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MM5 high resolution simulations over Lisbon

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The work presented here has been produced within the framework of the Research Training Network, ATREUS (Advanced Tools for Rational Energy Use towards Sustainability). The ATREUS network aims to improve the understanding of the urban environment and its impact on the buildings' energy behaviour. The city of Lisbon has been chosen as a case study. The approach undertaken by the network requires the downscaling of a numerical weather prediction, mesoscale model to a microscale model to be able to analyse and predict local turbulence fields around buildings. Hence, it is primordial to optimize both the vertical and horizontal outputs of mesoscale models, especially within high resolution domains.

A circulation weather typing system that has been developed in Portugal was used to identify the most typical periods of the most frequent circulation weather type (CWT) occurring annually over Portugal. The PSU/NCAR MM5 (Version 3.6.1) mesoscale model was used to simulate four typical CWT periods, one per season, as representative of the most frequently occurring CWT, namely anticyclonic.

The goal of the study is to tune the MM5 setup, at a resolution of 1 km for the characteristic features encountered in downtown Lisbon when it is under the influence of the most frequently occurring CWT round the year. The main sensitivity tests were carried out on the simulation of vertical profiles of wind speed and potential temperature, especially within the first 250 m from the ground. In this exercise simulations were carried out with (0.5 x 0.5˚) and (2.5 x 2.5˚) global input data, both obtained from the European Centre for Medium-Range Weather Forecasts (ECMWF). Results obtained from the two data sets were compared to observed radiosonde data available at the

Gago Coutinho meteorological station in Lisbon.

In the four anticyclonic situations, at 1 km resolution, MM5 simulates relatively well the vertical wind speed profiles during the night but underestimates the wind speed during the day. The MRF Planetary Boundary Layer (PBL) scheme seems to be the most appropriate to use for this region up to 3000 m. However closer to the surface, up to 250 m all PBL schemes behave similarly. The results presented will include comparisons of surface parameters in the 1 km domain when using the two sets of input global data.

MM5 shows fairly good skill for wind speed measured at 10 m when using MRF especially during night hours and when the wind speed is very low. Similarly, in all situations, MRF tends to overestimate the 2 m air temperature during the day but underestimates it during the night.

The choice of Lisbon as a study case, turned out to be challenging in optimizing the MM5 setup in order to provide data to be further processed by microscale models and consequently to generate physically realistic data to calculate energy requirements by buildings, under various meteorological conditions.

Keywords: mesoscale modelling, PBL parameterizations, vertical resolution, circulation weather types