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Satellite-based phenology detection in broadleaf forests in South-Western Germany

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Many techniques exist for extracting phenological information from time series of satellite data. However, there have been only a few successful attempts to temporarily match satellite-derived observations with ground based phenological observations (Fisher et al., 2006; Hamunyela et al., 2013; Galiano et al., 2015). Such studies are primarily plagued with problems relating to shorter time series of satellite data including spatial and temporal resolution issues. A great challenge is to correlate spatially continuous and pixel-based satellite information with spatially discontinuous and point-based, mostly species-specific, ground observations of phenology. Moreover, the minute differences in phenology observed by ground volunteers might not be sufficient to produce changes in satellite-measured reflectance of vegetation, which also exposes the difference in the definitions of phenology (Badeck et al., 2004; White et al., 2014).

In this study Start of Season (SOS) was determined for broadleaf forests at a site in south-western Germany using MODIS-sensor time series of Normalised Difference Vegetation Index (NDVI) data for the years covering 2001 to 2013. The NDVI time series raster data was masked for broadleaf forests using Corine Land Cover dataset, filtered and corrected for snow and cloud contaminations, smoothed with a Gaussian filter and interpolated to daily values. Several SOS techniques cited in literature, namely thresholds of amplitudes (20%, 50%, 60% and 75%), rates of change (1st, 2nd and 3rd derivative) and delayed moving average (DMA) were tested for determination of satellite SOS. The different satellite SOS were then compared with a species-rich ground based phenology information (e.g. understory leaf unfolding, broad leaf unfolding and greening of evergreen tree species). Working with all the pixels at a finer resolution, it is seen that the temporal trends in understory and broad leaf species are well captured. Initial analyses show promising results and suggest that different satellite SOS extraction techniques work well for specific phases of ground phenology information. More than half of the broadleaf pixels show an earliness in SOS which matches with the trend in ground phenology.

References

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