WHAT DOES THE FUTURE CLIMATE LOOK LIKE IN WESTERN NEPAL?

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CHALLENGE

Long-term water resource development and climate adaptation require a comprehensive understanding of the future climate and its impact. However, **a rigorous analysis of the future climate in Western Nepal, using state-of-the-art regional climate models (RCMs), is lacking.** Past studies have characterized the future climate for the greater Hindu Kush Himalayas, based on lower resolution global climate models (GCMs). RCMs are better suited than GCMs for climate impact assessments at a finer scale in Nepal's heterogeneous and steep terrain. However, **there is limited guidance on which and how many RCMs to use for generating robust climate projections for practical adaptation planning.**

NEXT STEPS

- What do these projections mean for different sectors? Using these projections, we are now analysing trends in future climate, unpacking sectoral impacts climate change and investigating climate extremes to identify strategies for building climate resilience.
- How do we make climate projections for Nepal more reliable? Long-term climate monitoring and rigorous evaluation of climate model (RCMs and GCMs) performance over Nepal is necessary to generate realistic climate projections.

RESEARCH APPROACH

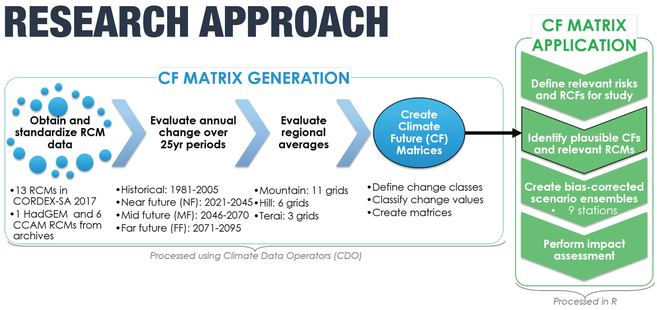

Figure 1. Two-tiered methodological framework for climate change impact assessments, using climate future (CF) matrices

We use the Australian climate future (CF) framework. First, to establish a basis for selection of RCMs, we generated CF matrices for the mountain, hill and Terai regions, summarizing projected changes from 19 RCMs. All RCMs were standardized, and regional spatio-temporal averages were evaluated for change in annual total precipitation (Δpr) and average maximum temperatures (Δtmax) over three 25-yr future planning horizons for representative climate futures (RCPs) 4.5 and 8.5. The regional Δpr and Δtmax were categorized into qualitative classes forming the CF matrix (Fig 2). Each cell in the matrix is called a *climate future*, representing a combination of Δpr and Δtmax classes.

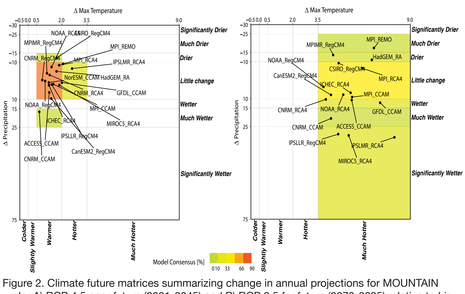

Figure 2. Climate future matrices summarizing change in annual projections for MOUNTAIN under A) RCP 4.5 near future (2021-2045) and B) RCP 8.5 far future (2070-2095) relative to historical period (1981-2005)

The 18 CF matrices were used to prepare application-specific future projections for water resources planning in Western Nepal, considering three relevant climate futures (RCFs):

- Low risk: CF with (slightly warmer OR warmer) + (wetter OR much wetter)
- High risk: CF with (hotter OR much hotter) + (much drier OR significantly drier)
- Consensus: CF with maximum model consensus indicating maximum likelihood

The RCF cells in each CF matrix are inspected to identify the corresponding relevant RCMs. If no RCMs are available, the RCF is ignored as implausible. Daily time series were extracted at the station latitude-longitude from the selected RCMs for each plausible RCF. The RCM time series were bias corrected and combined as equally weighted multi-model means to generate a single ensemble projection for each climate scenario. The procedure was applied across nine stations to generate ensemble projections at each station for 10 plausible future climate scenarios. The ensemble projections were used to characterize future climate of Western Nepal and assess the impact on future water availability.

INSIGHTS & INNOVATIONS

- Projections vary spatially across stations in the mountain, hill and Terai regions . The 18 CF matrices developed provide a basis for RCM selection and generation of location- and application-specific ensemble projections for robust climate impact assessment in Western Nepal.
- Variability in precipitation will increase, though the direction of change is not consistent across stations. Annual projections underestimate seasonal change in precipitation. High fluctuations in pre- and post-monsoon indicate a prolonged monsoon with sporadic rain in the winter months. (Fig. 3, left)
- Considering the uncertainty and seasonality in precipitation change, projects sensitive to precipitation should be required to conduct multi-scenario climate impact assessment extending beyond annual averages. Dependency of subsistence agriculture on rainfall should be reduced. Integrated measures to increase natural and artificial water recharge and storage should be emphasized.
- Average temperature is projected to increase across all stations and seasons. Mountains show the highest temperature increase, with values higher than projections for South Asia. Sector-specific impacts of high temperatures need to be identified to support adaptation planning. (Fig. 3, right)
- Spatial variability in climate change requires a spatially disaggregated assessment of the variability in climate risks and vulnerabilities faced by communities spread across the mountain, hill and Terai regions.

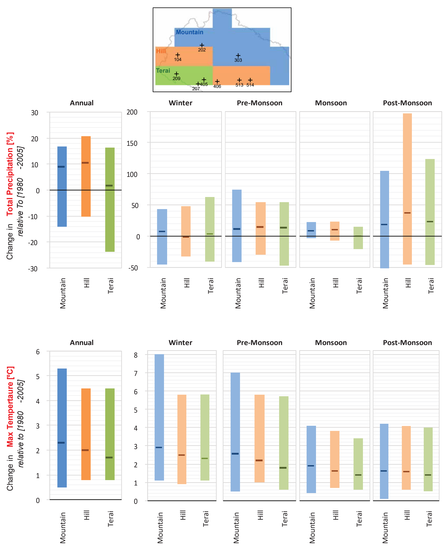

Figure 3. Projected changes in total precipitation and maximum temperature

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