GOBIERNO DE ESPAÑA
MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO
AEMet Agencia Estatal de Meteorología

NWP Activities at the AEMET (Spain)

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33rd EWGLAM & 18th SRNWP Meeting. Tallinn, Estonia, 10-13 Oct. 2011

SYSTEM

Cray X1E

16 physical nodes X1E

8 MSP each : 1.2 GHz, 19.2 Gflops – 64 bits by MSP,

32 logical nodes (31 application nodes + 1 support node)

128 MSP / 512 SSP

512 GB memory

2.304 Tflops theoretical peak performance for applications

Cross-compiler based in linux cluster

HIRLAM: mgutierrezm@aemet.es
SREPS: csantosb@aemet.es
MOCAGE: acansadoa@aemet.es
HARMONIE: fcalvos@aemet.es
RESEARCH: cgeijog@aemet.es
borfilae@aemet.es

OPERATIONAL SUITE

Operational runs on Cray X1E

3 **HIRLAM v7.2** experiments:

- ONR (0.16deg), HNR (0.05deg)
- Over Canary Islands 0.05 deg (CNN)

Four runs at 00, 06, 12 & 18 UTC

40 levels in the vertical (more resolution in the PBL)

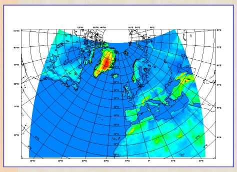
SL Dynamics

3DVAR assimilation

ISBA

ECMWF Blending

Integration area



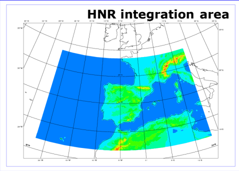
ONR (0.16 deg)

latxlon (582x424)

72 hour forecasts

Dynamics time step = 600 sec

HNR integration area



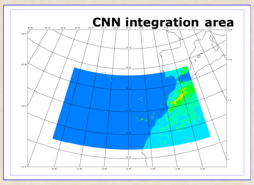
HNR & CNN(0.05 deg)

latxlon (606x430)

36 hour forecasts

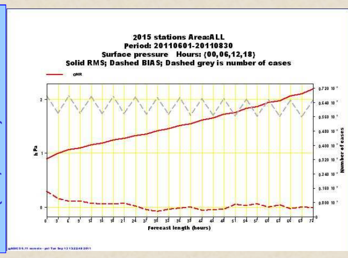
Dynamics time step = 240 sec

CNN integration area

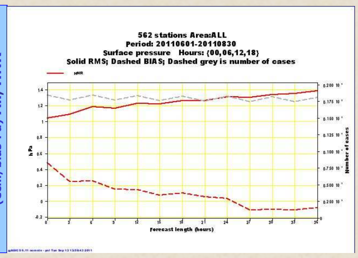


OBSERVATION VERIFICATION –June 2011 - August 2011

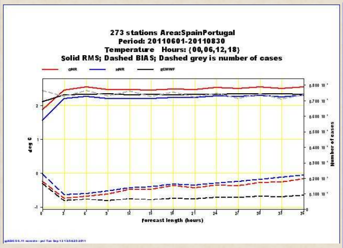
Sea level pressure (ecm/bias Pa) All ONR



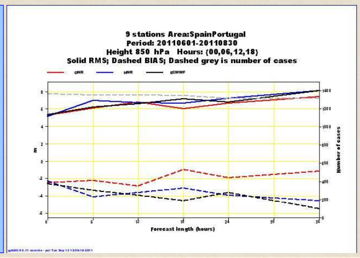
Sea level pressure (ecm/bias Pa) All, HNR



T2m (ecm/bias Pa) Iberia ONR/HNR/ECMWF



850 hPa Geopotential height (ecm/bias m) ONR/HNR/ECMWF



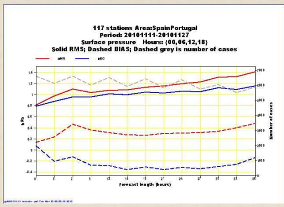
Last operational improvements

March 2011

- 0.05 deg HIRLAM operational experiments nested with ECMWF fields
- Horizontal resolution of ECMWF frames upgraded to 0.25º
- 0.05 deg HIRLAM operational models blending with ECMWF fields

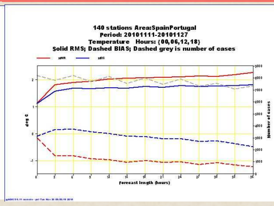
Obs verifications HNR nested with ONR (no blending) HEC nested with ECMWF & blending

MSLP Iberian area



T2m EWGLAM stations

T2m Iberian area



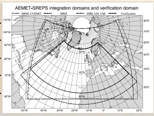
CNN vs. CEC CNN nested ONR (no blending) CEC nested ECMWF & blending

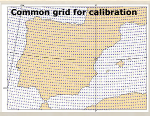
MSLP

SREPS

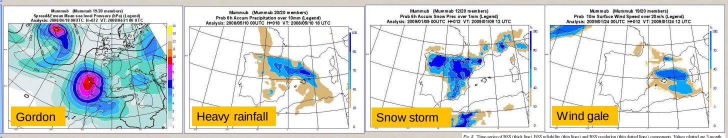
Settings

Multi-model	HIRLAM, HRM (DWD), LM (COSMO), MM5, UM (UKMO)
Multi-boundaries	CMC (MSC), ECMWF, GME, GFS, GSM (JMA)
Members	5 models X 5 bcs = 25
Daily runs	00, 12 UTC (twice)
Forecast range	72h
Horizontal resolution	0.25º

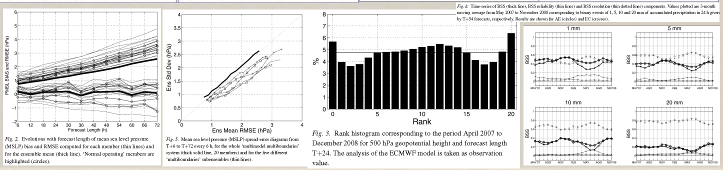




Case studies



Performance



MOCAGE CTM

MOCAGE is a Global Chemical Transport Model developed by Météo France and used at AEMET to make chemical weather forecasts and calculate the evolution of the dispersion of hazardous material released to the atmosphere (volcanic ashes, radioactive matter, etc). It allows nested domains (up to three, additional to the global one). Over Iberia and Balearic Islands AEMET runs MOCAGE at a horizontal resolution 0.1 degrees. Besides, we participate in the FP7 MACC Project (Monitoring Atmospheric Composition and Climate) using MOCAGE to model the atmospheric composition in Western Mediterranean at 0.05 degrees (horizontal resolution). Meteorological forcings come from ECMWF IFS (GLOB22) and HIRLAM AEMET ONR (INML05) and HNR (INMH01 and MACCH3)

OPERATIONAL (planned)

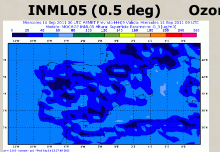
GLOB22 (GLOBAL 2 deg)

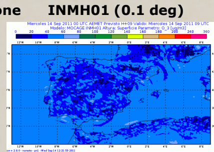
INML05 (0.5 deg)

INMH01 (0.1 deg)

Emissions: IPCC + GEMS_TNO

INML05 (0.5 deg) Ozone INMH01 (0.1 deg)





MACC PROJECT

MACCH3 (0.05 deg)

+

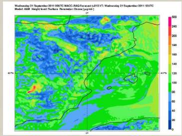
MACC RAQ ENSEMBLE MEAN

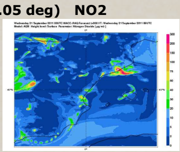
(AS BOUNDARY CONDITIONS)

Emissions: IPCC + GEMS_TNO

http://www.gmes-atmosphere.eu

Ozone MACCH3 (0.05 deg) NO2



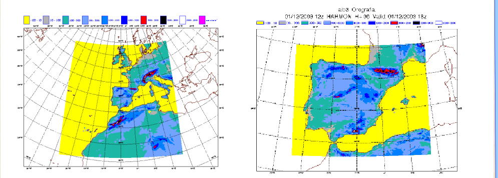


> European Air Quality > EAQ forecasting and monitoring > Air Quality Forecasts > Mediterranean Zooms > AEM forecasts

HARMONIE model

- HARMONIE system is a coordinated effort of ALADIN and HIRLAM consortia aimed to improved local forecasts.
- Two configurations are run at AEMET:
  - At 11 km with ALADIN physics and 3DVar analysis. The aim is to compare the quality of the model at synoptic scale with HIRLAM and to improve the assimilation (calibration and use of observations)
  - At 2.5 km resolution with AROME physics

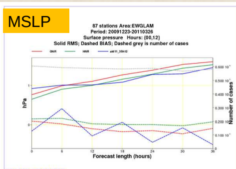
Domains at 11 and 2.5 km resolution

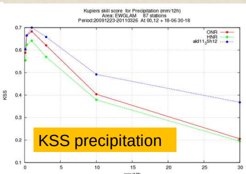


HARMONIE 11 km

- Daily runs H+36 at 00 and 12 UTC with **ALADIN physics, 3DVar upper air analysis and OI for surface variables**.
- Observations assimilated: SYNOP, SHIP, TEMP, BUOYS, PILOT, AMDAR, AMSU-A and AMVs.
- From objective verification HARMONIE 11 km model (blue line) compares well with HIRLAM operational runs (5 and 16 km resolution). It improves MSLP, cloud cover and precipitation whereas it deteriorates 10m wind and 2 m temperature.

Verification compared with operational HIRLAM

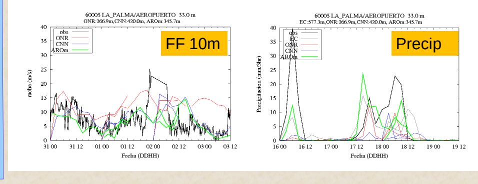




HARMONIE 2.5 km

- **Non-Hydrostatic dynamics and AROME physics** are only run for selected dates and case studies because the system needs most of our computer resources.
- The model (green line) is able to add value to HIRLAM and ECMWF models.
- The errors in local prediction are still big specially for convective precipitation events.

Comparison with OBS, HIRLAM and ECMWF at La Palma station (Three H+36 integrations)



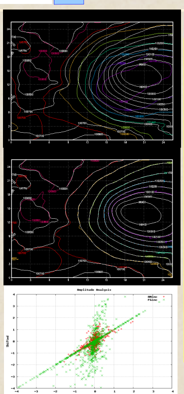
Research and Development

Data Assimilation by Field Aligment

Position errors are very difficult to account for in commonly used DA variational methods, even considering an ensemble approach[*]. This method tackles the problem by enlarging the analysis control space with a set of smooth 2D vector fields which give the displacements of the model fields that minimize the position errors. This addition of new control variables in the DA problem is formulated in terms of Bayesian theory, and it leads to the definition of a new "cost function" or "objective" which represents explicitly both amplitude and position errors.

The technique, which can be used in deterministic and probabilistic frameworks alike[*], can be classified as non-linear DA and some simplifications are necessary in order to implement it. The test presented here was done in a deterministic framework and used time-shifted (by 3 hours) model fields as surrogates for observations. The NWP system employed was HARMONIE (2.5 Km/60L). The test was designed to check the impact of the field alignment correction on the quality of state-of-the-art short-range forecasts. It consists of three runs: 1) CNTL or reference run. 2) SHFT run takes as initial conditions the time shifted fields after a conventional 3D-VAR analysis. 3) ALGN run takes the same initial conditions as the SHFT run but, previously to the 3D-Var analysis, an alignment to correct for position errors is done.

[*] *Ravela,S ;Emanuel K. and McLaughlin D."Data Assimilation by Field Alignmnet" Physica D 230 (2007) 127-145 available online at www.sciencedirect.com*



Test Results

The FA method turned out to work very well. On the left of these lines we can see the relative positions of a low in the dataset acting here as observations (white isobars) and in the dataset acting as background (coloured isobars) before the alignment process (above) and after it (below). The scatter plot shows the impact on the σ_o normalized increments due to the alignment. The size of these increments is clearly reduced in the aligned experiment.

On the right, we have a panel which displays the "field verification" for the 30m wind speed over the first four hours of the forecast. Each row corresponds to a specific forecast range, (top +1H, bottom +4H). The left column displays CNTL - SHFT diff. and the right column CNTL – ALGN diff. We note that the "error" in the aligned experiment for +1H is very small and that there is no indication of noise that could have been caused by imbalances in the initial conditions. We do see in +2H and after, a suspicious wind streak stretching from Mallorca to Menorca islands, but it is present too in the SHFT experiment and therefore we must conclude that it is not a spurious pattern produced by the FA correction. The wind speed in SHFT is severely underestimated (up to more than 10 m/s) during the first hours of the forecast over a big area to the southwest of Mallorca island. The error pattern shape suggests that the flow in the CNTL experiment is enhanced by a prominent orographic feature on the northwest of the island: "Serra Tramuntana" (1400m amsl). In the SHFT experiment the shallower and displaced low induces a weaker circulation over the island and the orographic channelling is not so intense.

The range of persistence of the impact in these experiments is surely conditioned by the proximity of the verification area to the eastern border of the model domain and the circumstance that the cyclonic circulation causes in-flow from this side. Because of this, the LBCs (which are identical for all experiments) take over relatively soon. A complete description and discussion of the results can be found in:

Carlos Geijo, "Data Assimilation by Field Alignment. Testing the Theory". HIRLAM Newsletters N58.