GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE
AEMet Agencia Estatal de Meteorología

# γ-SREPS: AEMET new Mesoscale Ensemble Prediction System


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**Reunión del Proyecto PREDIMED**
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# Introduction

- AEMET is running an EPS called SREPS from 2006.
  - Multimodel:
    - Hirlam
    - HRM from DWD
    - UM from UKMO
    - LM (COSMO Model)
    - MM5 (suspended in 2011)
  - Multiboundaries:
    - ECMWF
    - GSM from JMA (Japan Meteorological Agency)
    - GFS from NCEP
    - GME from DWD (German Weather Service)
    - CMC from SMC (Canadian Weather Service)

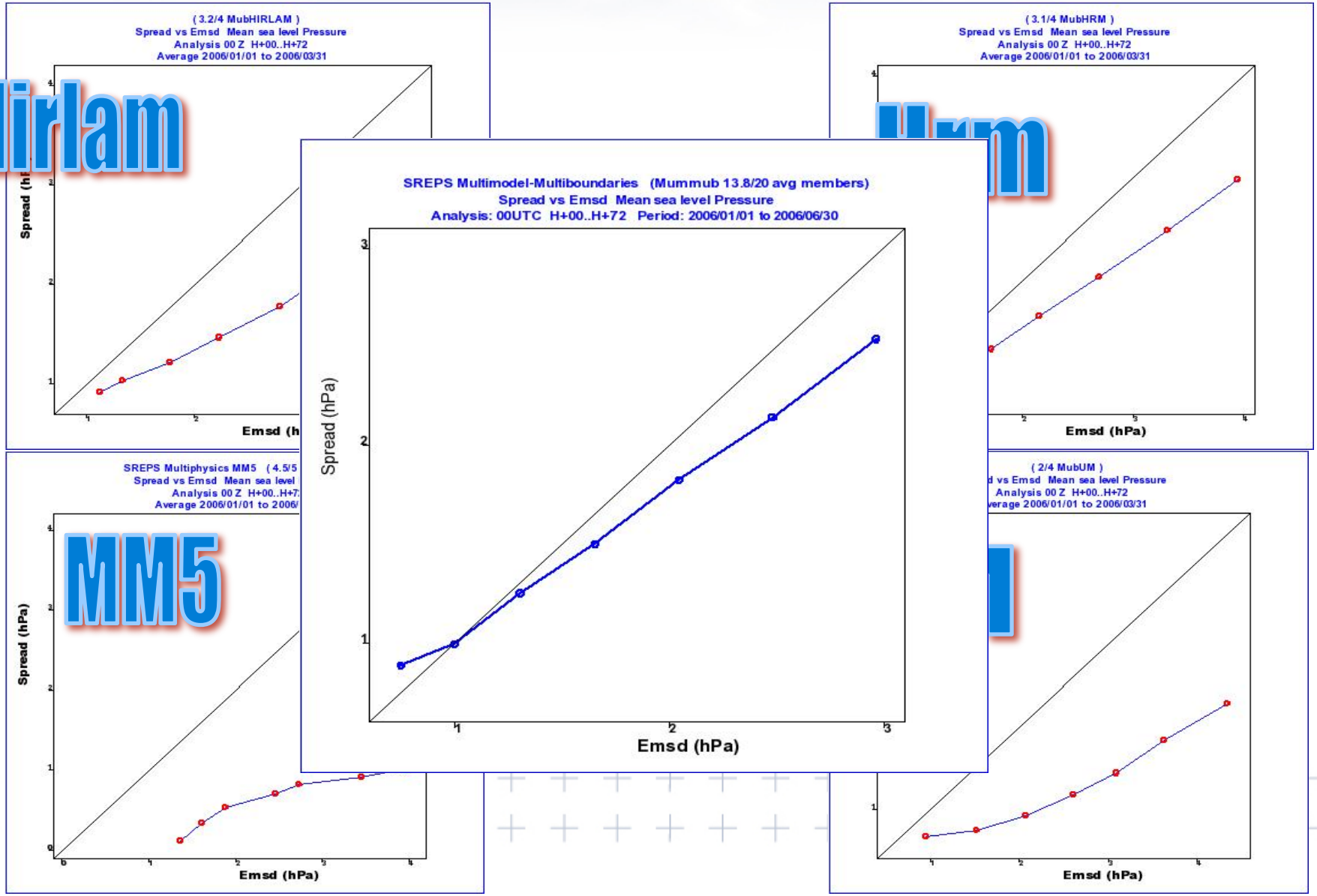
# Introduction II

- Characteristics:
  - 72 hours forecast two times a day (00 & 12 UTC).
  - Characteristics:
    - 4 models.
    - 5 boundary conditions.
    - 2 latest ensembles (HH & HH-12).
  - 20 member ensemble every 12 hours
  - Time-lagged Super-Ensemble of 40 members every 12 hours.
  - 0.25 deg (~25 Km horizontal resolution)

# What we have learned from SREPS

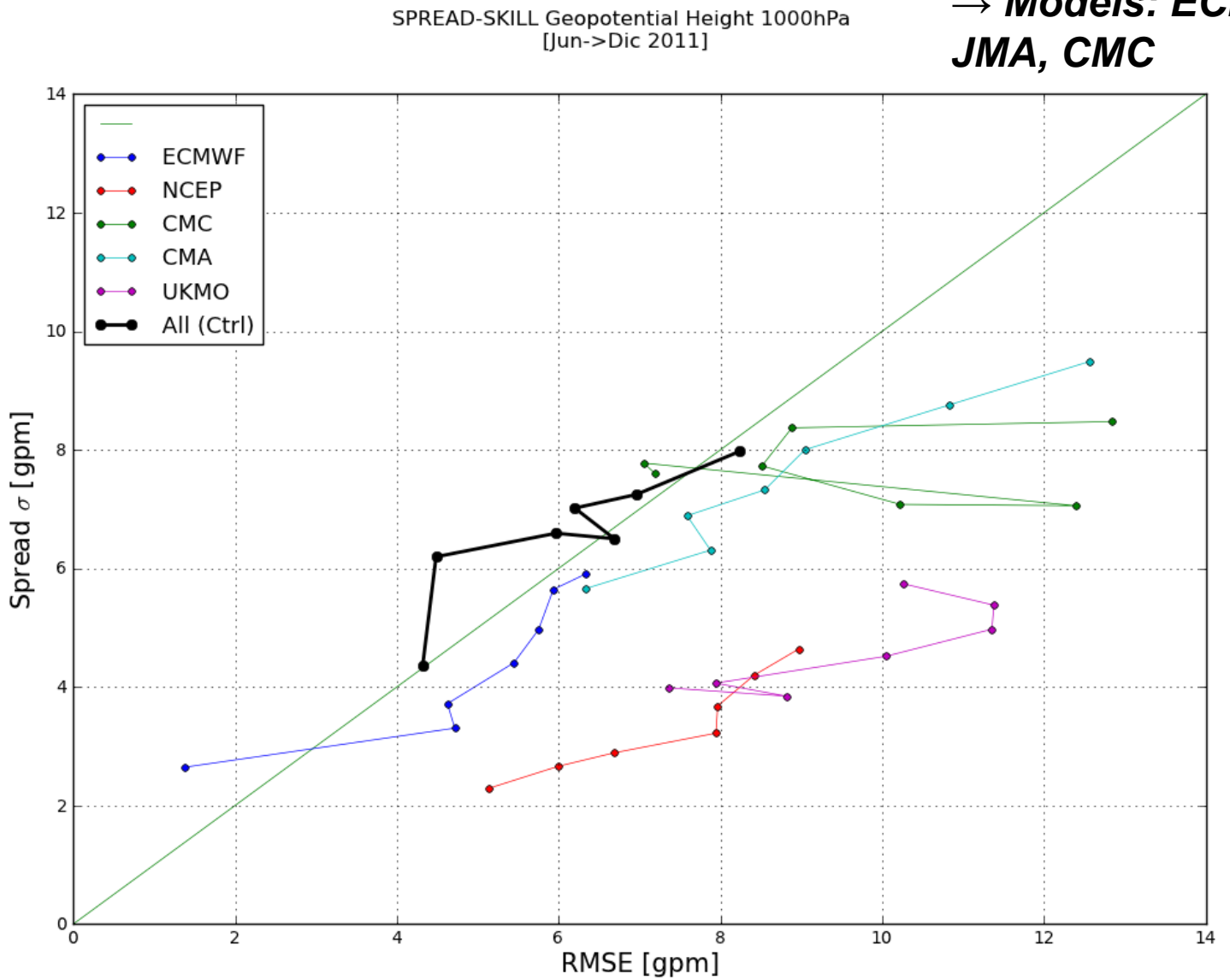
- Multimodel is the best strategy looking for model perturbations.
- Using different global models for boundaries give the best spread in the short range.
- Tim-lagged super-ensembles give additional quality almost for free.
- The number of EPS members saturates after around 25 for short range forecasting
- Resolution matters.

# Single model Ensembles (4 members each)

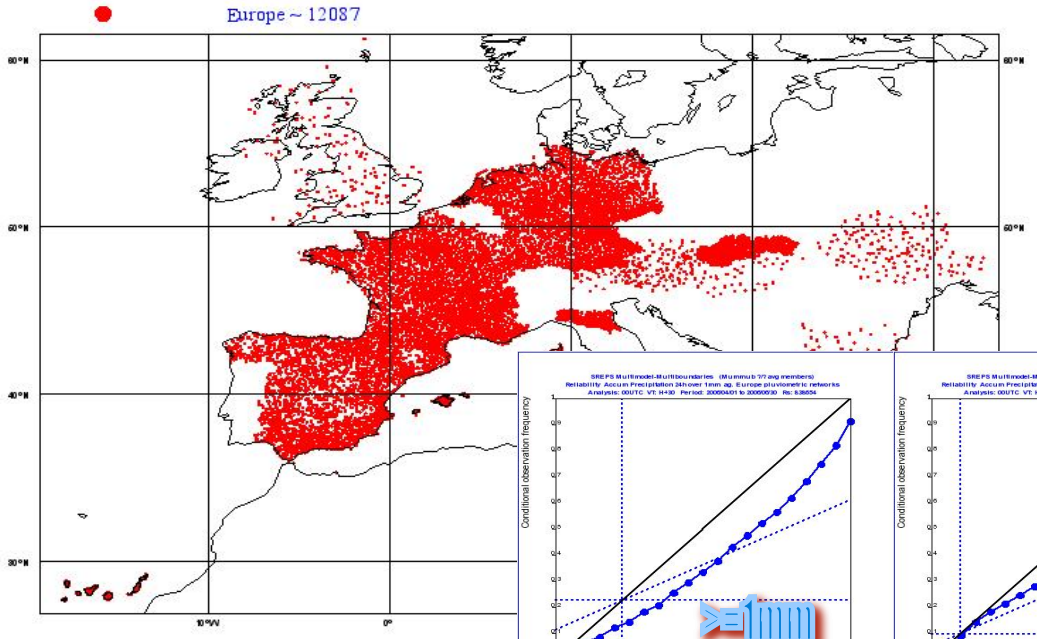


# Global models for boundaries (TIGGE)

***Spread-Skill (Jan-Dec 2011) → Models: ECMWF, NCEP, JMA, CMC***

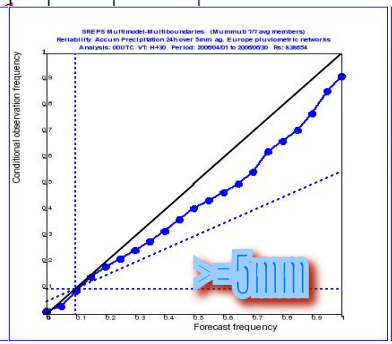


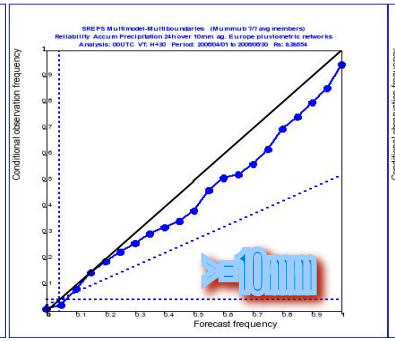
# Europe pcp networks 2006

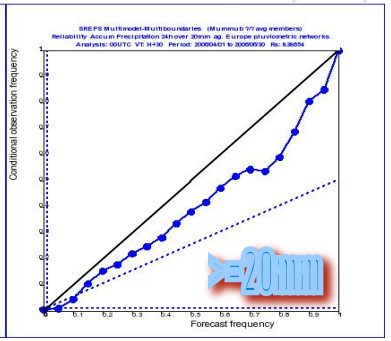






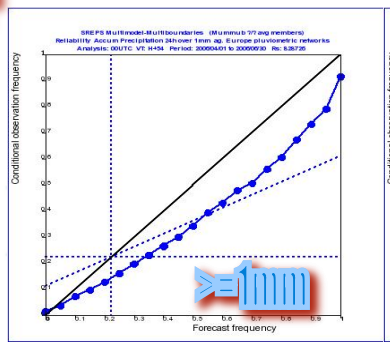


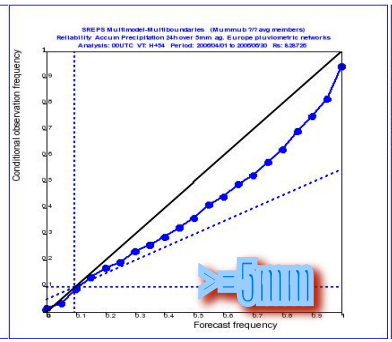



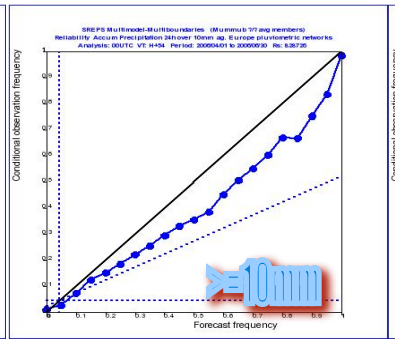



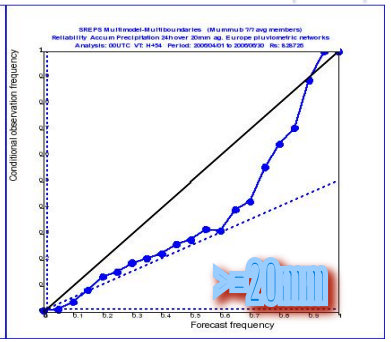

# H+30

# H+54



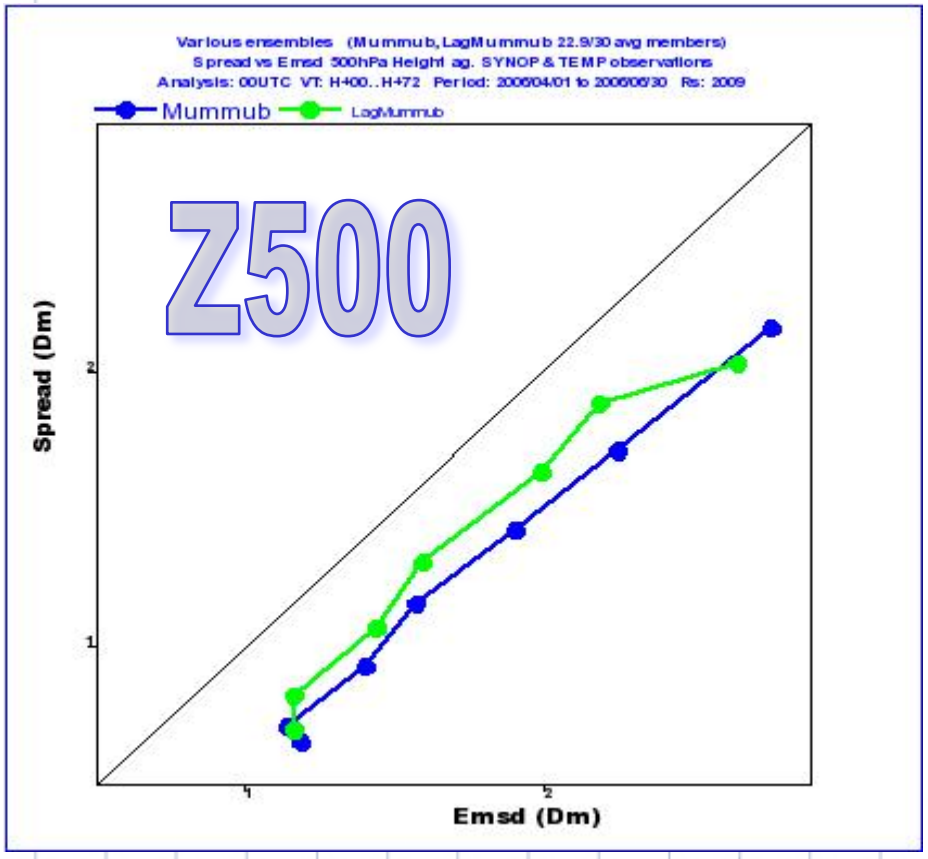



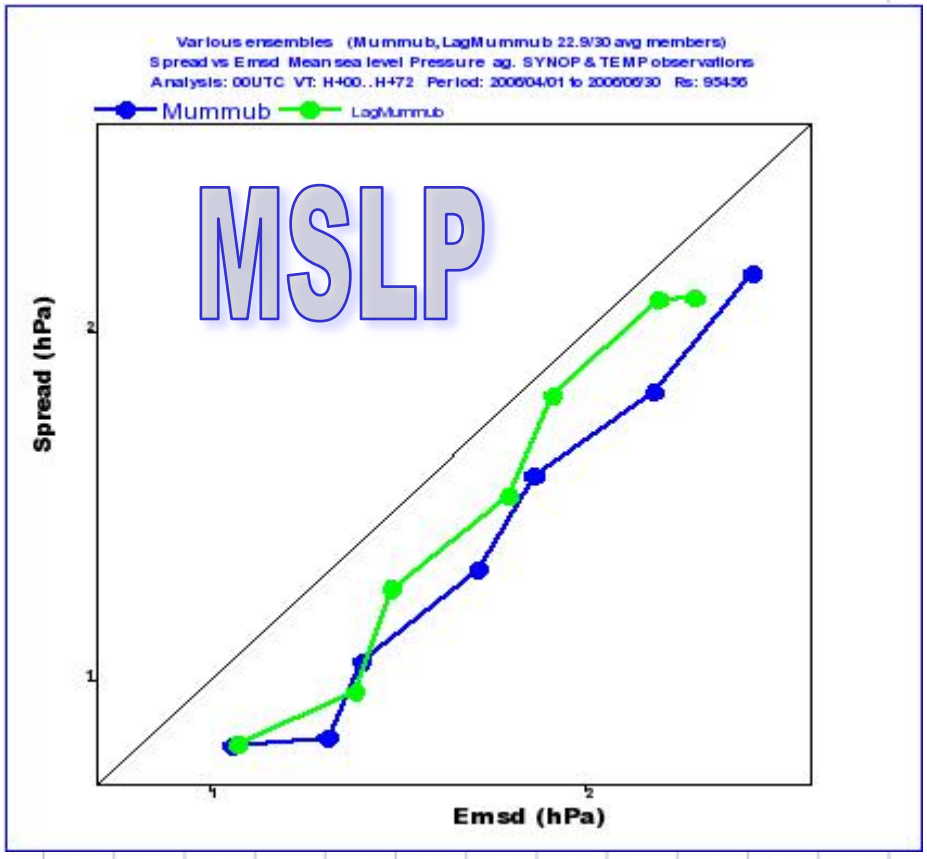



# Time-lagged super-ensemble - Spread-skill

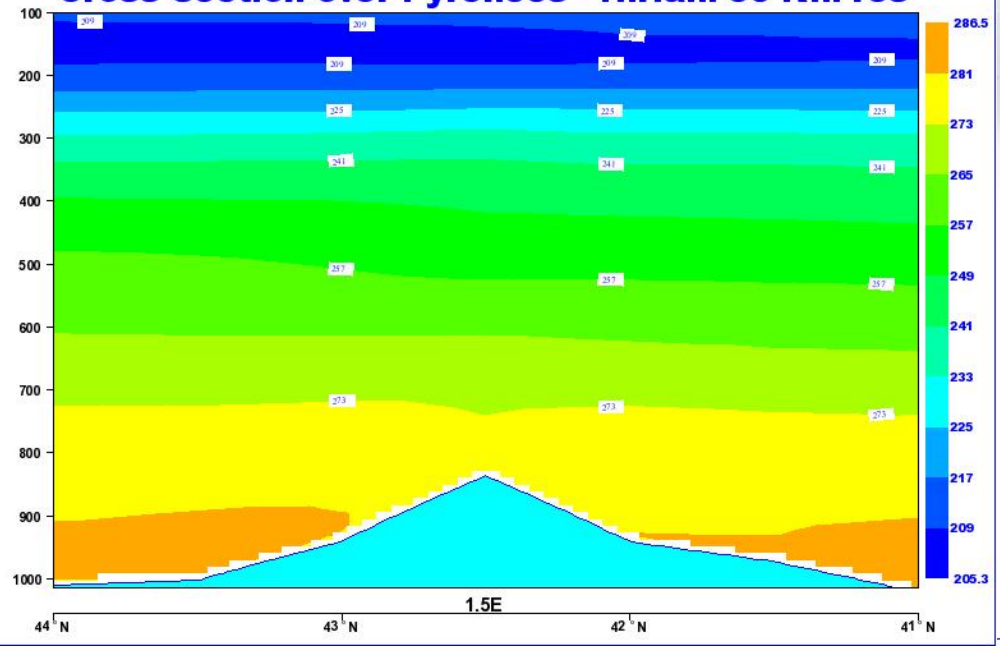
Green - SE-SREPS

Blue - SREPS

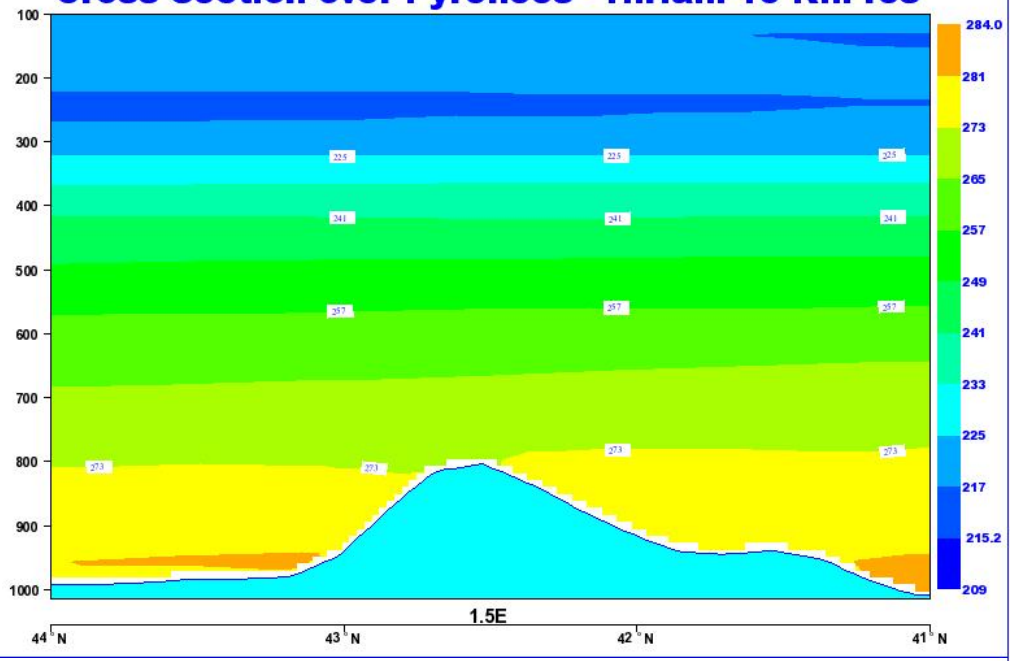


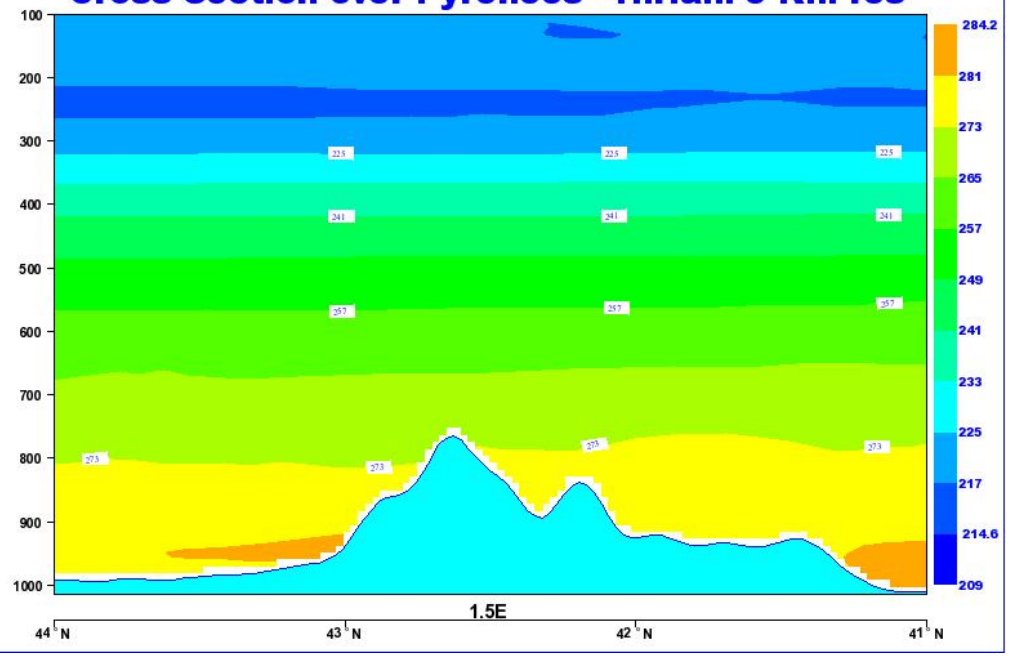
## Cross Section over Pyrenees - Hirlam 50 Km res



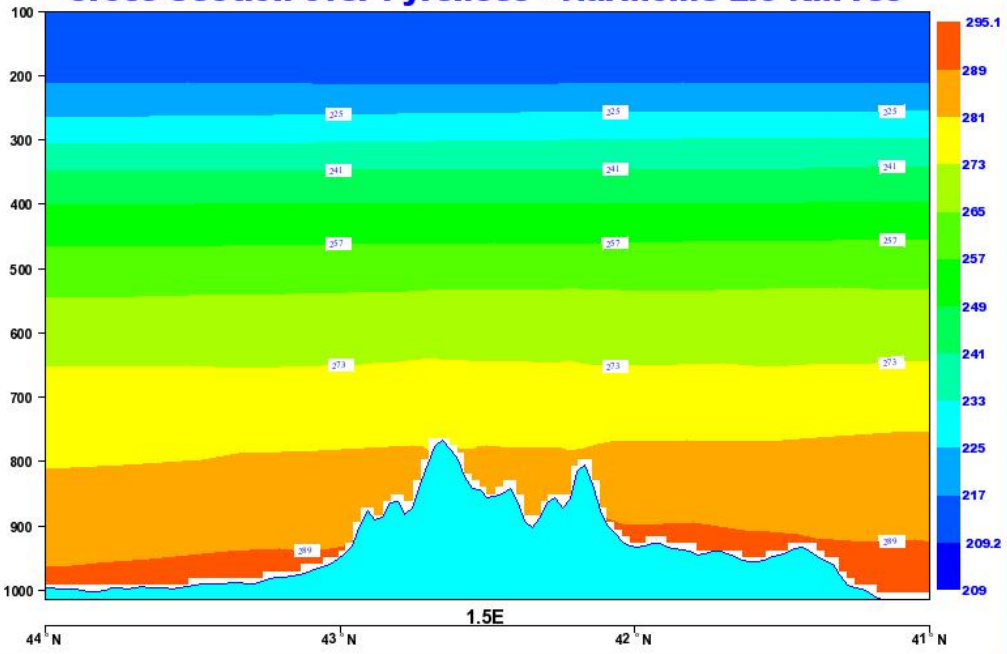

## Cross Section over Pyrenees - Hirlam 16 Km res




## Cross Section over Pyrenees - Hirlam 5 Km res

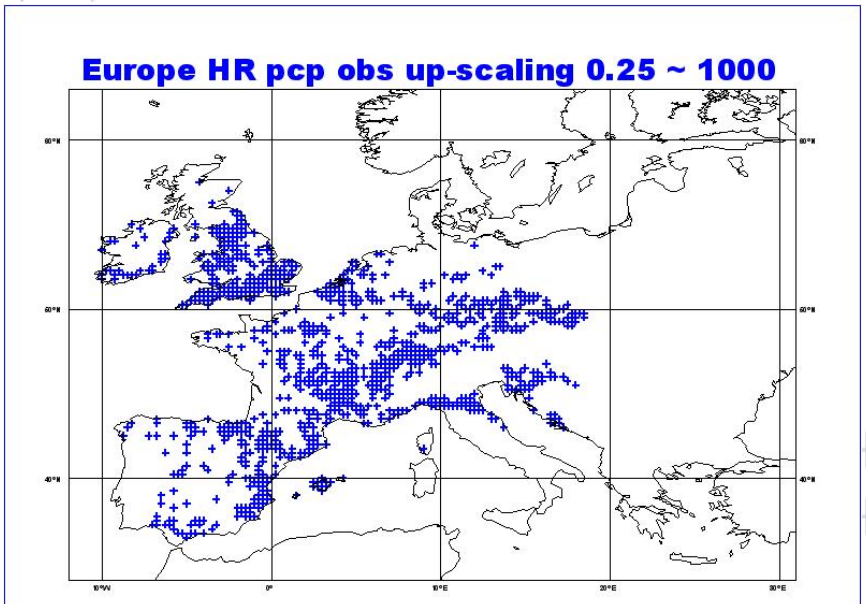


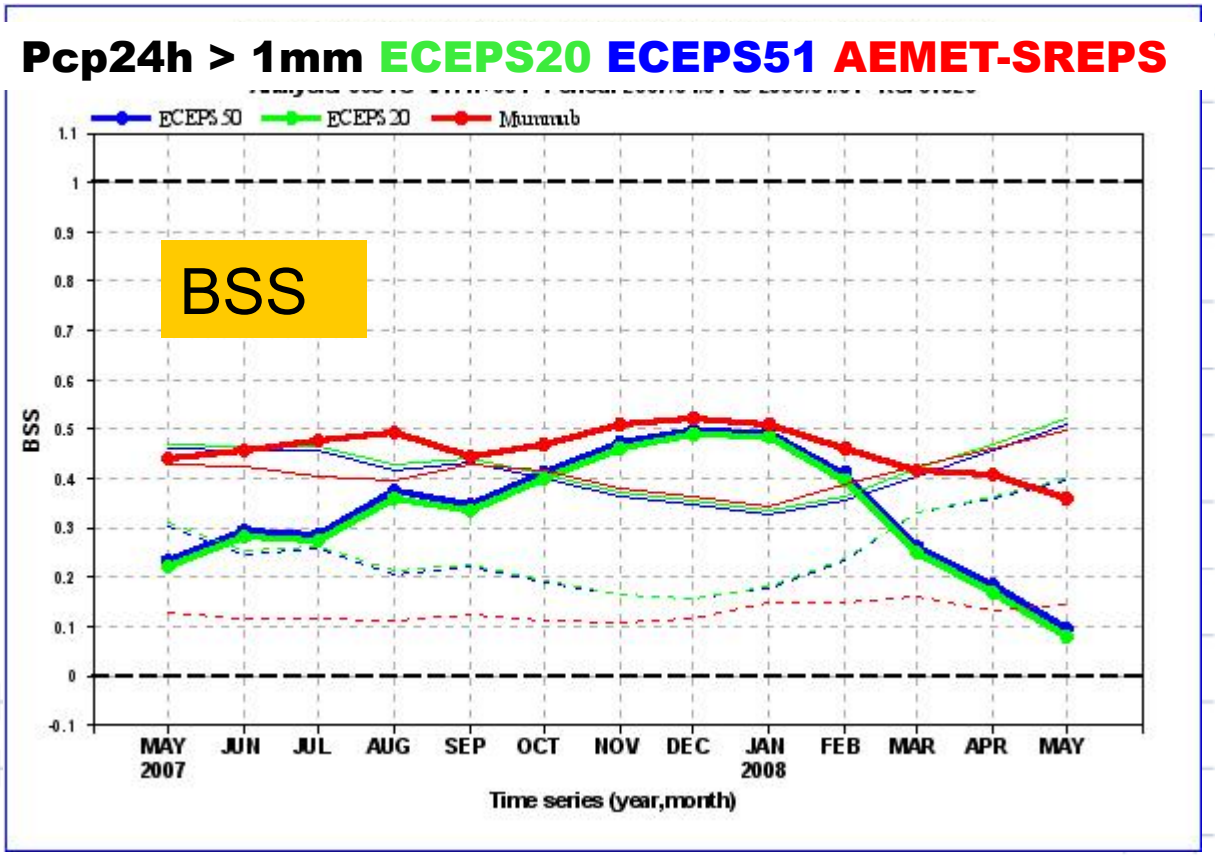

## Cross Section over Pyrenees - Harmonie 2.5 Km res



# Added value ECMWF EPS

- **Better performance** due to resolution and ensemble features: using pcp up-scaling over Europe and observational uncertainty method, SREPS shows better reliability, discrimination, etc. (2006-2010)

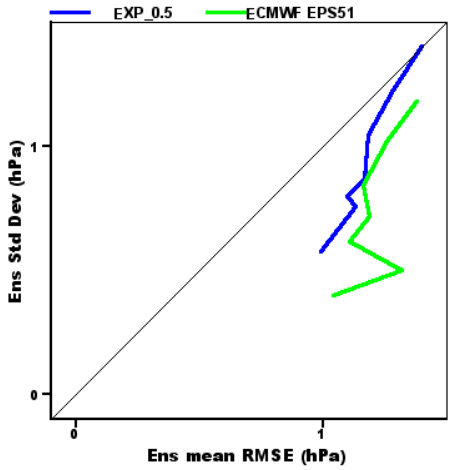


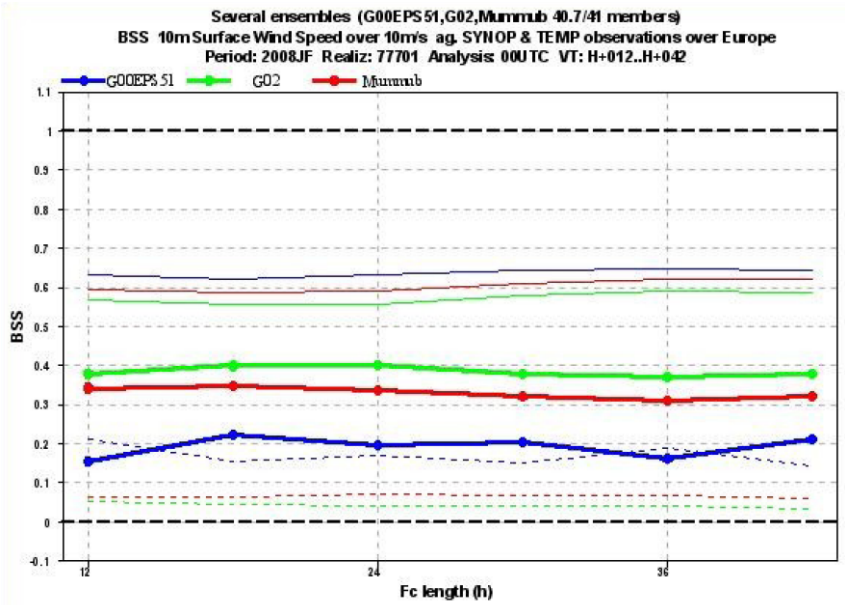



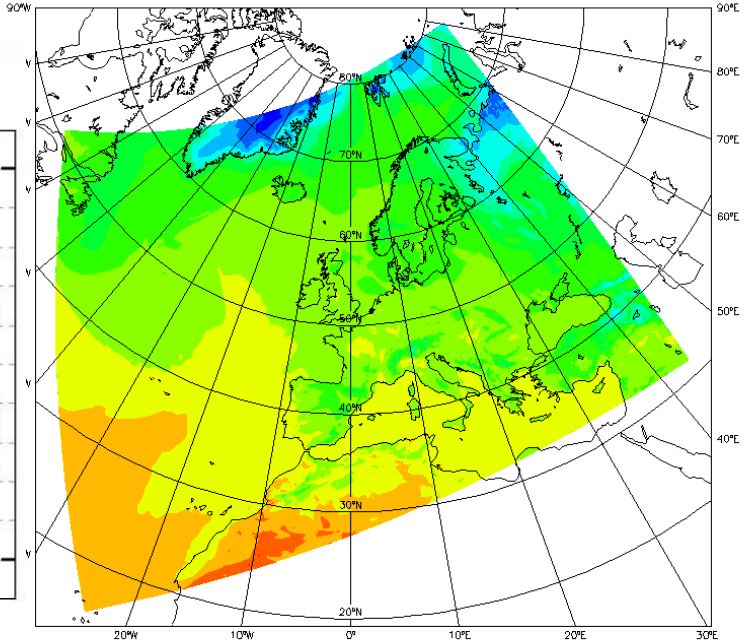
# Comparisonn with GLAMEPS

- Grand Limited Area Model Ensemble Prediction System
- HIRLAM – ALADIN pan-european ensemble, since 2006
- Norway, Sweden, Finland, Denmark, Belgium, Netherlands, Hungary, Spain, Ireland

- Current GLAMEPS settings
- Multi-model: Hir_Straco, Hir_K.Fritz, Aladin, ECEPS_subset
- ICs: downscaling ECMWF EPS (i.e. SVs + EDA)
- 10 km (GLAMEPS)
- Short range: 06 & 18 UTC, T+54
- Better performance than ECMWF & AEMET-SREPS

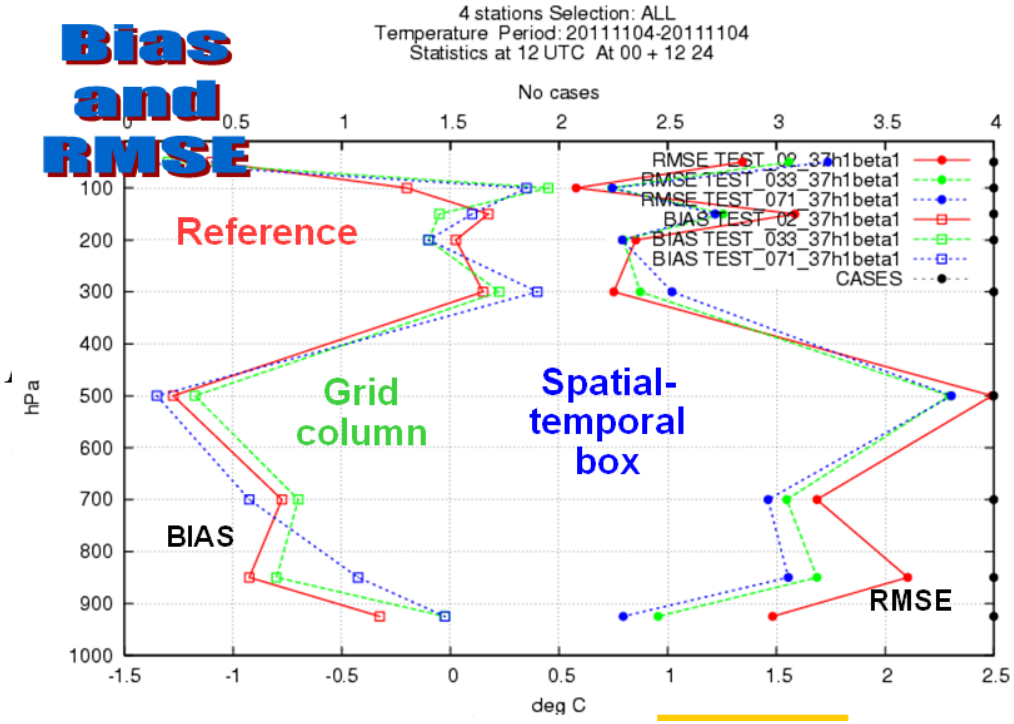


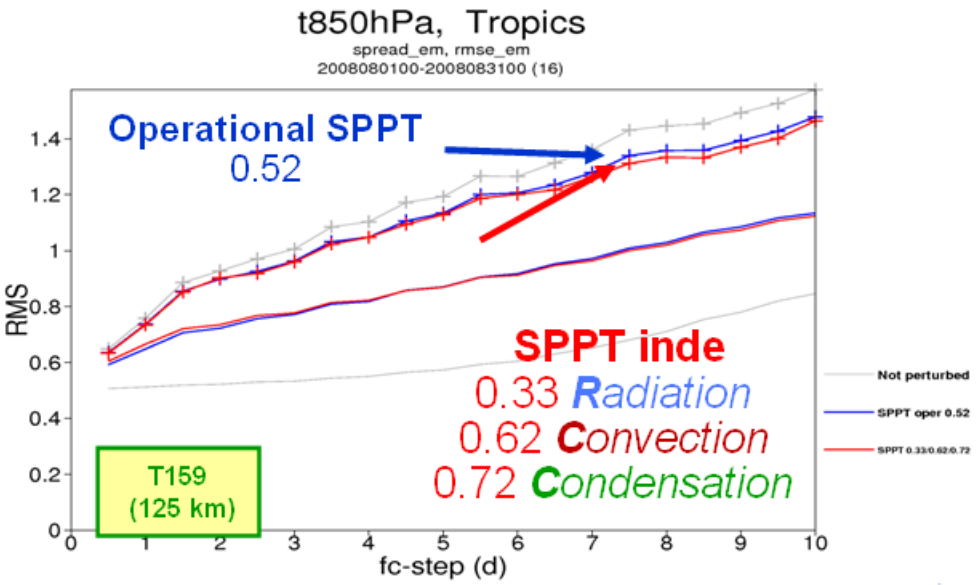



# SPPT

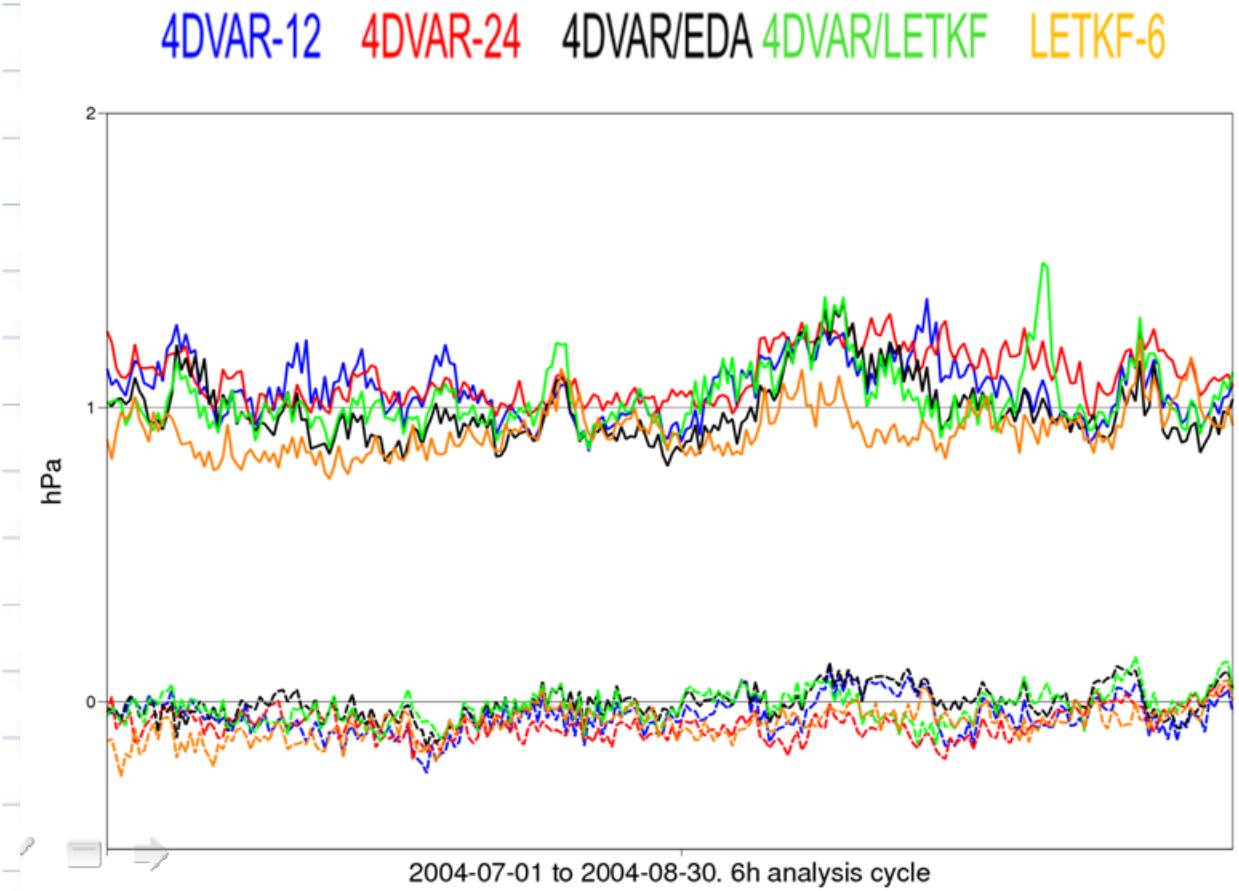
- Bias and RMSE of a parallel test of Harmon-EPS using Box-SPPT



# LETKF

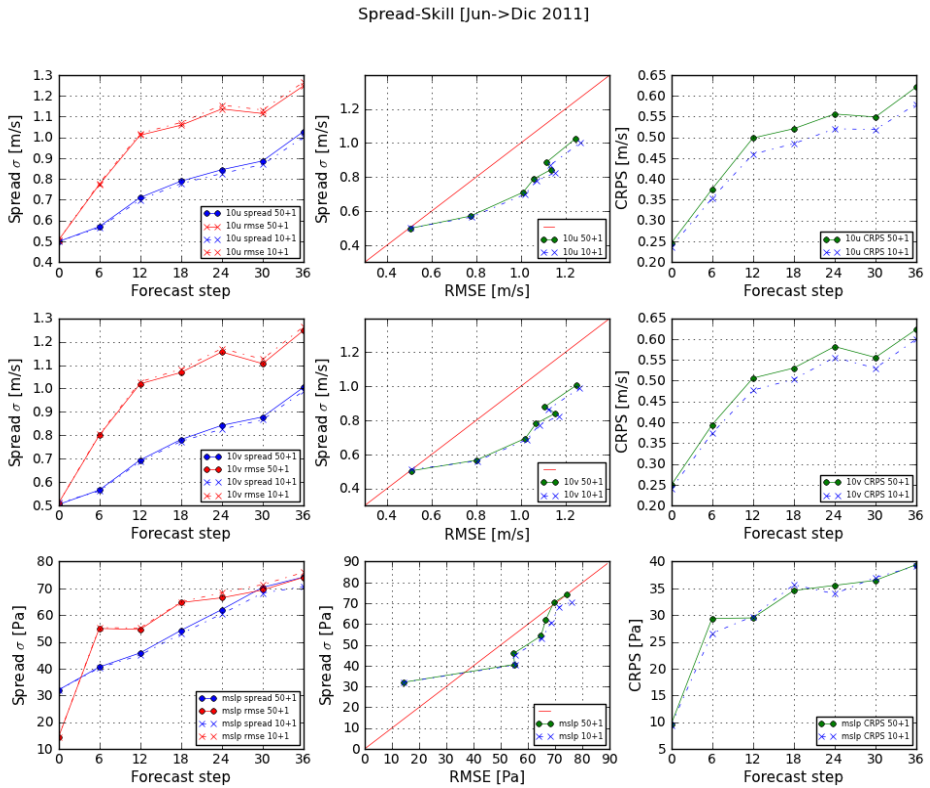
- **P Escribà: LETKF in Harmon-EPS**
- Local Ensemble Transform Kalman Filter (LETKF, Hunt et al., 2007).
- **6 months visit ECMWF**: M. Bonavita, M. Hamrud and L. Isaksen, comparing 4DVAR, LETKF and hybrids (EDA), in IFS (ECMWF) for analysis, assimilating only surface pressure
- Working on the migration of IFS LETKF to Harmonie system to use it as analysis scheme and generator of initial states for EPS at kilometric scale




2-months MSLP RMSE and BIAS time series for 5 analysis schemes available in IFS, assimilating only surface pressure at T159. In this case LETKF performs the best

# Perturbations LBCs

- **J Sancho: perturbations LBCs**
- **ECEPS_raw**: 51 members ECMWF EPS
- **ECEPS_rnd10**: 10 members rnd selected
- **ECEPS_DA10**: 10 members from EDA
- **ECEPS_tub10**: 10 tubing clusters
- **TIGGE_4**: 4 TIGGE from TIGGE: ECMWF, CMC, UKMO, GFS
- **EC_SLAF**: 9 members using SLAF applied to ECMWF deterministic T1279
- **AEMET_4**: 4 GCMs from AEMET_SREPS
- **Spread-error assessment**



# Perturbations LBCs

- J Sancho: perturbations LBCs Spread - error assessment
- *TIGGE Global models: ECMWF, NCEP, CMC,CMA,UKMO*

| Experiment | Ensemble Description | Members |
|---|---|---|
| Tigge_5 | *5 control members (T+00), one for each global model* | *5 control* |
| Tigge_15 | *5 control members (T+00) and 2 perturbed members (T+00) for each model* | *5 control + 2x5 perturbed =15* |
| TiggeSlaf_10 | *5 control members (T+00) and 5 control forecast (T+12) forming a Lagged Average Forecasting (LAF)* | *5 control + 5 fc(T+12) =10* |
| TiggeSlaf_15 | *5 control members (T+00) and 10 control forecast (T+12, T+24) forming a LAF* | *5 control + 5 fc(T+12) + 5 fc(T+24) =15* |
| TiggeFc_5 | *5 control forecast (T+06) LAF* | *5 fc(T+06)* |
| TiggeFc_10 | *10 control forecast (T+06, T+18) LAF* | *5 fc(T+06) + 5 fc(T+18) =10* |

# Harmonie - AEMET

- Running at ECMWF HP Computer (IBM- Cray)
- 4 times a day (00, 06, 12 and 18 UTC) up to 48 hours forecast.
- 60 levels in the vertical and 2.5 km of horizontal resolution Time step of 60 seconds
- Lateral boundary conditions from ECMWF global model
- 3DVAR scheme for data assimilation
- Results for case studies are quite encouraging
- Plans to run at home in 2015 when the new AEMET HP Computer will be available

# WRF - AEMET

- Well-known model (http://www.wrf-model.org/index.php)
- Running at ECMWF HP Computer (Cray)
- Non-hydrostatic.
- Physics for mesoscale.
- 60 levels in the vertical and 2.5 km of horizontal resolution Time step of 60 seconds
- Lateral boundary conditions from ECMWF global model
- Initial conditions: downscaling ECMWF global model
- First results for case studies are quite encouraging

# γ-SREPS

- Multimodel:
  - Harmonie
  - WRF
- Multiboundaries (Global models + SLAF):
  - ECMWF
  - GSM from JMA (Japan Meteorological Agency)
  - GFS from NCEP
  - CMC from SMC (Canadian Weather Service)
  - GME from DWD (German Weather Service)
  - Arpege from MeteoFrance (prov)

# γ-SREPS II

- 36 hours forecast four times a day (00, 06, 12 & 18 UTC)
- Characteristics:
  - 2 models.
  - 4*3 boundary conditions.
  - 2 latest ensembles (HH & HH-06).
- 24 member ensemble every 06 hours
- Time-lagged Super-Ensemble of 48 members every 6 hours.
- 2.5 km horizontal resolution
- LETKF for ICs perturbations
- SPPT for model perturbations
- Calibration – Extended Logistic Regression (ELR)
- Focused on surface parameters (Precip, 2mT, 10mwind)