Application and verification of ECMWF products 2013

AEMET – Spain

1. Summary of major highlights

- Maintenance and improvement of the AEMET Intranet website with high resolution and Ensemble gribs that are used as the main operational tool for short and medium range forecasters.
- Use of ECMWF gribs for generation of Digital Forecasting Data Base, DFDB, from H+48 up to 240: high resolution and EPS models.
- Use of EFI an SOT charts in operational duties.
- Use of ECMWF gribs for testing GFE (Graphical Forecast Editor) and its product generation.
- Use of ECMWF models into the McIDAS/NinJo workstations.
- Collaboration on research on objective verification methods for NWP. This is kept by Carlos Santos from AEMET, and Anna Ghelli from ECMWF/OD

2. Use and application of products

Use of high resolution, ensemble and monthly forecast models in an operational way:

- Atmospheric models:
  - Comparison of high resolution deterministic model with the EPS control model in Spanish area
  - Clustering of ECMWF EPS for two specific Spanish areas.
  - EPS Probabilities for various meteorological parameters in two specific Spanish areas with normal thresholds and special thresholds for severe weather.
  - EFI/SOT for T2m, Tmax, Tmin, PCP, SNOW, V10m, V10mGUSTS.
  - Meteograms
  - PCP and T2m anomalies and probabilities in the upper and lower terciles from monthly forecast for Monday and Thursday runs.
- Wave models:
  - EPS Probabilities in three specific areas for significant wave height for wind sea, swell and total sea.

2.1 Post-processing of model output

2.1.1 Statistical adaptation

- Application of Analogue Method, AM, to estimate the probability of precipitation from deterministic ECMWF model (12 UTC run), D+1 to D+3 in 24h periods (07-07 UTC).
- Use of Analogue Method from EPS, EPS-AM, to estimate the probability of precipitation from D+1 to D+7 (12 UTC run) in 24h periods (07-07 UTC).
- Adjustment of EPS precipitation probabilities for 6, 12 and 24h periods based on the ratio between the probabilities of EPS and EPS-AM in the common period 06-06 UTC.
- Maximum and Minimum temperatures predictions (D+7) using EPS mean and surface observations of 40 previous days to correct the bias.
- Estimation of the potential snow-rain limit considering 850 hPa temperature and geopotential from high resolution model output, up to D+7.
- Estimation of probability of snowfall considering the EPS-AM precipitation probability and the probability of snow-rain limit (D+3).
- Estimation of probability of thunderstorms using high resolution ECMWF model: Total of Totals Index, TT, CAPE and EPS-AM precipitation data from D+3 to D+7.

2.1.2 Physical adaptation

All the boundary conditions for the LAM short range NWP AEMET operational models (euro Atlantic HIRLAM ONR, 16km; HIRLAM HNR, 5km, over Iberia and surroundings; and HIRLAM CNN, 5km, over Canary Islands) are now directly taken from the ECMWF operational runs.

From October 2011 and after testing different nesting configurations, HARMONIE 2.5 km runs 4 times a day at H+30, in the ECMWF facilities nested directly in the ECMWF model outputs. Currently, boundaries are renewed every hour. It runs with surface analysis and blending with ECMWF upper air fields. HIRLAM models use their own assimilation, HARMONIE versions run in adaptation mode. This direct nesting performs well even for 2.5 km.

Daily experimental multimodel Short-range Ensemble Prediction System (SREPS) uses ECMWF model as one of the boundary condition of global models to initialize the system. Two runs a day (00 and 12 UTC) uses 12 hours-old ECMWF run.

2.1.3 Direct and derived fields for medium range forecast

In operational duties, a large amount of ECMWF products from medium to monthly range is used. We use both the high deterministic model and EPS system for medium range weather forecast. EFI/SOT products are used as much as probability maps to access the warning areas in our early warning system of high impact weather events, called “Meteoalerta“. Other activities and products are related to:

- Comparison of high resolution deterministic model with the EPS Control model in Spanish area.
- Specific Spanish clustering of ECMWF EPS in two specific Spanish areas, the Iberian Peninsula /Balearic Islands and Canary Islands.
- EPS probabilities that various meteorological parameters, from atmospheric EPS, surpass defined thresholds in two specific Spanish areas, from D+1 to D+10 or D+15.
- EPSgrams.
- Wave EPS probabilities that significant height of wind waves and total swell, exceed defined thresholds in specific Spanish areas.
- PCP and T2m anomalies and probabilities in the upper a lower terciles from monthly forecast.

2.2 Use of products

Use of ECMWF products for deriving:

- Frontal diagnosis parameters: TFP, THW, etc.
- Aeronautical and maritime products.
- Seudosounding graphics from deterministic model using pressure levels.
- Wind gust estimation maps.
- Specific parameters for diagnosing thunderstorms potential: CAPE, LI, CIN, convergence zones, etc.,
- New convective parameters in developing phases: SRH1, SRH3, left-right movement cells, etc.
- Defence support charts in different international areas (Afghanistan, Lebanon, etc.)
- Use of ECMWF products for training courses at some South American Meteorological Services.
- Use of products for the Experiment on Nowcasting of Severe Weather Events. Special emphasis and use of Ensemble mean and Spread charts: 300 hPa geopotential and MSLP. High resolution charts, with emphasis on CAPE and fields related to the forecast of heavy precipitation

3. Verification of products

3.1 Objective verification

3.1.1 Direct ECMWF model output (both high resolution and EPS models)

Post-processing of EPS 2m-temperature in Spain.

EPS 51 members forecasted 2m-temperature at 00, 06, 12 and 18 UTC is interpolated at each of the synoptic observatories of Spain. Its mean is calculated and corrected with the mean of the errors (forecasted – observed) from previous days. This procedure is also applied to the daily extreme temperatures as illustrated in the next graphics: monthly percentage of the days with absolute errors less or equal than 2ºC from 2010 applying Tmax and Tmin.

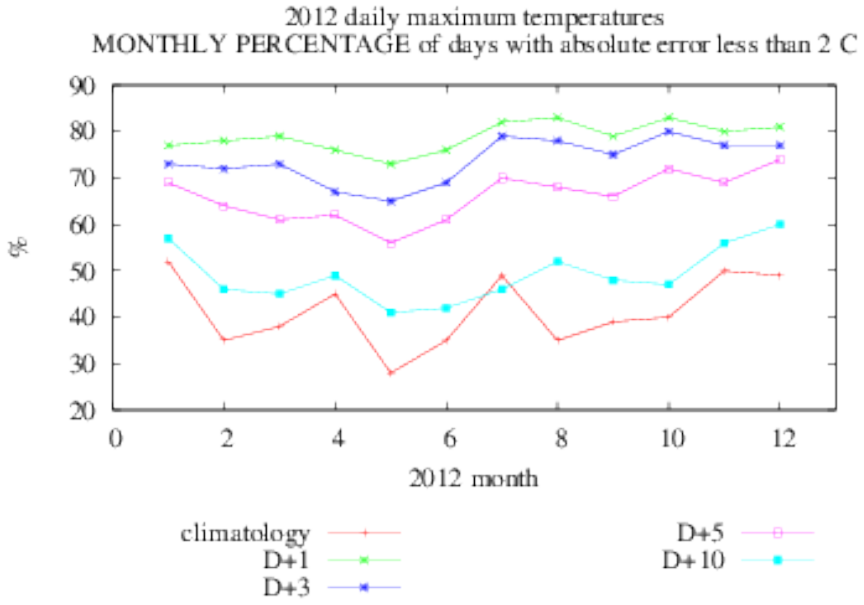

Figure 1. Time series of percentage of correct maximum temperature forecasts (error less than 2ºC) for different prediction ranges. The verification sample is composed by the forecasts made in 2012 for a set of 50 Spanish synoptic stations.

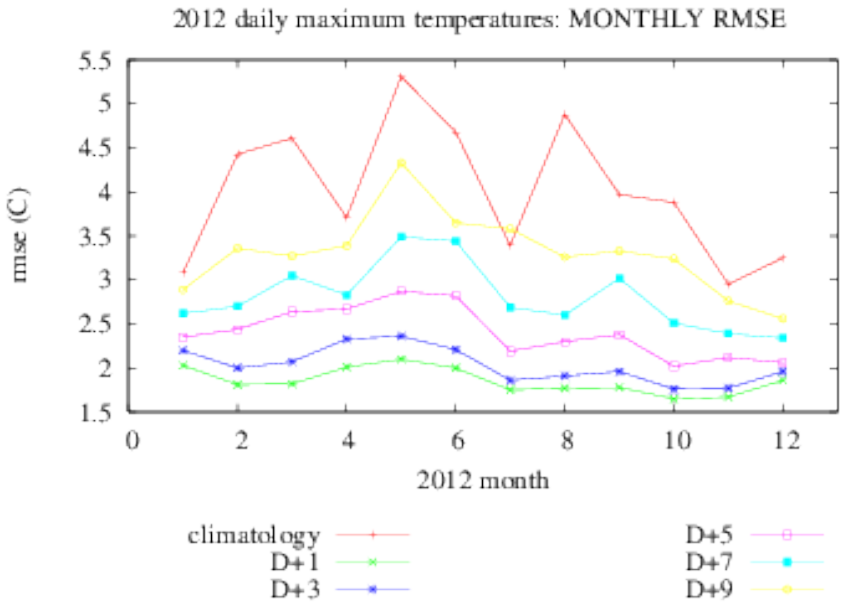

Figure 2. Time series of monthly mean values of RMSE for objective maximum temperature forecasts for different prediction ranges during 2012. Local forecasts are obtained from the filtering of the 2m-Temp EPS mean. The verification sample is composed by the forecasts for a set of 50 Spanish synoptic stations.

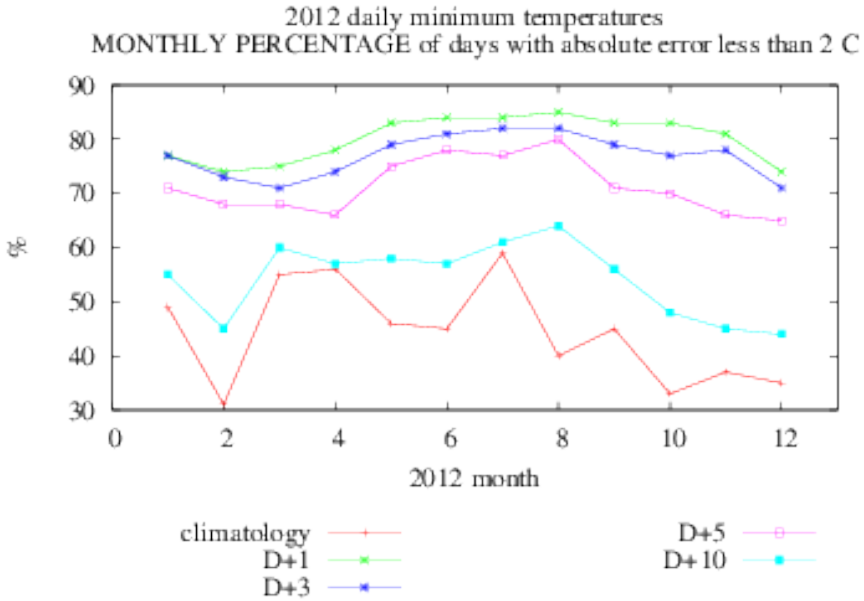

Figure 3. Time series of percentage of correct minimum temperature forecasts (error less than 2ºC) for different prediction ranges. The verification sample is composed by the forecasts made in 2012 for a set of 50 Spanish synoptic stations.

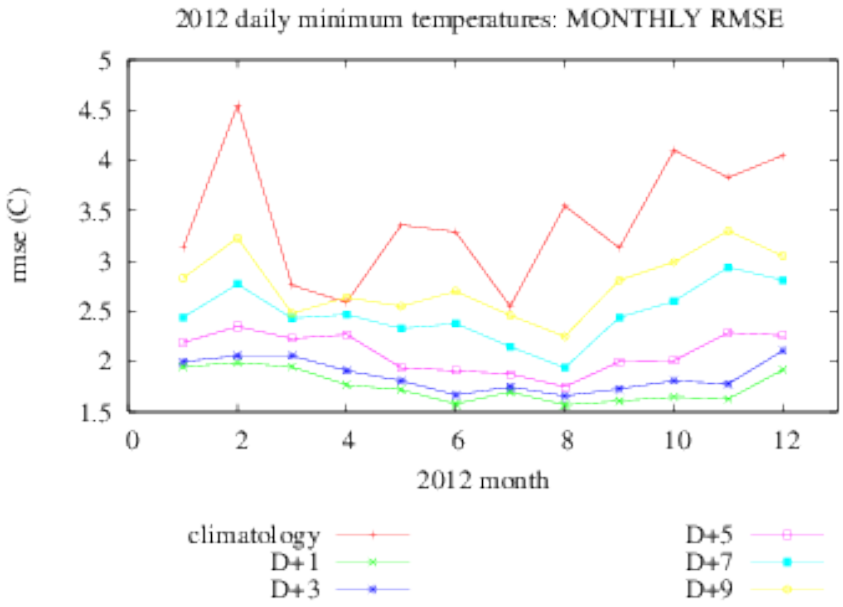

Figure 4. Time series of monthly mean values of RMSE for objective minimum temperature forecasts for different prediction ranges during 2012. Local forecasts are obtained from the filtering of the 2m-Temp EPS mean. The verification sample is composed by the forecasts for a set of 50 Spanish synoptic stations.

3.1.2 ECMWF model output compared to other NWP models

The most relevant differences among the three models ECMWF,HIRLAM ONR and HIRLAM HNR are found for precipitation forecasts, mainly the convective one. ECMWF model forecasts precipitation over more extended areas but with smaller amounts than the higher resolution models.

There are two projects AEMET is doing in collaboration with ECMWF. In particular Carlos Santos and Anna Ghelli are working together in two items:

One of them is an assessment of the impact of observational uncertainty in verification results for ensemble precipitation forecasts. This study compares performance of ECMWF EPS and AEMET-SREPS. The resulting paper has been recently published in QJRMS: Santos, C. and Ghelli, A., 2012, Observational probability method to assess ensemble precipitation forecasts. Q.J.R. Meteorol. Soc., 138:209–221. doi:10.1002/qj.895.

Another one is the application of new feature oriented techniques for verification of QPF using a method called Structure Amplitude Location (SAL). First tests (2010) showed interesting results comparing T799, T399, HIRLAM 0.16 and HIRLAM 0.05 in Central Europe and Spain during 2009. Laura Ferranti collaborates as well, introducing a clustering technique to stratify results. A couple of publications might come up from this.

3.1.3 Post-processed products

See point 3.1.1.

3.1.4 End products delivered to users

No end products different from Direct Model Output are delivered to users.

3.2 Subjective verification

3.2.1 Subjective scores (including evaluation of confidence indices when available)

3.2.2 Synoptic studies

- Evaluation of the behaviour of the deterministic and EPS forecasts in severe weather situations.

- Winter Workshop with senior forecasters of National Forecaster Centre testing products and methodologies.

- Brief summary about the large-scale episodes occurred during the NoSWEX 2012 campaign for the report of the experiment already finished in Spanish.