Dynamic downscaling of d4PDF large ensemble global projections for river basins in Philippine and Indonesia

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1. Introduction

High resolution downscaling is required for extreme rainfall and flood risk assessment

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Large ensemble climate projection captures uncertainty of climate change

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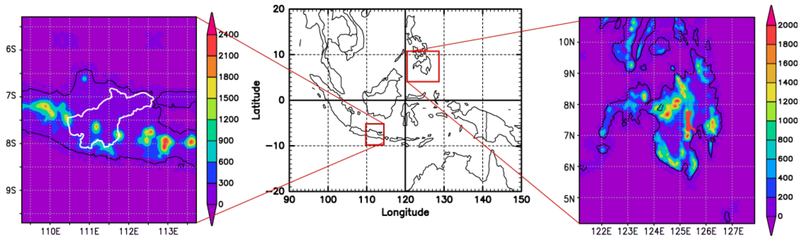
High resolution downscaling of large ensemble data can provide robust dataset

2. Method



▪(Left) Solo River basin, Indonesia: 16,100 km^2, 600 km long. (while envelop)
▪(Right) Davao River basin, Philippines: 1,632 km^2, 170 km long (red shading)

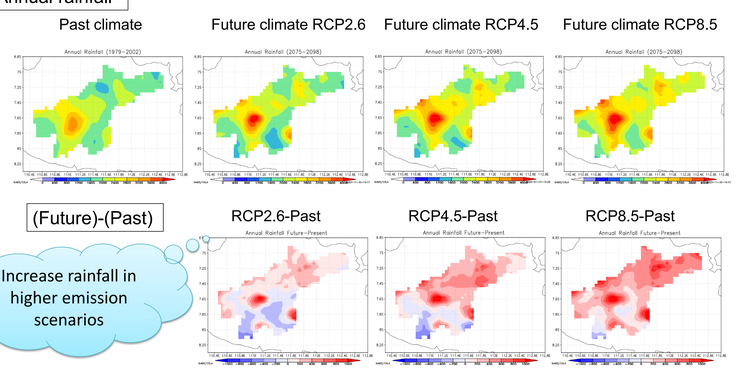
Horizontal grid interval:5km
Vertical: 40 layers
Cumulus Parameterization: No
Cloud microphysics: WDM6
PBL: MYNN2.5
Land Surface; Thermal diffusion

Boundary condition:
- MRI-AGCM3.2H (dx=60km) 25 years Past/Future
- d4PDF (the database for policy decision-making for future climate changes, dx=60km, Mizuta et al. 2017) 6000 years Past, 5400 years 4K increase future, Six different SST variability from CMIP5 were given. We downscaled 180 years for each scenario from the dataset.

Quantile mapping type bias correction based on the ground raingauges was implemented (Inomata et al. 2011).

3. Solo River basin (Single GCM downscaling)

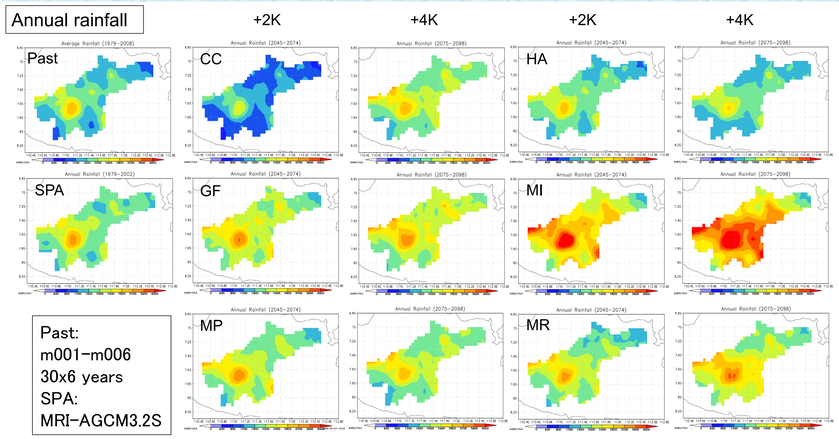
Annual rainfall



Increase rainfall in higher emission scenarios

4. Solo River basin (d4PDF downscaling)

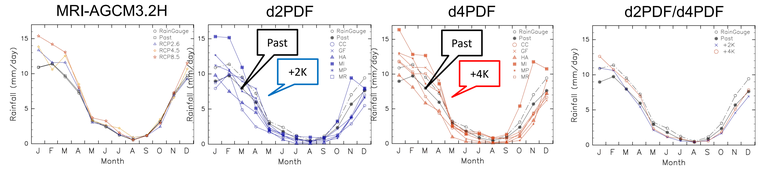
Annual rainfall



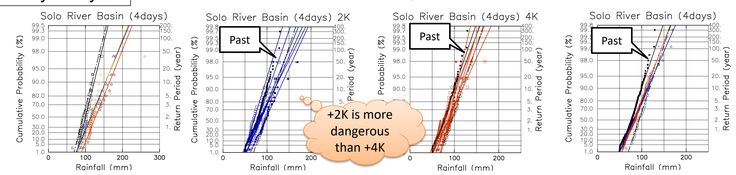
Past:
m001-m006
30x6 years
SPA:
MRI-AGCM3.2S

CC: CCSM4, HA: HadGEM2-AO, GF: GFDL-CM3, MI: MIROC4, MP: MPI-ESM-MR, MR: MRI-CGCM3

Annual rainfall



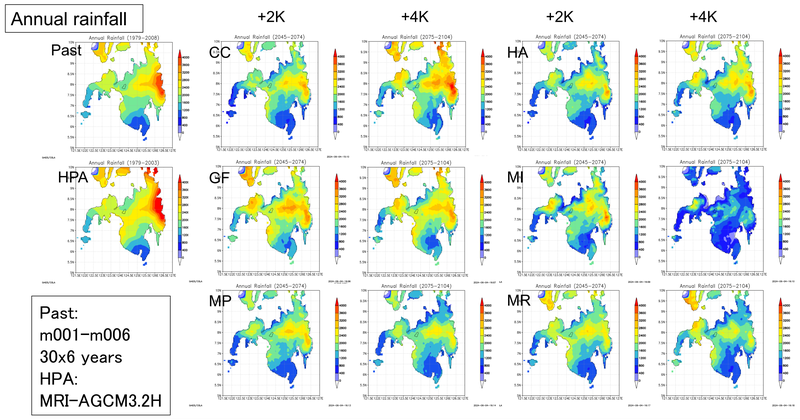
Frequency analysis



Most of them projected rainfall increase. MIROC projected huge increase, CC and HA projected rainfall decrease.

5. Davao River basin (d4PDF downscaling)

Annual rainfall

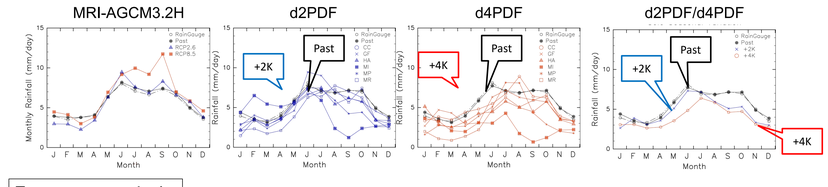


Past:
m001-m006
30x6 years
HPA:
MRI-AGCM3.2H

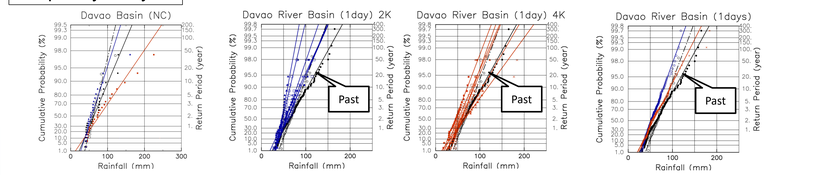
CC: CCSM4, HA: HadGEM2-AO, GF: GFDL-CM3, MI: MIROC4, MP: MPI-ESM-MR, MR: MRI-CGCM3

Most of them projected rainfall decrease, except GF 2K/4K and CC 4K. MIROC projected huge decrease. East coast heavy rainfall decrease in future, which may be the result of weakening of easterly monsoon.

Annual rainfall

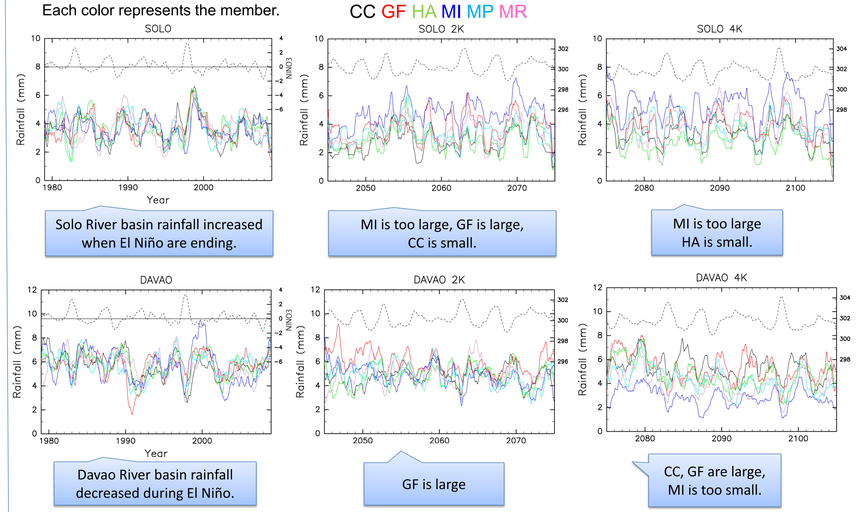


Frequency analysis



6. Annual variability (d4PDF downscaling)

Each color represents the member. CC GF HA MI MP MR



Solo River basin rainfall increased when El Niño are ending.

MI is too large, GF is large, CC is small.

MI is too large HA is small.

Davao River basin rainfall decreased during El Niño.

GF is large

CC, GF are large, MI is too small.

7. Summary

- Robust precipitation datasets (5 km resolution) suitable for flood risk assessment have been produced by downscaling d4PDF.
- The different SST pattern of d4PDF caused variability in the amount of precipitation, suggesting a large uncertainty for future projections.
- Rainfall trend is sometimes different with CORDEX-SEA (25 km downscaling).

		Wet season	Dry season
Solo	d4PDF DS	Increase	Decrease
	CORDEX	Decrease	Decrease
Davao	d4PDF DS	Decrease	Decrease
	CORDEX	Decrease	Increase

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The Ensemble Climate Prediction Database for Global Warming Mitigation (d4PDF), which was created under the Creation and Integration Program, was used.
Downscaling calculations were performed on the Earth Simulator.