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Evaluation of canopy cover dynamics using phenological and productivity indices: the case of Mediterranean oak forests affected by dieback

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Increasing aridity, primarily driven by higher temperatures and lower precipitation, will threaten the stability and health status of Mediterranean forest ecosystems. Vegetation phenology has been globally acknowledged as a key tool to track the timing of seasonal plant and animal activities as well as changes in the forest ecosystems in response to climate change. In this study, we sought to address the phenological behavior of Mediterranean forest stands exhibiting evident decline symptoms. We investigated how phenological and productive indices for *Quercus cerris*, *Quercus pubescens*, and *Quercus frainetto* stands would be able to reflect the seasonal vegetative dynamics of forests affected by dieback, through a multi-scale and multi-temporal approach. To this, we compared nearby stands showing different vigor, *i.e.*, dieback *vs* non-dieback, assessed as growths decline, elevated crown transparency, and rising tree mortality rate. For this purpose, phenological metrics of greenness (NDVI, Normalized Difference Vegetation Index) and phenological (PPI, Plant Phenology Index) spectral indices were derived from either MODIS Terra and Aqua or Sentinel 2 satellites. Our results indicated peculiar site-specific phenological patterns. We observed that dieback forest stands - characterized by a high percentage of trees showing canopy defoliation - exhibited different phenological behavior compared with non-dieback stands. Shifts in length of growing season and seasonal amplitude among dieback and non-dieback stands occurred, that probably affect seasonal productivity. Furthermore, climatic fluctuations may have also affected such phenological patterns. Aligning proxies for the phenological and productive status of forest vegetation may improve our understanding of the responses of dieback forests to the changing climate, mainly in the Mediterranean region.