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Projections of climate change effects on pasture productivity, GHG exchanges and soil carbon stocks

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Agriculture is intimately affected by climate change (atmospheric CO₂ concentration, temperature, precipitation and patterns of climate extremes), and there are major societal concerns about climate change effects on agriculture lands and hence food security in the 21st century. Despite those concerns, there is still only poor understanding of the possible impacts of climate change on the productivity and carbon dynamics of rain-fed pastoral systems in France, particularly their direction and magnitude over long time scales. The present study uses 3 scenarios (e.g. RCP 2.6, 4.5 and 8.5) of possible future climatic conditions and assesses their effects on productivity and SOC stocks of mowed and rotationally grazed grasslands. We used the CenW ecosystem model to simulate carbon, water, and nitrogen cycles in response to changes in environmental drivers and management practices. The simulations indicated that grassland productivity was increased through CO₂ fertilization and higher water use efficiencies but that SOC losses between 5% and 23% (if CO₂ fertilization is not accounted for in the simulations) are expected due to higher temperatures and biomass exports. Such losses may further affect climate feedback loop and jeopardize the agroecosystem sustainability. More extreme climate events were expected under more pessimistic climate change scenarios with very different outcomes if the CO₂ fertilization effect is accounted for or not. This study showed that under the current management practices implemented at the study site, soil C losses were expected over the 21st century under climate change conditions, highlighting the need to modify/adapt farming practices.