Verification of LAMI at SYNOP Stations

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1 Introduction

A synthesis of LAMI (the Italian version of LM) verification results for winter, spring and summer 2005 is presented, along with some seasonal comparison from 2003 to 2005.

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 on the COSMO web internet site. The verification concerns the 3.9 LAMI reference version.

These five parameters are not explicit model variables but they are computed through some internal post-processing which may introduce extra errors. Nevertheless, since the internal post-processing is generally based on some diagnostic balance among the model variables, which is derived from physical constraints, it is still possible to have some important information about problems in the formulation and in the configuration of the model itself.

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. Stations were divided in three classes according to geographical location; mountain stations (> 700m), valley stations or inner lowland stations and coastal stations. Stations subdivision in different classes has been choosen 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. In such way systematic errors due to inconsistency in the surface representation of the model (inconsistency in the terrain elevation and in the percentage of the surface covered by water are the main error sources over Italy) are somewhat dumped and the signal of daily and seasonal oscillation is retained. For each of the obtained samples the mean error (ME, forecast-obs) and mean absolute error (MAE) were computed.

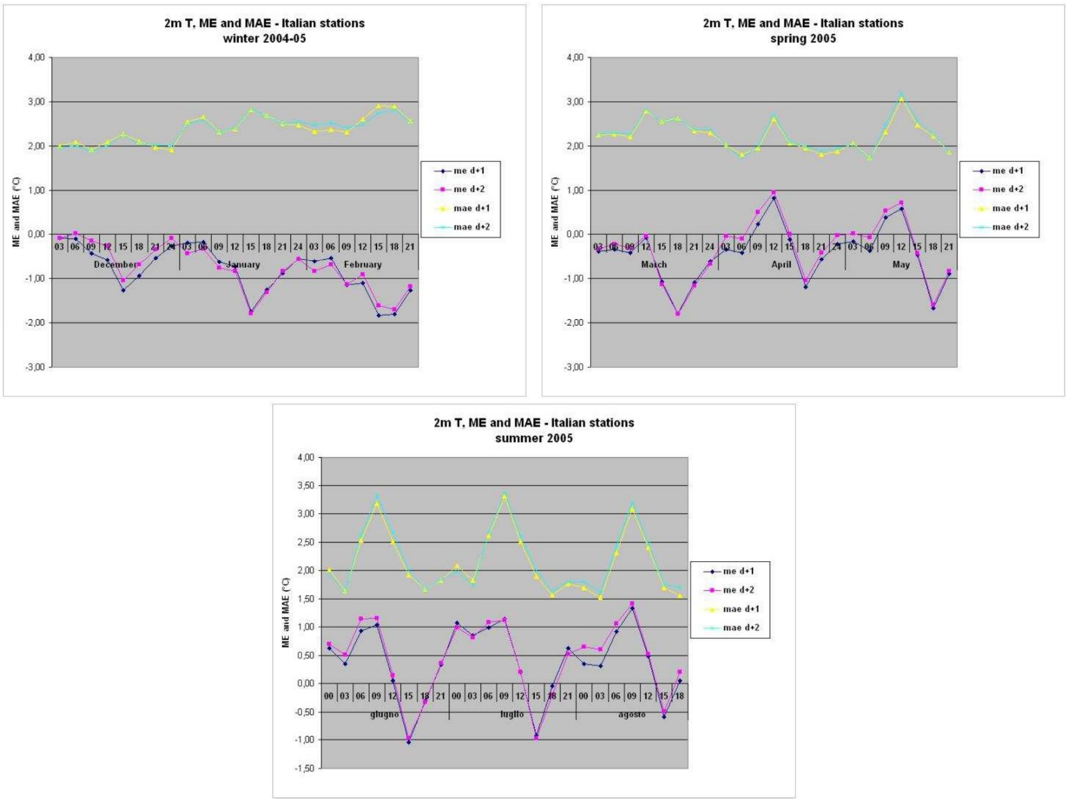

Figure 1: 2 m temperature forecast error for all italian stations.

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 especially from April to August when it becomes more evident. About the error pattern the figures show a strong cold bias in winter and already from April an increase in ME and MAE (low absolute accuracy) to reach the maxima in July always around 09-12 UTC, with a smaller but clear secondary peak around sunset, maybe a signal of an early warming.

Figures 2 and 3, resp., 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, while for valley stations this seems to disappear (in summer) or to be less evident (in spring). Again for valley stations MAE seems to be always higher (lower accuracy) and the bias in summer shows us a model warmer for almost all the day.

4 2m Dew Point Temperature

A diurnal cycle is also present in ME curves of 2m Dew Point Temperature, see Fig. 4 for all Italian stations. In general, from the ME or bias point of view, it can be said, the model has a better behaviour compared with temperature; in fact the mean is around zero except for the colder months (winter plus march) when a positive bias is evident (the model is too humid). About the absolute accuracy (MAE) the value remains relatively high, while a diurnal cycle is less evident.

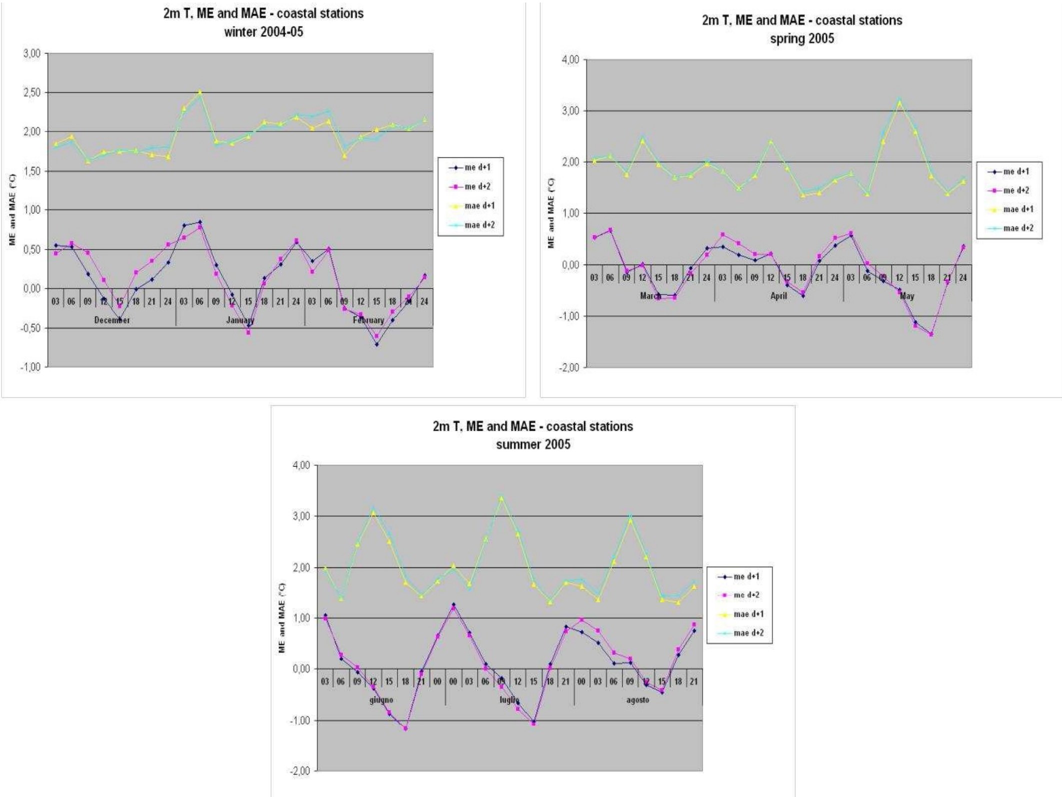

Figure 2: 2 m temperature forecast error for coastal stations.

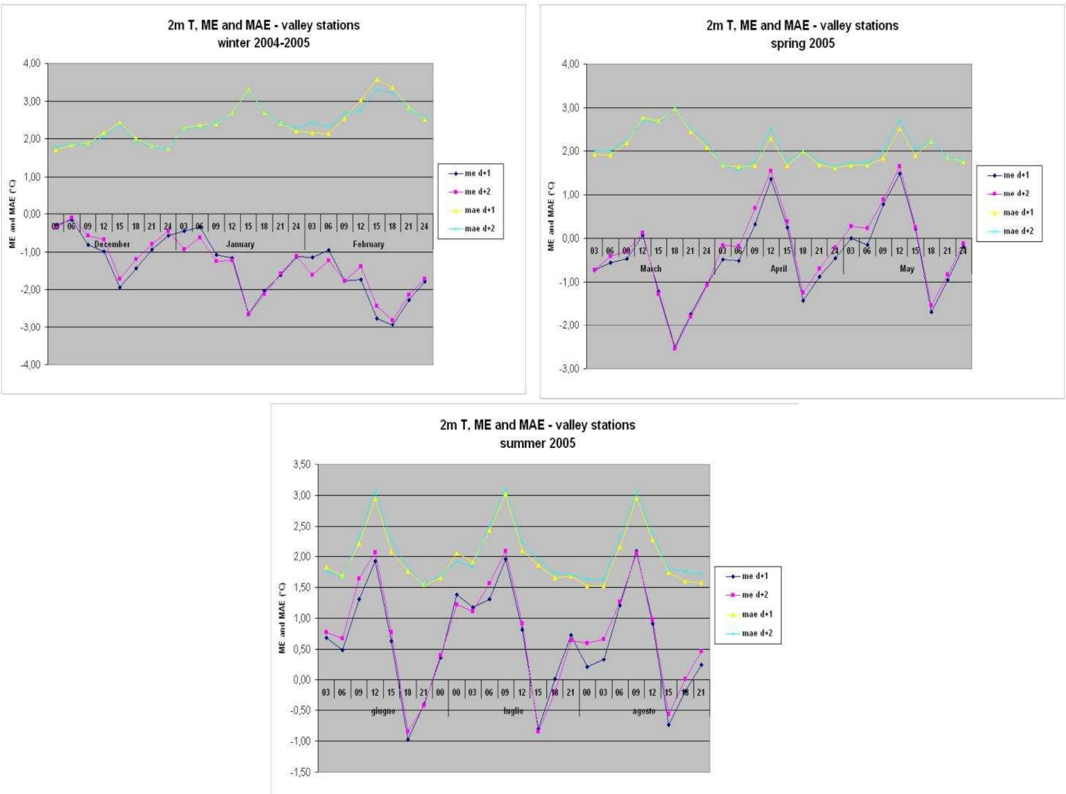

Figure 3: 2 m temperature forecast error for valley stations.

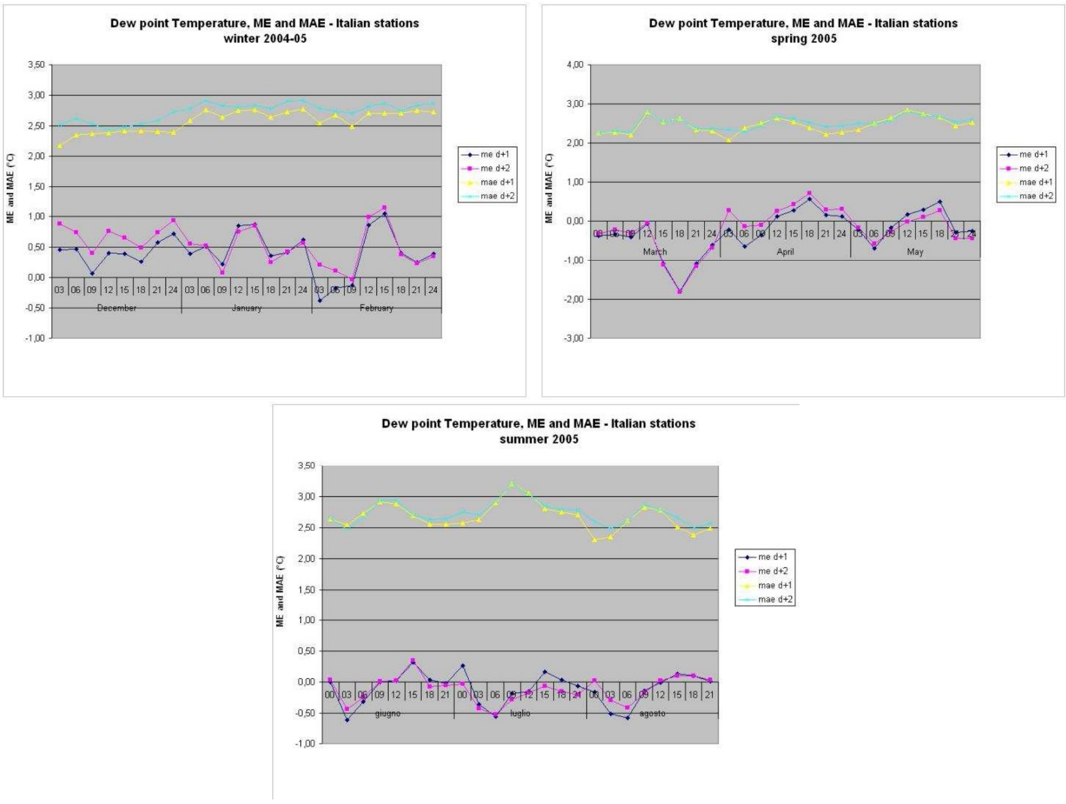

Figure 4: 2 m dew point temperature forecast error for all italian stations.

5 10m wind speed

In Fig. 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 for valley and coastal stations, when dynamical circulation is dominant. It is interesting to point the attention to low ME and MEA values in summer months for coastal stations: it could be interpreted as a good model interpretation of local breeze circulation.

6 Mean Sea level Pressure

Figs. 6 show MSLP mean error and mean absolute error for 2005 seasons all over Italy. Mean error curves does not show a clear diurnal cycle, also there is a good phase agreement between ME d+1 curve and ME d+2 curve. MAE curves shows how the mean sea level pressure is less affected by local circulations or by Model physics and is dominated by atmosphere dynamic; in fact, MAE increases quasi-linearly in function of forecast range (for each month, d+1 curve starts with +03 hrs and stops with +24 hrs while d+2 curve starts with +27 hrs to +48hrs forecast range) with a degradation in MAE values during the winter (characterized by strong atmospheric motions). Besides, in summer, there is a clear and strong negative bias for d+2 (a loss of mass?).

7 Precipitation

The results for 2005 seasons are summarized in Figs. 7, 8 and 9, where FBIAS, TS and POD-FAR scores are presented, respectively, for all Italian stations stratified for 12h cumu-

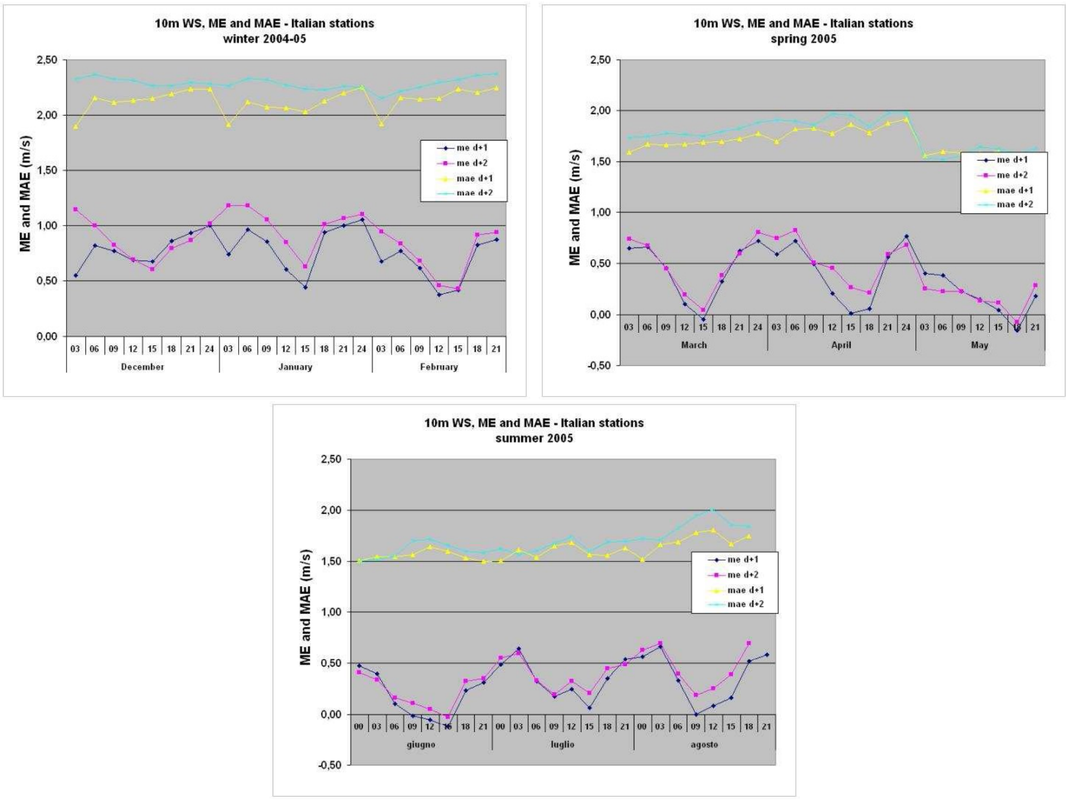

Figure 5: 10 m wind speed forecast error for all italian stations.

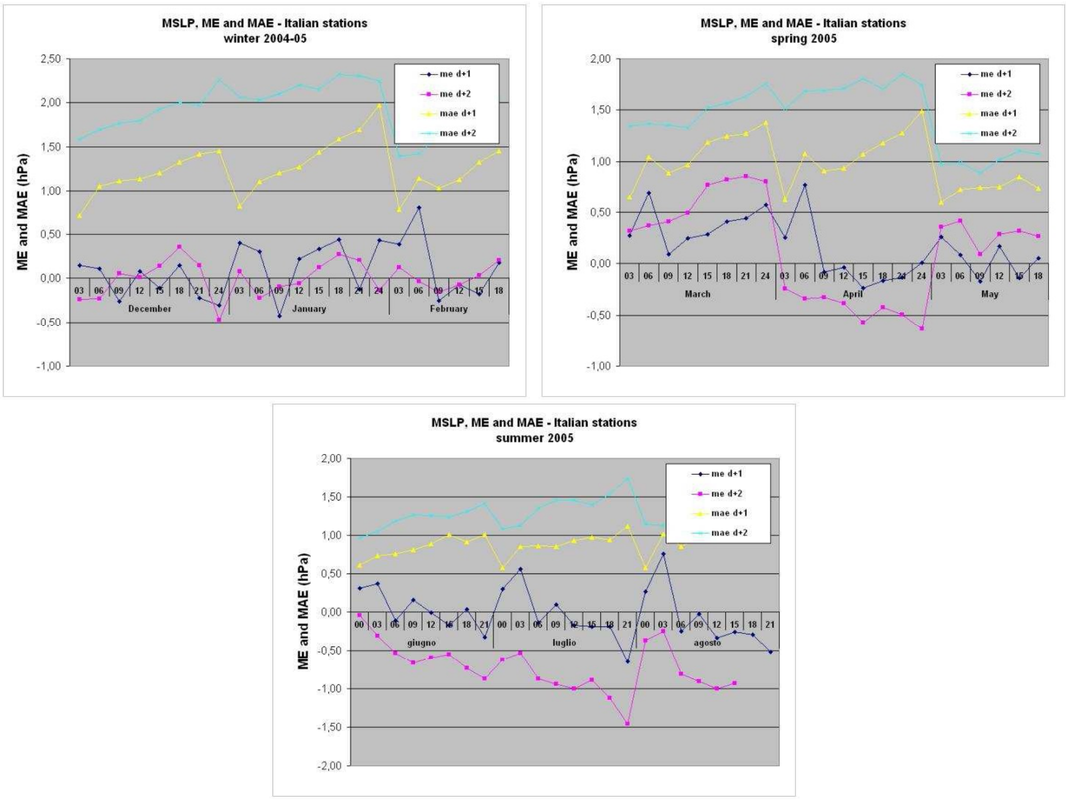

Figure 6: MSLP forecast error for all italian stations.

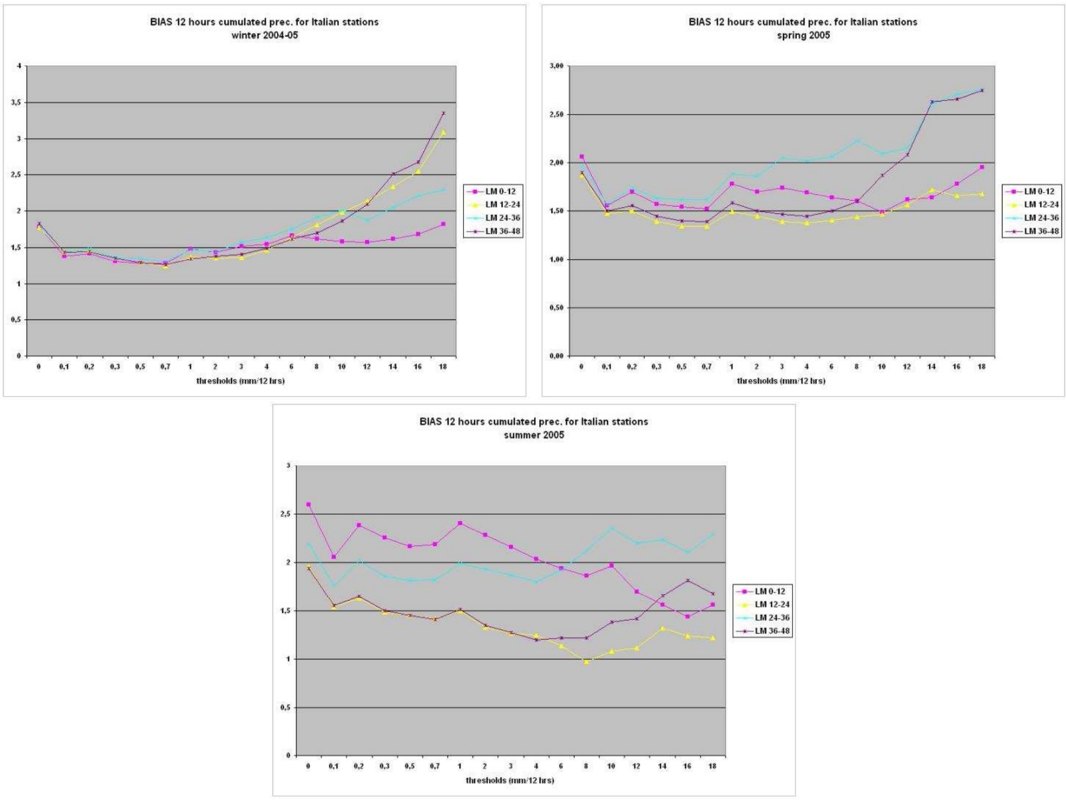

Figure 7: BIAS for 12-h accumulated precipitation for all italian stations

lated precipitations, without any morphological or regional stratifications (for details about stratified precipitation scores see COSMO web site).

Fig. 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 ones) 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.

Threat Score plots for 12 hours cumulated rainfall, reported in Fig 8, show that model performances decrease with the season and only 12-24 range remains on a acceptable values, also in summer.

LAMI Probability of Detection and False Alarm Ratio plots, Fig. 9, give useful information to understand the threshold range where forecast can be used with high benefit, that is the plot area where POD-FAR. The transition threshold is around 5-6 mm/12h for winter for all forecast ranges, and decrease with the season, becoming really low and confused in summer. Again this is probably due to the peculiar nature of precipitation (convective) and to the early morning shift in temperature.

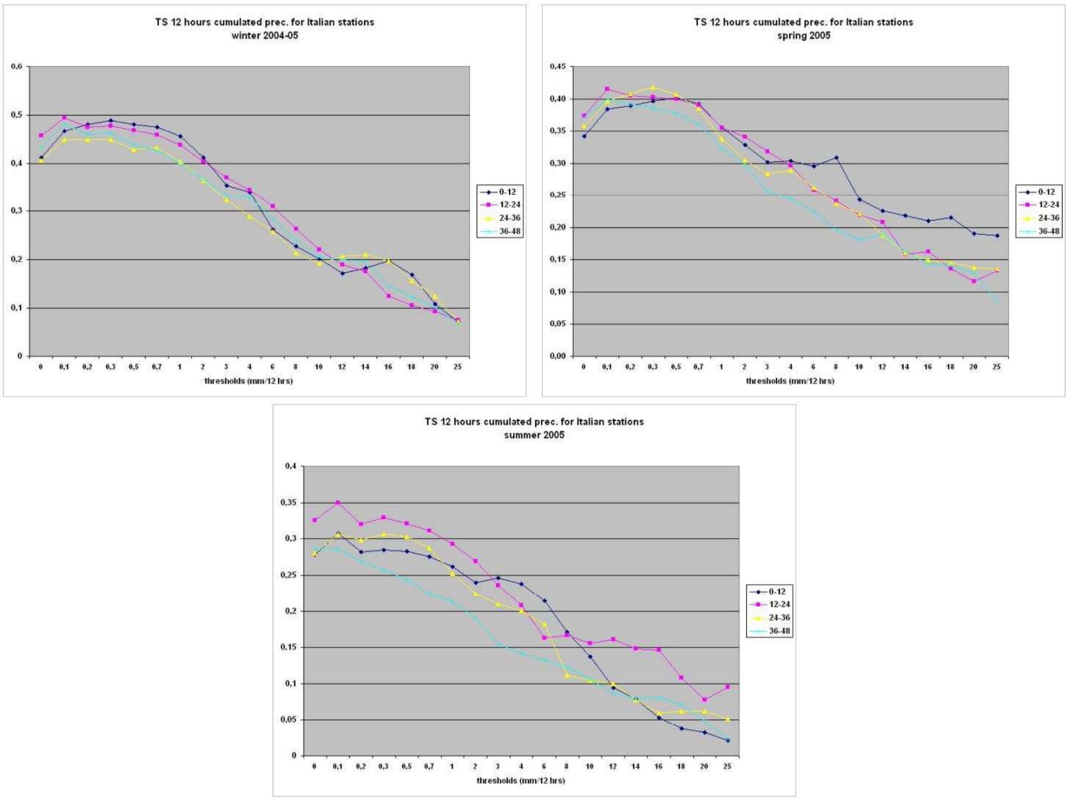

Figure 8: TS for 12-h accumulated precipitation for all italian stations

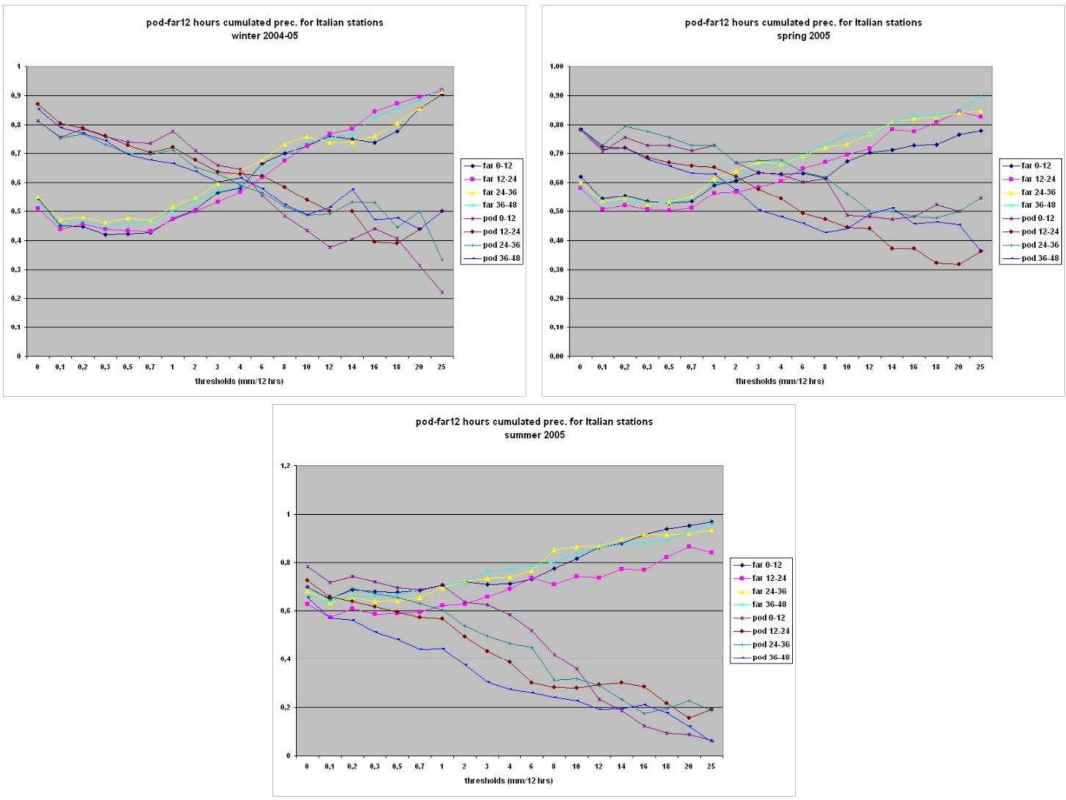

Figure 9: POD-FAR for 12-h accumulated precipitation for all italian stations