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Modelling vegetation dynamics for Alpine meadows

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Regional climate scenarios predict a temperature increase and a summer precipitation decrease for the European Alps. This is expected to lead to longer vegetation periods, but also to drought stress in Alpine meadows ecosystems. It is therefore uncertain if the predicted climatic changes will lead to an increase or decrease of biomass production in these grassland ecosystems. Understanding plant growth requires to consider the complex interactions between soil, atmosphere and climate via its physiological properties, in particular LAI, stomatal resistance, rooting depth, albedo, surface roughness and effects on soil moisture.

Vegetation Dynamic Models (VDM) coupled with hydrological models take into account these interactions in order to study and estimate biomass production quantitatively. In this contribution, the VDM previously developed by Montaldo et al. (2005) for semi-arid environments is extended to Alpine meadows in the Stubai Valley (Eastern Austria) which are typically not subjected to water and nutrient stresses, but undergoing low temperature limitations. The aim is to assess the model robustness. Moreover, the effects of mowing practice during the season were taken into consideration. The VDM has then been implemented in the distributed hydrological model GEOtop (Rigon et al., 2006). The VDM performed well in the considered case study. The validation and calibration of the model is presented and then the effects of increased temperature and decreased precipitation are investigated numerically.

In order to evaluate in the field the effects of climatic change on Alpine grassland biomass production, the inner Alpine continental Mazia Valley (South Tyrol, Italy) has been chosen in 2009 for Long-Term Ecological Research. These climatic changes will be simulated by manipulations along an altitudinal gradient comprising measuring stations at about 1000 m, 1500 m and 2000 m a.s.l.. Meadow monoliths will be transplanted downslope to simulate temperature increase and sheltering experiments will simulate decrease in summer precipitation. Moreover, the spatial variability in the ecohydrological conditions at the catchment scale is monitored by 14 micrometeorological stations distributed throughout the Mazia Valley. The data gained from these stations will serve as model input for the future work in comparing experimental manipulation with model simulation.