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Effects of Future Climate Change on some Production Patterns in Alpine Pastures

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Introduction

Alpine pastures are the results of peculiar environmental conditions coupled with centuries of human utilization by animal grazing (Orlandi et al., 2016). Their protection and conservation are vital not only for their productive role but also to ensure the continuing provision of benefits to society as a whole, thanks to the multiple ecosystems services they deliver (Hao et al., 2017). Currently, alpine pastures are facing changes in the socio-economic, management and environmental conditions likely affecting their composition, biodiversity and structure (Dibari et al, 2016). One of the most threatening factors reflecting negative consequences on mountain natural resources is climate change. This work presents some preliminary results of a study on the impacts of climate change on permanent mountain grasslands (above 1700 m a.s.l.) in two national parks (Parco Nazionale Gran Paradiso, Italy; Parc des Écrins, France). These are some preliminary results from the LIFE project PASTORALP (Pastures vulnerability and adaptation strategies to climate change impacts in the Alps), funded by EU in the Climate Change Adaptation LIFE programme (LIFE16-CCA-IT_000060). The impacts of the expected climate change have been assessed following a modelling approach, which investigated snow cover and growing season length changes under two RCP scenarios (4.5 and 8.5) for two future time slices (2011-2040 and 2041-2070).

Materials and Methods

The two test sites named Torgnon and Entrelor are located in the Italian western alps. The former is an unmanaged pasture located at 2200 m a.s.l., the latter is a managed pastures located at 2100 m a.s.l. with different botanical and pedological conditions. Climate scenarios were created to reflect the current and future climate conditions in the study areas. The period 1990-2010 was considered as current baseline, whilst two future time slices were used for reproducing near (2011-2040) and mid-far (2041-2070) future climate projections. Both time slices were considered for RCP4.5 and RCP8.5, considering climate variability and increasing CO_2 concentration levels as agreed by IPCC (2013). Pastures vulnerability was assessed using the simulation model DayCent, the daily time step version of CENTURY model (Parton et al., 1994), which reproduces C-N dynamics ad plant production as driven by different agronomic practices (tillage, mowing, fertilization). Once calibrated and validated against observed data from the two study sites (water content dynamics and C-fluxes at Torgnon and biomass production at Entrelor), the model was forced against future climate data to assess the expected changes in snow cover, length of grassland growing season and net primary production (NPP) pattern.

Results

Using the warmest scenario (i.e. RCP8.5), snow cover is projected to rapidly decrease at both sites as approaching the end of the century, while no relevant difference was observed with the other RCP/time

slice combinations. The greatest changes were observed at Entrelor, where under the warmest scenario the snow cover is expected to reduce by about 70% compared to the baseline.

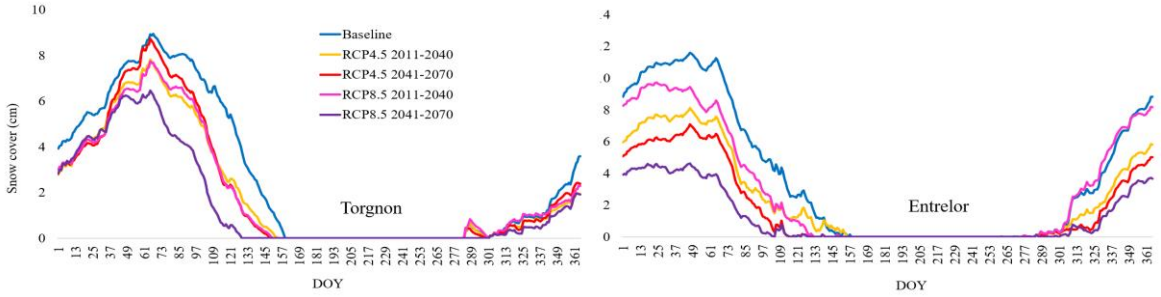

Figure 1. Average changes in snow cover between the baseline (blue line) and four future climate scenarios in the two study sites.

Accordingly, the length of the growing season is projected to increase in conjunction with the reduction of the snowpack in both sites. At Entrelor, a considerable increase in the length of the growing season was projected also for the time slice 2041-2070 using RCP4.5. The highest increase of growing season was found for the period 2041-2070 using RCP8.5.

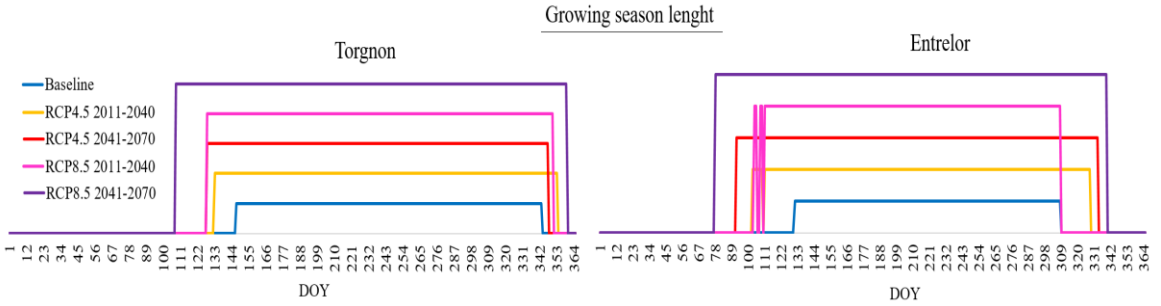

Figure 2. Average changes in growing season length between the baseline (blue line) and four future scenarios in the two study sites.

Finally, concerning patterns of biomass production and the achievement of the peak of maximum biomass in a year, no relevant changes were observed with the different scenarios (data not shown).

Conclusions

Future climate scenarios indicated that snow cover is expected to highly decrease by the end of the century in pastures of western Italian Alps. The length of the growing season should increase in conjunction with the reduction of the snowpack, but with no relevant differences in the seasonal forage provision (potential changes in forage quality were not assessed). Further investigations should test C-N processes occurring under different conditions in the Alps to support the development of suitable adaptation strategies to cope with pasture vulnerabilities under changing climate conditions.

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