NWP Activities at the AEMET (Spain)

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37th EWGLAM & 22nd SRNWP Meetings, 5th/8th Oct. 2015 Belgrade, Serbia

MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE

AEMet Agencia Estatal de Meteorología

NEW High Performance Computer

A new BULL supercomputer has been installed using Intel Xeon 2697 V2 Ivy Bridge processors.

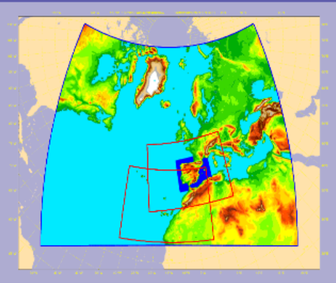
- The 1st Phase with 3456 cores what will allocate 2 deterministic runs of HARMONIE/AROME, HIRLAM suites and several runs of the environmental model MOCAGE.
- The 2nd Phase will be installed in early 2016 will have 7760processors and will allow to implement the **y-SREPS** ensemble system and RUC of the HARMONIE system.

HIRLAM Suite

3 **HIRLAM v7.2** suits with 6 hr cycle

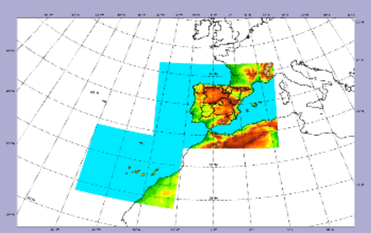
- **ONR** 0.16deg H+72 over a big domain
- **HNR** and **CNN** 0.05deg H+36

Many post-process products and applications are still based on the HIRLAM output.

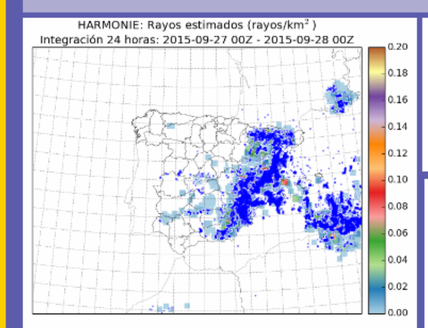


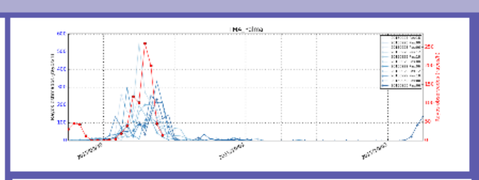
HARMONIE/AROME SUITE

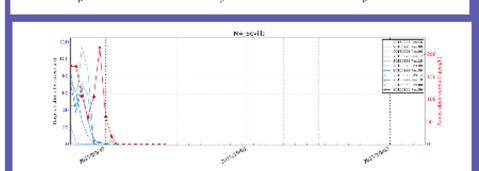
- HARMONIE/**AROME** at **2.5 km** is run 4 times per day with a forecast length of 48 hours for 2 geographical domains (Iberia and Canary Islands).
  - Currently run at **ECMWF** as a *Time Critical Facility* using *ecflow* scheduler. In the processes of migrating it to **AEMET-Bull**
  - ALADIN **NH dynamics**
  - **3DVar analysis** with **conventional obs 6hr cycle**
  - Boundaries: Direct nesting in ECMWF forecasts
  - Unified **scheme shallow convection** (EDMFM)
  - **Explicit deep convection**



Interesting applications are generated, like lightning forecast or aeronautical products

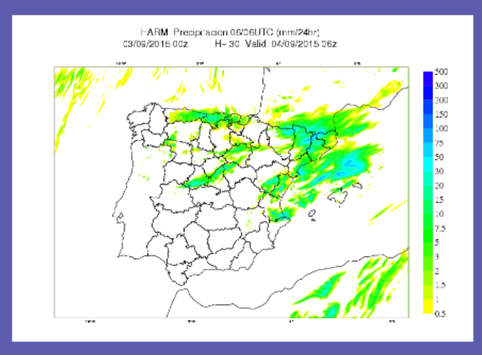


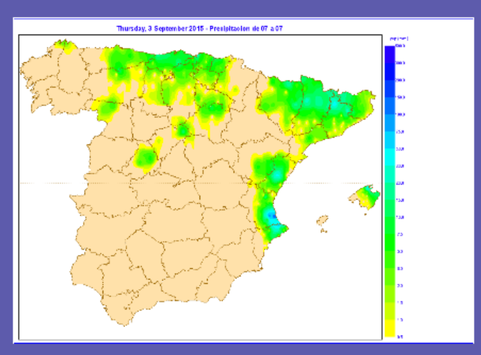




Lightning forecast takes in account the TMA (Terminal Maneuvering Area) for the most important Spanish airports.

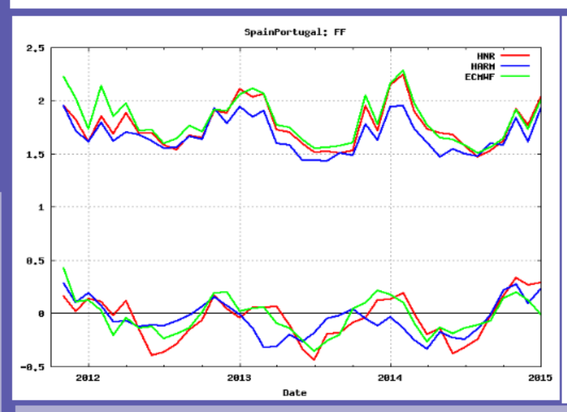
Some plots have been done comparing the number of lightning forecasted (blue lines) and observations (red).

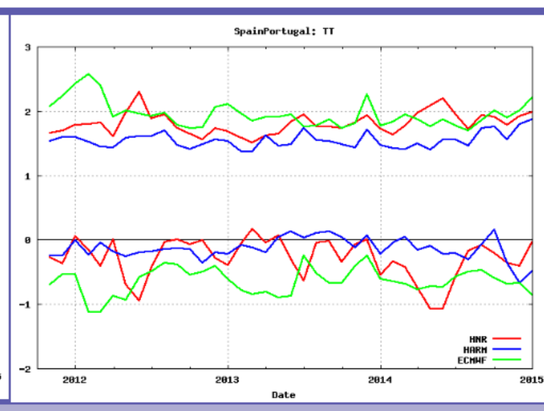




24hr-precipitation for HARMONIE compared with obs. The model is able to reproduce the spatial distribution and it is close to the maximum. In general it reproduces quite well the precipitation when there is a clear synoptic or geographical forcing what is no so clear when the forcing is weak. Nevertheless the uncertainty in the local scale (spatial and temporal) can be large.

Historical Verification





Long term verification charts for wind and temperature show that Harmonie high resolution model performs better than HNR and ECMWF.

γ-EPS

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Towards a γ-SREPS system at 2.5 km resolution based on a Multi-model and multi-BC approach (See poster ***Strategy for Lateral Boundary Conditions in mesoscale EPS*** by García-Moya et al.)

- Multi-boundaries: ECMWF, GFS, CMC, JMA, ARPEGE
- Multi-model: AROME, ALARO, WRF-ARW, WRF-NMM

It is expected to have it operational in 1st part of 2016 in the new Bull computer

ATOVS assimilation

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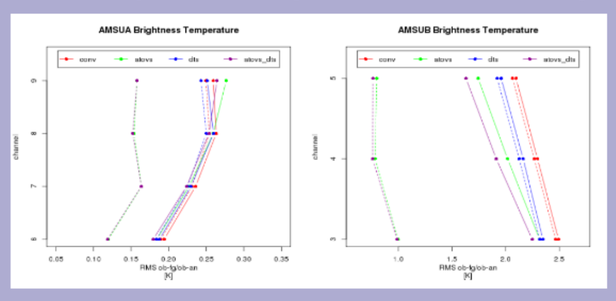
Impact of ATOVS assimilation during HyMeX-SOP1 (sep 2012)

- NOAA-15, NOAA-16, NOAA-18, NOAA-19 and METOP-A
- AMSU-A: Channels 6-9 and AMSU-B/MHS: Channels 3-5

VARBC, tuning and blacklisting

Background departures and analysis residuals for ATOVS



The assimilation of ATOVS is able to significantly reduce the background departures for AMSU-B/MHS and slightly for AMASU-A.

Verification against radiosondes shows little impact for most variables with some deterioration in middle levels humidity. In contrast the assimilation of ATOVS has a clear positive impact in the precipitation forecasts.

Future: Tuning, thinning, improving blacklist. ATOVS over land at high levels.

GNNS ZTD assimilation

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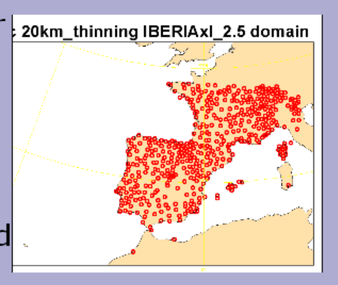
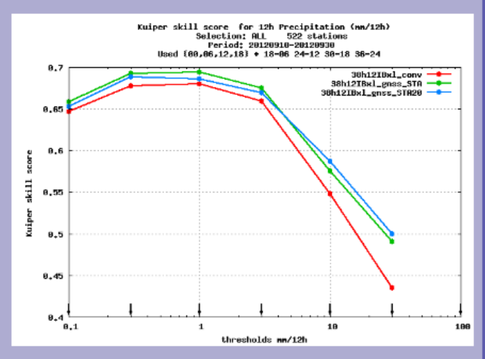
Impact of GNNS ZTD assimilation (sep 2012)

- Cy38h12, 3DVar with 3hr cycle.
- White List and 20 km Thinning has been applied for GNSS.



20km thinning: 470 sites



Kuiper Skill Score for 12 hr-precipitation

Use of GNSS ZTD observations together with a variational bias correction has shown an improvement of short range weather forecasts, both in a statistical sense and in individual case studies. For this period, the improvement is due to the ability of these observations to dry a too wet model state and therefore improve the precipitation scores.

Future: Tuning, scaling structure functions, increasing the number of predictors of the VarBC scheme..

RADAR DATA ASSIMILATION

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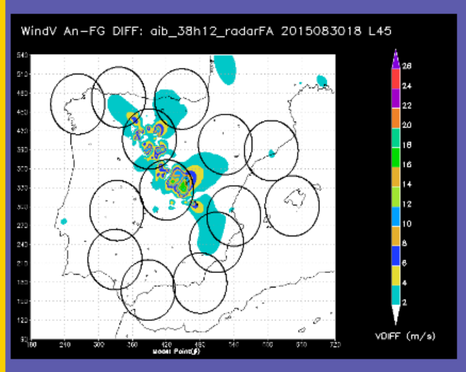
The **assimilation of reflectivity and Doppler wind data from the AEMET C-band radar network in the mesoscale NWP system HARMONIE** is now close to operational status. The last phase of development has focused on:

- Implementation of an effective and efficient **radar data quality control**
- **Parallelization** of the assimilation algorithm
- **Integration in the HARMONIE data flow** together with the rest of observations, either conventional or remote sensed
- **Evaluation of the impact** on operational verification skill scores, considering also the utilization of new verification metrics better suited to NWP-NWC (NWP for NowCasting), with emphasis on precision rather than on uncertainty



Snapshot of assimilation increments on the wind field as a result of assimilation of Spanish radar data on the 30th of August 2015 18UTC when an intense precipitation band was crossing from SW to NE the Iberian Peninsula. Noteworthy is the small scale of these increments, comparable to the radar data resolution

DYNAMICS

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With upper boundary conditions (LUNBC) the predictor-corrector (LPC_FULL) scheme is not needed.

The integral and derivative are not necessary invertible in LGWADV=.F., an independent choice of knots is chosen for RINTE and for RDERI, RDDERI what reduces the noise of their output.

We develop matrices RVFEG, RVFES, RVFEN to be used inside sigam.F90, sitnu.F90 and their associated subroutines in the non linear model. They satisfy the C1 constraint through its factorized version (G*-1)(S*-1)=(1-N*), the operators which relate exactly the two basis used are (G*-1), (S*-1) and (N*-1). The basis functions are not B-splines but $(\partial^*+1)\ N_{ik}$ and $-\partial^*\ N_{ik}$.The vertical laplacian L* is computed using RDERI and RDDERI

Two experiments have been submitted in version Harmonie version 40h1.1.beta.2 with domain IBERIA_2.5, 91 vertical levels, LNHDYN=.T., LSETTLS=.T., LGWADV=.F. during a week of dates. The scores are very similar in both cases but is needed a good choice of levels as pointed out by P. Smolikova in ASM2015 (Option LPC_FULL=.T. have been tested giving absurd values in mslp bias)

finite differences

finite elements + c1 operators

(code not in 40h1.1.beta.2)