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Vegetation phenology derived using Plant Phenology Index and Normalized Difference vegetation Index for the Balkan Peninsula, south-eastern Europe

This study analyses the performance of the satellite derived Plant Phenology Index (PPI) against the Normalized Difference Vegetation Index (NDVI) for estimating start of season (SOS) and end of season (EOS) of vegetation growth in part of the Balkan Peninsula, Southeastern Europe (2000 – 2016). Results revealed that PPI and NDVI differ considerably; SOS and EOS may diverge by more than one month between the two indices. The most pronounced differences were observed in the mountain regions, where NDVI SOS occurred up to 50 days earlier then PPI SOS. Even with changing the focus of the study, to a smaller area (transect), NDVI followed the pattern of preceding PPI in SOS and delaying in EOS estimates throughout the whole period of 2000 to 2016.

Examined phenology metrics trends showed an overall advance in SOS, with a rate of change for PPI SOS of 0.44 days/year and 0.43 days/year for NDVI. In contrast, the two VIs did not correspond with respect to EOS trends, PPI showing trends towards delaying EOS by 0.68 days/year as compared to NDVI with advancing trends by 0.20 days/year. Trends analyzed for specific cover types revealed large differences between the two indeces: PPI preserves its general trends of advances in SOS and delays in EOS for all land cover types. NDVI is inconsistent in change patterns, especially for the land cover classes of coniferous forests. NDVI SOS trend for coniferous forest is the only land cover type with delayed trend patterns (0.85 days/year) for spring onset. With regard to EOS trends in coniferous forests, PPI trends were found to be delaying by 0.18 days/year, whereas NDVI showed advancing in EOS to extreme magnitude of 9.13 days/year.

PPI showed better correlation with all examined phenology driving factors – air temperature, precipitation and elevation than NDVI. Consequently, PPI generated better agreement with ground phenology observations at broadleaved and coniferous forest sites, as compared to NDVI.

The main conclusion of this study supports previous findings of improved and more reliable performance of PPI over NDVI for satellite-based phenology metric retrieval. NDVI derived phenology must be interpreted with caution, particularly for land cover with dense vegetation cover and high levels of biomass, such as coniferous forests.

Keywords: Physical Geography, Ecosystem Analysis, Phenology, Climate Change, Remote Sensing, Plant Phenology Index, PPI, Timesat, Balkan Peninsula

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