

Opening insights: Flash drought monitoring under climate change in India

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Global occurrences of flash droughts, known for their sudden and intense onset, have seen an increasing frequency, thereby posing significant challenges in the field of drought monitoring. However, a definitive consensus regarding the status of flash droughts as the new norm remains elusive, as the occurrence of gradual, slow-developing droughts may also be increasing. This leads to short-term but devastating impacts on agriculture, water resources, and ecosystems. Despite the urgency to understand flash droughts, their drivers and characteristics in India have not been thoroughly explored. Additionally, the mechanisms, and underlying causes responsible for the rapid depletion of soil moisture during flash drought events are not well understood. This study proposes a flash drought detection method through standardization and threshold criteria which identify major flash drought events in India. The standardized precipitation index (SPI), standardized soil-moisture index (SSI) and standardized evaporative stress factor index (ESFI) and standardized solar-induced chlorophyll fluorescence index (SSIFI) are generated at short and mid-term time scales. The model utilized root-zone soil moisture, evaporation stress factor index (ESFI), precipitation and solar-induced chlorophyll fluorescence (SIF) as input variables continuous from 2001 to 2022 over India. The results indicate that most flash drought events occurred during the monsoon season (June to September) compared to the non-monsoon season (March to April; October to December) in India. Precipitation, evaporative stress factor, and the coupling of SIF significantly influence flash drought evolution, cascading to impact root-zone soil moisture dynamics. In conclusion, these findings emphasize the need to adapt to the increasing occurrence of faster-onset droughts in the context of a changing climate. Flash droughts can directly impact crop production and pose significant challenges for irrigation. Therefore, proactive measures are crucial to enhance resilience and preparedness in managing the consequences of these swift and intense drought events.

Keywords: Flash drought, climate change, and drought detection.