

THE EFFECT OF ENSO ON PRECIPITATION EXTREMES IN THE UPPER INDUS BASIN, PAKISTAN



by

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ABSTRACT

The El Nino Southern Oscillation (ENSO) phenomenon is devastating as it negatively impacts global climatic conditions, which can cause extreme events, including floods and droughts, which are harmful to the region's economy. Pakistan is also considered one of the climate change hotspot regions in the world. Therefore, the present study investigates the effect of ENSO on extreme precipitation events across the Upper Indus Basin. For this purpose, 11 extreme precipitation indices (EPIs) have been considered and their relationship with two ENSO indicators of Southern Oscillation Index (SOI) and Oceanic Nino Index (ONI) has been analyzed at annual and seasonal scales. Statistical tests (i.e., MK and ITA) were used to observe the variations in EPIs.

The results revealed that Consecutive Dry Days (CDD) is increasing more than Consecutive Wet Days (CWD); overall, EPIs exhibited increasing trends except for Rx1 (Max. 1-day precipitation) and Rx5 (Max. 5-day precipitation) indices. ENSO indicators, including SOI and ONI, resulted in opposite correlations, as the SOI is pressure-related, and ONI is a temperature-related ENSO index. The results further showed that CDD has a significant positive correlation with SOI for most of the Upper Indus Basin (UIB) region, whereas, for the CWD, high elevated stations gave a positive relationship. A significant negative relationship was observed for the lower portion of the UIB. Rx1 and Rx5 indices were observed to have a negative relationship with SOI, indicating that El Nino causes heavy rainfall. R95p (Very wet days) and R99p (Extreme wet days) indices were observed to have a significant negative trend in most of the UIB. In contrast, high elevated stations depicted a significant positive relationship that indicates they are affected by La Nina conditions. Total precipitation (PRCPTOT) index exhibited a negative relationship with SOI revealing that the El Nino phase causes wet conditions in the UIB. ONI gave a significant positive relationship for UIB, reinforcing the idea that both indices exhibit more precipitation during El Nino. The above observations imply that while developing policies to cope with the climate change impacts, the effects of ENSO should also be considered.