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Advances in estimating regional ecosystem phenology from satellite

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There is great potential for extracting ecosystem phenology information across large regions from remotely sensed time-series data. Many regional or global Earth observation based data products provide phenological parameters (start of season, end of season, etc.) generated from such data. Unfortunately many of the results are inconsistent, and match poorly with ground-observed phenology. This is due to differences in data source, processing methodology, and influence of non-vegetation factors, such as clouds and snow. Advancing the processing methodology and using remotely sensed parameters related to biophysical vegetation variables are ways to ensure higher consistency of the remote sensing estimates. We propose the use of data corrected for angular effects, and a new vegetation index, the Plant Phenology Index (PPI), derived to reduce problems with traditionally used indices, like the NDVI. The PPI is linearly related to green leaf area index, dynamic also in dense canopies, and avoids problems with snow influence. These advantages result in strong correlations with seasonal profiles of Gross Primary Productivity (GPP) estimated from flux towers, hence, more accurate phenology parameters. We also propose the use of field-installed multispectral sensors to better understand and validate the remotely sensed estimates. A further problem is the scale difference between ground observations and satellite data. New data from the ESA Sentinel-2 satellites will be very useful for estimating these parameters at high spatial resolution, and developments are currently ongoing for deriving phenological parameters from these data at 10 m spatial resolution. This will enable much better matching between satellite products and ground observed phenology. There are fundamental differences between ground-observed and satellite-observed phenology, however, better understanding how the two relate will enable better knowledge of regional ecosystem phenology, its changes across time and space, and relationships between phenology and climate drivers.