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Using large ensembles to investigate the impacts of climate extremes

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Large ensembles are key to investigate climate and weather extremes and their impacts, as they, by definition, rarely occur. One field that relies heavily on them is probabilistic event attribution, i.e. where one tries to quantify how human influence affects the probability of occurrence of the extreme event in question. An ensemble of over 130'000 members allowed us to quantify that human influence increased the probability of heavy precipitation by around 40% in the January 2014 floods in southern England. By using a hydrological model, we could then quantify that the probability of 30-day peak river flows of the Thames river was increased by around 20%. However, it was unclear whether the number of properties at risk in the catchment was affected. This study also showed how uncertainty increases at each step of the modelling chain and how some factors, like the characteristics of the Thames catchment in this case, might play a bigger role in assessing impacts than potentially the size of the ensemble.

Large ensembles are also useful to understand the physical mechanisms behind extreme events. In another study about the relationship between atmospheric blocking and heatwaves, we used three large ensembles from different climate models. While we found that the 2003 European heatwave and blocking conditions were well contained within the 3 ensembles' envelope, and that the models simulated even more extreme events, the 2010 Russian event was outside the ensembles' envelope, except for one single ensemble member.

Finally, I will present two projects, one on floods in Norway and one about the health impacts of having a heatwave combined with high air pollution, where large ensembles would be useful, but are competing with the need for high spatial resolution for computational resources.