Coordinated Experiments: why are they important and what is expected to achieve?

Air-sea coupling is important to bridge two important components of the climate system, the atmosphere and ocean. Future climate projections of the coastal zone might be fundamentally flawed if important regional and local air-sea feedbacks, which are not resolved in global climate models, are neglected in stand-alone ocean or atmospheric models (Schrum 2017). Air-sea interactions and feedback taken into account in coupled atmosphere-ocean regional climate models (AORCMs) lead to a significant improvement of simulated surface ocean conditions compared to stand-alone ocean models (Schrum et al. 2003; Gröger et al. 2015). Several studies indicated that air-sea coupling not only has an effect over the ocean, where the atmosphere and ocean communicate with each other, but also has a remote influence inland (Somot et al. 2008; Pham et al. 2014; Ho-Hagemann et al. 2015, 2017). For example, Ho-Hagemann et al. (2015) showed that the heavy rainfall over Central Europe during the Oder flood event in July 1997 was captured well in the coupled model while it was missed in the stand-alone atmospheric model (see figure). However, the effect of coupling on precipitation inland was found small in some other studies (Wang et al. 2015; Gröger et al. 2015). There are several potential reasons for the varying conclusions on the coupling effect: The used coupled models differ not only in their model physics and dynamics but also in their configurations, i.e. domain, resolution. In case the same coupled models were used, the components were coupled at different coupling frequencies and using different coupling methods. Computing systems used to run the coupled models at individual institutions are often not the same. Methods to evaluate the air-sea coupling effect are not unified.

In order to obtain robust results, setting up coordinated experiments for AORCMs is indispensable and this comprises also unified evaluation methods and shared observation data. This motivated us to initiate the Coordinated Experiments activity under the Baltic Earth Program.

We aim to conduct long-term (ca. 30 years) climate simulations from different coupled models using the same domain (EURO-CORDEX) and resolution. The simulations shall be commonly validated in an inter-comparison. More robust conclusions about the effect of air-sea coupling on climate simulations are expected.

A benefit from coordinated experiments is that sensitivity tests on the effect of specific coupling characteristics may be performed, for example, coupling frequency (e.g. 1hr, 3hr or longer) or coupling method. This allows a better understanding of their influence on climate simulations as other coupling factors such as domain or resolution remain unchanged in these tests. Based on these sensitivity tests the most optimal configuration for each coupled model will be determined for climate projections in the future.

It is planned that the results from these experiments will be published in joint publications.

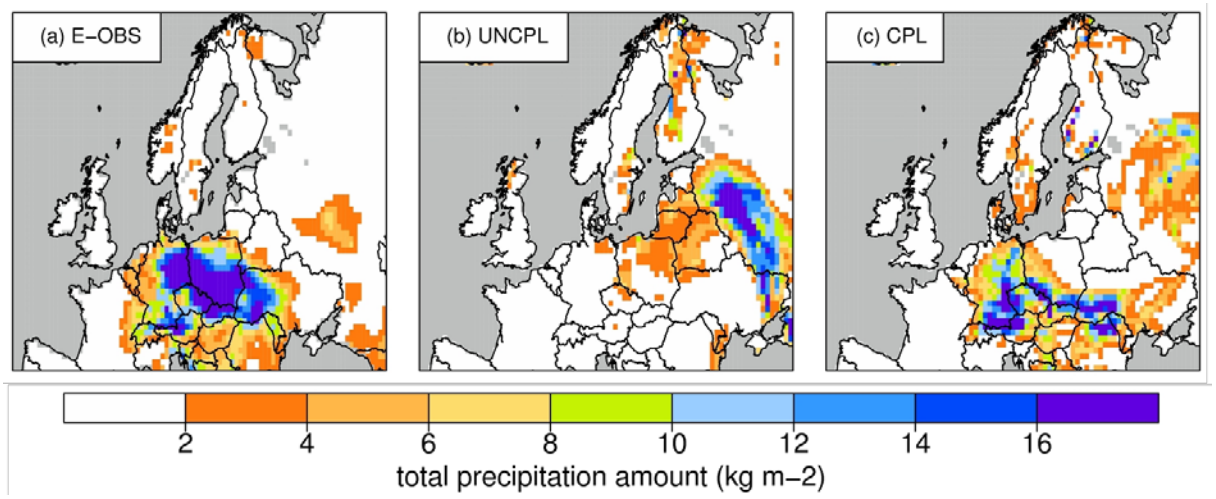

Figure: Mean precipitation (mm/day) of E-OBS data and simulated by the stand-alone atmospheric model COSMO-CLM and the coupled model COSTRICE averaged for 18-20 July 1997, the phase 2 of the Oder flood event. Taken from Ho-Hagemann et al. (2015).

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