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Transplantation experiments in an inner-alpine dry valley to predict Climate Change effects on agriculturally used grassland ecosystems

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Studying impacts of Climate Change (CC) is currently one of the most challenging scientific topics from plant physiology up to the ecosystem level. Especially for predicting effects of global warming there are various kinds of manipulation experiments in use. Most of them deal with in vitro experiments, such as electric heating or open top chambers (OTC). Even though microclimatic conditions and manipulated parameters are relatively easy to control, there are still disadvantages as the studied plants or plots are not exposed to real conditions anymore. Therefore, transplantation experiments can be an alternative for simulating effects of climatic change.
Within the project 'Climate Change in South Tyrol' effects of CC on vegetation and the water balance are studied along an altitudinal gradient. The transect is located in a dry inner-alpine valley in South Tyrol/Italy where climatic changes are expected to have earlier and stronger impacts. 33 plots of meadow grassland were transplanted from 2000m a.s.l. to 1500m, and, respectively, from 1500m to 1000m. All three sites are situated within a few km's beeline and comparable in type of management, soil conditions and exposure. The plots consist of a 50*50cm core area and a 10cm buffer-stripe on the borders in order to impede invasion of the surrounding vegetation. Accurate microclimate measurements on each altitude prove a temperature increase of 3.0° K for both 500m altitudinal steps corresponding approximately to the predicted temperature increase till the year 2100 for the Southern Alps (according to REMO and CLM regional models). The transplanted plots from higher elevations were compared with local transplanted plots considering ecosystem production (dry mass and Plant Area Index) as well as species composition, in order to monitor species invasion.
Results from the first vegetation period must be interpreted carefully as they are just a snapshot of the weather in 2010. Nevertheless, first results still deliver some interesting findings: during the summer months there was observed the expected considerable increase of dry mass between transplanted plots from 2000m and local plots from 1500m. However there were no significant differences between transplanted 1500m plots and local 1000m ones, suggesting that during the summer months a future warming will not cause effects on grassland production on elevations until at least 1500m.a.s.l. Afterwards in fall (September/October) there was observed in turn an increase in production also between the transplanted 1500m plots and the local 1000m plots due to higher temperatures and the longer vegetation period.
Finally, these results indicate that with suitable site conditions and specific measures against plant invasion transplantation experiments are a suitable alternative to simulate CC effects on grassland ecosystems.