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Characteristics of western European heat waves simulated by the CMIP5 models - Contributions to the ensemble spread in future climate projections

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It is known that the increasing greenhouse gas concentrations lead not only to an increase of the average temperature but can also cause a change of the form of the probability distribution of seasonal or daily temperature averages. Both effects influence the changes of extreme events like heat or cold waves which are relevant for climate change impacts. In this study, long lasting and spatially extended heat waves over western Europe simulated by the CMIP5 models are investigated. An algorithm for the detection of the heat waves has been developed and the heat wave characteristics duration, spatial extent and intensity have been calculated. The total severity of the heat waves in a 30-year period is defined as the product of the number of heat waves and their mean duration, intensity and extent. The gridded E-OBS dataset of daily maximum temperature is used for evaluation of the simulated heat wave characteristics in the historical simulations. The uncertainty due to internal climate variability is quantified by analysing an ensemble of 10 realisations of the historical scenario simulated by the CNRM-CM5 model. The projected changes of the heat wave characteristics until 2070 to 2099 are analysed for the RCP2.6, RCP4.5 and RCP8.5 scenarios. All models project an increase of the heat wave severity for all scenarios, but the spread of the ensemble is large. Reducing this spread would be helpful for planning of climate change adaptation. For this reason, it is investigated which contributes most to the ensemble spread: the uncertainties of the global and regional temperature change or the uncertainties of the change of the shape of the probability distribution of daily maximum temperature. Based on the results, future work can focus on the physical processes leading to the spread.