QPF verification for 2008/2009 of several COSMO-Model versions

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1 Introduction

In this report we present the QPF verification of the 4 model versions at 7 km resolution (COSMO-I7, COSMO-7, COSMO-EU, COSMO-ME) and 2 model versions at 2.8 km resolution (COSMO-I2, COSMO-IT) using high resolution network of rain gauges coming from COSMO dataset and Civil Protection Department, that counts about 1300 stations. In detail, we show an update of the most recent results highlighting the failings and the improvements of the 00 UTC runs up to +24h. The skills and the scores are calculated considering an accumulation time of 6h or 24h, averaged over 90 meteo-hydrological basins that cover all the peninsula with the exception of some Southern regions.

2 Long period verification

We have carried out the seasonal verification for the coarser models for the first and second day for the following thresholds: 0.2 mm/24h, 2 mm/24h, 10 mm/24h, 20 mm/24 starting from DJF 2004 to MAM 2009. The main results relatively to the first 24h for the lower and higher thresholds are reported in the next pictures, Fig. 1 and Fig. 2 respectively:

- for low thresholds it is noticeable a seasonal cycle in Bias with big peaks during summertime; the biggest overestimation is for Cosmo-I7 (Fig. 1);
- in general it is evident a Bias reduction trend for low thresholds (Fig. 1);
- the Pod index has got a stable or slight worsening trend in time for low thresholds (Fig. 1);
- the Pod index has got a slight improvement trend in time for high thresholds (Fig. 2);
- the best Pod performance is during spring/summertime for low thresholds (Fig. 1);
- the worst Pod performance is during summertime for high thresholds, probably due to the difficulty to detect correctly the intense and localized convective events (Fig. 2);
- a Far reduction has been achieved, with the worst performance during summertime both for low and high thresholds (Fig. 1 and Fig. 2);
- the Ets shows a slight improvement trend in time with a seasonal cycle both for low and high thresholds: it becomes better during moist seasons and worse during dry seasons (Fig. 1 and Fig. 2);
- for high thresholds the Bias reduction trend has been confirmed (at least for the latest years, where it appears to have a general good performance); also the seasonal cycle with the big peaks during spring-summertime (the convective period) has been confirmed, although it seems to disappear during the latest summer (Fig. 2);

- Cosmo-7 underestimates the precipitation amount and gets worse in terms of Pod during the latest seasons both for low and high thresholds (Fig. 1 and Fig. 2).

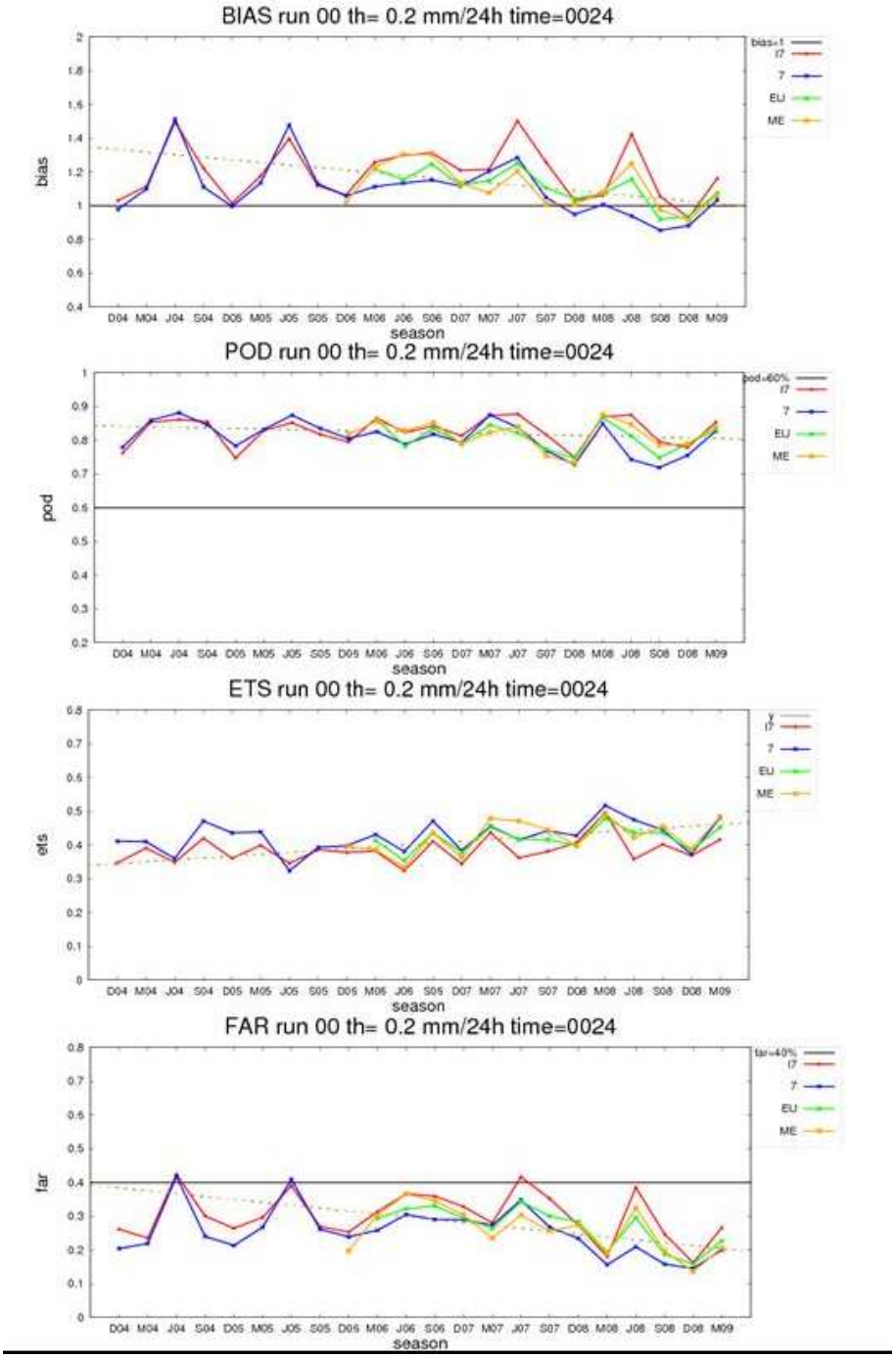

Figure 1: Bias, Pod, Ets and Far: seasonal trends from DJF 2004 to MAM 2009 for 0.2 mm/24h.

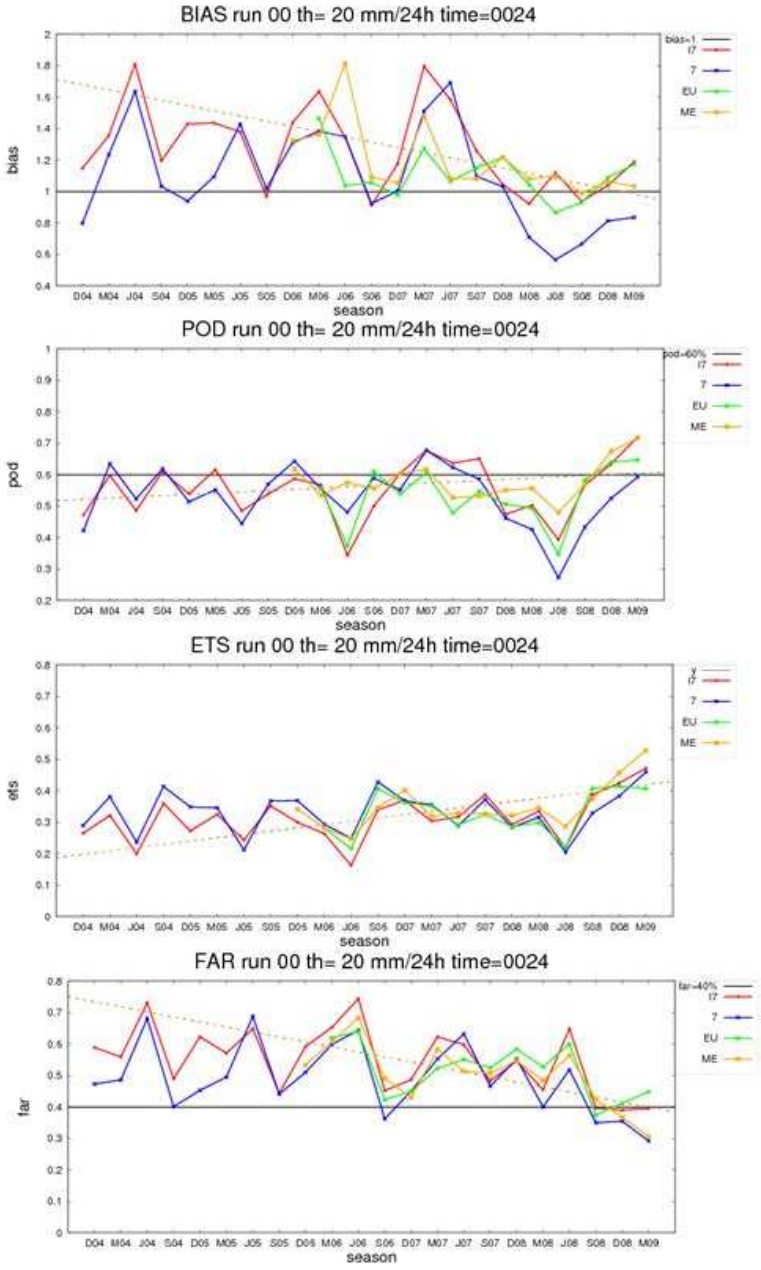

Figure 2: Bias, Pod, Ets and Far: seasonal trends from DJF 2004 to MAM 2009 for 20 mm/24h.

3 Verification over the latest years

A focus on the verification over the latest years is reported here.

Comparison between Cosmo-7 and Cosmo-EU

In Fig. 3 we plot Bias, Pod, Ets and 1-Pofd versus increasing thresholds considering a period from 200806 to 200905. It is noticeable a good performance of Cosmo-EU while Cosmo-7 underestimates the amount of precipitation (even if it forecasts more correctly the non-events).

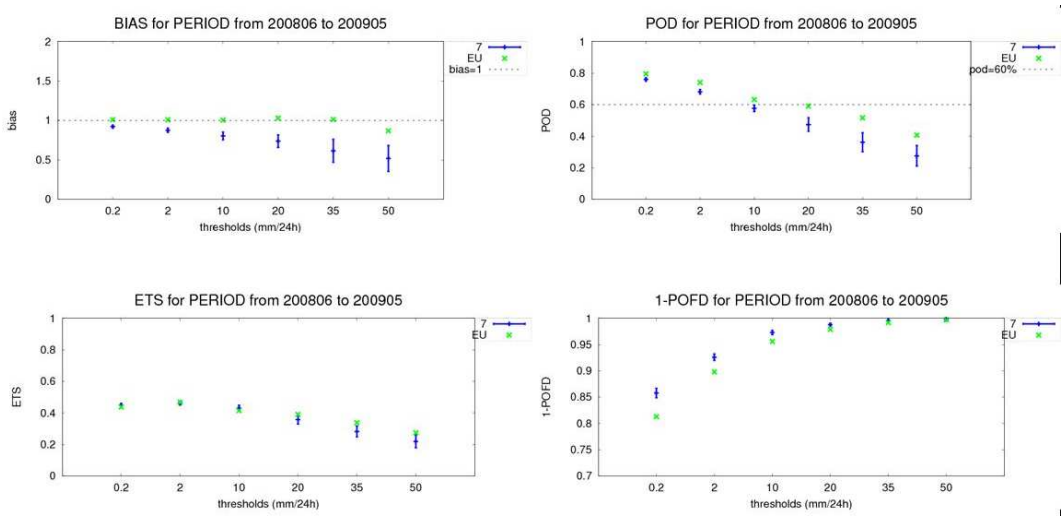

Figure 3: Bias, Pod, Ets, Far and 1-Pofd versus increasing thresholds.

In Fig. 4 we show the same indices at a fixed threshold of 20 mm/24h season by season. It is confirmed the general better results for Cosmo-EU and an underestimation for Cosmo-7. The slightly positive trend is significant and important for both the models.

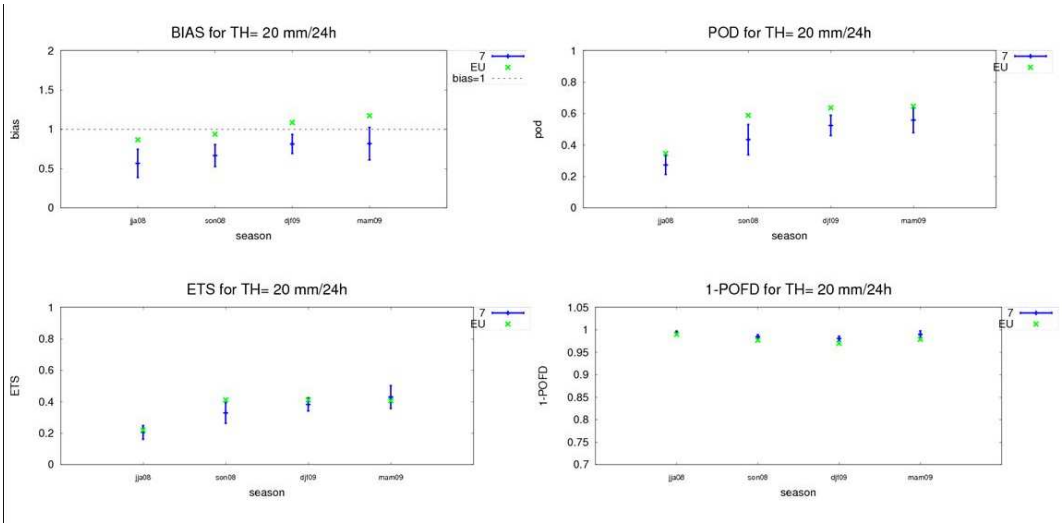

Figure 4: Bias, Pod, Ets, Far and 1-Pofd season by season.

Comparison between Cosmo-I7 and Cosmo-ME In Fig. 5 we plot Bias, Pod, Ets and 1-Pofd versus increasing thresholds considering a period from 200806 to 200905 and, in Fig. 6, the same indices season by season. The same results are obtained in both cases: similar and fairly good performances for the two versions, slightly better for Cosmo-ME.

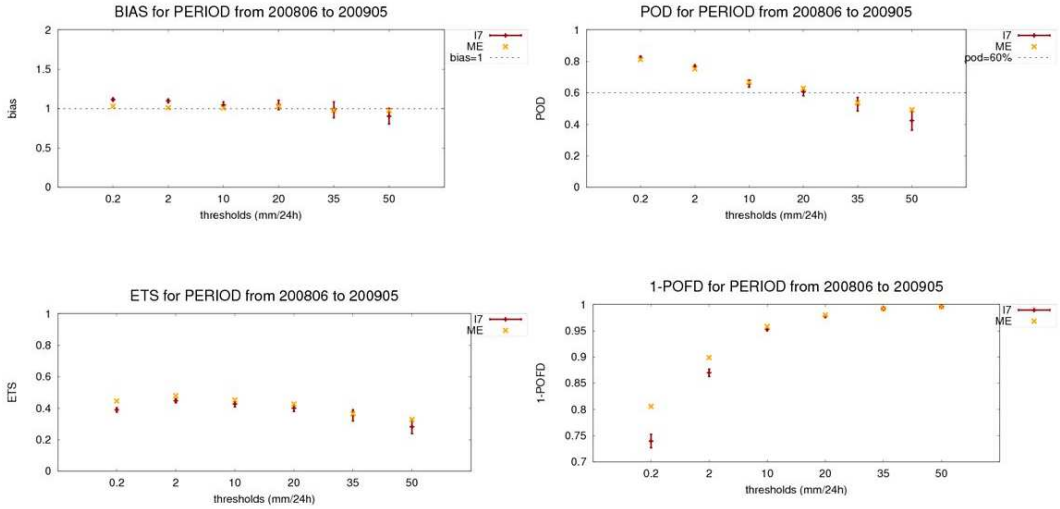

Figure 5: Bias, Pod, Ets, Far and 1-Pofd versus increasing thresholds.

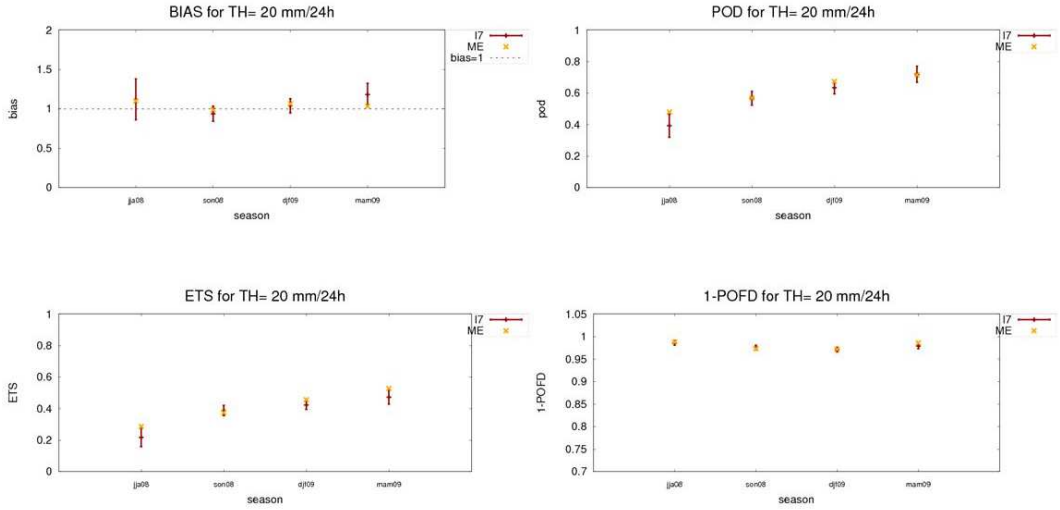

Figure 6: Bias, Pod, Ets, Far and 1-Pofd season by season.

Driving model comparison: Ecmwf, Cosmo-I7, Cosmo-I2

In the Fig. 7 the comparison among the three models versus increasing thresholds shows a general big gap between Ecmwf and the Cosmo-models. Moreover, Ecmwf overestimates for low thresholds and underestimates for the higher ones (it is an intrinsic feature and behaviour for hydrostatic and coarser models). In general, Cosmo-I7 is better than Cosmo-I2 (Cosmo-I2 underestimates the precipitation and, consequently, it has a smaller Far).

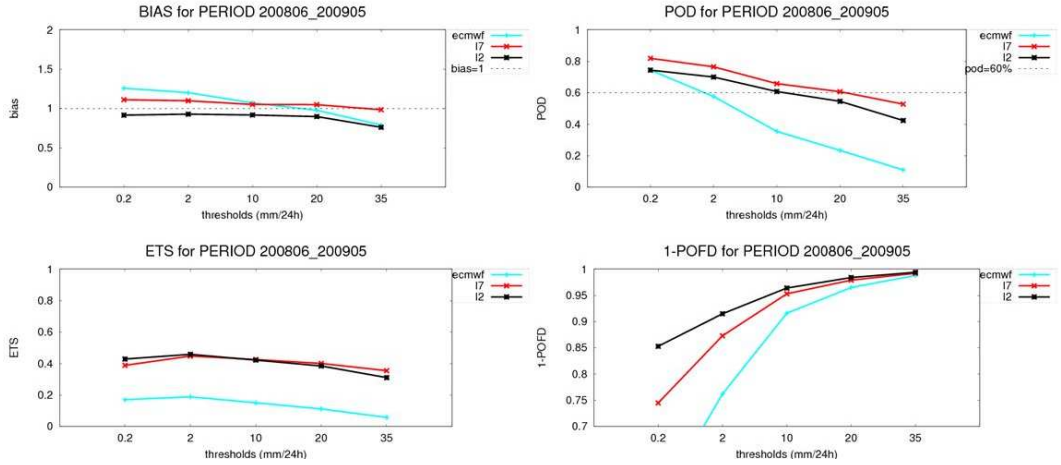

Figure 7: Bias, Pod, Ets, Far and 1-Pofd versus increasing thresholds.

In the following picture (Fig. 8) we plot the indices season by season at a fixed thresholds of 20 mm/24h: it is confirmed the big gap between Ecmwf and the Cosmo-models. Both Cosmo-models show a slightly positive trend, but Cosmo-I2 has got an underestimation tendency, more pronounced during summer (convective) periods.

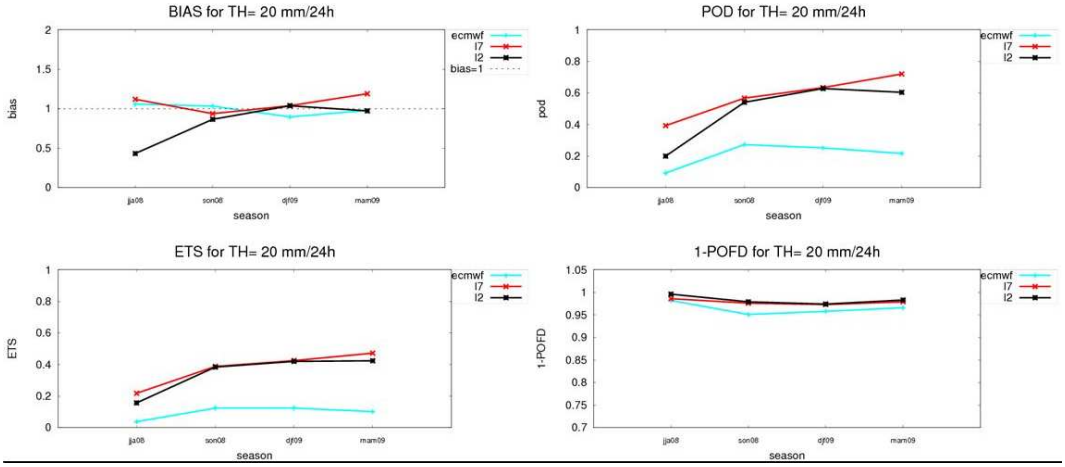

Figure 8: Bias, Pod, Ets, Far and 1-Pofd season by season.

Driving model comparison: Ecmwf, Cosmo-ME, Cosmo-IT

In Fig. 9 the comparison among the three models versus increasing thresholds shows again a general big gap between Ecmwf and the Cosmo-models. Cosmo-ME and Cosmo-IT display a similar behaviour, with an overestimation tendency by Cosmo-IT.

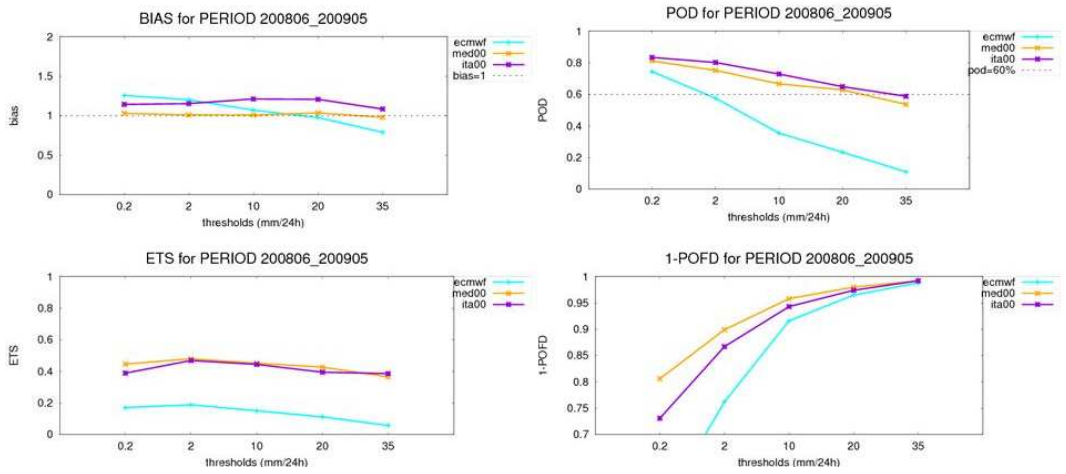

Figure 9: Bias, Pod, Ets, Far and 1-Pofd versus increasing thresholds.

In the following picture (Fig. 10) we plot the indices season by season at a fixed thresholds of 20 mm/24h: it is confirmed again the big gap between Ecmwf and the Cosmo-models. Both Cosmo-models have a similar performance, but Cosmo-IT overestimates quite a lot the precipitation, especially during summer (convective) periods.

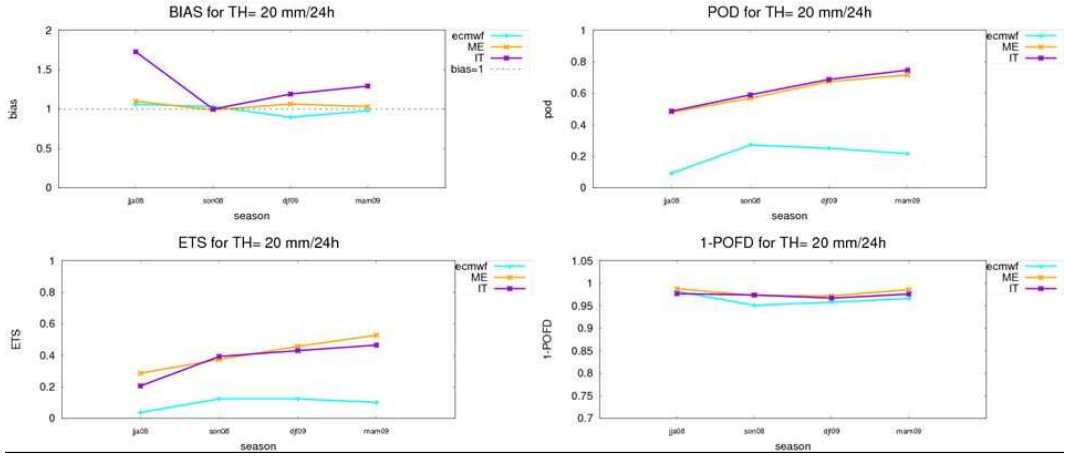

Figure 10: Bias, Pod, Ets, Far and 1-Pofd season by season.

The diurnal cycle

In the following picture (Fig. 11) we check the models features considering 6h integration precipitation starting from 06UTC to 72UTC forecast time. We analyze the behaviour of all the 6 model versions at low and higher threshold (0.2 mm and 10 mm) over the latest years. In particular, we note a Bias overestimation peak during midday for both thresholds and, moreover, it is confirmed an underestimation for Cosmo-7, more pronounced for high precipitation amounts. All the model versions, especially Cosmo-I7 and Cosmo-I2, present a

spin-up problem for low thresholds, that seems to disappear for the higher ones where the models underestimate the precipitation during the first 6h. In general it is noticeable a slight improvement with respect to the previous years results.

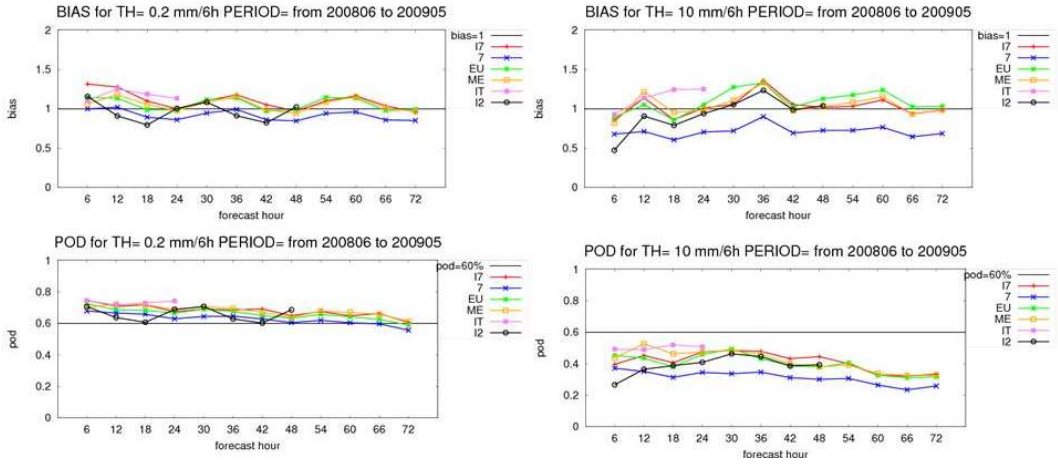

Figure 11: Diurnal cycle for Bias and Pod for 0.2 mm/6h and 10 mm/6h.

The spatial distribution of the error

Finally, the latest year skills and scores have been calculated over each meteo-hydrological basins in order to evaluate the spatial error distribution: here we show only the Bias for 10 mm/24h (Fig. 12) from 200806 to 200905 and the relative error (Fig. 13) for MAM 2009. Observing the Bias distribution over the territory (Fig. 12), apart from the general characteristics we have found before with the statistical indices, we can underline some more feature:

- all the versions overestimate the precipitation over the Alpine chain;
- there is a strong underestimation for Cosmo-7;
- there is a quite good general performance for Cosmo-ME, Cosmo-I7 and Cosmo-EU, with an underestimation over Southern Italy, Sardegna and Tyrrenian regions and an overestimation over the Adriatic area;
- there is an overestimation for Cosmo-IT and an underestimation for Cosmo-I2.

Eventually, Fig. 13 depicts the relative error distribution ((forecast-observed)/observed) in percentage during last spring:

- all the versions forecast too much precipitation over the Alpine chain;
- Cosmo-7 and Cosmo-I2 predict too less precipitation over some basins;
- Cosmo-IT predicts too much precipitation over some basins;
- Cosmo-I7 overestimates the precipitation in Central-Southern Italy;
- Cosmo-ME and Cosmo-EU have a general good performance.

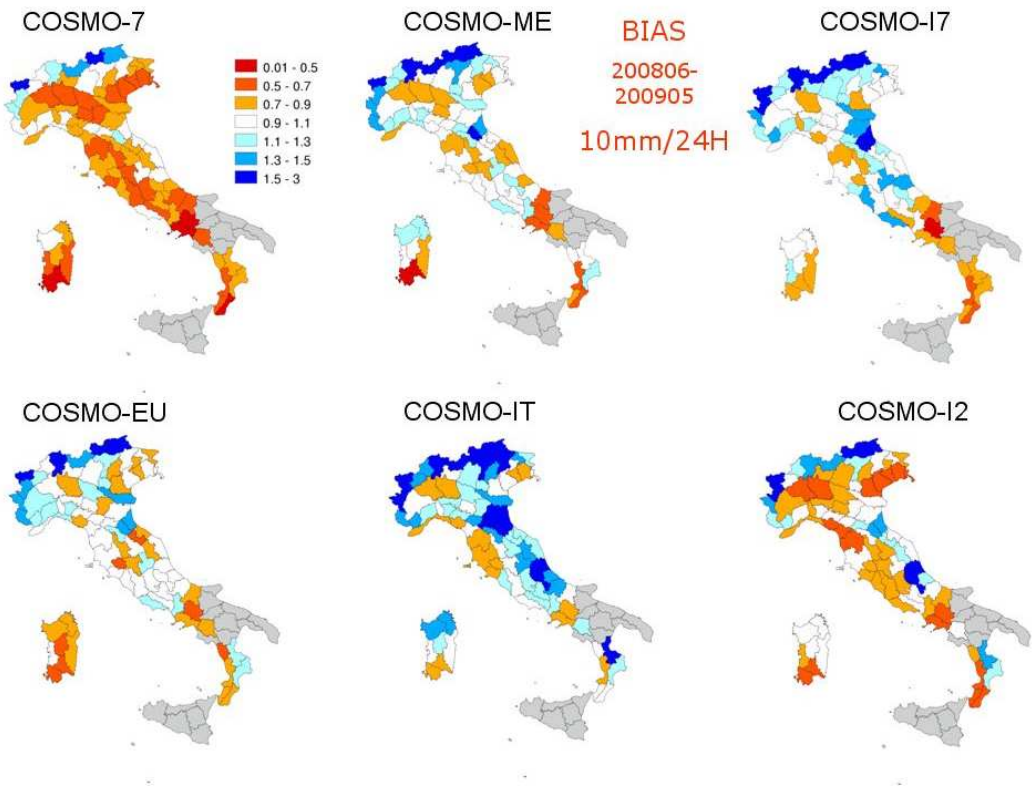

Figure 12: Bias spatial distribution for 10 mm/24h for MAM 2009.

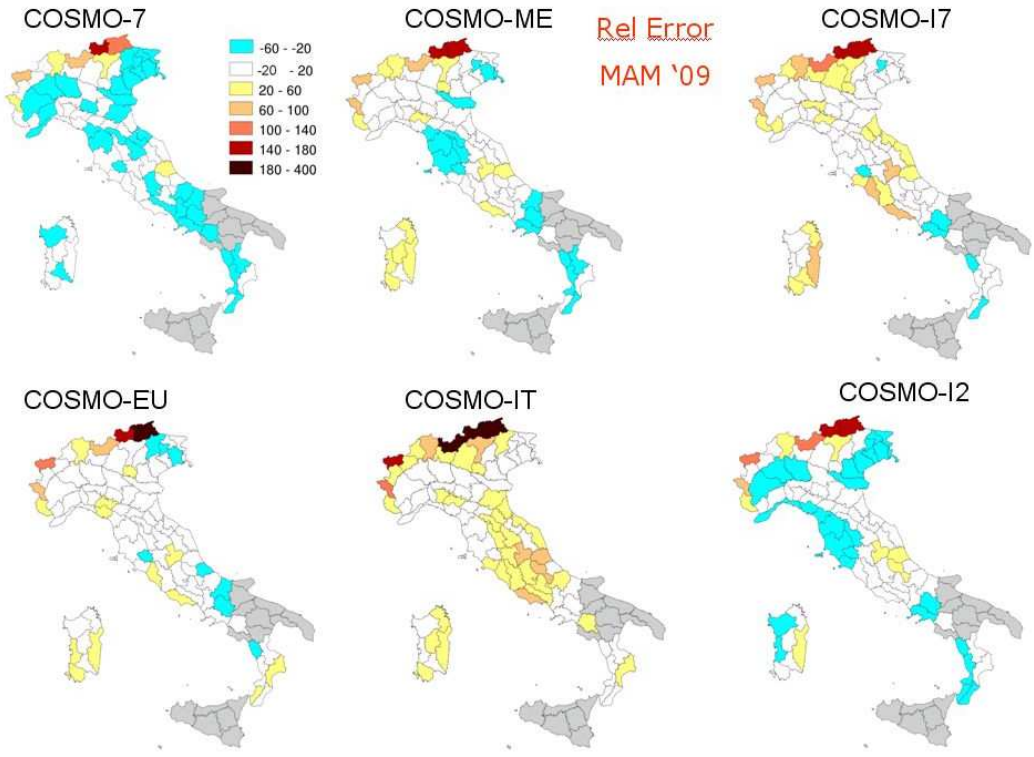

Figure 13: Relative error (%) distribution for MAM 2009.