# Monitoring global drought using the self-calibrating Palmer Drought Severity Index

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Hydrological drought results from a period of abnormally low precipitation, sometimes exacerbated by additional evapotranspiration (ET), and its occurrence can be apparent in reduced river discharge, soil moisture, and/or groundwater storage, depending on season and duration of the event. Here, an estimate of drought called the self-calibrating Palmer Drought Severity Index (scPDSI; Wells et al. 2004; van der Schrier et al. 2013) is presented, using precipitation and Penman-Monteith Potential ET from an early update of the CRU TS 3.26 dataset (Harris et al. 2014). Moisture categories are calibrated over the complete 1901–2017 period to ensure that "extreme" droughts and pluvials relate to events that do not occur more frequently than in approximately 2% of the months. This affects direct comparison with other hydrological cycle variables in Plate X that use a different baseline period.

After a notable peak in the overall area of drought across the globe in the second half of 2015 and all of 2016 (Osborn et al., 2017), drought area declined sharply by early 2017 (Fig. Y) before increasing to above-average once more (though still below the 2016 area). Extreme drought conditions affected at least 3% of global land area in every month of 2017, which was matched only by 1984, 1985 and 2016, but the geographical extents of moderate and severe droughts were not as unusual. The area where scPDSI indicates moderate drought began at 24% in January, fell below 22% by April before rising to around 25% in the latter months of 2017. Altogether, three months had moderate drought affecting more than 25% of the global land area, which has been matched or exceeded in 34 other years since 1950. The area of severe droughts exceeded 10% for ten months during 2016, which has been matched or exceeded in 12 other years since 1950. The 2017 values should be interpreted cautiously because additional observations will become available in due course. Drought area is just one of several ways to measure drought conditions, e.g. Heim (2018) shows that area-integrated drought *severity* or *duration* yield different rankings for the major droughts of the 20th and 21st centuries over the contiguous United States since 1900.

Extensive severe or extreme droughts affected all continents except North America during 2017 (Plate X). Starting in the western hemisphere, persistent moderate-to-severe drought conditions affecting south-central Chile (Garreaud et al. 2017) continued for the eighth consecutive year, though the geographic extent of extreme drought decreased with a slight increase in winter rainfall. Notably, severe drought in the semi-arid northeastern Brazil

(Jimenez-Muñoz et al. 2016) has continued in 2017 without much change in intensity and extent (Fig. Z). Moderate, or occasionally severe, drought was present across the Northern Hemisphere part of the South American continent (Plate X) though its intensity had eased compared with 2016 in most areas (Fig. Z).

Many coastal countries in Africa experienced drought in 2017, with the exception of some in East Africa. These droughts intensified compared with 2016 especially in southern Madagascar and the Western Cape of South Africa, the latter contributing to water supply restrictions in Cape Town in early 2018 (Le Page, 2018). The partial easing of drought further north, including in the Zambezi basin, is important given the increasing concentration of hydropower in the region that increases the risk of concurrent drought-related disruption to electricity production (Conway et al., 2017). There is a band across Eurasia around 45°N where 2017 conditions were drier than in 2016 (Fig. Z) that exacerbated drought in western and southern Europe. This resulted in many reported impacts, including reduced agricultural yields and hydroelectric power production in the Balkans and Albania[1], and wildfire and hydrological impacts in Iberia[2].

Parts of the Middle East remain in drought and particularly severe drought developed in SW peninsula of India (especially Kerala) during 2017[3]. Further north in Asia, severe drought conditions were present in the Krasnoyarsk region of Russia, extending down to northern China. Severe drought in Mainland Southeast Asia during 2016 was ended by much wetter conditions during 2017 (Plate X and Fig. Z). Much of Australia was drier than normal during 2017, with severe drought most notable in Tasmania.

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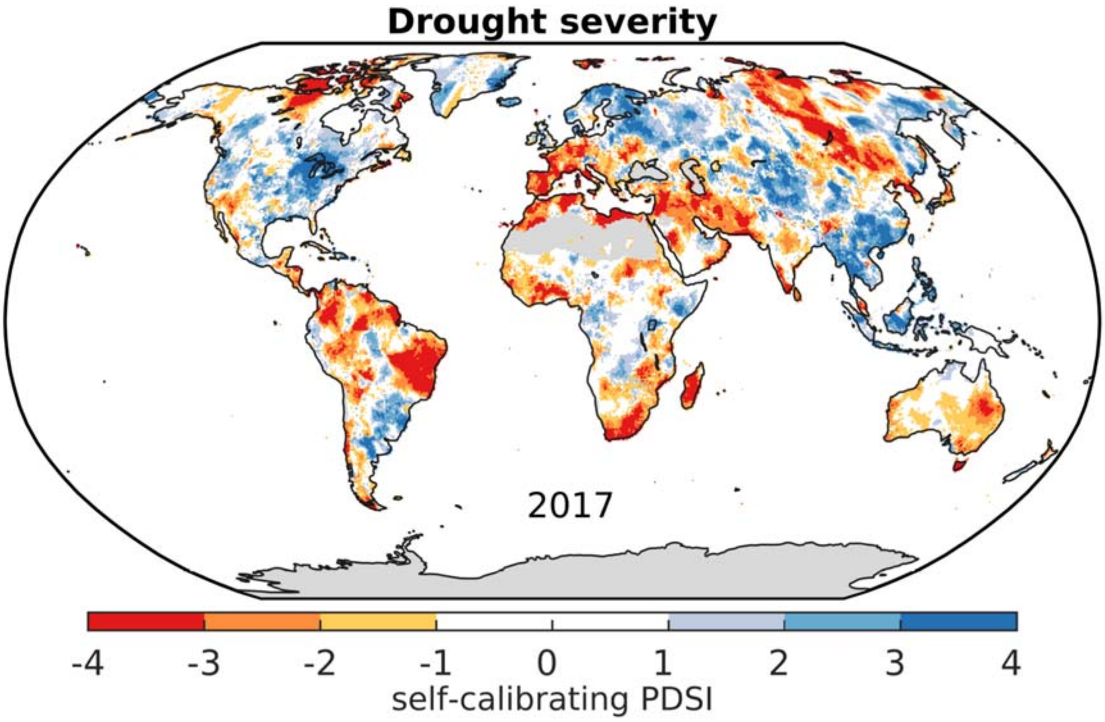


**PLATE X. Mean scPDSI for 2017. Droughts are indicated by negative values (yellow-red), wet episodes by positive values (pale-dark blue). No calculation is made where a drought index is meaningless (grey areas: ice sheets or deserts with approximately zero mean precipitation).**

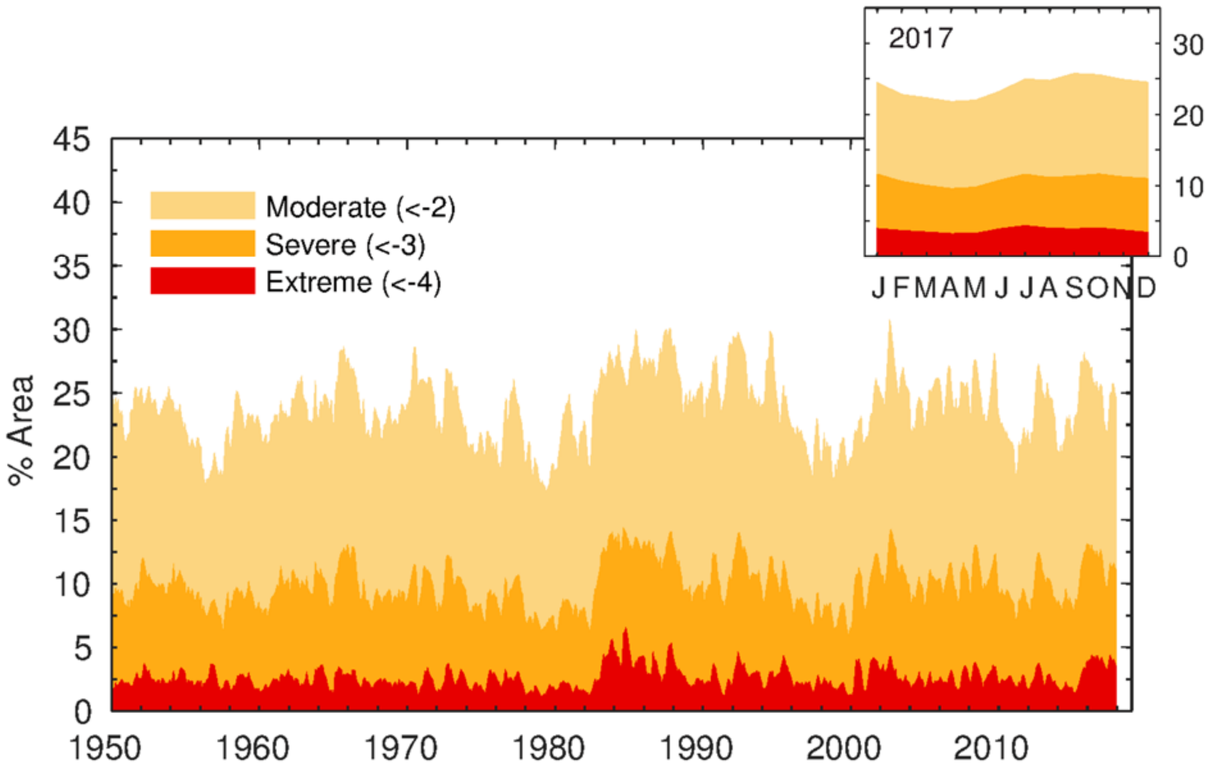


**FIG. Y. Percentage of global land area (excluding ice sheets and deserts) with scPDSI indicating moderate (<–2), severe (<–3) and extreme (<–4) drought for each month of 1950–2017. Inset: each month of 2017.**

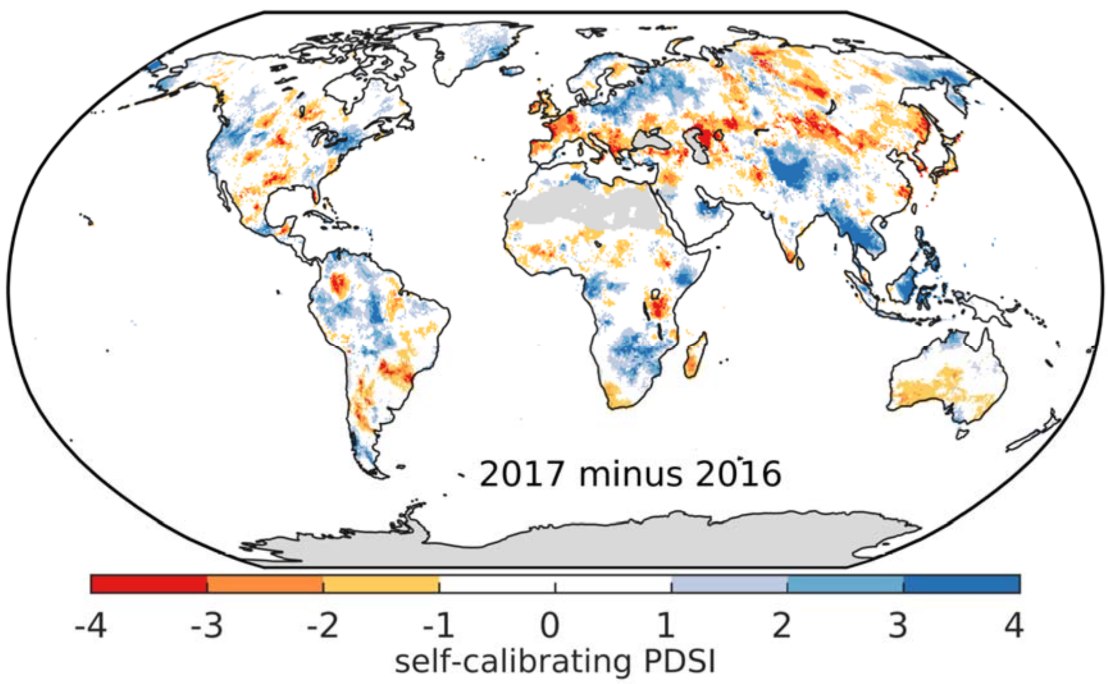


**FIG. Z. Change in drought from 2016 to 2017 (mean scPDSI for 2017 minus mean scPDSI for 2016). Increases in drought severity are indicated by negative values (yellow-red), decreases by positive values (pale-dark blue). No calculation is made where a drought index is meaningless (grey areas: ice sheets or deserts with approximately zero mean precipitation).**