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Heat wave beats green wave: the effect of a climate extreme on alpine grassland phenology as seen by phenocams

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The year 2015 has been one of the warmest on record for many regions of the world. The record-breaking temperatures did not spare the European Alps, where the summer anomaly reached +4°C. This heat wave caused important impacts on the seasonal development and structural properties of alpine grasslands that deserve investigations. Phenocams are useful tools to describe canopy greenness seasonal dynamics and many recent studies demonstrated that the major phenological events (e.g. budbrust, senescence, ...) can be extracted from greenness trajectories. In contrast, little is know about their capabilities to describe the impact of extreme climate events on a fully developed canopy. Moreover the relation between quantitative structural and functional vegetation properties (e.g. biomass, LAI, ...) and phenocam data remains poorly investigated.
In this study we examine the impact of the 2015 summer heat wave on a subalpine grassland by jointly analyzing phenocam greenness trajectories, proximal sensing and flux data together with field measures of vegetation structural properties. The effect of different environmental drivers on greenness seasonal development was further evaluated by a modeling approach (GSI model).
Phenocam tracked the impact of heatwave 2015 that caused a lower canopy development and an anticipation of yellowing by more than 2 months. The same pattern was observed for CO_2 fluxes, NDVI and field measures. GSI model results show that during the heatwave, a combination of moisture and high temperature limitation was responsible for the observed reduction of the canopy development. Moreover, spatially explicit analysis of digital images allowed to highlight the differential response of specific plant functional types to the extreme event.