Project: 983
Title: Decadal variability of flood triggering extreme precipitation events
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The objective of this project is to produce realistic highly resolved historical precipitation and temperature time series to assess flood triggering precipitation events for Europe. With this aim, we are using the regional climate model COSMO-CLM (CCLM) with global reanalysis data as initial and boundary conditions. Simulations were driven both with ERA-Interim (Dee et al., 2011) and with the ERA 20C (Hersbach et al., 2013) reanalysis datasets. During 2016, the ERA-Interim driven simulation was completed and the preparation of the ERA 20C nesting files was started. In 2017 the dynamical downscaling of the ERA 20C reanalysis was finished. It means that from the two downscaling simulations 37 (ERA-I) + 111 (ERA2 0C) years of regional data was prepared for Europe at 0.22° horizontal resolution. Since this data is primarily used for impact studies, where systematic biases are not negligible, bias correction was also performed for the daily precipitation and 2 meter temperature variables. The correction was done with a quantile mapping approach (Berg et al. 2012, Dobor et al. 2015) using the daily E-OBS gridded data set (0.25° horizontal resolution) (Haylock et al., 2008). For the precipitation, the dry day frequency was also corrected. In case of the ERA Interim-CCLM simulation the correction factors were calculated for the whole period and in case of the ERA 20C-CCLM simulation the correcting factors were calculated from the 1955-2010 period, and used also for the 1900-1954 time interval.

Example of apllication: Representation of the Atlantic Multi-Decadal Variability pattern (AMV/AMO)

The performed 20CR-simulation is jointly used for analysis of the Atlantic Multi-decadal variability pattern. Additional experiments with the same CCLM setup downscaling MPI-ESM global simulations, which assimilate ensemble members from the NOAA-ESRL 20th century re-analysis (Compo et al., 2011; Müller et al., 2014) are provided by the DKRZ project bb0893 (Hendrik Feldmann; simulation id: as20c). These simulations improve the coverage of different phases of the AMO and other climate variability pattern and their impact on the European climate (Figure 1).

The AMO represents the evolution of the de-trended North Atlantic sea-surface temperature (SST) and is a leading mode of the decadal to multi-decadal climate variability. The higher SSTs in a positive AMO phase lead to an increased heat-transport to the atmosphere, which in turn affects the climate in Europe. The forcing data for the centennial downscaling experiments are able to reproduce the multi-decadal variations of the AMV – especially the strong upward trends in the 1920s and the 1990th. The representation of the AMO for the first half of the 20th century seems to be better for as20c. After 1940 ERA20C seems to be closer to the reference.

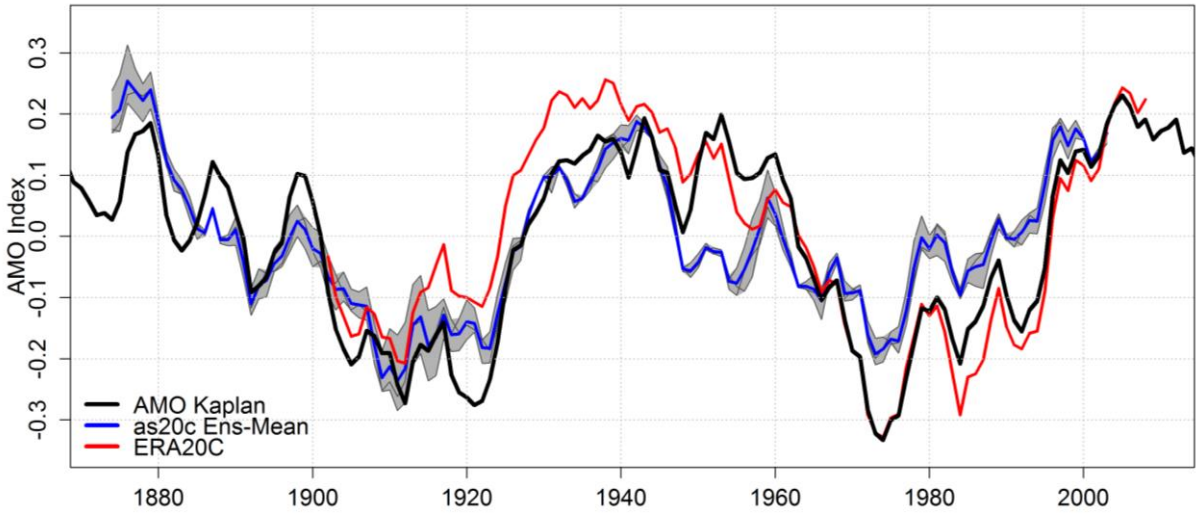

Figure 1: *Representation of the Atlantic multi-decadal oscillation (AMO) in the 20th century reconstructions from ERA20C (red line) and ensemble members of the NCEP 20CR ensemble (blue line: ensemble mean, grey area: ensemble range) compared the observation based AMO index. The time-series display 5-year running means.*

References

Berg, P, Feldmann, H, & Panitz, H-J (2012) Bias correction of high resolution regional climate model data. Journal of Hydrology, 448–449, 80–92.

Compo, G., et al. (2011): The twentieth-century-reanalysis-project, Q. J. Roy. Meteorol. Soc., 137, 1–28.

Dee DP, et al. (2011) The ERA-Interim reanalysis: configuration and performance of the data assimilation system. *Q. J. R. Meteorol. Soc*., **137**, 553–597, doi: 10.1002/qj.828.

Dobor, L, Barcza, Z, Hlásny, T, Havasi, Á, Horváth, F, Ittzés, P, & Bartholy, J (2015) Bridging the gap between climate models and impact studies: the FORESEE Database. Geoscience Data Journal, 2(1), 1–11

Haylock MR, Hofstra N, Klein Tank AMG, Klok EJ, Jones PD, New M (2008) A European daily high-resolution gridded dataset of surface temperature and precipitation. *J. Geophys. Res - Atmospheres*, **113**, D20119, doi:10.1029/2008JD010201.

Hersbach H, Peubey C, Simmons A, Poli P, Dee D and Berrisford P (2013) ERA-20CM: a twentieth century atmospheric model ensemble. *ECMWF Technical Report ERA Report Series* **16**, 44

Müller, W., Pohlmann, H., Sienz, F., Smith, D. (2014): Decadal climate predictions for the period 1901–2010 with a coupled climate model, GRL, 41 (6), pp. 2100–2107