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National drought monitoring services in Central Europe: how well do they capture observed drought impacts?

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Droughts may have severe impacts on the environment and economy, particularly in regions with high water demand and low annual precipitation. Central Europe is one such region, where droughts reportedly have led to losses in crop yield and biodiversity, disruptions in water transport, shortages of drinking water, among others. To mitigate these impacts, national weather and environmental agencies in the region have developed national drought monitoring tools. The monitoring tools enable early warning, support planning and policymaking, and foster resilience. However, the accuracy of these tools is usually unknown, since validation of such tools has been challenging due to the lack of validation data and the diversity of droughts and their impacts.

Here, we show a quantitative assessment of national drought monitoring products of six countries in Central Europe by comparing them with a novel impact database developed within the Clim4Cast project (1). The database synthesizes impacts of drought on various sectors, including agriculture, hydrology, household water supply, economy and technology, and wildlife, reported in national newspapers published between 2000 and 2023. The drought monitoring tools comprise drought indicators such as standardized precipitation index, standardized precipitation evapotranspiration index, and standardized soil moisture index with different integration periods. We assess the drought indicators in two ways: their ability to detect drought and their ability to capture the severity of the drought. First, the timing of drought impact reporting in the impact database is used to evaluate its ability to detect observed impacts. This evaluation is performed using the area-under-the-receiver-operating characteristics curve (ROC-AUC). The AUC value reveals how well the reported drought events are detected by the drought indicator. AUC value ranges from 0 to 1, where the value of 0.5 shows that the model is random while the value of 1 shows that the model is perfect. Second, for each reported drought event, we correlate the drought severity, as indicated by the drought monitoring tool, with the number of reported impacts in the database.

Our results show that the performance of drought indicators varies regionally in their ability to detect drought signals (AUC values) and their ability to capture the severity of impacts observed

(correlation values). The AUC values for some indicators exceed 0.85 for Czechia while in Austria, the AUC values remain below 0.6 for most of the drought indicators. Further, the AUC values first increase with longer aggregation times of the drought index, peaking at around 9 to 12 months and decreases again for longer aggregation times. The correlation values for many drought indicators in most of the countries remain below 0.6, and the values generally decrease with increase in aggregation time. These results aid to understand the strengths and weaknesses of drought monitoring products in each country and assist to develop a common drought monitoring framework for Central Europe.

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