Project: **1069**
Project title: **Boundary layer flows over complex terrain during the Perdigão field campaign**
Principal investigator: **Johannes Wagner**
Report period: **2018-01-01 to 2018-12-31**

In this project the Weather Research and Forecasting (WRF) model was used to perform simulations of the boundary layer flow during the Perdigão 2017 field campaign. This campaign took place during May/June 2017 over the double-ridge site in Portugal (see Fig. 1) to measure the boundary layer flow over complex terrain and its interaction with a single wind turbine. by means of a huge number of remote sensing and in situ-measurements. The large number of meteorological instruments involved during the measurement campaign was used to verify a WRF long-term simulation over 49 days with a horizontal grid resolution of 200m. It was found that the wind distribution was simulated surprisingly well in spite of the long simulation period (see Fig. 2) and that nocturnal low-level jets (LLJ) were mainly driven by thermally induced pressure gradients. The high quality of the model results were only possible by the implementation of a forest parameterisation, which impresses additional drag on the lowest model levels and enables the formation of LLJs over the double ridge. Several short-term simulations of LLJ-events indicated that improved landuse data sets including information about roughness lengths, heights of trees and buildings are necessary. As an example, the simulation of a LLJ over the double ridge on 8 May 2017 is shown in Fig. 3. Without forest parameterization winds are too strong near the surface and no LLJ develops. The LLJ structure considerably improves when the forest drag is switched on. This indicates that future LES simulations of real-case applications have to resolve not only the complex topography, but also roughness elements such as trees or buildings. This requires improved landuse satellite data, which have to be tested in further numerical studies.

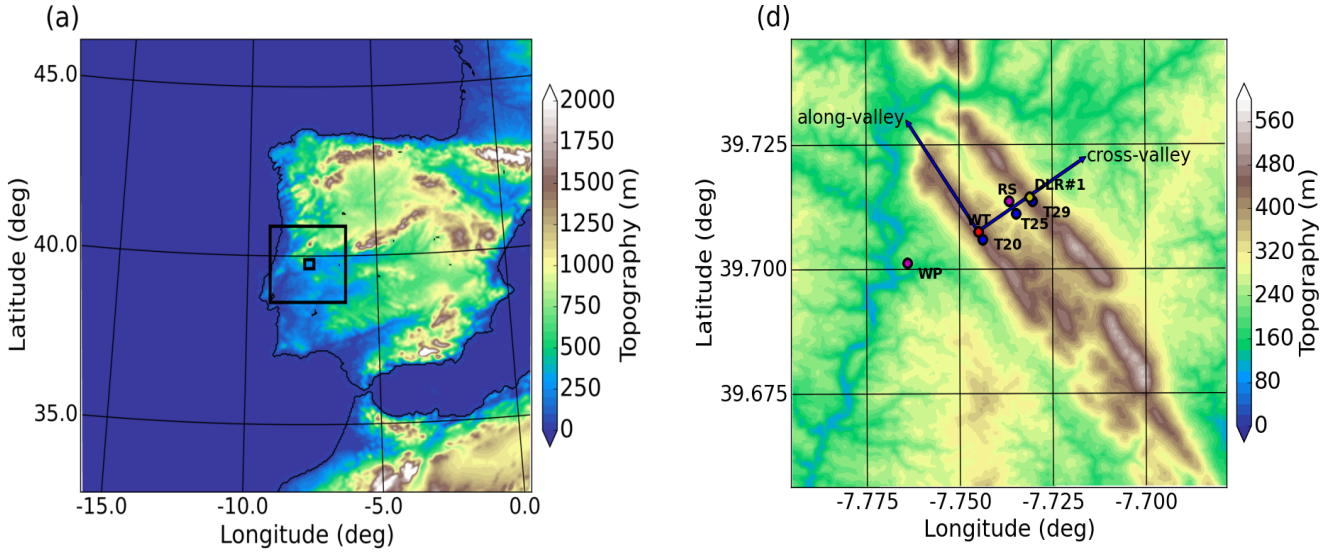

Figure 1: Site location, regional topography of the Perdigão 2017 experiment and modelling domains for the WRF long-term simulation.

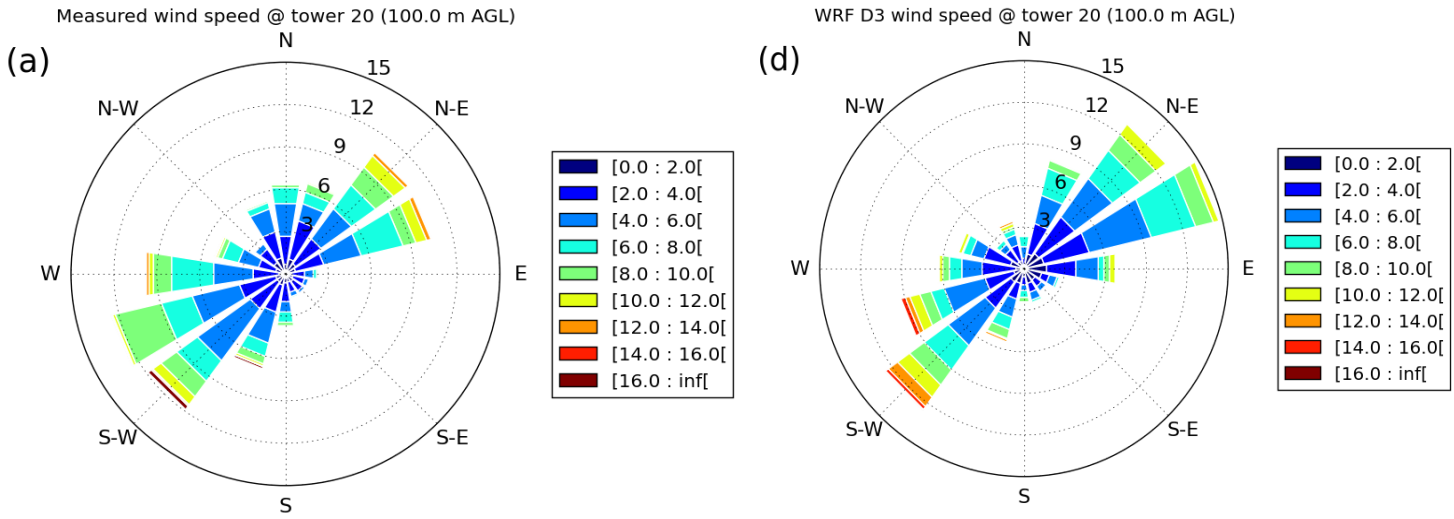

Figure 2: Observed (left) and simulated (right) wind distribution at tower T20 on the SW ridge (see Fig. 1) during the period 1 May to 18 June 2017.

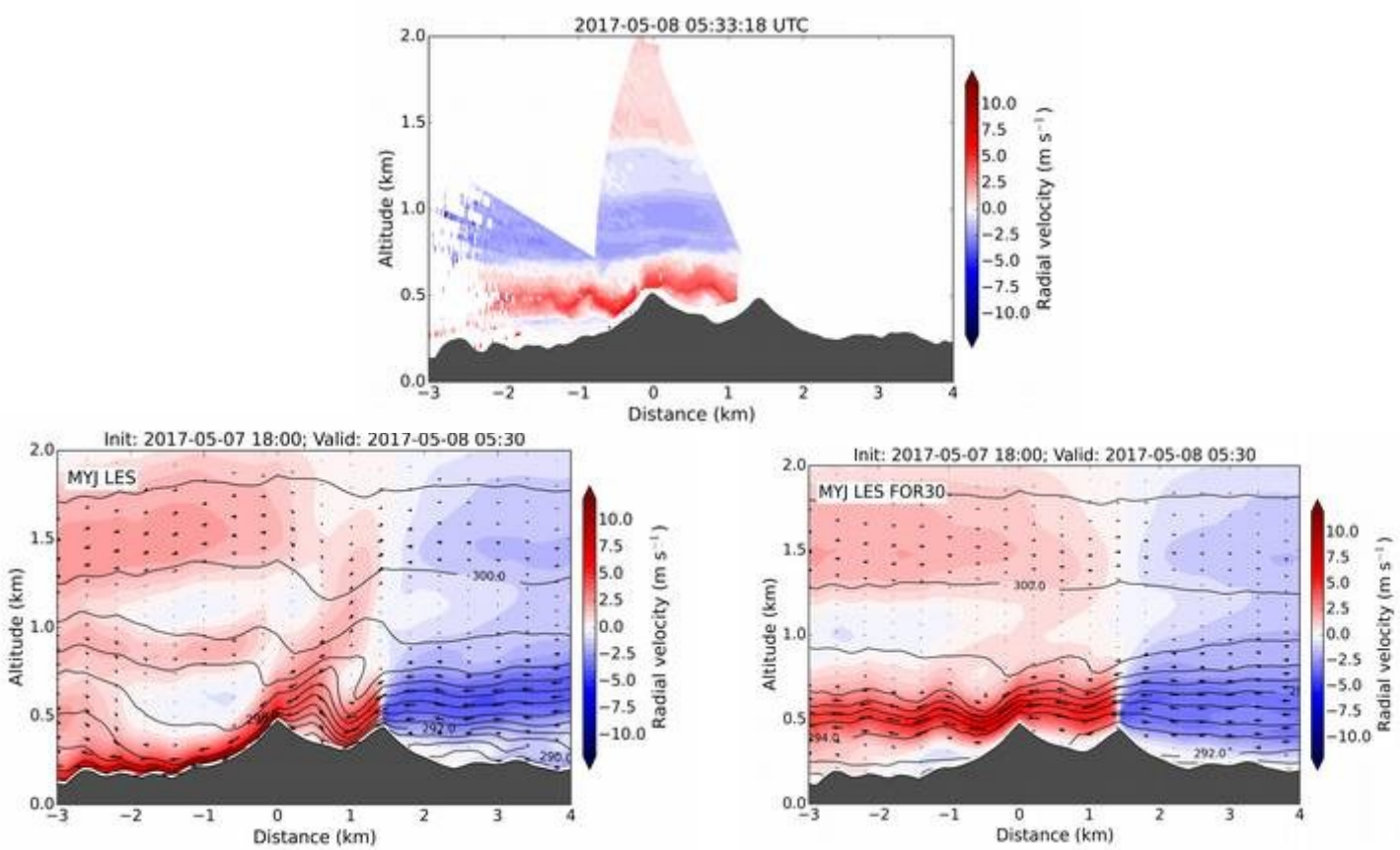

Figure 3: Radial velocity measured by the DLR lidar on 8 May 2017 at 05:33 UTC (top). Simulated radial velocities for a WRF run without (left) and with (right) forest parameterization.