Application and Verification of ECMWF Products 2010

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1. Summary of major highlights

IFS deterministic model output from both 12 and 00 UTC runs is used at CNMCA as plotted fields in the forecasting department mainly for the medium range, as input to statistical (PPM type) and physical adaptation schemes, but also 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 is 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 every 6 hours for the medium range (up to T+72H stepping in time) and every 12 hours for the long range (T+72H to T+168H stepping in time). Meteograms are produced targeting to a general purpose use 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.

Based on the ECMWF models output, several derived parameters are routinely calculated as well. Using the deterministic operational model forecasts, the derived fields produced 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 using the ECMWF Wave Model output. The most important derived parameter is the sea state code, which is based on the primary wind wave height (Beaufort Scale). Metgrams (sometime you call them meteograms, others 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. Most of the sites are chosen according to buoys and tide gauges deployment. Some of them do not correspond to any physical instrument deployed and for this reason they are named as “virtual buoys”.

The production of some graphical outputs from the EPS forecast system, is carried out directly from ECMWF Ecgate server using “ad hoc” built applications and Metview batch procedures. In particular, the following maps are created on a daily basis:

- 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 adjacent meteorological fields issued, is 6 hours from T+0h to T+168h and 12 hours between T+168h and T+240h forecast times.

The ECMWF products are classified in two main typologies: primary and secondary.

In the first one, 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 category belong all the maps concerning parameters which better summarize the related meteorological conditions (high, medium and low cloudiness, temperature, wind etc.). The fields are generally plotted in an overlapping mode, 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 events detection and issuing of warnings.

Every month, according to the availability of the ECMWF model products, 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 commentary, 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) verification statistical indices for the free atmosphere parameters (e.g wind, Temp, RH and geopotential at standard pressure level) are produced and compared to CNMCA COSMO-ME model output verification results,.

(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, using several stratifications. Graphics have been elaborated for a number of parameters: 2m Temperature, 2m dew point, 10m Wind Speed, MSLP, Tot Cloud Cover (ME, MAE).

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

For the present document, data covering the period from DJF 2009/10 to SON 2010 have been used for the verification of these parameters and only some selected results are presented in the next pages, for ECMWF 00 UTC run, only.

In order to compute the scores, no interpolation from grid point to observation location is performed. The "nearest point" method is used, optimised by the "smaller" difference in altitude combined with the horizontal distance 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).

A short note on the results is given below.

24-h Cumulated Precipitation: Model shows an overestimation for all the seasons for lower thresholds, while tends to underestimate the really higher ones. FBI score is overestimated for almost all the seasons and thresholds (FBI =1 only around 25 mm/24h), only in Autumn the overestimation is less evident (FBI =1 only around 10 mm/24h). Comparing these results with the previous year, overestimation appears to be slightly more evident for all the seasons. About the accuracy (ETS), all seasons exhibit the best results, mainly for low thresholds and for the first 3-5 days of integration. For all thresholds there is a gradual decrease in accuracy with integration time.

2m Temperature: clear diurnal cycle in both ME and MAE. It is clear a general underestimation especially during the night. MAE increases with the forecast time and its values are mainly comprised between 2 and 2,5°C (reaching up to 3,5°C in winter). 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 during winter and summer. A general underestimation is shown in ME, but really small. MAE, around 1,5-2 m/s in summer and fall and 2-2,5 m/s in winter and spring, with a tendency to increase slightly with forecast time.

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

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

About FBI scores, COSMO-ME shows a better distribution and representation than ECMWF especially for almost all the thresholds for all the seasons. In general higher thresholds are underestimated with both IFS and COSMO-ME models, but clearly overestimation is less evident in COMSO-ME than in the IFS one.

Accuracy, represented here through ETS score, tends to be higher for COSMO-ME especially for lower thresholds and for all seasons.

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.

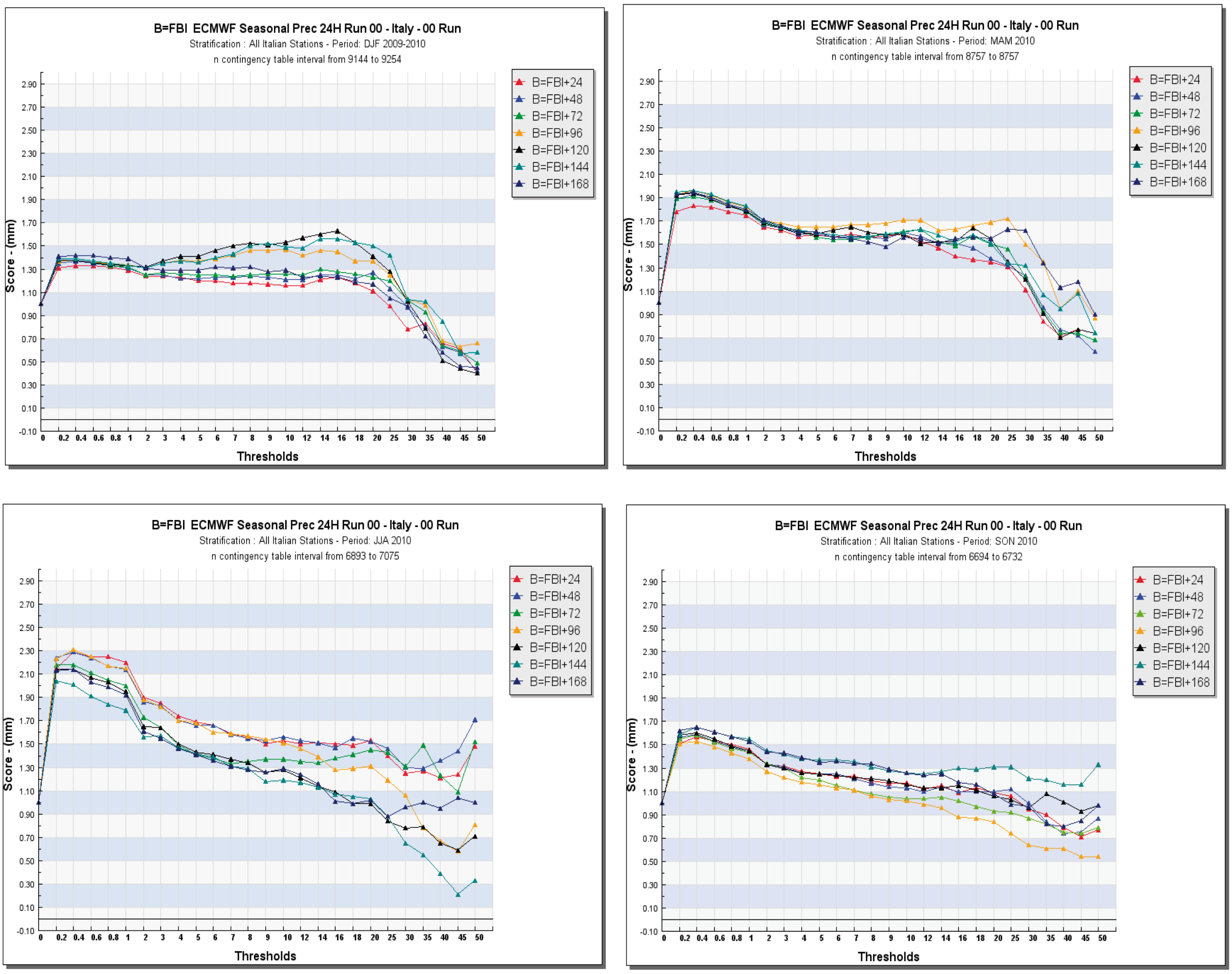
3.2 Subjective verification.

3.2.1 Subjective scores:

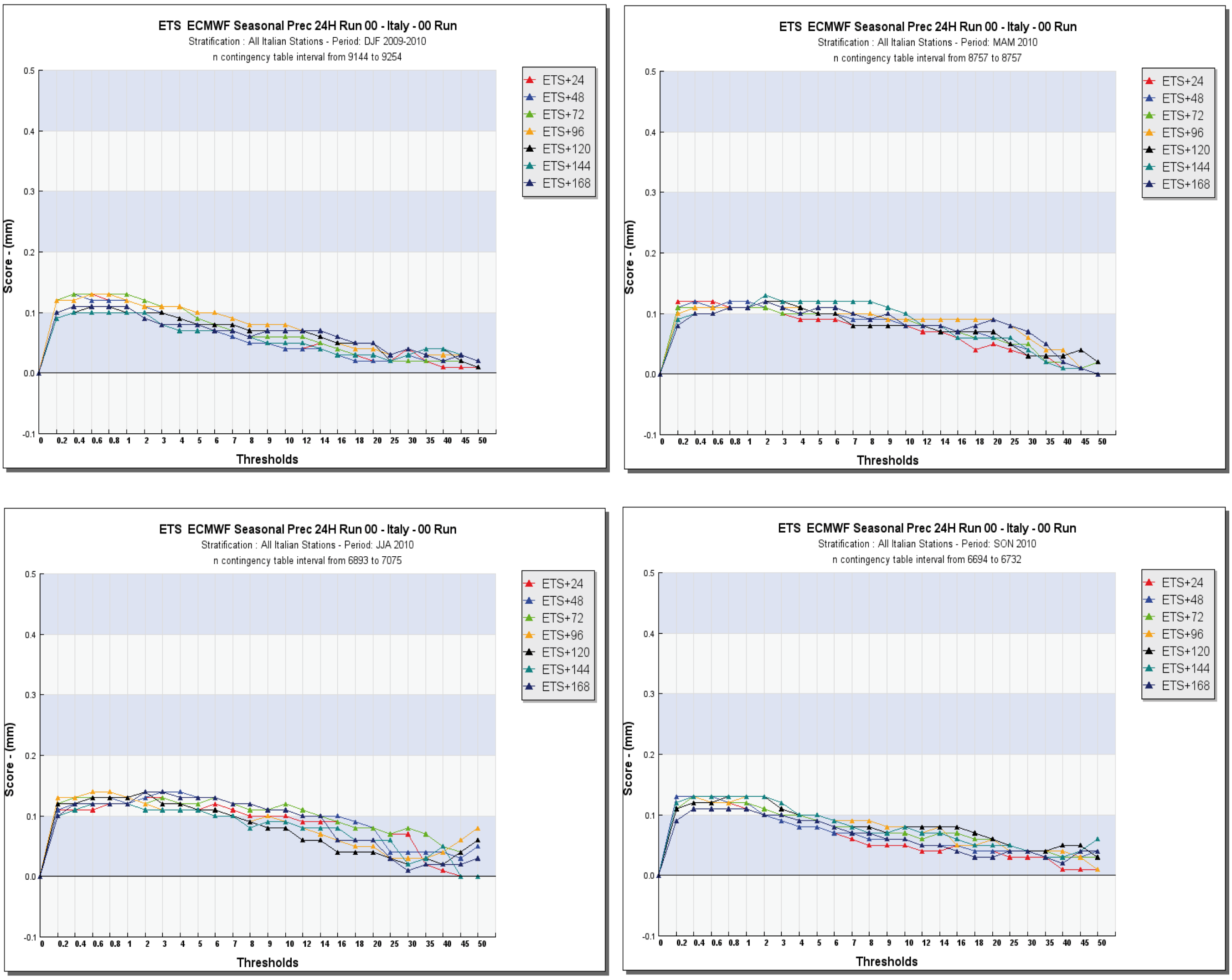
None

3.2.2 Synoptic studies:

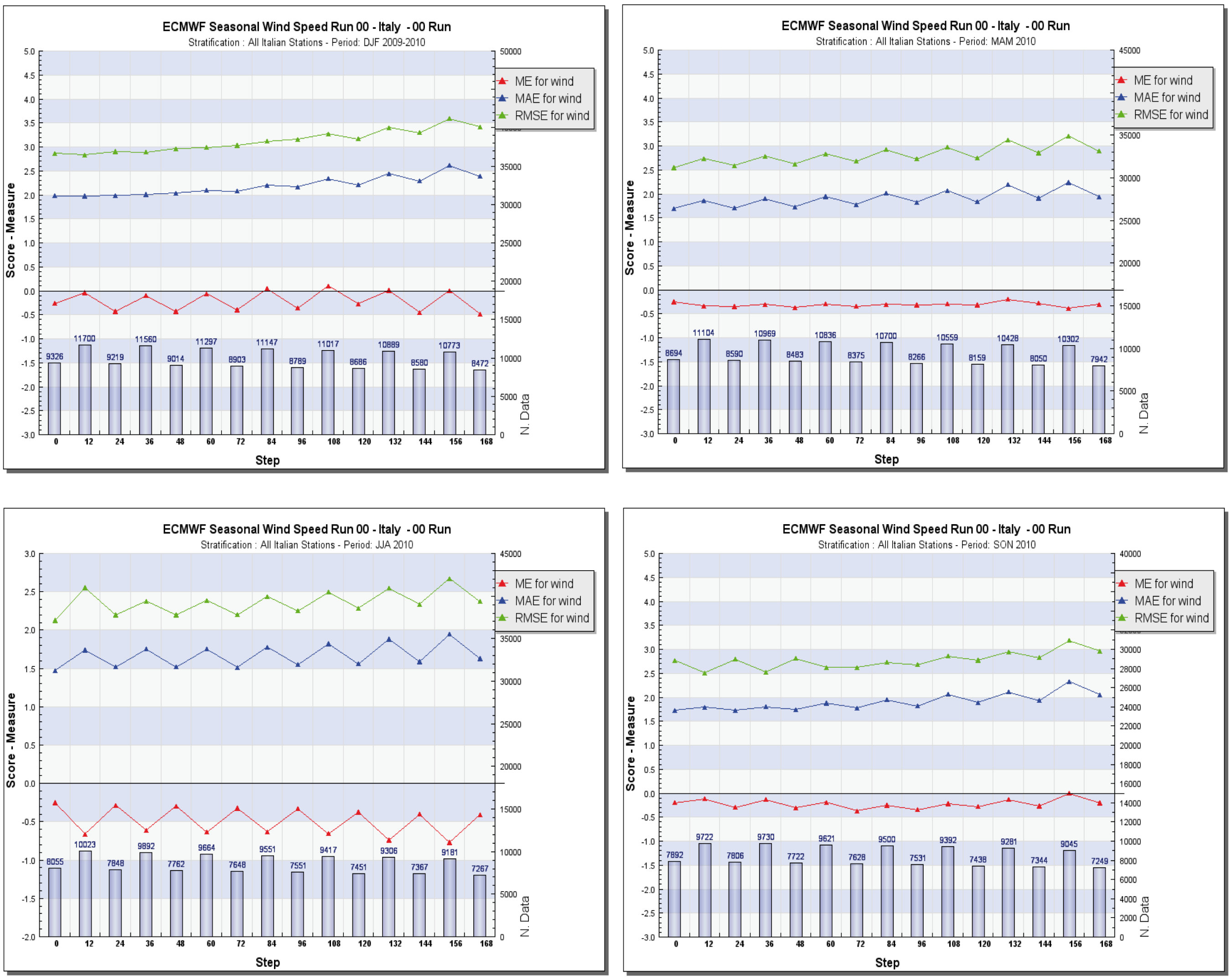
None



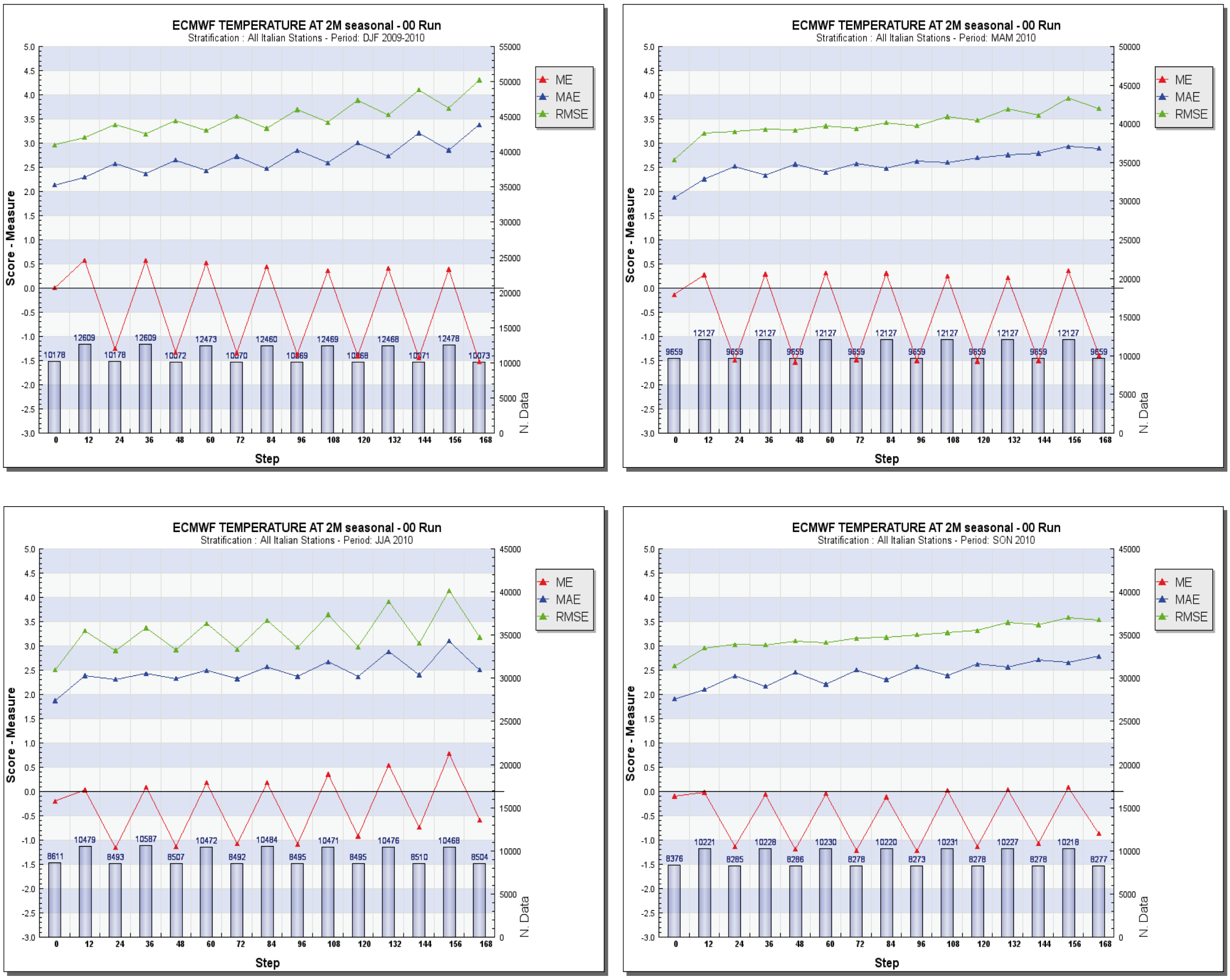
IFS Precipitation in 24 hours - FBI score



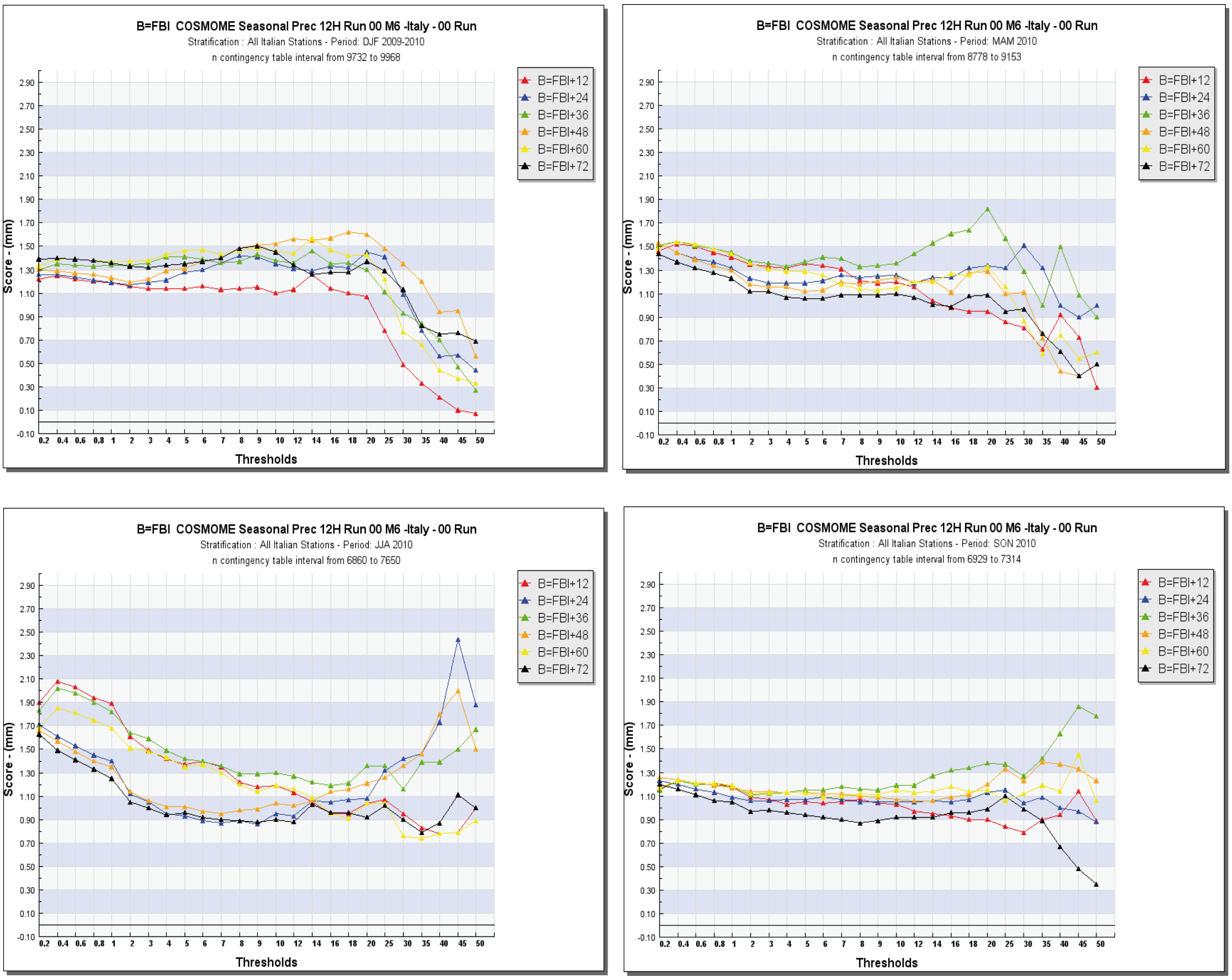
IFS Precipitation in 24 hours - ETS score



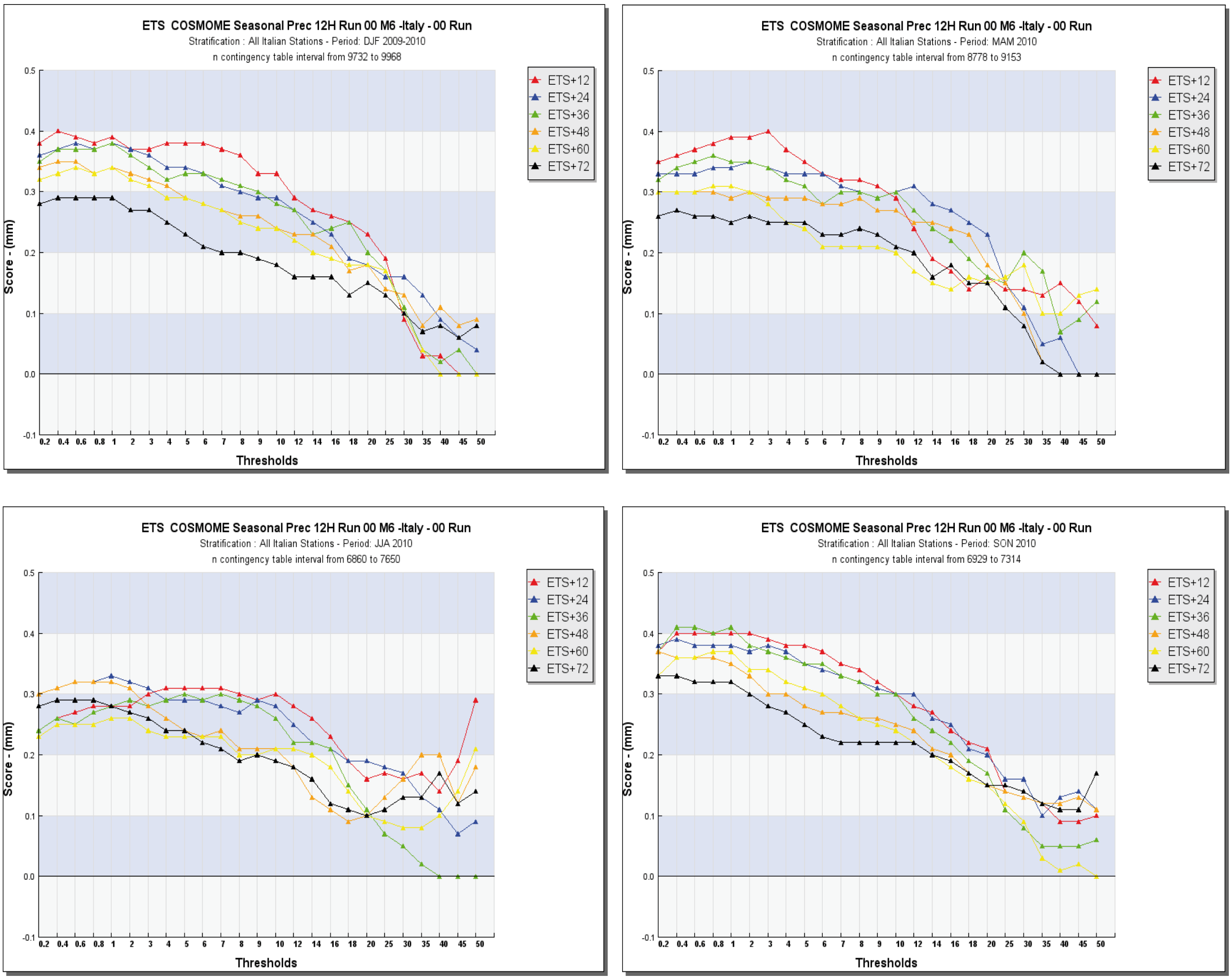
IFS Wind Speed (Mean Absolute Error, Mean Error and Root MSE)



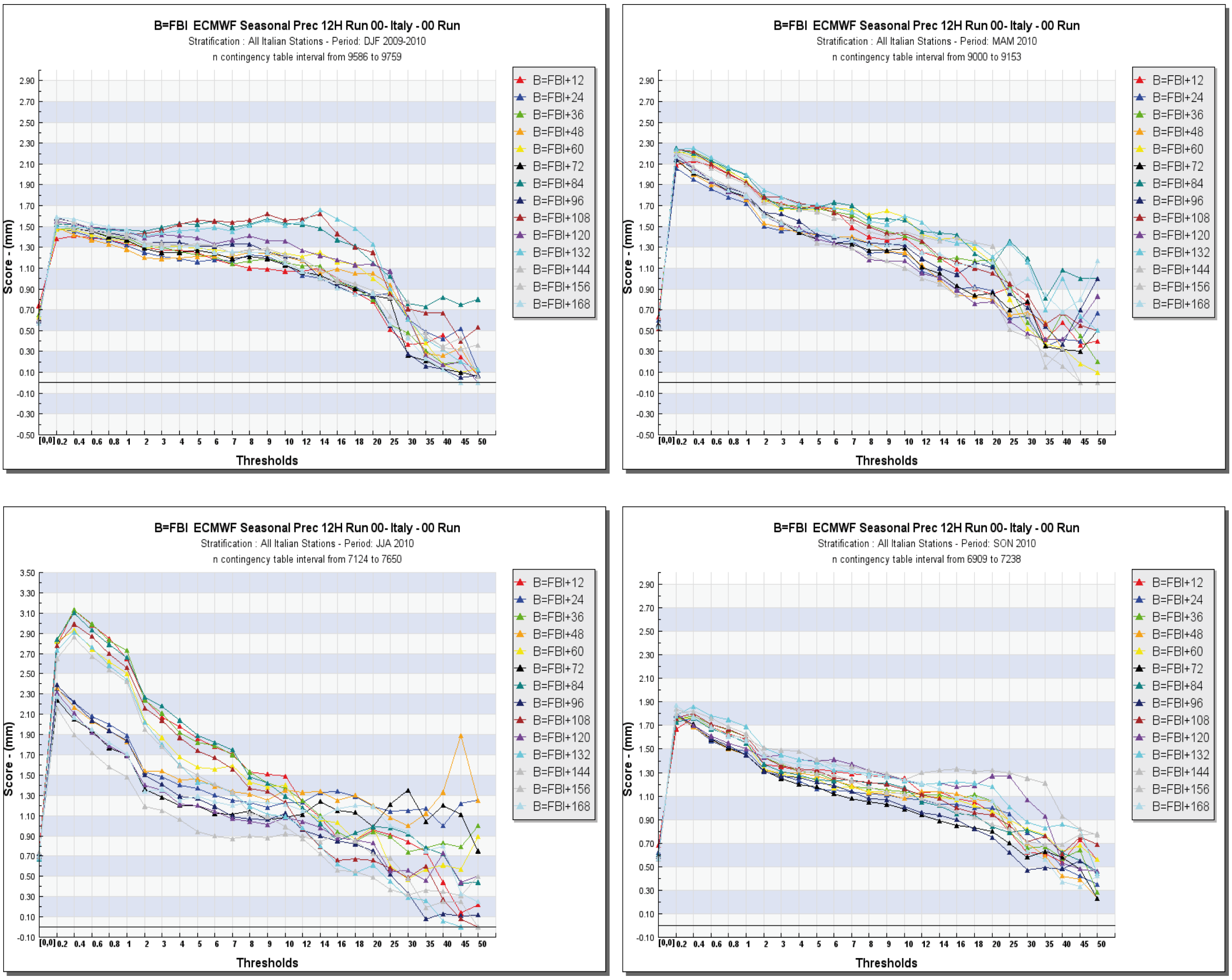
IFS T2m (Mean Absolute Error, Mean Error, Root MSE)



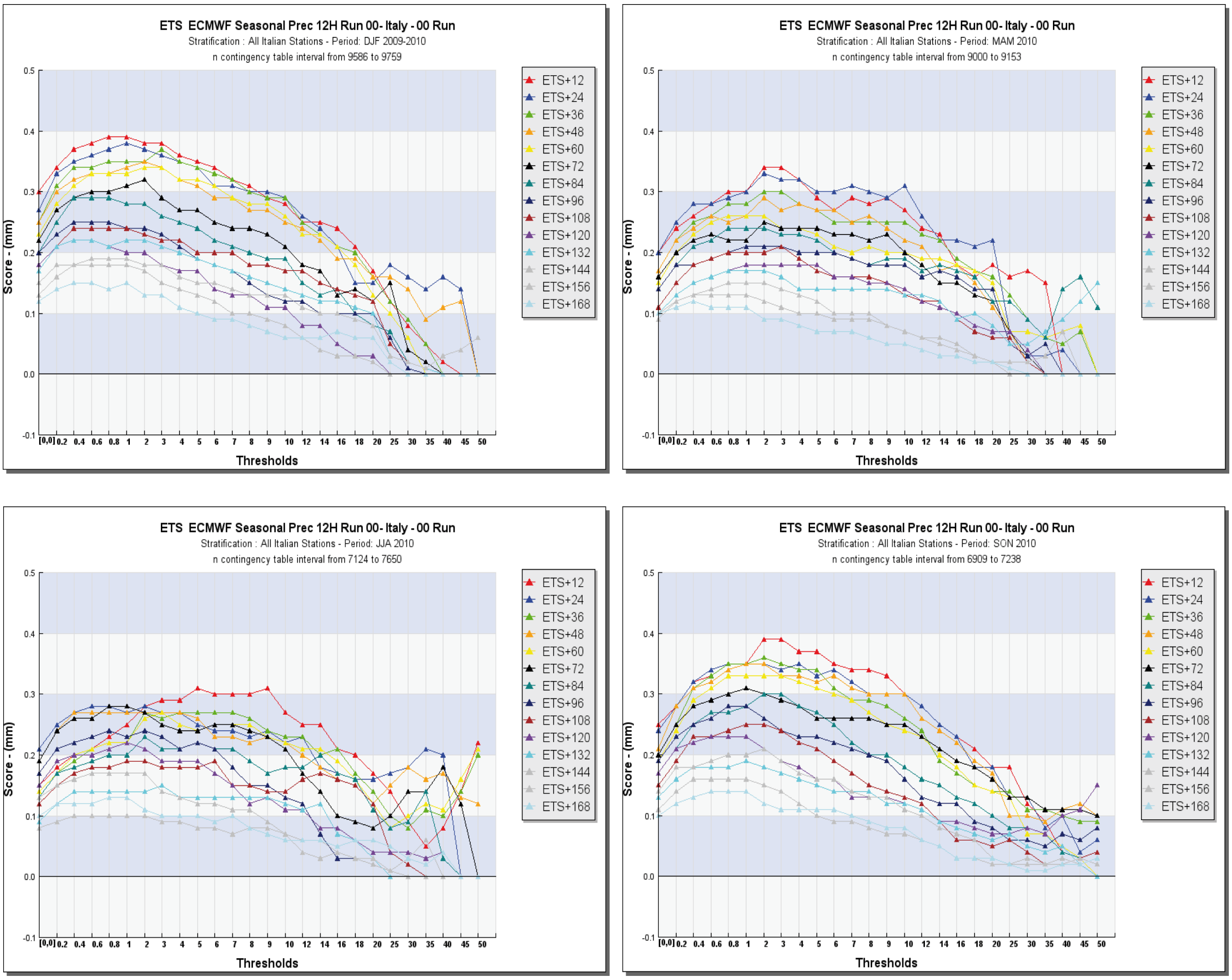
COSMO-ME Precipitation in 12 hours - FBI score



COSMO-ME Precipitation in 12 hours - ETS score



IFS Precipitation in 12 hours - FBI score



IFS Precipitation in 12 hours - ETS score