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Different tree-ring width sensitivities to satellite-based soil moisture from dry, moderate and wet pedunculate oak (Quercus robur L.) stands across a southeastern distribution margin

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Associations of pedunculate oak (Quercus robur L.) radial growth with satellite-based soil moisture (SM) during the intensive tree growth period over a 30-year time span (1980–2010) were analyzed. This study included tree-ring width (TRW) chronologies from 22 stands located in four southeastern (SE) European countries (Slovenia, Croatia, Serbia and Bulgaria), which were grouped into three wetness groups (WGs): dry (<650 mm), moderate (650–750 mm), and wet (>750 mm), following the annual sum of precipitation. High correlation strengths during the intensive growth period—late spring and early summer months (April to June) was noted, which was opposite to the trend in late summer months. Variations in detrended TRW (TRWi) sensitivity to SM were also observed among the WGs. Specifically, the TRWi chronologies from the dry and wet WGs provided a greater number of significant correlations ($p<0.01$) than trees from the moderate WG did. In wetter stands, TRWi correlated more negatively in the wettest (spring) months, while the correlation was weaker in summer months; these trends were opposite to those of trees growing in drier conditions that had the strongest responses to SM. A generalized additive mixed model (GAMM) based on 38 variables indicated that the fit for SM and radial growth was as strong as the fits for other traditionally measured parameters (temperature, precipitation, and river water level) and calculated drought indices (standardized precipitation index and the Ellenberg index) and TRW. Additionally, radial growth chronologies from drier sites had stronger fits with surrounding environmental factors. In conclusion, our findings suggest that SM can potentially be used as a reliable remote sensing indicator of the soil wetness in oak forests, which affects tree productivity and radial growth patterns and provides a new opportunity in dendrochronology research on larger scales.