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Satellites reveal increase in length of dry periods preceding monsoonal rains worldwide

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Drought is arguably the climate and weather phenomenon that most strongly impacts societies worldwide, causing severe socioeconomic and ecologic damage. While models unanimously project an overall increase in aridity and drought occurrence in the future, observational evidence has so far been inconclusive. The discrepancies between the various drought definitions and drought indices has been a major factor contributing to our low confidence in observed global trends. In this study we investigate global trends in meteorological dry spells using a simple and intuitive diagnostic: the maximum annual number of consecutive dry days (CDDs). In contrast to popular drought indices, the number of CDDs is a direct measure of rainfall scarcity, easy to quantify based on rain data, free of parametrizations, and independent from other proxies.

Previous analyses of trends in CDDs have been based on in situ rain gauges. While they may cover relatively long periods, they still suffer from spatial and temporal discontinuity, changes in accuracy in time, and various other quality-control issues. Because the time-span of available precipitation data records is constantly increasing, current satellite-based products are becoming an alternative to obtain spatially and temporally consistent global trends in CDDs. In particular, the Tropical Rainfall Measuring Mission (TRMM) has now been operational for over twenty years, thus offering a unique opportunity to analyze temporally-coherent single-platform precipitation data. Here, we use TRMM3B42 3-hourly data for 1998–2018, gap-filled with CMORPH-v1.0, to calculate and analyze the maximum annual number of CDDs worldwide.

Preliminary results show that 30–40% of the continental land monitored by TRMM experiences significant positive trends in the maximum annual number of CDDs. In depth analysis reveals that about 60% of this signal lies in regions that are affected by seasonal monsoons, and originates at most during the spring dry season. Further analyses relate the trends in CDDs to the intensity of monsoonal circulation and rainfall, and the role of land–atmospheric feedbacks. Our findings emphasize the vulnerability of global monsoon regions, where agriculture is mostly rainfed and population relies on rainfall availability and variability. An increasing length of dry spells as we progress into the future might lead to devastating socioeconomic and ecologic consequences in these regions.