Application and verification of ECMWF products 2017

AEMET. SPAIN

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1. Summary of major highlights

2. Use and application of products

In AEMET, we use deterministic model, HRES, ensemble (ENS) and monthly forecasts, to generate graphic and text products for forecasters of short, medium range and monthly forecasts, and for automatic products. Units for defence and some warnings aviation forecasting centers support use EcCharts outputs directly from the ECMWF web.

2.1 Post-processing of ECMWF model output

2.1.1 <u>Statistical adaptation</u>

- 2m temperature: The high resolution ECMWF model (both 12 and 00 UTC run) 2T grids are statistically interpreted up to 10 days to generate 1km grids. The method uses both bias correction ('exponential decay correction' based on observed temperatures from the automated Spanish network) and altitude correction (from a 1km altitude grid) and is applied to 'peninsular Spain' and 'Canary Islands' areas.

2.1.2 <u>Physical adaptation</u>

- 5 km grid: We adapt the original resolution of ECMWF fields (HRES and ENS) to a 5 km “standard” resolution in our Digital Forecast Database (BDDP), used for automatic products. In this BDDP we use forecasts from several models; ECMWF High Resolution Model is generally used from H+72 ahead and the Ensemble Model is used from H+0.
- 2m temperature for mountain points: We adapt the temperatures values contained in our Digital Forecast Database to the real altitude of the point, by an altitudinal interpolation taking into account a local vertical gradient of temperature.

2.1.3 <u>Derived fields</u>

- Every day for 00 and 12 runs, we generate 6 objective clusters in two specific areas, day by day up to D+15 and then, the forecaster on duty, decides a subjective re-clustering, day by day, from D+2 until D+4, only for Iberian Peninsula and Balearic Islands Area.
- Also, we elaborate probability maps for cloudiness, rainfall, snow, CAPE, wind, wind gusts, temperature and temperature variations.
- We obtained other derived fields for several specific uses (turbulence indices, 0ºC wet bulb temperature altitude, etc…)

2.2 ECMWF products

2.2.1 <u>Use of Products</u>

- Obtaining maps for forecasters of short, medium, extended and seasonal range forecasts, and for our web site.

- EFI and SOT maps from ENS are used as an early warning or possible extreme events in medium range forecasts. It is used in conjunction with clusters and probability maps for different thresholds and variables.

- As an input for AEMET Digital Forecast Database (BDDP), with other NWP models.

- Automatic products (from BDDP) in text and pictogram formats for AEMET web site, including deterministic and probabilistic information.

- Obtaining soundings frome the HRES model up to 84 hours

- Snowpack evolution analysis in order to assess snowfall (Spain and synoptic regions). The difference from the snowpack depth analysis of the lasts two HRES-IFS runs is constructed and visualized in order to evaluate possible snowfall in the last 12 hours. This process is extended to 24, 48 and 72 hours.

2.2.2 *Product requests*

3. Verification of products

3.1 Objective verification

3.1.1 *Direct ECMWF model output (both HRES and ENS)*

- Global and direct irradiance forecasts from high-res ECMWF model (SSRD and FDIR fields) have been verified against observations from the RRN, the Spanish radiation network, for the years 2013 to 2016.

3.1.2 *ECMWF model output compared to other NWP models*

- Global and direct irradiance forecasts from high-res ECMWF model (SSRD and FDIR fields) have been compared with forecasts from Arome-Harmonie, the local area model used in AEMET, for the years 2015 and 2016. ECMWF model gives a slightly better performance.

3.1.3 *Post-processed products*

- DNI forecasts from ECMWF (obtained from the FDIR field) have been compared with libRadTran DNI forecasts, produced using meteorological information from the ECMWF model and aerosol data from CAMS, for the years 2013 and 2014. It has been shown that adding aerosol information and post-processing the forecasts improve the predictions (Casado-Rubio, 2017).

3.1.4 *End products delivered to users*

3.2 Subjective verification

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

We have experienced some particular problems with ECMWF forecast:

- Lack of temporal accuracy in changing situations such as frontal passes and convection initiation and dissipation (e.g. too early dissipation on 25th and 26th May 2017).
- Low-cloud cover forecasts can be improved.
- Precipitation underestimation in episodes with orographic rainfall enhancement and/or efficient convection.
- Some mesoscale structures that finally were not observed (artifacts), like mesolows in the Mediterranean Sea with high winds and precipitation (see the last slide).
- Lack of skill in seasonal forecasts (in our area of interest).

3.2.2 *Case studies*

Stationary severe storms over Malaga on 19 February 2017 (Presented in the UEF-2017)

During the dawn of 19 February 2017, a set of intense storms occurred over south Spain. Malaga city was especially affected by these storms. Precipitation, that started at about 01:30 UTC (02:30 local time) and lasted around 8 hours, peaked just after 02:00 UTC. Precipitation distribution was quite variable, showing some maxima over the center and eastern Malaga city. 152.6 mm over 7 hours were reported at Malaga-Puerto station, located at the port of Malaga, with a 87.4 mm hourly accumulation just before 2:50 UTC, which is the highest hourly precipitation ever measured at Malaga municipality. However, at the Regional Weather Center, that is barely 5 km away from the port, only 65.2 mm were reported; and at the airport, located at less than 10 km away from the port, only 28.4 mm were reported over the whole period. It should also be mentioned the high lightning activity that occurred, with 74 lightning strikes registered at Malaga-Puerto station, most of them, between 03:00 and 05:00 UTC.

This case study, that discusses the highly localized and stationary storms previously described, is tackled from both scales, synoptic and mesoscale, adding some issues at microscale. To carry out this task, both deterministic and probabilistic outputs and convective diagnostic products of the ECMWF model, and remote sensing (radar, lightning and both basic and NWCSAF satellite products) and observation data products are used.

4. Feedback on ECMWF “forecast user” initiatives

5. References to relevant publications

Casado-Rubio, José Luis; Revuelta, María Aránzazu; Postigo, María; Martínez-Marco, Isabel; Yagüe, Carlos; "A Postprocessing Methodology for Direct Normal Irradiance Forecasting Using Cloud Information and Aerosol Load Forecasts” ,Journal of Applied Meteorology and Climatology, 56, 6,1595-1608, 2017