Bias correction of precipitation from regional climate model using quantile mapping

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Statistical bias correction

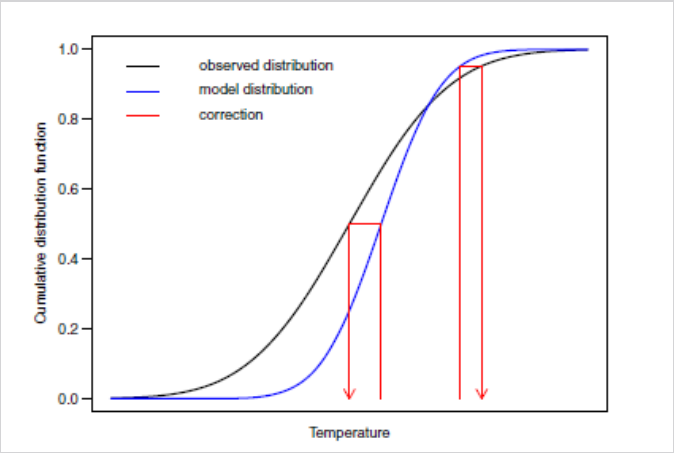
- Statistical bias correction of simulation data is broadly applicable to the climate impacts research.

- Several bias correction method
  - Delta change
  - local intensity scaling
  - analog methods
  - fitted histogram equalization
  - quantile mapping

- The QM method has been widely used in hydrological impacts of climate change (Dobler and Ahrens, 2008; Piani et al., 2010).

Quantile mapping

QM is an empirical statistical technique that matches the quantile of an Climate Model simulated value to the observed value at the same quantile



QM can alter the Climate Model driven

- mean change (Pierce *et al.* (2015)
- Extreme events (Hagemann *et al.*,2011; Maraun, 2013; Cannon *et al.*,*2015).*

Detrended quantile mapping (DQM)

If Projected value falls outside the historical range

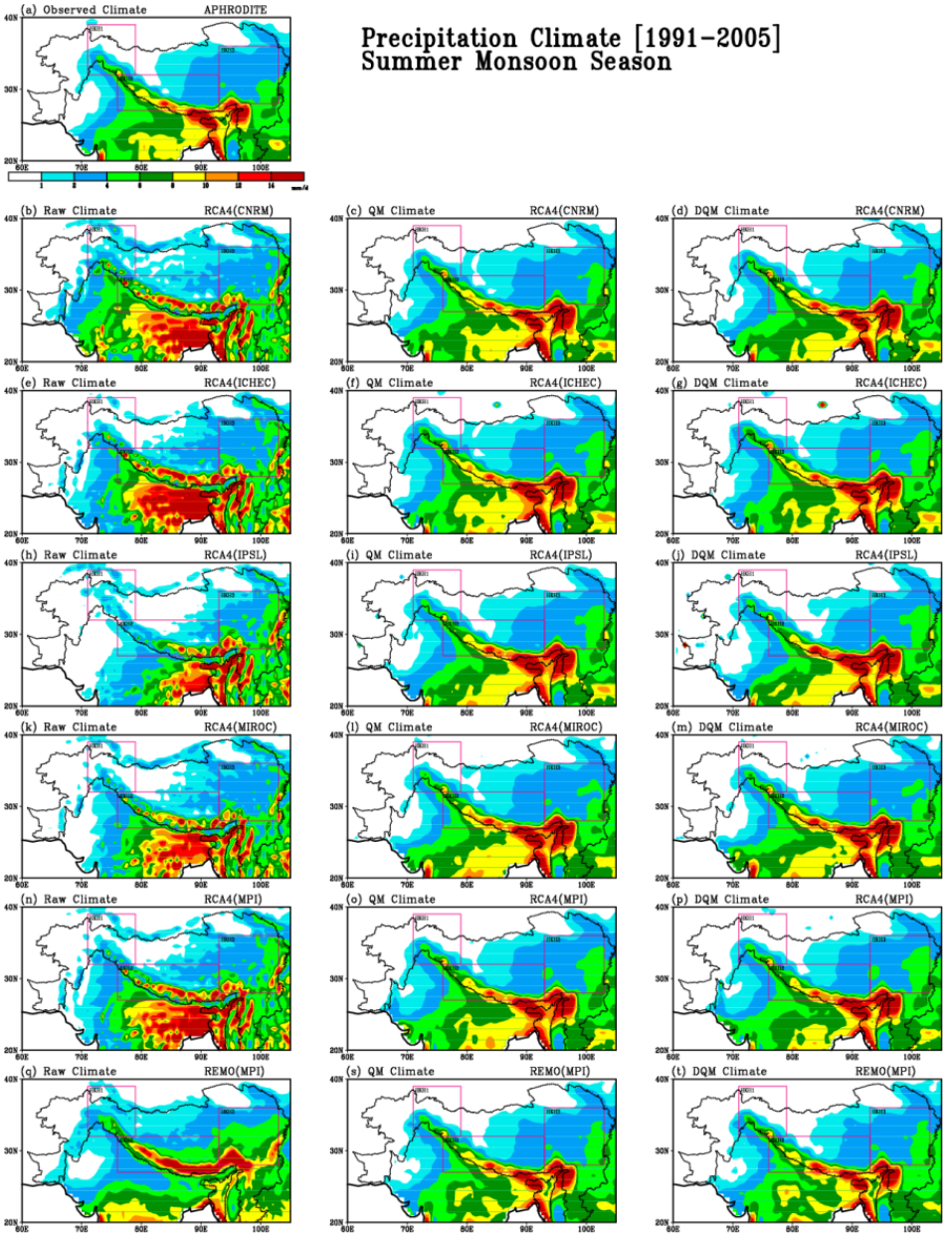
- Removes long-term mean trends from projected values variables
- Apply quantile mapping for the Detrended values,
- introduced the removed long-term mean trends

List of Regional climate model driven with CIMP AOGCM

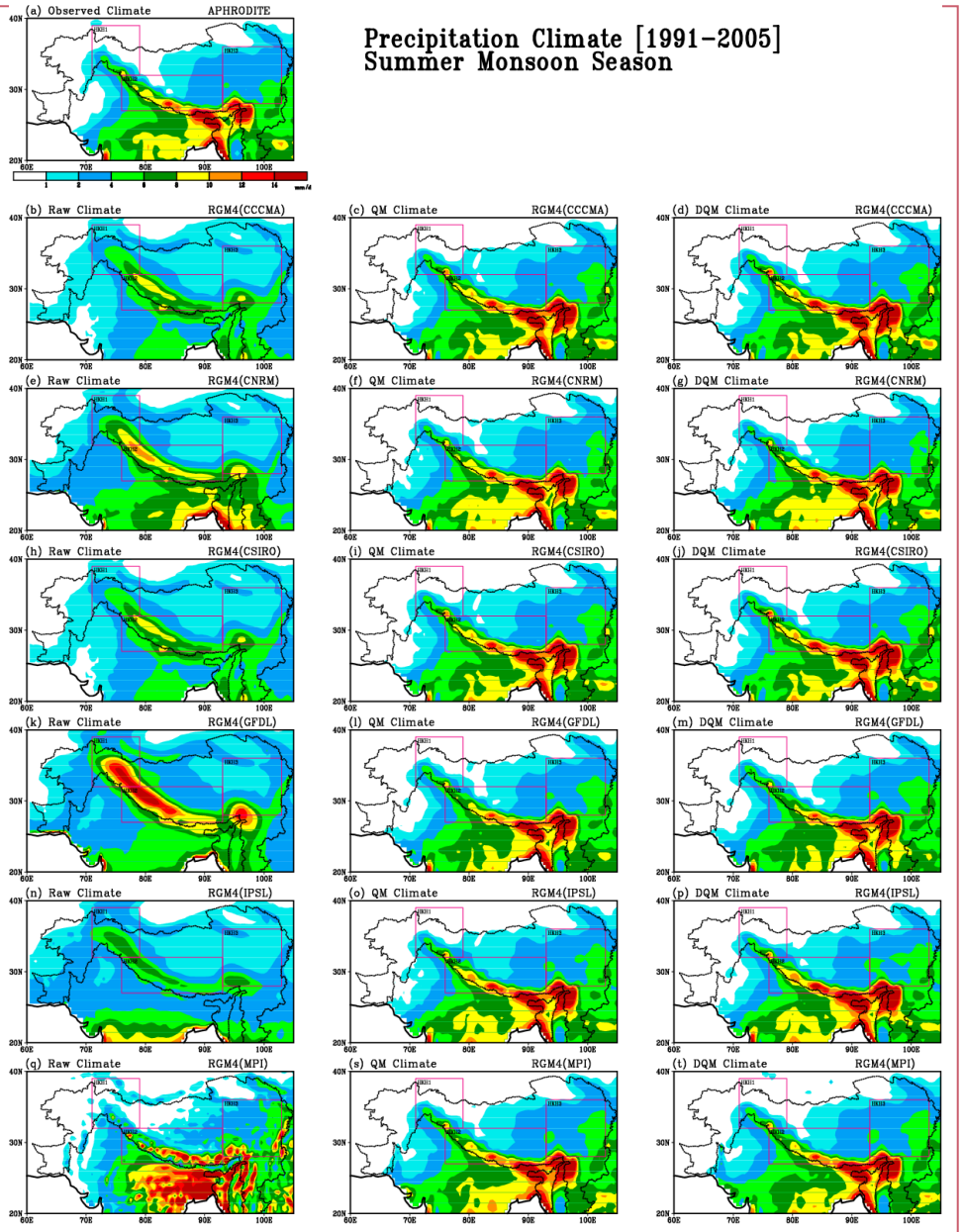
CORDEX South Asia RCM	Contributing CORDEX Modeling Center	Driving CMIP5 AOGCM (see details at https://verc.enes.org/data/enes-model-data/cmip5/resolution)
IITM-RegCM4 (6 ensemble members)	Centre for Climate Change Research (CCCR), Indian Institute of Tropical Meteorology (IITM), India	CCCma-CanESM2
		NOAA-GFDL-GFDL-ESM2M
		CNRM-CM5
		MPI-ESM-MR
		IPSL-CM5A-LR
		CSIRO-Mk3.6
SMHI-RCA4 (5 ensemble members)	Rosssy Centre, Swedish Meteorological and Hydrological Institute (SMHI), Sweden	ICHEC-EC-EARTH
		MIROC-MIROC5
		CNRM-CM5
		MPI-ESM-LR
		IPSL-CM5A-MR
MPI-CSC-REMO2009 (1 ensemble member)	Climate Service Center (CSC), Germany	MPI-ESM-LR

Mean climatology for JJAS precipitation for 1991–2005 for the raw RCM output and Bias corrected QM and DQM

- Calibration period - Jan 1976 to Dec1990
- Validation. period - Jan 1991 to Dec 2005



Mean Climatology for JJAS precipitation for 1991–2005 for the raw RCM output and Bias corrected QM and DQM



The TM index using QM (left)
an DQM (middle)
Added value (right)

$$TM = |\Delta P_{BC} - \Delta P_{OBS}| - |\Delta P_{raw} - \Delta P_{obs}| \; mm\; day^{-1}$$

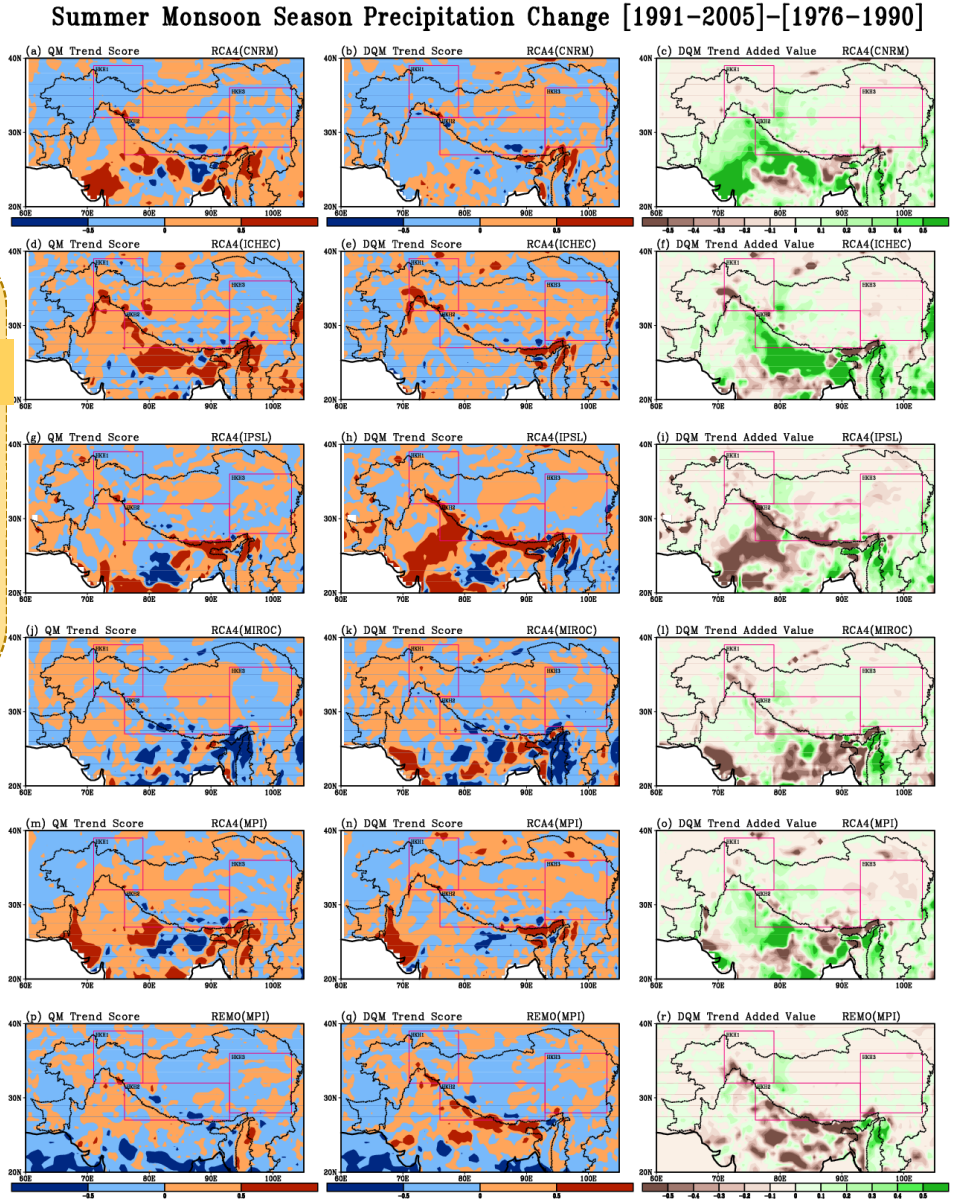
$$\Delta P_x = \Delta \overline{P}_{(1991-2005)} - \Delta \overline{P}_{(1976-1990)}$$

TM values > 0 bias correction degrades
TM values < 0 bias correction improves

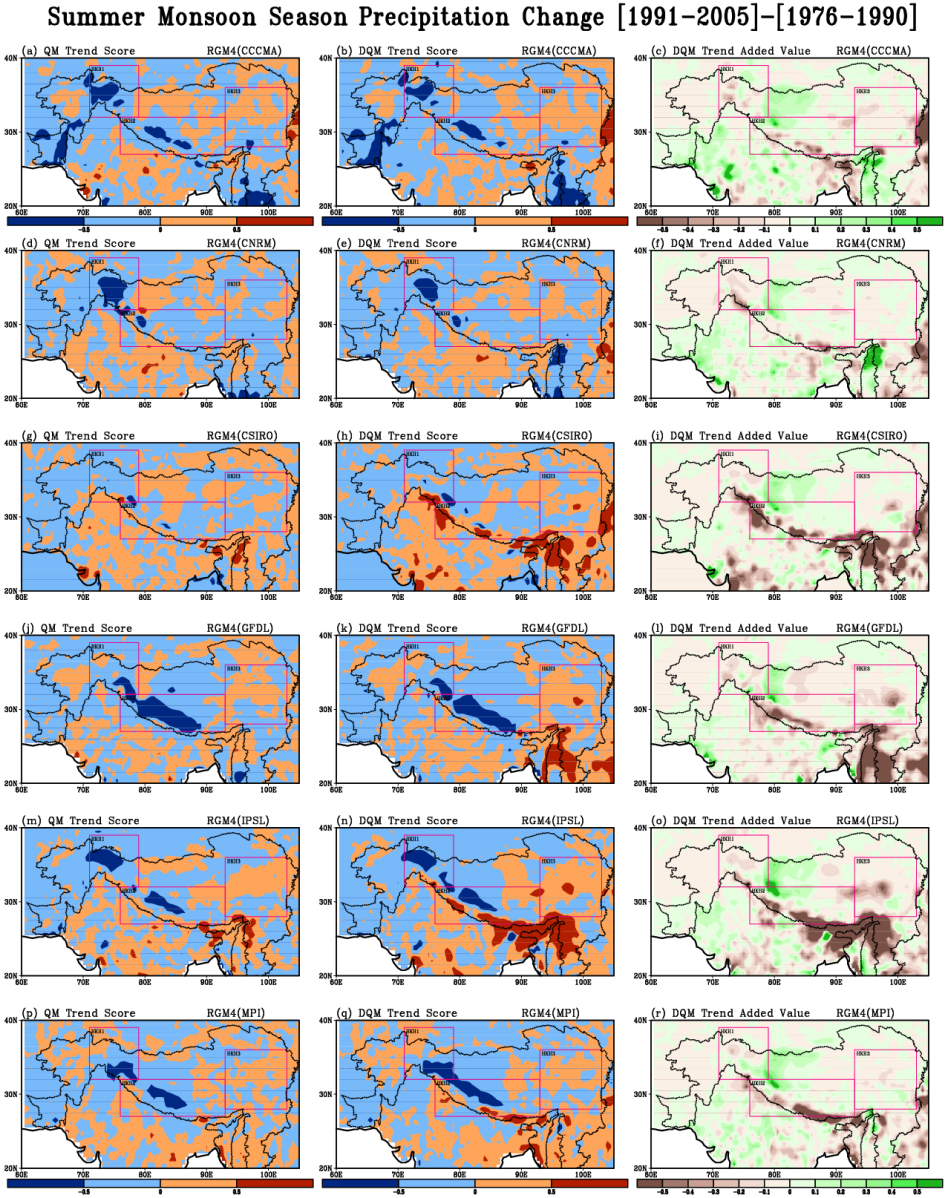
In order to quantify the added value of Detrended Quantile Mapping over the QM.

$$Added\ valued = TM_{DQM} - TM_{QM}$$

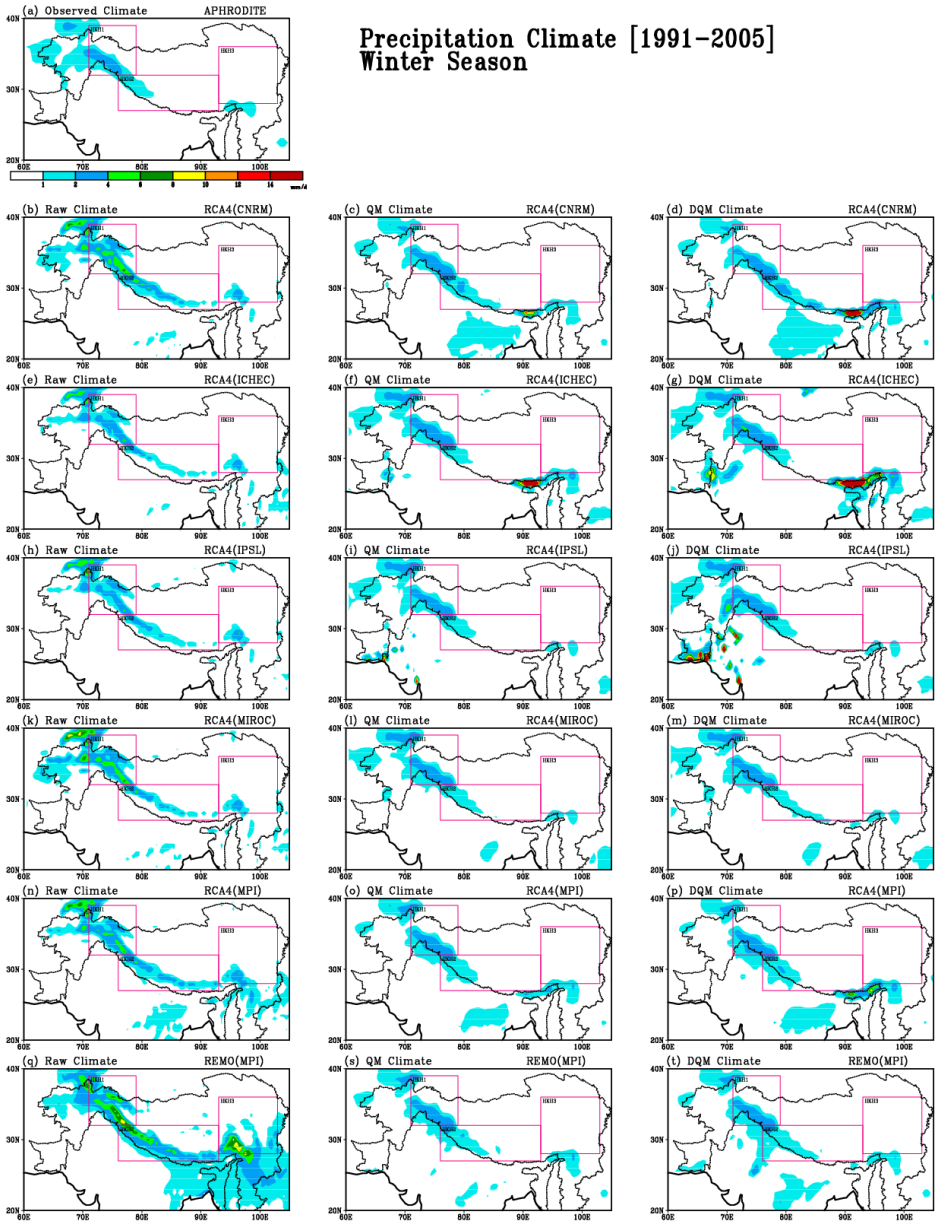
If TM index is smaller for DQM than QM , if AV is positive



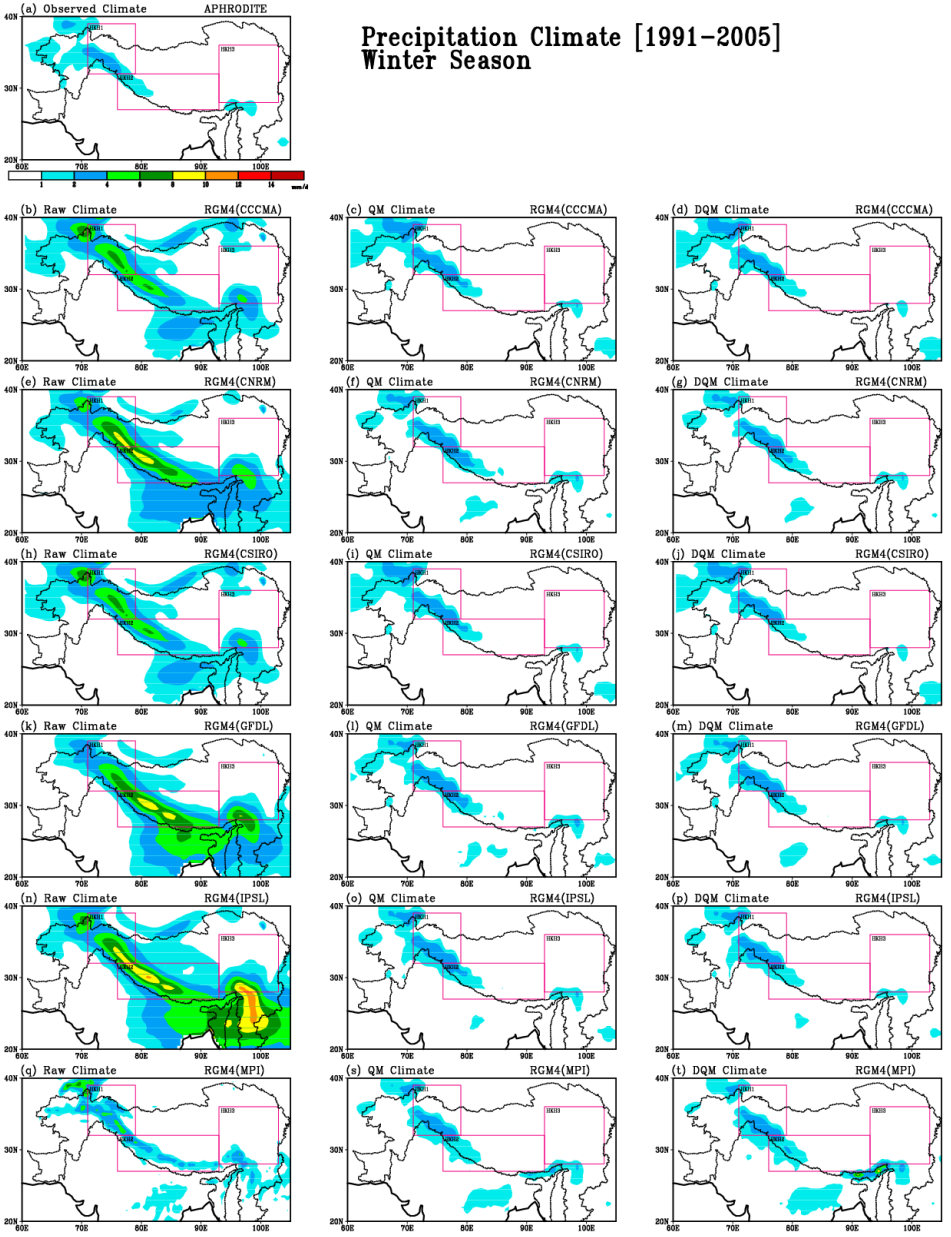
The Trend Modification index using QM (left) and DQM (middle) Added value (right) for Summer



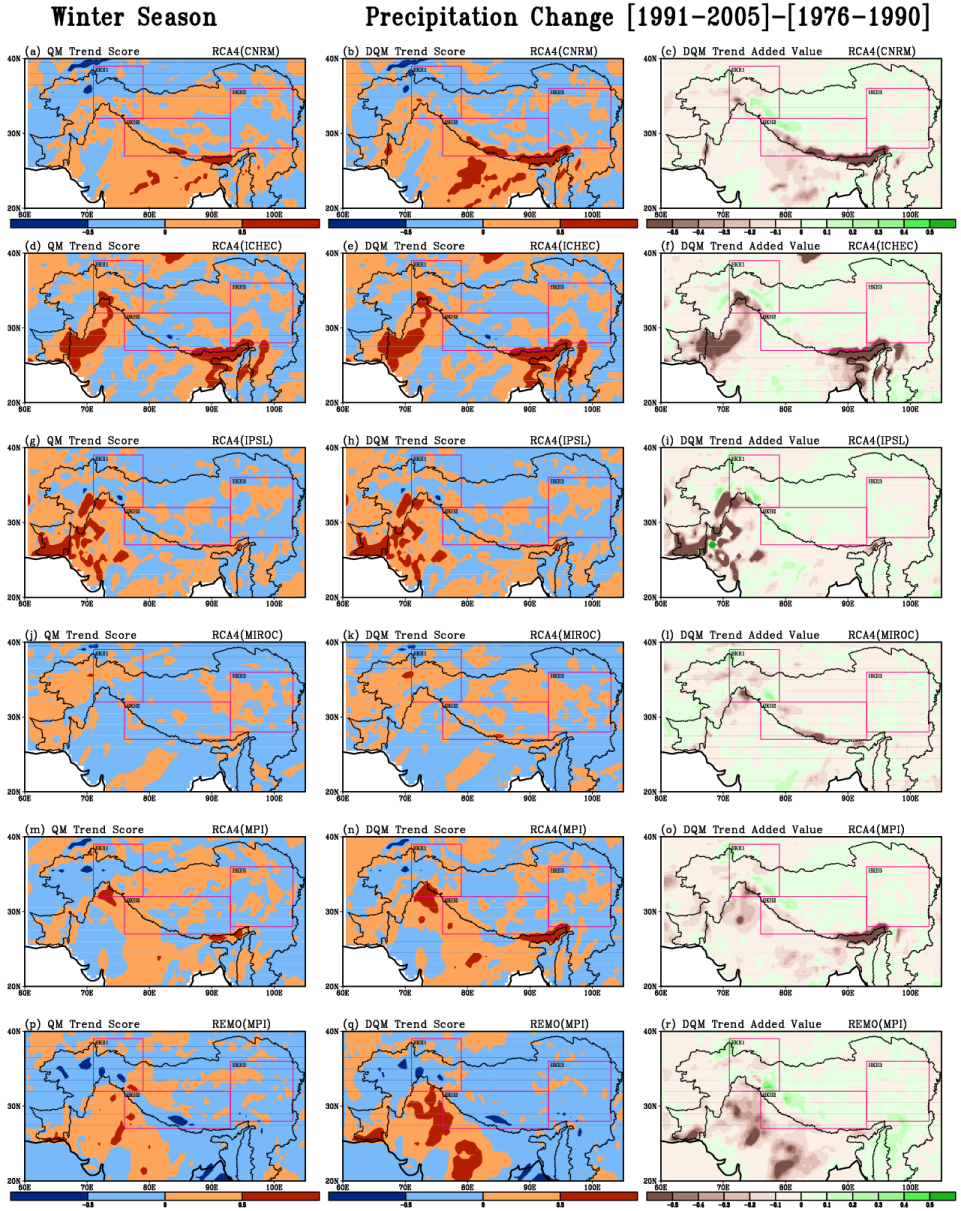
Climatology for DJF precipitation for 1991–2005 for the raw RCM output and Bias corrected QM and DQM



Climatology for DJF precipitation for 1991–2005 for the raw RCM output and Bias corrected QM and DQM



The Trend Modification index using
QM (left) and DQM (middle)
Added value (right) for Winter



The Trend Modification index using
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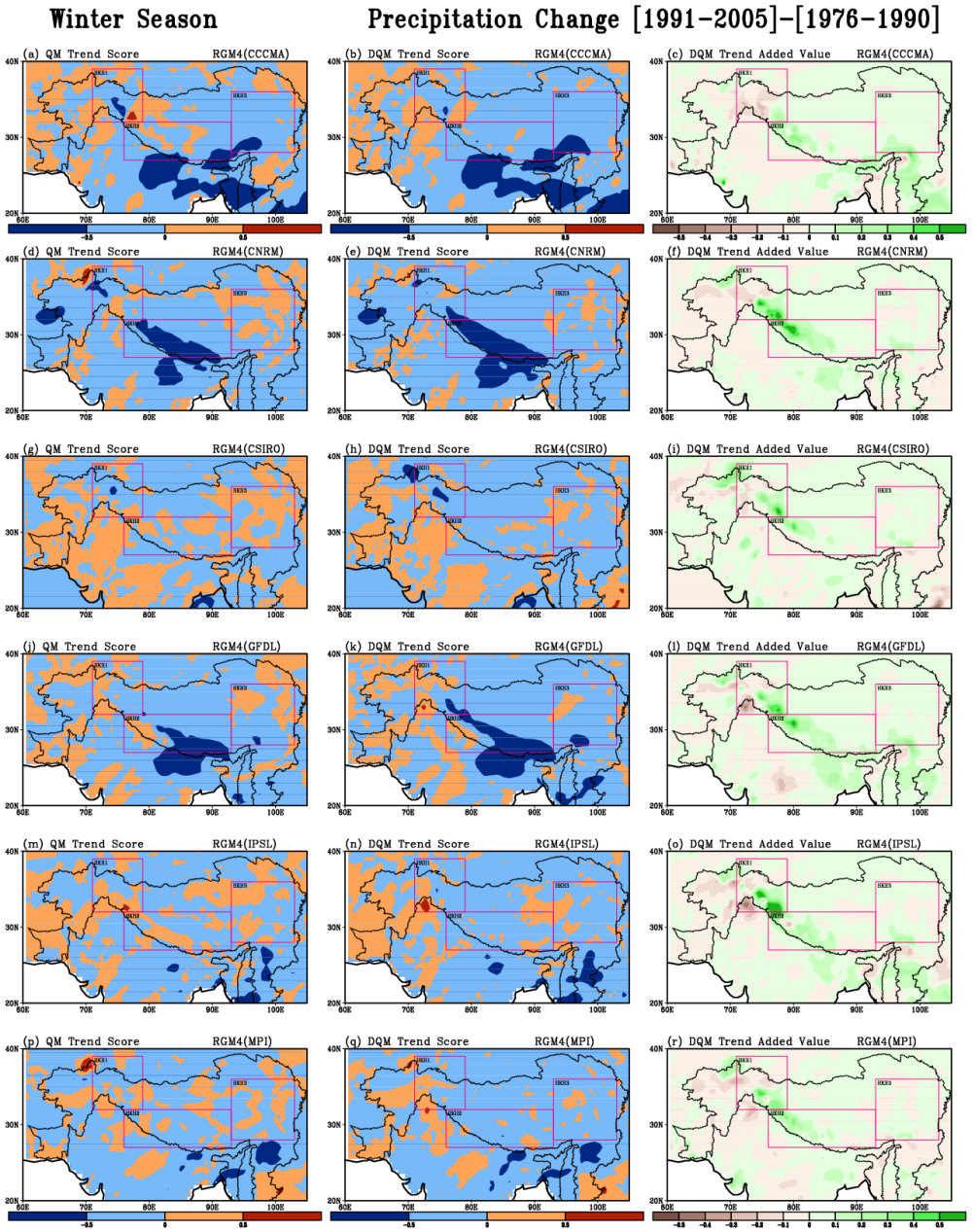
Added value (right) for winter



Summary

• Trend modification index with improved or degraded change vary from model to model as well as region to region for both QM and DQM.

•No clear difference can be seen to apply Detrended Quantile mapping over Quantile mapping .

Thank You