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Earth System Dynamics
Discussions

Interactive comment on "Evaluating the dependence structure of compound precipitation and wind speed extremes" *by* Jakob Zscheischler et al.

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This manuscript compares the dependence structure of compound precipitation and wind speed extremes in different sets of data: the ERA5, the dynamically downscaled ERA-Interim using the regional WRF model, the dynamically downscaled CESM with present conditions using the WRF model, and also a dynamically downscaled CESM run for the future. The technique used is an advanced statistical technique on bivariate asymptotic tail dependence. This is an interesting study which deserves publication in ESD. I have a few points on the interpretation of the results, and the limits of this study, that the authors may consider.

Thank you.

First, it seems to me strange to study extremes in a nudged system (ERAI-WRF). This means that there is a modification of the dynamical equations of WRF and the extremes could then be biased. First could you run it without the nudging, and if not this should appear somewhere in your interpretation or conclusions.

The reviewer is correct that the ERAI-WRF is nudged to the driving reanalysis ERA Interim. The reason for this is that the simulation should stay close to large-scale behavior of the reanalysis data. As mentioned in the manuscript, we only use wind, temperature and humidity above the planetary boundary layer and the nudging is not strong. So, we agree that to some extent the behavior of extremes might be changed due to the modification of the dynamical equations, but we think that this effect is minor. We also would like to point out that the precipitation is not nudged. To quantify the effect of nudging (and show that the effect is minor) a second simulation would be helpful, but currently we do not have the computational resources to perform such a simulation. To clarify this, in the revision we will comment on this aspect in our discussion of the results related to the ERAI-WRF simulation.

A second aspect is the fact that the domain over which downscaling is done looks small (no information provided on this by the way on the specific configuration of running WRF). This should have considerable impact on the extremes in particular for wind but also for precipitation. There were a lot of work done in this context at the beginning of the 21th century on that topic, showing that small domains are considerably constraining the internal dynamics of the regional model, and hence all the statistical properties within the model. This should also play an important role and should be discussed in the conclusions or in the interpretation of the results.

We see that the manuscript was not clear regarding the setup. We only show the innermost domain of a nested regional climate modelling approach using four nests in total. Domain 1 spans over Europe. The regions of the four nests are illustrated in the

figure below and we will include this figure in the revised manuscript. In addition, we will add the following explanation: "The horizontal resolution of the four two-way nested domains (Fig. 1) are 54, 18, 6 and 2 km, respectively. The innermost domain 4 covers the box $[4.75E, 15.25E] \times [43.25N, 48.75N]$ *and is used in this study exclusively."*

In Figure 1. It would be nice to see the observations too.

This is a pure modelling study and we do not have observational data for wind speed at different height at hand. This is why we refer to published results.

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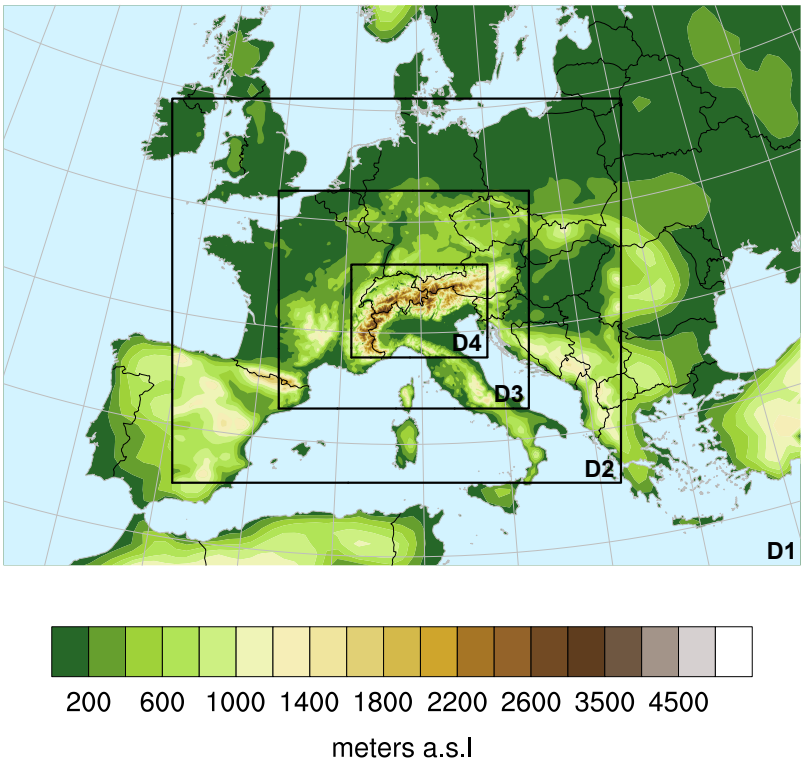

Fig. 1. The four nested domains used in the dynamical downscaling.