Application and Verification of ECMWF Products 2009

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1. Summary of major highlights

IFS deterministic model output from both 12 and 00 UTC runs are used at CNMCA as plotted fields in the forecasting department mainly for medium range, also as input to statistical (PPM type) and physical adaptation schemes, and at last as initial and/or boundary conditions for CNMCA Local Area Models (Euro-HRM, 7km COSMO-ME and very high resolution 2.8km COSMO-IT).Verification of ECMWF products are carried out at CNMCA for operational model T799. Surface parameters and forecast ranges mainly used by weather forecasters are considered.

2. Use and application of products

2.1 Post-processing of model output.

2.1.1 Statistical adaptation.

Statistical adaptation is involved in a Perfect Prog application currently being used named ARGO. The model is used to infer surface weather parameters such as precipitation, 2T, humidity, cloudiness, wind etc. over about one hundred geographical sites corresponding to the locations were the Italian network of weather stations are deployed and observations are available.

2.1.2 Physical adaptation.

No physical adaptation is being used within the meteograms generation application. Routines selecting for each geographical site the most likely point among nearest grid points make use of land/sea mask and elevation comparisons. No correction at all is being performed once the grid point has been chosen.

2.1.3 Post-processing products and derived fields.

Thousands of meteograms are routinely produced over geographical sites within the 80°N-60°S area. At present meteograms are being produced in PNG graphical format and in text mode for medium range meteograms up to T+72H stepping in time every 6 hours and long range meteograms up to T+168H stepping every 12 hours. Meteograms are intended as a general purpose product and for this reason the weather parameters included are 2m temperature, 2m humidity, mean sea level pressure, total-high-medium-low cloud cover, convective precipitation, grid scale precipitation and 10 m wind.

Basing on the ECMWF models output, several derived parameters are routinely calculated as well. For the atmospheric operational model the derived fields are:

- freezing level;
- wet bulb potential temperature;
- KO and other stability indexes;
- liquid water content;
- accumulated precipitation over fixed time interval;
- heat index (Steadman);
- wind-chill;
- tropopause height and maximum wind;
- 2m relative humidity.

Derived fields are also calculated for the ECMWF Wave Model. The most important derived parameter is the sea state code according to primary and wind wave height (Beaufort Scale). Metgrams over sea geographical sites are being produced too. For each site primary sea swell height, wind wave height, 10 m wind and wave direction behaviours are described from T+12H up to T+96H. The sites are chosen correspondingly to buoys and tide gauges deployment.

Some outputs from EPS system are carried out directly from ECMWF Ecgate server using "ad hoc" built applications and Metview batch procedures. In particular the following maps are created:

- Epsgrams and Plumes for 40 main Italian cities
- Probability maps on Europe from t+ 48 to t+168 (precipitation, wind, 850 hPa Temp)
- Tubes on Europe t+96 and t+168

2.2 Use of products

The ECMWF T799L91 operational model is being used at CNMCA. Surface and upper air fields of the 00Z and 12Z runs are routinely downloaded via RMDCN on 0.5° horizontally spaced mesh for surface fields and on a 1.0° horizontally spaced mesh for upper air fields. The time step between two following meteorological fields products issued is 6 hours from T+0h until T+168h and 12 hours between T+168h and T+240h.

The ECMWF products are classified in two main typologies: primary and secondary. In the first ones parameter fields, identified as synoptic tracers, are considered, like Potential Vorticity at 300 Hpa and equivalent temperature at 850 hPa as well; they allow to localize and define the path of synoptic configurations, especially in cases where they are not well defined at 500 hPa maps.

In the second ones, all the maps regarding parameters which better summarize the related meteorological conditions are analyzed (high, medium and low cloudiness, temperature, wind etc.) The fields are generally overlapped among them, including satellite images; many combinations are used using proper tools. In this way the forecaster is able to detect the subjects of interest, like Conceptual Models.

Besides these maps, products from EPS and EFI are used for severe weather warnings detection .

Every months, according with the ECMWF production, maps from System 3 Seasonal FC, (ensemble mean, probability and climagrams) are subjectively analyzed to obtain an outlook for the next quarterly period. Along with a concise comment, these maps are shown on the internal intranet website (available on request also for external users).

In the last part of 2008 also the use of monthly forecasts system started routinely.

3. Verification of products

3.1 Objective verification

3.1.1 Direct ECMWF model output

(i) in the free atmosphere

Some basic (MA, MAE or RMSE) verifications for free atmosphere parameters (e.g wind, Temp, RH and geopotential at standard pressure level) compared with CNMCA COSMO-ME, are produced.

(ii) of local weather parameters verified for locations

Objective scores are computed for ECMWF 12 and 00 utc run (d+1 to d+7) after collecting data, retrieved from all available Italian Synop stations, in several stratifications. Graphics have been elaborated for a number parameters: 2m Temperature, 2m dew point, 10m Wind Speed, MSLP, Tot Cloud Cover (ME, MAE).

Cumulated precipitations quarterly event scores (POD/FAR, FBI, KSS, ETS, ORSS, POD, FAR) respect to fixed thresholds and for d+1 to d+7 ranges are computed.

For the present document, data covering the period from DJF 2007/08 to SON 2008 have been used for the verification of these parameters and only some selected results are showed in the next pages, for ECMWF 00 UTC run, only.

To compute the score no interpolation from grid point to observation location is performed and the "nearest point" method is used, optimised by the "smaller" difference in altitude, between a station and the corresponding grid point. The software used for verification products is called VERSUS (VERification System Unified Survey) that replaced operationally the previous package Common Verification Suite (CVS) in mid 2008. This new system has been developed at CNMCA and it is based on DB architecture with a GUI. Through this tool Conditional Verifications are also possible (cross conditions on different parameters).

Here a short note on results.

24 h Cumulated Precipitations: Model shows an overestimation for all the seasons for lower threshold, while tends to underestimate the really higher ones. In winter, FBI score is around 1 for thresholds between 4 mm and 20 mm. It is worthwhile to note that for 14 mm threshold FBI is around 1 for all the seasons, as it was a sort of "limit". Comparing these results with the previous year overestimation appears to be more evident for all the seasons. About the accuracy (ETS), winter, spring and autumn show the best results, mainly for low thresholds. All the thresholds show a decrease in accuracy with integration time. A better behaviour is evident in springtime comparing with 2007.

2m Temperature: clear diurnal cycle in both ME and MAE especially in winter and summer. It is clear a general underestimation especially during the night. MAE increases with the forecast ranges and its values are mainly between 2 and 2,5 °C. It is clear a decrease in accuracy (higher MAE values) with integration time.

10m Wind Speed: Clear diurnal cycle for all the seasons for ME and MAE especially in winter and summer. A general underestimation is shown especially in summer and autumn, but really small. MAE, around 1,5-2 m/s in summer and fall and 2-2,5 m/s in winter and spring, tends to increase with forecast time.

3.1.2 ECMWF model output compared with CNMCA COSMO-ME limited area model.

ECMWF 00-UTC scores for 12 hours cumulated precipitation (ETS, FBI) have been calculated and graphically compared to those evaluated for Italian 00-UTC run non-hydrostatic LAM named COSMO-ME, 7 km of resolution for d+1 and d+2. These scores are shown in the next pages on Italian global area.

Accuracies of the two models are comparable, with better performances for lower thresholds (but no up-scaling is performed on COSMO-ME model, that could be in this case penalised).

About FBI scores, COSMO-ME shows a better distribution and representation than ECMWF especially for lower thresholds for all the seasons. In general higher threshold are underestimated for both IFS and COSMO-ME. Accuracy, shown here through ETS score, tends to b higher for COSMO-ME especially for lower thresholds for all the season.

3.1.3 Post processed products.

Metgrams, Automatic Weather Interpretation (AWI), Trajectories, Sounding Forecast

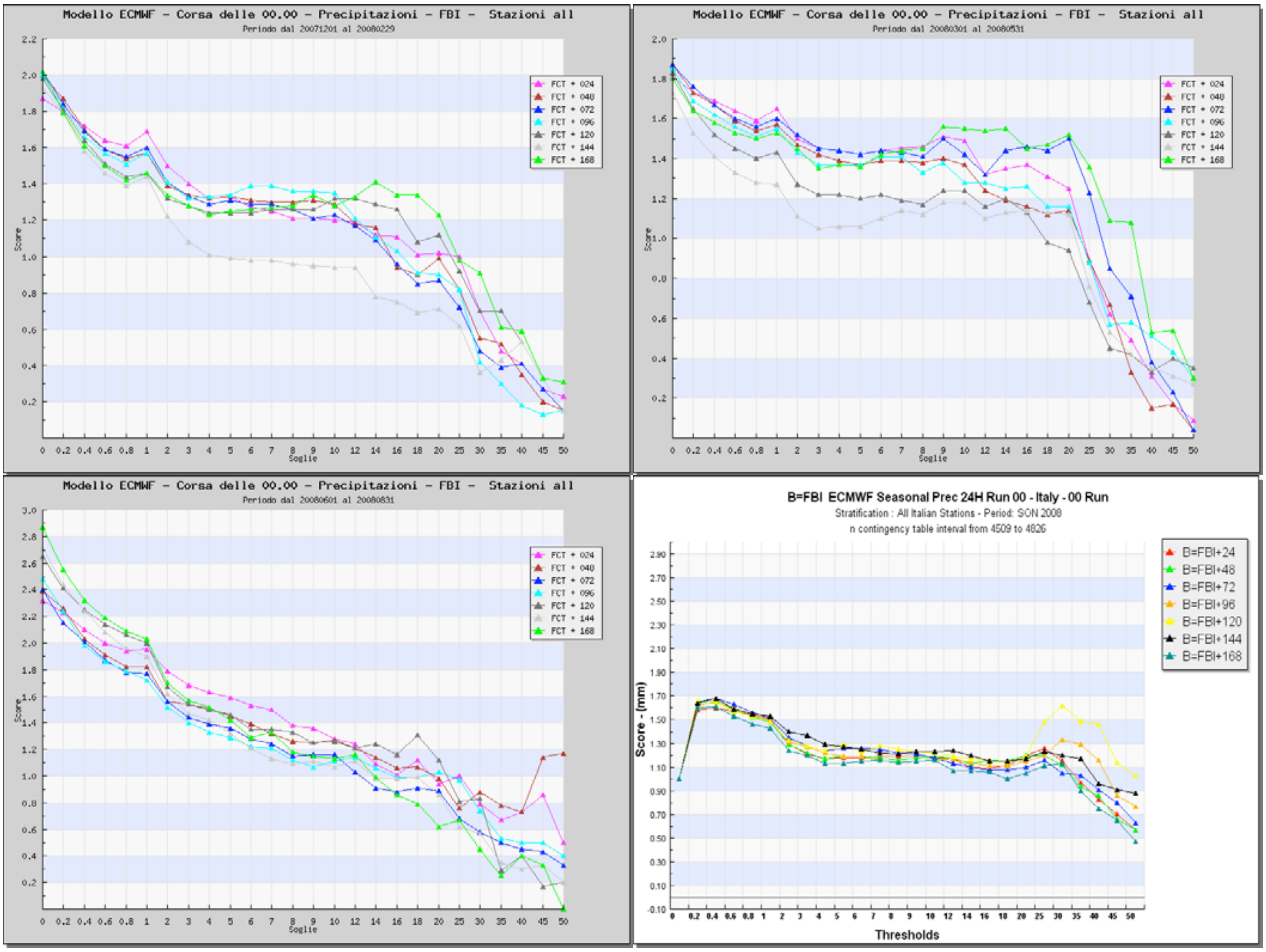
3.1.4 End products delivered to users.

Quarterly reports are made available to Intranet and Internet users as well as Forecasts and Research division.

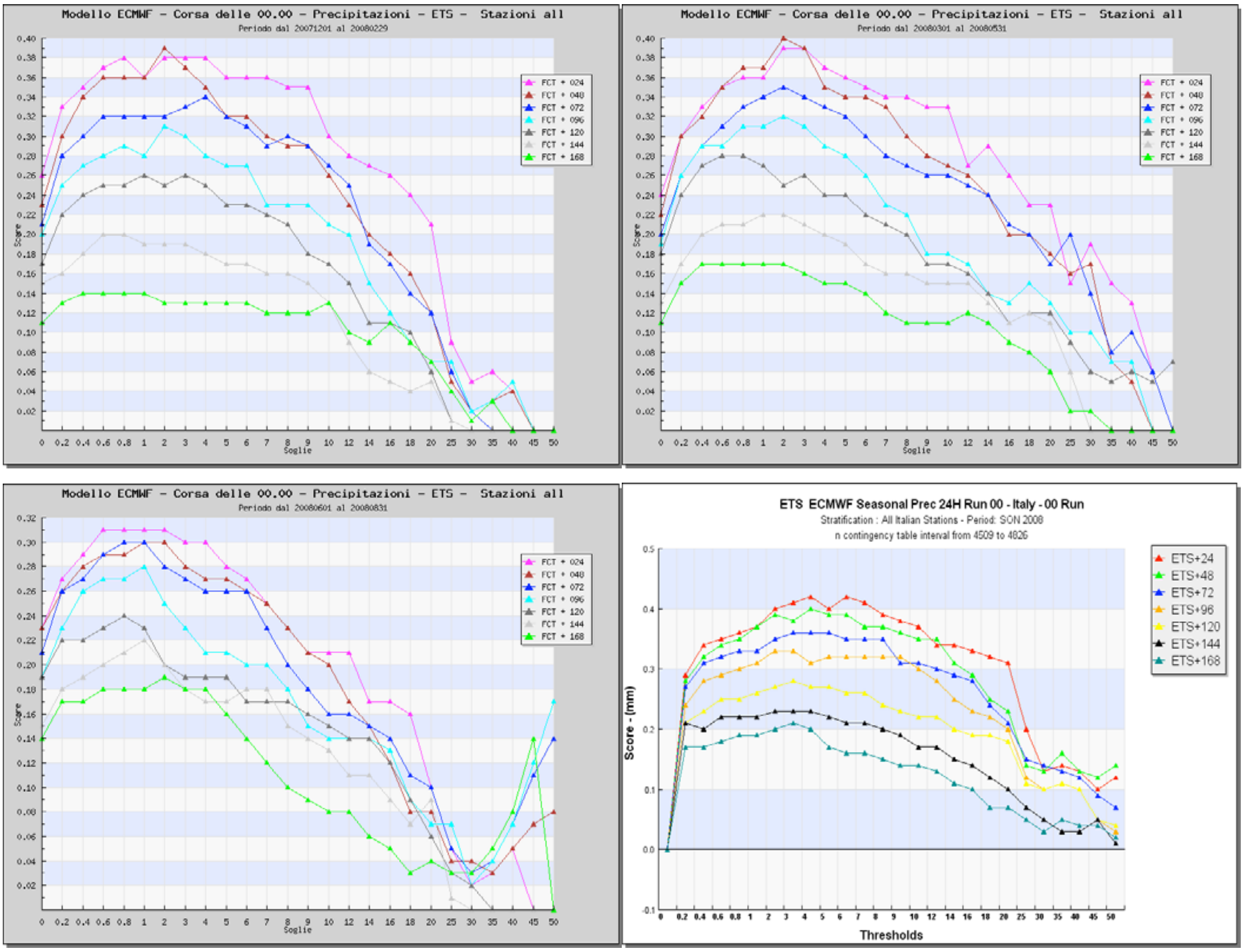
3.2 Subjective verification.

3.2.1 Subjective scores: none

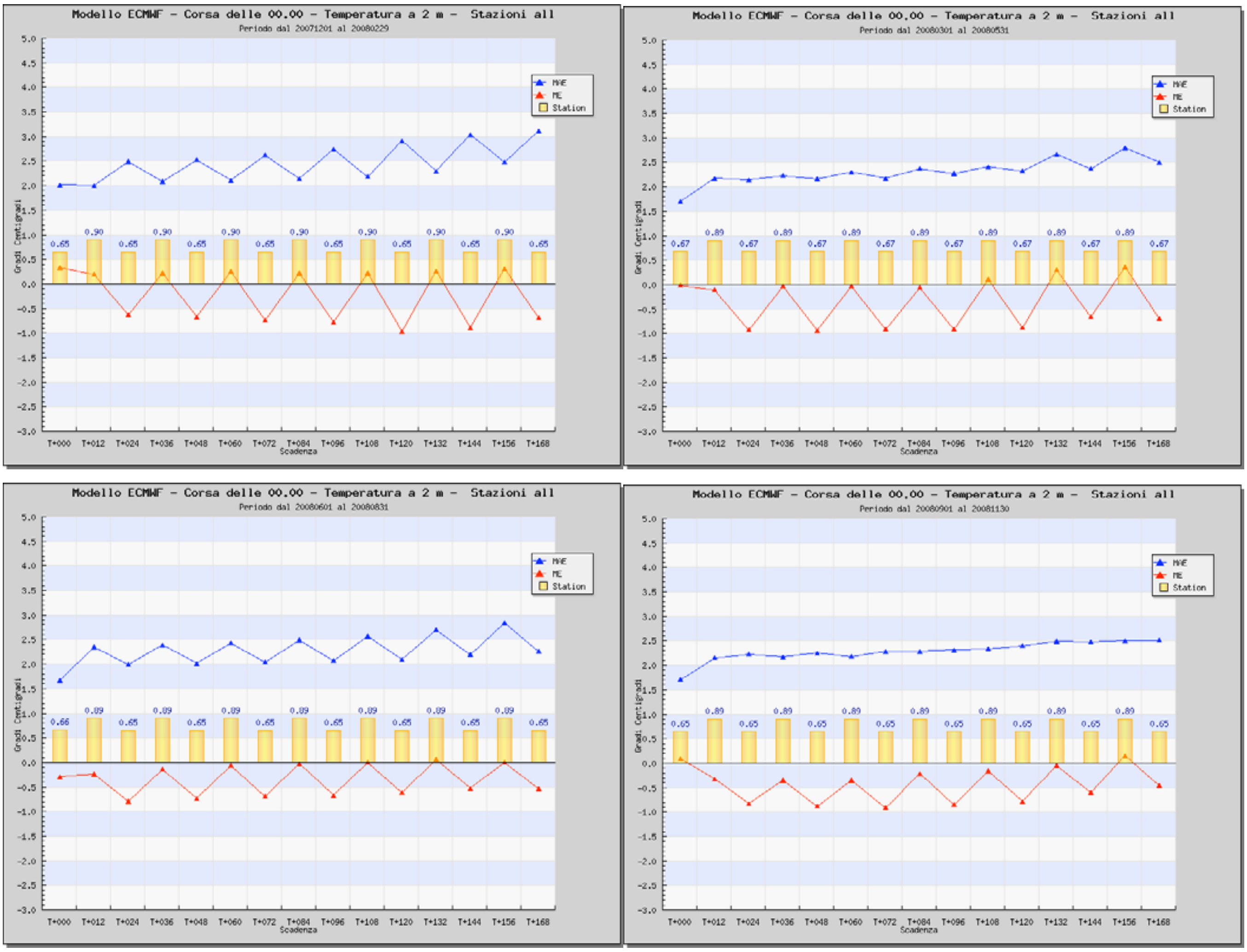
3.2.2 Synoptic studies: none



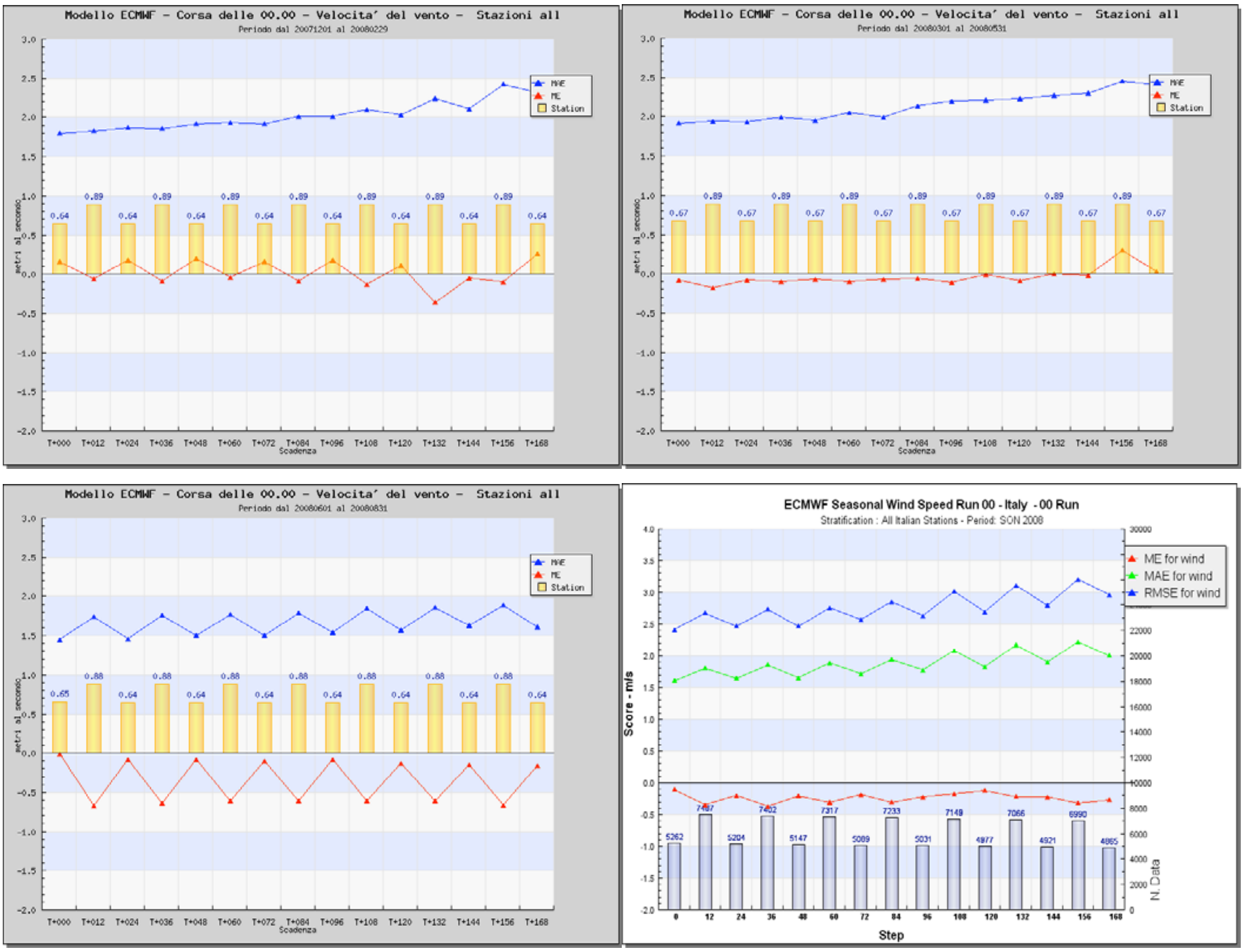
IFS Precipitation in 24 hours – FBI score, white plot from new package VERSUS



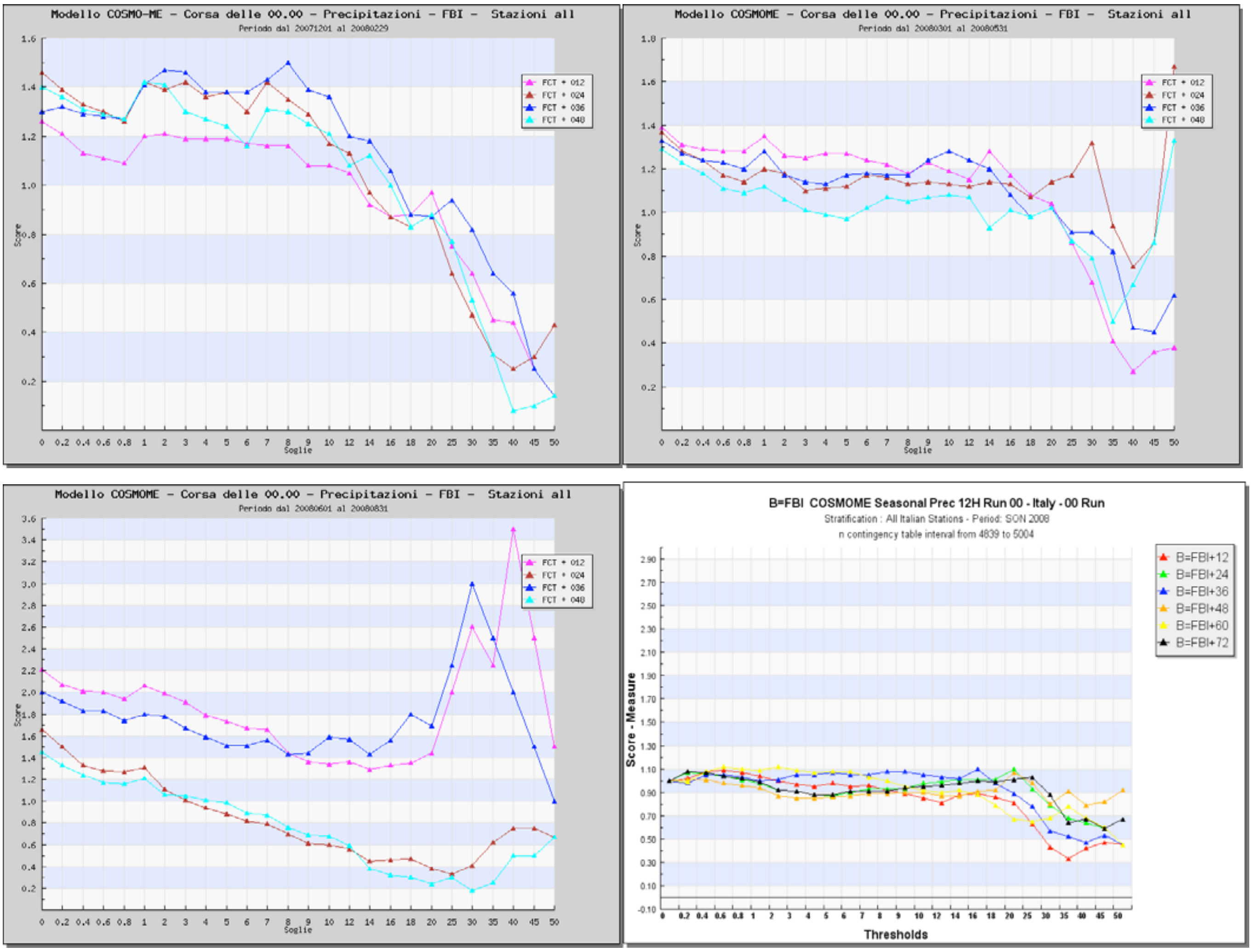
IFS Precipitation in 24 hours – ETS score, white plot from new package VERSUS



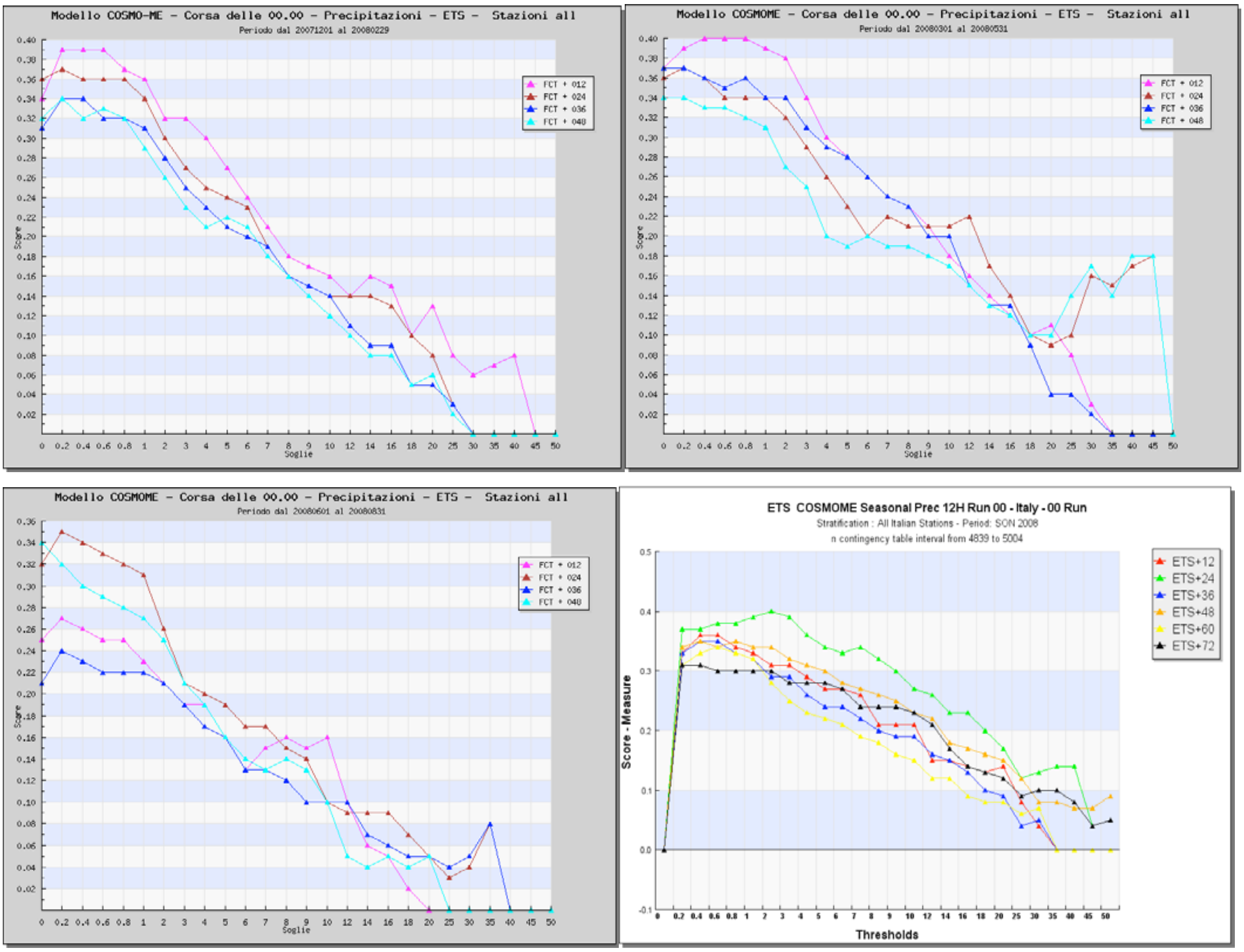
IFS T2m temperature (Mean Absolute Error and Mean Error)



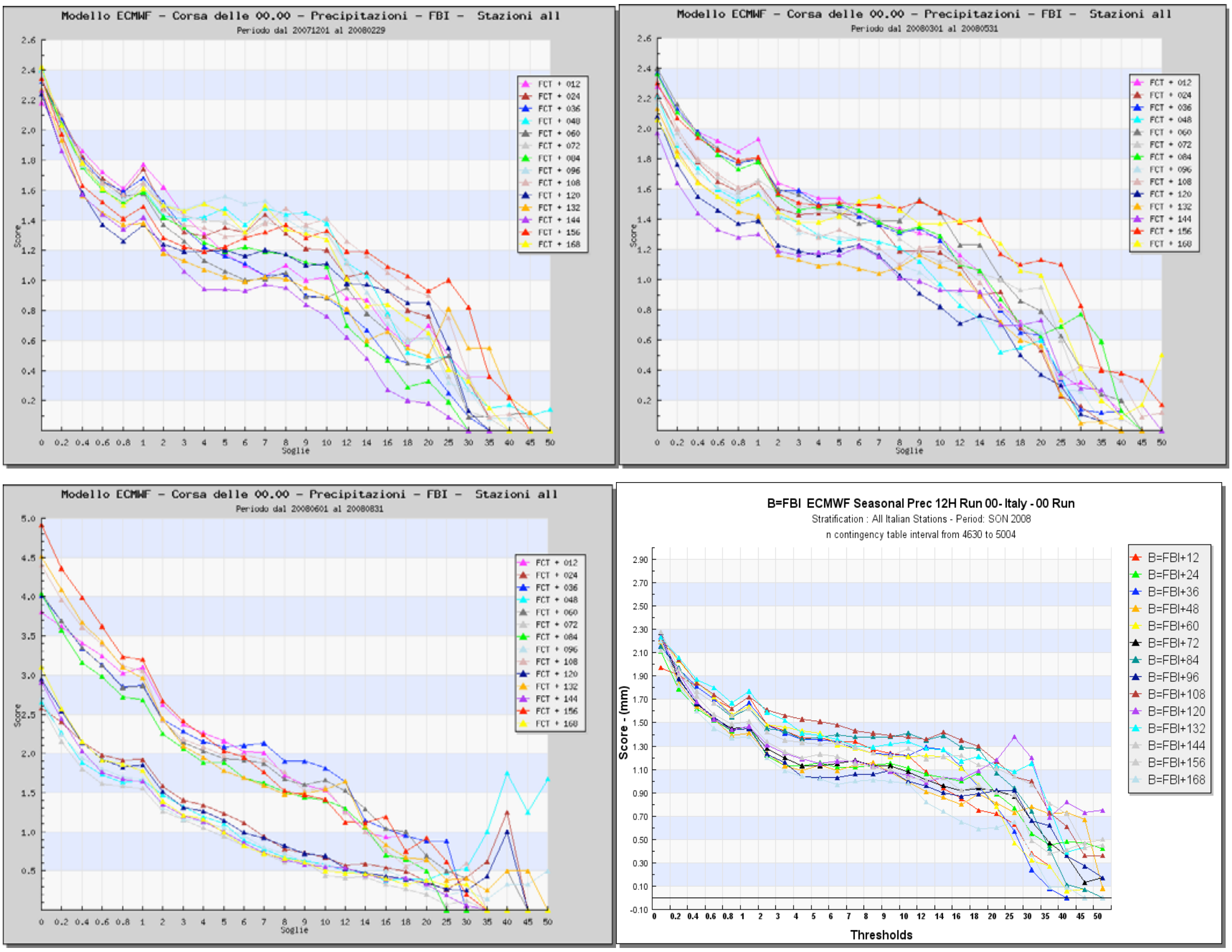
IFS Wind Speed (Mean Absolute Error and Mean Error), white plot from new package VERSUS



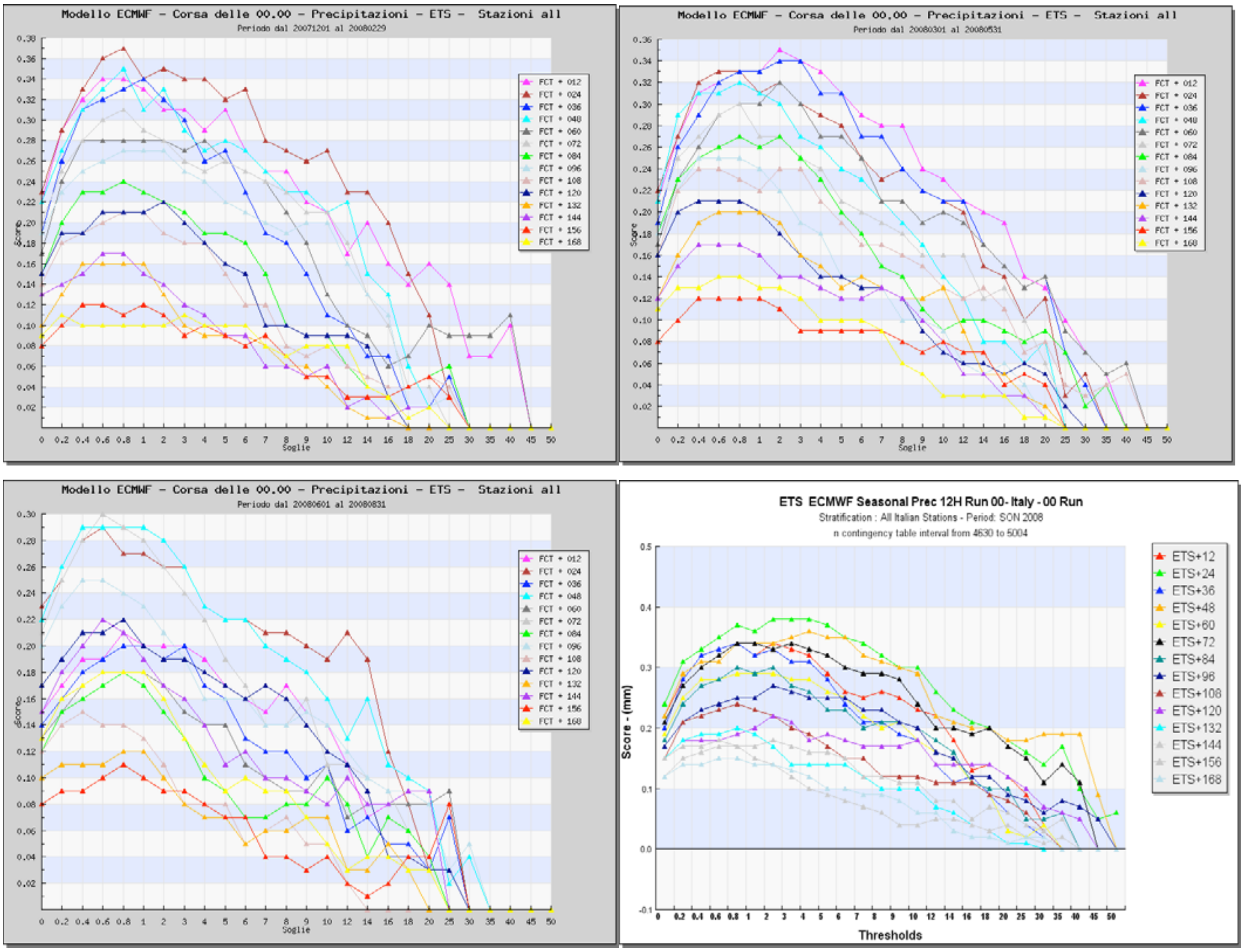
COSMO-ME Precipitation in 12 hours – FBI score, white plot from new package VERSUS



COSMO-ME Precipitation in 12 hours – ETS score, white plot from new package VERSUS



IFS Precipitation in 12 hours – FBI score, white plot from new package VERSUS



IFS Precipitation in 12 hours – ETS score, white plot from new package VERSUS