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# How Realistic Are the Reported Drying Trends in the Central Europe during $20^{th}$ Century?

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The series of recent studies by several teams used Palmer Drought Severity Index (PDSI) or its component (Z-index) to assess drought trends across Central Europe. Most of the papers indicated that during second half of the $20^{th}$ increasing frequency, severity and/or duration of negative soil moisture anomalies in the Central European region. In case of the Czech Republic we reported steady increase of the drought intensity and proportion of months/weeks in the drought episode with the time using both PDSI and Z-index in past 130 years. We also found that the soil moisture anomalies (expressed in terms of ZIND (weekly) and PDSI (time scale up to 12 months) during 1976-2005 exhibit significantly different distribution characteristics compared to the period 1876-1905 or 1901-1930. As the calculation of PDSI and Z-index is based on Thornthwaite method, it is obvious that the trends in soil moisture anomalies are driven by increased ambient temperature as there has been no significant change in the precipitation amount or distribution in the region. So far the evidence of higher drying trend in the region has not been sufficiently backed up by estimates based on other methods or direct measurements of soil moisture.

The presented study tries to validate reliability of drying trends (and their magnitude)

using estimated daily soil moisture provided by the SoilClim model and also through available soil-moisture observations (that are in general very rare). SoilClim is not only more detailed but also better validated model for the region of interest compared to the PDSI. It operates on a shorter time step with daily inputs of maximum and minimum temperatures, global radiation, precipitation total, mean air humidity and wind speed used to derive value of reference (ETr) and actual evapotranspiration (Eta) and soil moisture content. Unlike the Thornthwaite method the Penman-Monteith formula takes into account available energy, wind speed and saturation deficit while deriving ETr. The effect of temperature trend on the daily values of ETr is thus taken into account only indirectly (via changes in the saturation deficit). In this study we calculated the trends in the seasonal soil moisture content (as well as trends in ETr and Eta) based on the SoilClim outputs at 50 sites in south-east Czech Republic and northern Austria for period 1961-2006. The results show statistically significant trends toward lower soil moisture content with time ($P < 0.05$) at 46 out of 50 sites. The spatial and temporal qualities of the trends in the soil moisture anomalies provided by SoilClim model and those based on PDSI (Z-index) show large degree of agreement. In the final step of the analysis both PDSI and SoilClim were run at two experimental sites, where long-term series of soil moisture data are available (i.e. Doksany, 1947-2006 and Žabčice 1971-2002). Both soil moisture models were highly correlated with the observations which showed very pronounced (and statistically significant) trend towards lower soil moisture content. The evidence so far seems to indicate that estimates of rate of drying trend based on the PDSI are supported not only by results of more detailed model but also in accordance with available long-term observations.

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