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Effects of prospective climate change on pasture productivity in the Italian Alps.

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We present here preliminary results in fulfilment of the project IPCC MOUPA (Interdisciplinary Project for assessing current and expected Climate Change impacts on MOUNTAIN PASTURES) project, funded by Fondazione Cariplo of Italy, aimed to i) evaluate potentially modified productivity of pasture lands under climate change scenarios, and subsequent on socio-economic, wildlife and biodiversity impacts, within the Italian Alps, and ii) propose management strategies for pasture and multi-functional use of mountain areas.

In high mountain areas pastures are a source of living for local communities, and further agriculture and livestock supply ecosystems services (ES). In the last century, increase of temperature nearby $+1.5^{\circ}\text{C}$ was observed in the Alpine region, to increase hereon, and future climate scenarios display potential reduction of water availability, with an increase in precipitation extremes, potentially impacting soil moisture, vegetation, and pasture dynamics (phenology/timing), deeply dependent upon precipitation, temperature, and snow cover.

We here defined some fragility indices (FIs), to sketch the effects of climate change on pastures in the Alps, with special focus on Valtellina valley, in the central Alps of Italy. FIs can be used to highlight pressures experienced by pastures, and thresholds for failure, and to develop policies to i) determine zones needing particular management, and adaptation, ii) monitor trends of global environmental stability, iii) evaluate the overall impact of climate change and anthropic influence, and iv) investigate the dynamics of pasture fragility. We chose indices of climate, productivity, and water usage. Some of these FIs can be evaluated starting from observations, but others have to be calculated using models of pasture growth, and water availability. For this reason, a pasture model Poli-Pasture has been set up to simulate the pasture growth, and to evaluate FIs in the target area.

To explore the broad range of variability under uncertain future climate, FIs are calculated for present conditions of pastures, and for future projected conditions using i) three climatic scenarios of AR5 of IPCC (RCP 2.6, RCP 4.5 and RCP 8.5) as depicted by three Global Circulation Models GCMs (EC-Earth, Echam6.0, CCSM4), and ii) four climatic scenarios of the AR6 (RCP 2.6, RCP 4.5, RCP 7.0, RCP 8.5) depicted by three GCMs (EC-Earth3, Echam6.3, CESM2), and some preliminary conclusion are reported for future pasture dynamics, and management therein.