GORDON EXTRA-TROPICAL DEPRESSION OVER PORTUGAL: A CASE STUDY WITH WRF (version 2.2)

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Abstract: *The 2.2 version of the Weather Research and Forecasting (WRF) model has been used to investigate the atmospheric behavior on extreme weather events, such as the passage of the Gordon extra-tropical depression over the Iberian Peninsula, on September 21st, 2006. The study of this particular event has been conducted using two nested domains, with 15 and 3 km resolution, respectively, and its results are directly compared with observational data collected by several Automatic Meteorological Stations, from the Portuguese Meteorological Institute, for the time span of the event.*

Introduction

The hurricane Gordon was one of the most intense events of the 2006 Atlantic Hurricane season, making it the first hurricane to directly impact the Azores since Bonnie, in 1992. Formed near Leeward Islands, Gordon was first declared as a tropical depression (at September 10th) moving northwestward, evolving later to a tropical storm (September 11th) and reaching category 3 on the Saffir-Simpson scale, on September 13th. Since its formation, the hurricane was moving easterly and the initial forecasts pointed to a high intensity impact over the Azores islands, which lead to the activation of several security measures. However, the damage caused by Gordon was limited to toppled trees and power lines, knocking out power to some communities, particularly on Santa Maria Island. After crossing the northwest region of the Iberian Peninsula, on September 21st, the event came to the end of its lifecycle, being absorbed by an Atlantic low pressure area, located over the west of the United Kingdom.

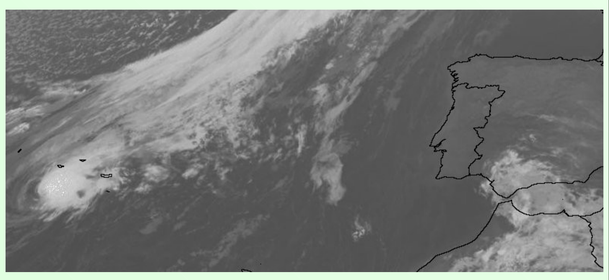
WRF Configuration

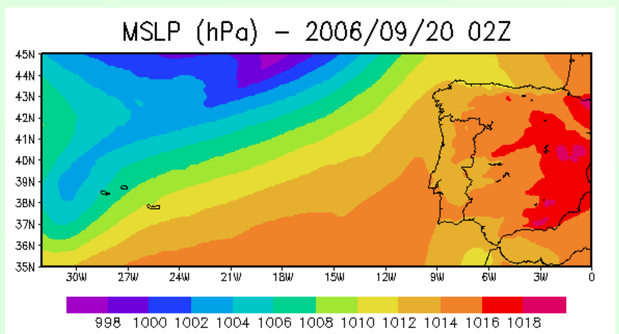
- Nested 1:5 grid configuration,
- Coarser 15 km grid spacing domain centered around 40.6 N latitude and 15.4 W longitude;
- 30" resolution geographical data on both nests;
- 40 vertical levels;
- 90 s integration timestep on the coarser nest, 18 s on the finer.
- LBC provided by NCEP's GFS (run #1) & ECMWF (run #2)
- Integration period: 72 hours, starting from 2006/09/19 – 00:00

Physics Options	Scheme
Microphysics	Eta microphysics
Longwave Radiation	RRTM
Shortwave Radiation	Dudhia
Surface Layer	MM5 similarity
Land Surface	5 layer thermal diffusion
PBL Layer	Yonsei University
Cumulus Parametrization	Kain-Fritsch

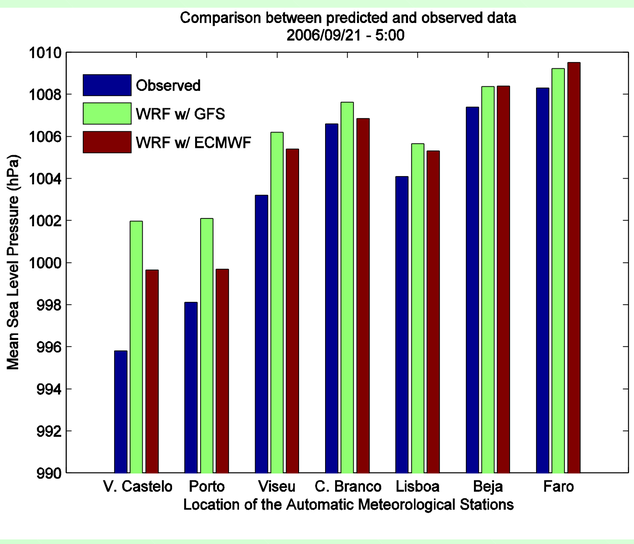
Results / Data Analysis

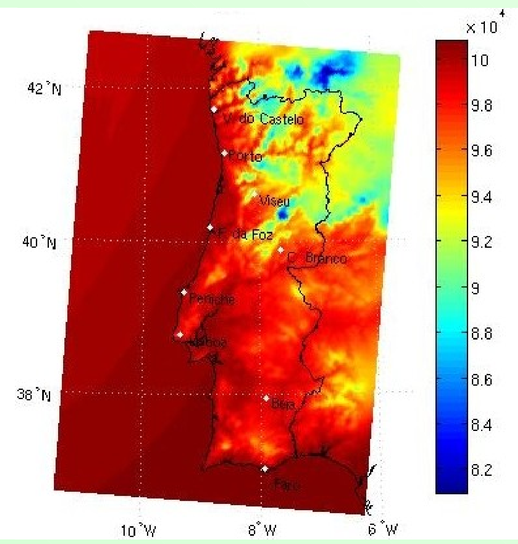
At a first glance simulated data, based on GFS initialization, resembles the conditions observed. Looking closely, and comparing with direct observed data from the Portuguese Meteorological Institute Automatic Meteorological Stations, some discrepancies could be found



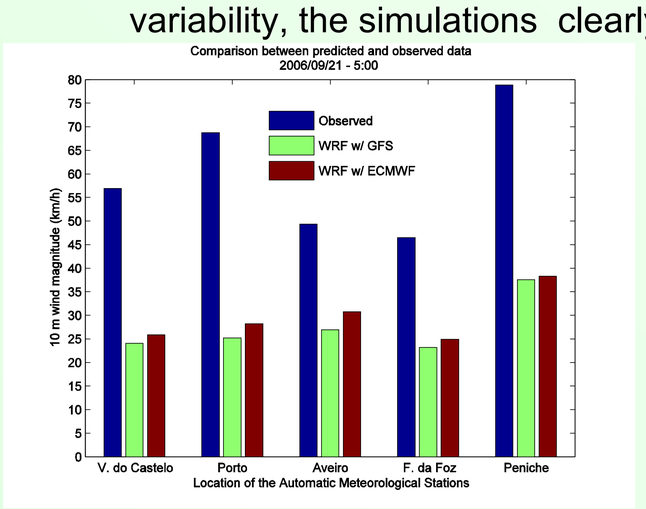


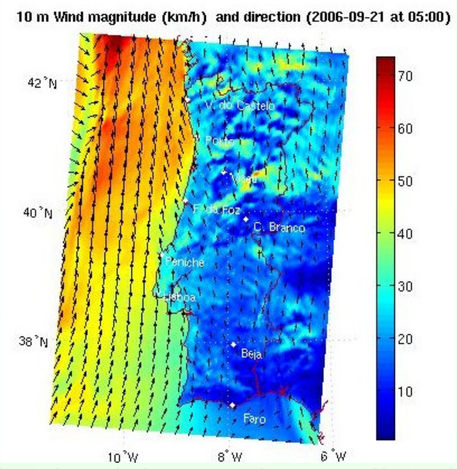
In the case of the mean sea level pressure, the ECMWF initialized model results seem to approach more accurately the observed data



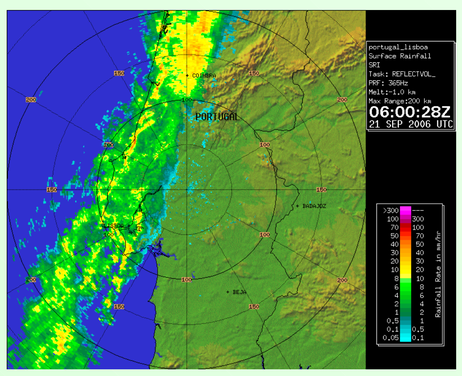


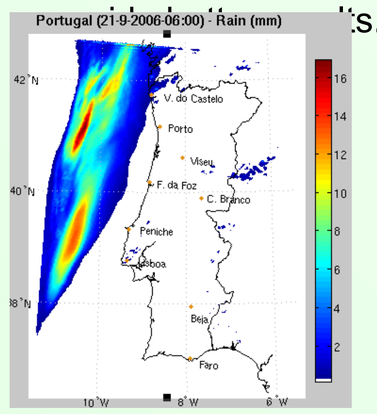
As for the wind intensity, and in spite of reproducing reasonably its local variability, the simulations clearly underestimate the wind magnitude.

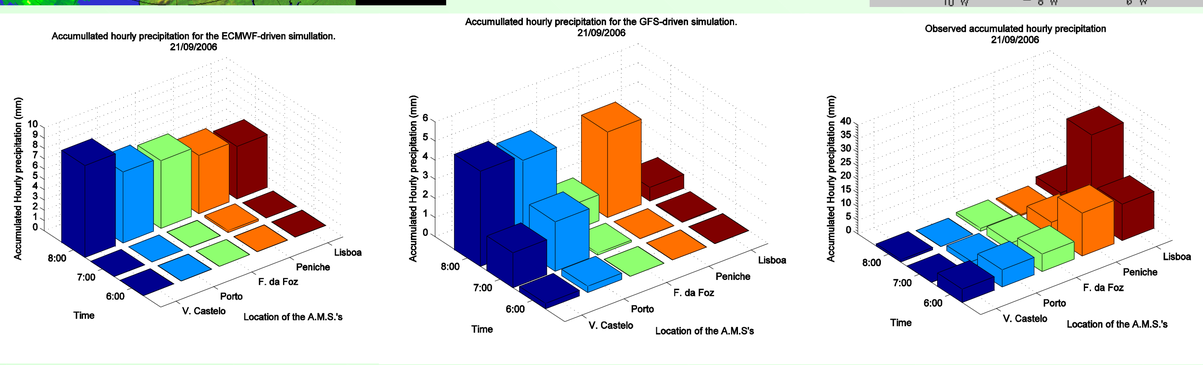




On what concerns total precipitation, it can be noticed a delay on the predicted hourly precipitation rate, as well as an underestimation of the total precipitation measured. However, the ECMWF driven simulation seems to







Conclusions

Unfortunately, a successful WRF run, reproducing accurately all the conditions observed, could not be shown. Nevertheless, the lack of success should not be pointed out as a deficient model calibration/parametrization, but, instead, by the initial-boundary conditions used. A solid conclusion that can be made lies on the fact that the ECMWF data used as initial-boundary conditions provides a slight improvement on the simulation results, in comparison with the GFS model data. Further explorations of this unusual situation shall include data assimilation from the Portuguese Meteorological Institute Automatic Meteorological Stations, in order to minimize eventual errors from the initial and lateral boundary conditions data.

Acknowledgments

The first author's research work is funded by the Portuguese Foundation for Science and Technology grant SFRH/BD/28602/2006.