Drought Index Evaluation for Assessing Agricultural Drought

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The main objectives of this study were (a) to improve a self-calibrated version of Palmer Drought Severity Index (ScPDSI) and, (b) to evaluate SPI, three PDSI variations (the original PDSI (OrigPDSI), ScPDSI and, a modified scheme employing Priestlay-Taylor's approach (ModPDSI) to compute potential evapotranspitation (PET) instead of Thornthwaite's method), and their respective moisture anomalies indices (Z-OrigPDSI, Z-ScPDSI, and Z-ModPDSI) for monitoring agricultural drought in two pilot cropping regions in north and central Greece. The second objective was achieved by using soil moisture information (a) proxied by the difference (Precipitation - Potential Evapotranspitation, (P-PET)) during 1950-2001, (b) derived from coarse-resolution (50 km) active microwave data from the ERS scatterometer (Soil Water Index, SWI) during 1992-2000. Two variations of Priestley-Taylor's approach (PT), with measured and modeled from air temperature data solar radiation (PTDC), were tested as alternatives to Thornthwaite's method (TH) for computing PET. Both models were compared against the Penman-Monteith approach. The drought index evaluation was conducted employing correlation-based analysis between the 12-month moving average time series of the above-mentioned drought indices and the soil moisture datasets.

A significant improvement in RMSE by over 48% in the southern (drier) location and 31% in the northern was achieved replacing TH with PTDC approach. Z-OrigPDSI and Z-ScPDSI were the best performers against the scatterometer-derived data in the northern and southern region, respectively. They explained 69.5% of the SWI monthly variability in the former region and 72.3% in the latter. Despite the strong correlation between the two soil moisture datasets ($r^2 > 0.56$), SPI was the most appropriate index for monitoring (P-PET) in the two regions. It performed better in the northern site, where it was able to predict 86.3% (vs. 66.3% in the southern region) of the monthly variability of estimated soil moisture deficit/excess. Improving the representation of PET in the PDSI algorithm, by employing the PTDC approach, did not improve the performance of PDSI schemes. The major differences in the ability of the drought indices used in this study for assessing agricultural drought illustrate why it is so important to select an appropriate drought index for a particular application.