

Tropical cyclone changes in convection-permitting regional climate projections: a study over the Shanghai region

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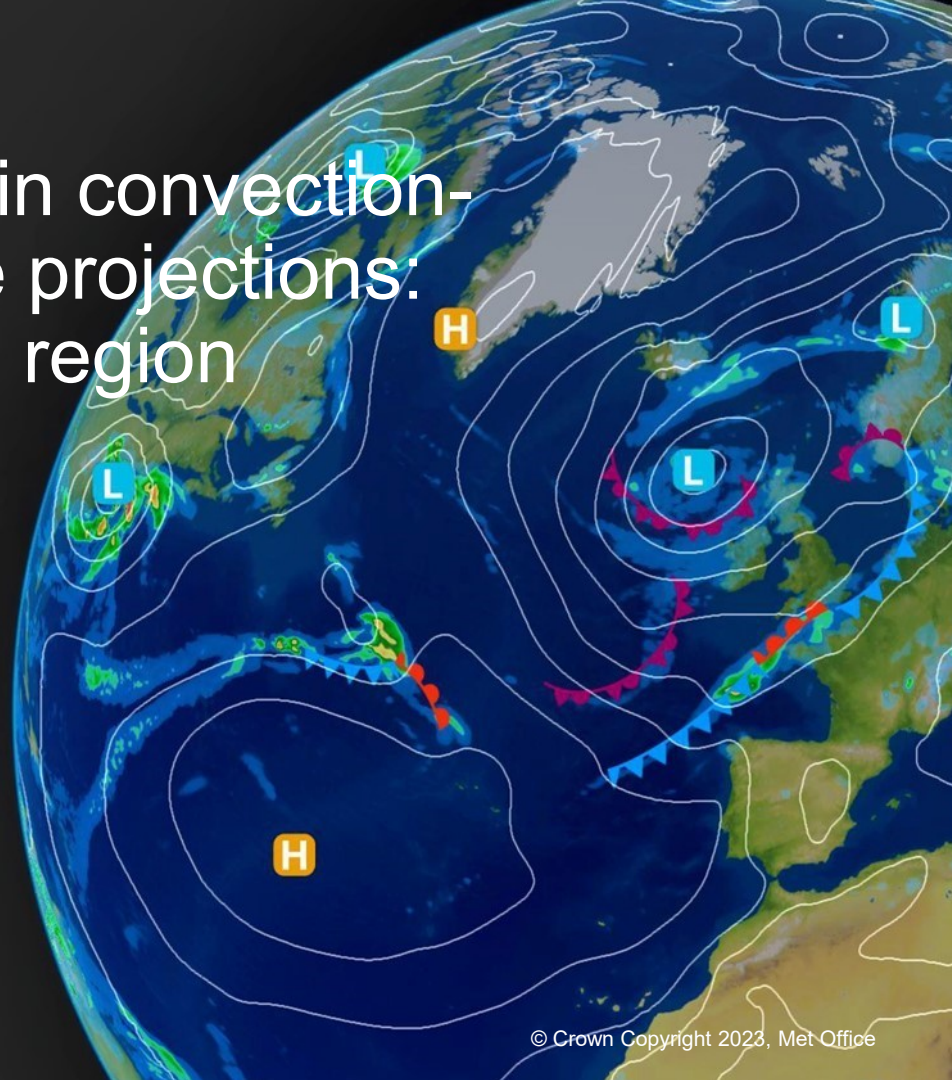
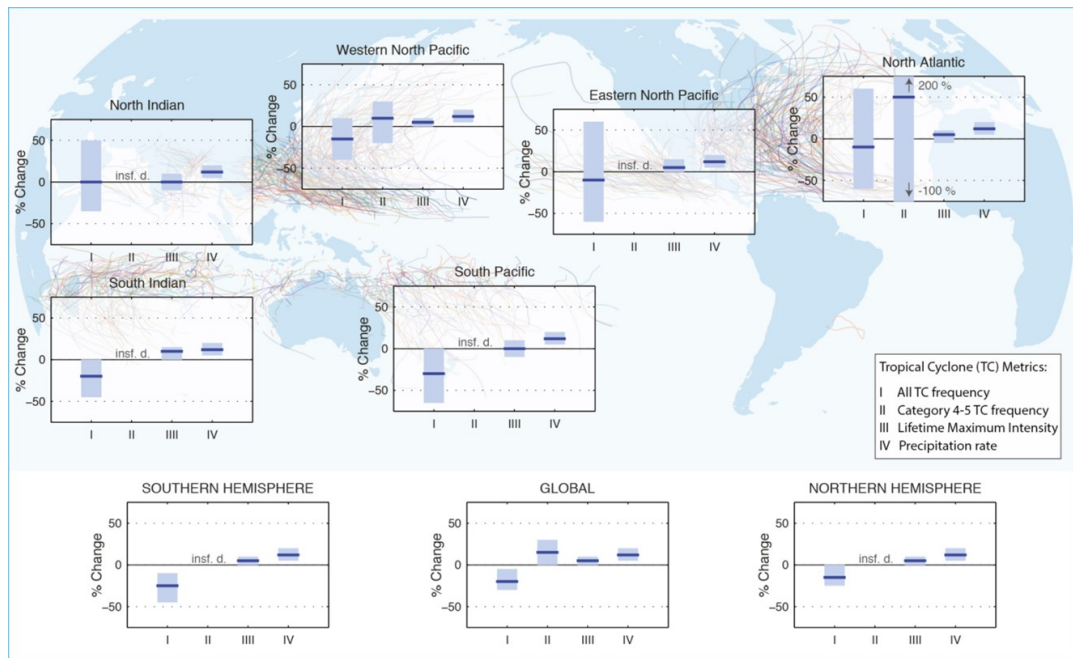


Figure 14.17
(IPCC AR5 WG1, 2013)
Climate Change for the end of the century (2080-2100), A1B, various modelling sources.



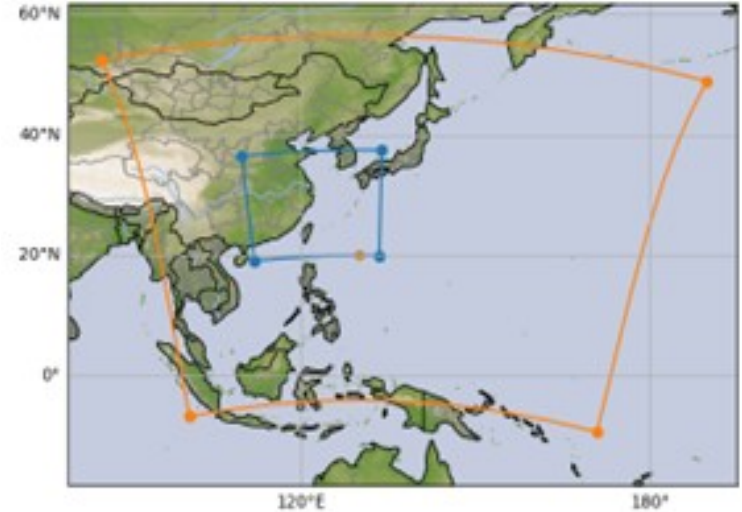
Most recent update: Knutson et al (WMO expert team, BAMS (2020) for 2K global temperature increase)
4km CPM projections used in Ke et al, Natural Hazard (2021) for coastal flooding

Double nesting experiment CORDEX setup

Met Office Double Nesting Setup driving GCM: HadGEM2-ES

Driving model	Model System		Simulation Period
	Outer Domain (Mesoscale)	Inner Domain (CPM scale)	
HadGEM2-ES	HadREM3-GA7.05 12km	HadREM3-RA1T Grid space 4km	Historical : 1981-2000 RCP8.5 : 2080-2099

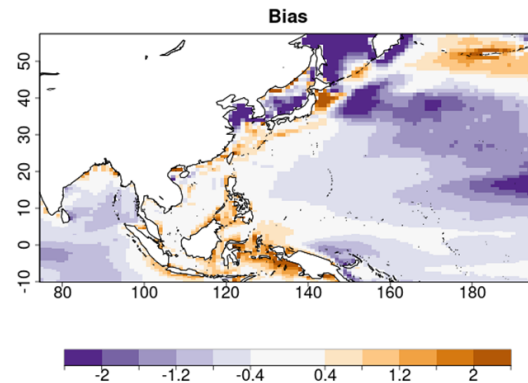
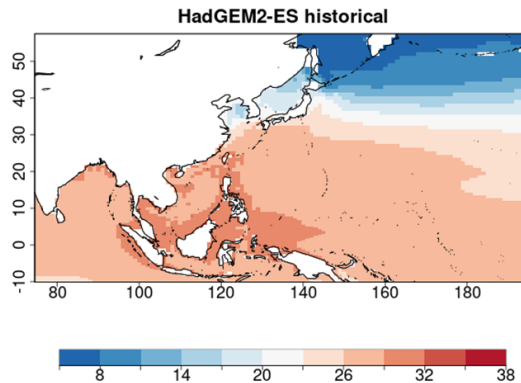
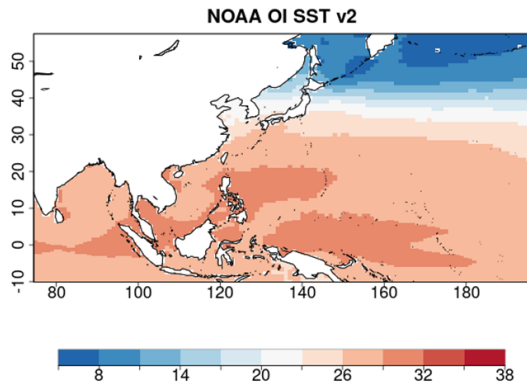
SST update daily
time-varying ghg concentrations
MACv2-SP, scenario dependent aerosol
radiation and cloud effects.
Lbc update: RCM, 6-hourly; CPM, 3-hourly
4km CPM projections used in Ke et al,
Natural Hazard (2021) for coastal flooding



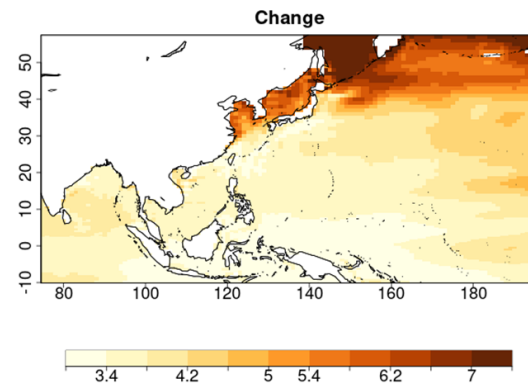
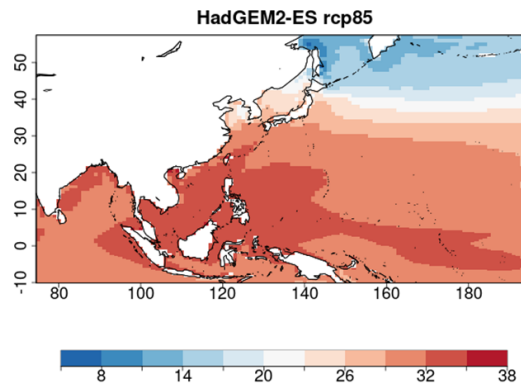
Outer domain (orange): 12km resolution, RCM
Inner domain (blue): 4km, CPM

Large Scale Environmental Conditions

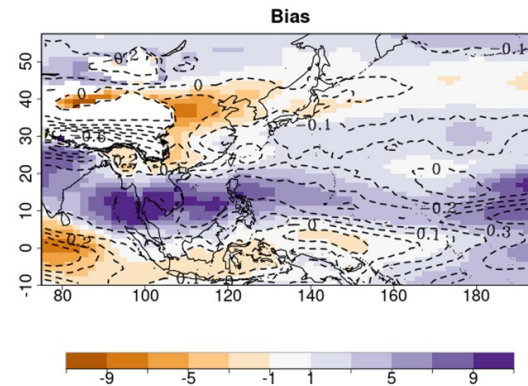
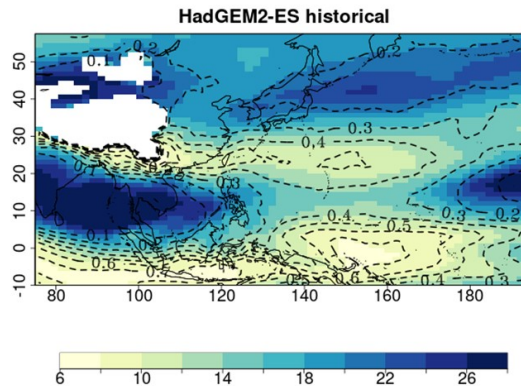
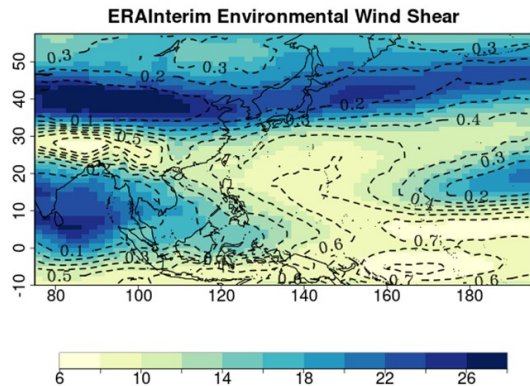
Met Office HadGEM2-ES SST, JJA



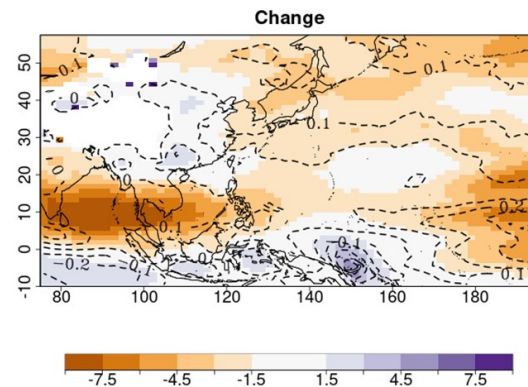
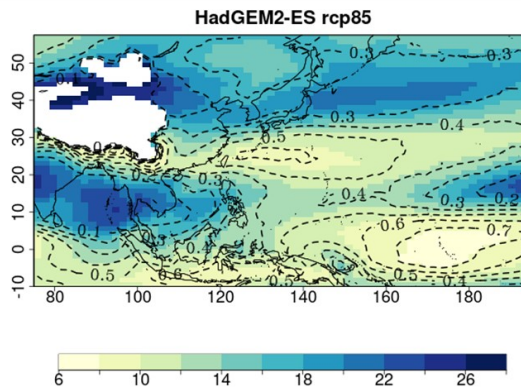
Climate Change Response:
Local SST Increase ~ 3.5K
Global Temperature Increase ~ 4.8K



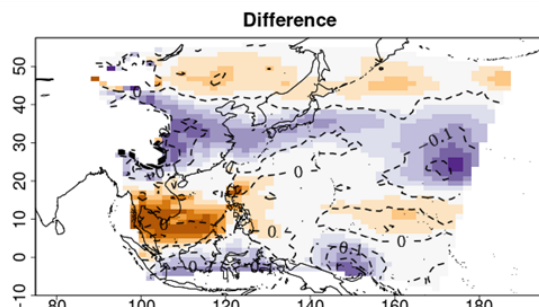
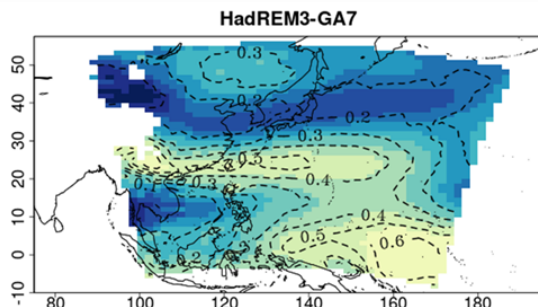
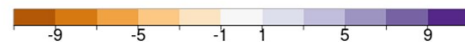
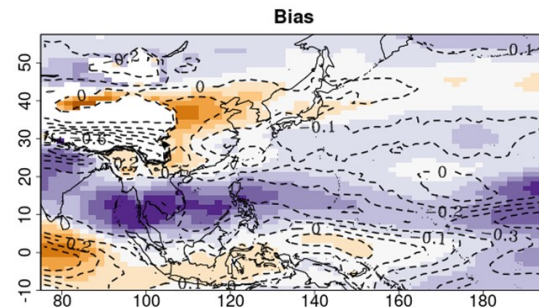
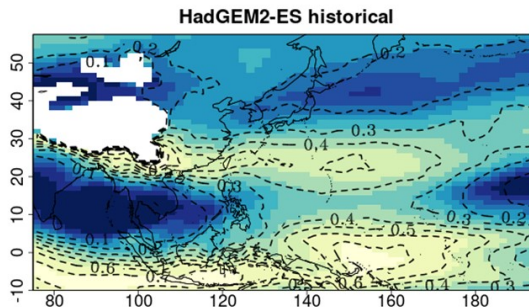
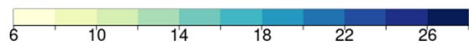
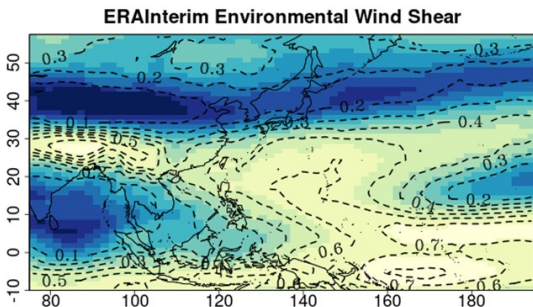
Met Office HadGEM2-ES Environmental Wind Shear, JJA



Difference Horizontal Wind at 250hPa and 850hPa
Contour levels: number of days with average wind shear < 10m/s



Met Office RCM large scale consistency with HadGEM2-ES

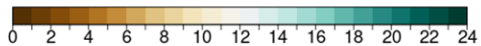
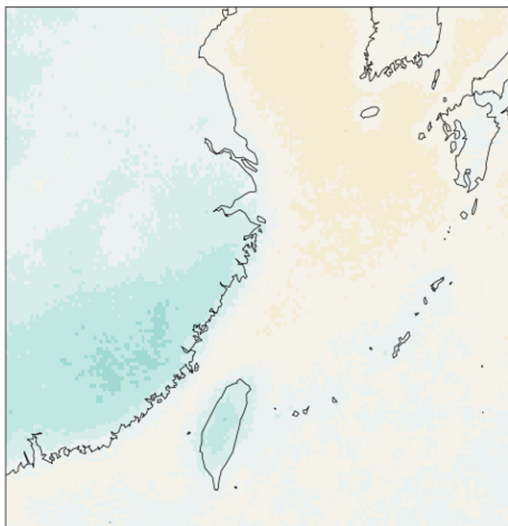
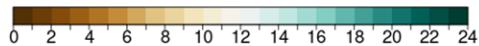
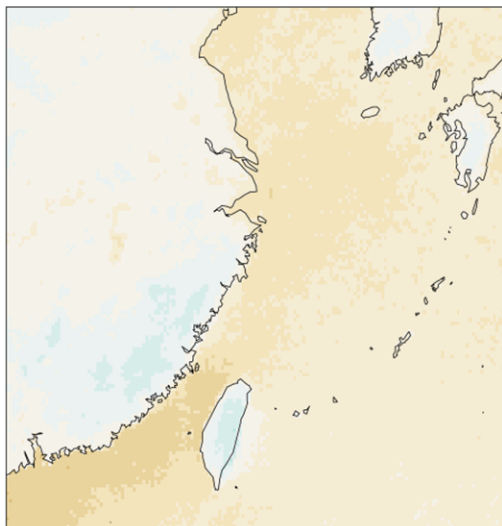
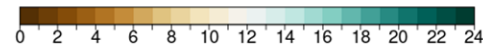
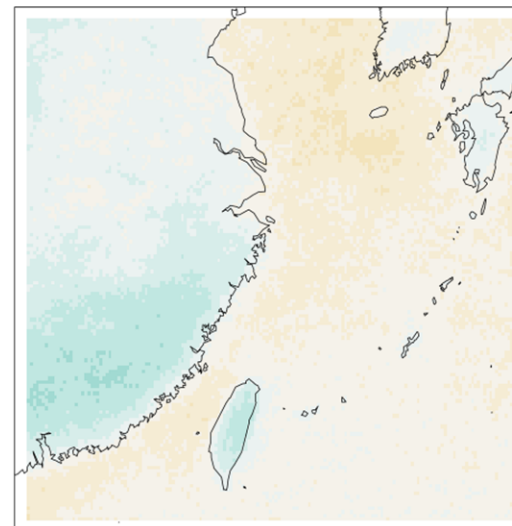


Similar results for temperature,
other environmental variables
not considered since strongly
affected by local variability (e.g.,
relative vorticity)
CPM perfectly consistent with
driving RCM.

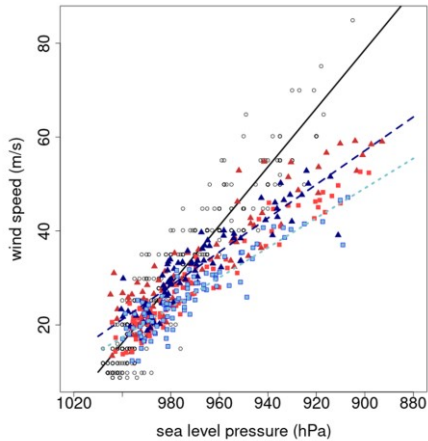
Results from the Double Nesting Experiment

Diurnal cycle rainfall

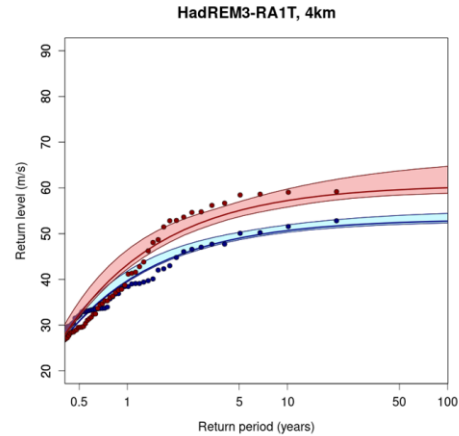
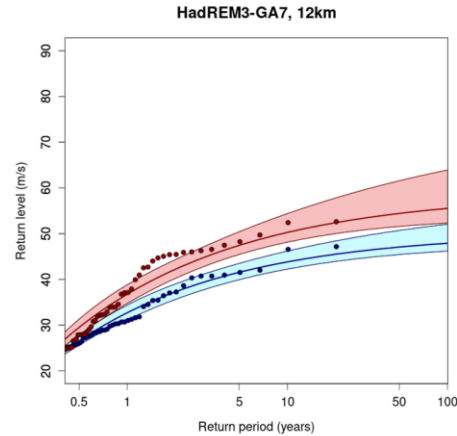
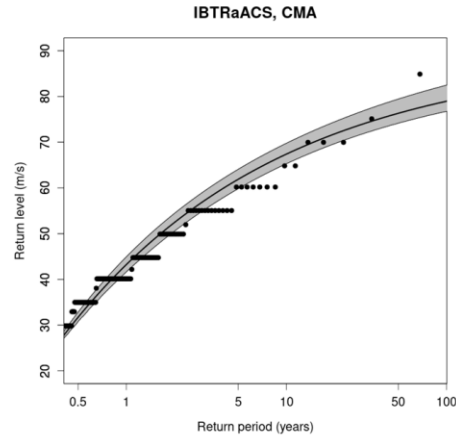
hour of peak rainfall, historical, JJA

CMORPH**Observations****HadREM3-GA7****12km RCM****HadREM3-RA1T****4km CPM**

Tropical Cyclones

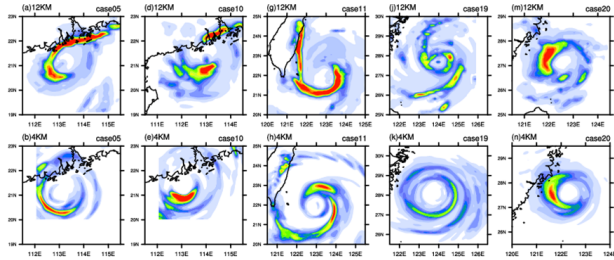


Intensity – Depth Scatterplot, max wind speed in region of interest (blue: historical; red: RCP8.5)
 Systematic improvement for 4km CPM, but far from observed relationship



Generalised Pareto Distribution fits of Intensity.
 Obs (left panel), 12km RCM (middle panel), 4km CPM (right panel)
 Blue: historical; Red, RCP8.5
 No significant change in average intensity but a reduction of return period for more extreme events (i.e., 4km CPM the 10 year event becomes 1 year event in the future)

Met Office Precipitation from Tropical Cyclones



12km RCM

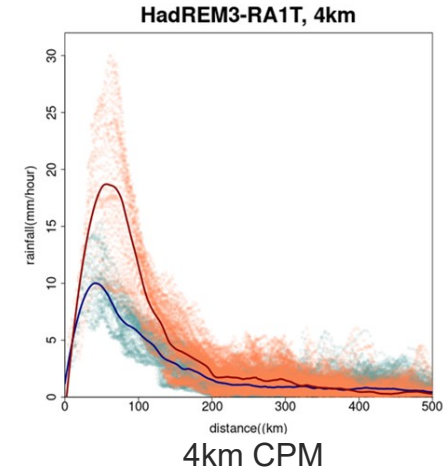
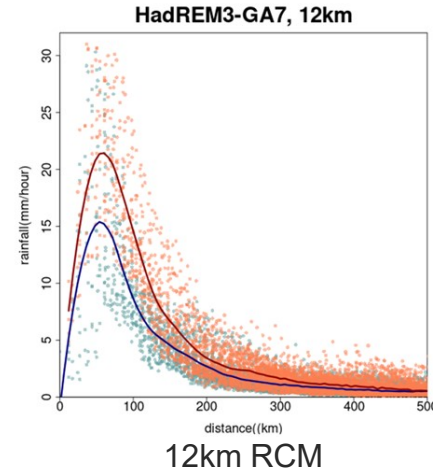
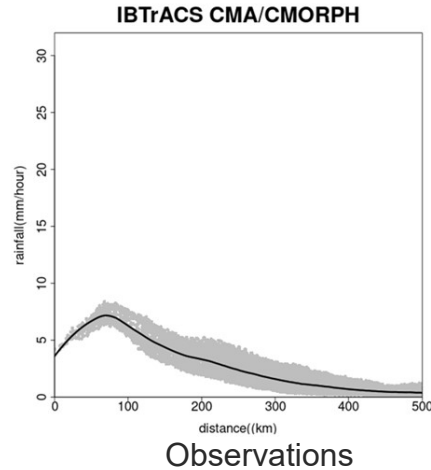
4km CPM

Precipitation Patterns for Matching Cyclones

Rainfall distribution from composite of tracks in the region of interest.

Blue: historical; Red: RCP8.5

RCM and CPM project increases in total and peak rainfall above the Clausius-Clapeyron limit.



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