



## **Explaining precipitation variability in the Indus River basin**

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The complex hydrological network of the Indus River basin has provided water for agricultural purposes since the establishment of the first villages and complex urban societies in the area (the Indus Civilisation, c.4.6-3.9 kyr BP). To understand precipitation patterns and variability during the transient Holocene and to investigate a possible multi-decadal drought toward the end of the Indus Civilisation apogee, we use climate model simulations to study precipitation seasonality and changes in climate dynamics. PMIP3's models simulate a large range of changes across the Holocene, and includes an even larger variability in the representation of the present day climatic mean. Therefore, we have developed metrics characterising present day precipitation variability that can assess climate model abilities and have the potential to statistically correct their results.

The northern part of the Indus River basin is a buffer zone between extra-tropical westerly activity and south-easterly monsoon influence that overlaps with major orographic features. We investigated the atmospheric dynamic associated with each component, as well as their coupling, mainly using ERA-Interim reanalysis at daily, monthly and annual timescales. We first show that orographic-led wind convergence alone is sufficient to explain precipitation generation at the basin scale, with little variability between the seasons. Then we characterise the influence of upper-level western disturbances on winter precipitation. We also show that summer synoptic activity is affected by a tropical/extratropical interaction. Finally, we address the question of large-scale teleconnections and inter-annual variability in relation to previous results.