Application and Verification of ECMWF Products 2007
Centro Nazionale di Meteorologia e Climatologia Aeronautica (CNMCA)

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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 metgrams 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 metgrams are routinely produced over geographical sites within the 80°N-60°S area. At present metgrams are being produced in PNG graphical format and in text mode for medium range metgrams up to T+72H stepping in time every 6 hours and long range metgrams up to T+168H stepping every 12 hours. Metgrams 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);
- windchill;
- 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.

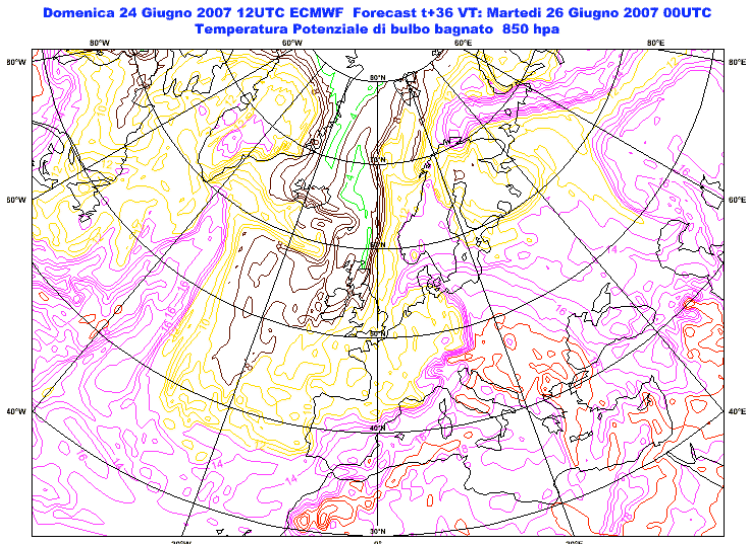
Some outputs from EPS system are carried out directly from ECMWF Ecgate server using "ad hoc" built applications and Metview batch procedures. In particular the following maps are created:

- 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 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. A primary map showing the equivalent temperature is reported.



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).

3. Verification of products

3.1 Objective verification

3.1.1 Direct ECMWF model output

(i) in the free atmosphere

Some basic (MA, MAE) verifications for free atmosphere parameters (e.g wind, Temp, RH and geopotential at standard pressure level) compared with CNMCA LAMs, 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. Graphical visualizations 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 2005/06 to SON 2006 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.

To compute the score no interpolation from grid point to observation location is performed and the "nearest point" method is used. The software used for verification products is called Common Verification Suite (CVS) developed at CNMCA and used as a common tool inside COSMO community.

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 higher ones. In winter, FBI score is around 1 for thresholds between 5 mm and 20 mm. It is worthwhile to note that for 10 mm threshold FBI is around 1 for all the seasons. About the accuracy (ETS), winter and autumn show the best results (precipitation due mainly to synoptic perturbations). All the thresholds show a decrease in accuracy with integration time.

2m Temperature: clear diurnal cycle in both ME and MAE. In summer and in autumn it is clear a general underestimation; in winter the daytime Temp ME is around 0°C, while during nigh time is around -0,5°C. In spring a more evident oscillation around 0°C can be found. MAE is mainly between 2 and 2,5 °C with a decrease in accuracy (higher MAE values) with integration time.

10m Wind Speed: Clear diurnal cycle for all the seasons for ME and MAE (except for winter). A general underestimation is shown with minimum value during daytime. MAE, around 2-2,5 m/s in winter and between 1,5-2 m/s for the other seasons, tends to increase with forecast time.

3.1.2 ECMWF model output compared to other NWP models used at CNMCA

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-I7, 7 km of resolution (old name LAMI in the plots) for d+1, d+2 ranges. These scores are shown in the next pages on Italian global area and for winter and autumn to take in account only large precipitation events.

Accuracies of the two models are comparable, with small higher values in ETS score for ECMWF (but no upscaling is performed on COSMO-I7 model).

About FBI scores, ECMWF shows a better distribution than COSMO-I7 in winter, when Italian model tends to overestimate for all the thresholds. In autumn lower and higher thresholds are better represented by Italian model, while 5 and 10 mm show almost no bias in ECMWF plots.

3.1.3 Post processed products.

Metgrams, AWI, Trajectories, Sounding Forecast

3.1.4 End products delivered to users.

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

3.2 Subjective verification.

3.2.1 Subjective scores: none

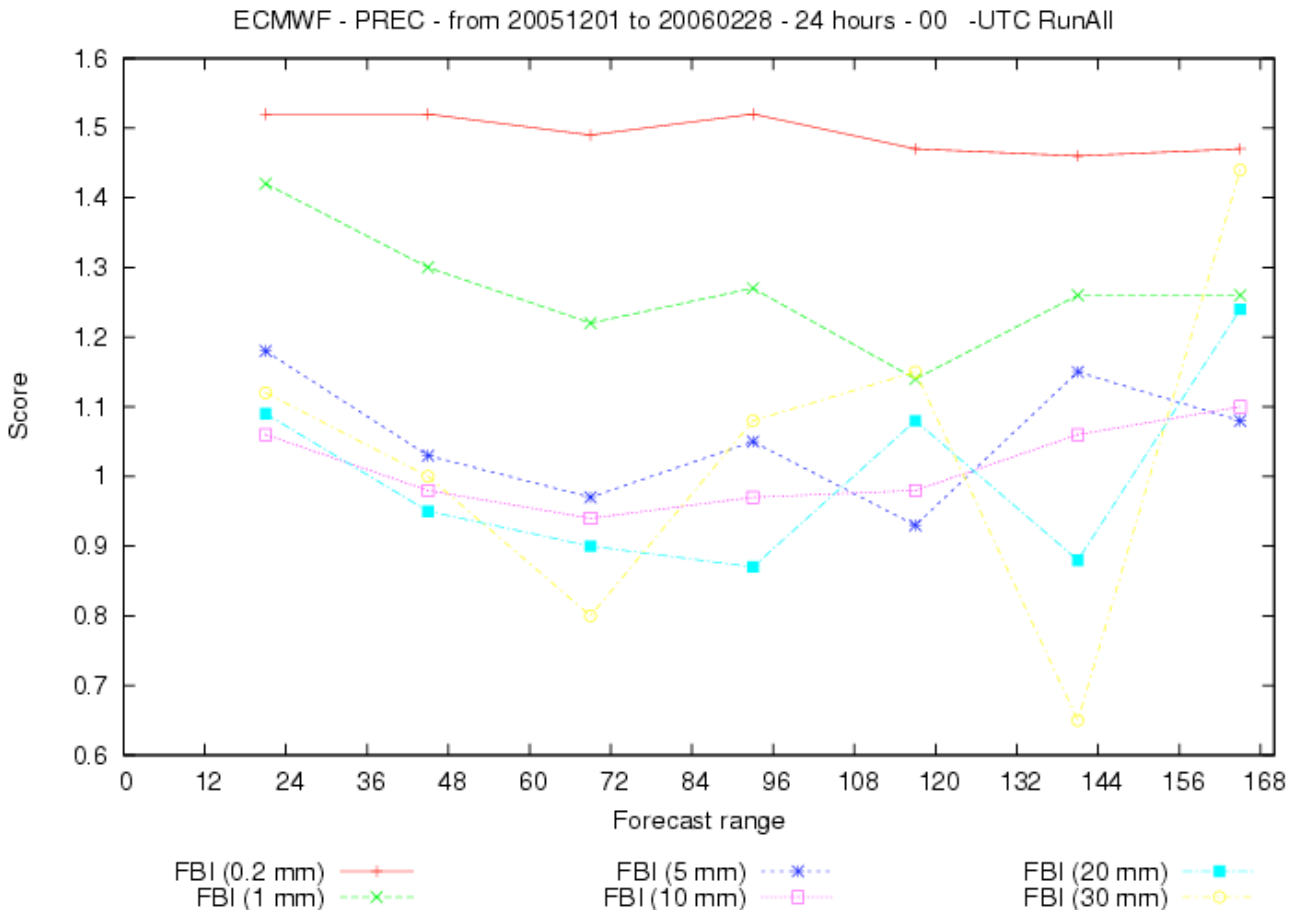
3.2.2 Synoptic studies

During 2006, no special hazardous events over great areas has been noticed in Italy, whose prediction can be considered like short or medium range; in fact nor considerable temperature increase, regarding intensity and duration identified as Heat Wave has been observed nor floods triggered by heavy and persistent precipitations.

Nevertheless, two flash floods with intense wind gust and precipitation have to be mentioned: the first one, taken place the 26th of June in the Po Valley, described as "rotating storm" and the second one, on the 3th of July in Lametia, southern part of Calabria, caused by a "supercell". The range of predictability of these events have to be considered as typical nowcasting, being their origin as convective; however, the respective short range precipitation fields of ECMWF model indicated a spread signal of rains and underestimated values if compared with the observations.

In the end, from an operative point of view, concerning issuing of alerts warning, the EFI fields are always tested, proving the goodness of probabilistic values regarding parameters with synoptic features but also a few cases of mesoscale events like the wind.

4. References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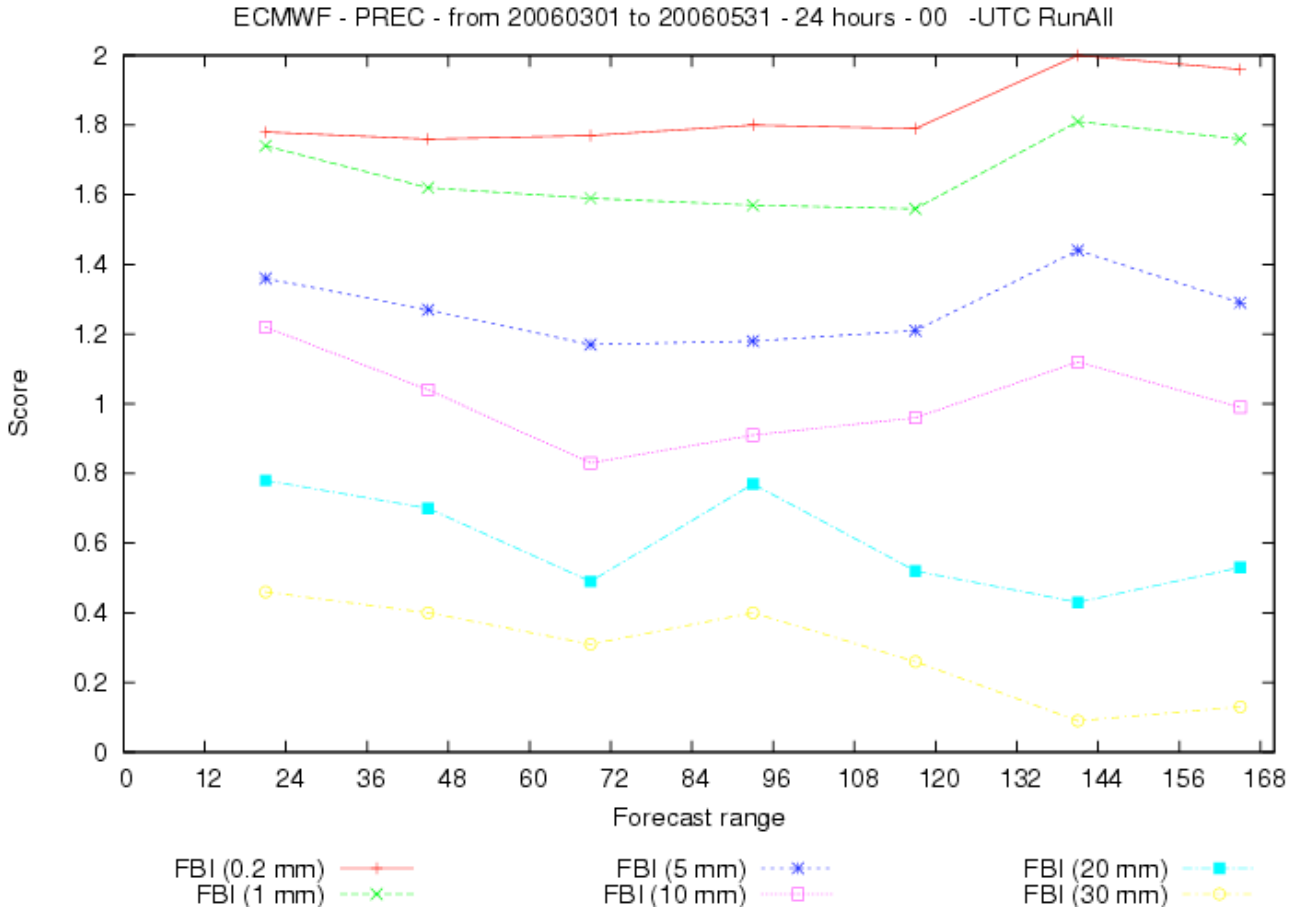
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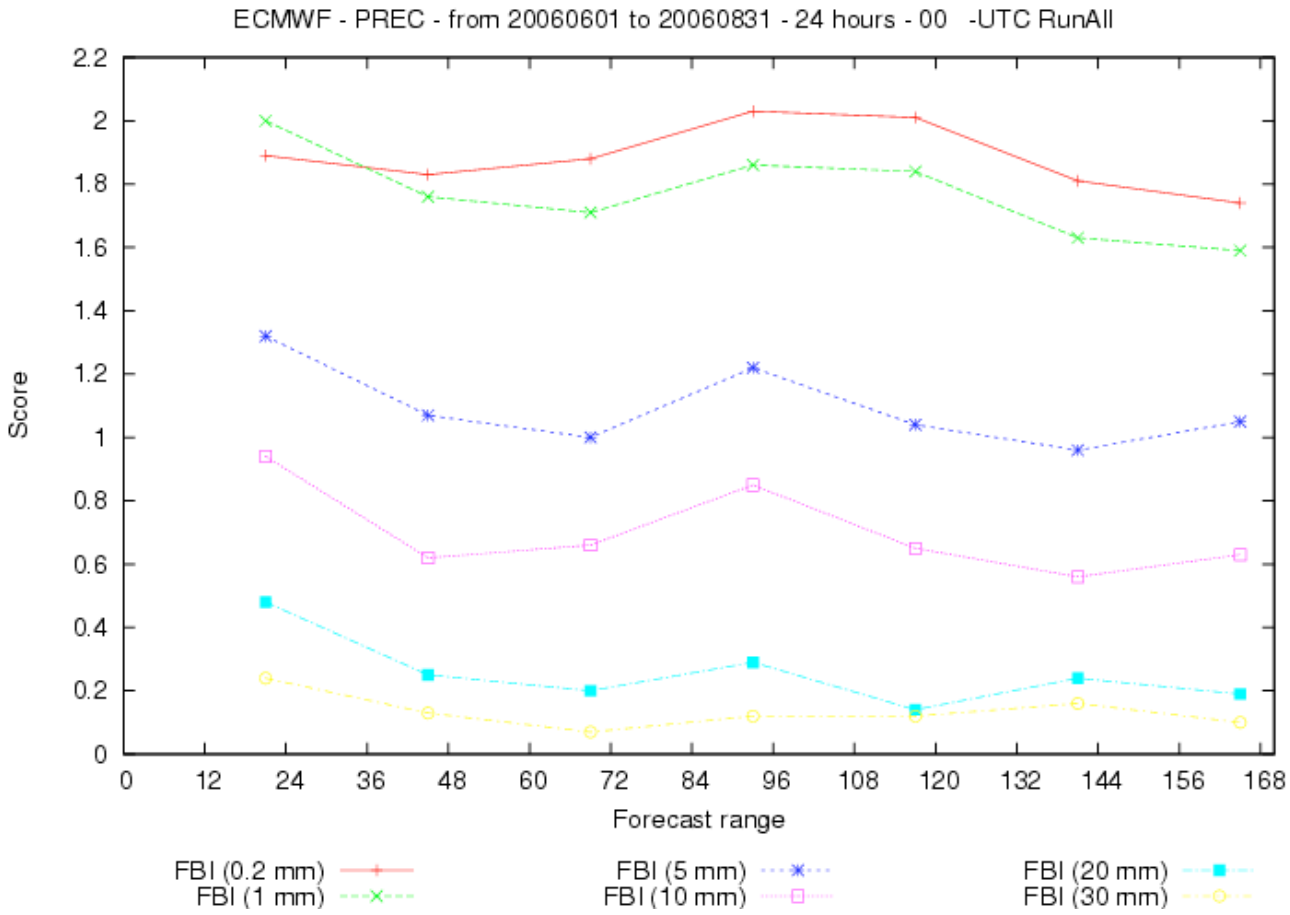
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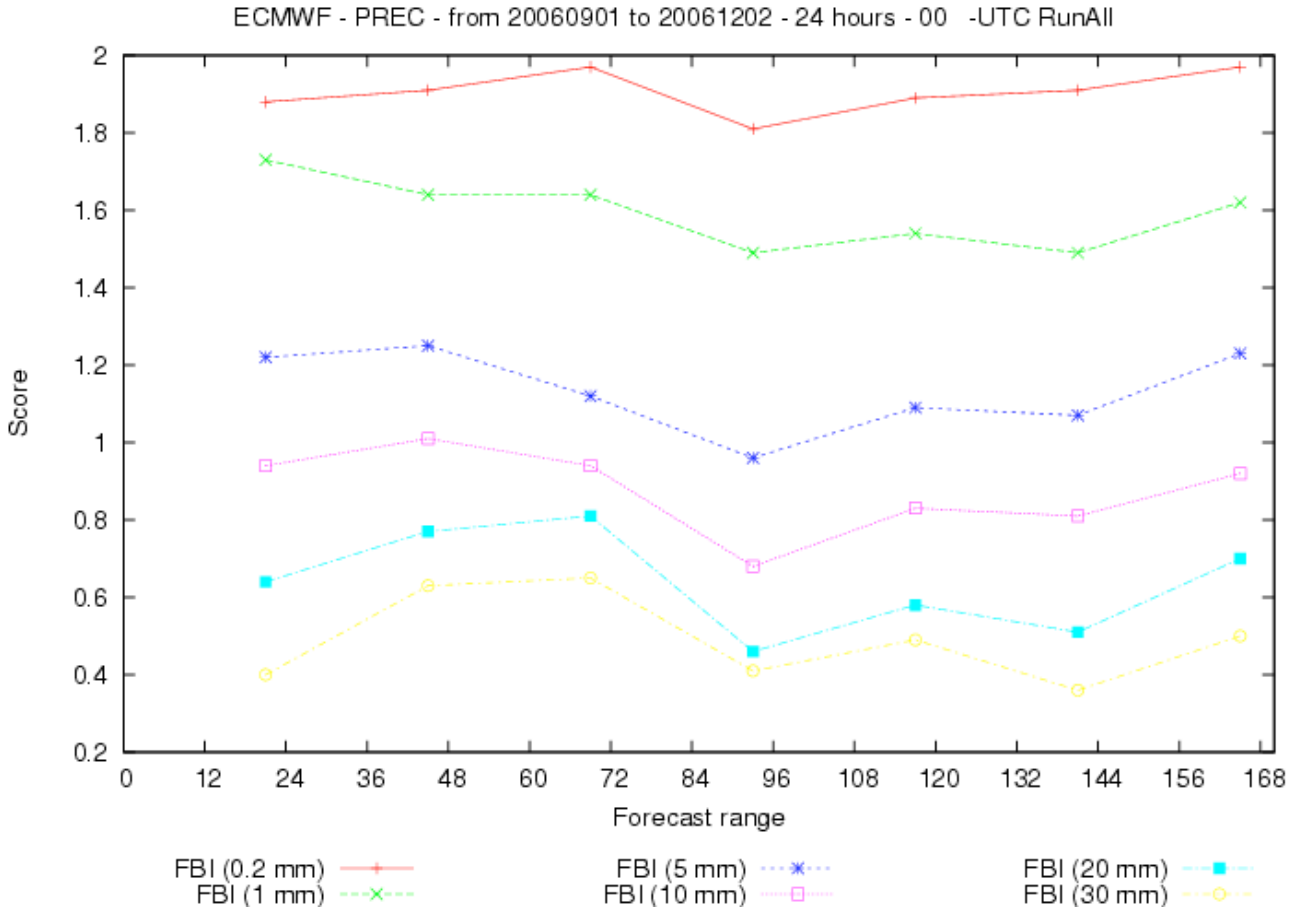
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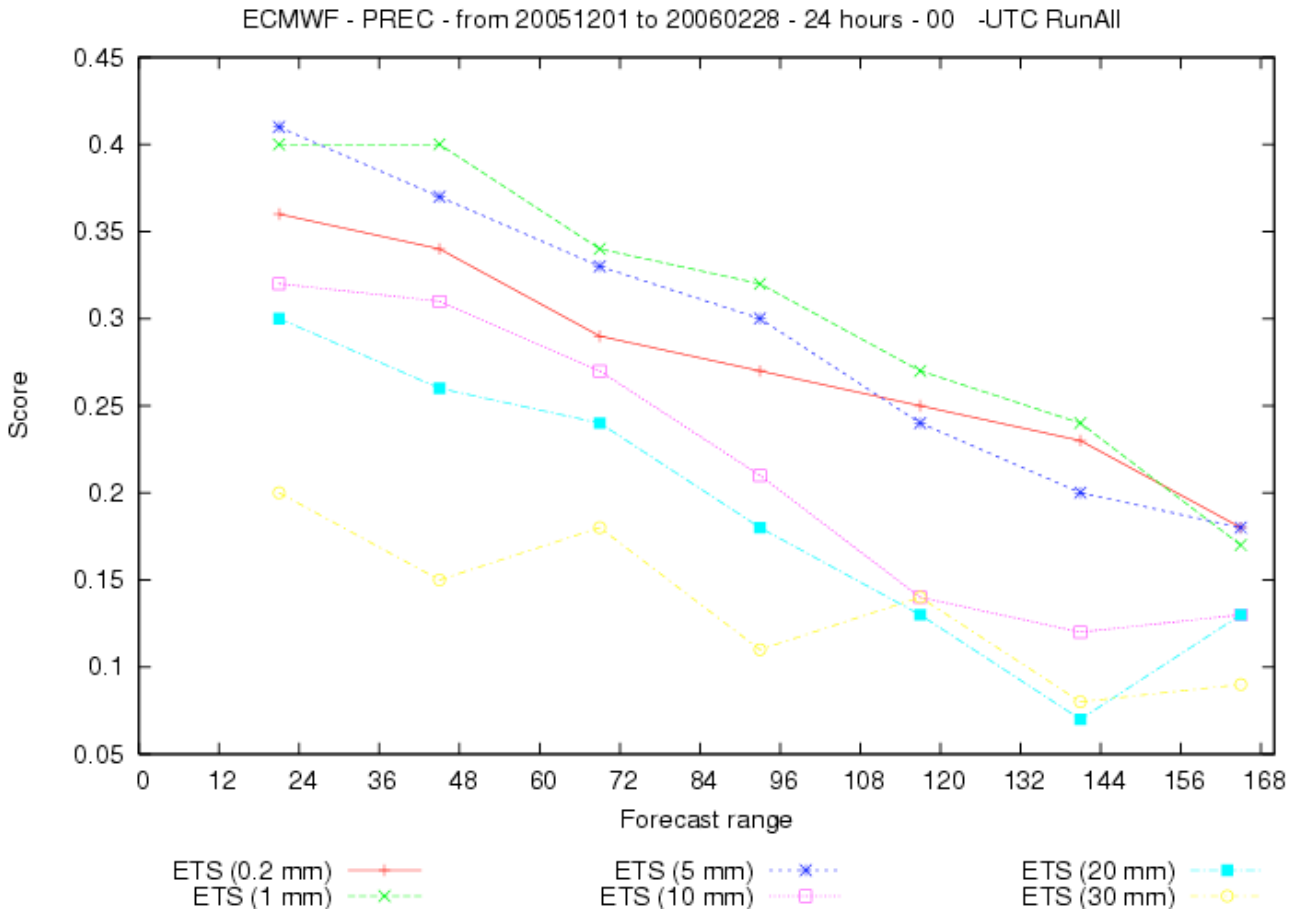
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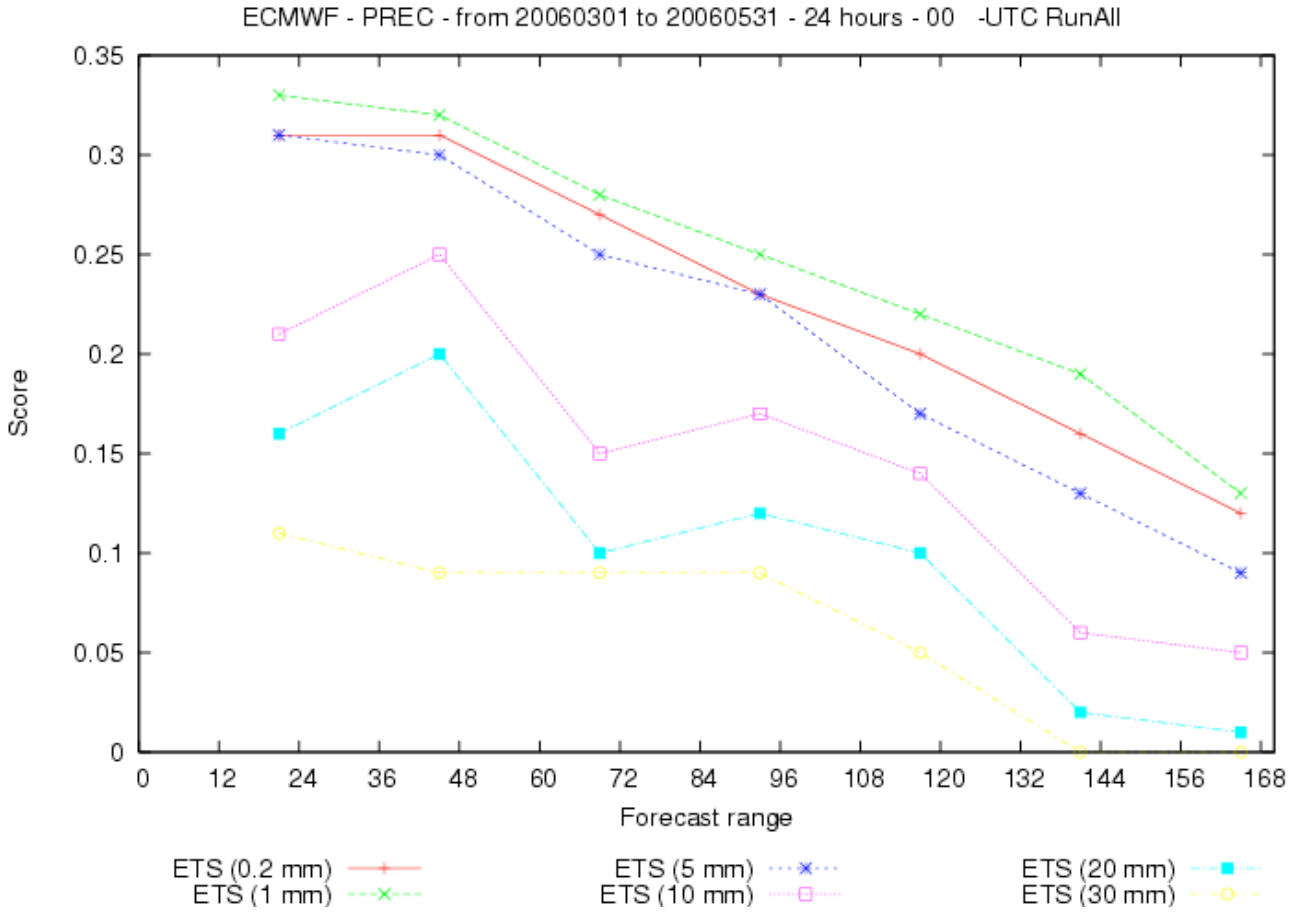
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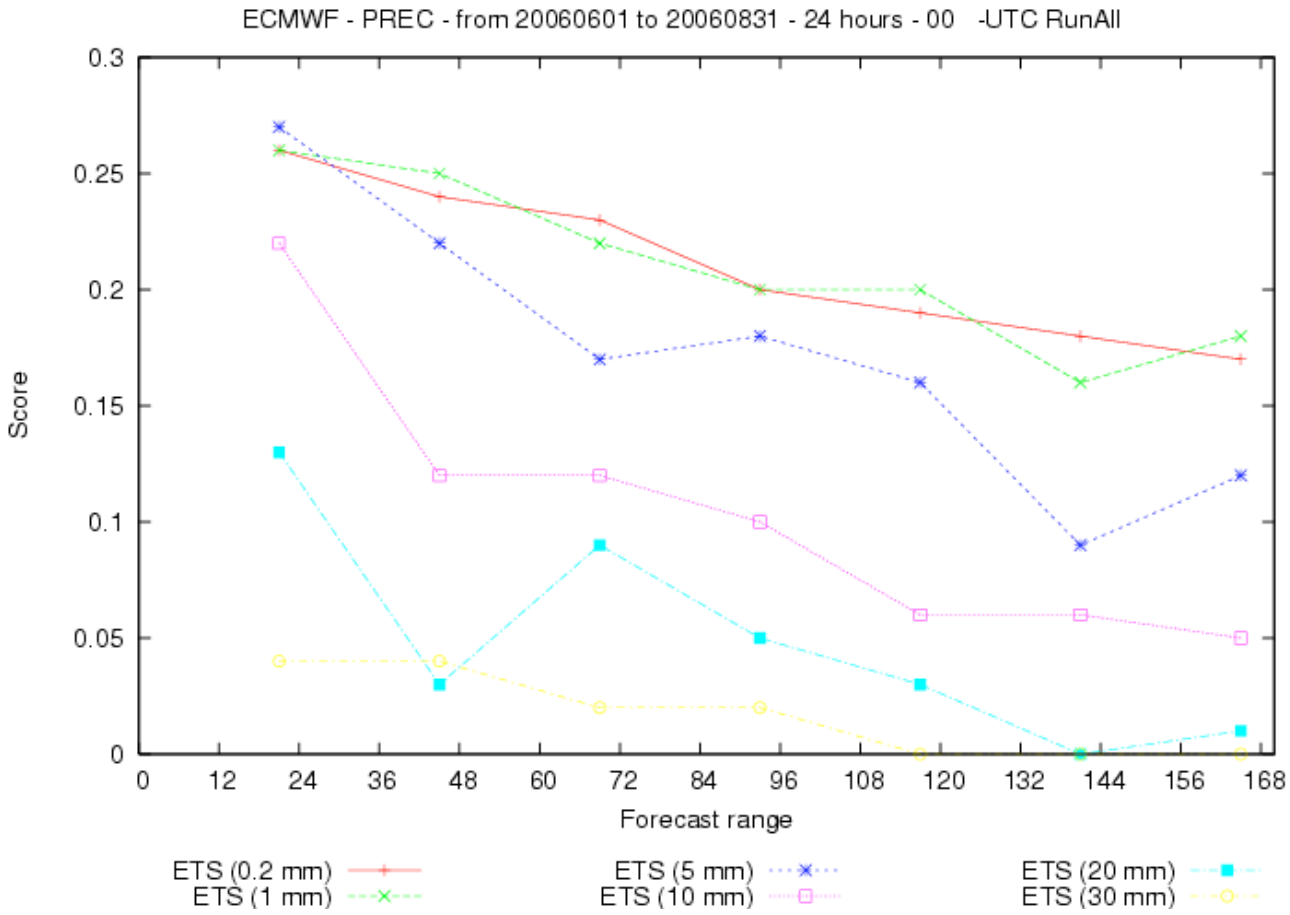
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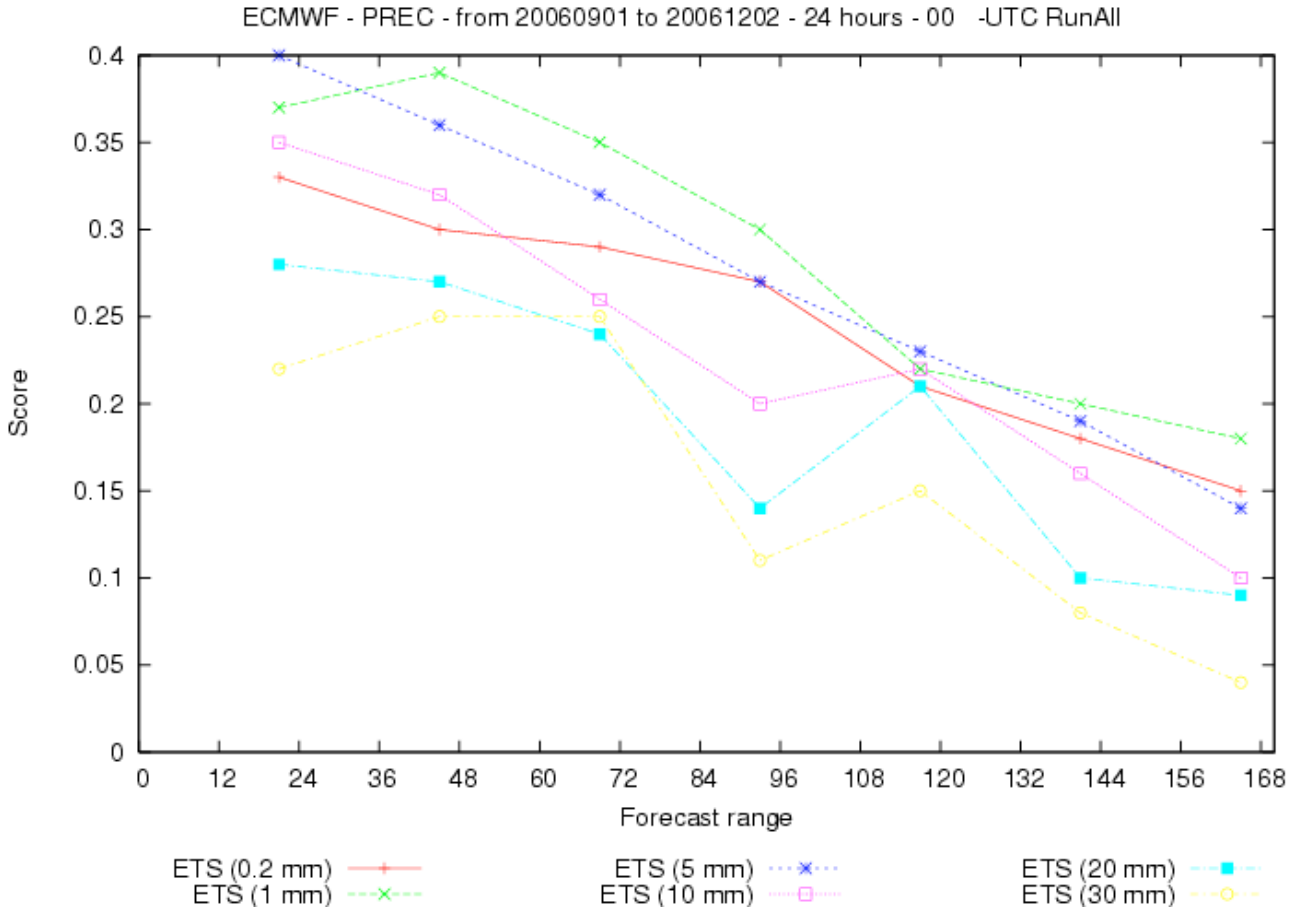
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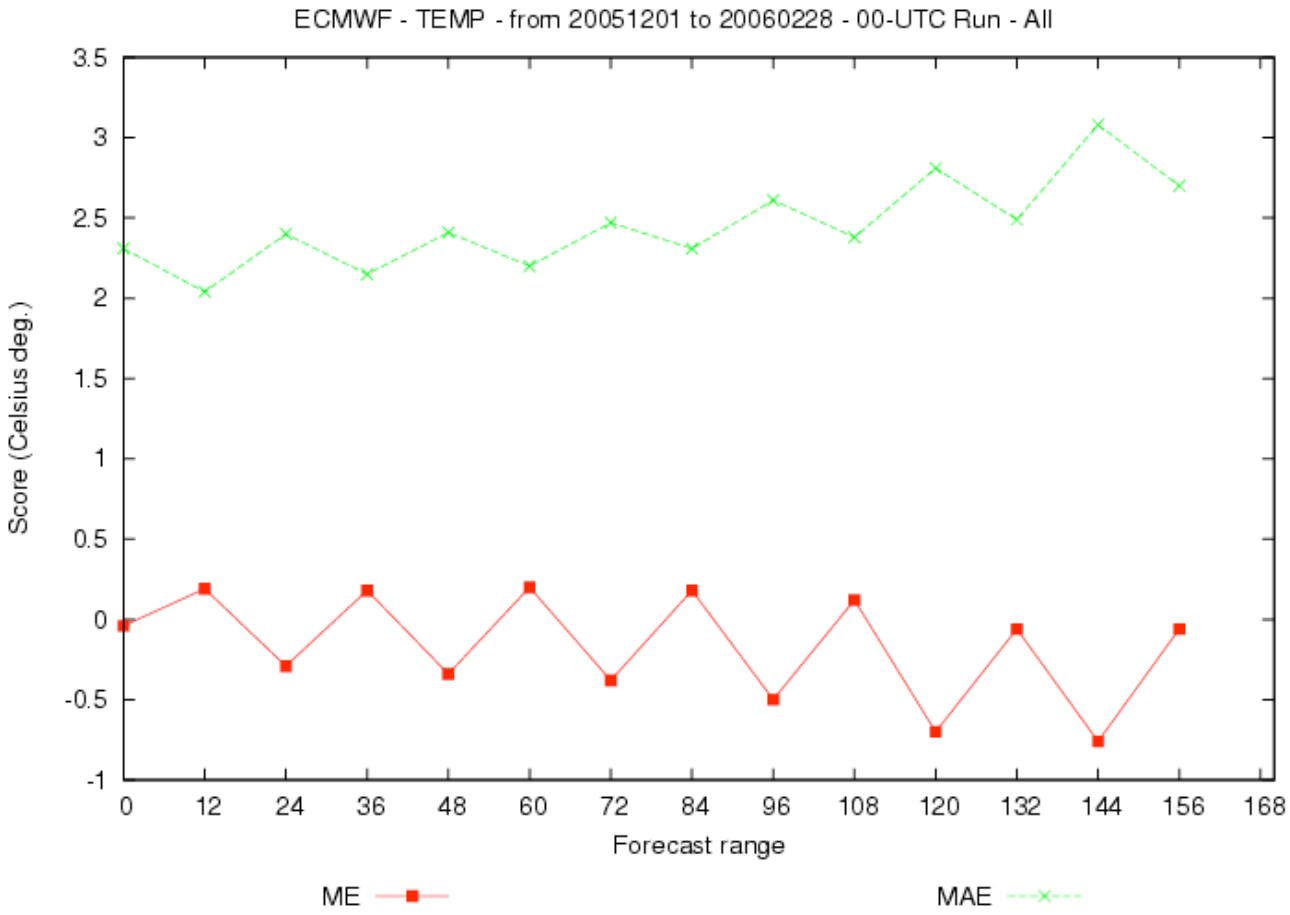
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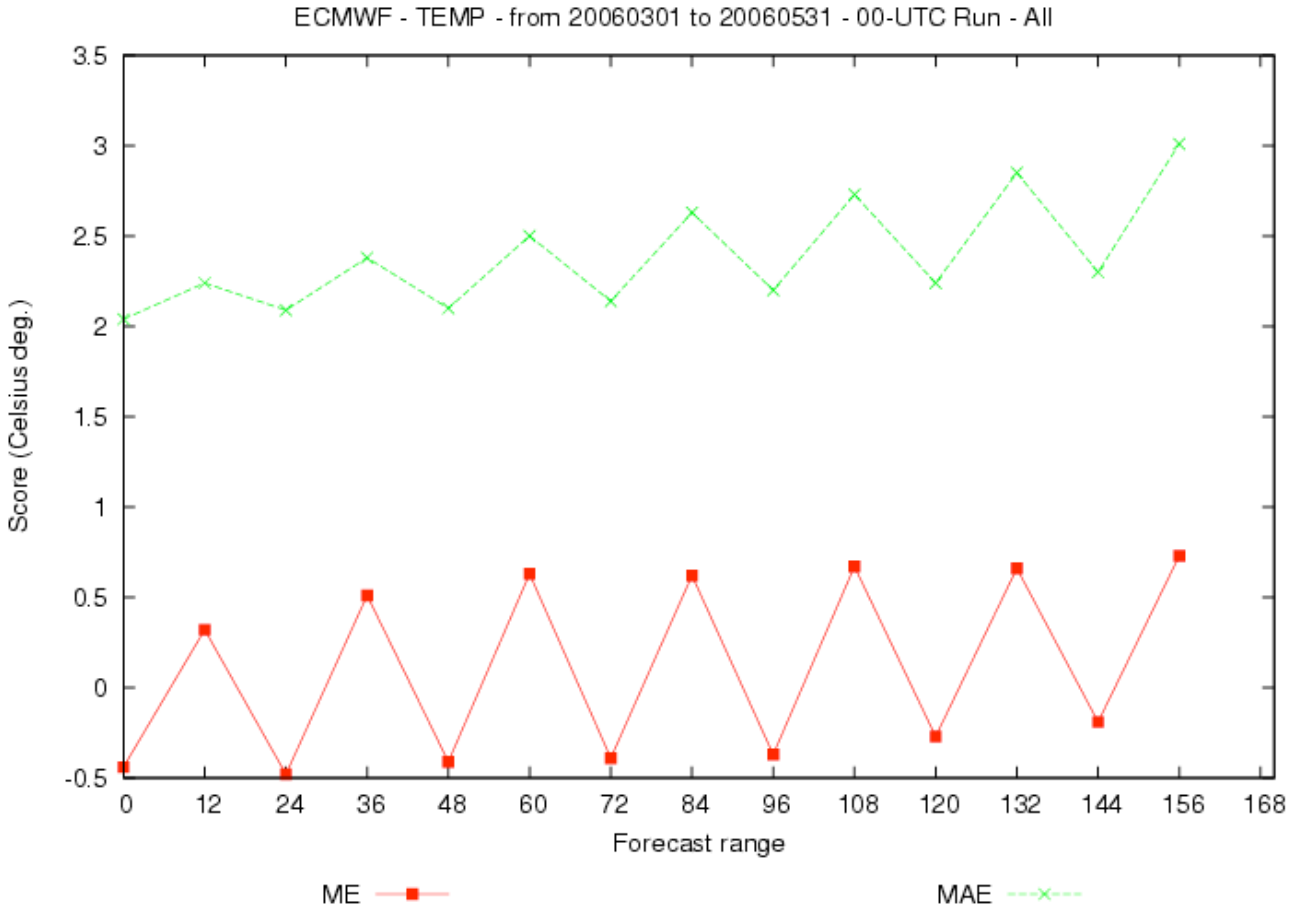
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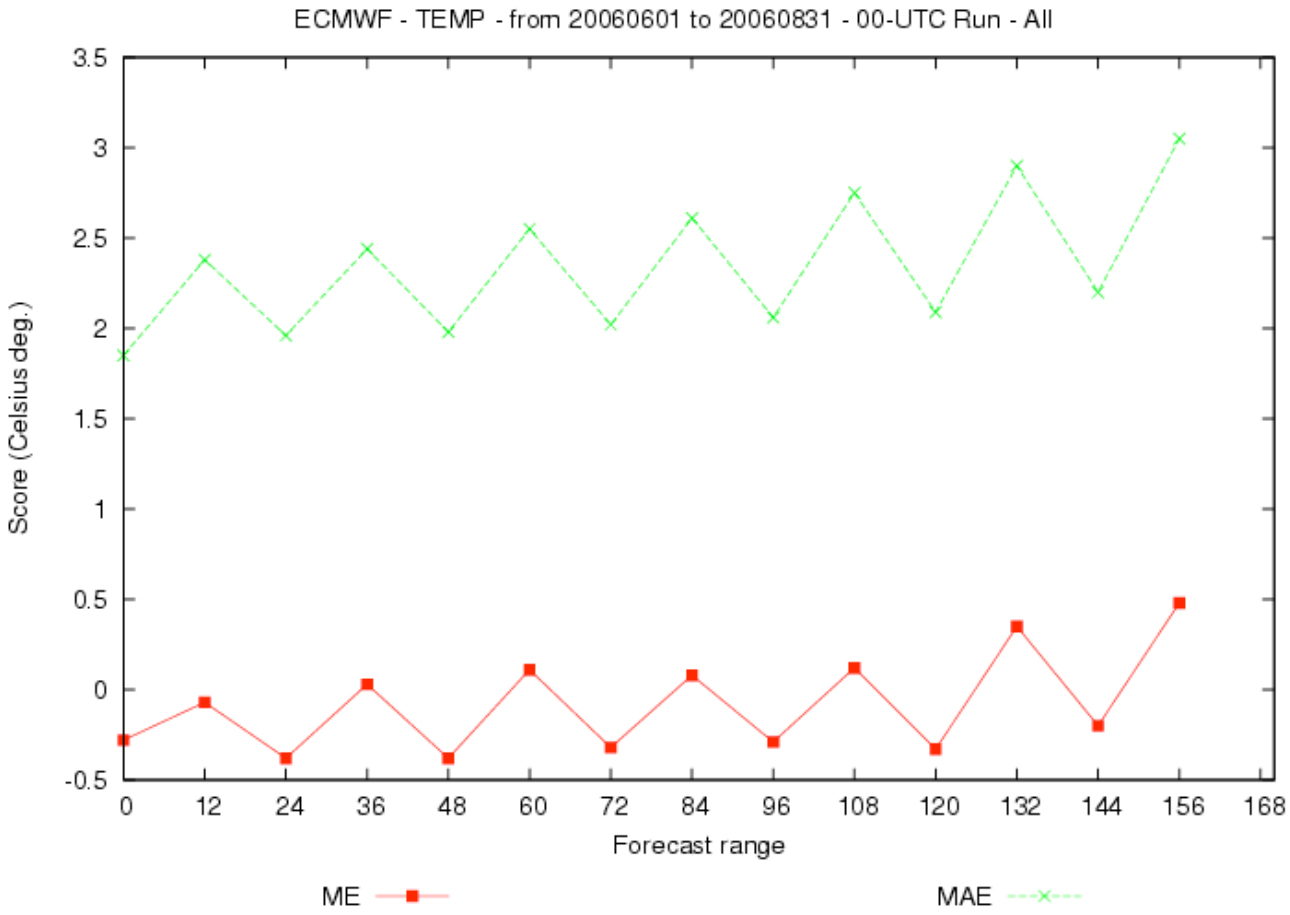
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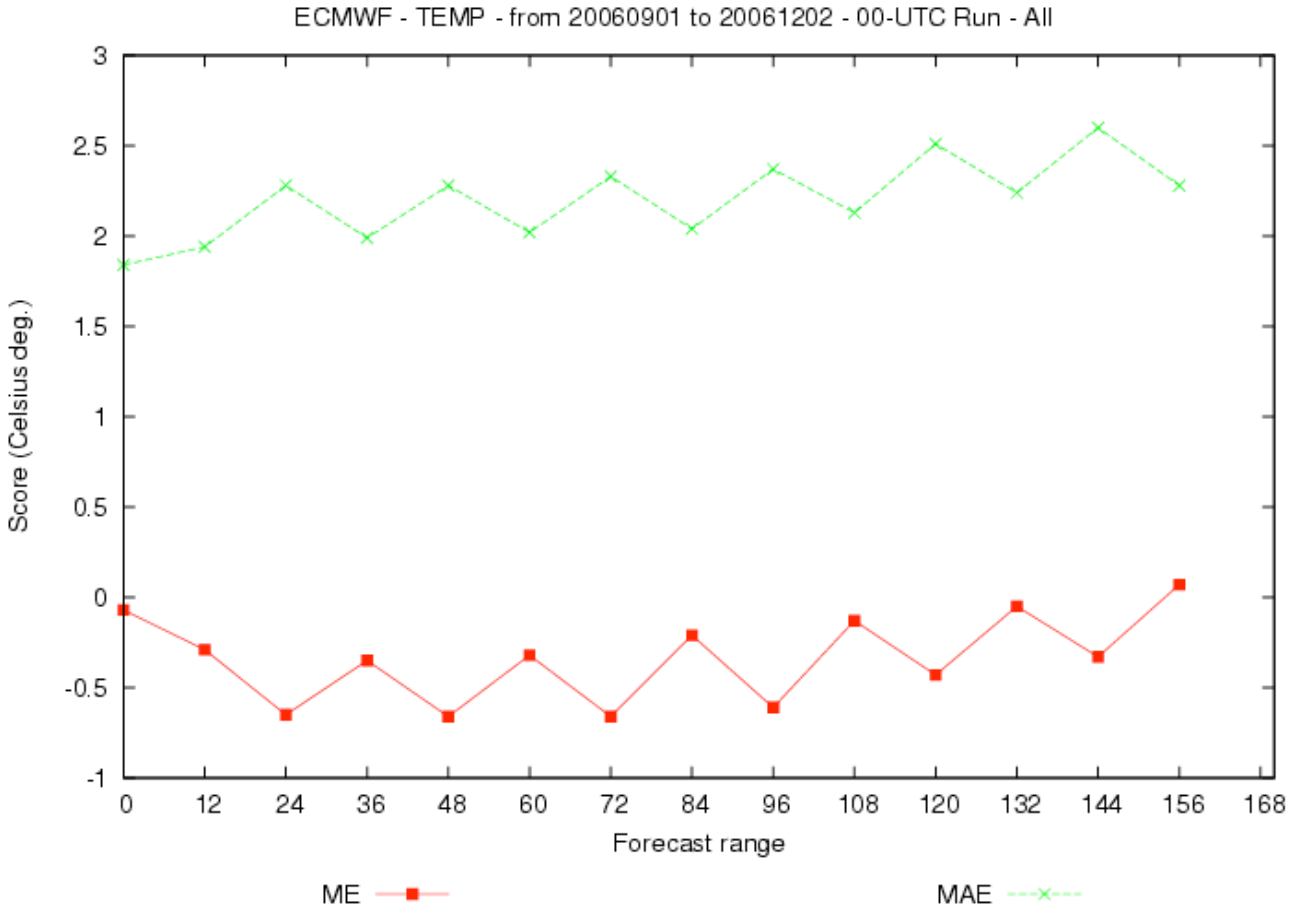
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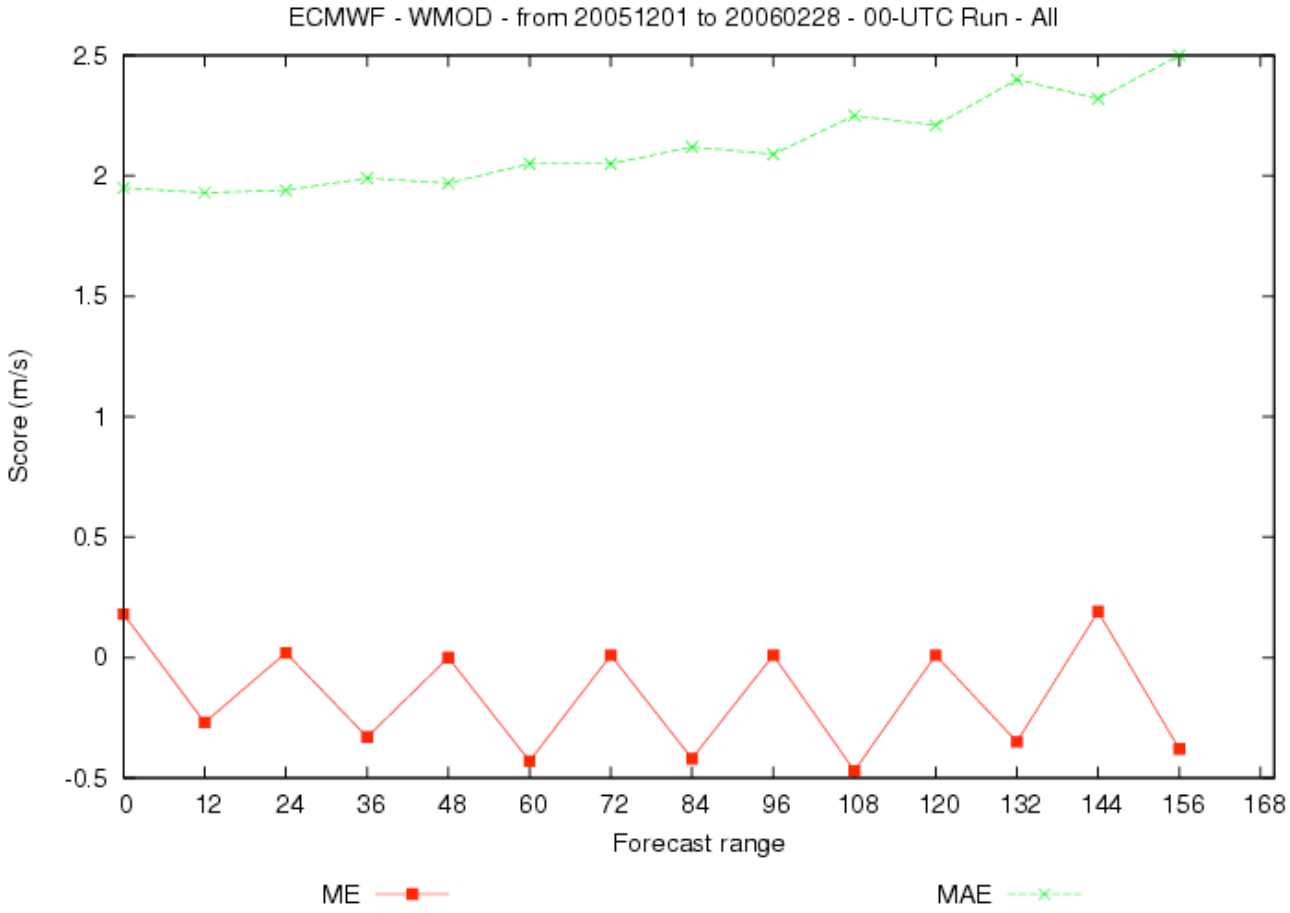
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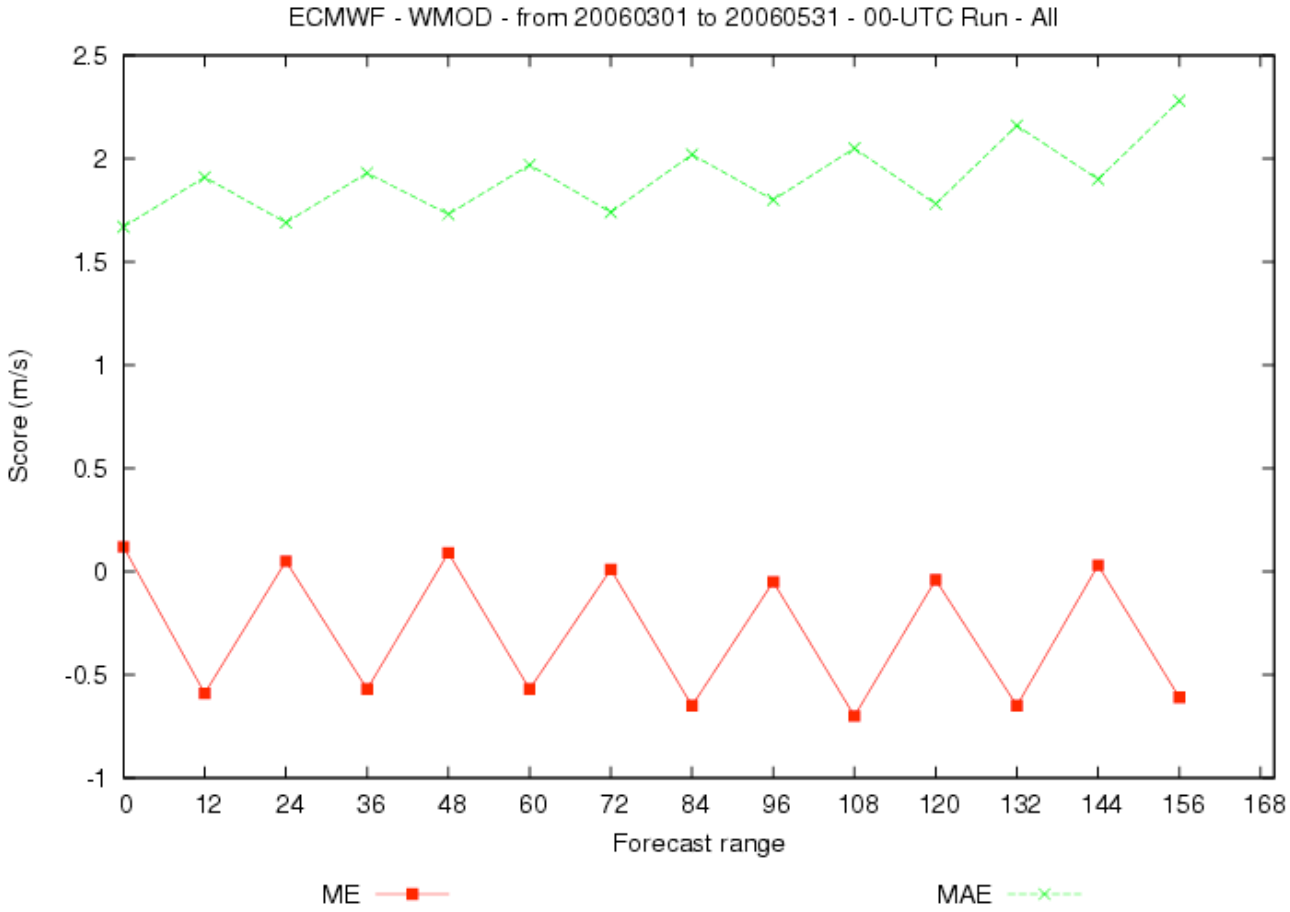
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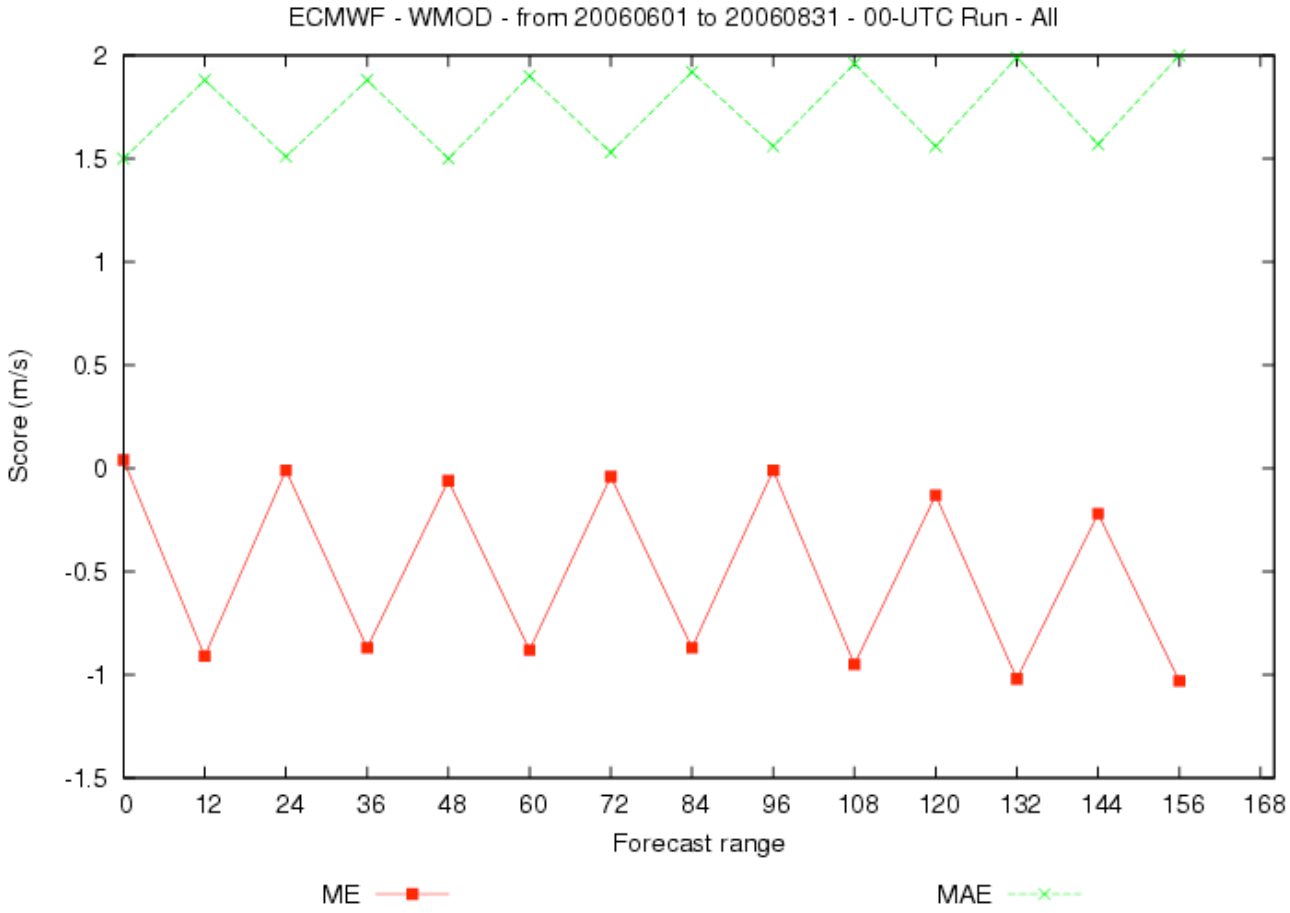
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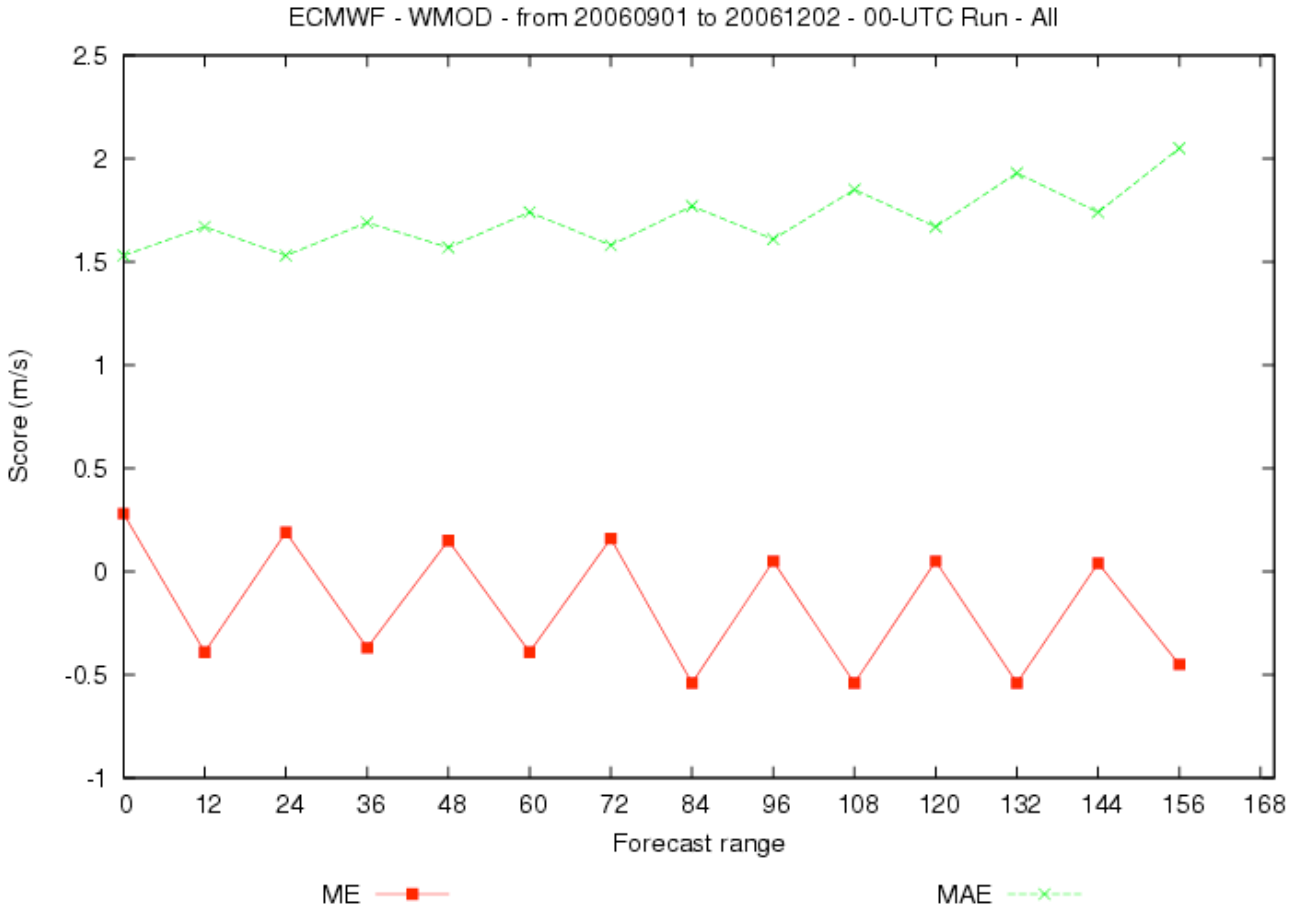
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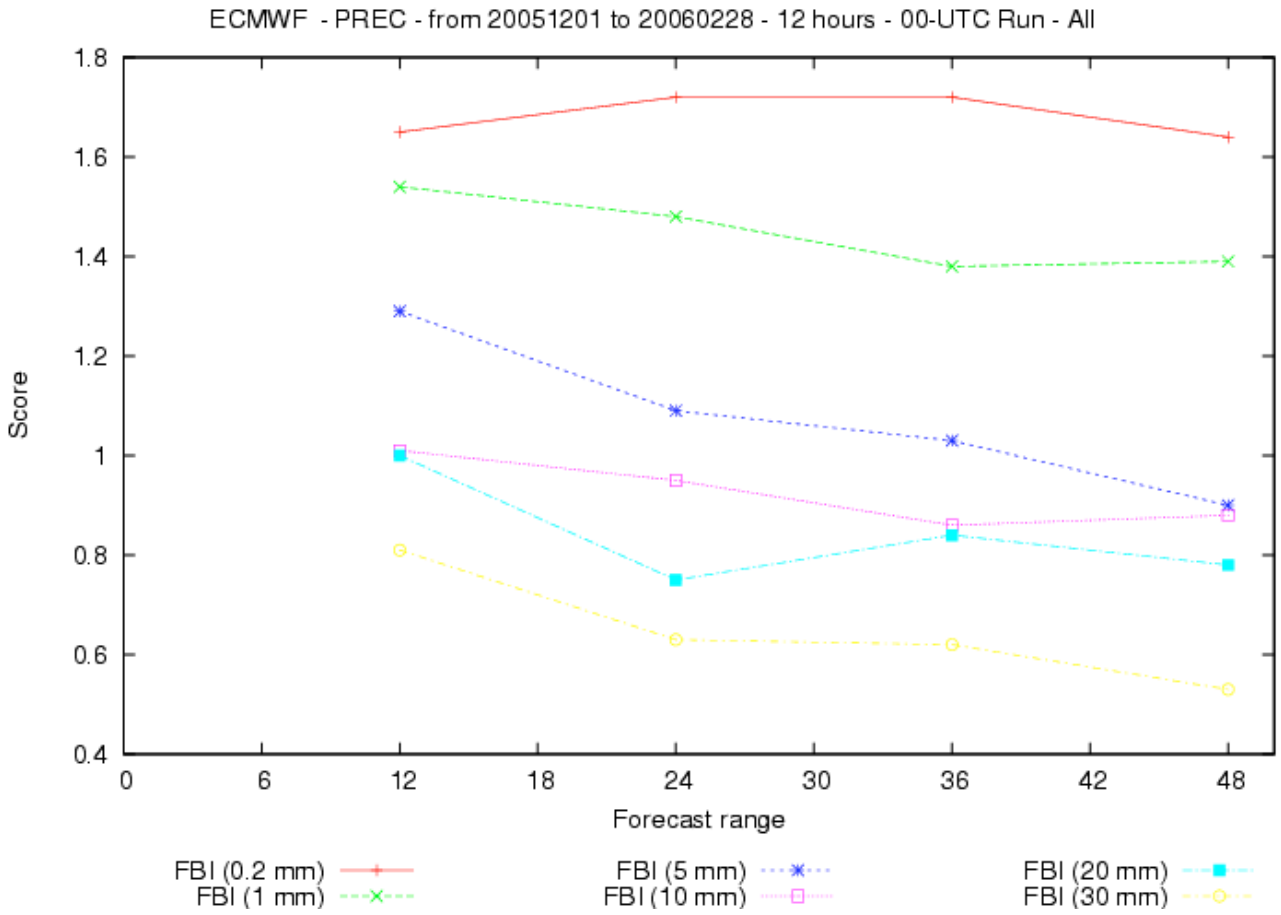
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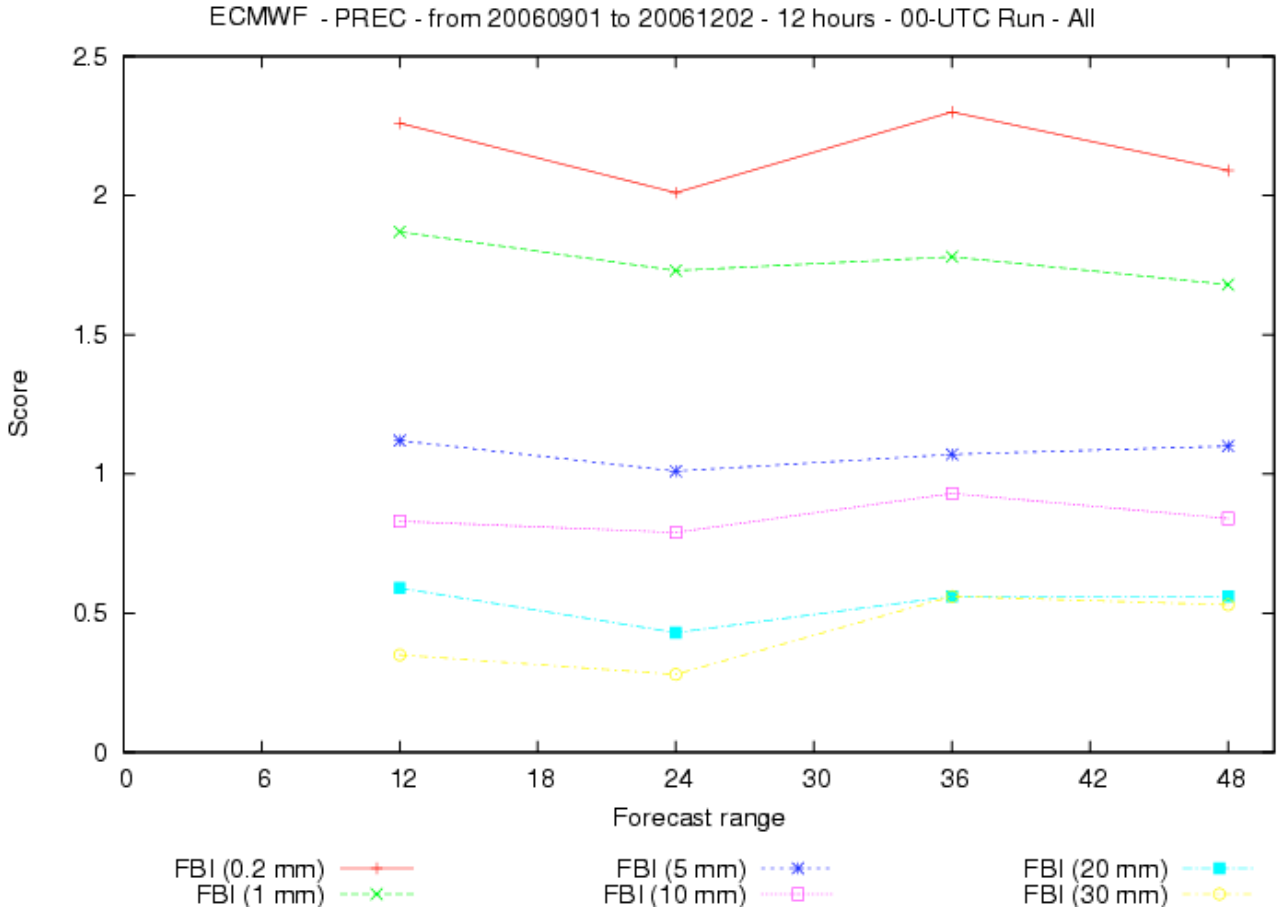
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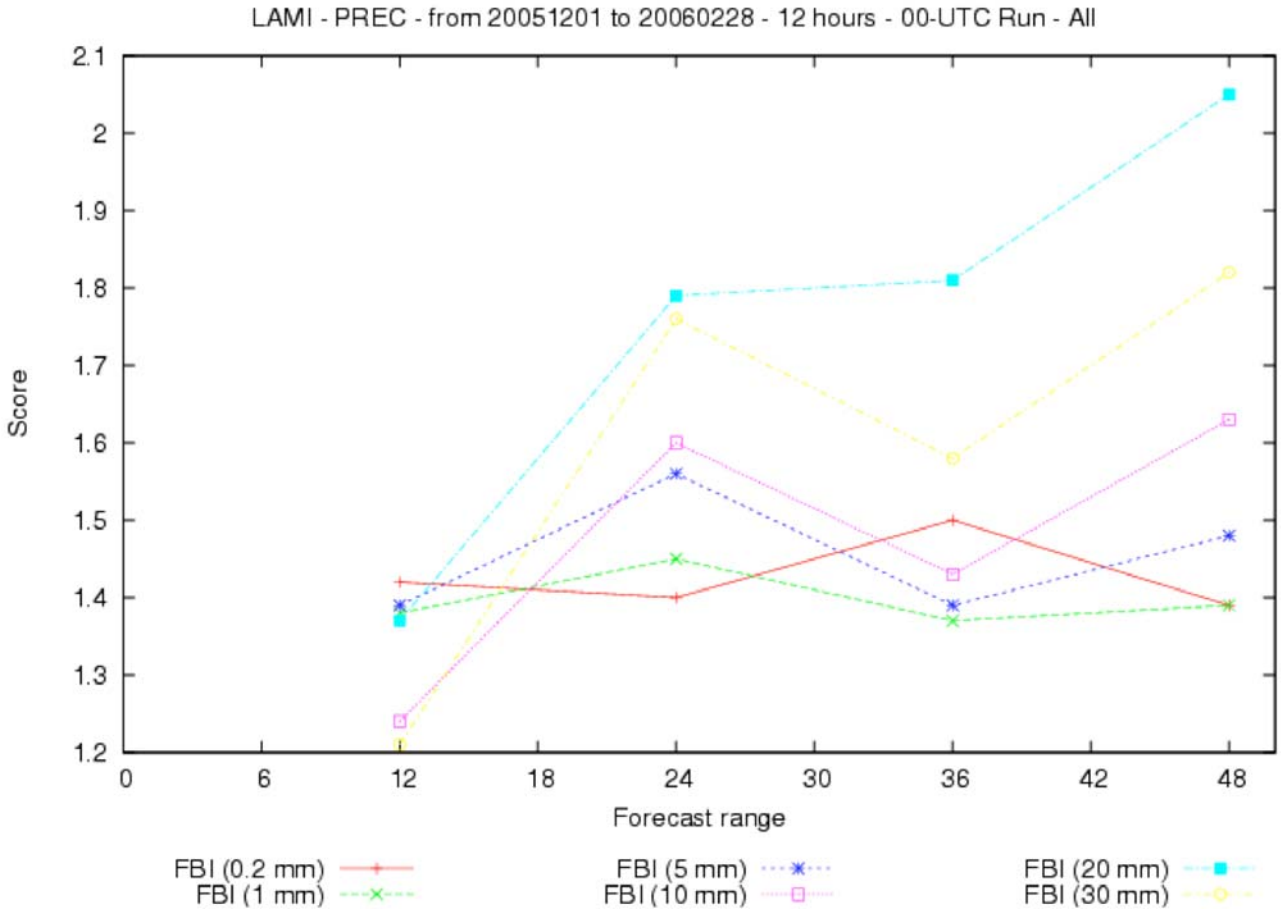
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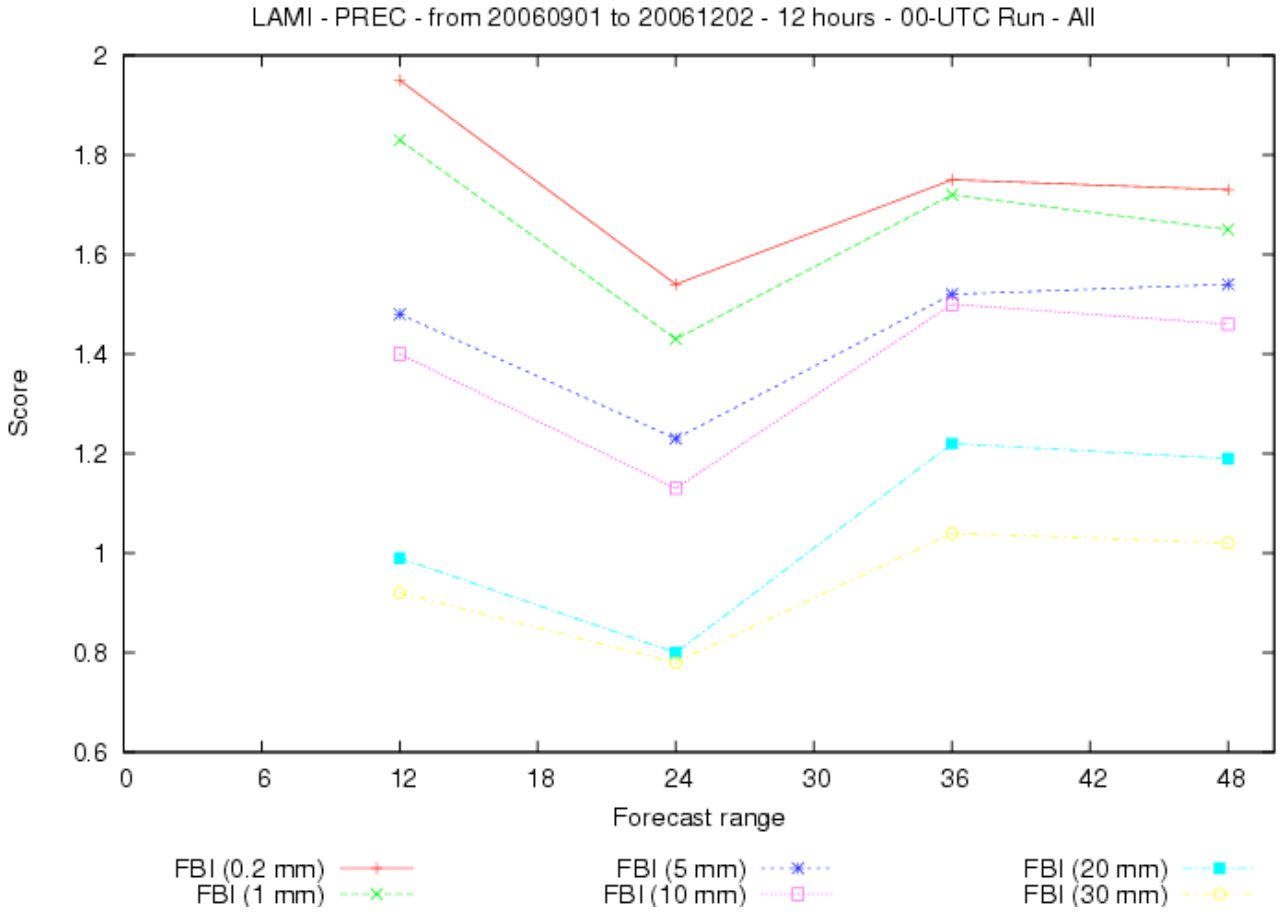
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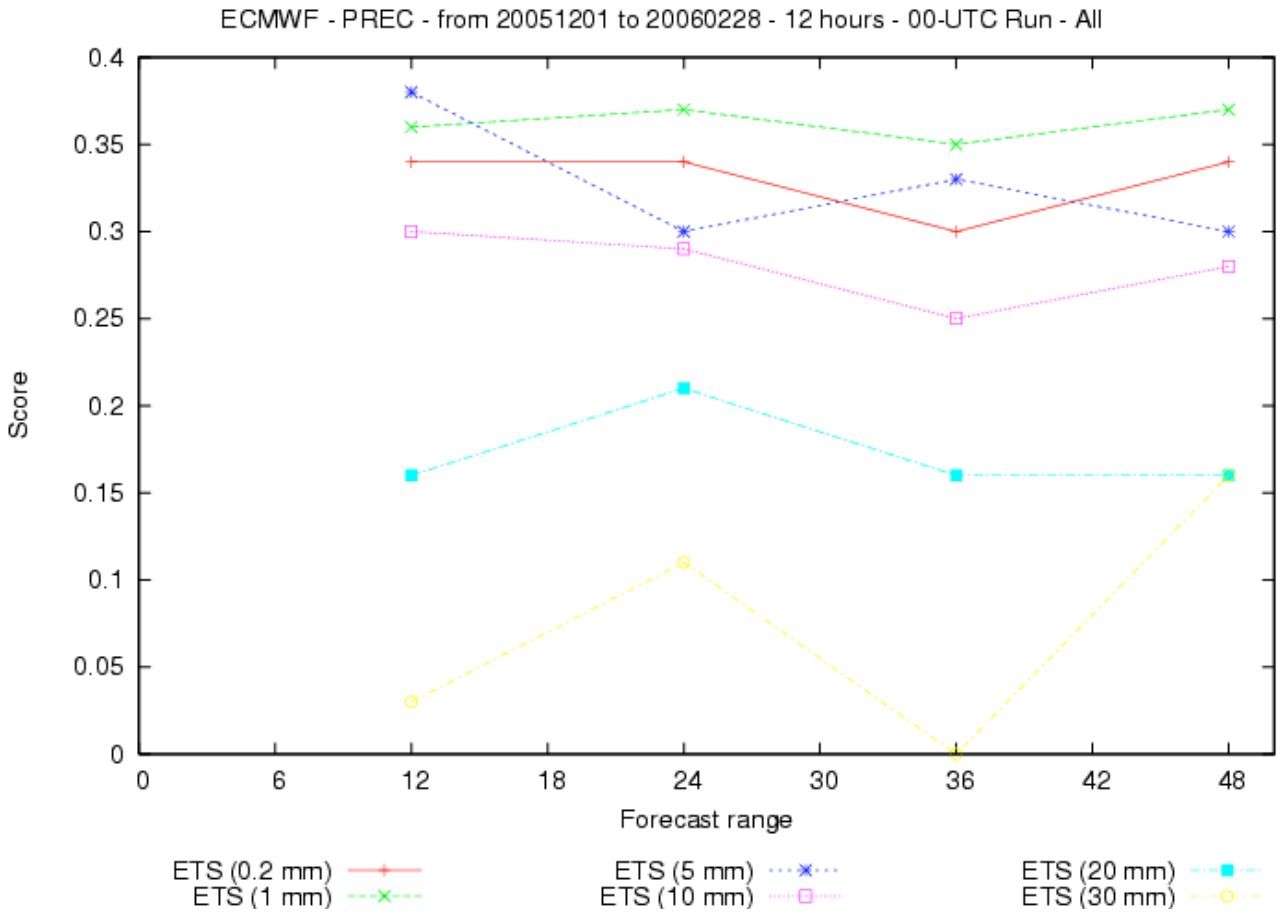
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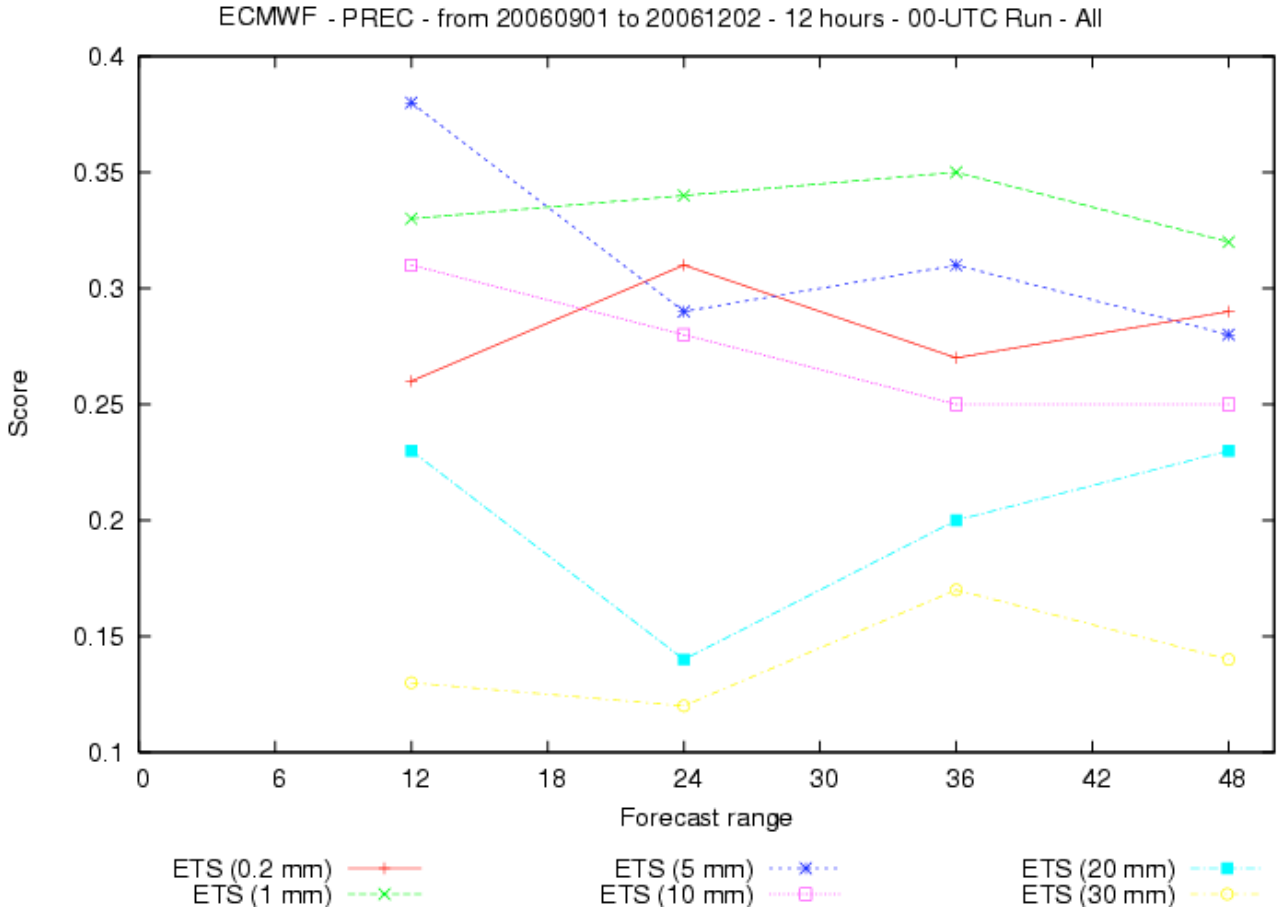
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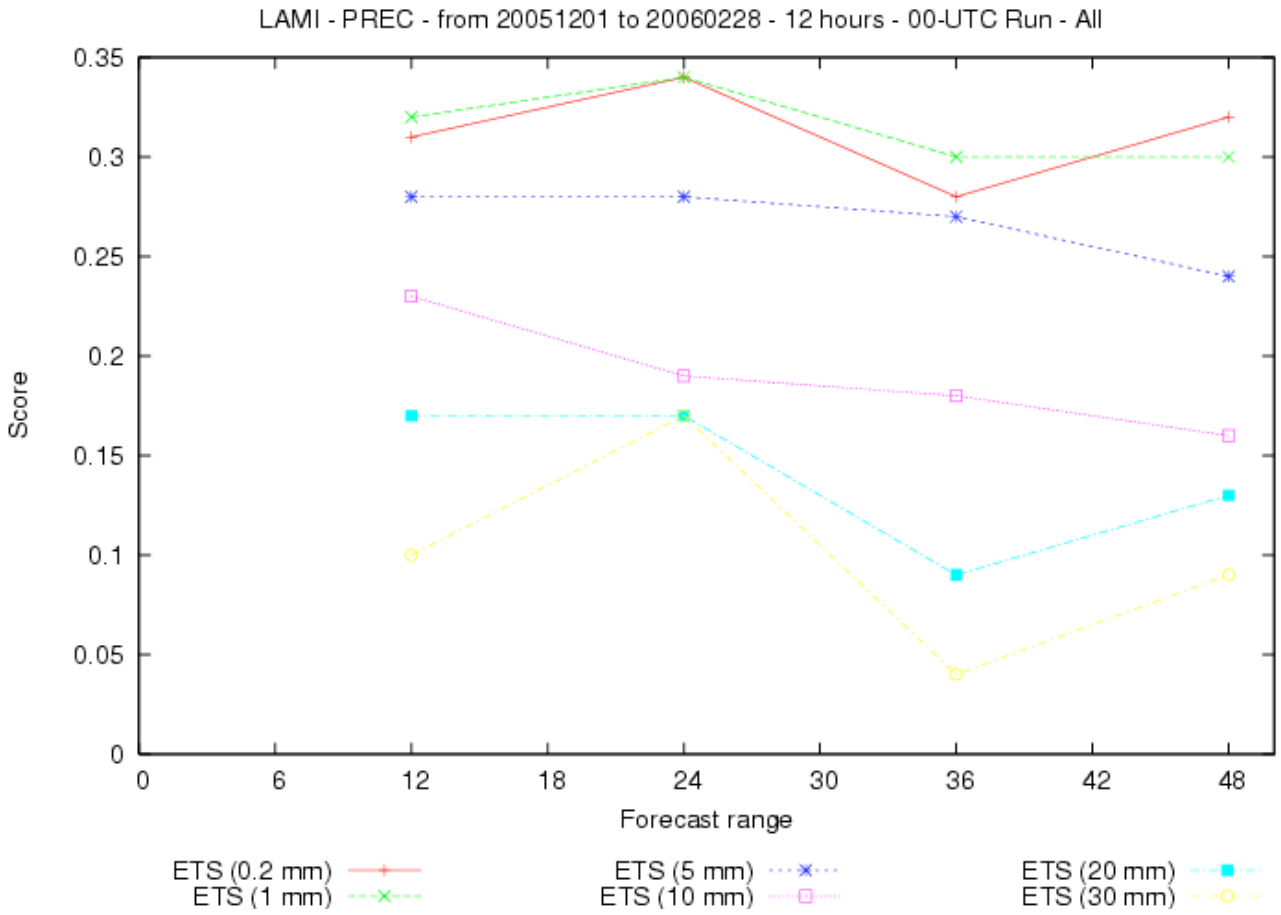
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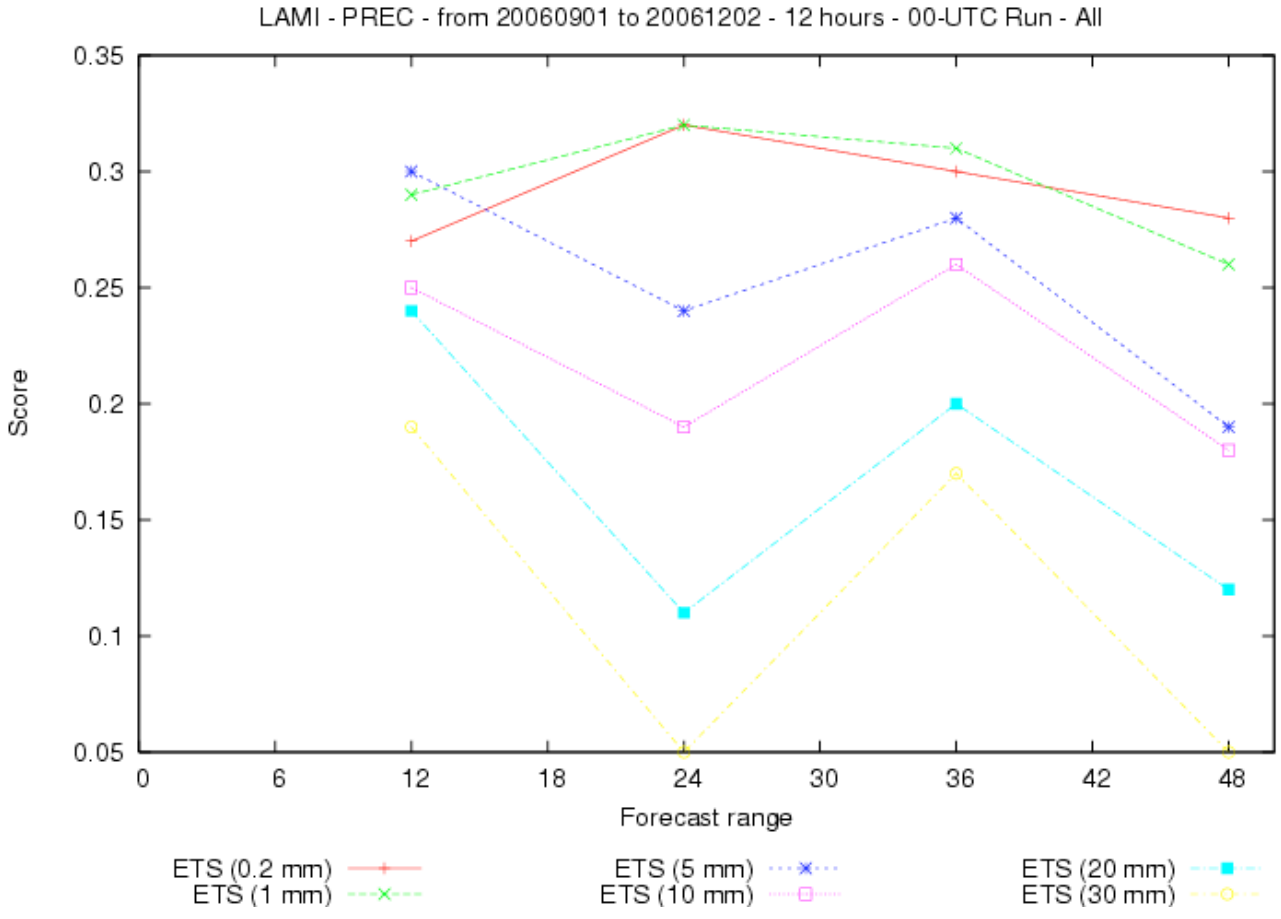
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