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Robust, ground-observed plant phenological metrics for applications in climate impact analyses at the landscape level

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Changes in the seasonality of life cycles of plants from phenological observations have been widely analysed at the species level. Trends and correlations with main environmental driving variables show a coherent picture across the globe. At the same time, seasonality changes in satellite-based observations and prognostic phenology models comprise information at a pixel-size or landscape scale. Few studies explicitly compared ground-observed, remotely-sensed and modeled phenology. The question arises whether there is a integrated phenological signal across species that describes common interannual variability at the landscape level? Can this signal – expressed as a synthetic phenological metric – be related to pixel-sized greenness from a satellite and a prognostic phenology model?

We address these questions by analysing two multi-species phenological data sets from a Mediterranean and temperate Swiss location. Both legacy data sets were collected by a single observer for 50 and 31 years, respectively, and contain phenological observations of several plant individuals within walking distance of the observer's home. Phases include leaf-out, flowering, fruiting, and leaf fall. We apply Principal Component Analysis (PCA) to detect groups of species with similar phenology and derive a phenological metric at the landscape level.

With this contribution we attempt to present a method for the statistical treatment of ground-observed phenological observations from legacy and network data sets for comparisons with remotely sensed and modeled greenness, and the application in climate impact studies.