Geophysical Research Abstracts
Vol. 19, EGU2017-17746, 2017
EGU General Assembly 2017

High resolution dynamical downscaling of air temperature and relative humidity: performance assessment of WRF for Portugal

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Air temperature and relative humidity are two of the atmospheric variables with higher impact on human and natural systems, contributing to define the stress/comfortable conditions, affecting the productivity and health of the individuals as well as diminishing the resilience to other environmental hazards. Atmospheric regional models, driven by large scale forecasts from global circulation models, are the best way to reproduce such environmental conditions in high space-time resolution.
This study is focused on the performance assessment of the WRF mesoscale model to perform high resolution dynamical downscaling for Portugal with three two-way nested grids, at 60 km, 20 km and 5 km horizontal resolution. The simulations of WRF models were produced with different initial and boundary forcing conditions. The NCEP-FNL Operational Global Analysis data available on 1-degree by 1-degree grid every six hours and ERA-Interim reanalyses dataset were used to drive the models. Two alternative configurations of the WRF model, including planetary boundary, layer schemes, microphysics, land-surface models, radiation schemes, were used and tested within the 5 km spatial resolution domain.
Simulations of air temperature and relative humidity were produced for January and July of 2016 and compared with the observed datasets provided by the Instituto Português do Mar e da Atmosfera (IPMA) for 83 weather stations. Different performance measures of bias, precision, and accuracy were used, namely normalized bias, standard deviation, mean absolute error, root mean square error, bias of root mean square error as well as correlation based measures (e.g., coefficient of determination) and goodness of fit measures (index of agreement). Main conclusions from the obtained results reveal: (i) great similarity between the spatial patterns of the simulated and observed fields; (ii) only small differences between simulations produced with ERA-Interim and NCEP-FNL, in spite of some differences between the input variables; (iii) the tested parametrizations do not force significantly different simulation patterns; (iv) observed and simulated hourly air temperature are very well correlated (91%), presenting similar variance and a low bias over the country. Obtained results are also in good agreement with other dynamical downscaling studies for Portugal supporting the use of WRF as a regional forecast model.

Acknowledgements: This work was supported by: (i) the project Interact - Integrative Research in Environment,Agro-Chain and Technology, NORTE-01-0145-FEDER-000017, research line BEST, cofinanced by FEDER/NORTE 2020; (ii) the FIREXTR project, PTDC/ATP¬GEO/0462/2014; and, (iii) European Investment Funds by FEDER/COMPETE/POCI–Operacional Competitiveness and Internacionalization Programme, under Project POCI-01-0145-FEDER-006958 and National Funds by FCT - Portuguese Foundation for Science and Technology, under the project UID/AGR/04033.