Verification of LAMI at Synop Stations

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1 Introduction

A synthesis of COSMO-I7 (the Italian version of the COSMO-Model) verification results for winter, spring, summer and autumn 2006 is presented. In this paper only the following surface parameters are analysed: 2m Temperature (2m T), 2m Dew Point Temperature(2m TD), 10m Wind Speed (10m WS), Mean sea Level Pressure (MSLP) and precipitation (PP). Further information concerning verification of upper-air parameters can be found in the COSMO web site, along with several stratifications for weather parameters.

The observations forming the control data set were collected on 3-hourly basis from synoptic Italian network, including 91 manned stations and distributed over the Italian area (soon this sample will increase with the use of all synoptic Italian stations). Stations were subdivided into three classes according to geographical location; mountain stations ($>$ 700 m), valley stations or inner lowland stations and coastal stations. Stations subdivision in different classes has been chosen in order to check systematic errors related with different geographical and surface conditions. This approach can give two type of results: information about models ability in reproducing correct surface processes through a correct climatology in different geographical areas and indication of possible error sources through error comparison in different areas. For this reason, the results obtained in the verification of daily cycle for 2m T, 2m TD, 10m WS, MSLP and for categorical rainfall verification are presented.

2 Daily Cycle

In order to verify the diurnal behaviour of the model, the couples observation-forecast were stratified according to the hour of the day (3-hourly frequency), the season of the year and the forecast range (day 1 and day 2). Synchronous and co-located couples observation-forecast independently from the station position then form each sample. For each of the obtained samples the mean error (ME, forecast-obs) and mean absolute error (MAE) were computed.

3 2m Temperature

Figure 1 shows the behaviour of 2m-Temperature forecast error for all the set of Italian stations. A clear diurnal cycle is present for all months with the amplitude increasing form spring, through summer, to autumn. About the error pattern the figures show a strong cold Bias in winter becoming a warm one in the other seasons until 12 UTC with a fast decreasing between 15-18 UTC. Low absolute accuracy in the early morning and around midday, maybe a signal of an early warming.

Figures 2 and 3, the seasonal 2m-Temperature for coastal and valley stations, show, of course, the same behaviour of the previous graphs, with some more interesting characteristics. For example for coastal stations the model seems to be colder during afternoon, as even more for valley stations except for summer when it is a bit warmer. Again for valley stations MAE seems to be always lower (higher accuracy) and the Bias in summer shows us a model warmer for almost all the day (except at the sunset).

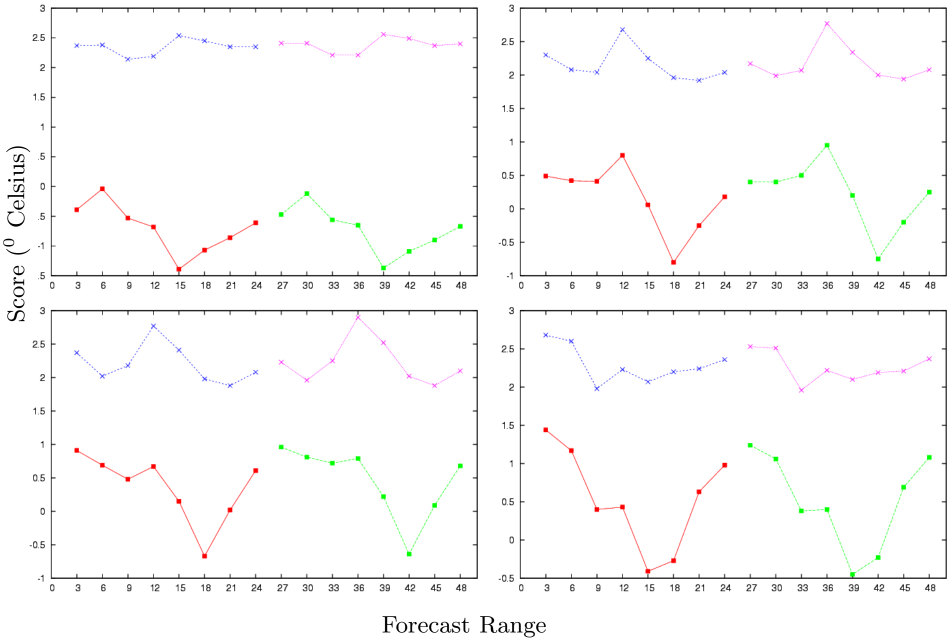

Figure 1: 2m-Temperature forecast error for 2006 (all stations): winter (upper left), spring (upper right), summer (lower left) and autumn (lower right).
Mean Error: day 1, day 2; Mean Absolute Error: day 1, day 2

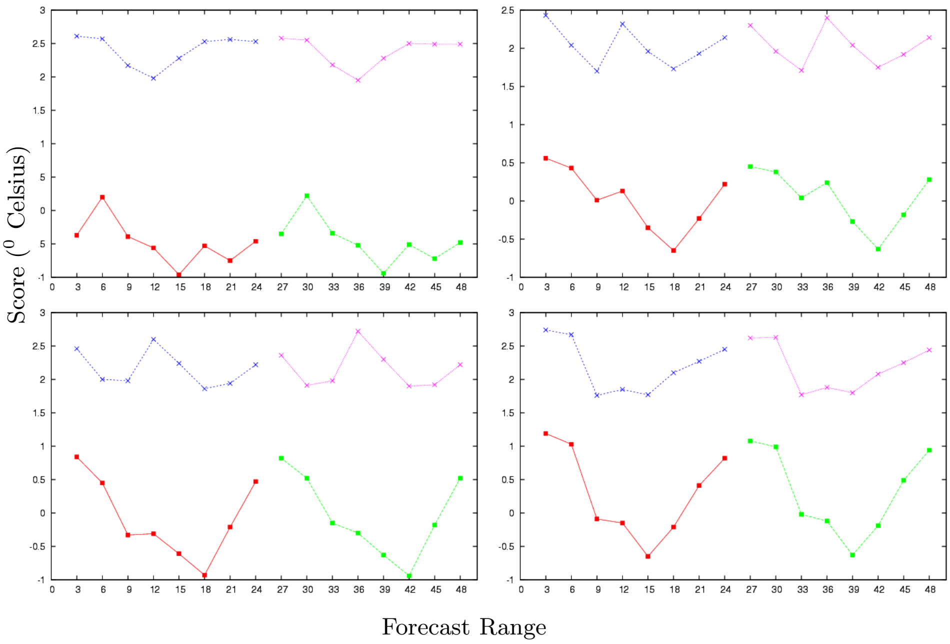

Figure 2: Seasonal 2m-Temperature for coastal stations: winter (upper left), spring (upper right), summer (lower left) and autumn (lower right).
Mean Error: day 1, day 2; Mean Absolute Error: day 1, day 2

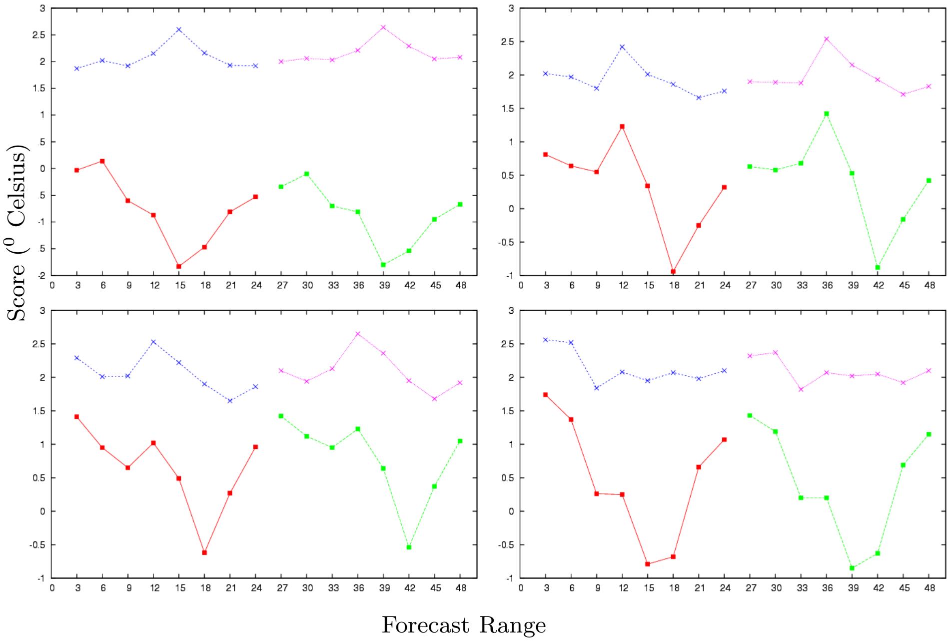

Figure 3: Seasonal 2m-Temperature for valley stations: winter (upper left), spring (upper right), summer (lower left) and autumn (lower right).
Mean Error: day 1, day 2; Mean Absolute Error: day 1, day 2

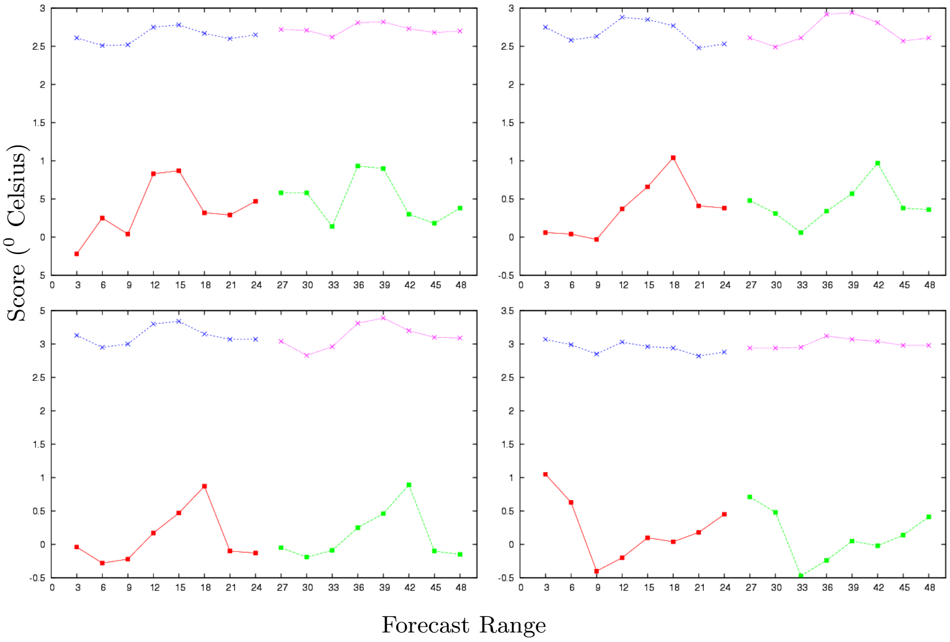

Figure 4: 2m Dew Point Temperature for all stations: winter (upper left), spring (upper right), summer (lower left) and autumn (lower right).
Mean Error: day 1, day 2; Mean Absolute Error: day 1, day 2

4 2m Dew Point Temperature

A diurnal cycle is also present in ME curves of 2m Dew Point Temperature, see Figure 4 for all Italian stations. In general, from the MAE or Bias point of view, it can be said the model has a better behaviour compared with temperature; in fact the mean is around 0/0.5 except for 15-18 UTC when it reaches the maxima values. An interesting behaviour can be found during autumn when the maxima are reached during the night. The absolute accuracy (MAE) values remain relatively high with maxima in summer, while a diurnal cycle is less evident.

5 10m wind speed

In Figure 5, the curves relative to mean error and mean absolute error of 10m wind speed for all Italian stations, are shown. Even if the amplitude is small a diurnal cycle is present in ME curves. An overestimation of wind speed, positive Bias, occurs especially during the cold months when dynamical circulation is dominant. It is interesting to point the attention to low ME and MEA values in spring and summer seasons: it could be interpreted as a good model interpretation of local breeze circulation.

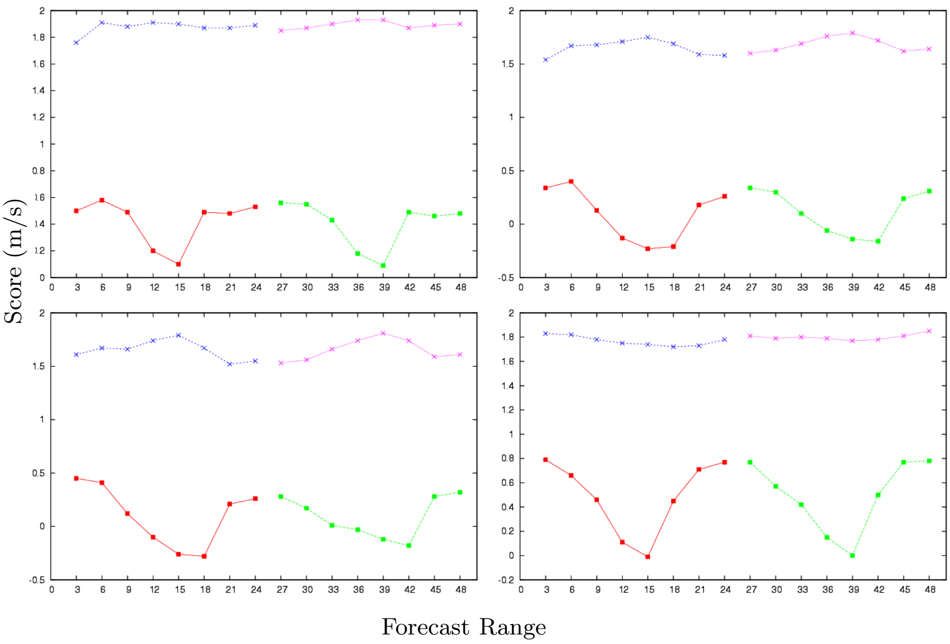

Figure 5: 10m wind speed for all stations: winter (upper left), spring (upper right), summer (lower left) and autumn (lower right).
Mean Error: day 1, day 2; Mean Absolute Error: day 1, day 2

6 Mean Sea level Pressure

Figure 6 shows MSLP mean error and mean absolute error for 2006 seasons all over Italy. Mean error curves do not show a clear diurnal cycle, also there is a quite good phase agreement between ME D+1 curve and ME D+2 curve, except for summer when a large positive Bias can be found during early morning at D+1 and decreasing with ranges. MAE curves shows how the mean sea level pressure is less affected by local circulations or by model physics and is dominated by atmosphere dynamics; in fact, MAE increases quasi-linearly in function of forecast with a degradation in MAE during the winter and autumn (characterised by stronger atmospheric motions). Besides, in summer, there is a clear negative Bias for D+2 (a loss of mass?).

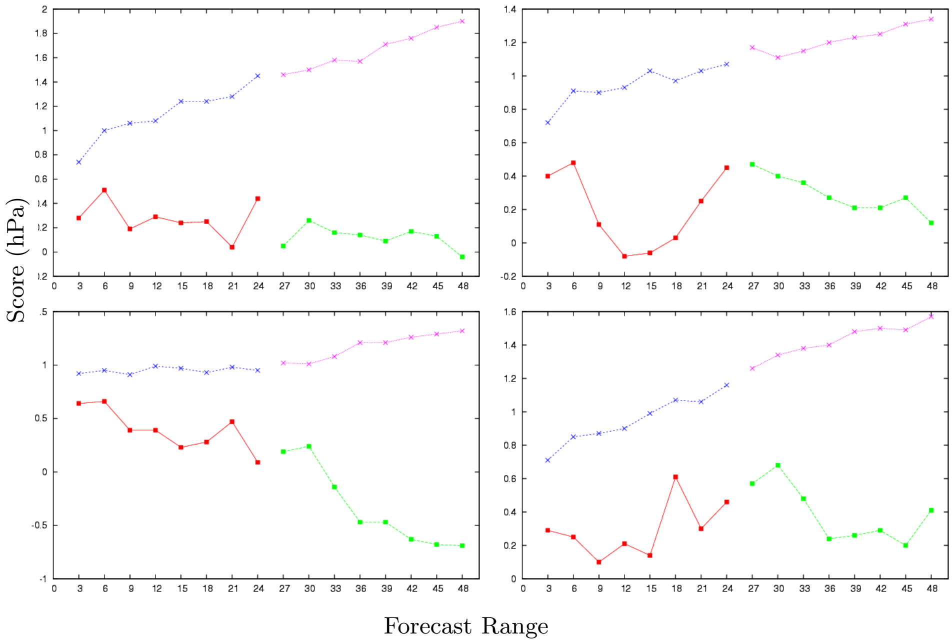

Figure 6: MSLP mean error and mean absolute error for all stations: winter (upper left), spring (upper right), summer (lower left) and autumn (lower right).
Mean Error: day 1, day 2; Mean Absolute Error: day 1, day 2

7 Precipitation

The results for 2006 seasons are summarised in Figures 7 and 8 where FBIAS, ETS scores are presented, respectively, for all Italian stations stratified for 12h accumulated precipitations, without any morphological or regional stratifications (for details about stratified precipitation scores see COSMO web site). Figure 7 (FBIAS) shows in winter (and less in spring) a better model performance, probably due to the type of precipitations (mainly large scale vs. convective) up to 4mm/12h, while in summer the shift in convective daily precipitations (model anticipates the occurrence) can be seen as a clear link with the same kind of signal in 2m-Temperature; in fact there are clear larger FBIAS scores for the morning ranges (00-12 and 24-36). In spring the signals are more complicated and, probably, a mix of the previous two. Equitable Threat Score plots for 12 hours accumulated rainfall, reported in Figure 8 show that the model performance decrease with the season and only 12 and 36 range remains acceptable, also in summer.

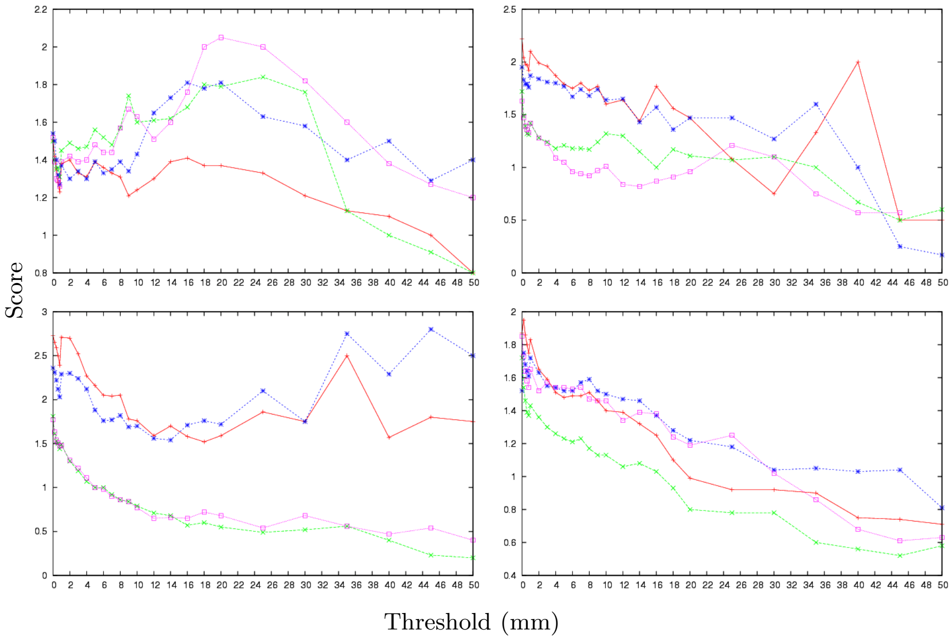

Figure 7: FBIAS for 12h accumulated precipitations for all stations: winter (upper left), spring (upper right), summer (lower left) and autumn (lower right).
FBI +12, FBI +24, FBI +36, FBI +48

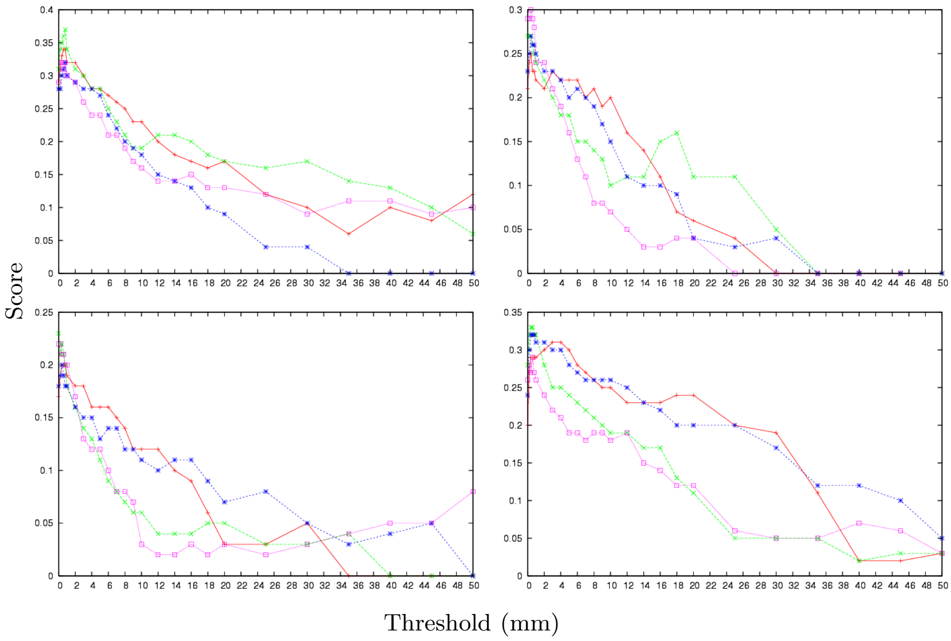

Figure 8: ETS for 12h accumulated precipitations for all stations: winter (upper left), spring (upper right), summer (lower left) and autumn (lower right).
ETS +12, ETS +24, ETS +36, ETS +48