Syed Bakhtawar Bilal[1] and Vivek Gupta[1]

[1]Affiliation not available

April 16, 2024

Unraveling the Patterns: A Comprehensive Study on Drought Propagation in India

Syed Bakhtawar Bilal, Vivek Gupta

Abstract

The effects of drought have been devastating, ranging from destruction of crops to millions of deaths. These effects are only magnified in countries like India due to its heavy reliance on rainfall for agriculture. In 2002 and 1987 India faced some of the most severe droughts, effecting over 250 million Indians. Understanding the connections between various types of droughts is essential for a better understanding of drought. Droughts are mainly classified into four categories, meteorological drought, agricultural drought , hydrological drought , and socioeconomic droughts. To quantify different type of droughts, various drought indices have been formulated in recent years. These indices involve utilization of multiple climatic, hydrologic and geographic parameters such as soil moisture, precipitation, runoff etc. Indices like the GRACE Drought Severity Index (GRACE DSI) have become a benchmark for quantifying hydrological drought. GRACE DSI has found wide applications due to its accuracy and ease of use. Most of the studies in India analyze each drought as an individual event. This creates a need for understanding the linkages between different droughts. The main objective of this study is to identify the lag at which meteorological drought propagates to different droughts. The study also aims to find spatiotemporal variations of different drought types across India. The study also puts forth a modified form of GRACE DSI suitable for Indian subcontinent.

In our study we identified two droughts occurring between 2002 to 2017, one occurring within the start of our study, i.e., 2002 and another occurring in the year 2015. The SPI values in the Northern India, showed low precipitation in the year 2002, and then again in 2015. Also, the precipitation level declined with a considerable amount till year 2018. The downscaled GRACE DSI value also showed a declining trend over the year 2002-2017, with sudden drops in the water storage in the year 2002 and then again in the year 2015. Correlation analysis results revealed that the highest correlation was between the meteorological drought and the soil-moisture drought. The lag analysis showed that on an average meteorological drought took about one month to convert to soil-moisture drought, and around three months to propagate from soil moisture drought to hydrological drought.