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Evaluating the simulation of extreme events with the land surface model CLM5.0 over Europe for 2018-2022: comparison with in situ and remotely sensed data

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Climate change is expected to amplify the frequency and intensity of extreme events in the future. Recently there was a series of summers with heat waves and droughts over central Europe from 2018 to 2022, but also severe flooding in 2021. These events had substantial effects on agriculture, water resources, and human lives. To monitor and assess the impacts of extreme events, in situ and remote sensing data for soil moisture, evapotranspiration and carbon fluxes are important. In this study we evaluate simulation results by the Community Land Model (CLM, version 5.0) over the EUROCORDEX domain for past extreme events between 2018 and 2022 and analyze to which degree the model is able to reproduce low soil moisture levels, and changes in evapotranspiration, leaf area index and carbon fluxes in the areas most affected by the extreme event, on the basis of a comparison with in situ (e.g., ICOS) and remotely sensed (e.g., SMAP, MODIS) data. Additionally, we will compare CLM5.0 results to other land surface models, such as ERA5-Land, GLDAS, GLEAM. Our model setup over EUROCORDEX is driven by atmospheric forcings from the ERA5 reanalysis. The soil texture information is obtained from FAO at 10 km resolution and the land use data is from LULC from NCAR mapped to plant/crop functional types. It was found that CLM5.0 overestimates soil moisture and exhibits a wet bias compared to SMAP during heat waves. In addition, the comparison of measured evapotranspiration with CLM5.0 shows that drought stress response is underestimated by the model. A systematic underestimation or overestimation of the impact of past extreme events on the land surface would point to model limitations which is important to resolve to gain confidence in the simulation of future extreme events under conditions of climate change.