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Winter weather extremes in the Euro-Atlantic region under the 1.5°C and 2°C levels of global warming

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Severe extratropical winter storms, accompanied by hazardous wind and precipitation, can cause severe damages with complex socio-economic consequences for communities in Europe. In this study we investigate potential changes in simulated winter storminess and extreme precipitation under 1.5°C and 2°C global warming scenarios, facilitated by the output of the HAPPI (Half A Degree Additional Warming, Prognosis and Projected Impacts) experiment. This approach allows an assessment of climate change impacts under different temperature targets, established by the recent Paris agreement (Adoption of the Paris Agreement FCCC/CP/2015/L.9/Rev.1,UNFCCC 2015), which provide information relevant to the policymakers, economists and local communities.

Our results show that the very high-resolution (0.25°x0.25°) horizontal and temporal (3hr) output of the atmospheric model CAM5 is not only refining regional-scale features of the extremes, but also improves the representation of large-scale atmospheric circulation, which governs storm tracks over the Euro-Atlantic region. This remarkably contributes to the fidelity of the simulated future extremes, projected under 1.5°C or 2°C warming scenarios.

Our analysis of the future response for the 2°C warming scenario indicates a poleward shift and intensification of the storms over the Euro-Atlantic region. This corroborates previous model analyses. A key result is however that the shift occurs mainly after exceeding the 1.5°C global warming level, when the midltatitude jetstream manifests a strengthening north-eastward. This phenomenon causes an increase in the mean as well as daily and sub daily precipitation and wind extremes (e.g. their return values) and storminess over the North Europe with a maximum over the northwest coasts of British Isles and Scandinavia. Findings of this study indicate that the near-future changes in the winter storm activity over Euro-Atlantic sector may have radical socio-economic consequences and should be considered in climate adaptation and resilience initiatives. In addition, near-term changes will increase nonlinearly with further warming rather than linearly.