WRF Modelling System Experiments With Different Land-Surface Options

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1. Introduction

In this study, we present some results of the Weather Research and Forecast (WRF) modelling system with different land-surface schemes. These results are from a WRF 48 hours forecast in the autumn season (22th and 23th November 2004). The purpose of the study is to evaluate the effects of the different land-surface models available in the WRF modelling system on the predicted 2-meter temperature over Portugal.

2. Experiments

For these experiments we had used a single domain with 30 km horizontal resolution centred at the Iberian Peninsula. This domain uses 26 vertical levels, with the model top at 50 mb. The model is initialised with 1º resolution AVN datasets. For the initialisation of soil conditions it was used the global geographical information tiles for the WRF Standard Initialisation (WRFSI) system. We performed three simulations for the same location and for the same period of time, only varying the land-surface schemes: the thermal diffusion scheme (Dudhia, 1996), the Noah land surface model (Ek et al, 2003) and the RUC model (Smirnova, 2000). These three models were used with the following non-soil physics options: i) the Mellor-Yamada-Janjic PBL scheme, ii) the Kain-Fritsch cumulus parameterisation scheme, iii) the Monin-Obukhov-Janjic surface-layer parameterisation scheme and iv) the Dudhia radiation scheme.

3. Results and Conclusions

The results of the experiments were compared with 6 stations distributed along Portugal. In general, with respect to the 2-meter temperature, we observed that the Thermal and RUC models have quite similar behaviours, while the Noah land-surface model tends to predict higher 2-meter temperature values, as can be seen, for example, in Coimbra (Fig. 1). However, in most of the stations compared, the Thermal and RUC schemes tend to underestimate the maximum temperature whilst the Noah land-surface model predictions of the maximum 2-meter temperature are more accurate. The minimum temperature was badly predicted in all experiments.

Manifestly, the predicted temperature evolution shows insufficient accuracy in these three experiments, especially for the minimum temperature. This indicates that, in order to

obtain better temperature predictions, the land-surface schemes have to be combined with other non-soil physics options. One example we obtained that clearly improves the 2-meter temperature predictions, combines the thermal diffusion scheme with the Monin-Obukhov surface-layer parameterisation scheme and the YSU PBL scheme.

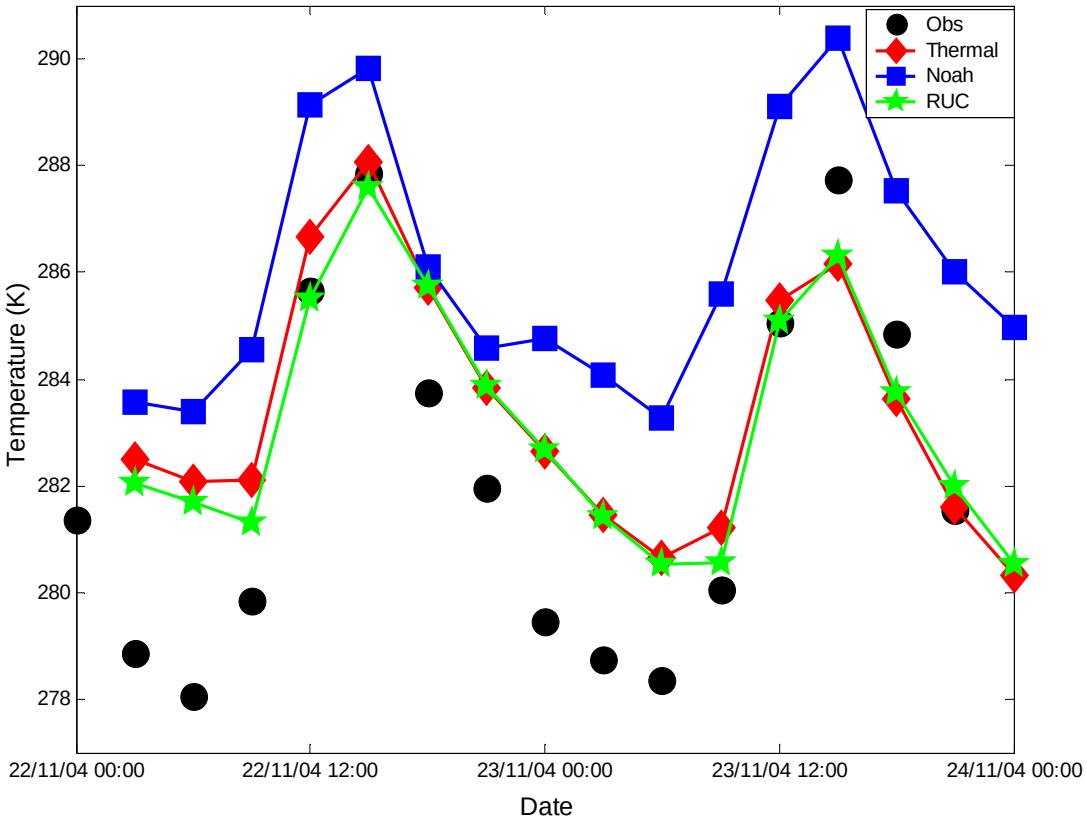

Figure 1 – 2-meter temperature evolution for Coimbra. Observed data (circles), RUC scheme (stars), thermal scheme (diamonds) and Noah land-surface model (squares).

References

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