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Spatiotemporal variability of increasing temperature impacts on grassland vegetation along an elevation transect in the Alps

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Different manipulative approaches have been developed to study and quantify impacts of temperature increase on grassland ecosystems. Many of them share the problem of unwanted effects on the surrounding microclimatic conditions. Transplantation of grassland mesocosms along elevation gradients can be a realistic alternative, although with some restrictions. Here we present 3 years of data from a double-transplant-experiment, were 70*70*20cm grassland turves were transplanted at two elevations from 2000m to 1500m a.s.l. and from 1500m to 1000m a.s.l. respectively, along an inner-alpine elevation gradient in the Vinschgau Valley (South Tyrol, I). All donor and receiving sites are comparable regarding land use (meadows), soil conditions or exposition and are located within a few km's distance ensuring comparable weather conditions apart from the intended air temperature (0.54°K/100m) and annual precipitation (20mm/100m) lapse rate. Phytodiversity and above ground net primary production (ANPP) of the transplanted mesocosms were assessed and compared with locally transplanted monoliths of the respective donor site. Furthermore, growth dynamics was continuously observed throughout the vegetation season with a non–destructive method based on measurement of light (photosynthetic active radiation) extinction within the canopy.

After 3 years no significant changes in absolute species numbers has been detected at all, whereas slight variations have been observed regarding species composition. Those shifts could be differentiated both to transplantation artifacts and effects of the elevated temperature. Total aboveground phytomass, unsurprisingly, showed higher values on transplanted (lower) mesocosms, however: data from single cuts and growth rate analysis reveal differing effects between the two transplantation steps as well as over the course of the vegetation period. Transplanted plots from 2000m to 1500m showed continuously higher productivity from spring to autumn, whereas on the lower transplants (from 1500m to 1000m) during summer months the temperature benefit gets balanced by higher evapotranspiration rates, resulting in more frequent drought stress.

Summarizing, gained experiences confirm well-designed transplant approach to be an interesting alternative for mid- to longterm simulations of future climate conditions in grassland ecosystems. Furthermore, results indicate that the impact of increasing temperatures in the studied grassland highly depends on elevation and acts rather by a prolongation of the vegetation period than by elevated summer temperatures.