

4-3. Climate Change effect on Rainfall in Philippines (Pampanga, Davao)

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Public Works Research Institute (PWRI)



IFI meeting Feb.7th 2019



United Nations
Educational, Scientific and
Cultural Organization

Pampanga River Basin, Philippines

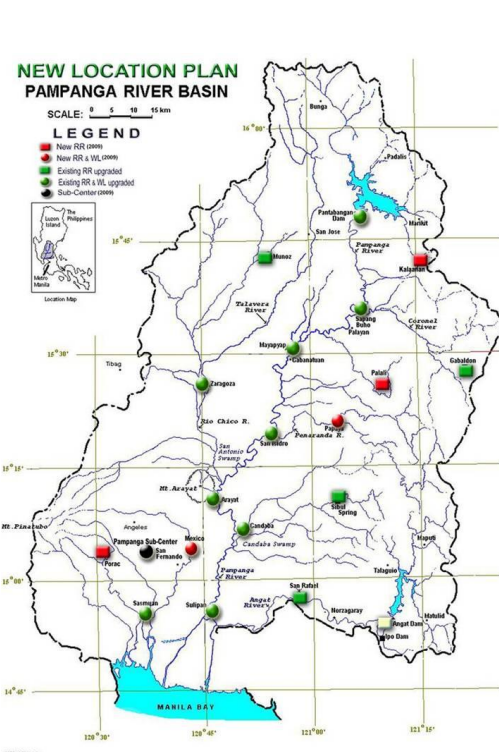
- Catchment : 10,434km²
- River length : 260km
- Annual rainfall : 2,155mm
- Raingauge : 18 sites
- Water level : 11 sites

Recent flood events

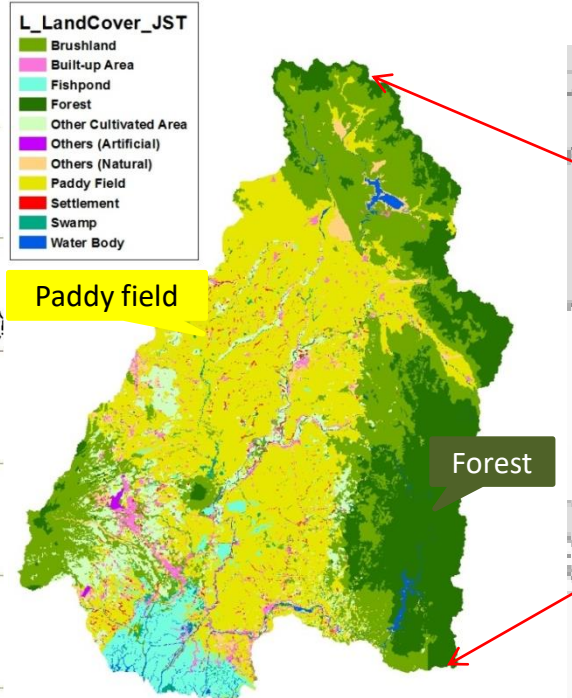
- Aug. 2012 Monsoon Rainfall
- Sep. 2011 typhoon Nesat, Nalgae
- Jun. 2011 typhoon Meari
- Sep. 2009 typhoon Ketsana, Parma



Flood by typhoon Pedring on Sep. 2011



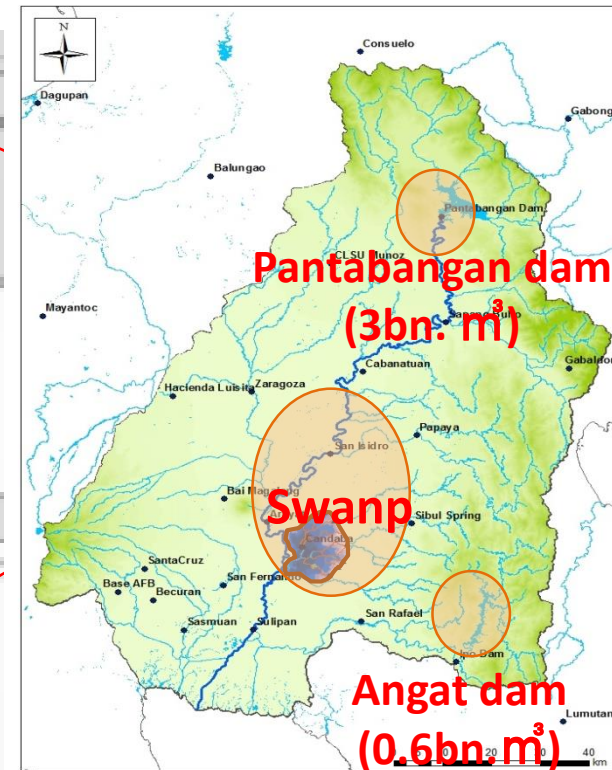
Hydrological site



Paddy field

Forest

Land use



Objective and steps

Step 1

- GCM global warming experiments

Step 2

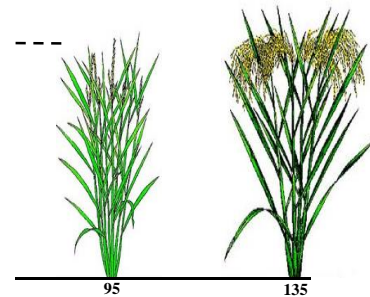
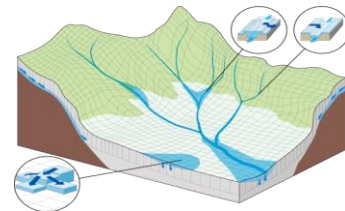
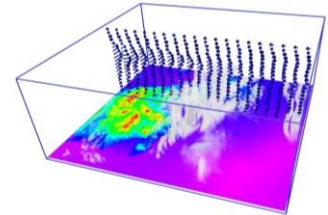
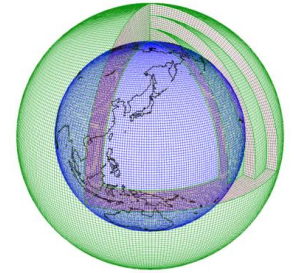
- Dynamical downscaling (MRI-AGCM3.2S)
- Bias correction based on raingauges

Step 3

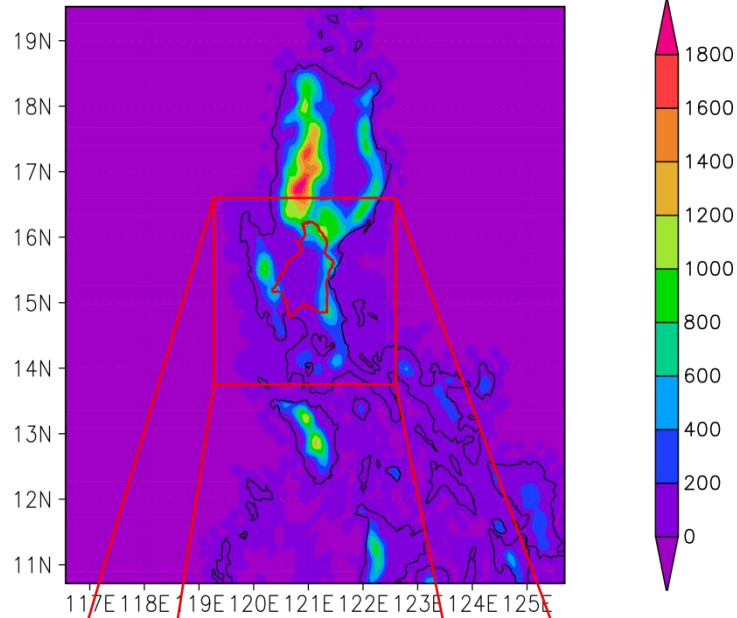
- Hydrological modeling

Step 4

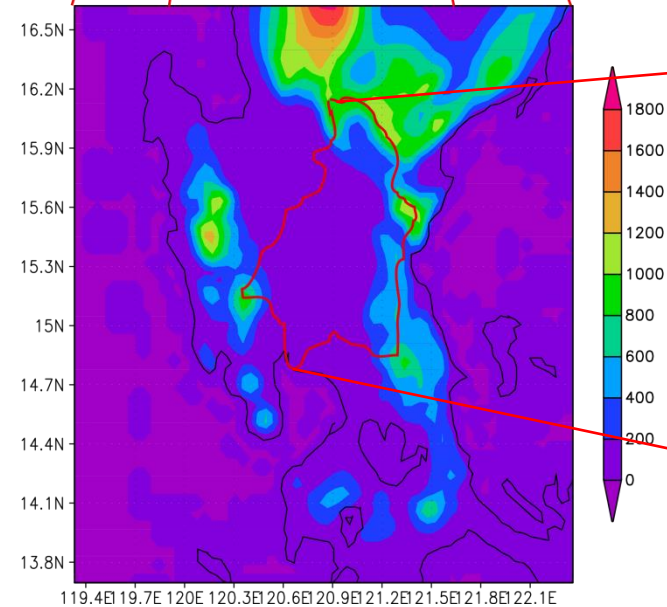
- Risk analysis (e.g. agricultural damages)



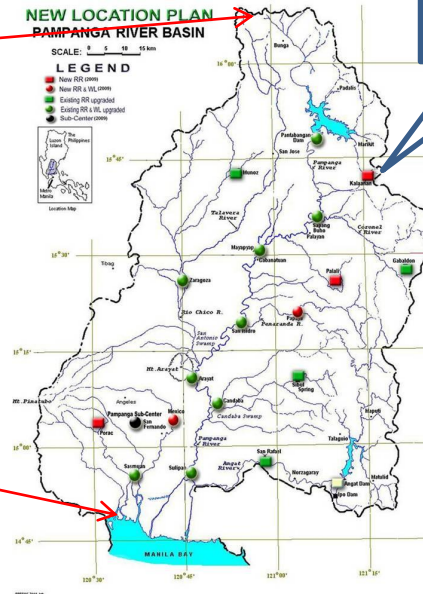
Regional model



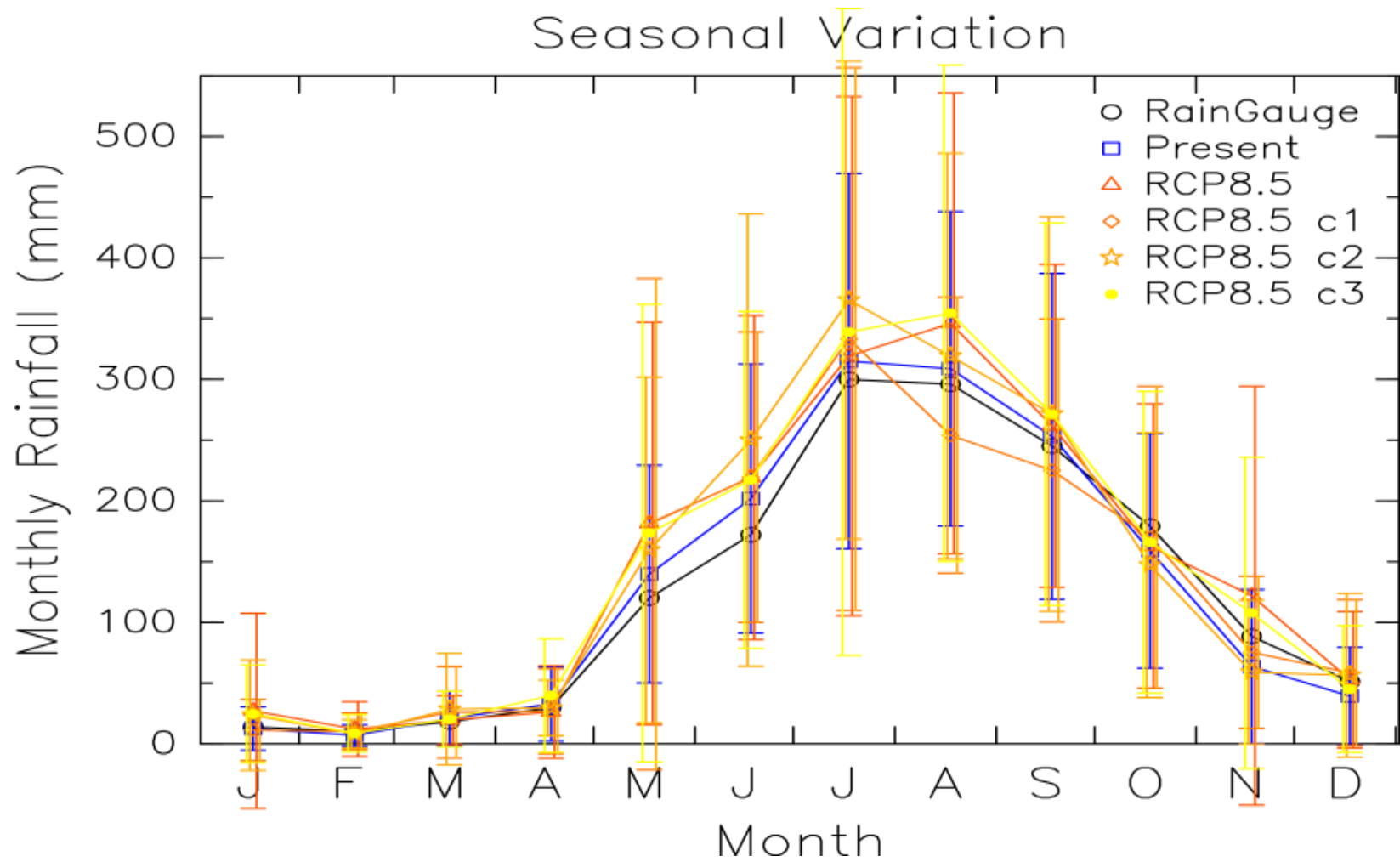
Weather Research and Forecasting (WRF) ver.3.4.1
Horizontal resolution: 15km/ 5km
Coordinate: $67 \times 67 \times 40$ (outer), $67 \times 67 \times 40$ (inner)
Cumulus parameterization: Grell 3D
Microphysics: WSM3class
PBL scheme: MYNN2.5
Surface: Thermal diffusion



Pampanga River Basin



Seasonal Variation of Rainfall

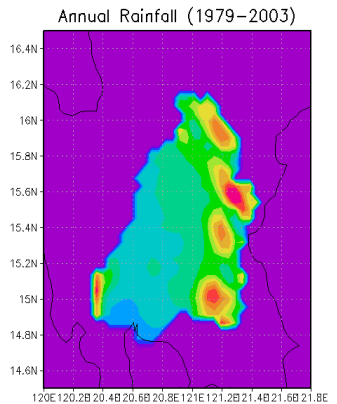


Monthly Rainfall increases a little, but not so much.

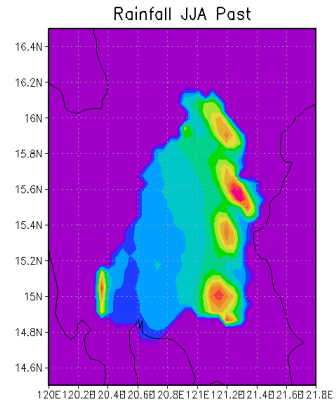
Rainfall distribution in the Pampanga Basin

Past climate

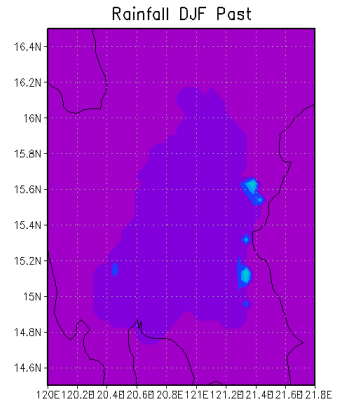
Annual total



JJA

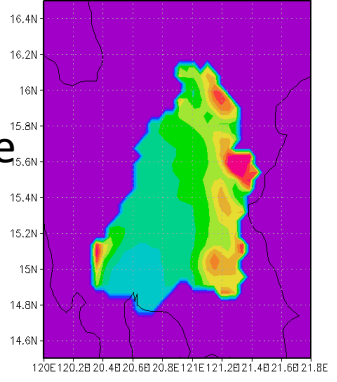


DJF

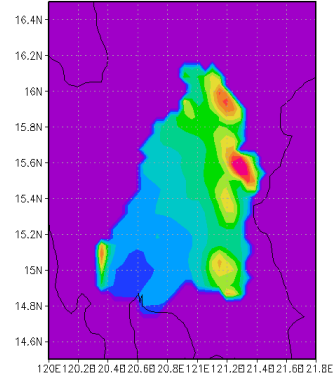


Future climate
RCP8.5

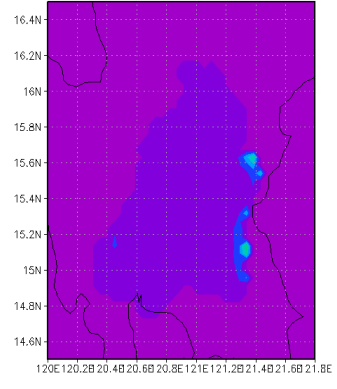
Annual Rainfall (2075-2099)



Rainfall JJA RCP8.5

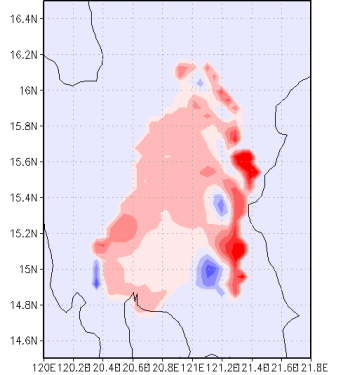


Rainfall DJF RCP8.5

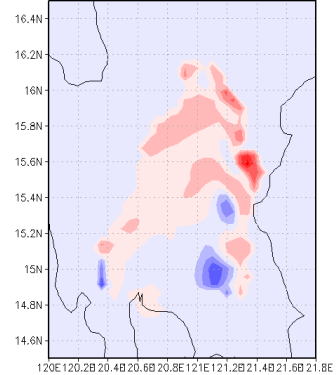


Difference
(future)-
(past)

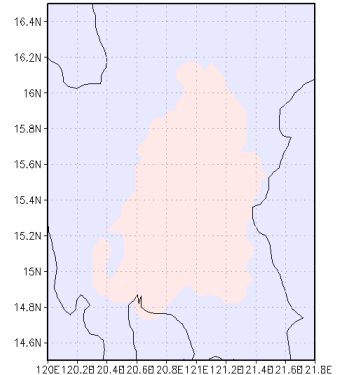
Annual Rainfall Future-Present



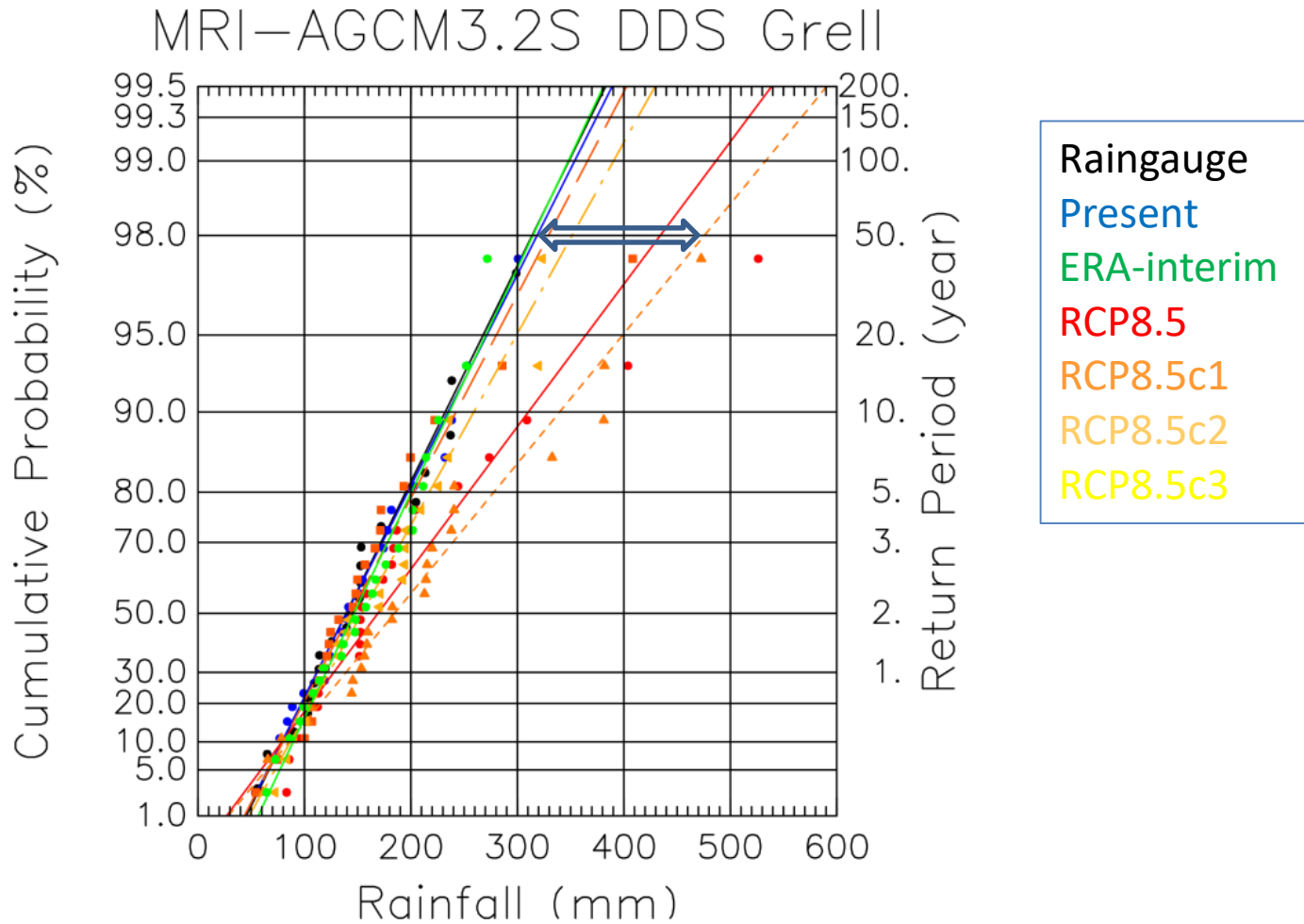
JJA Rainfall Future-Present



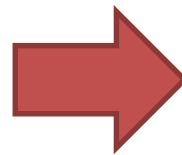
DJF Rainfall Future-Present



Frequency analysis (annual maximum 48 h rainfall)



1/50 extreme rainfall in present climate 320 mm would increase into 470 mm in future. (45% increase)



More severe rainfall & flood likely to occur in future.

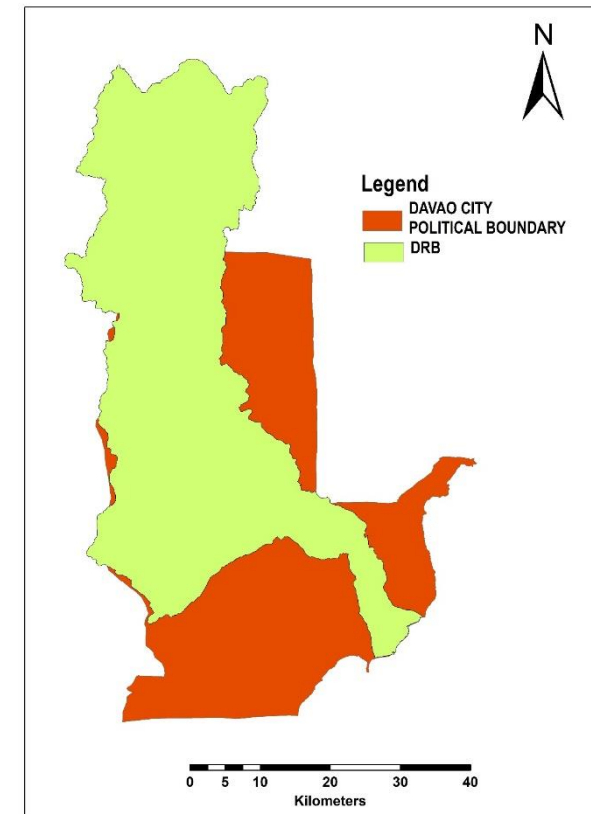
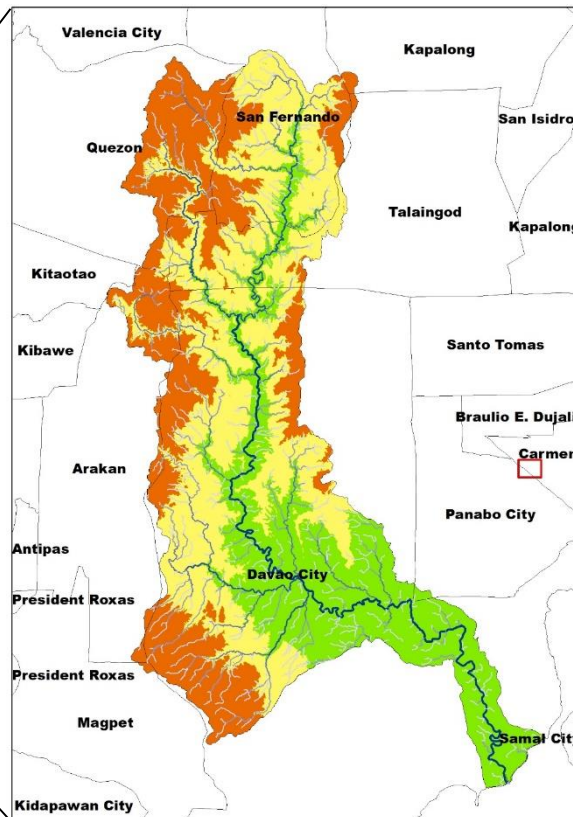
Davao River Basin, Philippines

Davao City

- Largest city in the Philippines in terms of land area
- Approximately 67% of DRB Area
- 182 Barangays (villages)
- 110 barangays within the basin
- About 95% of DRB Population
- Third (3rd) most populous city in the Philippines with a total Population of 1.6 million as of August 2015

Davao River Basin

- 15th largest river basin in the Philippines
- Catchment Area: 1.7 km²
- River Length: 150 km
- Maximum Elevation: 1,875km
- Annual Rainfall: 1, 800 mm



Computational domain for Davao

WRF model setting

Outer frame: 15km, 100x100

Inner frame: 5km, 79x79

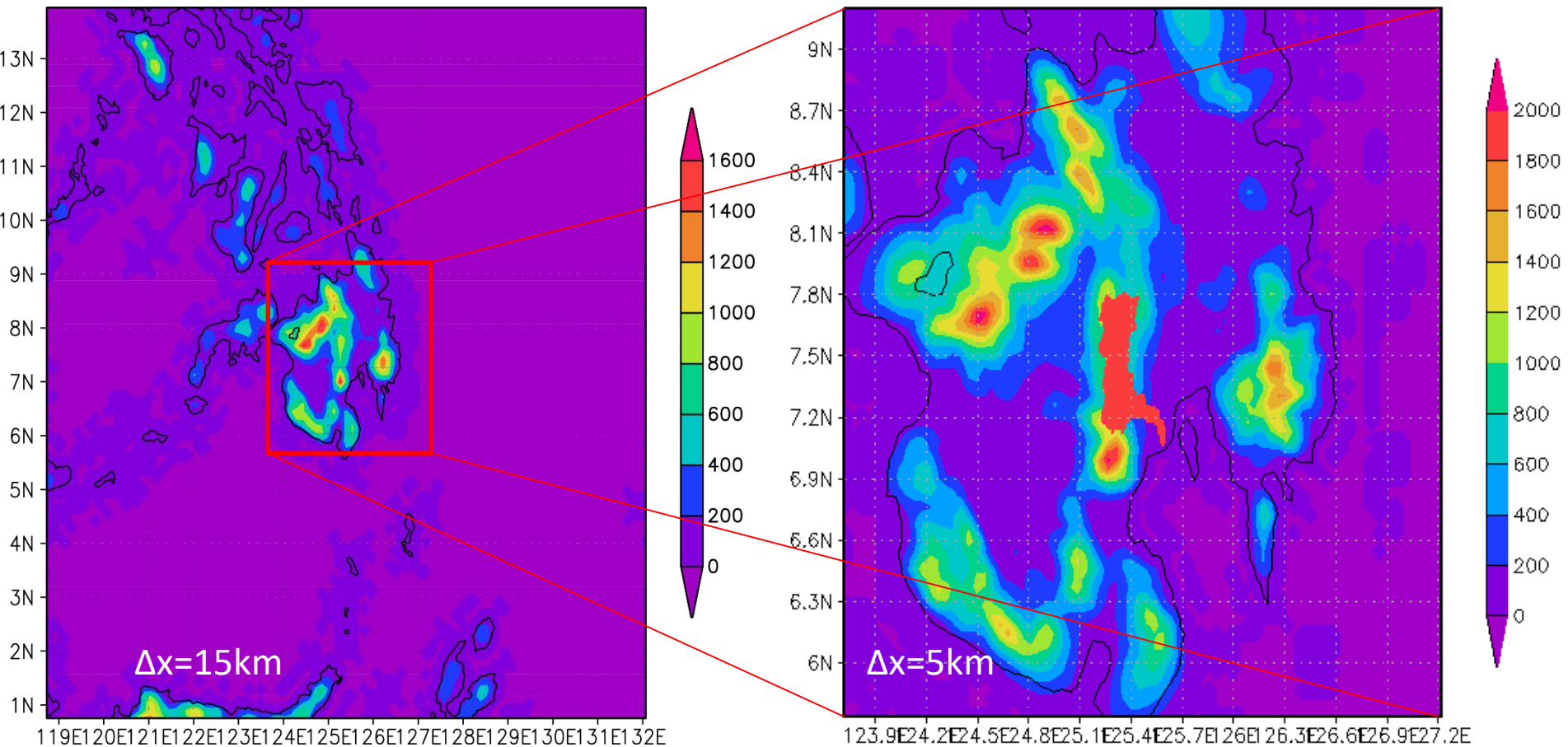
Vertical layer: 40

Cumulus: Grell 3D scheme

Davao River

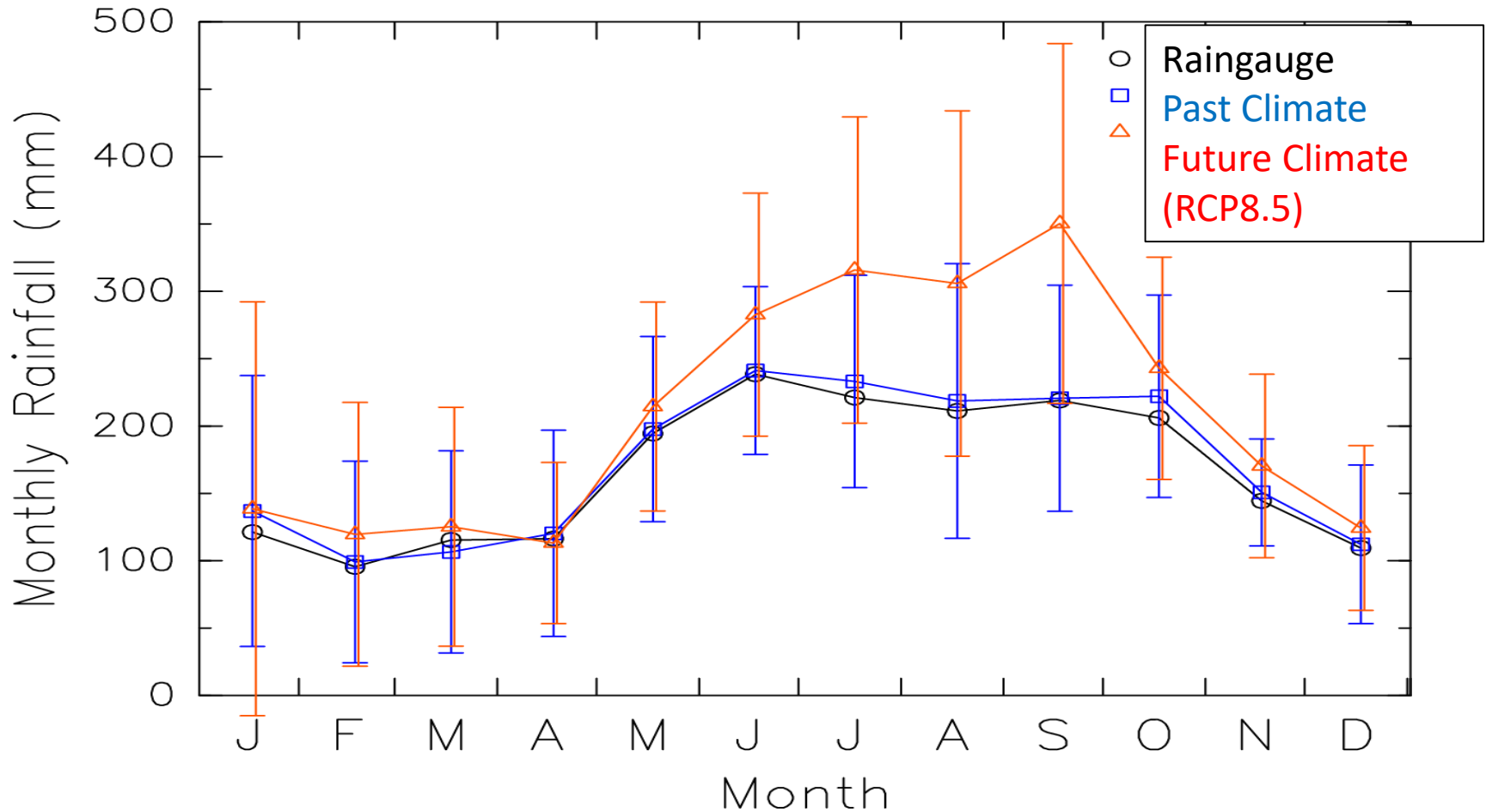
Area: 1623 km²

Length: 160 km



Seasonal Variation of Rainfall

Seasonal Variation

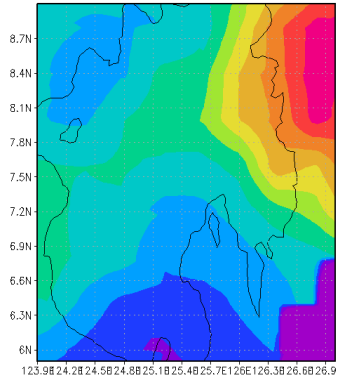


Monthly Rainfall increases 80-130mm in July-September.

Rainfall distribution in Davao River Basin

Annual total

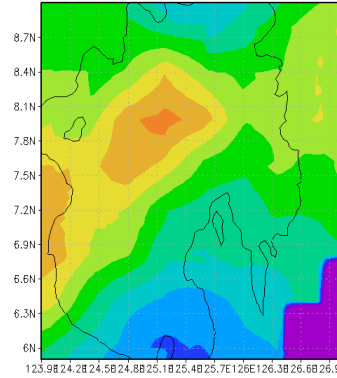
Annual Rainfall (1983–2003)



GHRS: COJA/GES

JJA

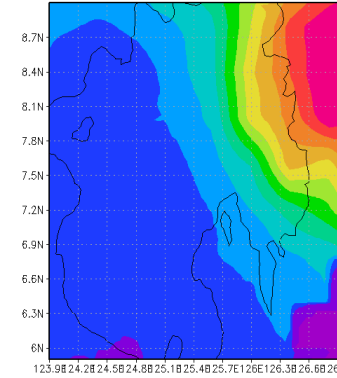
Rainfall JJA Past



2019-01-24-1315 3

DJF

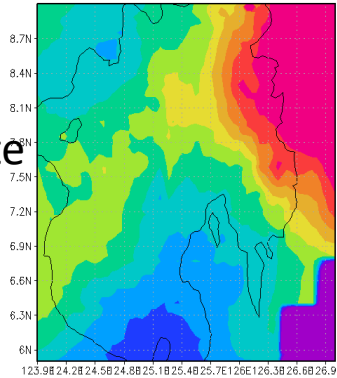
Rainfall DJF Past



2019-01-24-1316

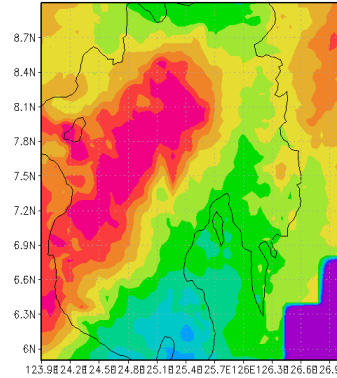
Past climate

Annual Rainfall (2079–2099)



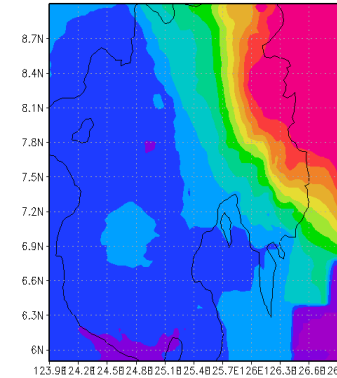
GHRS: COJA/GES

Rainfall JJA RCP8.5



2019-01-24-1312 3

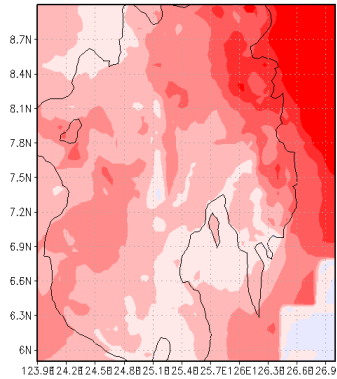
Rainfall DJF RCP8.5



2019-01-24-1316

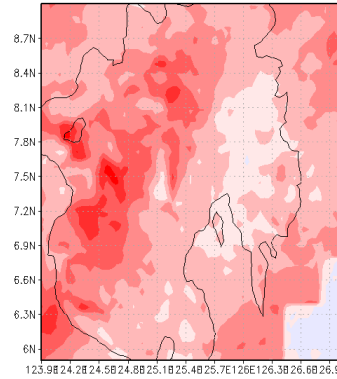
Future climate
RCP8.5

Annual Rainfall Future–Present



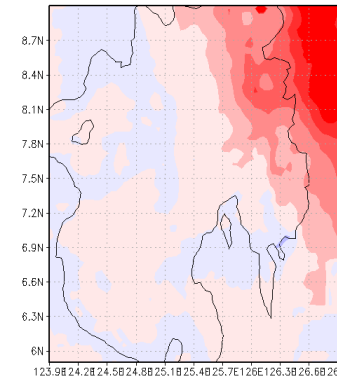
GHRS: COJA/GES

JJA Rainfall Future–Present



2019-01-24-1315 3

DJF Rainfall Future–Present



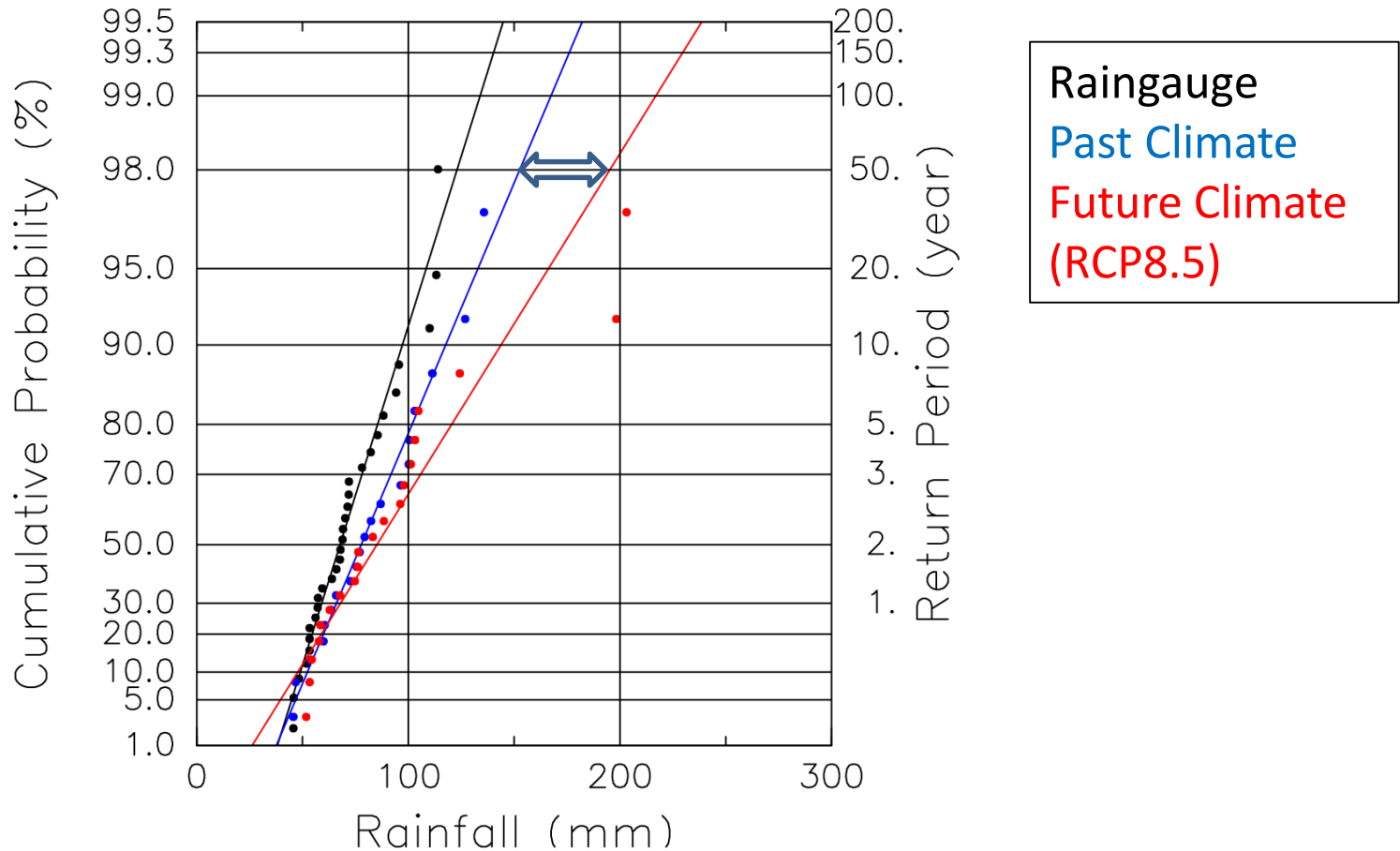
2019-01-24-1317

2019-01-24-1319

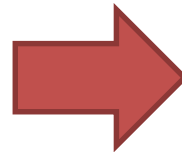
Difference

Frequency analysis (annual maximum 24 h rainfall)

Davao Basin



1/50 extreme rainfall in present climate 150 mm would increase into 200 mm in future (33% increase).



More severe rainfall & flood likely to occur in future.

Summary

- **Pampanga**; 46% increase of 1/50 extreme rainfall ⇒ One flood event causes more damage
- **Davao**; 33% increase of 1/50 extreme rainfall & July-September rainfall increase 45% ⇒ Average discharge increases + one flood event causes more damage