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Identification of Novel Remote Sensed Based Indicators for Phenology

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Shifts in the ecosystem phenology due to climate change are a key source of variations in biosphere-atmosphere interactions and play a fundamental role in the definition of annual carbon budget. Modelling of phenology is still challenging in many regions because the drivers are not fully understood. Greenness based vegetation indices (VI), such as Normalized Difference Vegetation Index (NDVI), are often used to parameterize land surface models, but in fact they are not ideal proxies for canopy photosynthesis and structure. These VIs fail in predicting the correct start and end date of a growing season, especially when greenness and photosynthesis become uncoupled (e.g. drought and senescence or needle-leaf trees). Additionally, the validation of VI based phenological metric estimations with in-situ observations still lacks for many ecosystems due to broad spatial (1 km) and poor temporal resolution (bi-weekly or monthly) of used sensors to derive greenness VI. The advent of novel Very High Resolution platforms (e.g. Sentinel-2) allow us to track the phenology more accurately with a pixel resolution of about 30 m or less. In addition, the spectral bands of Sentinel-2 offer the opportunity to calculate VI related to pigment content such us Modified Terrestrial Chlorophyll Index (MTCI).
In this study, we tested several structural and chlorophyll sensitive VI derived from Sentinel-2 for an improved estimation of the start and end date of a poplar plantation in Flanders (Belgium). VI phenological metrics are computed with different algorithms to define the most suitable one for the studied plantation. In addition, the derived VI metrics are validated against in-situ observations of Gross Primary Productivity (GPP), based on eddy covariance measurements, and biophysical parameters measured at the field site to evaluate the goodness of our prediction. Furthermore, the analysis of the impact of different meteorological drives are done to find out which environmental variables are accurate enough to explain ecosystem phenological changes.
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