Topic: Addressing uncertainty and risk in climate change impact studies
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Sensitivity of a grassland model ensemble to climate change factors: the MACSUR approach.

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In grassland modelling, understanding feedbacks between grassland ecosystems and the atmosphere in the context of regional scale climatic changes is essential for the accurate quantification of ecosystem water and carbon (C) fluxes. Different grassland models respond differently to environmental conditions and climatic circumstances. To test the sensitivity of different models to changes in input variables, ensemble modelling approaches are used because they generate an expanded envelope of possible systemic outputs. Here, an ensemble modelling approach was applied to explore water and C fluxes from grasslands in Europe. Seven grassland models were run at nine long-term grassland sites representing a broad gradient of geographic and climatic conditions. The sensitivity to climate change factors including precipitation (P), temperature (T) and atmospheric CO2 concentration [CO2] was assessed. Baseline weather series (including [CO2]=380 ppm) were modified by changing T and P by -25%, -10%, -5%, +5%, +10%, +25% of the observed standard deviation and [CO2] by +5%, +10%, +15%, +25%, +50%, +100%. The obtained multi-model responses for each driver showed different levels of sensitivity. Soil temperature and gross primary production (GPP) displayed strong sensitivity to air temperature and precipitation. Based on the multi-model median of model responses, altered scenarios of precipitation had an important effect on modelled evapotranspiration from grassland swards. In general, yield biomass and GPP increased with elevated levels of [CO2]. Rising T and [CO2] had a fundamental effect on the C cycling of terrestrial ecosystems. This study demonstrates the use of ensemble modelling to address critical issues of uncertainty associated with individual model predictions, and provides increased understanding of water and C fluxes in grasslands under climate change.