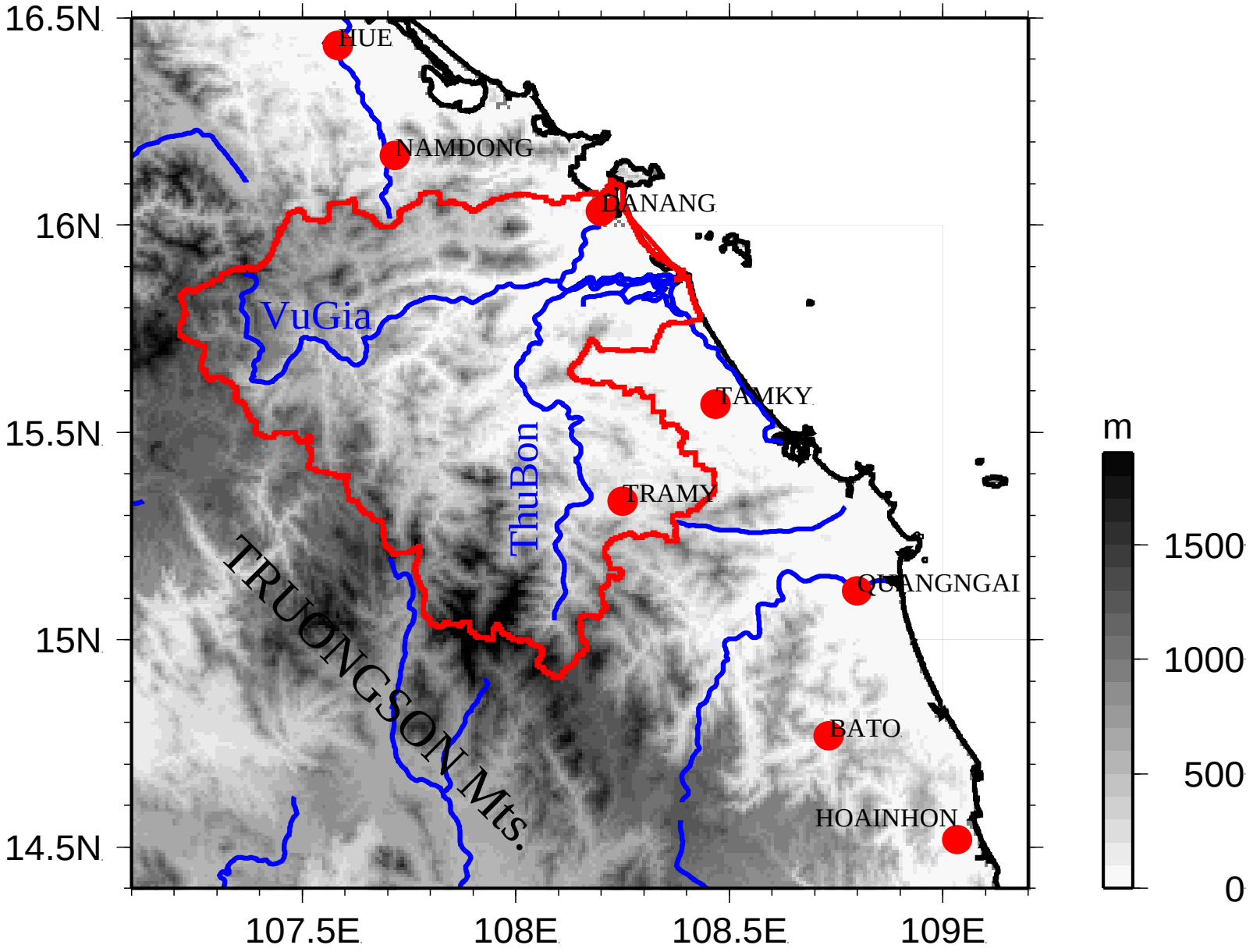


The ThuBon-VuGia basin has the North-East monsoon regime (peak in SOND)

1. Examine the performance of GSMaP over Vietnam
2. Case study: GSMaP adjustment for the VuGia-ThuBon river basin

(Ngo-Duc et al., 2013,Hydro. Res. Lett.)

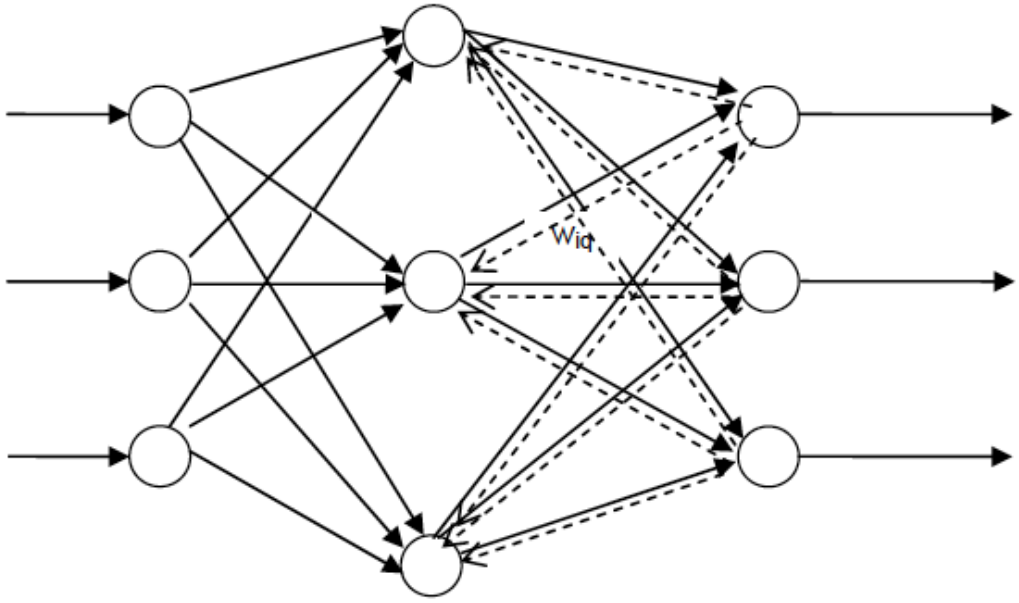
Case study for the VuGia – ThuBon river basin



- Topography of the VuGia–ThuBon River basin (red boundary) and surrounding areas. Locations of eight meteorological stations are indicated by red circles.

Artificial Neutral network technique for GSMaP adjustment

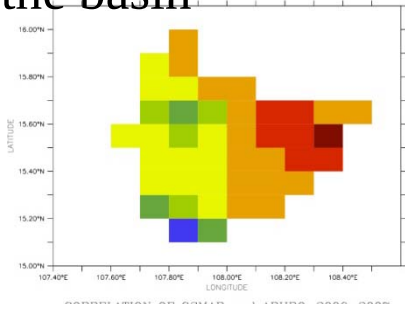
- Feed-forward multi-layer structure
  1 input, 1 hidden, & 1 output layers



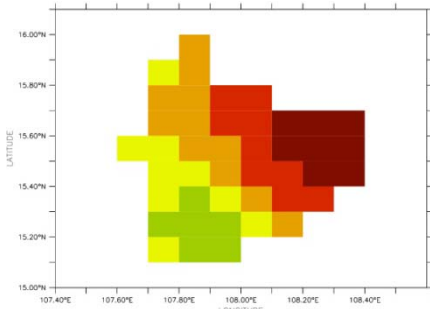
Input Hidden Output

- Training period: 2001-2005
- Testing period: 2006-2007
- Weight coeffs are estimated for each month

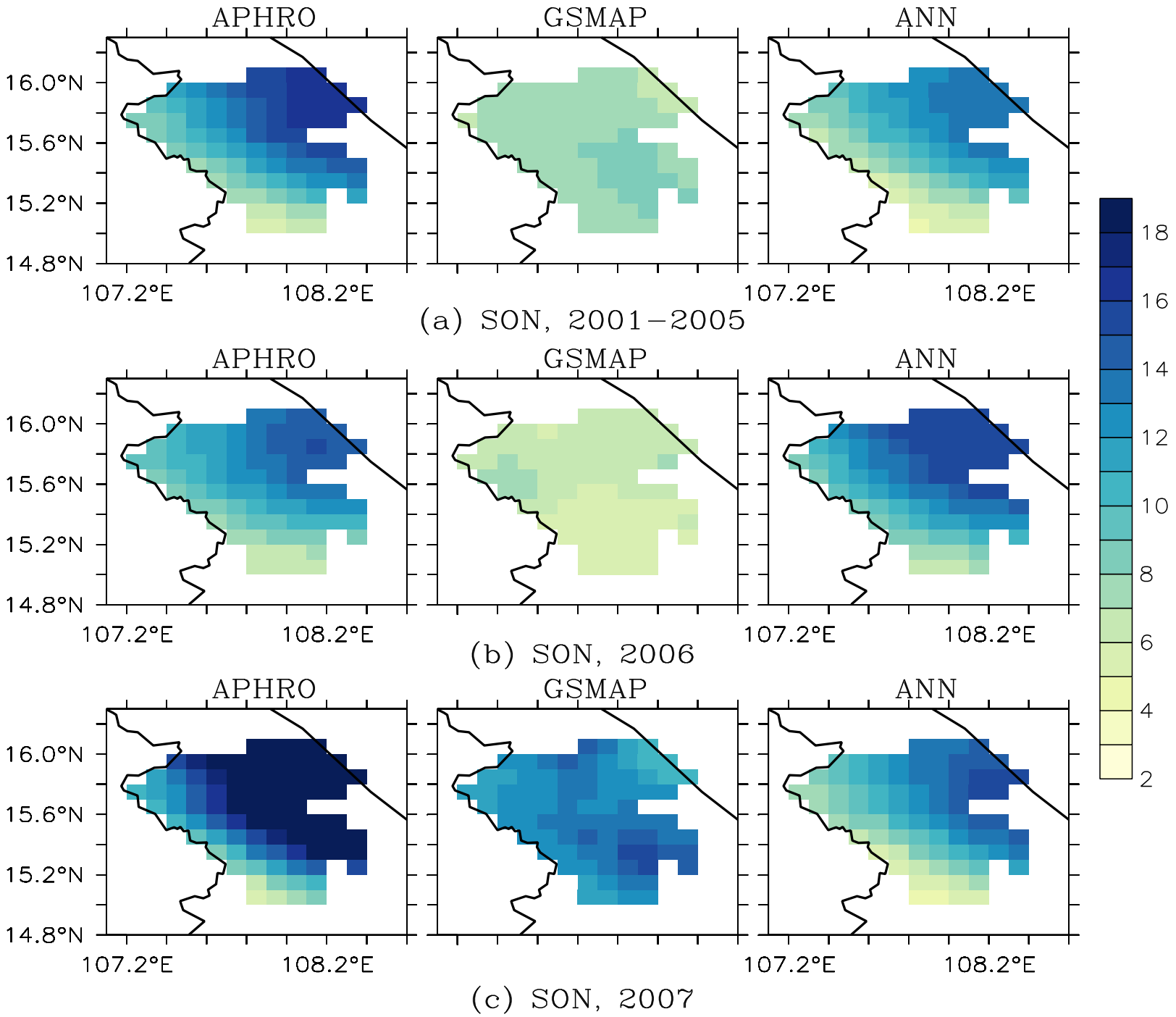
Monthly data, 44 points x 5 years over the basin



Monthly data, 44 x 5 years points over the basin



Average SON precipitation (mm/day)

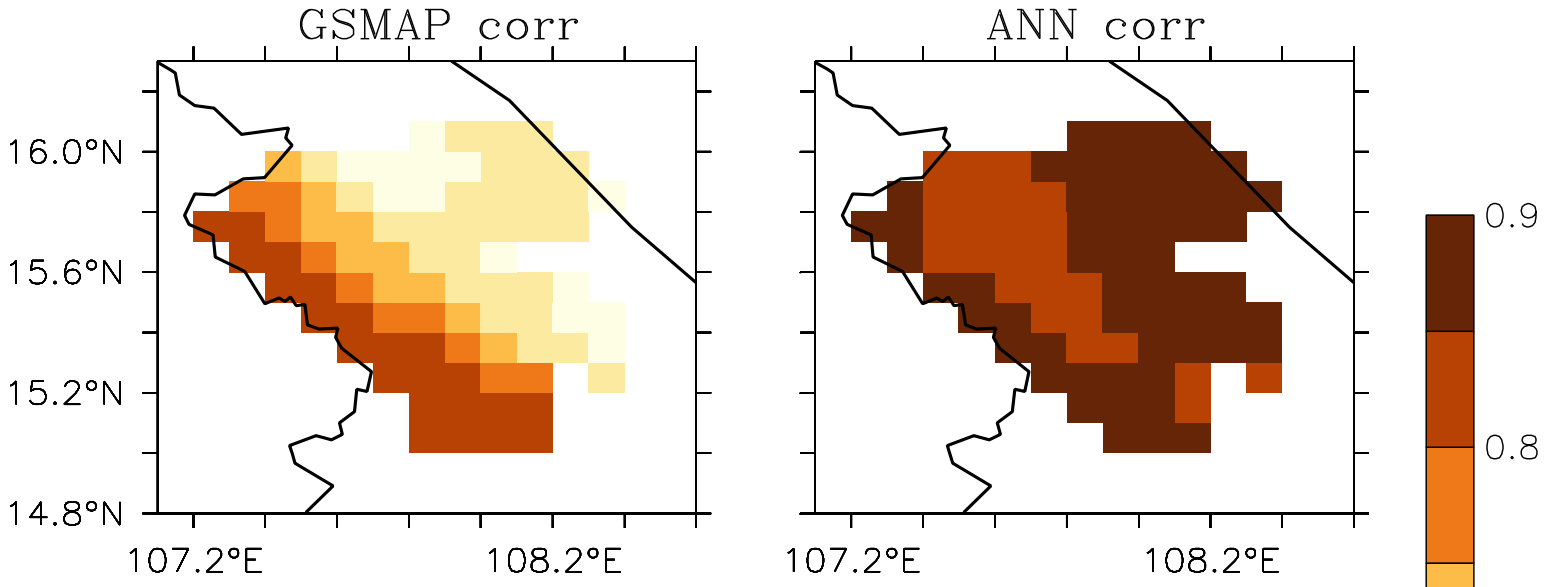


Dependent period 2001-2005

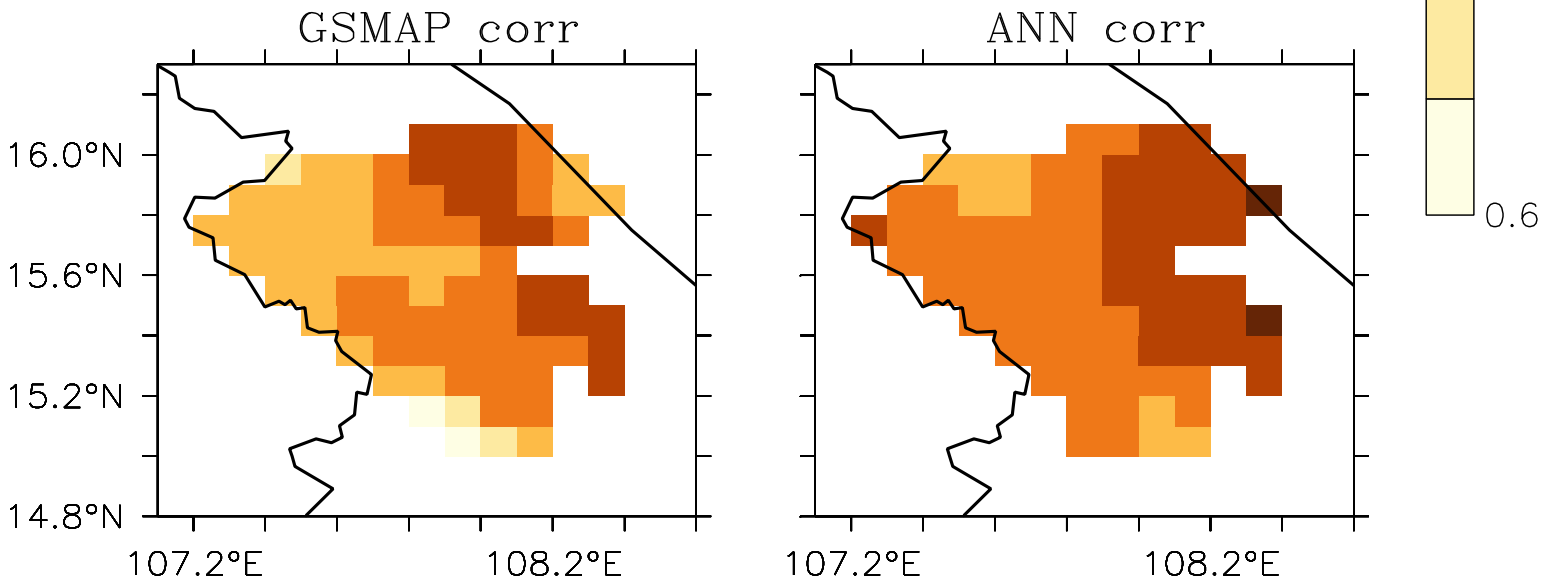
Independent year: 2006

Independent year: 2007

Correlation of the monthly APHRODITE with GSMaP_MVK and the ANN products



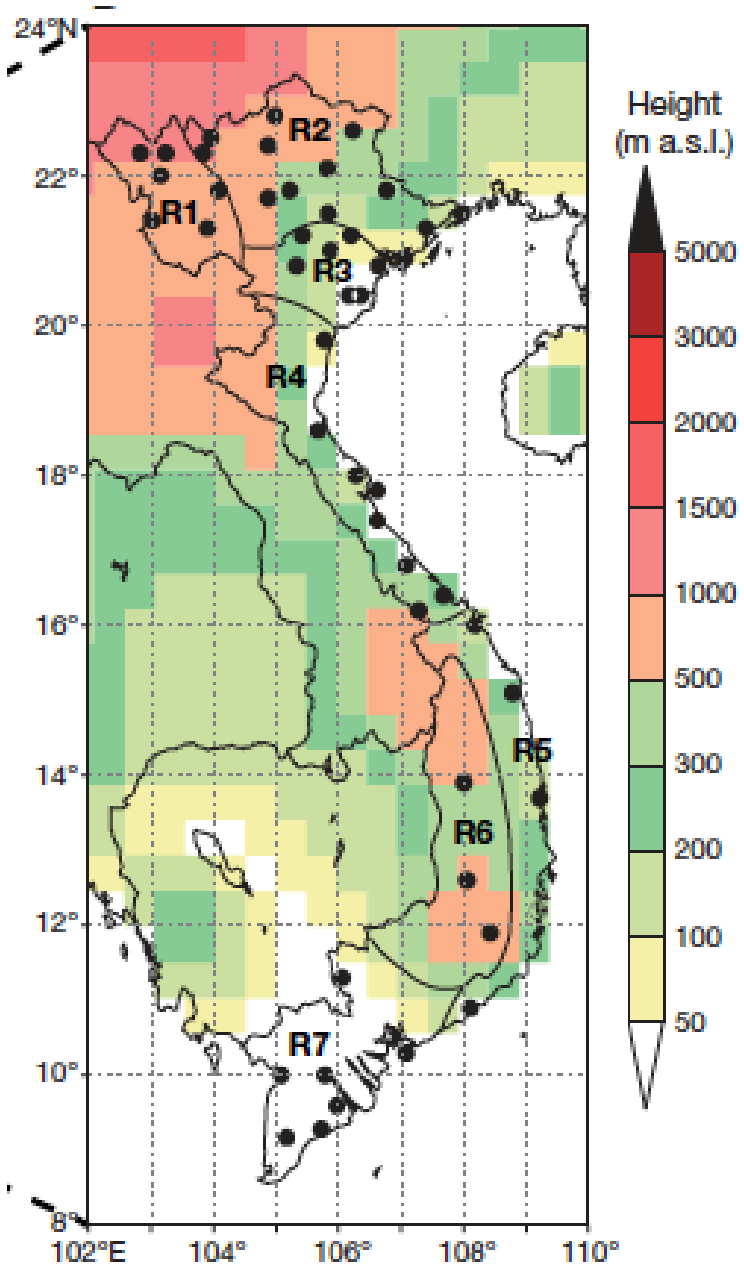
(a) Dependent period of 2001–2005



(b) Independent period of 2006–2007

the dependent period: 2001–2005

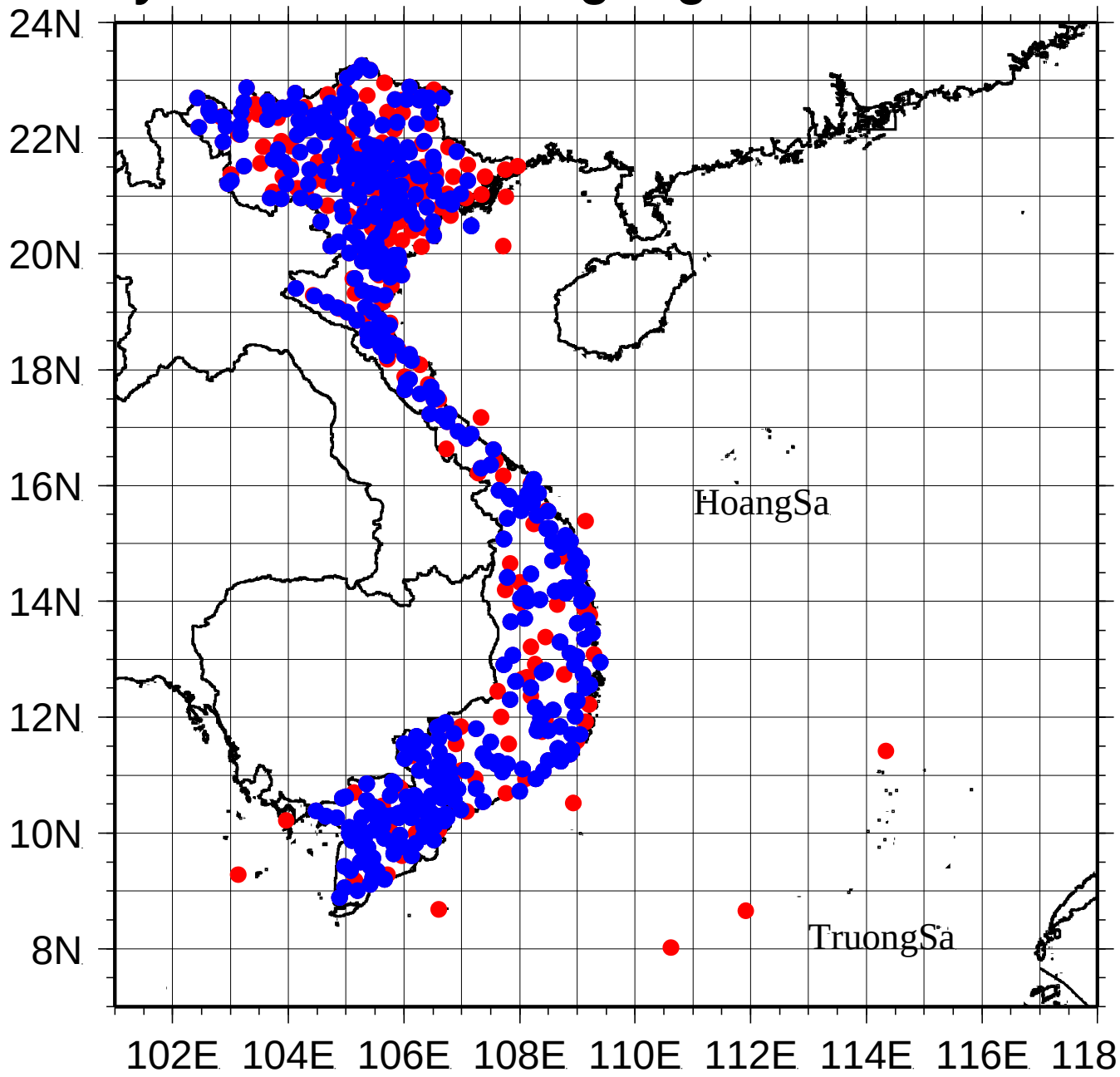
the independent period 2006–2007.



In the previous papers:

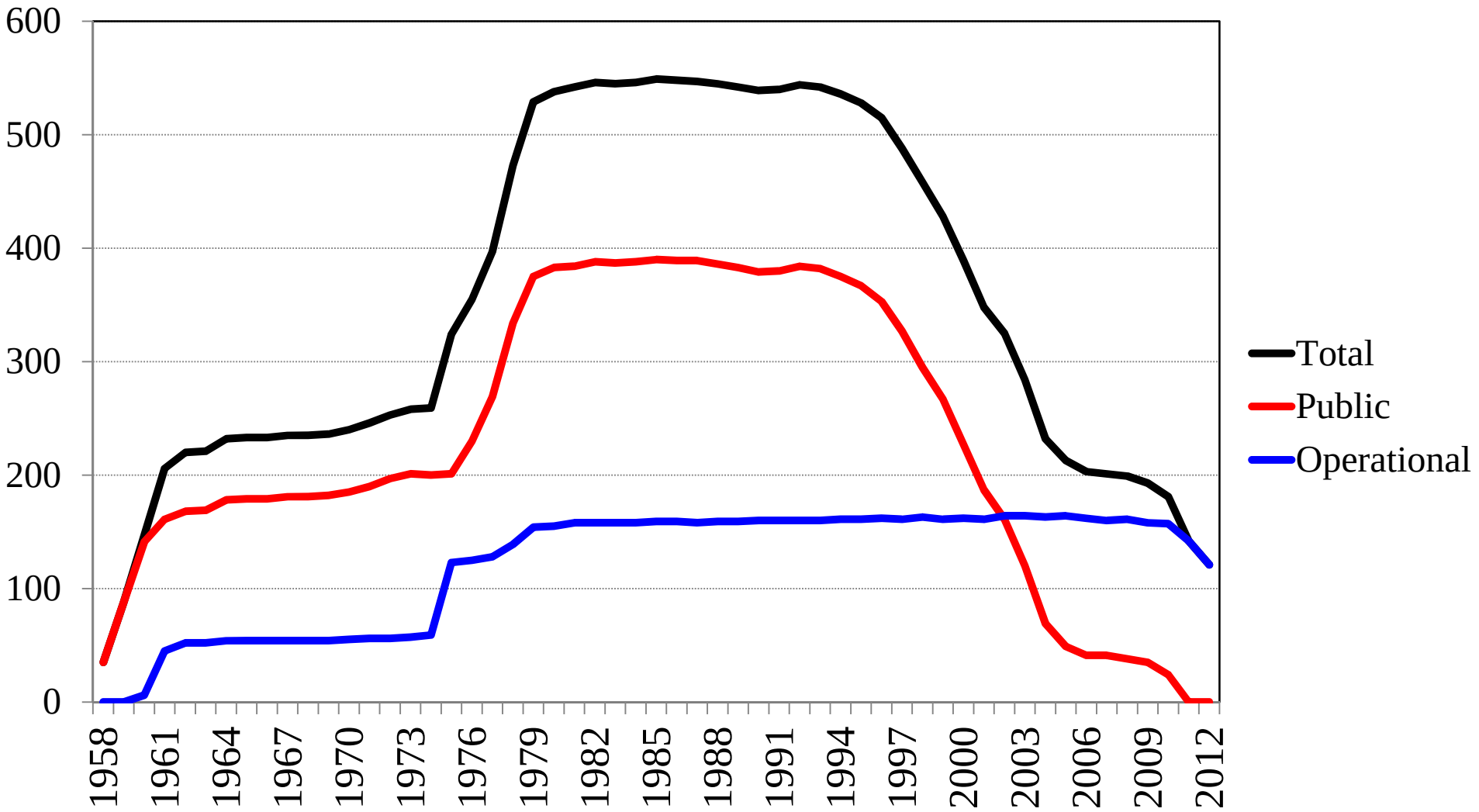
- Vu-Thanh et al. 2013, TAC ***(past droughts)***: **50 stations**
- Nguyen-Le et al. 2013, Int. J. Climatol. ***(monsoon onset)***: **54 stations**
- Nguyen-Thi, et al., 2012, SOLA ***(tropical cyclone rainfall)***: **16 coastal stations**
- Phan et al, 2009, Clim. Res. ***(Verification of RegCM3 for Vietnam)***: **58 stations**

Recently available: Rain-gauges in Vietnam



- **615 rainfall stations**, among them there are 435 public rain-gauges.
- Daily data from 1958-2012

Number of rain-gauges stations in Vietnam



Former results

- GSMaP_MVK represents reasonably well the two main seasonal rainfall regimes in the whole Vietnam
- Low quality of GSMaP over Central Vietnam region, in particular, in coastal mountainous regions.
- ANN technique is promising for adjusting GSMaP in monthly time-scale.
- New rain-gauge dataset in Vietnam has been available (615 stations, 1958-2012), but its quality need to be checked and improved.

Project activities

(1) Analyses of further GSMaP data (GSMaP_Gauge)

(2) Construction and analysis of rain gauge-based data

(3) Apply satellite rainfall adjustment

(4) Analyses and evaluation of GPM data

(5) Application of GPM data for hydrological-operational purpose

For various time-scales and various regions in Vietnam.