Project: 105
Project title: ANDIVA (Analyse, Diagnose und Validation)
Principal investigator: Joaquim G. Pinto
Report for period 01.01.2021 - 31.07.2021

During the year 2021, the main focus in this project was on the transition from COSMO-CLM to ICON-CLM. In this report, we give a short overview of achieved and ongoing research projects.

Transition COSMO-CLM → ICON-CLM

This topic is still ongoing in 2021 and will continue in the next years. The ICON code is running on mistral @DKRZ utilizing resources in this computing time project and the Starter Package for ICON-CLM Experiments (SPICE-Environment) has been setup up successfully. First experiments using ERA-Interim initial and boundary conditions have been performed this year. Within this project KIT contributes to the ICON-CLM model development with partners at DWD, HZG, FU-Berlin and BTU-Cottbus. As new member of the project group ICON-core, KIT is a key partner now for the development and testing of the ICON-CLM runtime environment and will contribute to namelist parameter sensitivity testing.

Development of a unified CMIP6-converter

KIT develops a converter that produces ready to use input files based on available CMIP6 data in the DKRZ data pool (pool/data). The overall aim is to build a flexible converter, that produces caf-files (that can be read by either COSMO-CLM and ICON-CLM) from as many CMIP6 models as possible (depending on general data availability, e.g., 6-hourly 3-d atmospheric data is mandatory). The caf-files will be used in the next CORDEX activities by various modelling groups

Two-Way nesting with ICON-LAM

Within a MSc project, the European windstorms Xynthia (2010) and Christian (2013) are modelled with the ICON model in limited-area mode driven by ERA5 data. Simulations are conducted on a horizontal resolution of 10 km with nested domain of 5 km and 2.5 km horizontal resolution. The nested domains are either placed over the development area of the windstorms (North-Atlantic) or over the impact region (Europe). Several sensitivity experiments are conducted with different nesting areas, 1-way vs. 2-way nesting, and parameterized convection on/off.

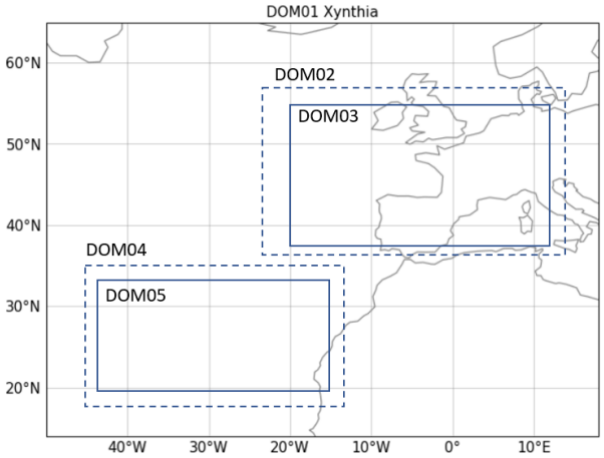

Figure 1: Configuration of the domains for the Xynthia case (2010). A simulation over the whole domain (DOM01) is forced by ERA-5 data. Nestings are divided between development and impact regions. For the development, we assume the biggest effect on the development of the storm over the North Atlantic (DOM04 and DOM05). For the impacts, we conducted high resolution nests over Western Europe, to analyze the impacts of Xynthia.

A special focus is on the sensitivity of the modelled European windstorms with 1-way vs. 2-way nesting. With this aim, the focus is on two different classes of windstorms: Xynthia as a more diabatically driven storm, and Christian as mostly baroclinically driven. The analysis is completed by analyzing 3-d trajectories of air streams, e.g., warm conveyor belts. The simulations perform quite well when maximum wind gusts are compared to observations (Fig. 1). The results for Xynthia and Christian

suggest, that 2-way nesting might not play an important role for the simulation of mid-latitude windstorms, as the differences between 1 and 2-way nesting are small. The results suggest, that the synoptic-scale forcing may superimpose any regional to local effects on the storm developments. However, the results are not conclusive and a much bigger sample needs to be investigated to draw more general conclusions. The MSc thesis is closed to be submitted, further investigations are envisaged for this and next year that will lead to a publication probably next year.

Tornado outbreak in Luxemburg

On 9 August 2019, a supercell thunderstorm crossed over the south-western part of Luxembourg during the evening hours and produced a significant tornado along its path. Roughly 400 trees and a total of 310 houses were damaged, 50 of which lost their roofs Moreover, the tornado was associated with 17 minor casualties and 2 seriously injured persons. The vortex lasted for about 10 to 15 minutes and travelled a distance of 18 to 20 km. The tornado was rated as IF2+ based on the scale currently in development by a steering group lead by the European Severe Storms Laboratory which corresponds to estimated maximum wind speeds of approximately 241 km h^{-1}. We used DKRZ capacities to analyze this event in more detail with a focus on predictability and uncertainties in ensemble forecast products (COSMO-DE ensemble). A corresponding study has been published in 2021:

Mathias, L., Ludwig, P. and Pinto, J.G. (2021), The damaging tornado in Luxembourg on 9 August 2019: towards better operational forecasts. Weather. https://doi.org/10.1002/wea.3979