



Severe drought events inducing soil moisture depletion and evaporative stress across Poland during 1981-2019

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In recent decades, an increasing frequency and severity of meteorological and hydrological droughts has been observed in most parts of Europe, including Poland. This is due to (among other factors) increasing atmospheric water demand, longer rainless periods, especially during the growing season, and decreasing winter snow retention. In consequence, a widespread soil moisture drying cascades to evaporative stress limiting the ecosystems productivity. Thus, a quantification of such events might give a better understanding of underlying inter-connected mechanisms. A range of different single or multiple indices are already in use to quantify the drought duration, severity and intensity. Moreover, recently introduced dedicated software tools help to conduct the spatial-temporal analysis of drought propagation through the hydrological system. In this study, I try to answer the question when, where and how the most severe droughts have been occurring during the last four decades, and in particular in the 21st century. Resulting from the weather extremes (precipitation and air temperature anomalies), the cascading impacts are analyzed as they subsequently occur through a subsurface soil system, and then translate into the evaporative stress and vegetation health conditions. The underlying assumption is that relevant drought indices might be derived from the reanalysis products including variables such as precipitation, air temperature, evapotranspiration and corresponding soil moisture estimates. For a relatively large territory (in this case over 300 thousand sq. kilometers) such data provide consistent set of variables allowing the multi-year analysis. Here, I used recently developed ERA5-land data, validated against basic variables acquired from the E-OBS data. First, drought events were identified using standardized indices at the 1-3-6 month time scales. Then, following a threshold approach, Contiguous Drought Area analysis was conducted in each time step for the growing season. Subsequently, the imprints of soil moisture depletion were detected in vegetation health quantified independently by remote sensing indices at relevant resolution. This study provides an evidence of moderate, severe and extreme drought occurrence. Recent biggest drought events occurred in 2003, 2005, 2006, 2015, 2018 and 2019 as a consequence of high monthly precipitation deficits reaching 100% of the long-term norm, and the air temperature 1-5 degree C higher as referred to average monthly thermal conditions.