



Clustering forest types by means of remotely-sensed phenology: Italy as a case study

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Vegetation phenology is an area of ecology concerning seasonal rhythms of plants. Phenology is a responsive indicator of how climatic and physiographic factors affect ecosystems. Long-term phenological observations, such as those provided by satellite remote sensing, are fundamental to understand spatio-temporal dynamics in forests. Satellite Enhanced Vegetation Index (EVI) data represent a well-known proxy suitable for forest productivity monitoring and seasonal variations detecting. The Italian National Forests Inventory and forest Carbon pools (INFC) was considered as a reference dataset of Italian forest types. We used Google Earth Engine for extracting, processing and exporting mean MODIS EVI (2000-2017) profile of each INFC point. Then we applied a multivariate approach for the purpose of (i) deriving clusters of phenologically homogeneous forest stands, (ii) identifying the key seasonal metrics for each cluster and (iii) quantifying the driving role of geographic and physiographic variables on the phenological timing of each cluster. Results show that the obtained clusters follow a clear elevation gradient, with a distinct separation of the forest phenological groups along the Mediterranean-to-temperate climatic transition of Italy. This study demonstrates that the characterization of vegetation phenology can provide valuable information with respect to forests ecosystem responses to environmental conditions and climate change.