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2.X. Monitoring global drought using the self-calibrating Palmer Drought Severity Index - J. Barichivich, T. J. Osborn, I. Harris, A. Gollop, G. van der Schrier and P. D. Jones

The self-calibrating Palmer Drought Severity Index (scPDSI) for 1950–2024 indicates a decrease in global drought severity and extent in 2024, following a historical peak in late 2023 (Barichivich et al., 2024; Fig. Y). Extreme drought (scPDSI ≤ -4) affected around 5% of the global land throughout 2024, down from over 7% in July–August 2023. Severe and extreme drought combined (scPDSI ≤ -3) stabilized near 12% of the global land area after reaching a record 17% in July 2023. Similarly, moderate or worse drought (scPDSI ≤ -2) affected about 23% of global land in 2024, compared to 28% in mid-2023. Most of this decline occurred in

regions where drought conditions of 2023 transitioned to normal or wetter conditions, particularly in the La Plata Basin, much of non-Mediterranean Europe, and the mid-latitudes of Central Asia (Fig. Z). Meanwhile, severe drought persisted in southwestern and northern North America, tropical South America, the Mediterranean and northwest Africa, southern Africa, parts of the Middle East, southwest Australia, and Mongolia (Plate X).

In Canada, 2024 ranks as the driest year on country-averaged yearly scPDSI for the 1950–2024 period. Severe to extreme drought conditions continued through California and Nevada, despite experiencing normal precipitation. Mexico and most countries across Central and South America experienced a mix of moderate drought and normal conditions (Plate X). On a country-averaged basis, 2024 ranks as the third driest year in both Peru and Brazil, with vast areas of the Amazon basin enduring extreme drought. By mid-October, the Rio Negro at Manaus, a major tributary of the Amazon River, recorded its lowest water levels since records began in 1902 (updated from Barichivich et al., 2018). In contrast, Chile, which had been enduring a prolonged megadrought, saw a recovery, with 2024 ranking as the 18th in average drought severity, following the driest years on record in 2021 and 2022.

Countries in northwest Africa experienced record or near-record drought levels (Plate X), with 2024 ranking as the driest year in the Canary Islands and Morocco, second driest in Algeria, and third driest in Tunisia. In southeastern Europe, it was the driest year in Greece and third driest in Bulgaria and Romania. In Italy, 2024 was ranked sixth driest for country-average drought severity, with the top six drought years all occurring in the last eight years.

Although uncertain due to sparser observations, moisture patterns in tropical Africa did not change much in 2024 with respect to 2023 (Plate Z). Southern Africa, experienced a

continuation of drought conditions seen since 2018 and its severity continued mostly as moderate (Plate X). In Australia, the moisture pattern in 2024 also remained similar to that in 2023, with the coastal parts of the country continuing under moderate drought (Plate X). Wet conditions seen through most of India and South East Asia since 2022 continued during 2024. Most of previous severe-to-extreme drought conditions through China and Kazakhstan shifted to normal or wet conditions, but continued in Mongolia.

Hydrological drought results from a period of abnormally low precipitation, sometimes exacerbated by a concurrent increase in evapotranspiration (ET). Its occurrence can be apparent in reduced river discharge, soil moisture, and/or groundwater storage, depending on season and duration of the event. Here, a metric called the self-calibrating Palmer Drought Severity Index (scPDSI; Wells et al. 2004; van der Schrier et al. 2013) is presented, using global precipitation and Penman-Monteith Potential ET from the CRU TS 4.09 dataset (Harris et al. 2020). A simple water balance at the core of the scPDSI estimates actual evapotranspiration, soil moisture content and runoff based on the input precipitation and potential loss of moisture to the atmosphere. Estimated soil moisture categories are calibrated over the complete 1901–2024 period to ensure that "extreme" droughts and pluvials (wet periods) relate to events that do not occur more frequently than in approximately 2% of the months. This calibration affects direct comparison with other hydrological cycle variables in Plate X that use a different baseline period. All country rankings mentioned above are based on the ranking of spatial averages of annual scPDSI for each country for the 1950–2024 period; pre-1950 data are not used for rankings because observational coverage is poor in some countries.

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Figures

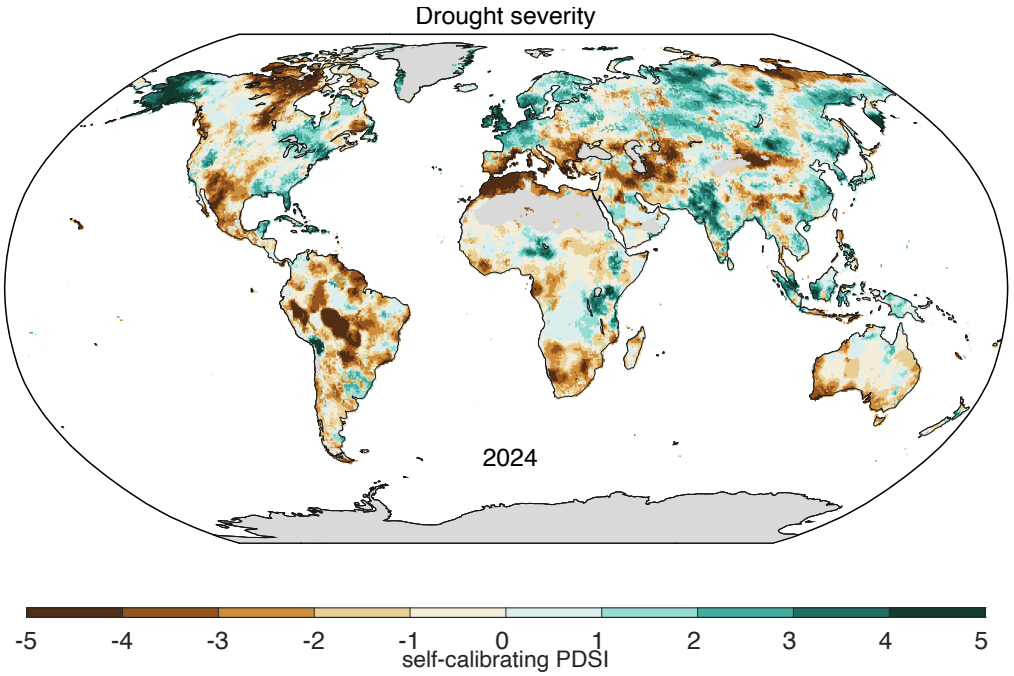

PLATE X. Mean scPDSI for 2024. Droughts are indicated by negative values (brown), wet episodes by positive values (blue). No calculation is made where a drought index is meaningless (grey areas: ice sheets or deserts with near-zero mean precipitation).

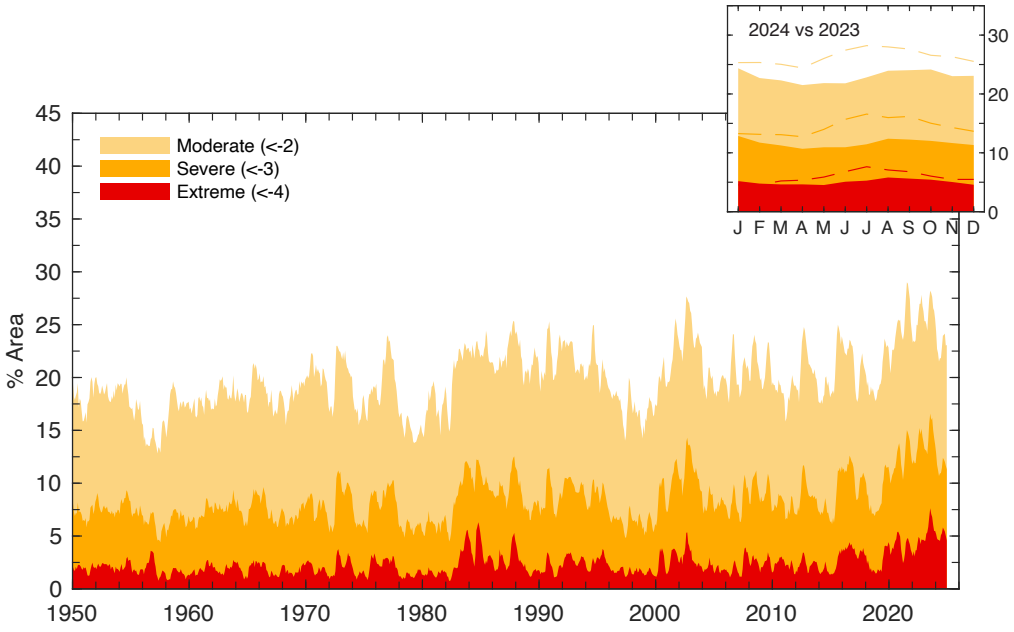

FIG. Y. Percentage of global land area (excluding ice sheets and deserts) with scPDSI indicating moderate (<–2), severe (<–3) and extreme (<–4) drought for each month of 1950–2024. Inset: each month of 2024 (shading) compared with 2023 (lines).

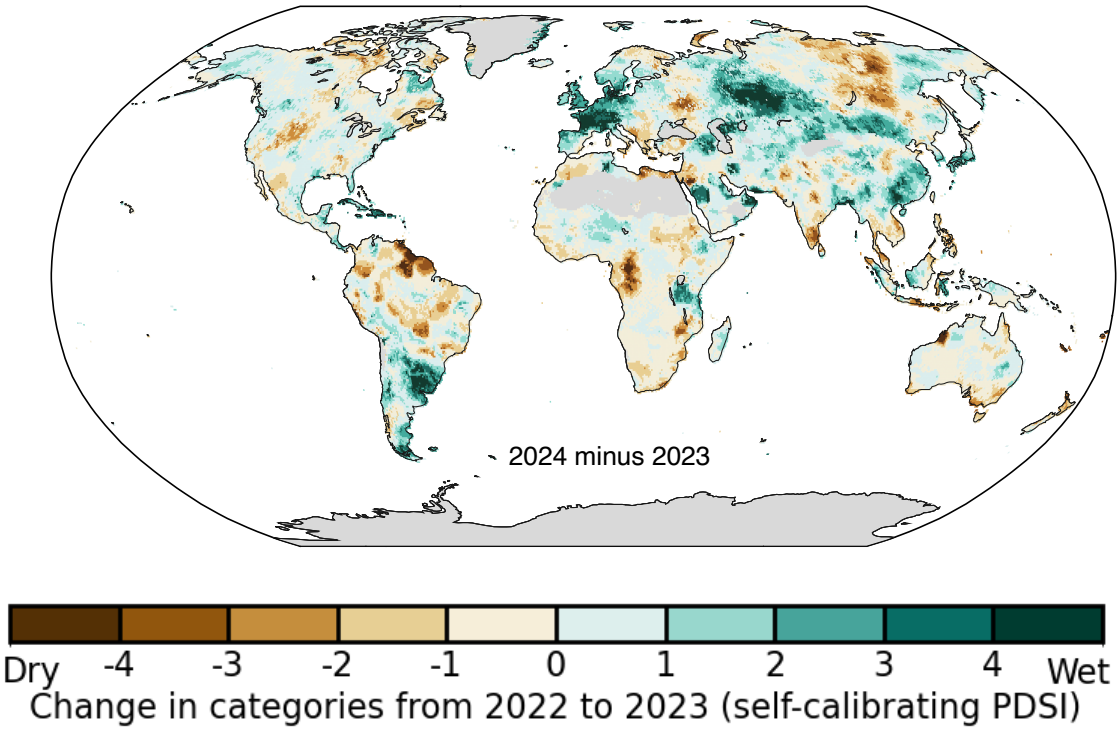

FIG. Z. Change in drought from 2023 to 2024 (mean scPDSI for 2024 minus mean scPDSI for 2023). Increases in drought severity are indicated by negative values (brown), decreases by positive values (blue). No calculation is made where a drought index is meaningless (grey areas: ice sheets or deserts with approximately zero mean precipitation).

Tables

Datasets used and their URLs

https://crudata.uea.ac.uk/cru/data/drought/

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Summary bullet points

- Following a historical record in global severe and extreme drought areas in 2023, drought severity and extent are decreased in 2024.

Supplementary Information