Project: **1064**

Project title: **Atmospheric Drivers of Extreme Flood Events (ADEFE)**

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Report period: **2020-11-01 to 2021-08-31**

Despite progress in flood research during the recent decades, there is still a large knowledge gap on the causative processes of extreme river floods and their spatial and temporal evolution. The objective of the research unit "Space-Time Dynamics of Extreme Floods" (SPATE) funded by the Deutsche Forschungsgemeinschaft (FOR 2416, http://spatefloods.com/) is to investigate these processes. Last year the SPATE project was extended for three more years until summer 2023. The main goal of the Atmospheric Drivers of Extreme Flood Events (ADEFE) project is to support the SPATE project with information about the atmospheric state and atmospheric drivers of flood events.

The advantage of the high-resolution downscaling for EC-Earth CMIP6 phase

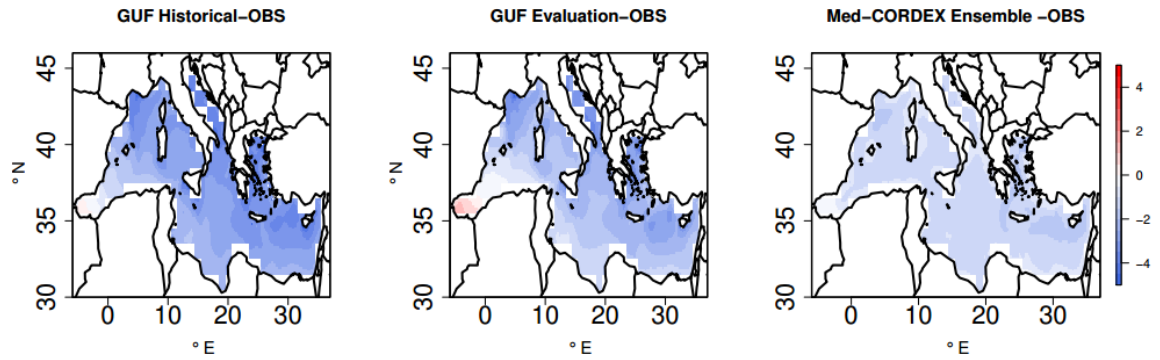
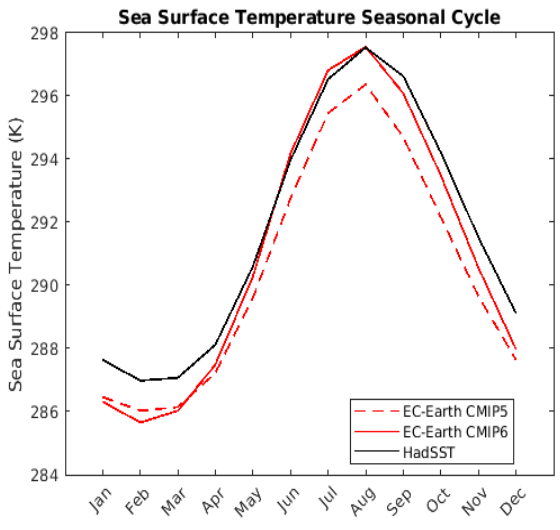


Figure 1. Bias of the Mediterranean SST against the observations (HadSST) for the whole historical period in (a) as observed in the GUF historical (b) GUF Evaluation (c) Med-CORDEX ensemble.



In 2019/2020, EC-Earth CMIP5 model was downscaled using COSMO-CLM and NEMO ocean model. Sea surface temperature was characterised a pronounced cold bias with respect to observations (Hadley SST) (Figure 1,2). Late in 2020, we started the downscaling of EC-Earth CMIP6 phase. Figure 2 shows that the cold bias issue is solved mostly, especially in the warm season, in which our studies regarding Vb-cyclones will be affected the most, given Mediterranean SST's importance in regulating moisture supply (Krug et al. 2021). The period shown in figure 2 is from 1951 to 1960, as the beginning of the simulation was delayed. The model simulation is expected to finish the simulation by the end of the year.

Figure 2. Sea surface temperature seasonal cycle of the Mediterranean Sea for EC-Earth CMIP5 and CMIP6 phases, compared with observation HadSST dataset.

Evolution of Blocking in CMIP6 Simulations in Historical and Future Simulations

Figure 3 shows the comparison of the blocking frequency between two members of the CMIP6 model CNRM-CM6-1. The figures left and, in the centre, show the relative frequency of days with blocking and the right one the difference between the two others. The analysis was done using the ESMValtool which is a software to evaluate Earth System Models. ESMValtool is installed on Mistral. Thus, it is possible to evaluate the CMIP6 models which are available on Mistral regarding blocking without the need of downloading the input data for blocking calculation which saves a lot of time. Therefore, it is useful to be able to use Mistral in future for further calculations with CMIP6.

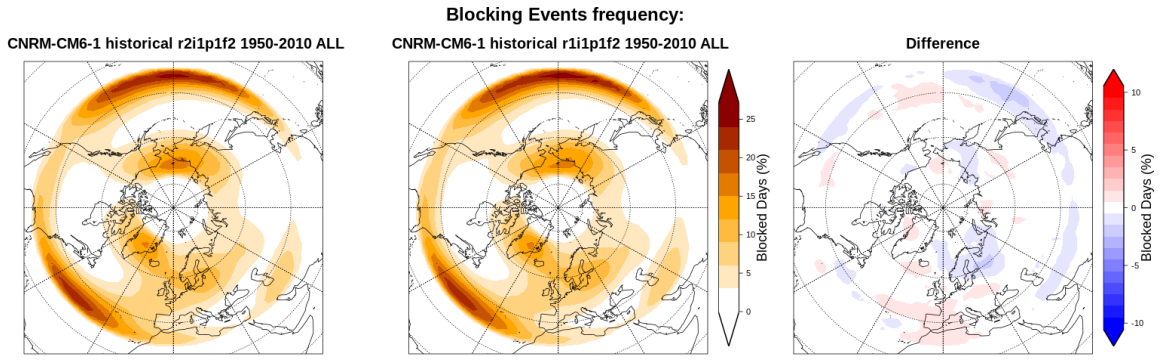


Figure 3. Blocking events frequency for the historical period (1950-2010) of two members of CNRM-CM6-1 CMIP6 model.

Publication:

Amelie Krug, Praveen Kumar Pothapakula, Cristina Primo, and Bodo Ahrens. Heavy Vb cyclone precipitation: a transfer entropy application showcase. Meteorologische Zeitschrift, (2021).

Krug, A., F. Aemisegger, M. Sprenger, B. Ahrens (2021) What intensifies Vb-cyclone precipitation in Central Europe? Climate Dynamics. In revision.

Other presentations and posters:

Kirschner, M. J., Krug, A., Lun, D., and Ahrens, B. (2021): Zeitliche Häufung von Rain-on-Snow Hochwasser – Zufall oder Grundlage ihrer Vorhersagbarkeit?, Deutsche Klimatagung, online, 15–18 March 2021

Krug, A., Aemisegger, F., Sprenger, M., Primo, C., and Ahrens, B. (2020): Moisture sources of extreme Vb-floods in Central Europe. EGU General Assembly 2020, Vienna, Austria, 04–08 May 2020. doi:10.5194/egusphere-egu2020-2315.
Krug, A., Fischer, S., Primo, C., Ahrens, B., and Schumann, A. (2019): Atmospheric drivers of Germany-wide flood events during the 20th century. IUGG 2019 General Assembly, Montreal, Canada, 08–12 August 2019.

Poster (Auswahl)

Pothapakula, P.K., Krug, A., Obermann, A., Keber, T. and Ahrens, B. (2021): Projected future changes in Vb-cyclone precipitation and moisture source region characteristics. ICCARUS meeting 2021, Offenbach, 08–12 March 2021

Krug, A., Aemisegger, F., Purr, C., Primo, C., Sprenger, M., and Ahrens, B. (2020): Intensification processes of extreme Vb-floods in Central Europe. AGU Fall Meeting, online, 01–17 December 2020

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Pothapakula, P.K., Krug, A., Primo, C., Ahrens, B. (2021): Source code for a transfer entropy application showcase (Heavy Vb-cyclone precipitation). Zenodo. doi: 10.5281/zenodo.4568218.
Krug, A., and Ahrens, B. (2020): Cyclone tracks from 1901 to 2010 in dynamically downscaled ERA-20C reanalysis (COSMO-CLM+NEMO). Zenodo. doi: 10.5281/zenodo.4333258.