Operational NWP systems in AEMET

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BULLx, the new High Performance Computer

Initial system
144 compute nodes (3456 cores)
Intel Xeon 2697 V2 Ivy Bridge 2.7 GHz with 64 GB per node

Final system (Currently in validation phase)
324 compute nodes (7776 cores)
This represents a theoretical peak performance of 168 Tflops

InfiniBand FDR for system interconnect
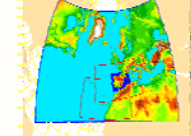LUSTRE Parallel File System for SCRATCH (360 TB)
SLURM Batch Management

nimbus

HIRLAM Suites

3 HIRLAM v7.2 suites with 6 hr cycle
• ONR 0.16deg H+72 over a large domain
• HNR and CNN 0.05deg H+36
Many post-process products and applications are still based on the HIRLAM output and need a large area (wave and chemistry models)

HARMONIE/AROME at ECMWF

Time Critical Application at ECMWF computers
• HARMONIE/AROME at 2.5 km based on cycle 38h1
• Run 4 times per day with a forecast length of 48 hours
• 2 geographical domains (Iberia and Canary Islands).

Set up
• NH dynamics and AROME physics
• 3DVar analysis with conventional obs 6hr cycle
  Cut-off time: 1:10 hours
  (Canary domain only with surface analysis)
• Boundaries: Direct nesting in ECMWF forecasts
• Unified scheme shallow convection (EDMFM)
• Explicit deep convection
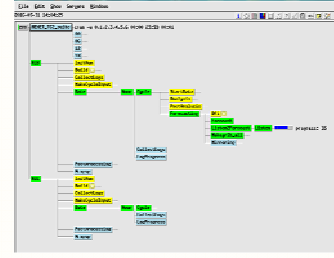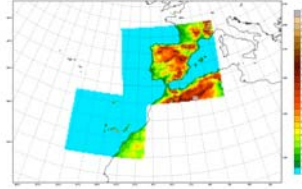
Key aspects
• Observations obtained from AEMET, GTS and pre-processing.
• Boundaries obtained through local dissemination
• A selection of the results is sent to AEMET through dissemination.
• ECMWF operators may switch between HPC computers (cca/ccb) and between different disc systems (sc1/sc2). *(Only limited interaction with model tasks due to lack of help at task level)*
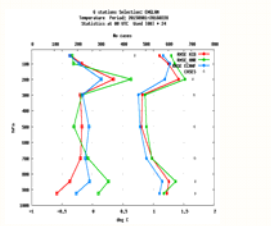
The system is stable and regular
• Complete results available 2:30 hours after the nominal time of the integration

The system will be kept as a backup
• Soon the HARMONE/AROME runs will be moved to AEMET computer but probably the ECMWF system will be kept as a backup system.
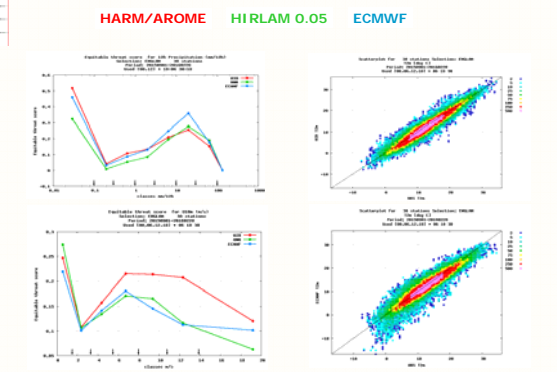
Verification against observations (Sep 2015-Feb 2016)

HARM/AROME   **HIRLAM 0.05**   **ECMWF**

*For upper level fields, errors in HARM are lower than in HIR 0.05 but worst than in ECMWF model*
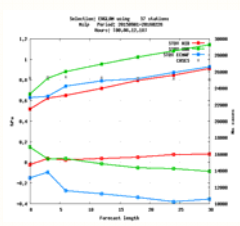
*RMSE and BIAS of MSLP per forecast length*

ETS for different wind categories (bottom) and precipitation categories. HARM shows clearly better scores for wind speed. In precipitation, despite double penalty issues, HARM verifies only slightly worst than ECMWF.

2m temperature: events observation-forecast for HARM (upper plot) and ECMWF with clearly better results for HARM

MSG HRVIS

HARM/AROME

HIRLAM 0.05
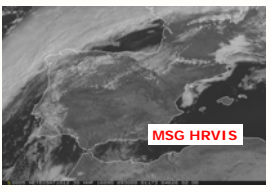
Low level clouds: HARM predicts the coastal fog in the Mediterranean coast but the low cloud cover is overestimated. HIRLAM produces a lower amount of low clouds over the sea.
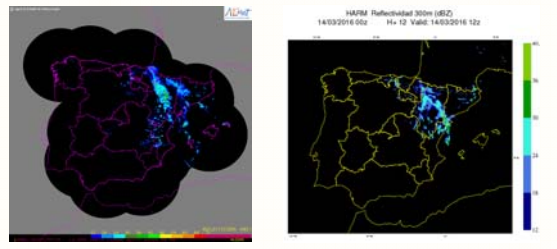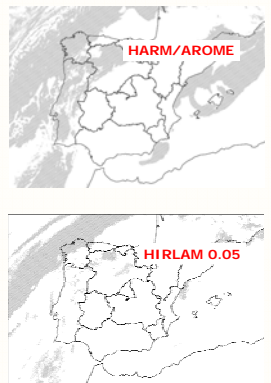
Radar reflectivity: HARM is able to represent a relatively small cut-off low moving to the East.

HARMONE/AROME e-suits in AEMET's HPC

Set up
• Based on cycle 40h1 (several versions are under test)
• **3DVar** analysis with conventional obs **3hr cycle for both areas. (IBERIA & CANARY ISLANDS)**
  ATOVS and GNNS are in tuning phase (see poster *Use of observations in AEMET HARMONIE suit* by *Sanchez et al*)
  Cut-off time: 1:10 hours. Optimal time is under investigation
• Boundaries: Direct nesting in ECMWF forecasts.
• Enlarged domain for Iberian peninsula
• Routine monitoring of analysis and use of observations
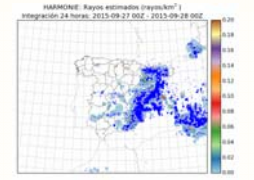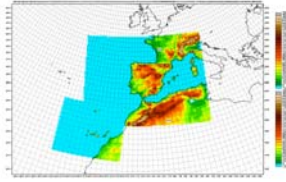
Lightning forecast compared with the obs (blue crosses). The diagnostic based on vertical integrated graupel generally gives a good estimatiion of the electric activity
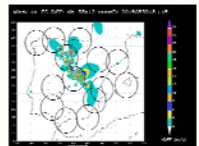
Towards a γ-SREPS system at 2.5 km resolution based on a Multi-model and multi-BC approach: talk *gSREPS: Mesoscale EPS in AEMET* by *García-Moya et al.*
• Multi-boundaries: ECMWF, GFS, CMC, JMA, ARPEGE
• Multi-model: AROME, ALARO, WRF-ARW, WRF-NMM
Under test in the new Bullx computer

Highlights

HARMONIE Time Critical system at ECMWF working smoothly

HARMONIE/AROME system:
• Clear added value on near surface variables compared with models of larger scale (HIRLAM and ECMWF)
• Improvement of wind forecasts
• Clear improvement of fog forecast but with many false alarms.
• Significant improvement of precipitation forecasts including spatial distribution and amount of precipitation but revealing uncertainty in the prediction of small scales.
• Currently more used than HIRLAM in the Operational Prediction System.
• Significant increase in the number of observations assimilated
• Routine monitoring of the observations and the analysis.
• The system is very stable in the new hpc system.

Radar assimilation *(cgeijog@aemet.es)*

• The assimilation of reflectivity and Doppler wind data from the AEMET C-band radar network are assimilated in the HARMONIE/AROME suite
• A parallel experiment H+12 is run daily
• The Field Alignment technique is under test