Analyzing phenology of grassland along a transect through altitudinal zones using remote sensing

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Abstract

Phenology, the timing of plant and animal life cycle events, is controlled by climatic factors such as temperature, light, precipitation, soil moisture and snowmelt. At the same time, it also gives feedbacks to the ecosystem influencing albedo and fluxes of water, energy and CO2. Therefore it is a good way to observe the impact of climate change on ecology.

Geographically, phenology in mountain areas have been less studied due to lack of information sources. However, mountain areas are known to be particularly sensitive to climate change due to their complex climate system. In fact, some studies have already reported changes in grassland phenology (Colombo, et al., 2011; Rammig, Jonas, Zimmermann, & Rixen, 2010). Grasslands in the mountain areas, especially alpine grasslands, have short growing season and thus small changes in length of growing season will affect its ecosystem greatly. Furthermore, grasslands are used in many cases as meadows and pastures and changes in its phenology will likely influence agricultural practices. Thus, a better understanding of climatic impacts on grassland phenology is necessary for future agricultural management under climate change.

This research aims at investigating grassland phenology in mountain areas at different altitudes and at providing a better understanding of how climatic factors affect grassland phenology. The study sites are arranged along an altitudinal gradient in the European Alps covering thus different climatic conditions over a short distance.

Land surface phenology based on remote sensing is used to investigate and compare grassland green up dates at different altitudes, expositions and land use influences. For this research, a Normalized Difference Vegetation Index (NDVI) product from Landsat 8 is used. TIMESAT software is applied for the analysis and a threshold approach based on amplitude of NDVI time series is taken to estimate the green up dates. While Landsat 8 has not been used in many studies expectedly due to its low temporal resolution (every 16 days) and data loss resulting from cloud occurrence in scenes, it was chosen here since its relatively high spatial resolution (30m) was preferable for the study area where topography and altitude differ over a short distance. The results will be validated by comparison to existing records (e.g. PhenoCam).

The temporal resolution and the availability of data can be further improved by using another sensor (e.g. Sentinel 2).

References

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