Latest Results in the Precipitation Verification over Northern Italy

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1 Introduction

The purpose of this work is to summarize the main results on precipitation verification during last year. More specifically, in order to highlight the different behaviour and performance of the three model versions (aLMo, LAMI, LM-DWD), we consider a common domain, composed by 47 meteo-hydrological basins of Northern Italy (about 1023 stations), as shown in Fig. 1. In addition we take into account also the Piedmont region, with high density, spatial homogeneity and high operational percentage of the observational network, for a special focus about LAMI study.

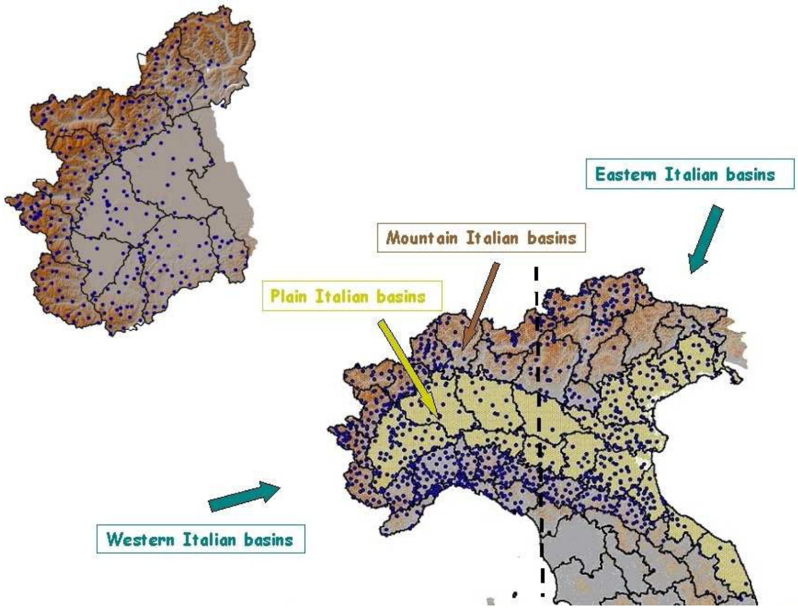

Figure 1: Right: Northern Italy raingauges and basins (30 mountainous areas in brown, 17 flat areas in yellow). Left: zoom with North-West warning areas and raingauges distribution.

2 The main purpose

In the fist part of this work we present the latest results concerning the precipitation verification over Northern Italy, pointing out the model error trend during the last seasons. We verify both runs (00UTC and 12UTC) over the latest six seasons (from December 2003 to May 2005) for each model version: we calculate skills and scores considering 24h cumulated precipitation averaged over basins for several increasing precipitation thresholds for +24h and +48h forecast time. Furthermore, in order to check if there is an error linked to the orography or to the synoptic, we subdivide the 47 meteo-hydrological basins into two big subsets:

mountain and plain areas, and western and eastern areas. We estimate therefore seasonal skills and scores considering 24h cumulated precipitation averaged over these different kinds of basins for several increasing precipitation thresholds, for +24h and +48h forecast time for both runs.

In the second part, we suggest a comparison over Piedmont between the standard version of LAMI and LAMI with the prognostic precipitation scheme, using a eyeball verification approach linked to the statistical categorical indices. In particular, we present seasonal observed/forecasted precipitation maps considering 24h cumulated precipitation every day for the first and the second 24h forecast time (D+1 and D+2), in order to obtain a visual comparison of the two different versions; in addition we also carry out the statical verification averaging 24h forecasted and observed rain over 13 warning areas (11 in Piedmont, Val d'Aosta and Ticino).

3 General results

The following three figures (Fig. 2, Fig. 3, Fig. 4) show the seasonal errors at a fixed threshold of 10 mm/24h over the whole domain, represented by the 47 basins, and besides, over mountain/plain basins (30 and 17 warning areas respectively) and over western/eastern basins (21 and 26 warning areas respectively). In this study we consider 00UTC run for each model version. The main remarks are:

- As we note in Fig. 2 there is a general increasing in overestimation trend during the latest seasons, with the greatest BIAS in JJA 2004 and DJF 2005.
- The role of soil moisture analysis during summer seasons seems to be decisive in term of QPF (better BIAS index for LM-DWD in JJA 2004 as seen in Fig. 2) but not in term of capability to localize and predict accurately the precipitation pattern (ETS very low as seen in Fig. 2).
- There are large differences in term of BIAS between mountainous and plain areas (see Fig. 3) and we obtain the greatest overestimation over the mountain.
- Concerning the error sensitivity with respect to western or eastern areas subdivision (see Fig. 4), aLMo shows a general increasing in QPF, but much greater overestimation on Western areas; LM-DWD shows a large worsening during the latest seasons but it has anyway a great overestimation over western areas; LAMI has similar behaviour with respect to the other version, but not for DJF 2005, in fact there is a large overestimation over the East where we have the greatest majority of precipitation cases (110 cases over the East and 40 over the West respectively).
- We find again a strong overestimation during the latest winter time probably due to the introduction of prognostic cloud-ice scheme (open problem). But how much does an halved statistic affect the results interpretation? How much more difficult is to estimate quantitatively the precipitation pattern during a particularly dry winter with respect to a normal winter? In fact, during the latest winter only few events occurred: about 150 events with precipitation $>$ 10mm/24h on average, in comparison with about 400 during DJF 2004.
- There is a remarkable LAMI performance during DJF 2005 (Fig. 3 and Fig. 4): only LAMI runs without prognostic precipitation scheme, so that the role of the prognostic precipitation scheme has been investigated during a very dry season (see results over Piedmont).

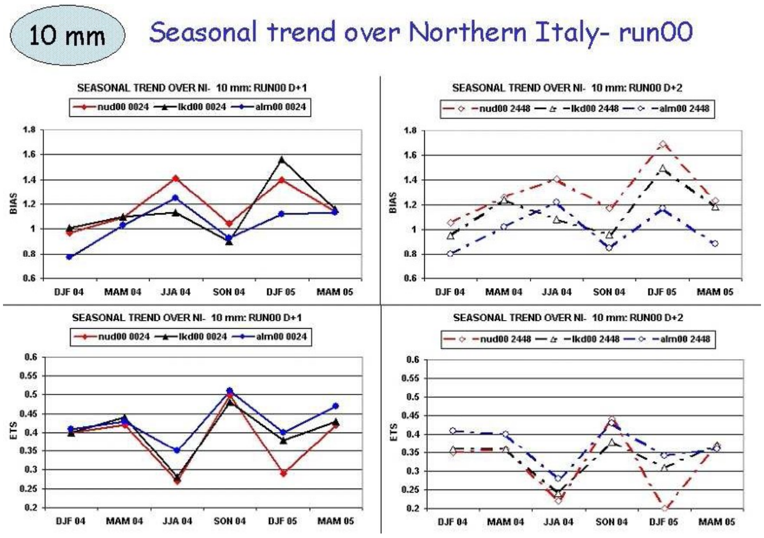

Figure 2: Seasonal indices over whole domain for each model version (00UTC run). On the left +24h forecast time, on the right +48h forecast time.

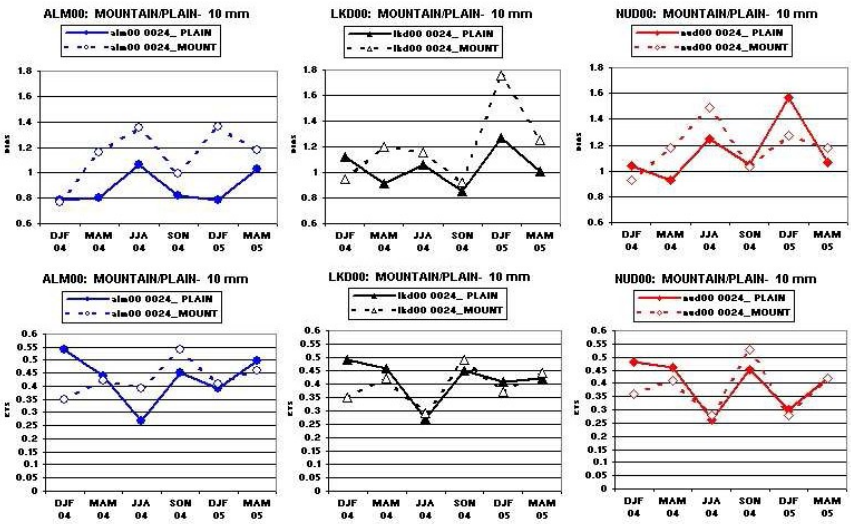

Figure 3: Seasonal indices over mountain/plain areas separately for each model version.

Finally we present a comparison between the standard version of LAMI and LAMI with the prognostic precipitation scheme, using Piedmont (11 basins), Val d'Aosta and Ticino on the period August 2004 - July 2005. In this case BIAS and ETS are obtained by averaging the 24h precipitation over the 13 mentioned warning areas: the error bars indicates 2.5th and 97.5th percentiles of resampled distribution, applied to the reference model (see Turco, 2005). BIAS and ETS calculated over the whole study period are shown in Fig. 5: there is a statistically significant reduction of the error for high thresholds that is evident especially for the wet seasons. In fact if we analyze separately the seasonal cumulated maps in Fig. 6, we note a different behaviour during the last dry winter time: for LAMI with prognostic precipitation we do not find the precipitation amount reduction as occurred in the other seasons and the precipitation pattern seems to be better described by the standard version of LAMI. This effect could be strictly linked to a weather type dependent verification: in fact during the latest winter a strong dry northwestern flux was the predominant type of weather and that could have caused an incorrect pattern prediction up/down the Alps for

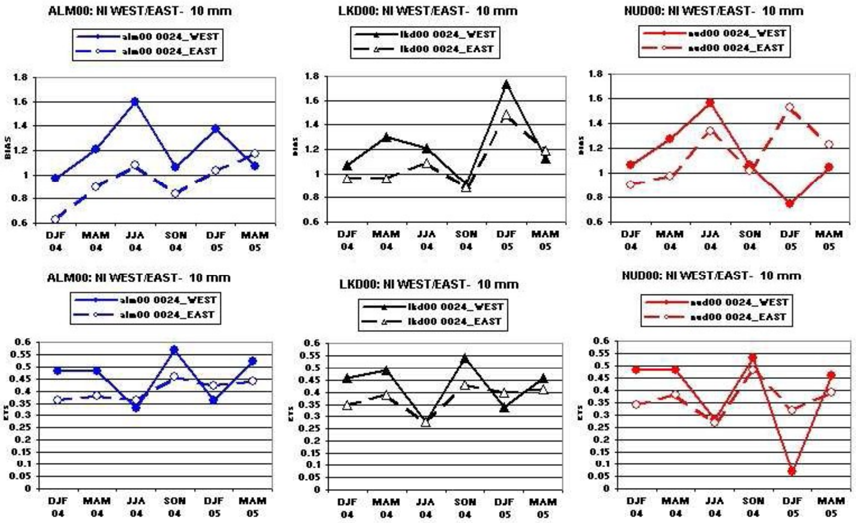

Figure 4: Seasonal indices over western/eastern areas separately for each model version.

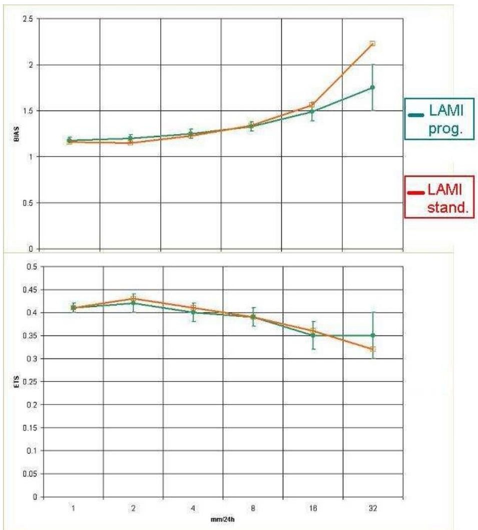

Figure 5: BIAS and ETS (Aug 2004 - Jul 2005) over Piedmont, Val d'Aosta and Ticino: standard version of LAMI versus LAMI with prognostic precipitation.

the prognostic precipitation version; in that case LAMI standard version performs better probably because it does not feel the effects of particle drift through the alpine obstacle.

References

Turco, M., Oberto, E. and Bertolotto, P., *COSMO Newsletter*, No. 5, 2005

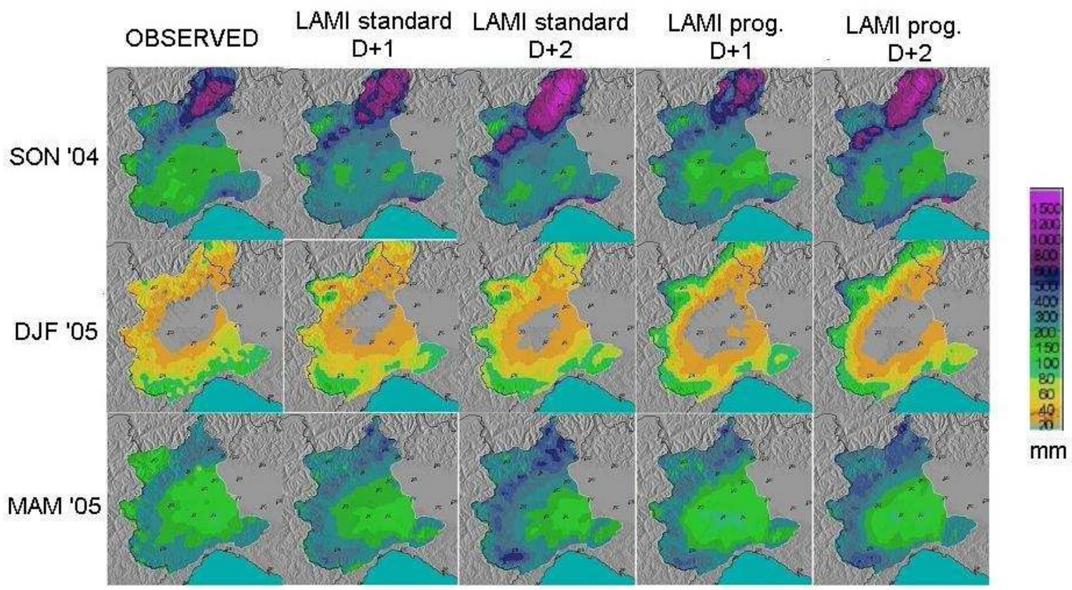

Figure 6: Seasonal maps: standard version of LAMI versus LAMI with prognostic precipitation, D+1 and D+2. For the last season (MAM 2005), the Ticino data have not been included because too few stations were present.