Title:	Comprehensive analysis of thermal stress over northwest India: Climatology, trends and extremes
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Abstract:	Heat waves are quite frequent over the Indian subcontinent during the summer season (April–July) owing to an increase in anthropogenic activities and global temperatures. These extreme heat conditions induce a high level of outdoor discomfort, adverse health effects and mortality, depending on the degree of thermal stress. The present study investigates the climatology of thermal stress and its trends over northwest (NW) India during the summer. The Universal Thermal Climate Index (UTCI) derived from Human thErmAl comforT (ERA5-HEAT) dataset was used for the period of 1981–2019. The monthly and seasonal climatological mean of UTCI exhibits moderate to strong thermal stress over NW India (ranges from 27 to 34.5 °C) than in the rest of the country (below 25.5 °C), with a peak during the months of June (34.5 °C) and July (33.5 °C) months. The seasonal mean UTCI shows significant rising trends (0.9 °C per 39 years) over NW India and entire India (0.6 °C per 39 years), indicating that the thermal discomfort amplifies at a faster pace compared to the rest of India. Similar rising trends are also noticed in the major cities of the study region. Surface temperature and relative humidity also exhibit a substantial increasing trend, which resulted in the intensification of thermal discomfort over NW India. Furthermore, the number of thermal discomfort days over NW India exhibits an increasing trend during 1981–2019. The composite analysis of UTCI greater than 32 °C (referred to as strong heat stress) depicts the highest thermal discomfort conditions in NW India. During summer, strong soil temperatures and high sensible heat fluxes over the study region may enhance the warming at the surface during UTCI (> 32 °C) days as it depends on surface radiative fluxes through the mean radiant temperature. In addition to high temperatures, a substantial amount of moisture transported by strong westerly wind from the Arabian Sea towards the NW India during strong thermal stress days seems to have contributed to high thermal stress conditions in the region.
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