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A process-based soil erosion model ensemble to reduce model uncertainty in climate change impact assessments

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The impact of climate change on future soil loss is commonly assessed with soil erosion models, which are potentially an important source of uncertainty. Here we propose a soil erosion model ensemble, with the aim to reduce the model uncertainty in climate change impact assessments. The model ensemble consisted of five continuous process-based soil erosion models that run at a daily time step, i.e. DHSVM, HSPF, INCA, MMF and SHETRAN. All models simulate detachment by raindrop impact (interrill erosion), detachment by runoff (rill erosion) and immediate deposition of sediment within the cell of its origin. The models were implemented in the SPHY hydrological model. The soil erosion model ensemble was applied in a semi-arid catchment in the southeast of Spain. We applied three future climate scenarios based on global mean temperature rise (+1.5, +2 and +3 °C). Data from two contrasting regional climate models were used to assess how an increase and a decrease in extreme precipitation affect model uncertainty. Soil loss is projected to increase and decrease under climate change, mostly reflecting the change in extreme precipitation. Model uncertainty is found to increase with increasing slope, extreme precipitation and runoff, which reveals some inherent differences in model assumptions among the five models. Moreover, the model uncertainty increases in all climate change scenarios, independent on the projected change in annual precipitation and extreme precipitation. This supports the importance to consider model uncertainty through model ensembles of climate, hydrology, and soil erosion in climate change impact assessments.

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