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Screen-level data assimilation of observations and pseudo-observations in COSMO-I2

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The COSMO model has been developed by the COnsortium for Small-scale MOdelling, an over-national consortium coordinating the cooperation of the national and regional weather services of Germany, Italy, Switzerland, Greece, Poland and Romania. Its operational version does not make use of the 2m temperature, since it has been shown to have potentially adverse effects on the stability of the planetary boundary layer. Moreover, in pre-operational tests, it has been showed to degrade the low-tropospheric thermal structure of the model. The 2m temperature is at the moment only used in the soil moisture analysis, where it has the potential to modify the surface fluxes and to improve the prediction of 2m temperature during the forecast time. Despite these facts, there is an option in the model for the inclusion of 2m temperature in the assimilation cycle. For this reason, considering the great number of non-GTS stations in the ARPA Piemonte ground network, it has been decided to try the assimilation of 2m temperature in the COSMO-I2 version of the model, which has a horizontal resolution of about 3 km more similar to the average resolution of the thermometers. Two different test periods have been considered, from 1 to 15 September 2008 (summer-like weather) and from 3 to 17 January 2009 (winter-like weather). Every day we have run two simulations up to +24h, starting at 00UTC and 12UTC in order to investigate also the dependence on the initial state of the PBL. The aim of the work is to investigate the assimilation of the non-GTS data in the first 12h of the simulations in order to create an operational very high-resolution analysis, but also to test the option of running in the future a very short-range forecast (+12h to +18h) starting from these analyses. The results, in terms of RMSE, Mean Error (ME) and diurnal cycle of some surface variables such as 2m temperature, 2m relative humidity and 10m wind intensity, and in terms of vertical profile of temperature, show in general a positive impact during the assimilation cycle and below 1000-1500 m respectively and a neutral impact elsewhere, because the effect of the nudging vanishes a few hours after the end of the assimilation.
As a second step, we introduced the assimilation of the 2 m temperature forecasts given by the Multimodel SuperEnsemble technique for all the available stations of the ARPA Piemonte network into the model, as if they were observations (we call them pseudo-observations), from +12h to +24h. The Multimodel SuperEnsemble technique is a powerful post-processing method for the estimation of weather forecast parameters. Several model outputs are combined, using weights calculated during a so-called training period. This technique has already been tested and implemented in many works on limited-area models in order to obtain reliable forecasts in complex orography regions. Also in this case we observe a positive impact mainly on the surface variables, but the effect lasts up to +24h.