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Large Eddy Simulation over three-dimensional mountain topography

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A new generation Large-Eddy Simulation (LES) is applied to study wind fields and the influence of local topography.
In this study we focus on the implementation of three-dimensional topography in our LES algorithm using an immersed boundary method. To validate the model, the LES results are compared with two sets of measured data. The first one is made of measurements from wind tunnel studies taken from the literature. The second set was measured by WSL scientists in the context of GAUDEX field campaign. This field experiment took place in 2003 at an altitude of 2280m in the Graubünden, Switzerland. Using both sets of data gives us the opportunity to compare our model with idealized conditions and real atmospheric conditions.
The impact of topography in our modeling results is discussed with the main point that each system (idealized and real) provides unique challenges. In particular, the wind tunnel topography is “perfect”, i.e. it has no sharp angles that can trigger the separation of a turbulent boundary layer while with real topography these separation points are often fixed. The three-dimensional hills are included in the model using a Digital Elevation Model (DEM). When comparing the computed results with the real data, it is discussed what is the impact of the resolution of the DEM on the simulated wind fields.