Coupling WA^{S}P and Mesoscale Results: Wind Atlas and Stability

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Abstract

The scarcity of wind measurements in many sites throughout the globe and the need for more rapid and reliable wind analysis has lead to the use atmospheric modeling techniques, for a wide range of applications across scales ranging from meters to thousands of kilometers. These powerful weather models have the ability to generate a great amount of climate information that could be used in conjunction with other flow models, either linear or non-linear, to improve accuracy of estimates.

The authors developed a coupling method to use the mesoscale model WRF (Weather Research and Forecasting) and the linear flow model WA^{S}P (Wind Atlas Analysis and Application Program) as a way to answer the problem of wind assessment in places where there is an absence of wind data.

Firstly, a precursor WRF simulation, version 3.3.1, is carried out forced by FNL (FINAL Analysis) climatic data from and using SRTM (Shuttle Radar Topography Mission) in the topography description. The model is configured to use a two-way feedback between three nested grids, with horizontal resolutions of 27, 9 and 3 km. All fields required by the coupling process are extracted from the 3 km grid.

The coupling process from WRF results has, as its basis, the utilization of large scale wind fields solved by the mesoscale numerical model, where all interactions from mechanical and thermal effects are computed in a limited area. From these simulations data is extracted to construct the regional Wind Atlas, which is fed to the microscale model WA^{S}P improving the wind analysis at a smaller scale. The method includes the calculation of a height above ground, from which a temporal wind series is extracted, based on an analysis of neutral winds events using diagnostic equations (Petra Seibert et al. 2000). Considering this wind data as geostrophic winds, the regional Wind Atlas is estimated using the logarithmic wind profile law in neutral conditions. Information about atmospheric stability regimes is also considered in WAsP projects, through the Sensible Heat Fluxes parameters, namely, the Root Mean Square (RMS) and Standard Deviation.

To verify the robustness of the methodology the authors gathered nineteen sites in Portugal and one in Brazil and the process was applied. The sites in Portugal are scattered in a geographic area of 400km by 600km, covering distinct atmospheric conditions. In Brazil only one test was available located in the South of the Rio Grande do Sul state.

Metric statistics associated to the annual mean wind speed, Weibull distribution parameters and power density were quantified. A comparison between two result sets: a) WRF directly results and measurements b) Coupling process and measurements were carried out. Preliminary results point to a general improvement of all quantities when the coupling process is used.