On the effective resolution of WRF simulations at microscale grid resolution

P. Bolgiani[1*], J. Díaz-Fernández[1], L. Quitián-Hernández[1], M. Sastre[1,2], D. Santos-Muñoz[3], J.I. Farrán[2], J.J. González-Alemán[1], F. Valero[1], M.L. Martín[2]

[1]Department of Earth Physics and Astrophysics, Faculty of Physics, Universidad Complutense de Madrid. Madrid, Spain.
[2]Department of Applied Mathematics. Faculty of Computer Engineering. Universidad de Valladolid. Segovia, Spain.
[3]High Resolution Limited Area Model Consortium (HIRLAM). Agencia Estatal de Meteorología (AEMET). Madrid, Spain.
*Pedro Bolgiani: pbolgian@ucm.es

INTRODUCTION

As the computational capacity has been largely improved in the last decades, the grid configuration of numerical weather prediction models has stepped into microscale resolutions (Wyngaard, 2004). Even if mesoscale models are not originally designed to reproduce fine scale phenomena, a large effort is being made by the research community to improve and adapt these systems (Rai et al., 2017). However, reasonable doubts exist regarding the ability of the models to forecast this type of events, due to the unfit parametrizations and the appearance of instabilities and lack of sensitivity in the variables (Wyngaard, 2004; Rai et al., 2017; Bolgiani et al., 2020). Here, the Weather Research and Forecasting (WRF) model effective resolution is evaluated for several situations and grid resolutions.

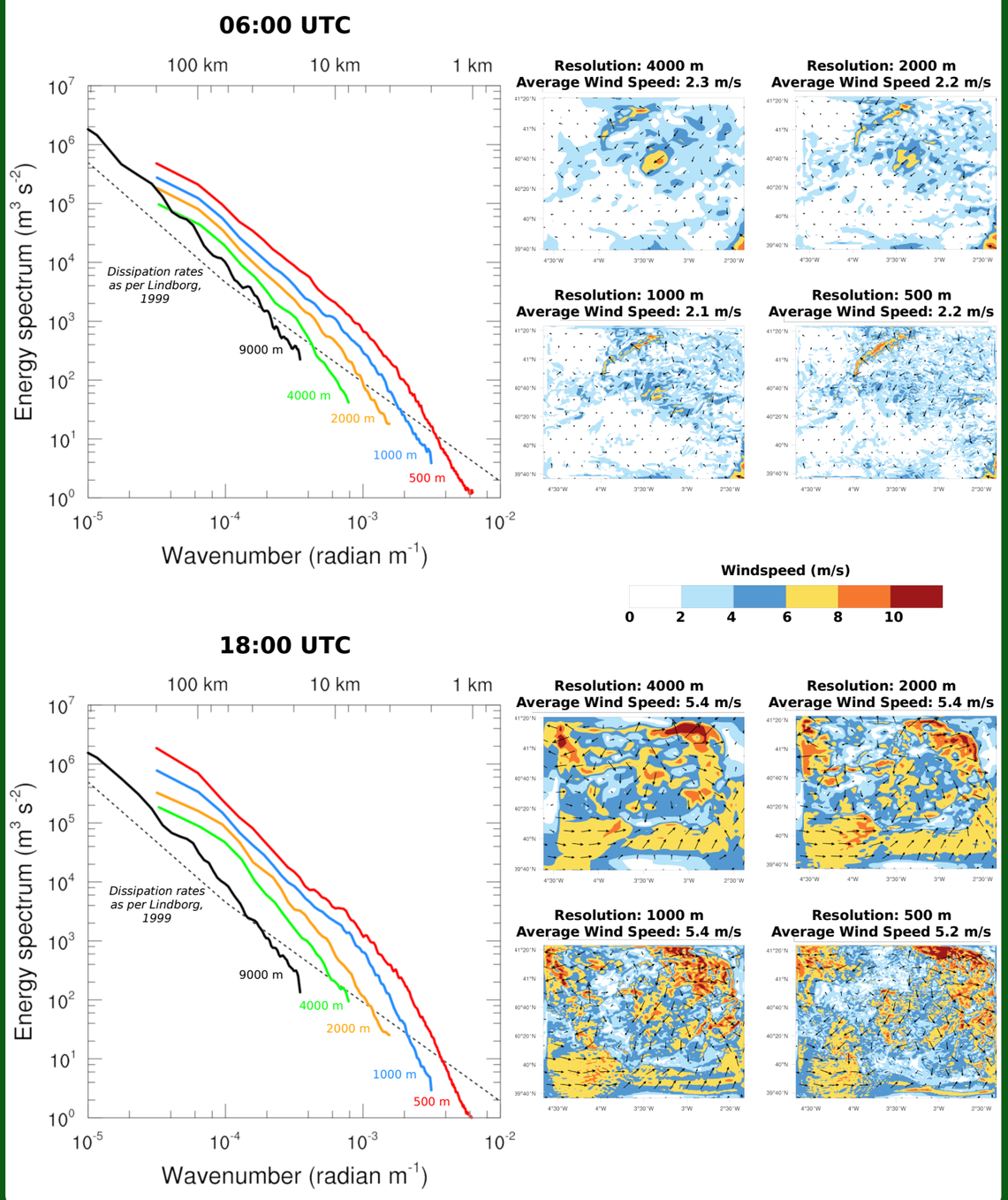
METHODOLOGY

The meteorological situation assessed is a convective system associated with a cut-off low at mid levels which swept over the area of Madrid (Spain) during 07 JUL 2017 (Bolgiani et al., 2018).

The model used is the Advanced Research WRF version 4.0.3 with the parametrizations adapted for microbursts as per previous works by the authors (Bolgiani et al., 2020). Four simulations where performed using an outer domain at 9000 m grid resolution and an inner domain at 4000, 2000, 1000 and 500 m grid resolutions.

The kinetic energy spectrum is created following the procedure described by Skamarock, 2004. Wind at 1000 hPa is used.

RESULTS



CONCLUSIONS

- The simulated kinetic energy spectrum responds to different conditions and fits reasonably well the observations at meso-beta grid resolutions.
- When the model is forced into microscale grid resolutions the atmospheric energy dissipation curves present an unrealistic status, even if there are not large differences in the wind field. This imposes a large uncertainty to forecasting at these resolutions, in accordance with Bolgiani et al., 2020.
- Effective resolution results are in agreement with Skamarock, 2004, approximately 8 times the grid resolution. However, the unrealistic energy spectra have to be considered to stablish a minimum effective resolution when dealing with microscale grids.

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