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Characterising recent drought events using current reanalysis and remote-sensing soil moisture products within a common framework

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Drought events cause multiple impacts on the environment, the society and the economy. Here, we analyse recent major drought events with different metrics using a common framework. The analysis is based on current reanalysis (ERA5, ERA5-Land, MERRA-2) and merged remote-sensing products (ESA-CCI soil moisture, gridded satellite soil moisture from the Copernicus Climate Data Store), focusing on soil moisture (or agricultural) drought. The events are characterised by their severity, magnitude, duration and spatial extent, which are calculated from standardised daily anomalies of surface and root-zone soil moisture. We investigate the ability of the different products to represent the droughts and set the different events in context to each other. The considered products also offer opportunities for drought monitoring since they are available in near-real time.

All investigated products are able to represent the investigated drought events. Overall, ERA5 and ERA5-Land often show the strongest, and the remote-sensing products often weaker responses based on surface soil moisture. The weaker severities of the events in the remote-sensing products are both related to shorter event durations as well as less pronounced average negative standardised soil moisture anomalies, while the magnitudes (i.e., the minimum of the standardised anomalies over time) are comparable to the reanalysis products. Differing global distributions of long-term trends may explain some differences in the drought responses of the products. Also, the lower penetration depth of microwave remote sensing compared to the top layer of the involved land surface models could explain the partly weaker negative standardized soil moisture anomalies in the remote-sensing products during the investigated events. In the root zone (based on the reanalysis products), the drought events often show prolonged durations, but weaker magnitudes and smaller spatial extents.