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The use of an atmospheric model to resolve wind forcing turbulent flows over complex terrain for wind resource assessment

N. Barranger and G. Kallos

University of Athens, Faculty of Physics, Environmental Physics-Meteorology, Athens, Greece (nbarranger@mg.uoa.gr, 00302107295281)

In wind resource assessment studies where orography plays a significant role, two families of numerical models are distinguished according the characteristic length scale of diagnostic processes. At very small scale, engineering CFD models are used to accurately represent recirculation, speed up, and wake interaction in the case of a steady neutral stratified flow. On the other hand, mesoscale models are particularly interesting in solving larger scale processes that contribute to local wind characteristics. They also take into account effect of radiation, moisture and stratification that can influence local wind prediction through variation in turbulence and buoyancy parameters.

Although non hydrostatic compressible atmospheric models are theoretically capable of solving high resolution wind features like CFD models do, they are limited by a generally coarse horizontal grid resolution and linearized anisotropic turbulent closure schemes. Using Very Large Eddy Simulation (VLES) and a set of nested grids, state of the art models can nearly close the gap in accuracy with microscale models. Continuing this effort in reducing the wind prediction errors in complex terrain areas, the mesoscale model RAMS is used at identical resolution with CFD models.

To properly compare these two models, RAMS is simplified in order to accurately resolve neutral stratified steady state flow over idealized two 2D hills. The results are then compared against various well know experiments such as Rushil wind tunnel measurements. In this last, three hill shapes with various slopes are used to evaluate the model response in case of recirculation and detaching flows. It is shown that RAMS can accurately reproduce CFD results in complex terrain using a k-ε turbulent closure. Further testing is currently carried on in order to take into account different stability conditions.