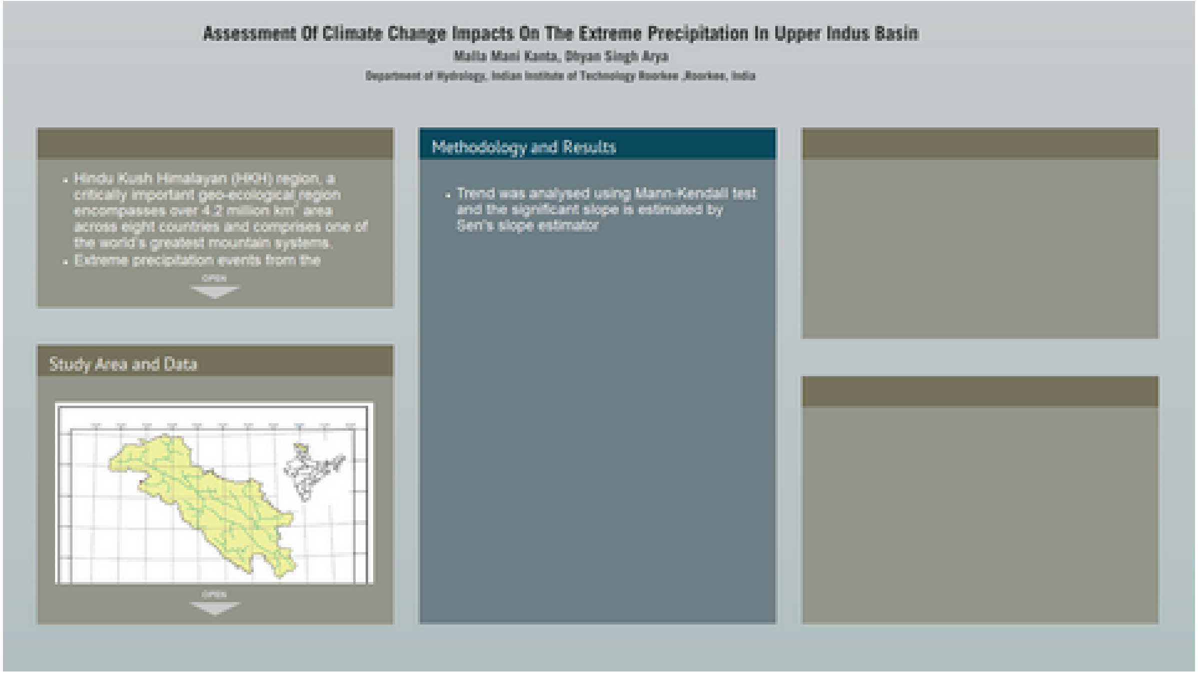
Assessment Of Climate Change Impacts On The Extreme Precipitation In Upper Indus Basin



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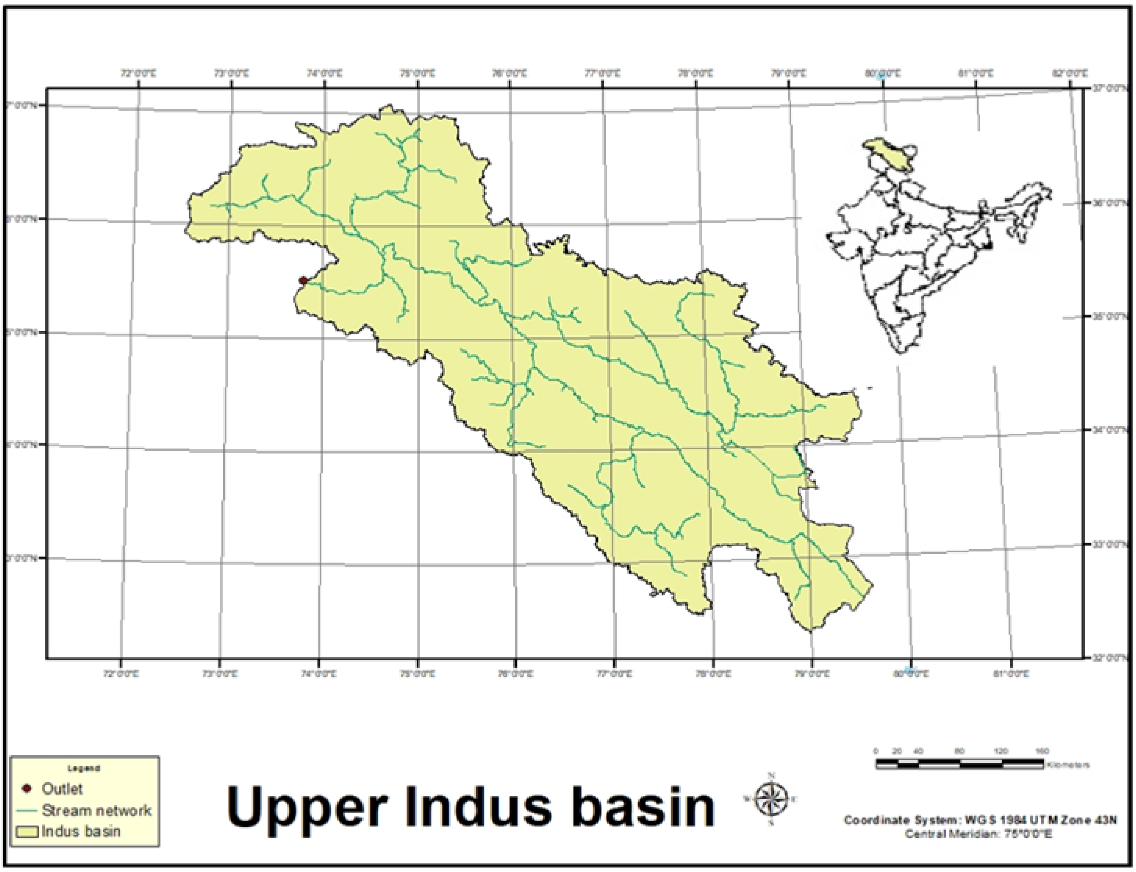
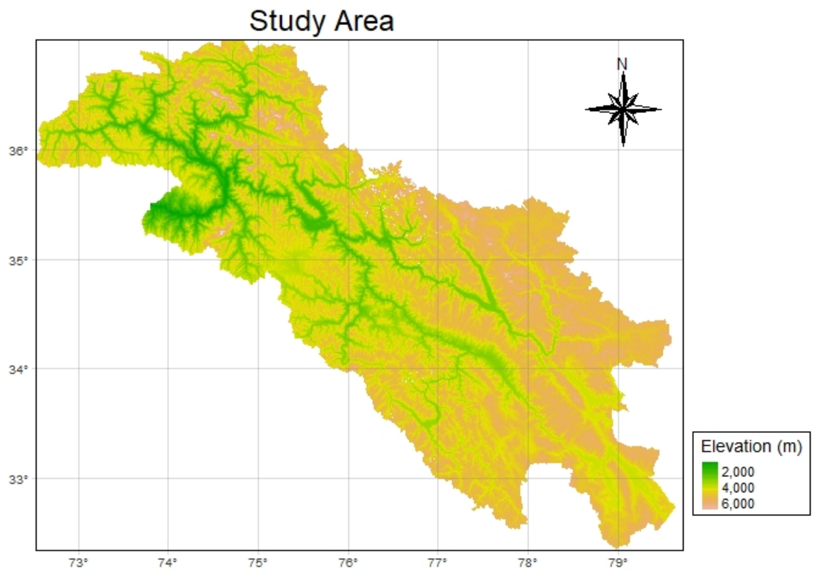
- Hindu Kush Himalayan (HKH) region, a critically important geo-ecological region encompasses over 4.2 million km^2 area across eight countries and comprises one of the world’s greatest mountain systems.
- Extreme precipitation events from the western disturbances have significant impacts on water management and ecosystem services in the Upper Indus basin, a part of the Hindukush Himalayan region.
- The recorded total annual rainfall in the Upper Indus Basin (UIB) varies widely in amount, ranging from an annual total of ~1400mm at stations in the southern slopes of the Himalaya to<200mm at valley floor stations in the Karakoram(Nathan Forsythe et al., 2019).
- The upper basin is mainly dominated with rugged and high mountains including the cold desert regions of Tibet and Ladakh.

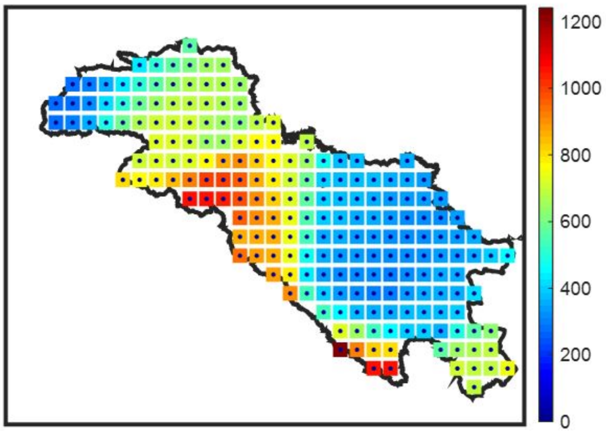
STUDY AREA AND DATA





- IMD New High Spatial Resolution (0.25X0.25 degree) Long Period (1901-2019) Daily Gridded Rainfall Data Set Over India is used in the current study

Mean Precipitation



METHODOLOGY AND RESULTS

- Precipitation based ETCCD Indices were calculated for the entire study area.
- Trend was analysed using the Mann-Kendall test, and the significant slope is estimated by Sen's slope estimator for all the Indices.

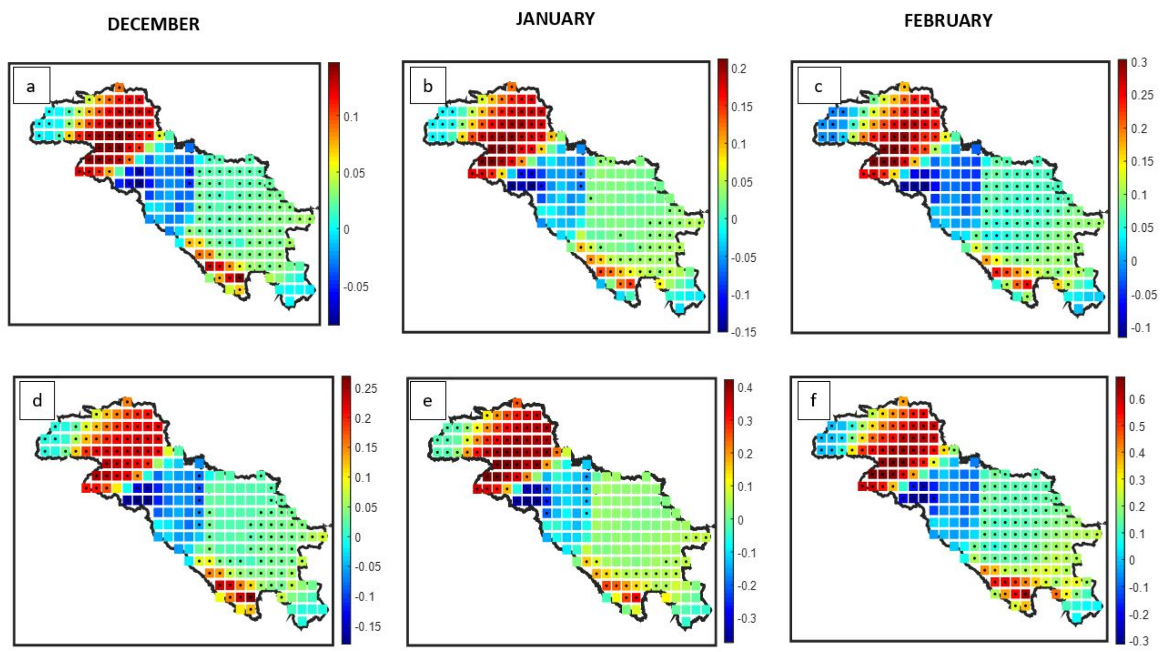


Figure 1: Grid wise trends in maximum one-day precipitation (Rx1 day) in the months a)December,b)January,c)February and maximum 5-day precipitation (Rx5 day) in the months d)December,e)January and f)February for the time period 1901-2019. (Black dots indicates significant trends at a 5% significance level)

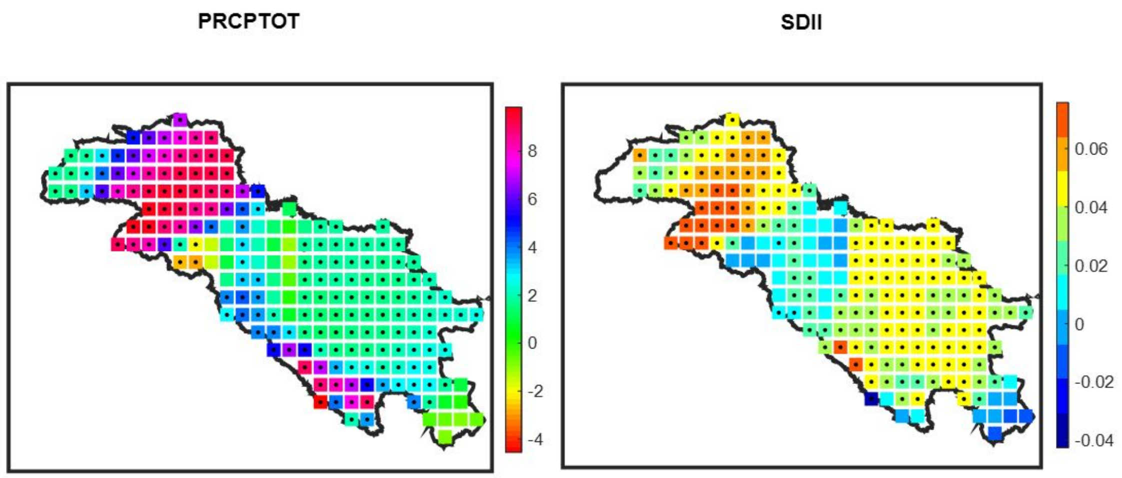


Figure 2: Grid wise trends in Annual total precipitation in wet days(PRCPTOT) and Simple precipitation intensity index (SDII)

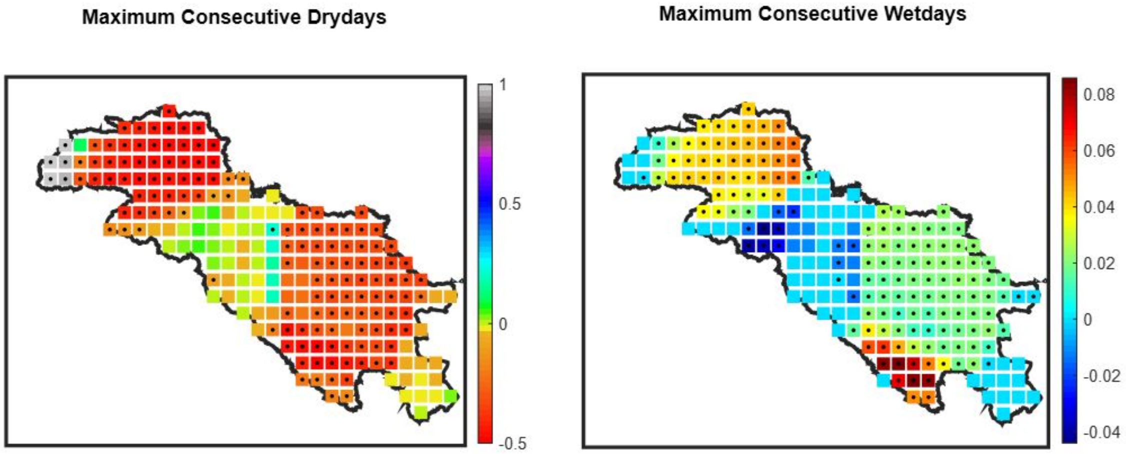


Figure 3: Grid wise trends in Maximum Consecutive Dry Days (CDD) and Wet days (CWD)

RESULTS(CONTD..)

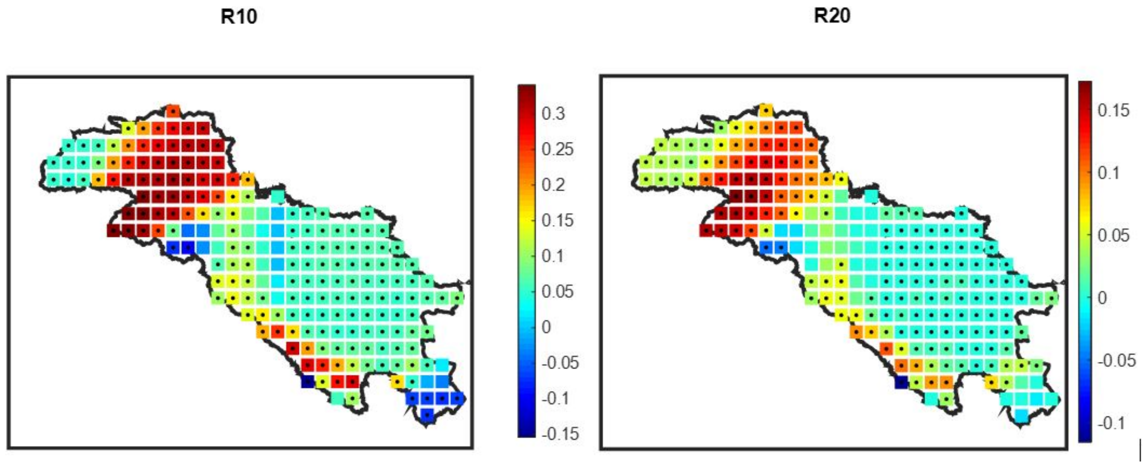


Figure 4: Grid wise trends in Annual count of days when PRCP≥ 10mm (R10) and Annual count of days when PRCP≥ 20mm (R20)

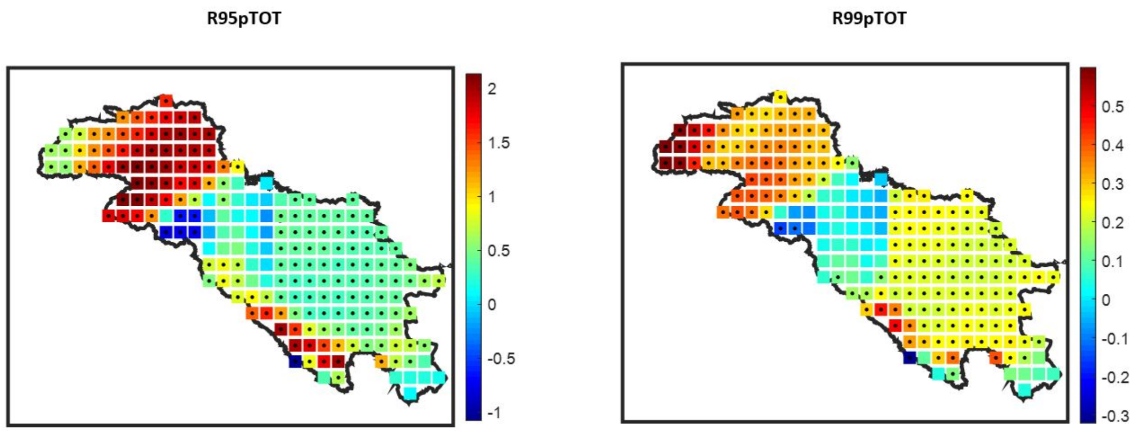


Figure 5: Grid wise trends in Annual total PRCP when RR > 95p (R95pTOT) and Annual total PRCP when RR > 99p (R99pTOT).

CONCLUSIONS

- Overall wetness is increasing in the Northwest part of the study area.
- Intensities of Maximum 1 days precipitation and 5 days precipitation is increasing from December to February.
- Max 1 day precipitation is increasing at a higher rate than max 5 days precipitation in December whereas it is converse in January and February.
- Precipitation on wet days is increasing at a maximum rate of 8 mm/year in some parts of the study area.
- Amount of precipitation falling on Heavy precipitation days (R95pTOT) in increasing at a higher rate than Very Heavy precipitation days(R99pTOT).

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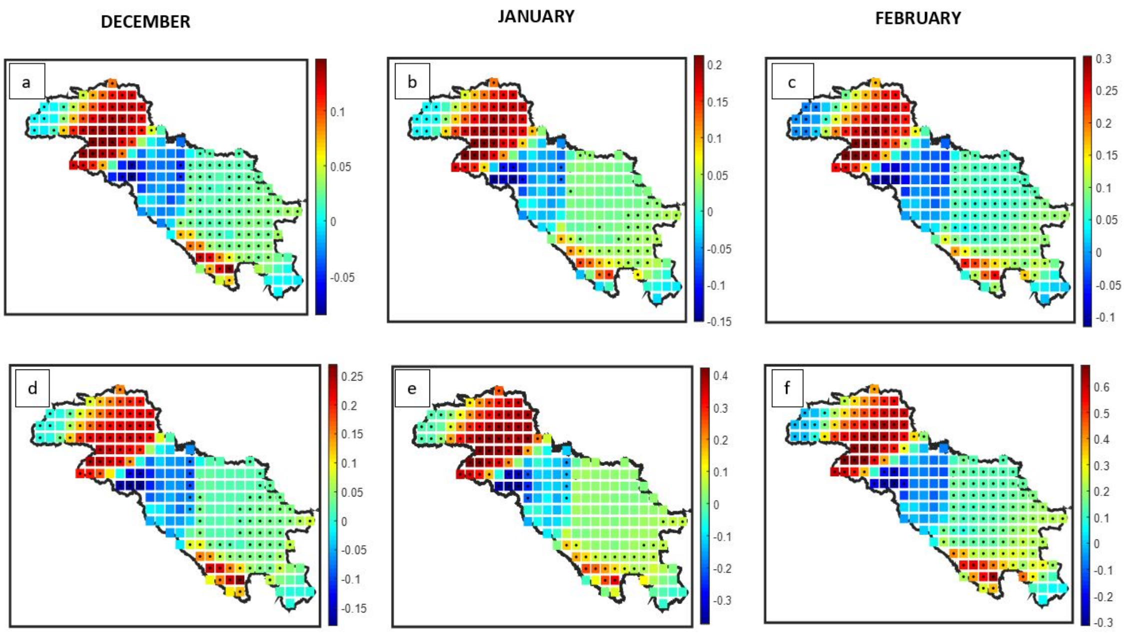
ABSTRACT

Extreme precipitation events from the western disturbances have significant impacts on the water management and ecosystem services in the Upper Indus basin, a part of the Hindukush Himalayan region. Further, there are changes in the duration, intensity, spatial extent and frequency of extreme events due to climate change. In this domain, a few studies have assessed the impact of climate change in the study area with limited data. There will be high uncertainty in the outcomes obtained from the investigation of extreme events with limited data. Therefore, a comprehensive analysis of extreme precipitation events from western disturbances considering high resolution with long-term data is required in the study area. Accordingly, In the present study, Precipitation based ETCCDI Indices are calculated for every year, and non-parametric Mann-Kendall test is applied Sen slope is calculated to detect the changes in the monthly precipitation during the winter season for the period 1901-2019. The findings of the present study reveal the northwest region has an increasing trend in RX1day extreme precipitation of 1.85 mm per decade in December, and the rate has amplified due to the effect of western disturbances in January and February. Also, the pattern of RX5day extreme precipitation is consistent in January and February. Overall the wetness in increasing over the north-west part of the study area In recent decades, the northwest region of the upper Indus basin had faced more extreme events with severe impacts due to western disturbances, and outcomes from the study can improve the understanding of extreme events.



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