Impact of Domain Size on LM Forecast

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1 Introduction

The impact of the domain size on LM forecast was investigated in the period 1 March – 30 June 2004. LM was integrated on LAMI and EuroLM domain (Fig. 1) domain. EuroLM is the UGM version of LM covering Italy and the western part of Europe and the Mediterranean Sea. The LM configuration used in this experiment is shown in Table 1. IFS fields were used as initial and boundary conditions. The LM forecast fields were objectively evaluated through comparisons with radiosonde and conventional surface observations. Mean error and root mean square error (RMSE) vertical profiles are computed for the Italian radiosounding stations (Milano, Udine, Pratica, Brindisi, Cagliari, Trapani, Bologna, Cuneo). Surface parameters are verified for about one hundred synop lowland stations satisfying the COSMO WG5 specification ($H_s < 700$ meters, $|H_s - H_n| < 100$ meters, where H_s is the station height and H_n is the height of the nearest land grid point).

Table 1: **LM Configuration (Version 3.11)**

Domain Size	234 × 272 grid points (LAMI) 465 × 385 grid points (EuroLM)
Horizontal Grid Spacing	0.0625° (∼ 7 km)
Number of Layers	35, base-state pressure based hybrid
Time Step and Integration Scheme	40 sec, 3 time-level split-explicit
Forecast Range	60 h
Initial Time of Model Runs	12 UTC
Lateral Boundary Conditions	3 hourly from op. IFS
Initial State	Op. IFS

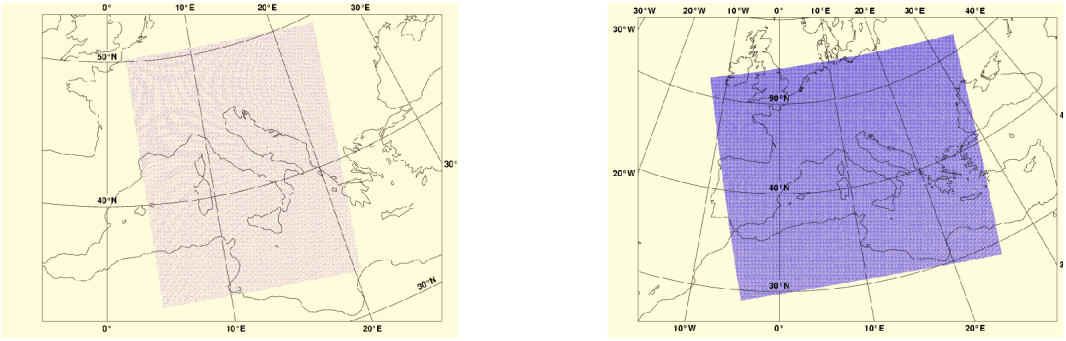

Figure 1: LAMI (left) and EuroLM (right) integration domain.

2 Vertical profiles

Temperature ME and RMSE vertical profiles of LM forecasts T+12 h, T+24 h, T+36 and T+48h are shown in Fig. 2 for the LAMI (red dashed line) and EuroLM configurations (blue solid line). RMSE for EuroLM (larger domain) is greater than for the LAMI between around 250 hPa at T+24h and below 250 hPa after T+36h. A warmer bias for the larger domain configuration is found at the jet level.

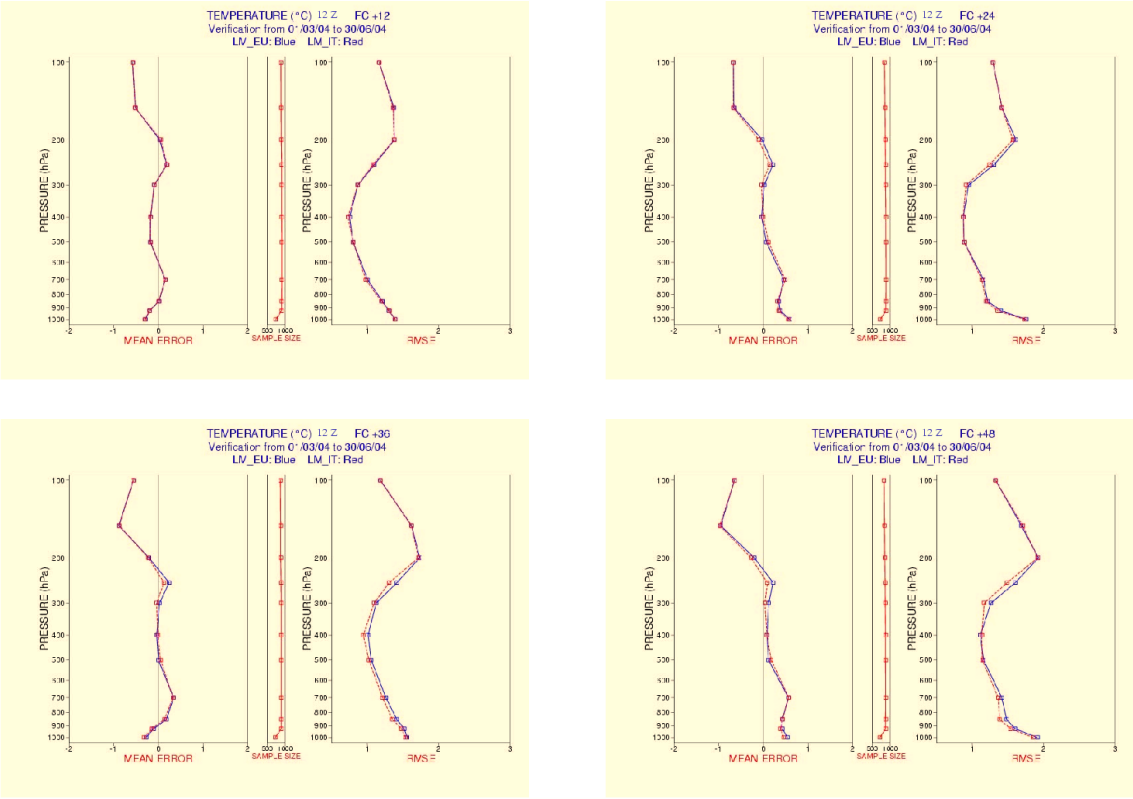

Figure 2: Temperature mean error and root mean square error vertical profiles of 12/24/36/48 h forecasts for LAMI and EuroLM.

Wind speed ME and wind vector RMSE vertical profiles of LM forecasts T+12 h, T+24 h, T+36 and T+48h are shown in Fig. 3 for the LAMI (red dashed line) and EuroLM configurations (blue solid line). Wind vector RMSE for the EuroLM runs is greater than for LAMI in the layer 250 hPa – 500 hPa at T+12h and below 250 hPa after T+24h. A slower bias for the smaller domain configuration in the wind speed bias is also found.

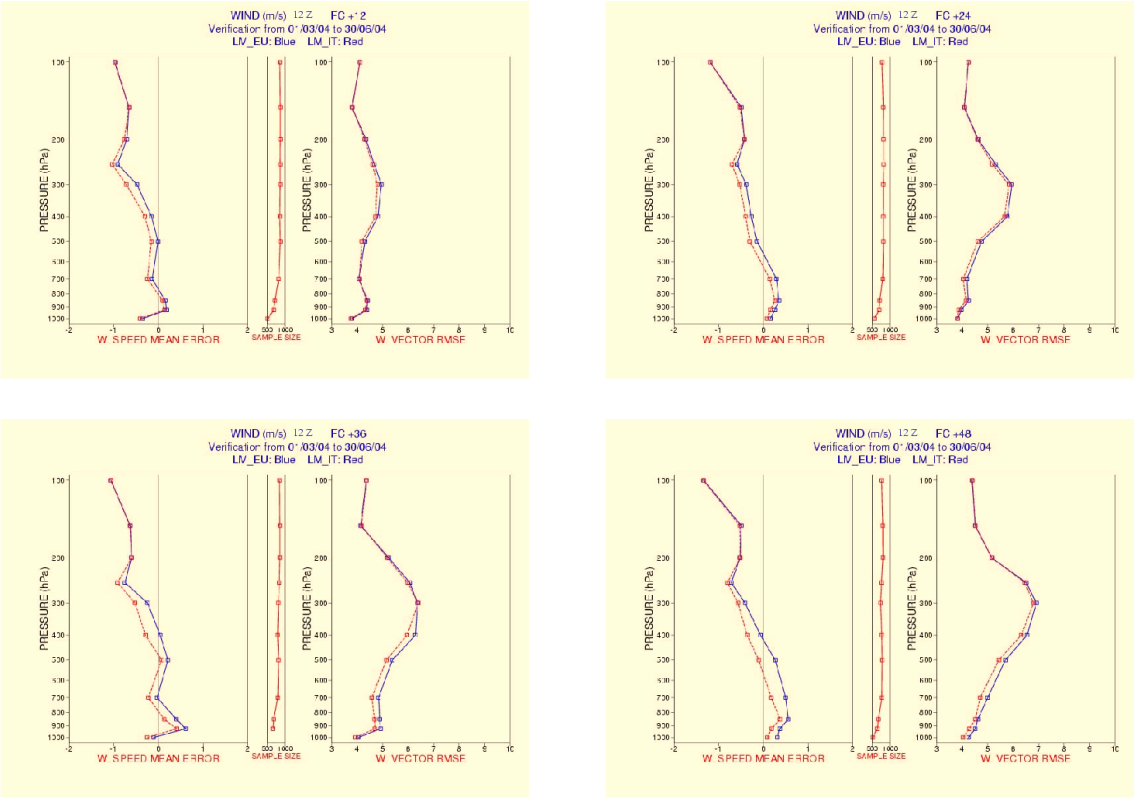

Figure 3: Wind speed mean error and wind vector root mean square error vertical profiles of 12/24/36/48 h forecasts for LAMI and EuroLM.

3 Surface variables

Mean error and RMSE of two meter temperature, two meter dew point, ten meter wind speed and mean sea level pressure (MSLP) as a function of the forecast time are represented in the Fig. 4 for the LAMI (red dashed line) and EuroLM configurations (blue solid line). MSLP ME and RMSE for LAMI are less than for the EuroLM after T+12h. Similar results to those of MSLP are found for the ten meter wind speed, but with smaller differences. Two meter temperature and dew point scores for both configurations have no significant differences.

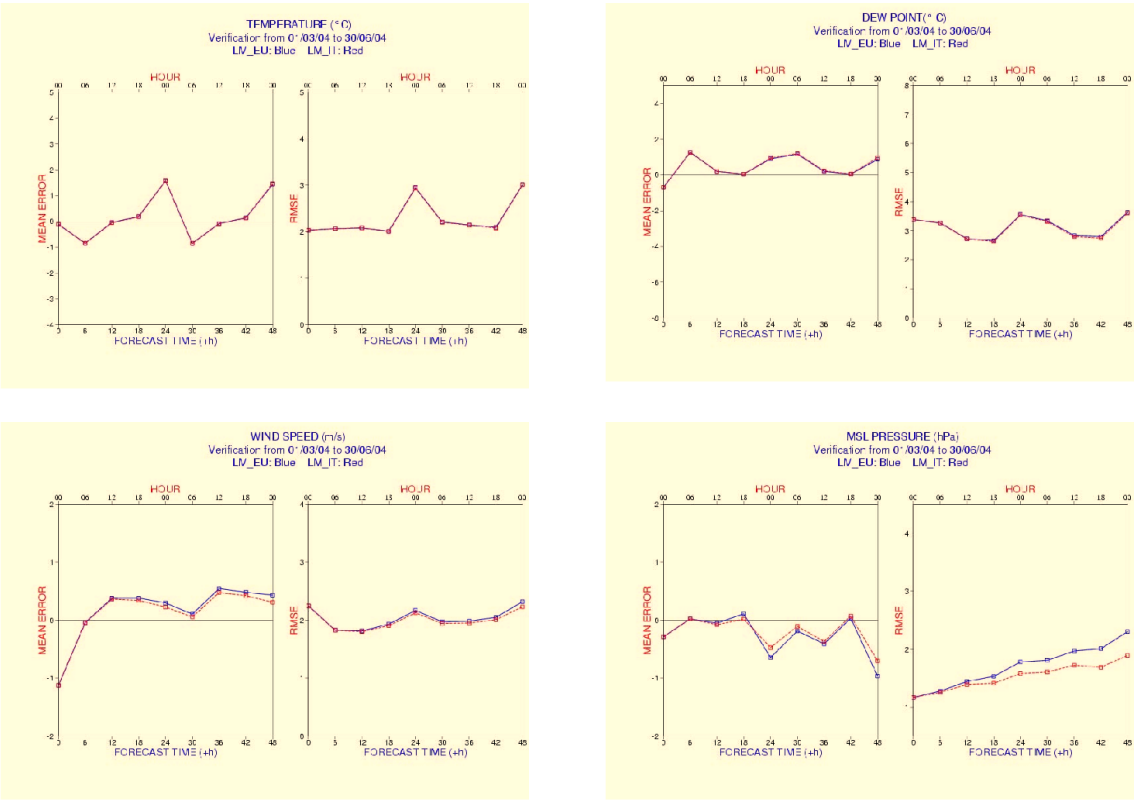

Figure 4: Mean error and RMSE of 2m temperature, 2m dew point, 10m wind speed and mean sea level pressure of LAMI and EuroLM.

4 Conclusions

The results of the domain size impact study on LM forecast are surprising. Statistical verification results have showed that the enlargement of the domain has a measurable negative impact on LM forecast skill. In particular the wind vector and the MSLP have the worst scores after T+24h. It seems that LM dynamics does not give a good representation of the meteorological evolution in the larger domain. It may be related to the accuracy of the discretization scheme currently used in LM (Leapfrog with second order spatial differencing). On the other hand, BC fields definitely affect the weather system evolution in the smaller domain, since the domain borders are closer to the location of the verification stations used in this experiment. The use of more accurate discretization schemes than the operational one seems to be necessary not only for very high-resolution application, but also for integration on large domains.