High-resolution Climate Information for the Vu Gia-Thu Bon River Basin (1961-2050) for Climate Impact Modelers

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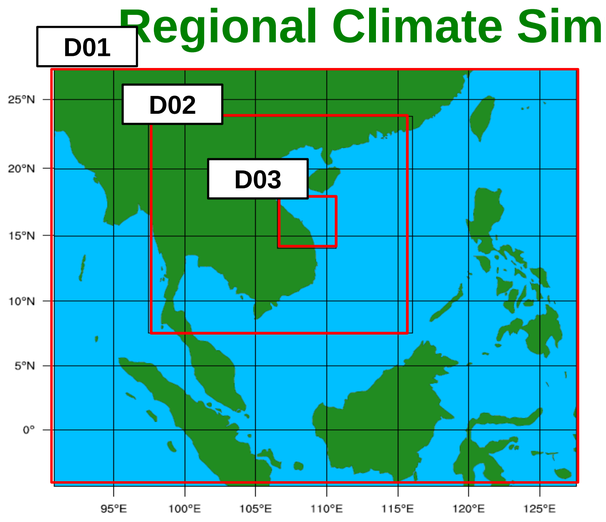
Introduction

High-resolution hydrometeorological information is crucial for regional and local impact studies, especially for data sparse regions such as Vietnam (Souvignet et al., 2013). Regional Climate Models (RCMs) are suitable to dynamically downscale large-scale climate information to regional and even local scales. Transient (1961-2050) ***Weather Research and Forecast*** **(WRF)** simulations are forced by **ECHAM5** and the **A1B and B1 SRES scenarios** using a nested approach, finally resulting in **climate information of 45 km, 15 km and 5 km**, respectively (Fig. 1). After appropriate bias correction, the data can be used for climate impact studies such as future estimations of water availability, crop yield, renewable wind and solar energy productivity.

Regional Climate Simulations using WRF



Domain 1:
- horizontal: **45 km (**99x99 grid cells)
- vertical: 50 layers up to 50 hPa
- time step: 180 s

Domain 2
horizontal: **15 km** (142x145 grid cells)
vertical: 50 layers up to 50 hPa
time step: 120 s

Domain 3
- horizontal: **5 km** (66x75 grid cells)
- vertical: 50 layers up to 5000 Pa
- time step: 30 s

Fig. 1: WRF simulation domains (red boxes) as used for the transient climate simulations.

Parameterization experiments (Table 1) are conducted using reanalysis data (NCEP/NCAR, ERA40) to identify a suitable set of physical schemes for **Microphysics**, **Planetary Boundary Layer**, and **Cumulus Convection**. The patterns of WRF rainfall and temperature (D02) are compared to the gridded APHRODITE and CRU data for rainfall and temperature, respectively (Fig. 2). See Laux et al. (2012 & 2013) for more information.

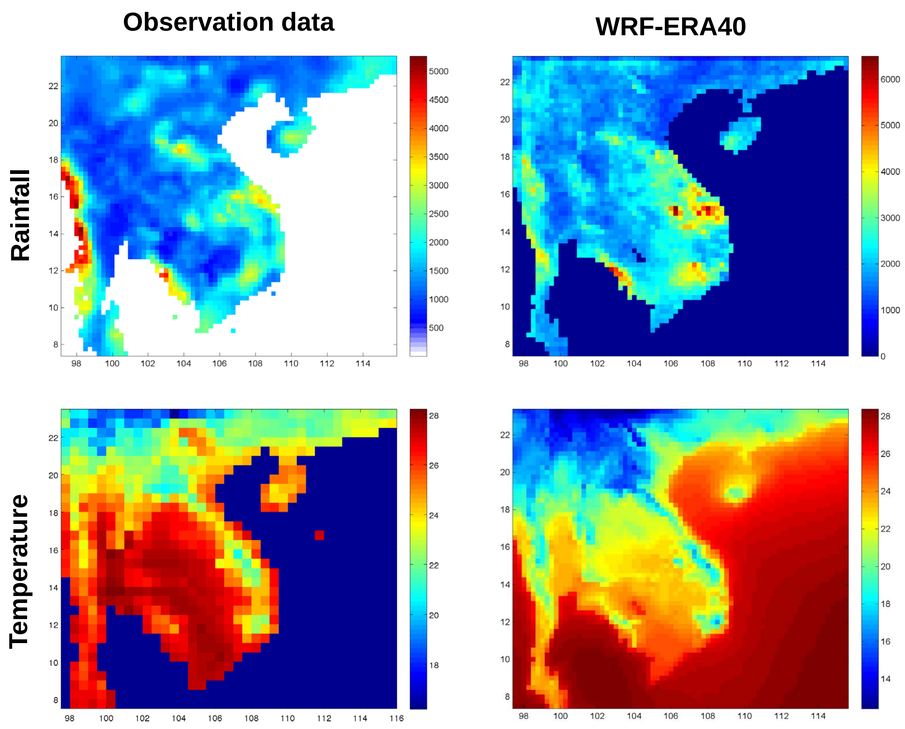


Fig. 2: Rainfall amount and mean temperature for 2000 of observations (left column) and WRF simulations using ERA40 reanalysis data and parameter combination of **run G** (see Table 1).

- **Precipitation:** patterns well captured
- T**emperature:** patterns very well captured, low sensitivity of parameterization runs (not shown here)

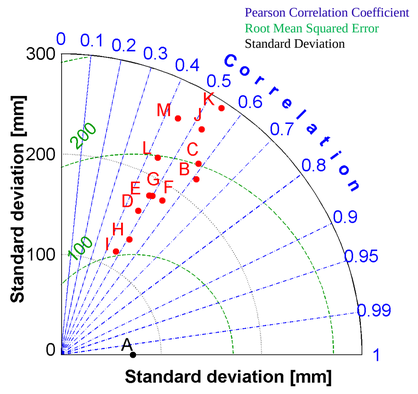


Fig. 3: Taylor diagram showing performance of WRF to simulate precipitation (run B to M) compared to Aphrodite (A).

Table 1: 12 combinations of parameterization schemes used for both NCEP/NCAR and ERA40 reanalysis data:

Run	Microphysic schemes	PBL physic schemes	Cumulus physic schemes
B	Lin et al.	Hong et al.	Betts-Miller-Janjic
C	Lin et al.	Nakanishi and Niino	Betts-Miller-Janjic
D	Lin et al.	Nakanishi and Niino	New SAS
E	Lin et al.	Hong et al.	New SAS
F	WRF Single-Moment 3-class	Hong et al.	Betts-Miller-Janjic
G	WRF Single-Moment 3-class	Nakanishi and Niino	Betts-Miller-Janjic
H	WRF Single-Moment 3-class	Hong et al.	New SAS
I	WRF Single-Moment 3-class	Nakanishi and Niino	New SAS
J	WRF Double-Moment 6-class	Hong et al.	Betts-Miller-Janjic
K	WRF Double-Moment 6-class	Nakanishi and Niino	Betts-Miller-Janjic
L	WRF Double-Moment 6-class	Nakanishi and Niino	New SAS
M	WRF Double-Moment 6-class	Hong et al.	New SAS

➡ Long-term climate simulations (based on parameterization G) performed, Climate data are available at **RBIS database** (http://www.lucci-vietnam.info/), access on request

Zooming In: Reliability for the VGTB Basin

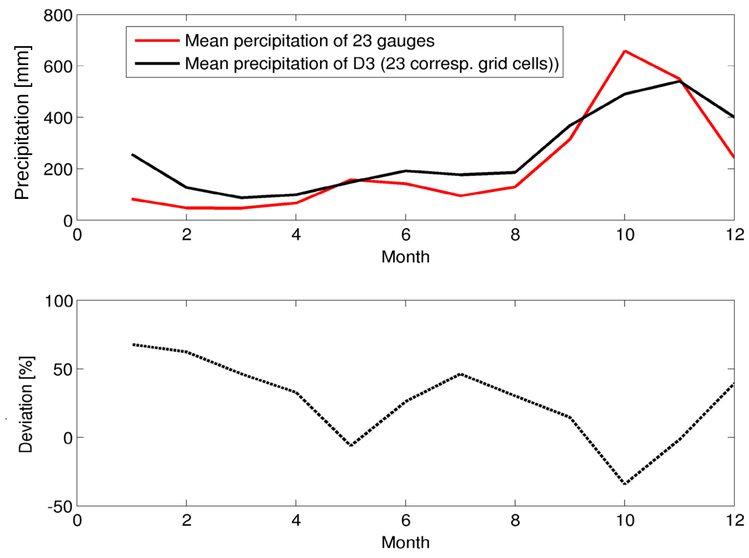


Fig. 4: Validation of precipitation in the VGTB basin. Top: mean monthly precipitation (red: mean of 23 observation stations (OBS), black: modeled (WRF) with a resolution of 5 km, Domain 3). Bottom: relative deviations (OBS-WRF)/OBS.

- WRF captures precipitation well (seasonality, amounts)
- Still deviations between local scale (rain gauges) and WRF grid cells (→ if required, data from further statistical bias correction for local impact studies provided)

Expected Change of Extreme Precipitation

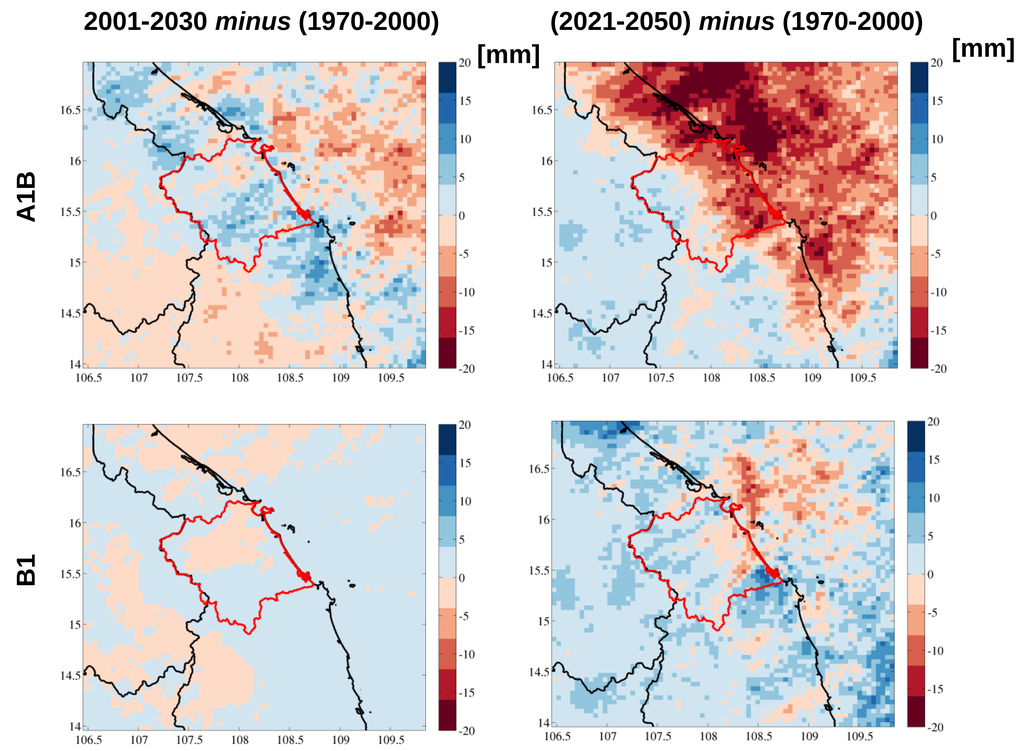


Fig. 5: Expected change of extreme precipitation (q95) frequencies in the VGTB basin (outlined in red) as simulated by WRF and ECHAM5, based on two different scenarios (A1B (business-as-usual), B1 (moderate emissions).

Laux, P., Phan, V.T., Lorenz, Ch., Thuc, T., Ribbe, L., Kunstmann, H. (2012), Setting up Regional Climate Simulations for Southeast Asia. High Performance Computing in Science and Engineering ' 12, Conference Proceedings, Wolfgang E. Nagel, Dietmar B. Kröner, Michael M. Resch (Eds.), Springer
Laux, P., Phan, V.T., Kunstmann, H. (2013) High Resolution Climate Change Information for the Lower Mekong River Basin of Southeast Asia. High Performance Computing in Science and Engineering '13, Conference Proceedings, Wolfgang E. Nagel, Dietmar B. Kröner, Michael M. Resch (Eds.), p. 543-551, Springer.

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