Atmospheric blocking modulates the odds of heavy precipitation over Pakistan

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Floods or wet spells have increased over Pakistan in recent years, however a long-term classification of large-scale and synoptic-scale configuration for these events has been lacking. In this study, a total of 53 wet spells during the period of 1951-2015 over the core monsoon domain of Pakistan are identified. Based on daily geopotential height fields from NCEP/NCAR re-analysis, the dominant synoptic-scale systems, displaying distinct low-level circulation and moisture transport, are found during these wet spells over Pakistan. They are categorized as trough with low pressure system (LPS, 30 cases), trough without LPS (19 cases), and LPS only (4 cases) wet spells. Without the accompanying LPS over India, the trough tends to be deep and intrudes to south Pakistan with moisture transport mainly from Arabian Sea. In contrast, the trough is relatively shallow and interacts with presence of the LPS to steer moisture from the Bay of Bengal towards Pakistan. We found that subtropical trough associated with the blocking ridge over west Asia is an essential ingredient of wet spells over Pakistan. The patterns observed from wet spells over Pakistan are different from wet spells over the core monsoon domain of India, which is mainly dominated by LPS. The ridge development and blocking over Siberia is a precursor to wet spells over Pakistan and provides guidance for prediction.