Report about the Latest Results of Precipitation Verification over Italy

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1 Introduction

In the last year we carried out the QPF verification of the three model versions (COSMO-I7, COSMO-7, COSMO-EU) using high resolution network of rain gauges coming from COSMO dataset and Civil Protection Department (about 1300 stations). In this report we present an update of the most recent results highlighting the failures and improvements of the model: the skills and scores are calculated considering 6h or 24h averaged cumulated observed/forecasted precipitation value over 90 meteo-hydrological basins that cover all the peninsula with the exception of two Southern regions, Sicilia and Puglia (see Fig. 1).

Figure 1: Italian high resolution raingauges distribution.

2 Spatial distribution of the error

We plot the statistical indices over each basin to map the spatial distribution of the model error. This allows to obtain a visual verification linked both to the territory characteristics and to the orography. The following maps represent BIAS, POD and FAR over Italy for D+2 of the three model versions with respect to a fixed threshold of 10 mm/24h (statistically significant), concerning the most recent period according to the data availability, therefore

from January 2006 to August 2007. The results over Abruzzo region have not to be considered because of observed data problems. So, in Fig. 2 the BIAS is shown for the three versions: it has a quite similar pattern over North Italy, with a general overestimation over the mountain areas and an underestimation over the lowlands; over Centre and South Italy, COSMO-7 and COSMO-EU have similar behaviours with more cases of underestimation, while COSMO-I7 presents more cases of overestimation.

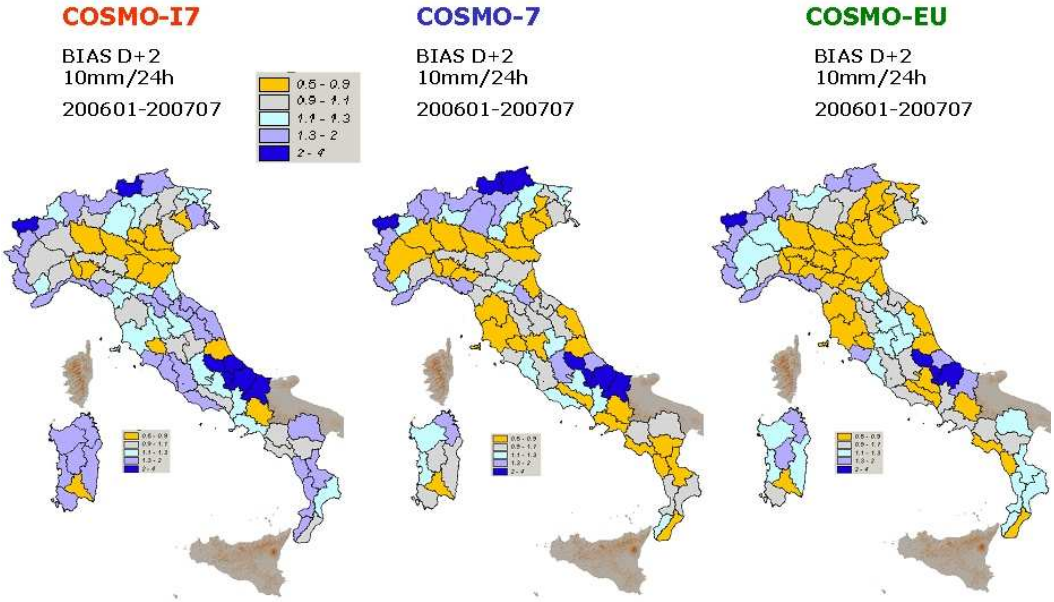

Figure 2: BIAS index over each basin for 10 mm/24h threshold (200601-200708).

Afterwards, the POD is represented in the Fig. 3: we obtain the best values in North Italy generally, but the three versions reach different skills, with very good values for COSMO-7 over alpine chain and for COSMO-EU in Northwest. In general, the East side presents the lowest values.

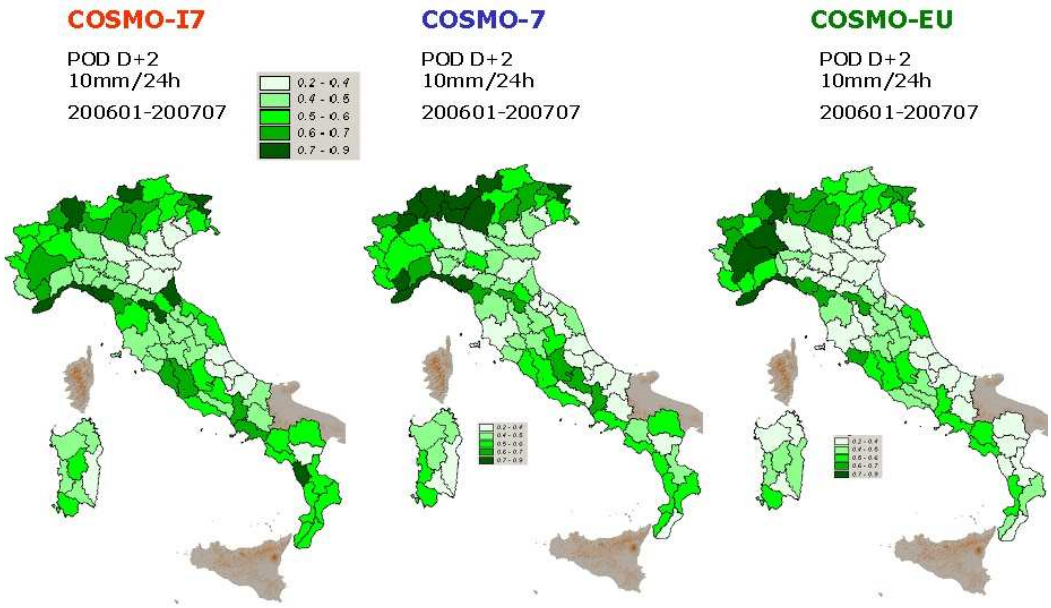

Figure 3: POD index over each basin for 10 mm/24h threshold (200601-200708).

Finally, the FAR is plotted in Fig. 4: the three versions have quite similar pattern skill, the worst values are placed in South and Centre Italy and over mountains areas. To remark the slightly more false alarm for COSMO-I7 and the slightly less for COSMO-EU.

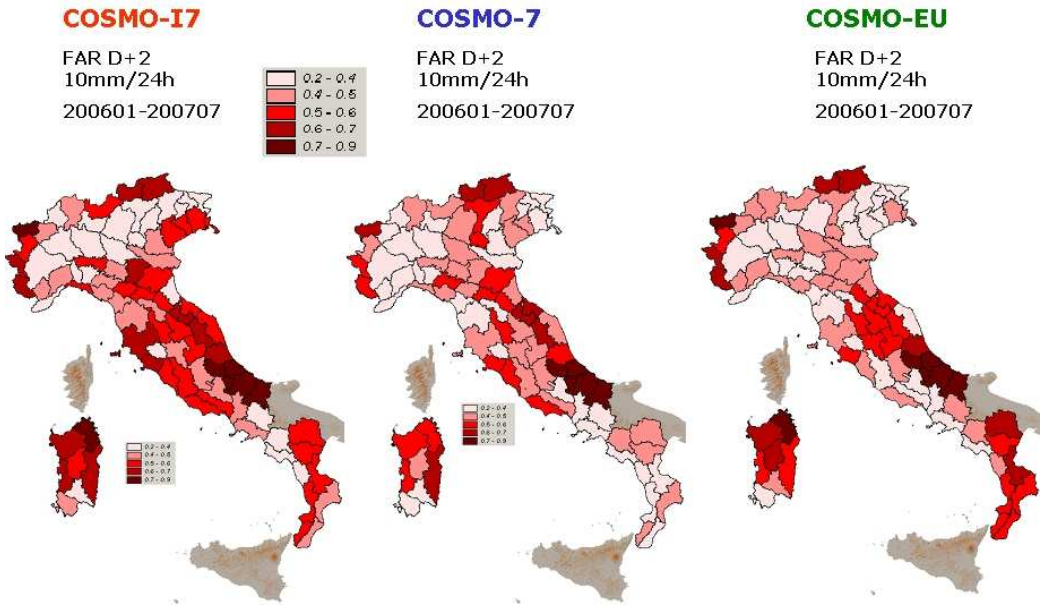

Figure 4: FAR index over each basin for 10 mm/24h threshold (200601-200708).

3 Seasonal comparison

In this section we analyse the performance of the three versions by a comparison among the three possible couple of the models using a bootstrap technique developed by Hamill: in order to compare two model versions, a confidence interval is necessary to assess the real differences between skill and scores and so the three versions are compared season by season in terms of BIAS, POD and FAR for a fixed threshold of 15 mm/24h. We consider the average precipitation values over each meteo-hydrogeological basin and the error bars in the following graphs indicate 2.5th and 97.5th percentiles of resampled distribution, applied to the "reference" model. Looking at Figures 5, 6 and 7 we can observe season by season the behaviour differences: in particular, COSMO-7 is most of the time better than the others, whereas the performances of COSMO-EU and COSMO-I7 are fairly equivalent. Anyway, the most relevant and remarkable result, common to all versions, is an improvement trend in the last three seasons, clearly visible in a BIAS and FAR reduction combined with a POD increase.

But we do not forget that statistical indices do not describe exhaustively the model skill: if we point out our attention to the last season (mam 2007), COSMO-EU has a very good BIAS (around 1) and it seems to performe well on average over the territory, but this is a balance effect of negative and positive errors distributed all over the territory. A very different result can be observed calculating and plotting the relative error over each basin, where underestimated/overestimated areas are highlighted (Fig. 8).

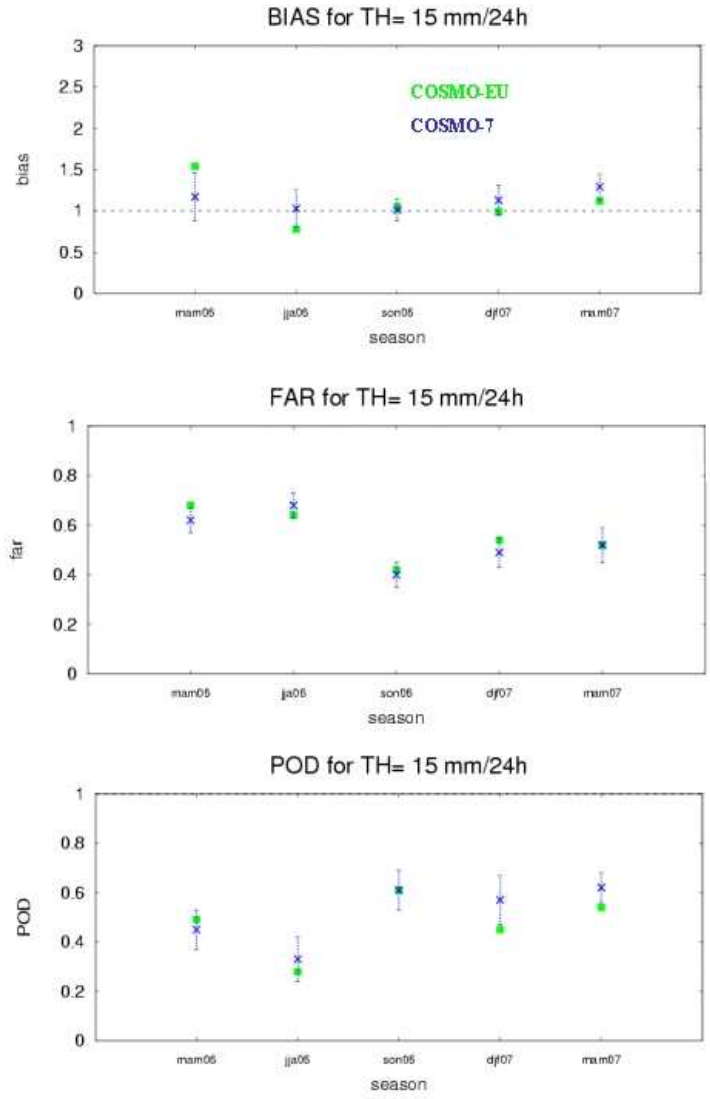

Figure 5: Seasonal comparison between COSMO-EU/COSMO-7 for D+2.

4 Error diurnal cycle

We performed the error diurnal cycle considering 6h cumulated precipitation average over the basins on the period from January 2006 to August 2007 for increasing threshold (Fig. 9). We note some general remarks: the BIAS is greater than 1 (particularly for COSMO-I7) and a sort of diurnal cycle is evident with some peaks in correspondence of different forecast hours. In particular, it is noticeable how the BIAS peak occurs during midday for low thresholds, and for high thresholds it is shifted to midnight. This is an unusual result, difficult to understand. A possible explanation could be that for high thresholds the events mainly occurred during spring-summer (we have verified that) so the precipitation has a great convective component: moving from low to high precipitation amount the overestimation peak is shifted from midday to midnight, so the model seems to "see" too much instability at night during the convective events.

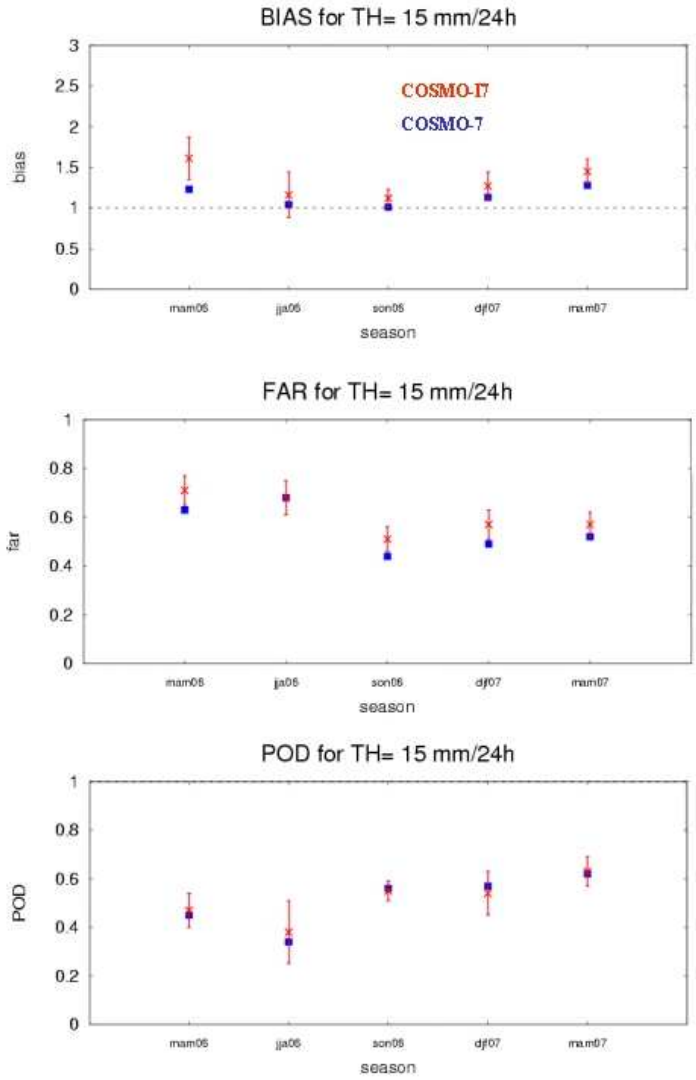

Figure 6: Seasonal comparison between COSMO-I7/COSMO-7 for D+2.

5 Seasonal trend over long period

Now, we focus on COSMO-I7 to evaluate the performance over a long period and to highlight the possible improvements due to the changes of the model during the years. We plot the statistical indices season by season for increasing thresholds and for D+1 and D+2 starting from winter 2003 until spring 2007: in general there is no remarkable trend, but we show the threshold 20 mm/24h because of a slightly positive trend (Fig. 10). Anyway, there is a worsening with the forecast time accompanied by a seasonal cycle with generally better skills during autumn and worse skills during summer.

6 Preliminary results for COSMO-I2

COSMO-I2 dissemination became operational in May 2007, so we start with a brief and preliminary verification with classical indices, BIAS, POD and FAR for D+1/D+2 over the

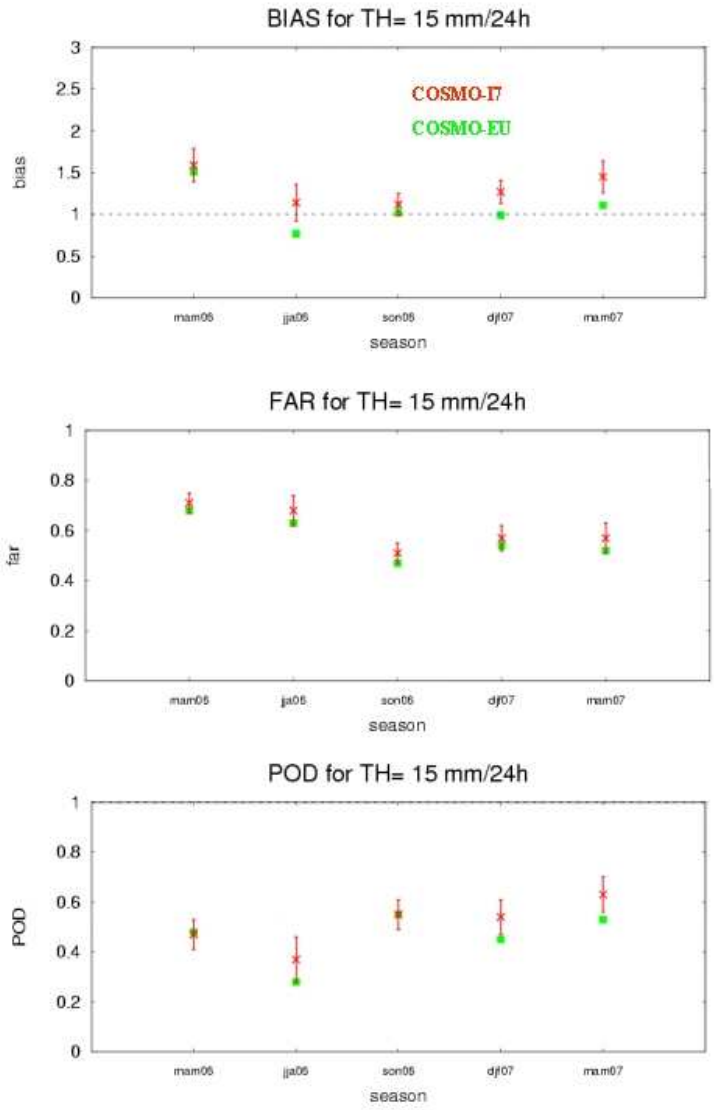

Figure 7: Seasonal comparison between COSMO-I7/COSMO-EU for D+2.

basins for increasing thresholds on a limited period of three months (200705-200707). The BIAS difference is statistically significant only for threshold above 10 mm/24h (Fig. 11), where COSMO-I2 overestimates more then COSMO-I7; on the other hand we obtain a slightly better POD for COSMO-I2 with a greater numbers of false alarms with respect to COSMO-I7 (results not shown here). According to this preliminary study, the comparison between COSMO-I7 and COSMO-I2 during the last three months shows better scores for COSMO-I7.

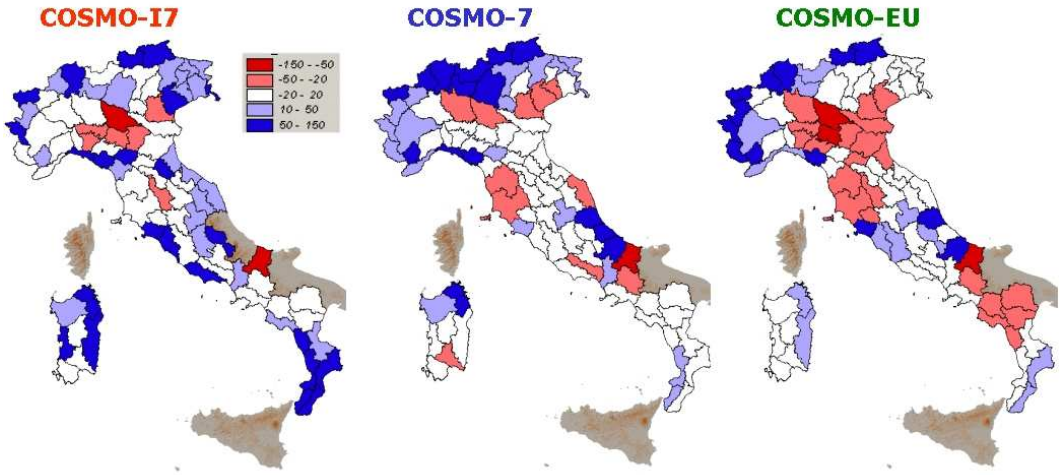

Figure 8: Seasonal comparison: relative error in mam 2007.

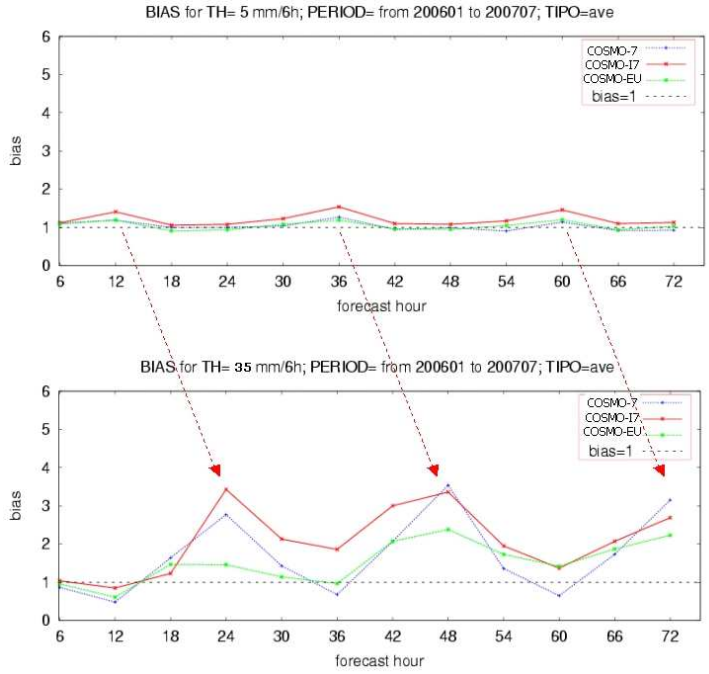

Figure 9: Error diurnal cycle for two chosen thresholds, 5 mm/6h and 35 mm/6h.

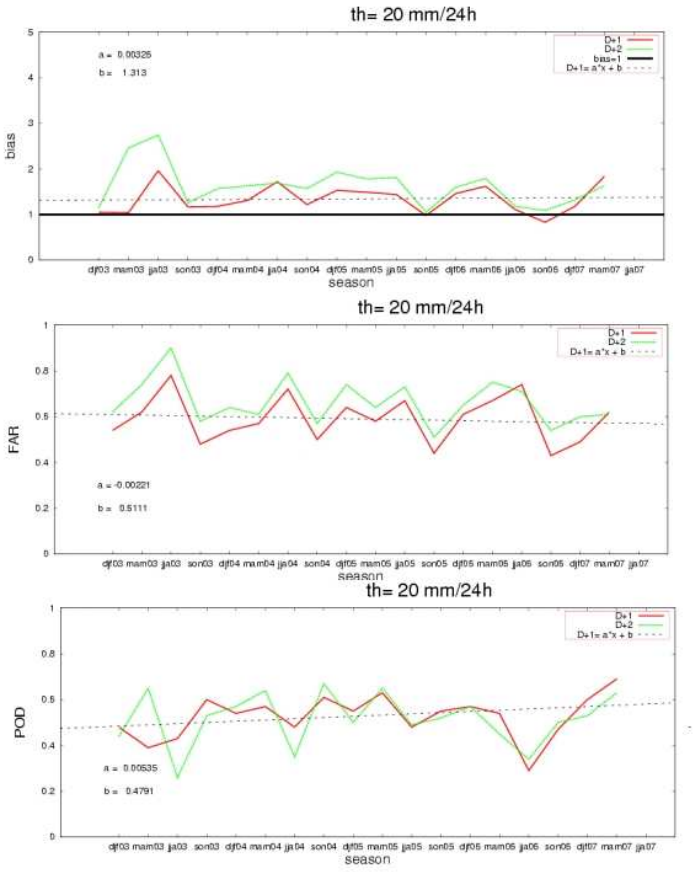

Figure 10: COSMO-I7 seasonal trend for 20 mm/24h for D+1, D+2.

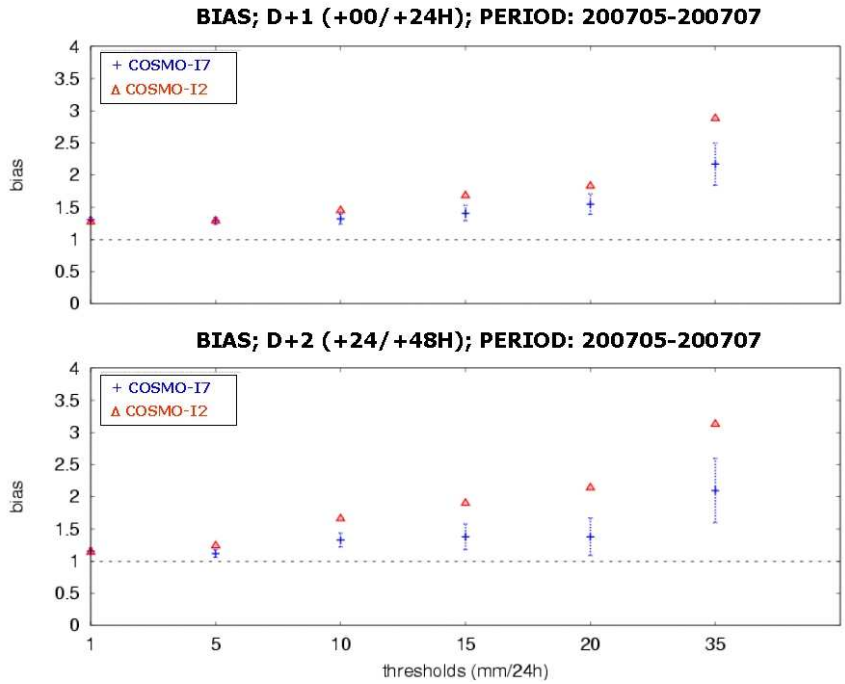

Figure 11: COSMO-I7/COSMO-I2 comparison D+1/D+2 (200705-200707).