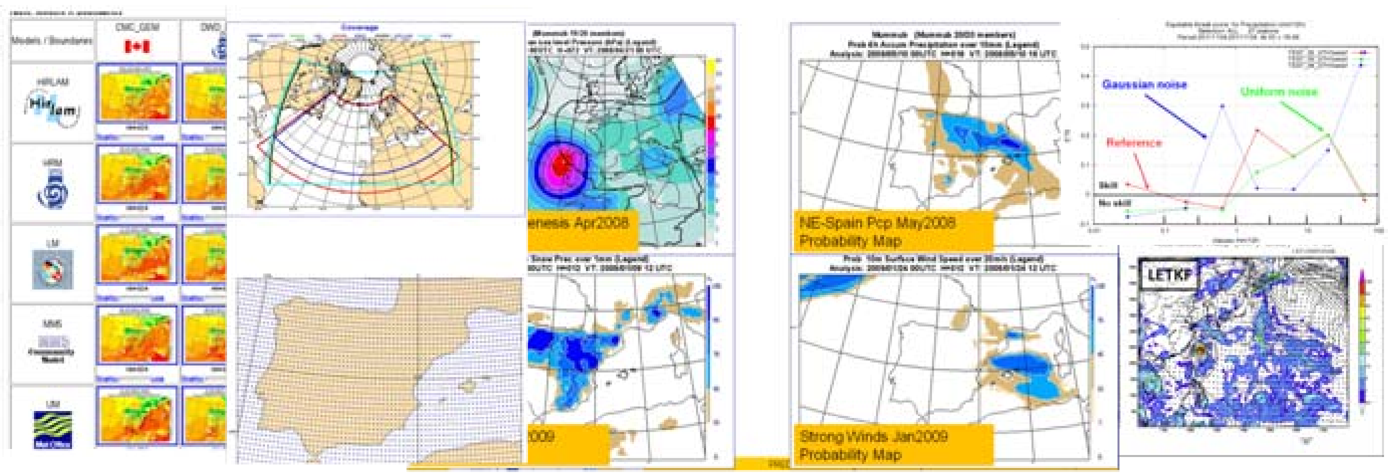
AEMET-SREPS status & plans

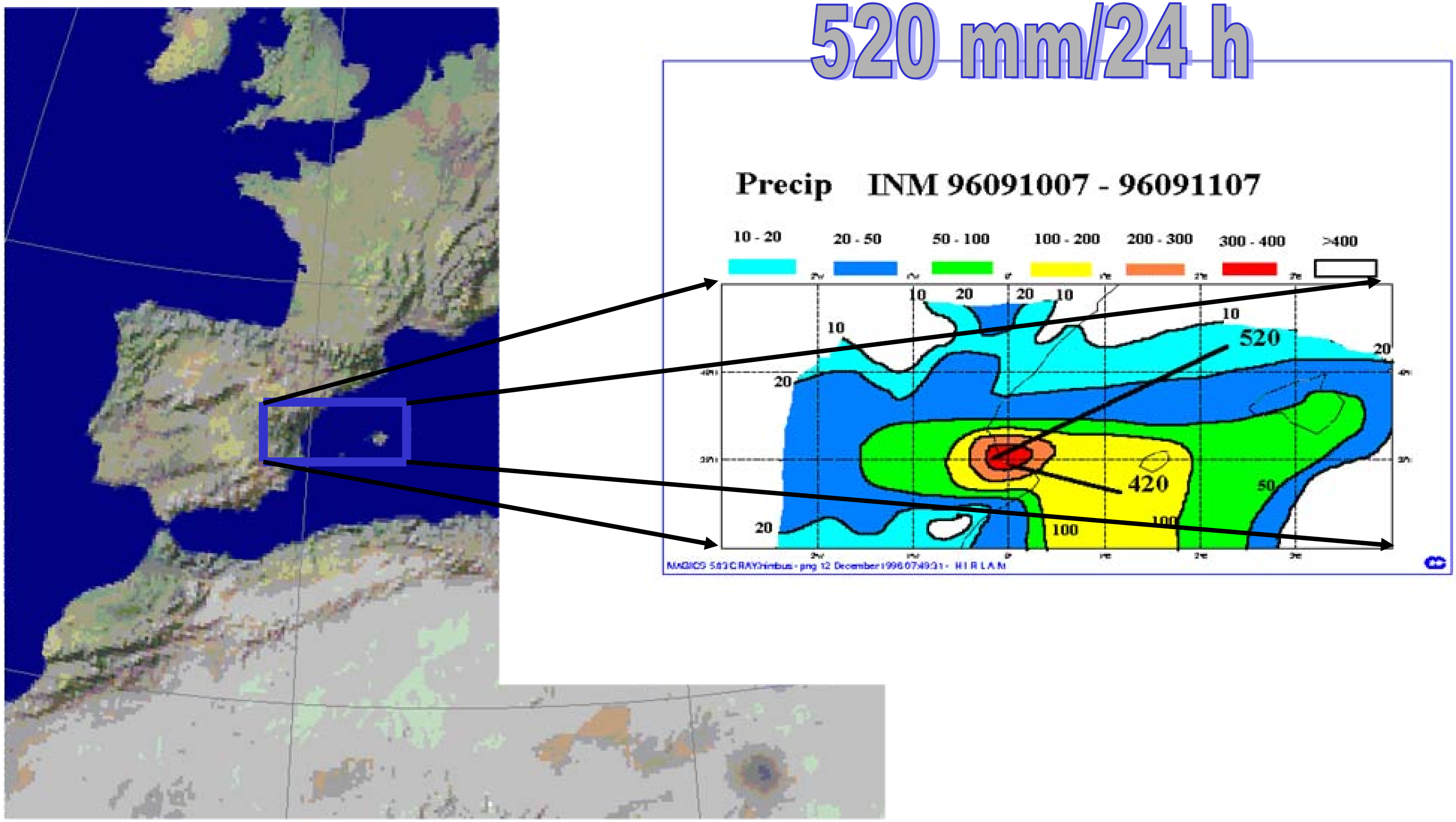


Carlos Santos – AEMET (Spain), Predictability Group, NWP Apps
AA: I. Martínez ← J.A. García-Moya
Predictability Group: A. Amo, A. Callado, P. Escribà, J. Montero, J. Sancho, D. Santos, J. Simarro
Acknowledgements: J. A. López, A. Chazarra, O. García, J. Calvo, B. Navascués, Climatic Database Staff, Computer Systems Staff, member and cooperating states ECMWF
This work is partially funded by project PREDIMED CGL2011-24458 from the Spanish Ministerio de Ciencia en Innovación.

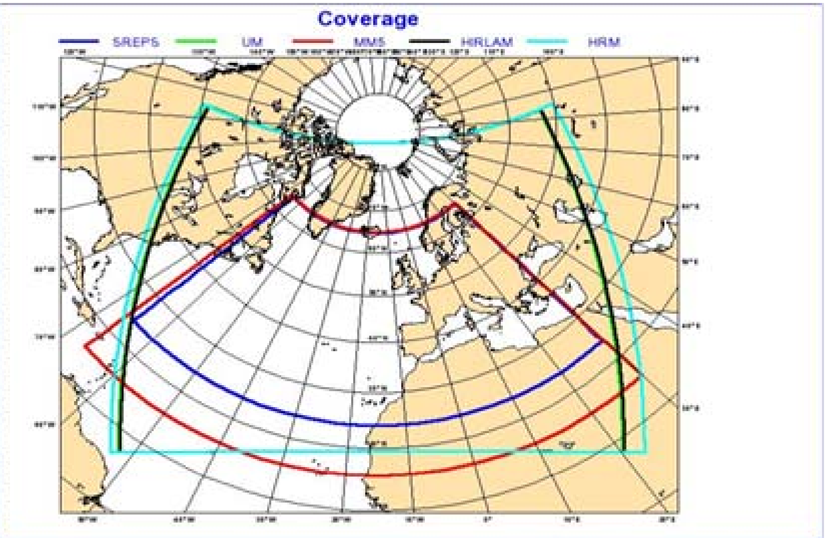
Outline

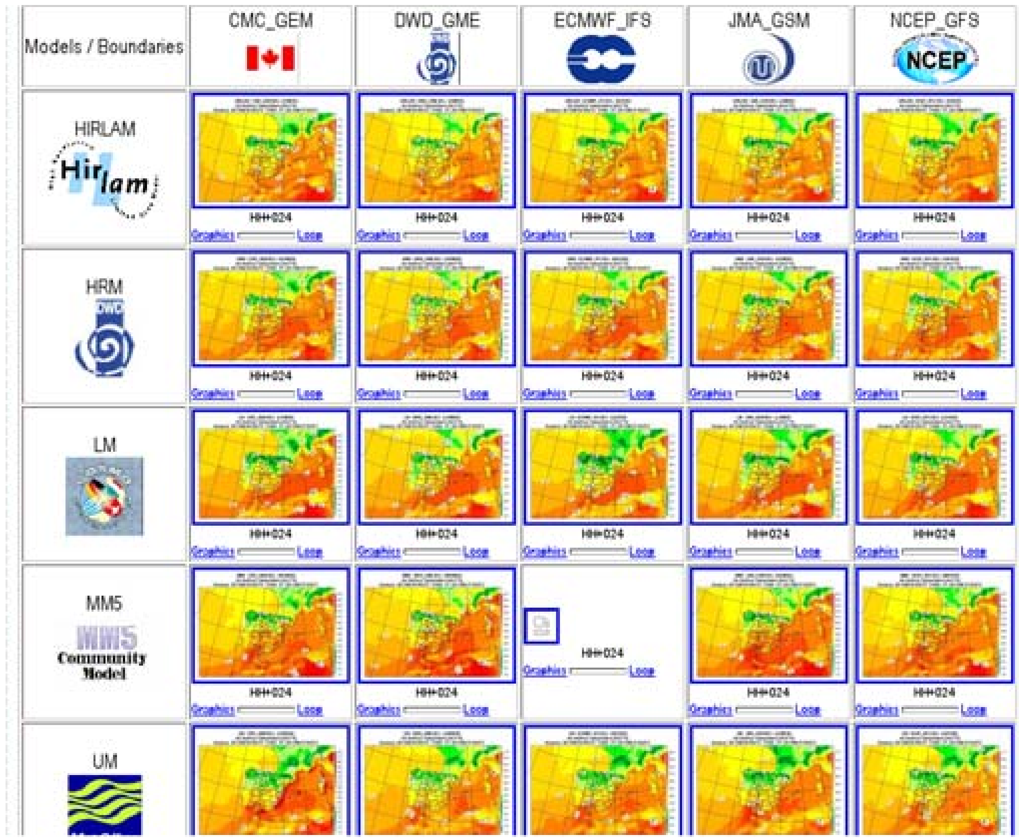
- AEMET-SREPS summary
- AEMET-γ-SREPS plans

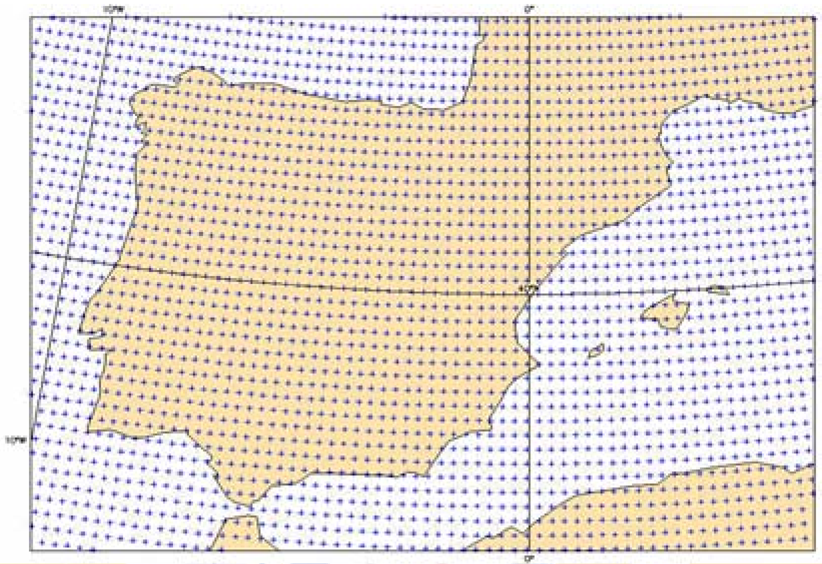
Why an EPS for SR?



AEMET Multi-model LAM SREPS

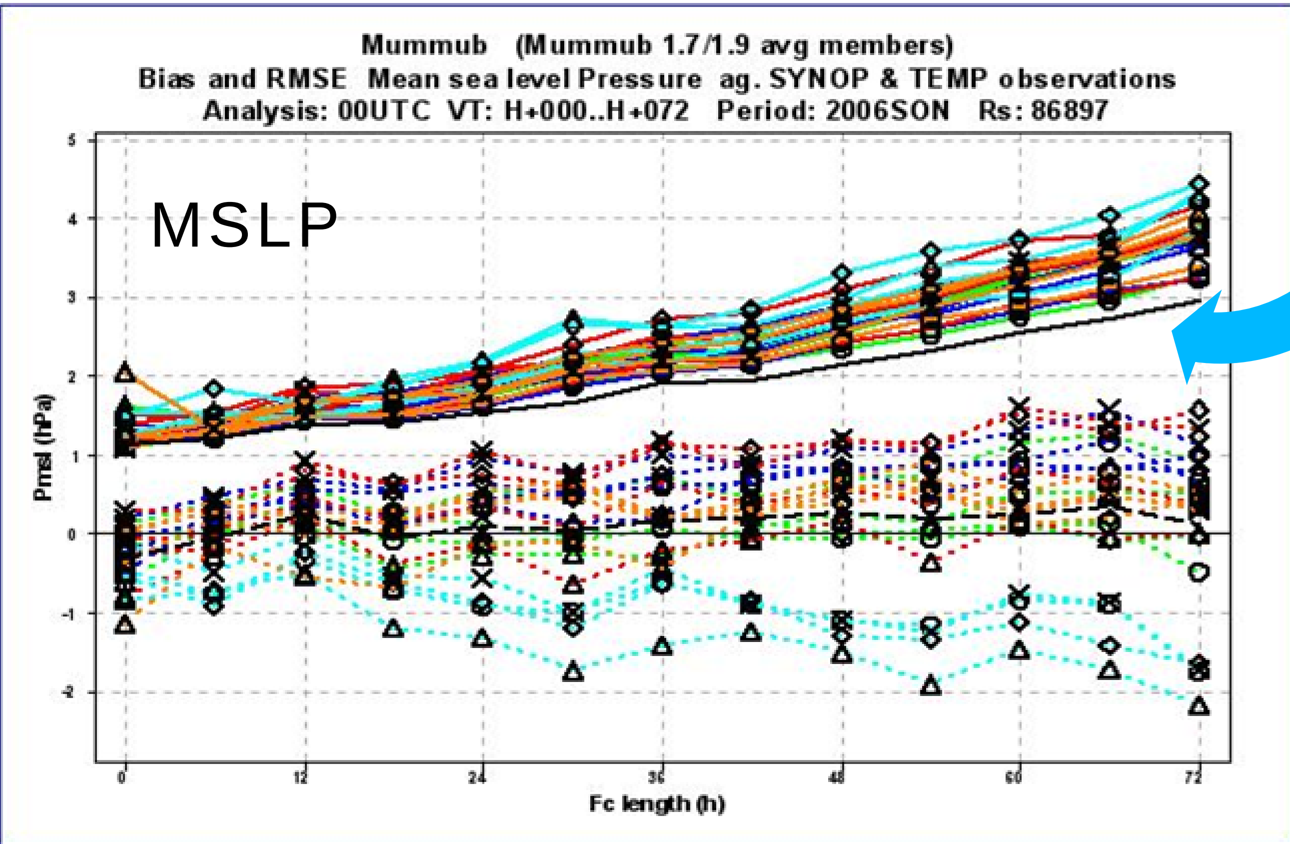


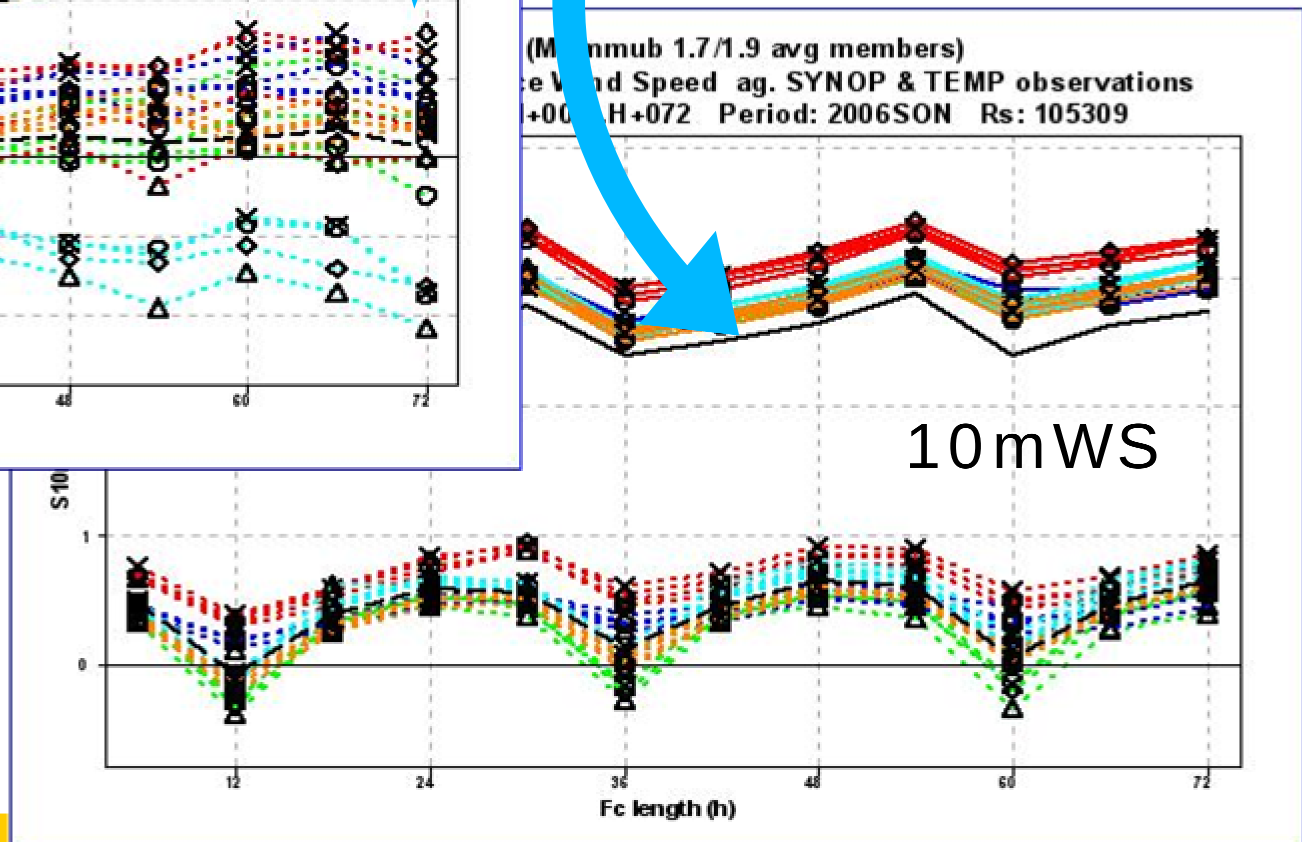




- 72 hours forecast range
- Twice a day (00,12 UTC)
- 4LAMs x 5IcBc = 20 members
- 0.25º ~ 25 km

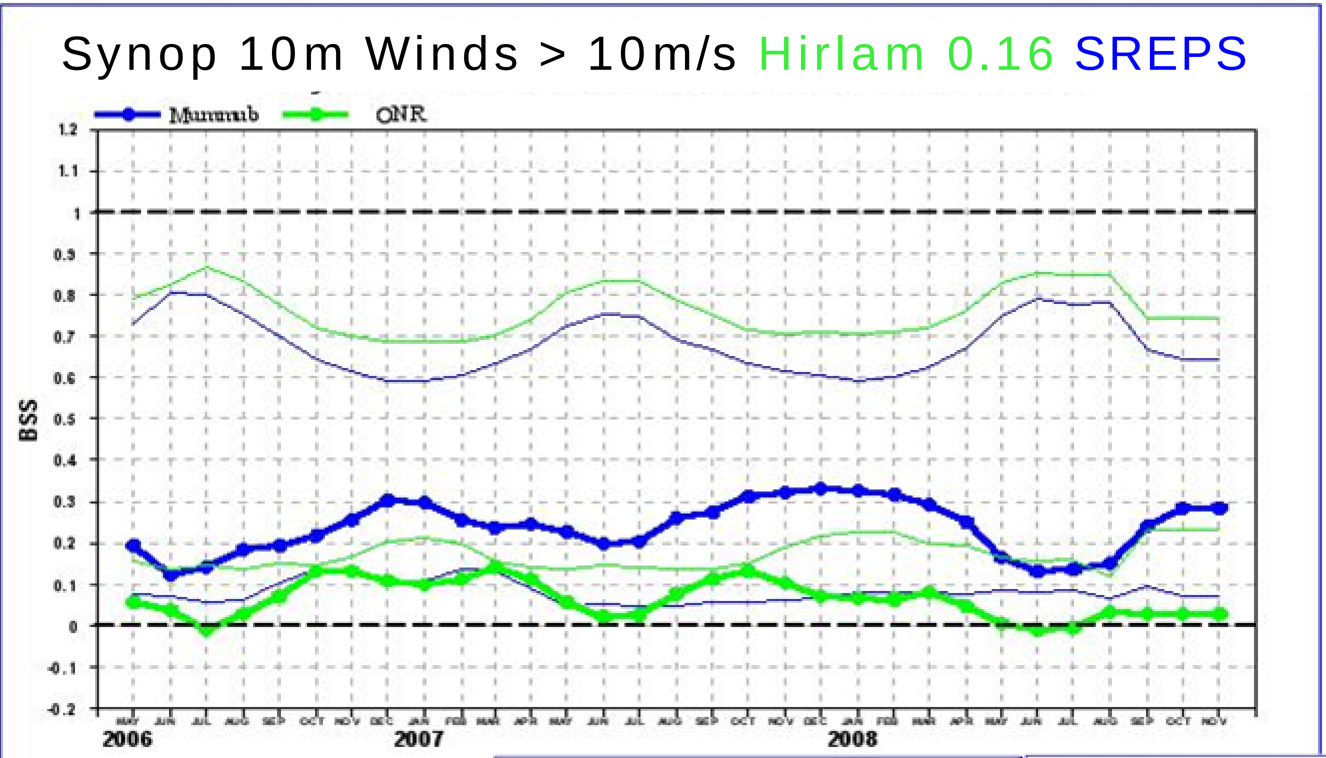
Tuning



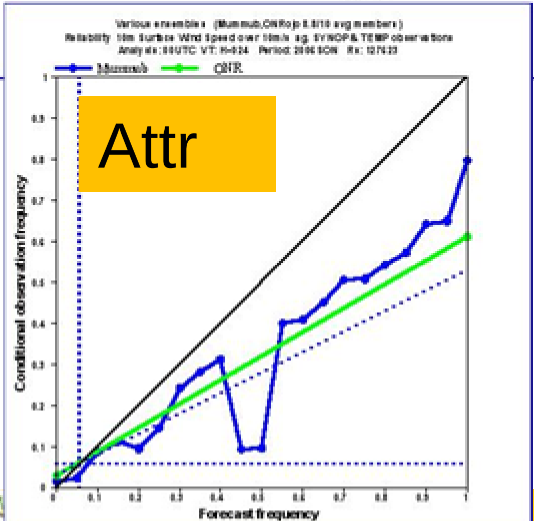


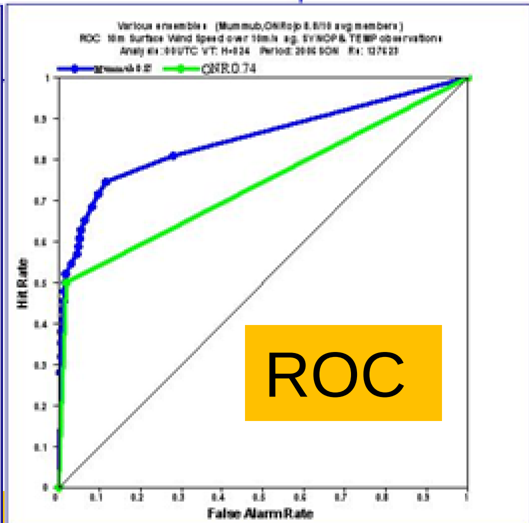
- Ensemble mean (black) performs better than any member

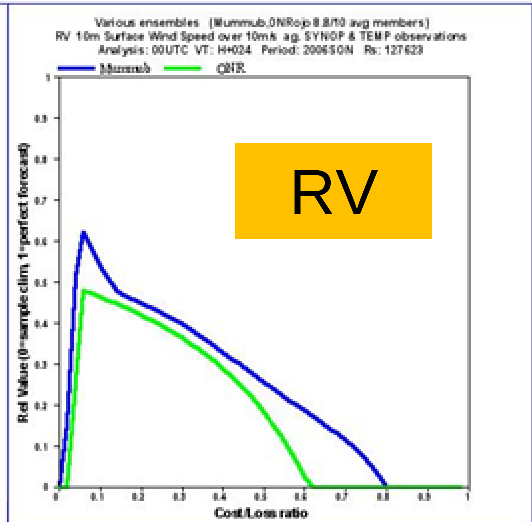
Added value w.r.t det. Hirlam



- Added value w.r.t. our deterministic model?
- SREPS purpose: **probabilistic forecasts**
- Better performance measures:
  - Better reliability & Resolution (BSS, Attr)
  - Better discrimination (ROC)
  - Higher relative Value (RV)

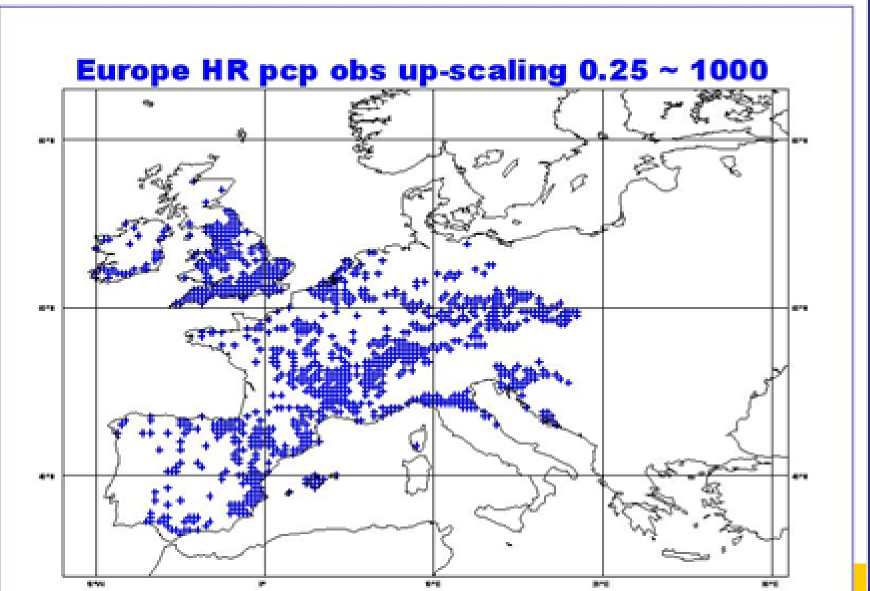




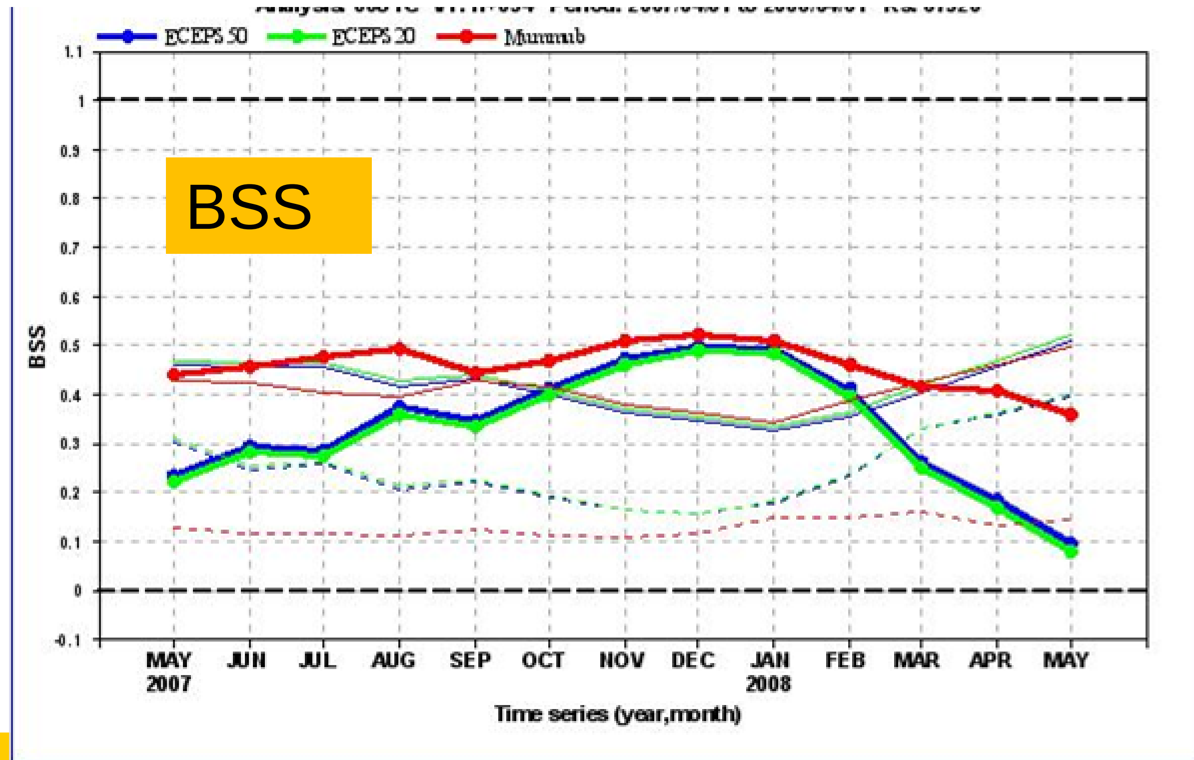


Added value w.r.t. ECMWF EPS

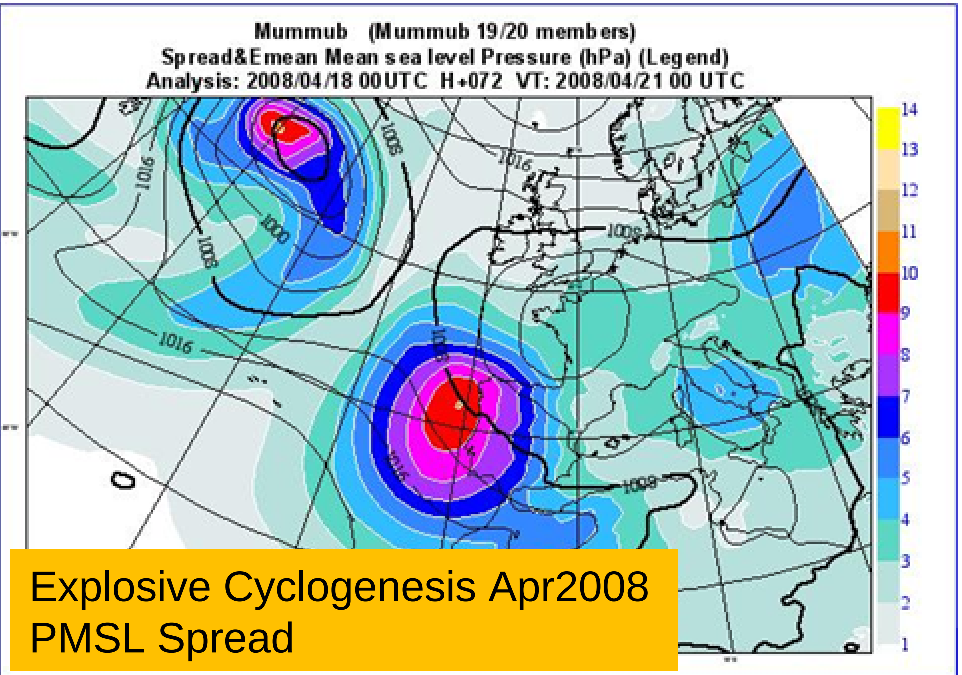
- Added value w.r.t. ECMWF EPS?
- SREPS covers the **SHORT RANGE**
- **Better performance** due to resolution and ensemble features: using pcp up-scaling over Europe and observational uncertainty method, SREPS shows better reliability, discrimination, etc.

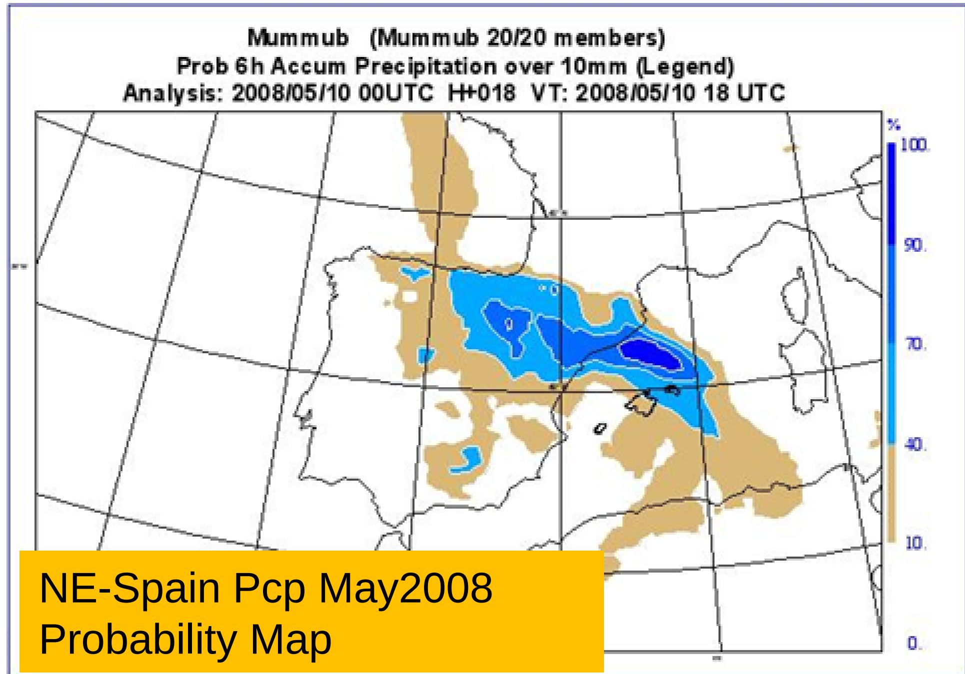


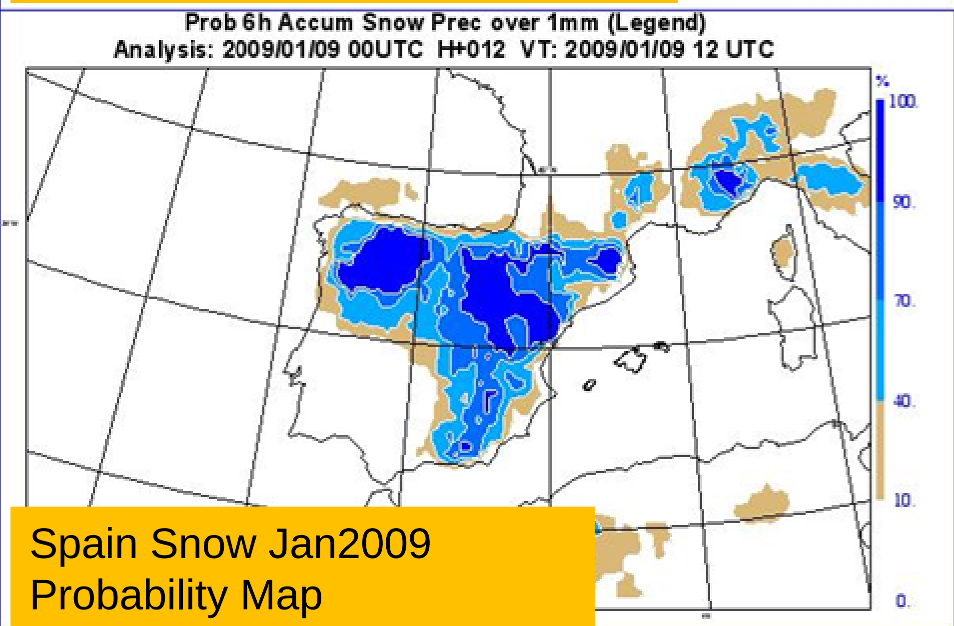
Pcp24h > 1mm ECEPS20 ECEPS51 AEMET-SREPS

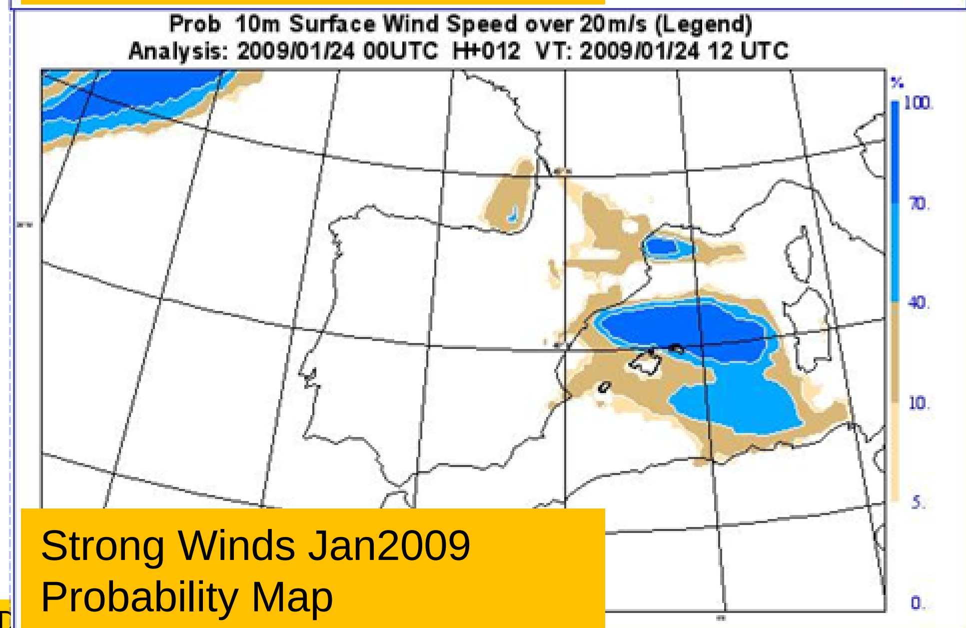


Case Studies









Relevant pubs

Ensemble Forecasting, chapter from Weather Forecasting, INTECH

GARCÍA-MOYA, J.-A., CALLADO, A., ESCRIBÀ, P., SANTOS, C., SANTOS-MUÑOZ, D. and SIMARRO, J. (2011), Predictability of short-range forecasting: a multimodel approach. Tellus A, 63: 550–563. doi: 10.1111/j.1600-0870.2010.00506.x

IVERSEN, T., DECKMYN, A., SANTOS, C., SATTLER, K., BREMNES, J. B., FEDDERSEN, H. and FROGNER, I.-L. (2011), Evaluation of 'GLAMEPS'—a proposed multimodel EPS for short range forecasting. Tellus A, 63: 513–530. doi: 10.1111/j.1600-0870.2010.00507.x

Santos, C. and Ghelli, A., 2011, Observational probability method to assess ensemble precipitation forecasts. Q.J.R. Meteorol. Soc., 138: 209–221. doi: 10.1002/qj.895

Callado, A., Santos, C., Escribà, P., Santos-Muñoz, D., Simarro, J., and García-Moya, J. A., 2011: Performance of multi-model AEMET-SREPS precipitation probabilistic forecasts over Mediterranean area, Adv. Geosci., 26, 133-138, doi:10.5194/adgeo-26-133-2011,

Escribà, P., Callado, A., Santos, D., Santos, C., García-Moya, J. A., and Simarro, J., 2011: Probabilistic prediction of raw and BMA calibrated AEMET-SREPS: the 24 of January 2009 extreme wind event in Catalunya, Adv. Geosci., 26, 119-124, doi:10.5194/adgeo-26-119-2010,

Outline

- AEMET-SREPS summary
- AEMET-γ-SREPS plans

AEMET γ-SREPS

Research phase

- SREPS (25 km) → γ-SREPS (4-7 km)
- **Convergence with GLAMEPS:** staff and efforts, but an independent suite
- Road map: 2012-2013 research phase

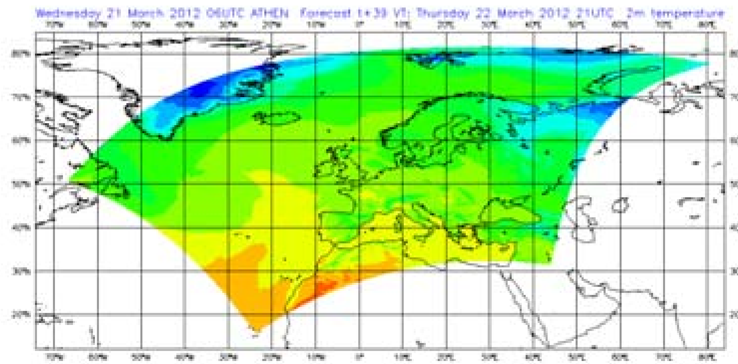
Research lines

- **Predictability issues** at convective scale are different than at synoptic/mesoscale
- Starting point: HARMONIE as base model
- Sampling uncertainties: SPPT (model), ETKF/EDA (ICs), LBCs
- Case studies: according to scale
- Feature-based verification: MODE
- Python wrapping

About GLAMEPS

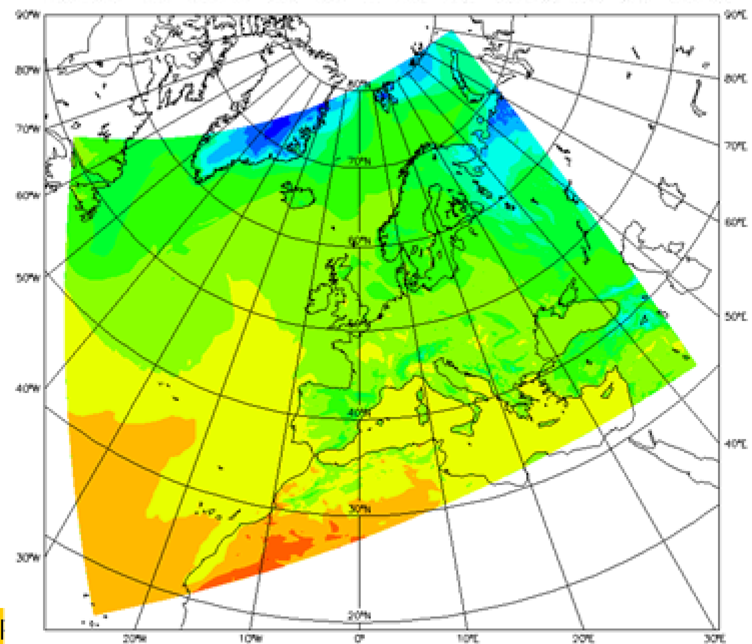
Grand Limited Area Model Ensemble Prediction System

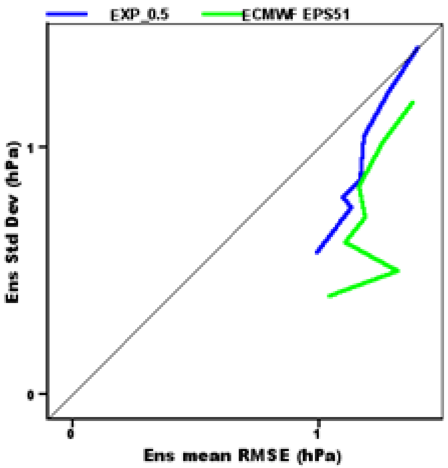
- HIRLAM – ALADIN pan-european ensemble, since 2006
- **Norway**, Sweden, Finland, **Denmark**, **Belgium**, Netherlands, Hungary, **Spain**, Ireland

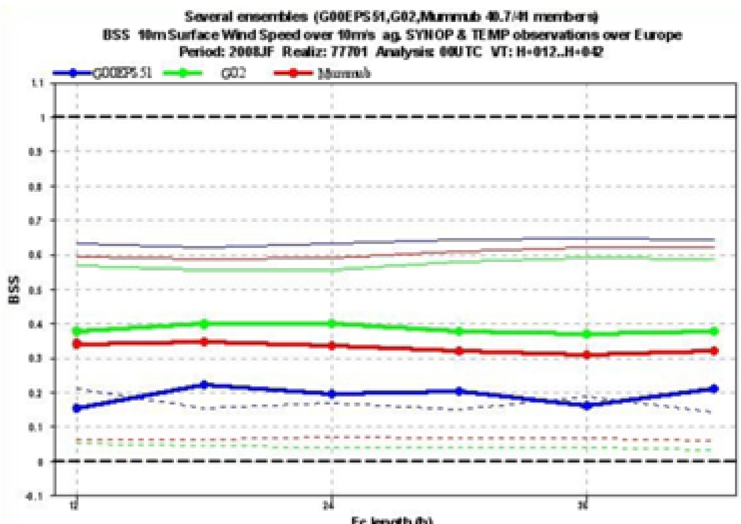


Current settings

- Multi-model: Hir_Straco, Hir_K.Fritz, Aladin, ECEPS_subset
- ICs: downscaling ECMWF EPS (i.e. SVs + EDA)
- 10 km (GLAMEPS) → 2-4 km (Harmon-EPS)
- Short range: 06 & 18 UTC, T+54
- Better performance than ECMWF & AEMET-SREPS







Predictability issues at convective scale

Grand Limited Area Model Ensemble Prediction System

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- **Norway**, Sweden, Finland, **Denmark**, **Belgium**, Netherlands, Hungary, **Spain**, Ireland

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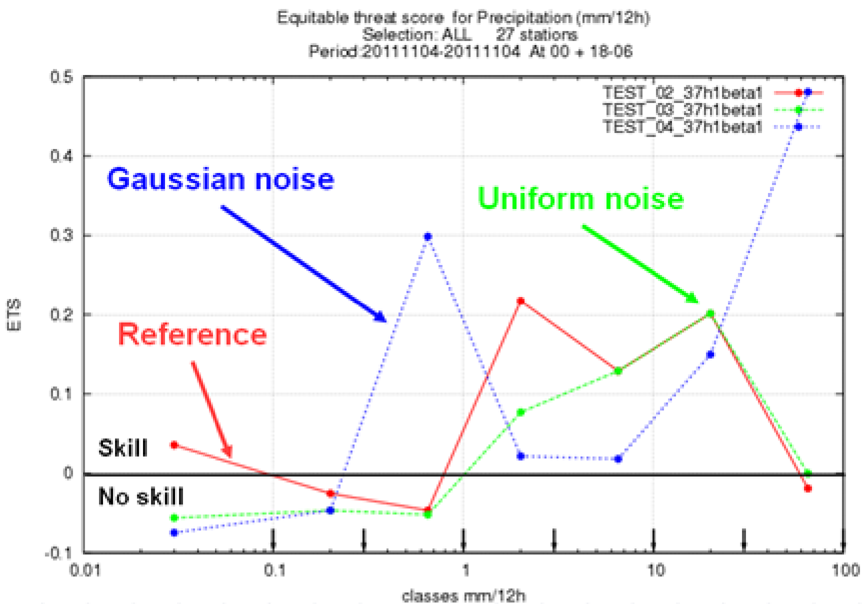
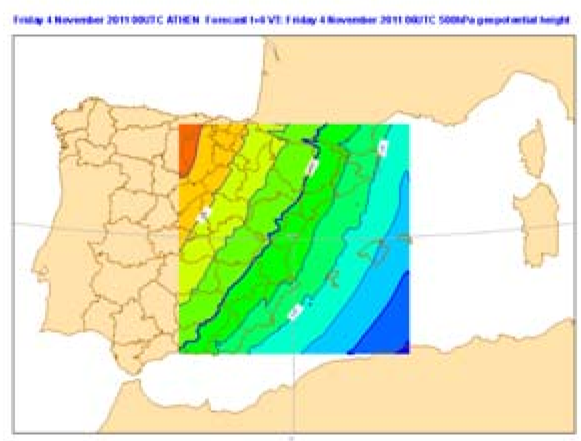
SPPT

A Callado: stochastic parameterization to take into account uncertainties of NWP HARMONIE in an EPS

- **6 months visit ECMWF**: Glenn Shutts, Roberto Buizza
- **SPPT:** Stochastic Perturbed Parameterization Tendencies (Buizza et al., 1999)
  - Multiplicative noise applied to each physics variable tendency
  - Spectral spatial and time correlations (at ECMWF)
- **Harmon-EPS** experiment: to apply multiplicative noise (~SPPT) to physics temperature tendency independently to each grid point, i.e. without spatial and temporal correlations



$$\frac{\partial X}{\partial t} = D_X + K_X + P_X + \delta P_X$$

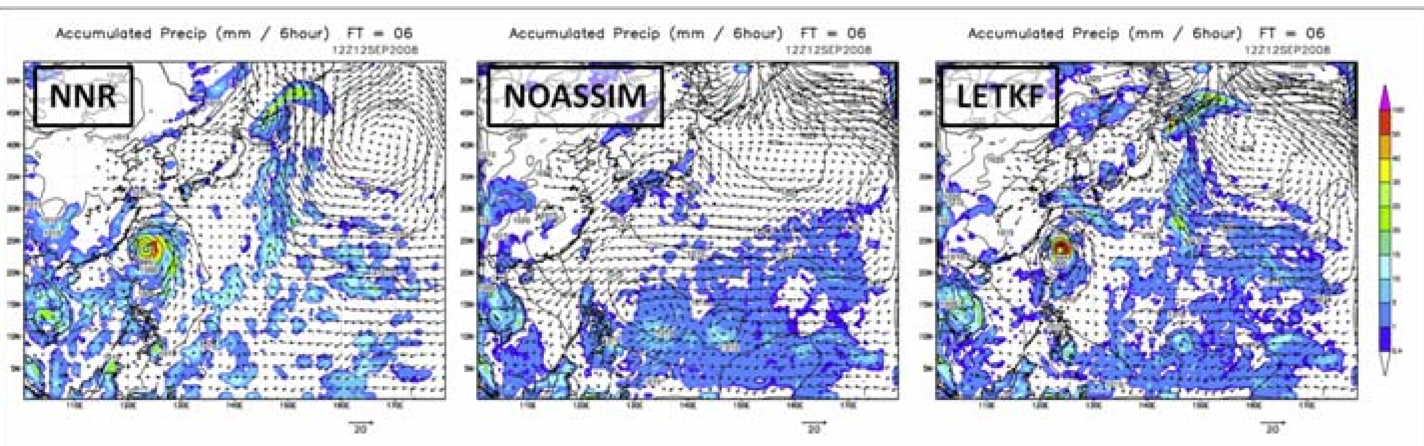


ETKF & EDA

P Escribà: ETKF in Harmon-EPS

- **6 months visit ECMWF**: Massimo Bonavita, Lars Isaksen
- EDA, hybrid 4D-Var/EDA and the EnKF implemented at ECMWF

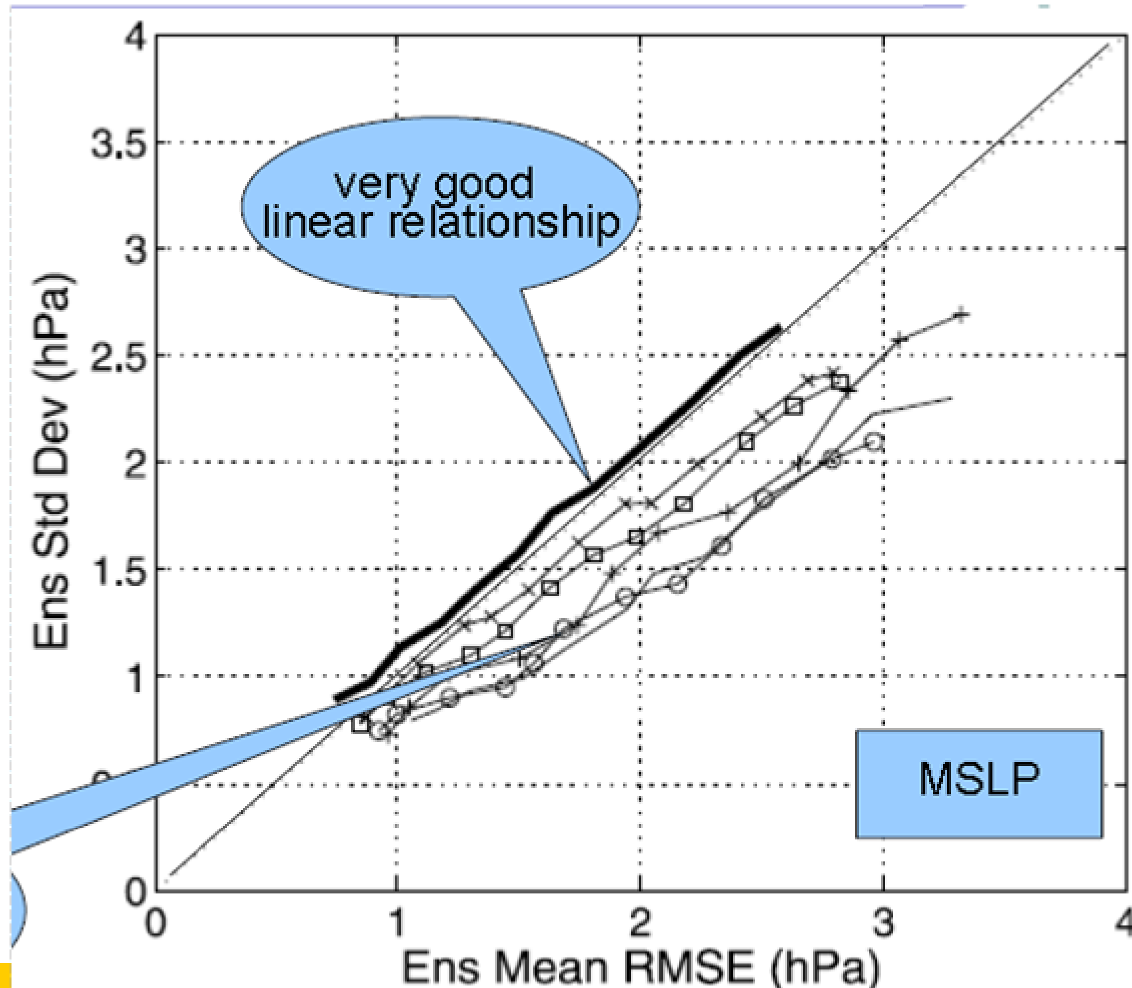
$$K = CH^T(HCH^T + R)^{-1}$$



Perturbations LBCs

J Montero → J Sancho: perturbations LBCs

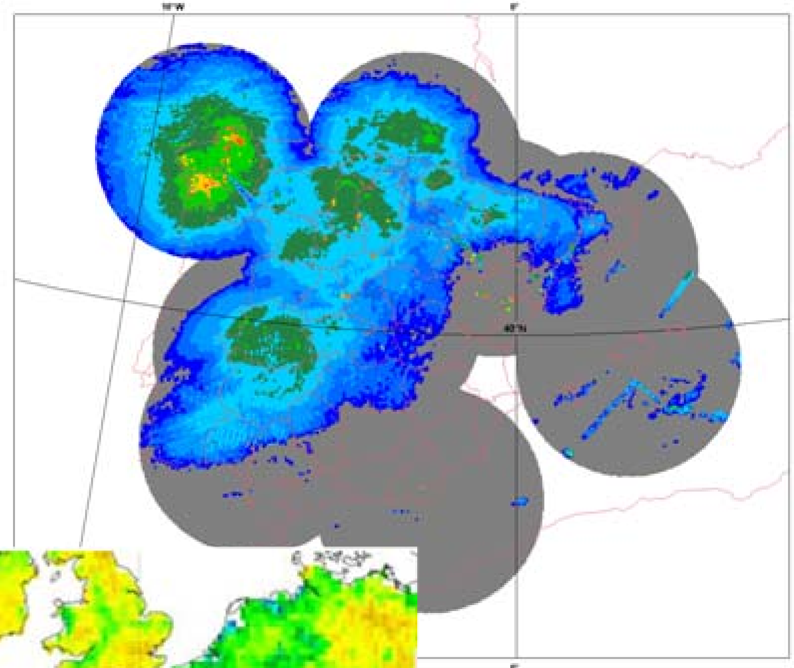
- **TIGGE** AGCMs
- Spread comparison



HR observations

A Amo / C Santos

- SEVIRI (Roebeling et al 2011)
- RADAR



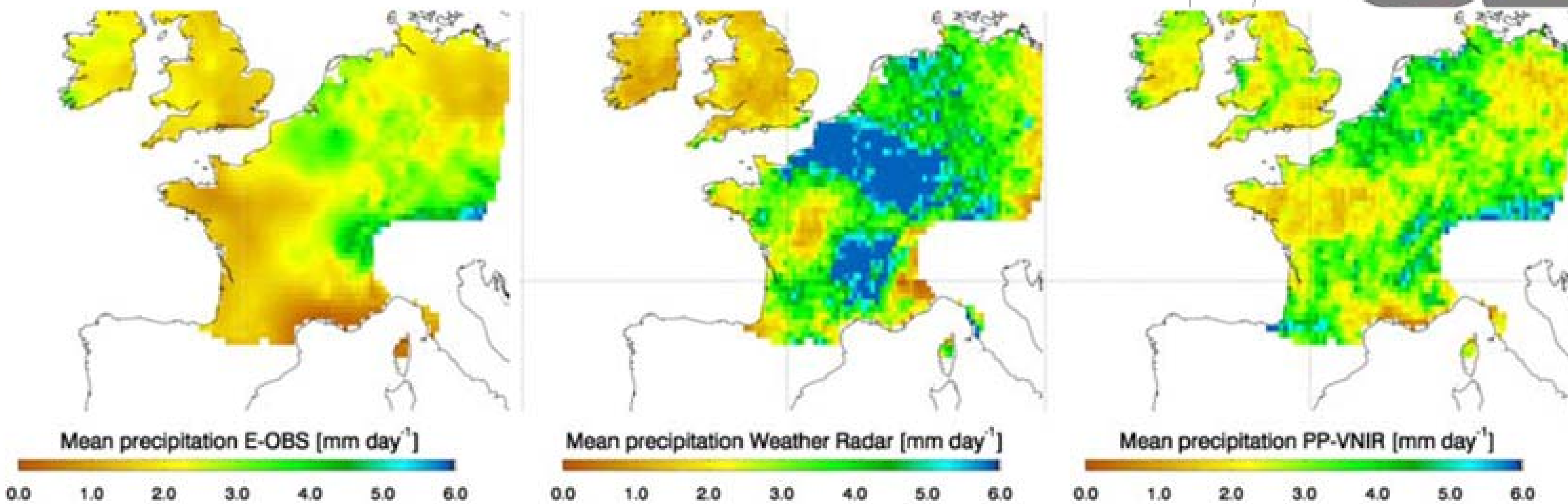
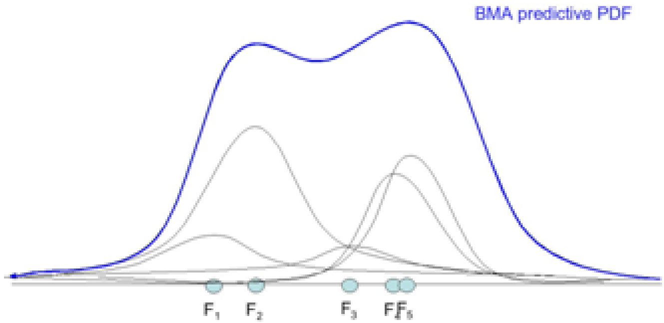


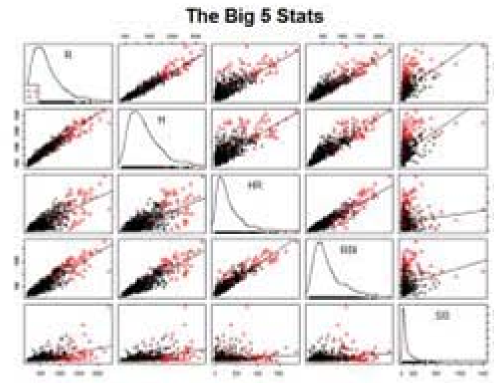
FIG. 1. Example of the mean daily precipitation amounts from E-OBS (left panel), Weather radar (middle panel), and PP-VNIR (right panel) in mm day^{-1} over the period May-August 2006.

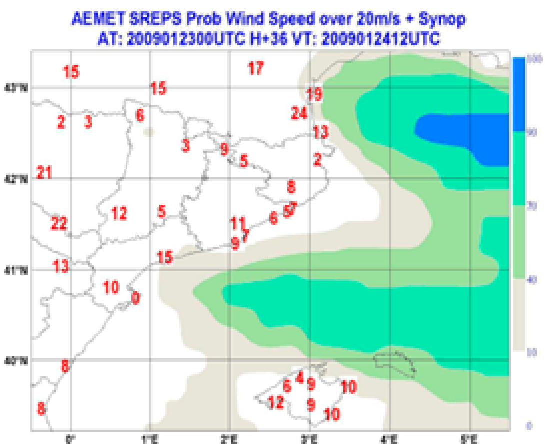
Calibration

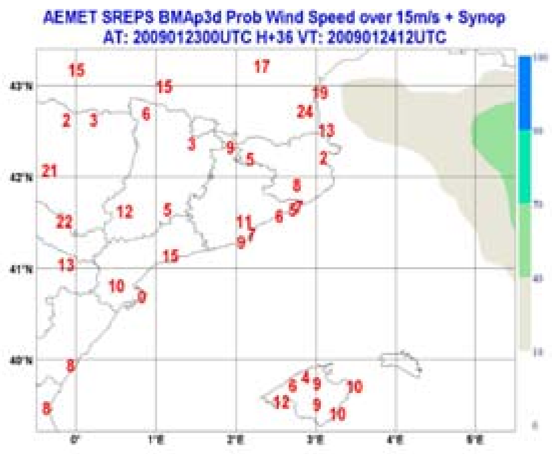
Research lines

- Experience with BMA
- Issue of extreme events
- Bayesian Model Averaging → Extended Logistic Regression







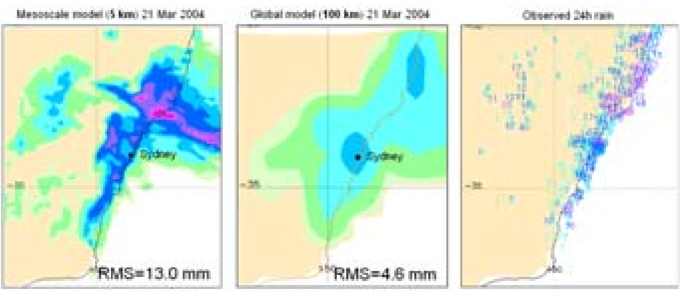


Aplicaciones a la Meteo Aeronaútica

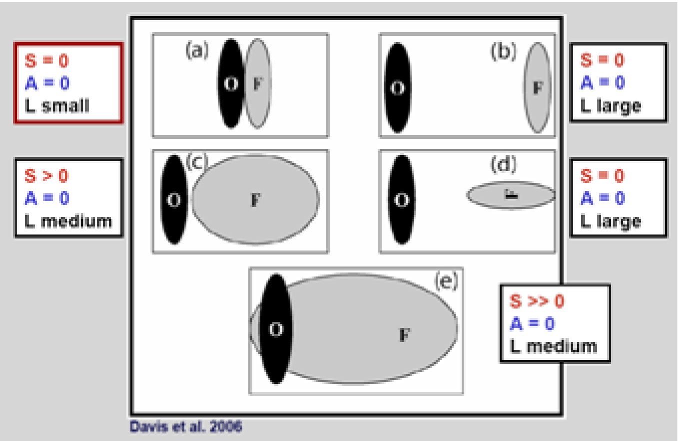
E Abellán / Callado and Escribà

- Basado en una comunicación dinámica con los Grupos de Predicción y Vigilancia (GPV) para evaluar sus necesidades, van a generarse EPS-gramas, predefinidos y dinámicos, específicos en aeropuertos.

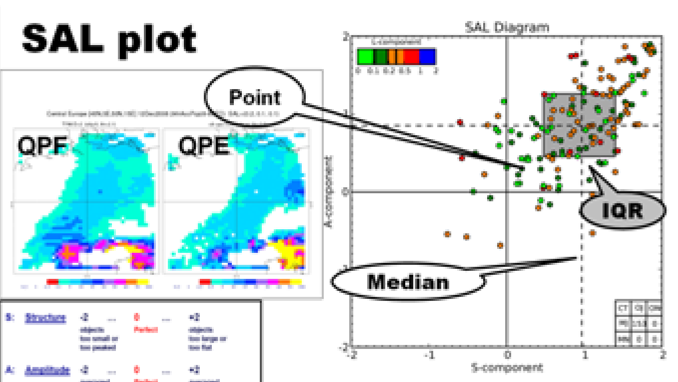
Feature-based verification



Courtesy Beth Ebert



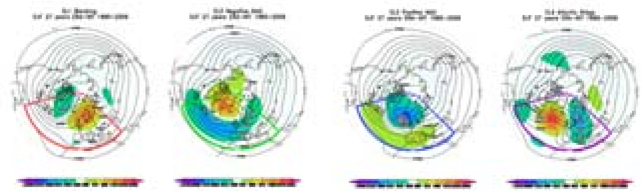
Davis et al. 2006

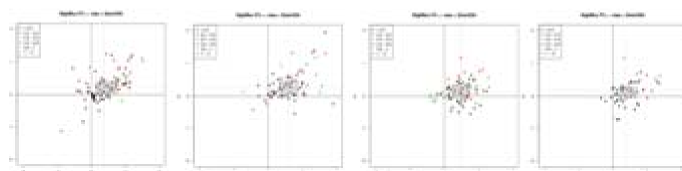


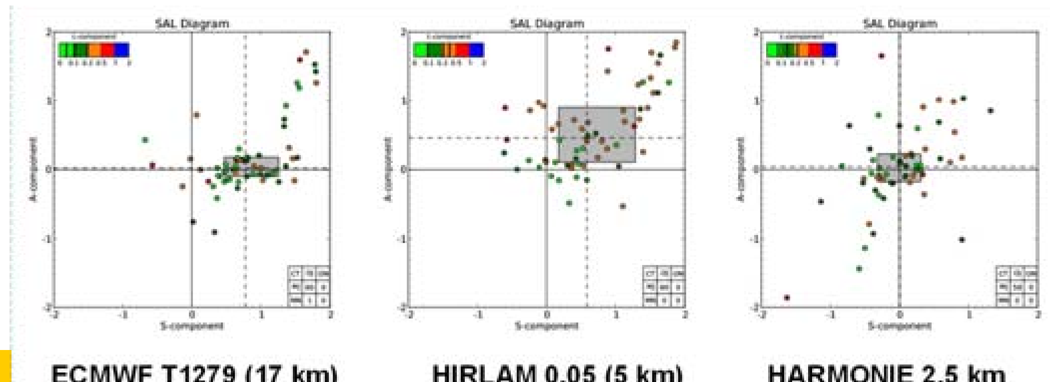
Quantitative, explicit and accumulative information about different aspects of precipitation forecast performance

A Amo / C Santos

- Scale issues → feature-based methods
- SAL: valid for deterministic models
- MODE: possible for ensembles
- Flow dependent verification



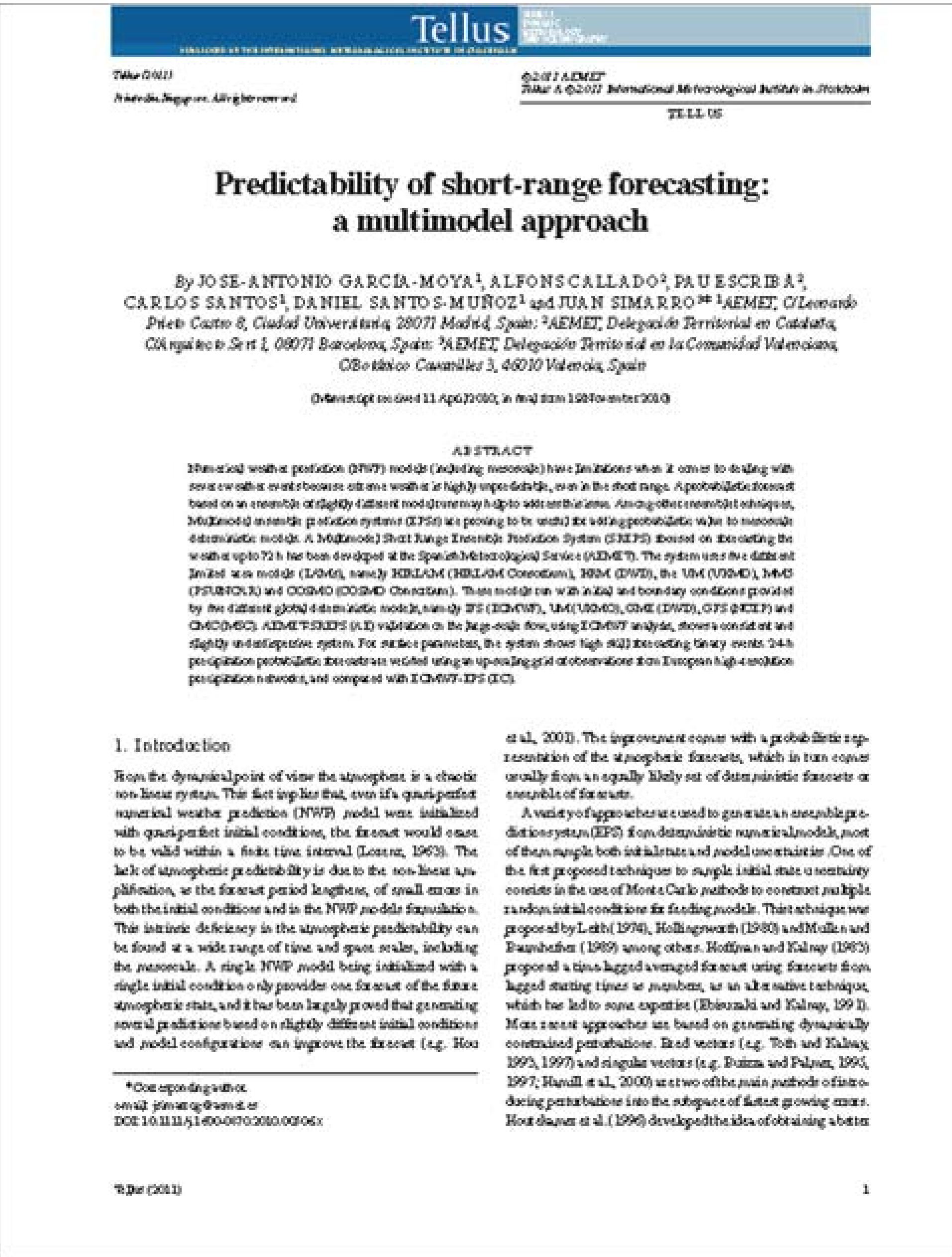




Verification Software

- No hay paquetes de verificación completos ni estandarizados (de hecho no hay un sistema abstracto estándar de verificación)
  - Inmensos volumen y diversidad de datos: GRIB, netCDF, BUFR, etc
  - Volumen / complejidad colosales de metadatos: SQL o similar
  - Entorno de desarrollo
  - Lenguaje de programación OO
  - Soporte array, estadístico, geográfico, gráfico, plug-in de C++/Fortran
- Algunas opciones
  - Model Evaluation Toolkit (MET, NCAR)
  - Paquete de verificación R (CRAN)
  - **MetPy+Verify** (ECMWF pero no liberado)
- Python
  - Ofrece ventajas descritas arriba
  - Niveles scripting / alto / medio / bajo
  - Utilizado en NCEP / NCAR / NSSL (Wicker 2005: Improving Scientific Productivity using Python: An Example from an Ensemble Data Assimilation System in Meteorology)

References


Tellus

Predictability of short-range forecasting: a multimodel approach

By JOSE-ANTONIO GARCÍA-MOYA[1], ALFONS CALLADO[2], PAU ESCRIBÀ[2], CARLOS SANTOS[1], DANIEL SANTOS-MUÑOZ[1] and JUAN SIMARRO[3*]

ABSTRACT

1. Introduction

García-Moya et al (2011): Predictability of short-range forecasting: a multimodel approach.
Tellus A, 63: 550–563.
doi: 10.1111/j.1600-0870.2010.00506.x

Bonus slides

Plans

ECMWF Operational Model Resolution (< 26 Jan 2010)

- Det: T799L91 25 km GG 0. 25º en MARS
- Eps: T399L62 50 km GG 0.5º en MARS

ECMWF Operational Model Resolution (> 26 Jan 2010)

- Det: T1279L91 16 km GG 0.125º en MARS
- Eps: T639L62 31 km GG 0.25º en MARS

GLAMEPS verification numbers

How many files?

- 4 sub-ensembles, 12+1[+1+1] each ~ 54 members
- 00 and 12 UTC = 2 run times
- 3/TO/42/BY/3 = 13 forecast steps
- 54·2·13 = **1378 daily files**

How many parameters inside?

- Intermediate output set: z500, t500, t850, mslp, 10mW, gusts, 2mT, AccPcp, etc = 18 params
- Minimum verif set: z500, t850, mslp, 10mW, gusts, 2mT, AccPcp = 8 params

Data volume to process daily?

- Intermediate set: 11 Mb/file ~ **30 Gb**
- Minimum verif set: 5 Mb/file ~ 18 Gb

Data volume to process?

- ~ 540 Gb monthly,
- ~ 1500 Gb seasonally
- ~ **10 Tb yearly**

Who to compare with?

- ECMW EPS = 1 set of graphs
- Deterministic HARMONIE (not here) = x2

Deterministic verification (a minimum)

- Bias & RMSE for any member + ensemble mean = 2 daily (or season) graphs

Probabilistic verification: large scale flow

- Dynamical fields typically z500, t500, t850, mslp: spread-skill + talagrand = 8

Probabilistic verification: weather parameters

- 2mT, wind, AccPcp: here come the thresholds!!!
- E.g. prob (pcp>=0.3,1,5,10…) = x5, x10
- Reliability, Sharpness, ROC, RV = x3
- BS, BSrel, BSres, BSS, BSSrel, BSSres[and decompositions?] = x3
- DRPS, CRPS, DRPSS, CRPSS [and decompositions?] = x2

The number of possible verification graphs grows up to 10 000 → we need to select a summary of information to show