Project: 105
Project title: ANDIVA (Analyse, Diagnose und Validation)
Principal investigator: Joaquim G. Pinto
Report for period 01.01.2019 - 31.12.2019

During the year 2019, several aspects of regional modelling of extreme events have been tackled. In this report, we give a short overview of achieved and ongoing research projects.

Compound-Events:

Weather events associated with concurrent wind and precipitation extremes, so-called compound events, can lead to severe damage. This year, we focused on compound events on the Iberian Peninsula. At first, an objective ranking of concurrent events is produced for the period 1979-2018 and the top100 ranked events are analyzed in detail. Then, three of these occurrences, namely the 5th Nov 1997 storm, Storm Emma on 28th Feb 2018 and Storm Ana on 10th Dec 2017 are simulated with the regional WRF model. These events were related to exceptional economic and societal impacts and record-breaking meteorological extremes have been observed. The WRF model is used with a horizontal resolution of 3km. Several spin-up times have been considered (up to 3 days prior the day of maximum intensification of the cyclone) so that the best agreement (in terms of trajectory and time evolution of the cyclone intensity) with ECMWF-ERA5 reanalysis estimates is reached. It is observed that short spin-up time is preferable: larger time intervals lead to weaker and East-shifted cyclones than observed. Current research focuses on the analysis of possible drivers for the intensification of the cyclones and the observed impacts. This work will continue in 2020.

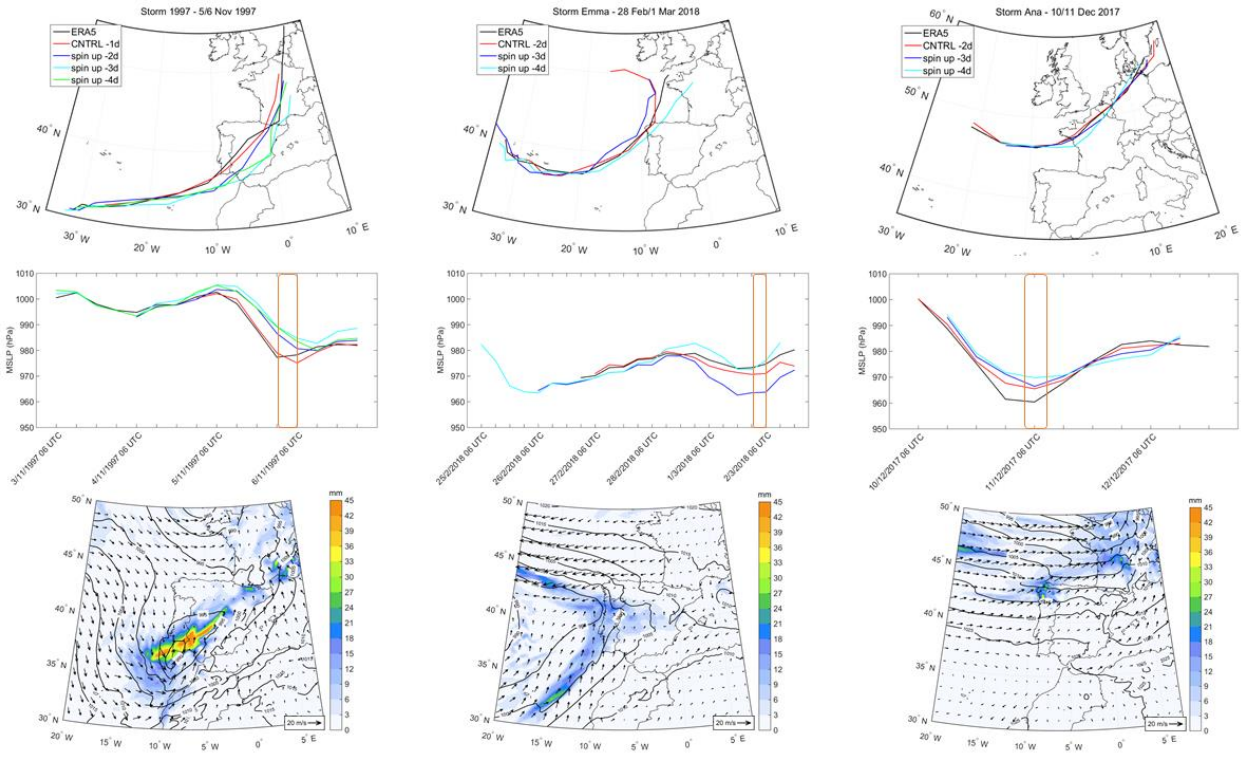

Figure: Sensitivity of cyclones trajectories (first row, d=days) and intensities (second row) to spin-up time for the three events considered (one event per column). Third row: MSLP, 10m wind speed and 6h accumulated precipitation, centered at the time instant of minimum MSLP at the cyclone center, as highlighted above.

Transition COSMO-CLM → ICON-LAM

To achieve a seamless transition between the currently used COSMO-CLM and the planned use of the ICON model, different types of windstorms are modelled with the new DWD ICON model. The ICON model is used in a limited-area mode driven by ERA5 data and several sensitivity experiments are conducted. The main focus lies on the sensitivity of European windstorms on the modelling with 1-way and 2-way nesting. Therefore, simulations are conducted with a horizontal resolution of 13.2 km, 6.6 km and 3.3 km. It turns out that there is a high case-to-case variability. For e.g. Windstorm Kyrill, which was mainly synoptically driven, almost no differences are observed between 1 and 2-way nesting. For Windstorm Xynthia, on the other hand, diabatic processes play an important role. Differences in the dynamics in an early stage lead to a slightly different storm development 24 hours later, with, in this case, stronger wind speeds over Europe in 1-way nesting (Fig.). The goal main goal is to get a better understanding of the ICON model and modelling windstorms in general and to use this knowledge in upcoming projects. Additionally, this pre-study serves as a contribution to the windstorm community.

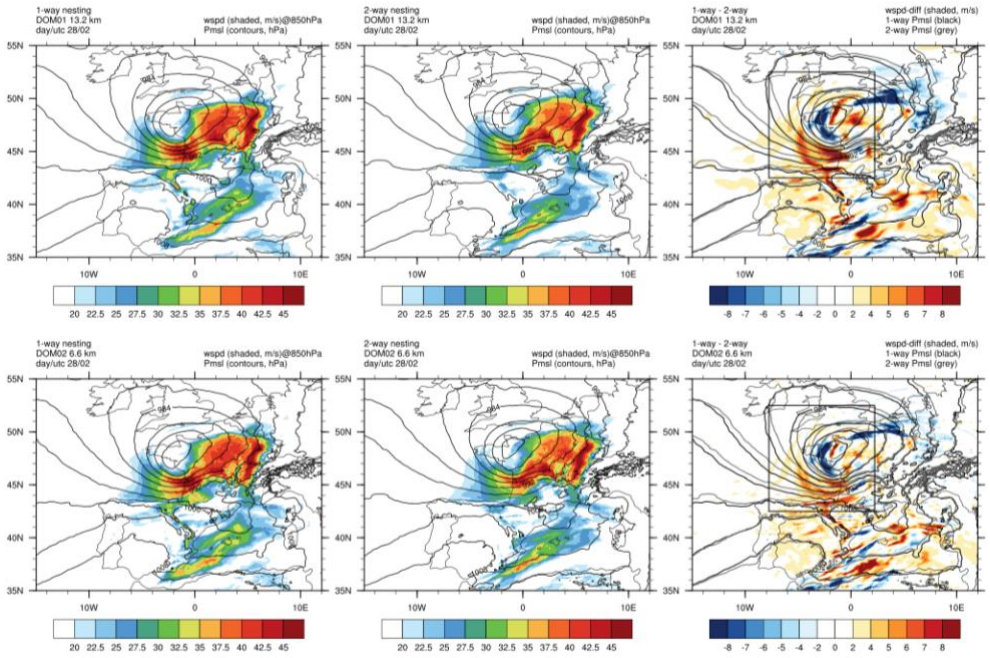

Figure: Comparison between 1-way (first column, 13.2 and 6.6 km) and 2-way nesting (second column; 3rd column difference between 1- and 2-way nesting) for winter storm Xynthia, February 2010, with the ICON model.

Publications made possible through DKRZ-resources in project bb0105:

Mathias, L., Ludwig, P., and Pinto, J. G.: Synoptic-scale conditions and convection-resolving hindcast experiments of a cold-season derecho on 3 January 2014 in western Europe, Nat. Hazards Earth Syst. Sci., 19, 1023–1040, https://doi.org/10.5194/nhess-19-1023-2019, 2019.