Evaluation of Extreme Precipitation Climate Indices over HKH in CMIP5 and CMIP6 Models

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Highly complex system — Mountainous terrain

Water tower of Asia — sources major Asian rivers

Glacier (Third pole) — Permanent ice cover with a varying degree of topographic complexity

Unique geographical setting with steep southern slopes and, bare and gentle northern slope

Orographic barrier separating the wet Indian subcontinent from the arid Tibetan Plateau

Modulates global weather patterns and is a climate regulator for much of Asia via interaction between atmosphere and topography
Climate warming enhances snow avalanche risk in the Western Himalayas

Changes in western disturbances over the Western Himalayas in a warming environment

Time-series meridional temperature difference (30N–35N minus 50N–55N) (K) averaged over the Eurasian longitudes (20E–100E) for the DJFMA season a 500 hPa, b 200 hPa, c Map showing the difference of baroclinic instability index (C) between the second half (1980–2011) and the first half (1948–1979)

Kulkarni et al. (2018)
Taylor skill score (TSS) was used in ranking the models.

\[
TSS = \frac{4(1 + PCC)^2}{\left(\frac{\sigma_{\text{Model}}}{\sigma_{\text{Observation}}} + \frac{\sigma_{\text{Observation}}}{\sigma_{\text{Model}}}\right)^2 (1 + R_0)^2}
\]

Data, Models, Methodology

Extremes indices, defined by the Expert Team on Climate Change Detection and Indices (ETCCDI)
The CMIP6 and CMIP5 model ensembles generally reproduce the overall pattern of the seasonal evolution of precipitation in the HKH.
Statistical performance for annual and seasonal extreme precipitation climate indices

CMIP5 Models

CMIP6 Models
Improvement (%) in CMIP6 over CMIP5 Vs APHRODITE

Improvement Parameter (IP)

\[ IP = 1 - \left( \frac{RMSE_{CMIP6}}{RMSE_{CMIP5}} \right) \]
Statistics of CMIP5 and CMIP6 for Climate Indices

Index of Agreement (IOA)

\[
d_r = \begin{cases} 
1 - \frac{\sum_{i=1}^{n} |P_i - O_i|}{c \sum_{j=1}^{n} |O_j - \bar{O}|}, & \text{when} \\
\frac{\sum_{i=1}^{n} |P_i - O_i|}{\sum_{j=1}^{n} |O_j - \bar{O}|} - 1, & \text{when} \\
\frac{\sum_{i=1}^{n} |P_i - O_i| > c \sum_{j=1}^{n} |O_j - \bar{O}|}{c \sum_{j=1}^{n} |O_j - \bar{O}|} 
\end{cases}
\]

(C. J. Willmott et al., 2012)
Box plots for best multi-model mean changing rates in future times over the historical period

**Historical period**

*(1980-2005)*

**Entire HKH**
Extreme events are linked with the slow-moving amplified Rossby waves, known as quasi-resonant amplification (QRA) - Kornhuber et al. (2019), Mann et al. (2018) and Coumou et al. (2014)


For Posdoctoral Program

Who can apply?

- Students with a PhD degree (or have submitted their PhD thesis)
- An applicant should have a PhD degree in Atmospheric Sciences/ Earth and Environmental Sciences/ Physics/ Geophysics/ Meteorology/ Hydrology/ Climate Sciences/ Mathematics/ Remote Sensing/ Computer Sciences/ Artificial Intelligence/ Data Sciences.

How to apply?

- Interested candidates may contact Dr. Raju Attada and e-mail their resume (with one-page summary of research pursued) and a brief write-up on research proposal (<1,000 words) to rajuattada@iisermohali.ac.in.
- We strongly encourage the interested candidates to apply for fellowships from IISER Mohali

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