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

gSREPS: AEMET new mesoscale multimodel ensemble prediction system using WRF

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Spanish Met Service - AEMET

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Outline

- Why we need mesoscale EPS?
- Characteristics of **gSREPS**.
- Main results of the development phase.

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- Validation daily runs at ECMWF.
- Verification of the first month (May 2016) of daily runs.
- Future plans

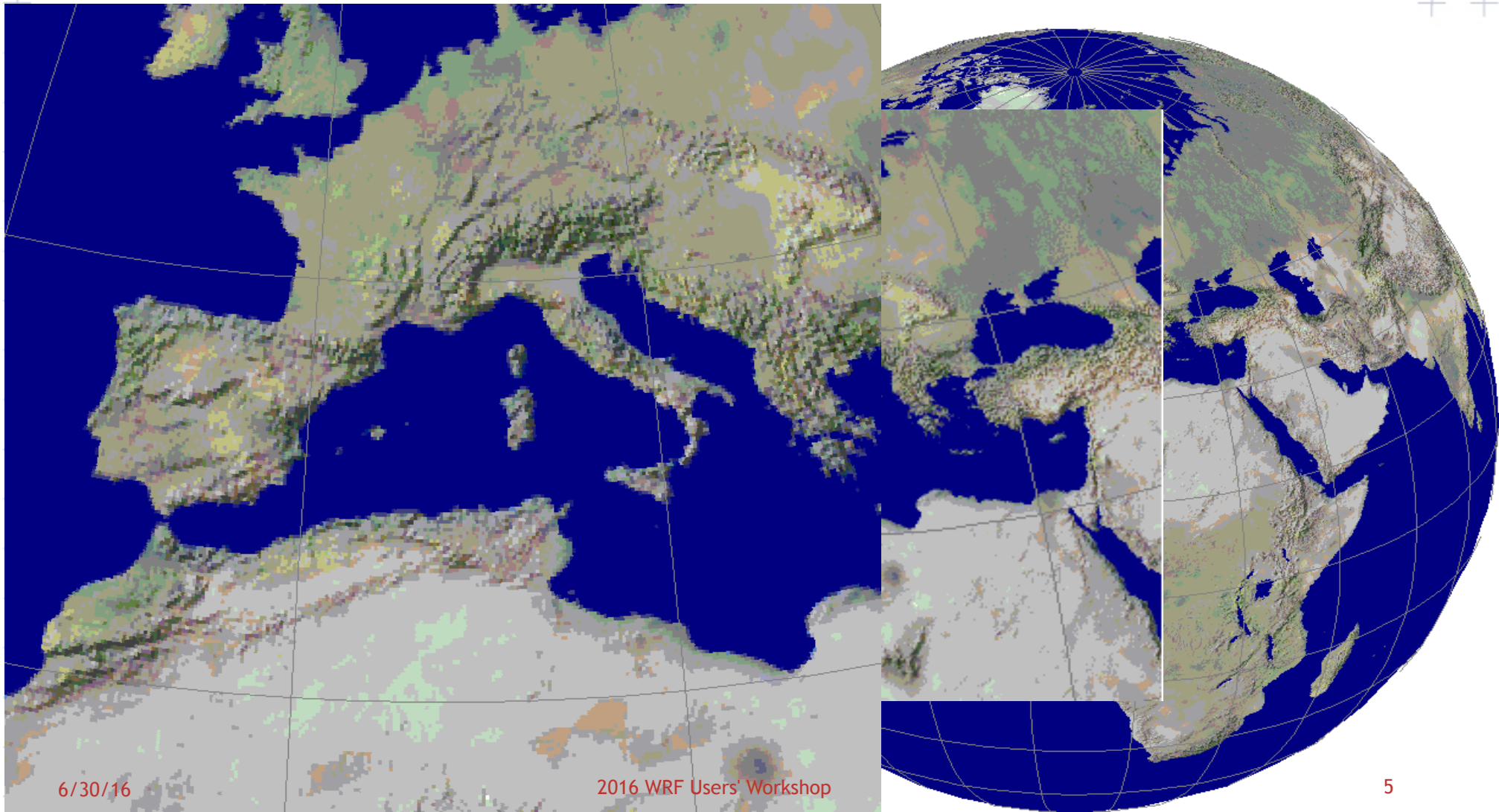
Introduction

- Main Weather Forecast issues are related with Short-Range forecast of extreme events.
- Convection and convective precipitation are, roughly speaking, the most dangerous extreme weather events.
- Wind is also quite important in Spain because, among others, of the huge number of sportive sailors in the West Mediterranean.
- Due to the small spatial and temporal scales of these events, forecast is very difficult.
- Increasing the horizontal and vertical resolutions of the numerical weather prediction models has been the traditional approach to improve the forecast of all these events.
- But it is not enough! Probabilistic approach gives useful information to the users and accounts for the uncertainty of such weather events

Examples in Spain

- Western Mediterranean is a close sea rounded by high mountains.
- In autumn sea is warmer than air.
- Several cases of more than 200 mm/few hours occurs every year.
- Some fast cyclogenesis like “tropical cyclones” also appears from time to time (called “medicanes” in the literature).
- Strong local winds, like Tramontana (Balearic Islands) and Cierzo (Aragon), are also more frequent in Spring and Autumn.

Geographical Framework



g-SREPS

- Multimodel:
  - Harmonie (AROME and ALARO)
  - WRF (ARW and NMM, next future NEMS-NMMB)
- Multiboundaries (Global models):
  - ECMWF
  - GSM from JMA (Japan Meteorological Agency)
  - GFS from NCEP
  - CMC from SMC (Canadian Weather Service)
  - Arpege from MeteoFrance
- 36 hours forecast four times a day (00, 06, 12 & 18 UTC)

g-SREPS

- Characteristics:
  - 4 models
  - 5 boundary conditions
  - [+2 latest ensembles (HH & HH-06)]
  - 20 members ensemble every 6 hours
  - Time-lagged Super-Ensemble of 40 members every 6 hours.
  - 2.5 km horizontal resolution – 65 vertical levels
- LETKF for ICs perturbations
- SPPT for additional model perturbations
- Calibration – Extended Logistic Regression (BMA or ELR)
- Focused on surface parameters (Precip, 2mT, 10mwind, radar reflectivity)

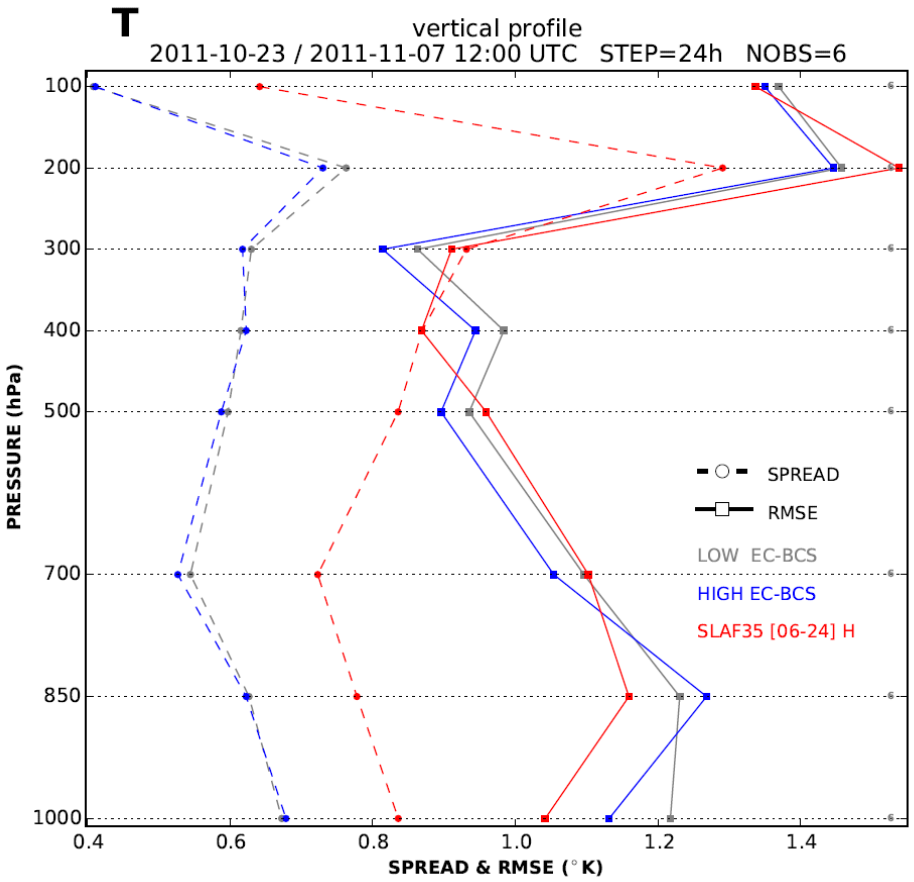
Lateral Boundary Conditions

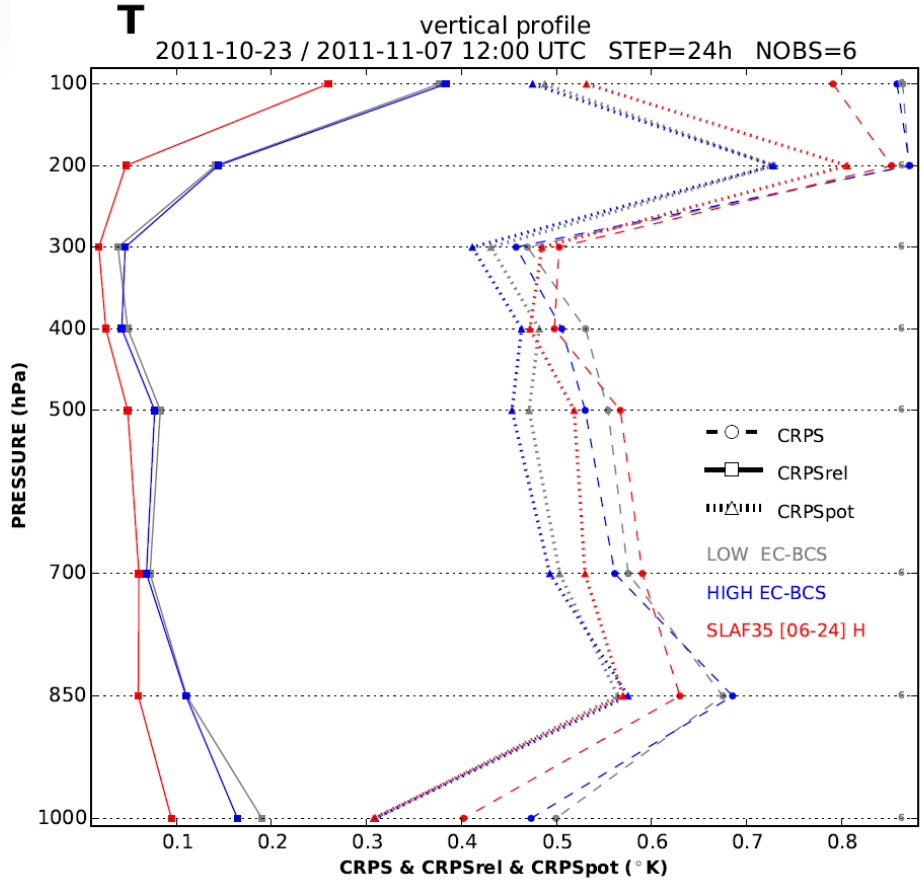
- **Downscaling global EPS**
  - Global EPS don't have spread enough in the short term.
  - Lot of communication to get full model level data from the global EPS at home.
  - Long delay to wait for Global EPS available for BCs.
- **SLAF – Scaled Lagged Average Forecast**
  - Cheap method based in one deterministic global model.
  - Good representation of the errors of the day based in deviations of past operational runs.
  - Very few communication to get full model level data from the global deterministic model at home.
  - Less delay to wait for BCs (better availability).
  - Good possibility of several different global models for BCs (multiboundaries).

Experiments

- HarmonEPS (using only Harmonie/AROME)
- Domain IBERIA_2.5 km hor res - 9 members (8 + control)
- Pure downscaling: no ICs perturbations
- Experiments:
  - **H2538H11** – Downscaling High Resolution ECMWF EPS (Det. Model resolution)
  - **L2538H11** – Downscaling Low Resolution ECMWF EPS (Opr EPS resolution)
  - **S3538H11** -
    - 'SLAFLAG' => [0, 6, 6, 12, 12, 18, 18, 24, 24] ,
    - 'SLAFK' => ['0.0','1.75','-1.75','1.50','-1.50','1.25','-1.25','1.0','-1.0'],

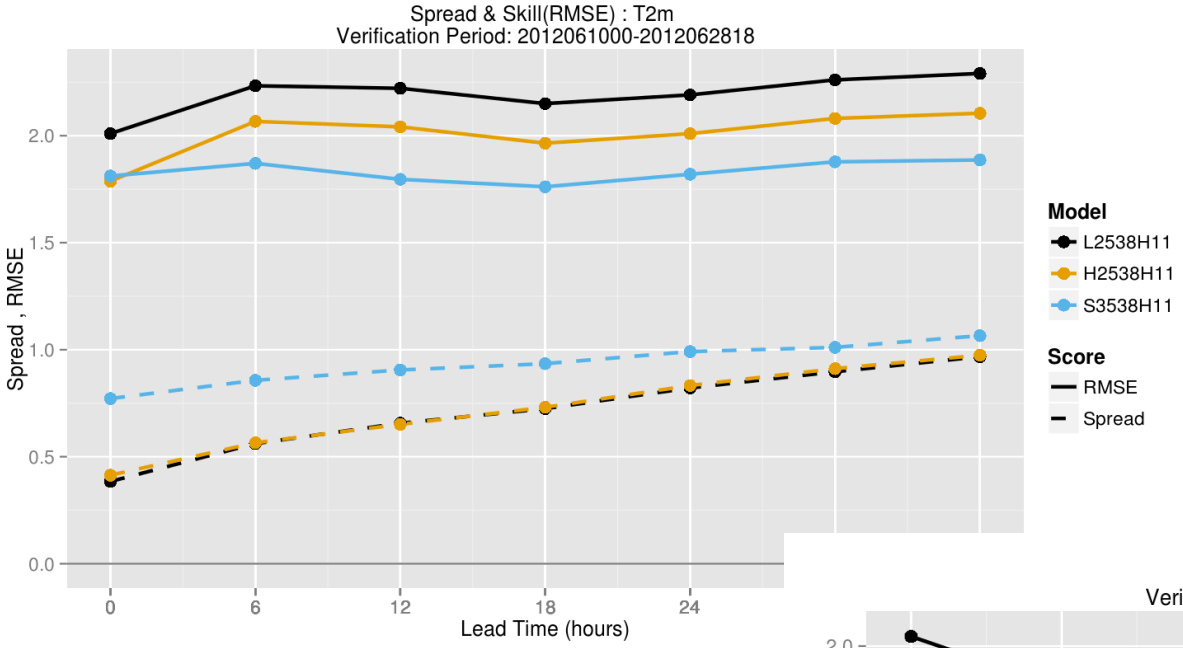
Spread-Skill Upper Air H+24

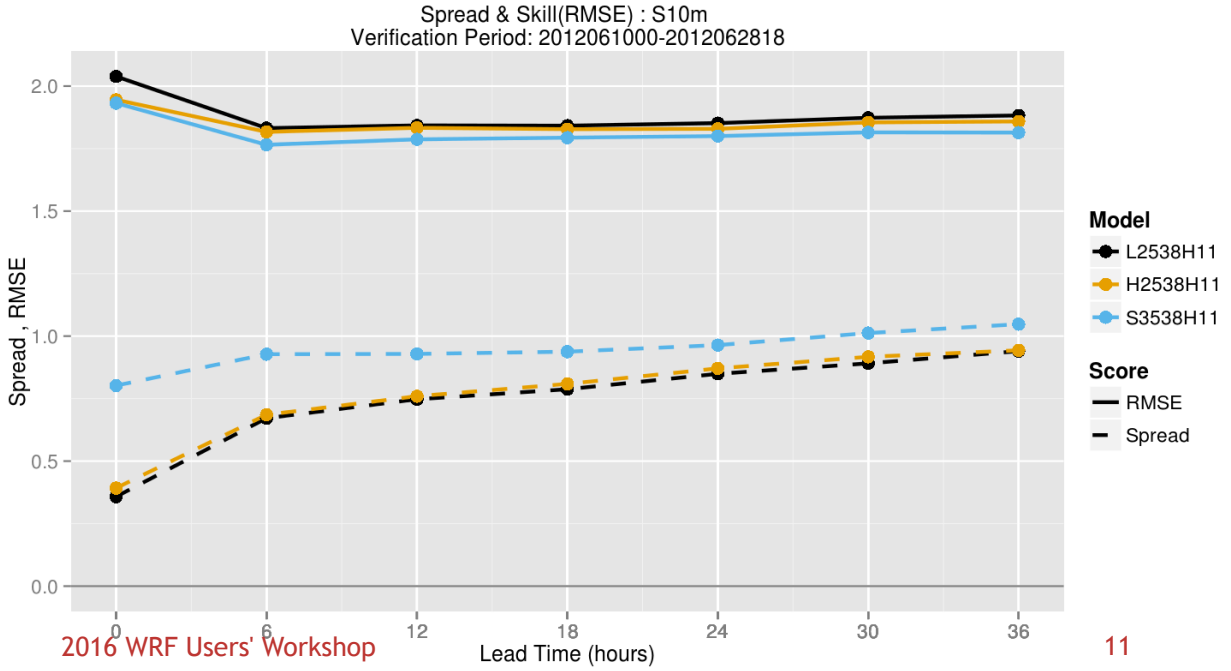




S35 L25 H25

Spread-Skill





Experiments - HGLOBAL

- Single Model: Model Harmonie AROME / ALARO.
- EPS5 members:
  - **0 → ECMWF** –ECMWF Global Det. Model.
  - **1 → GFS** – NCEP (USA) Global Det. Model.
  - **2 → CMC** – CMC (Canadian Met. Service) Global Det. Model.
  - **3 → ARPEGE** – MeteoFrance Global Det. Model.
  - **4 → JMA** – JMA (Japan Met. Agency) Global Det. Model.
- Period: 2015041000 - 2015042518

Global Models

Member	Model	How they are			What we get (Every 3 hours – 00 and 12 UTC)		
		Hor Res (km)	Vert Levels #	Type of levels	Hor Res (Km)	Vert Levels	Type of levels
0	ECMWF	16	137	Hybrid	16 (0.16 deg)	137	Hybrid
1	GFS	13	64	Sigma	26 (0.25 deg)	31	Pressure
2	CMC	25	80	Hybrid	25 (0.24 deg)	28	Pressure
3	Arpege	7	105	Hybrid	11 (0.10 deg)	28	Pressure
4	JMA	20	100	Hybrid	55 (0.5 deg)	86	Hybrid

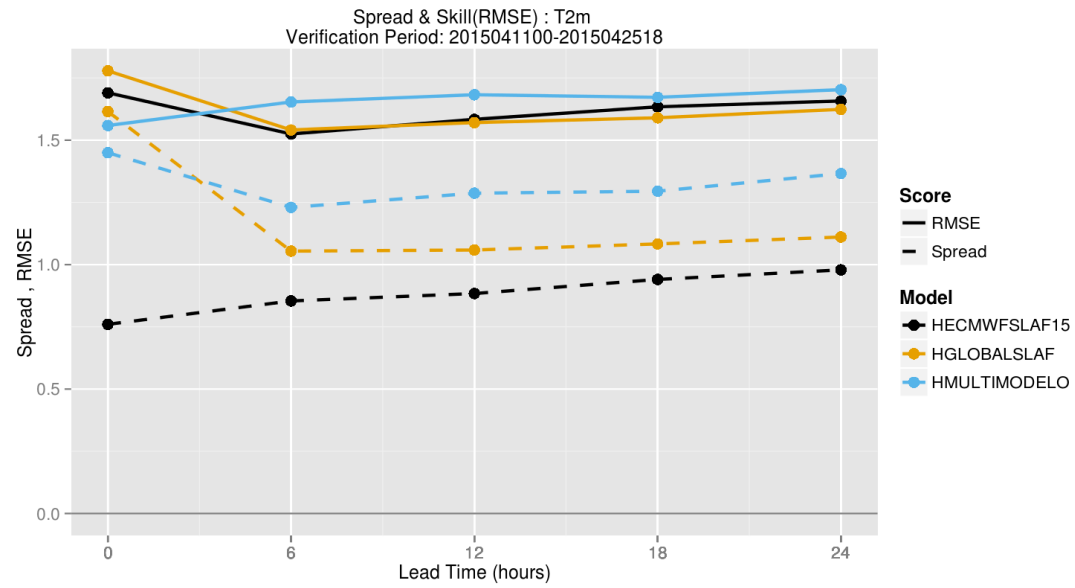
Multimodel / Global Models as LBCs

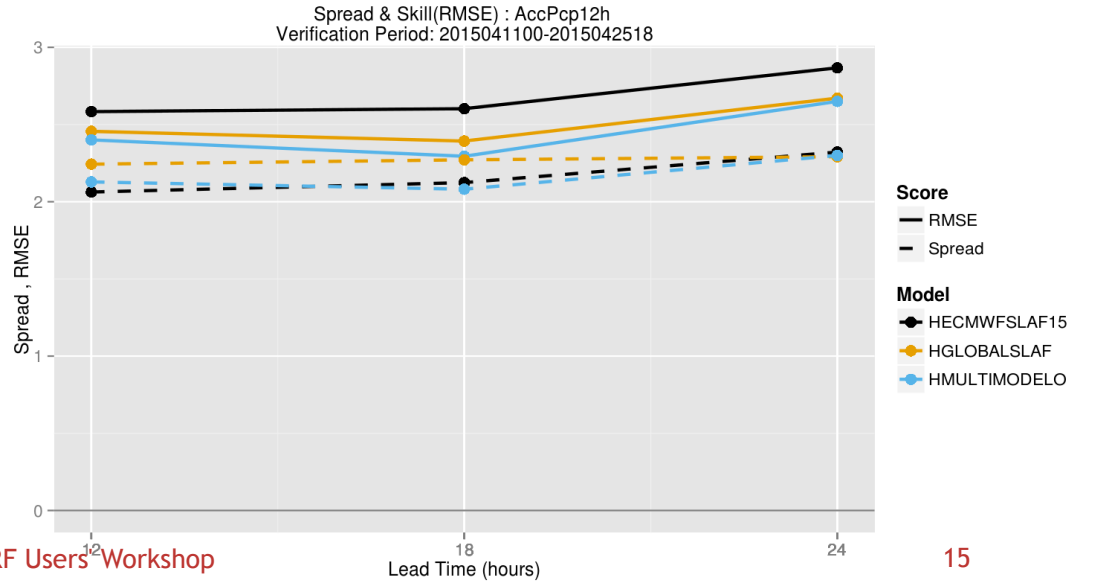
1 : HGLOBALSLAF

2 : HECMWFSLAF15

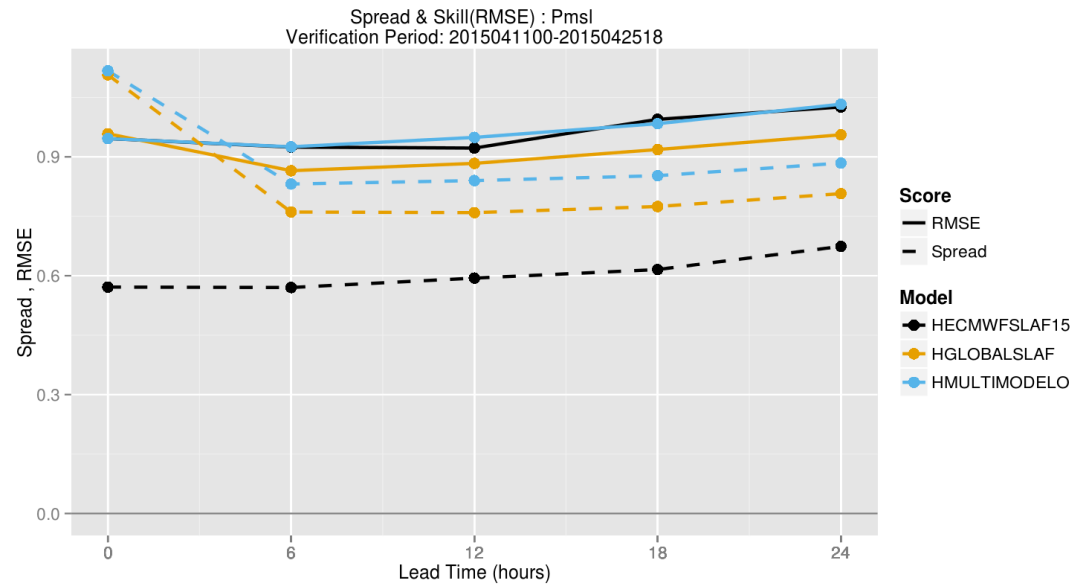
3 : HMULTIMODELO

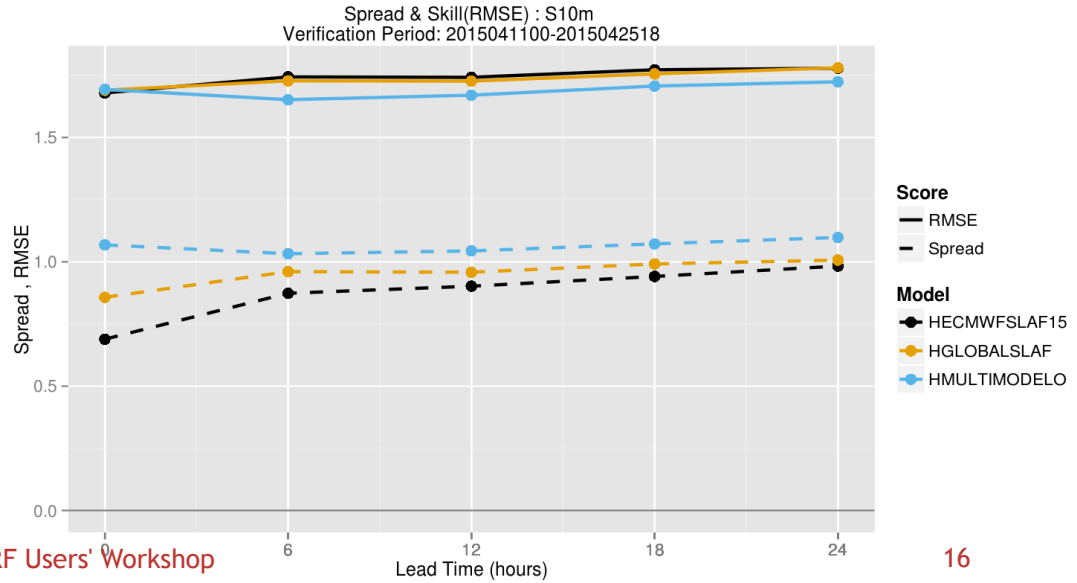
Spread - Skill





Spread - Skill





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4	JMA	20	100	Hybrid	55 / 25 (0.5 / 0.25 deg)	86	Hybrid

Pre-operational daily run

- Pre-operational daily run (00 and 12 UTC) at ECMWF from March the 29th,, 2016.
- Running smoothly without close monitoring.
- Checking member skills using deterministic verification. From **2016032900-2016050900**
- Probabilistic verification: comparison with GLAMEPSv2 with and without calibration. From **2016032900-2016050900**
- GLAMEPSv2 characteristics (https://glameps.hirlam.org):
  - Multimodel: Hirlam (Straco & Kain-Fritsch) Alaro (Sufex & ISBA).
  - BCs from ECMWF EPS
  - **52 members** (48 + 4 control) running at 00, 06 12 & 18 UTC
  - 8 Km horizontal resolution
  - **Calibration of T2m and u10m using ELR**

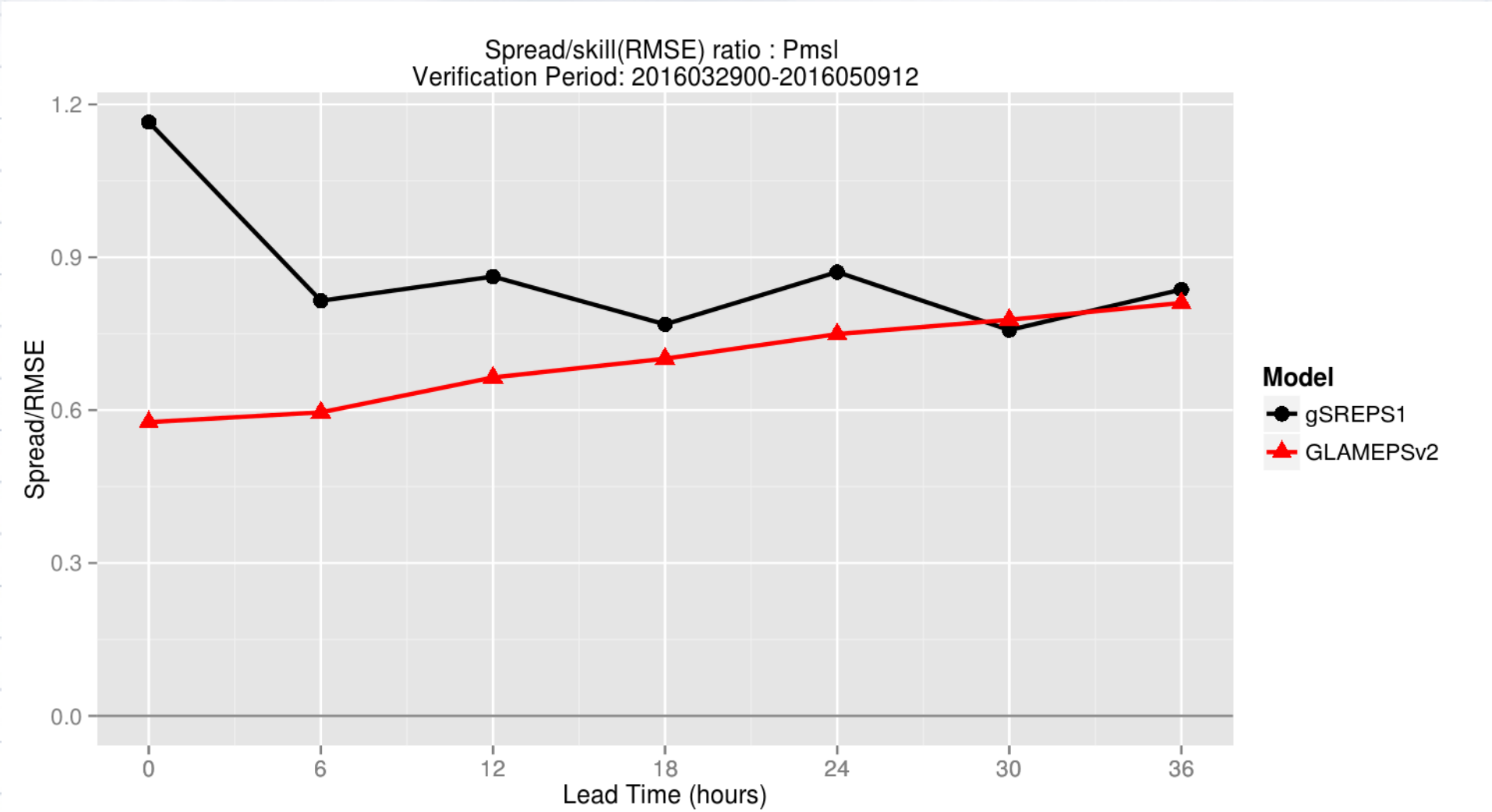
Probabilistic Verification

gSREPS1: Excluding members:
11, 12, 15, 16, 19 and 20

GLAMEPSv2 & GLAMEPSv2calib

2016032900 - 2016050900
00 & 12 UTC
36 hours Forecast

Prob Verif: MSLP



Conclusions and future work

- Fixing bugs in surface parameters, WRF-NMM model mainly
  - Fixing members 11, 12, 15, 16, 19 and 20
- Testing the system at AEMET Bull computer
  - Running Harmonie, WRF and NEMS (NMMB)
  - Using global models as BCs
  - Running the system in pre-operational mode (October 2016)
- General developments:
  - Increasing horizontal resolution of GSM from JMA (0.5 deg. to 025 deg.)
  - Increasing vertical resolution of Arpege data (from 28 to 60 vertical levels in model levels).
  - Increasing veritical resolution of NCEP-GFS model (from 31 to 40 levels)
  - Testing SPPT scheme in Harmonie and WRF
  - Testing LETKF in Harmonie
  - Calibration of products

Bonus slides

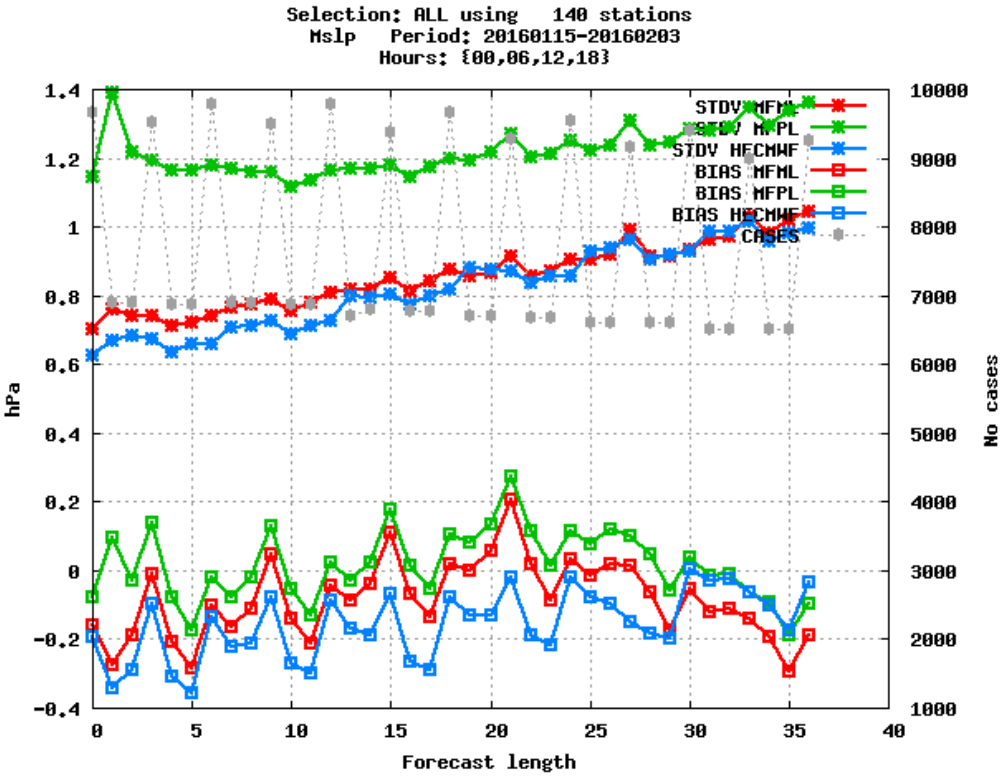
Experiments – MFML MFPL

- Harmonie – 5 members
- Experiments:
  - MFML – BCs from Arpege model levels (Thanks to MeteoFrance)
  - MFPL – BCs from Arpege pressure levels
  - HECMWF – Bcs from ECMWF
- Period: 2016011512 - 2016020300

Global Models

	Model	How they are			What we get (Every 3 hours – 00 and 12 UTC)		
		Hor Res (km)	Vert Levels #	Type of levels	Hor Res (Km)	Vert Levels	Type of levels
	ECMWF	16	137	Hybrid	16 (0.16 deg)	137	Hybrid
	Arpege MFPL	7	105	Hybrid	11 (0.10 deg)	**28**	Pressure
	Arpege MFML	7	105	Hybrid	10	**60**	Hybrid

MSLP

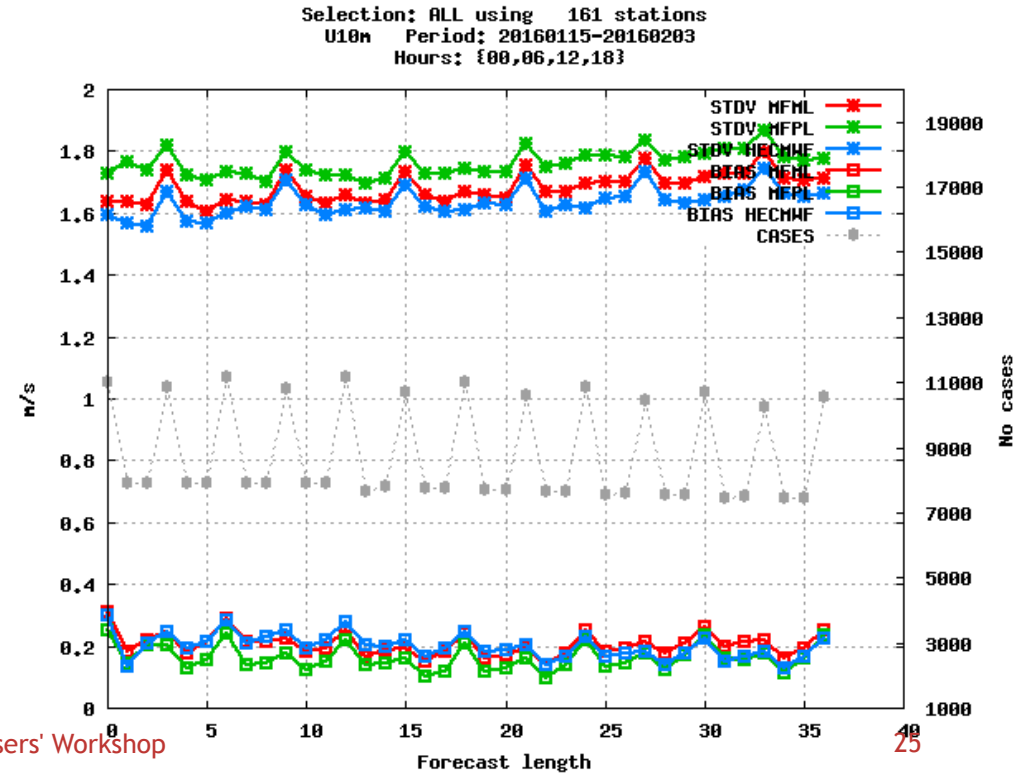


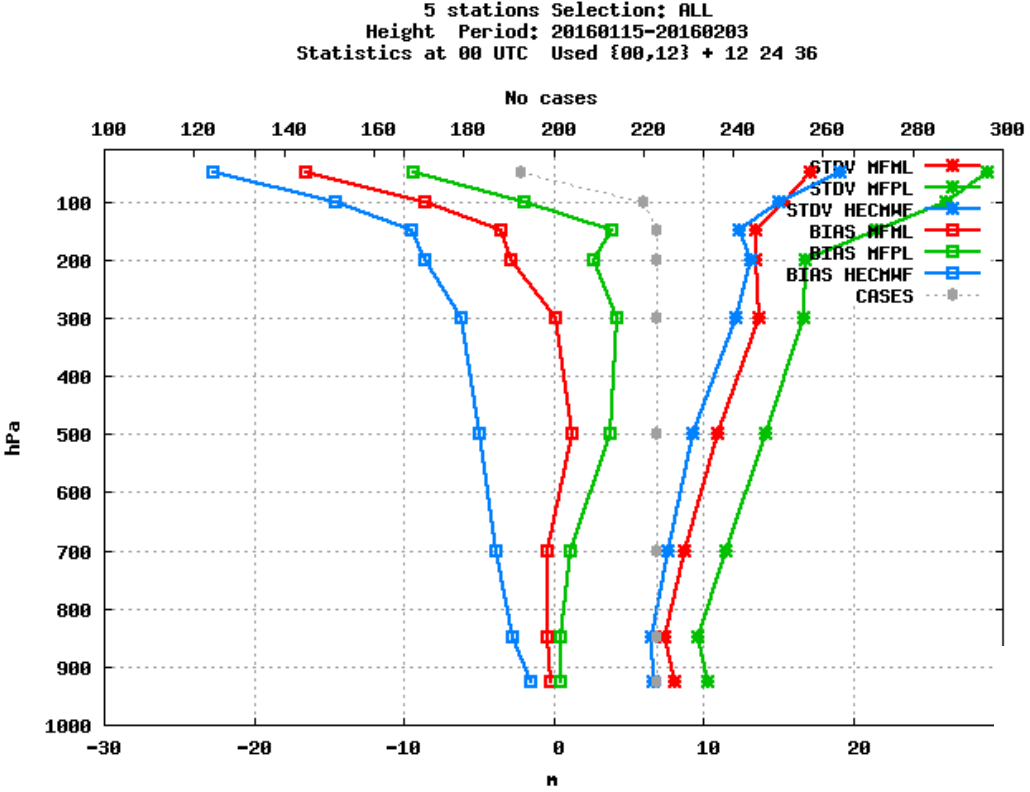
HECMWF - blue

MFPL - green

MFML - red

U10m





GEOPT

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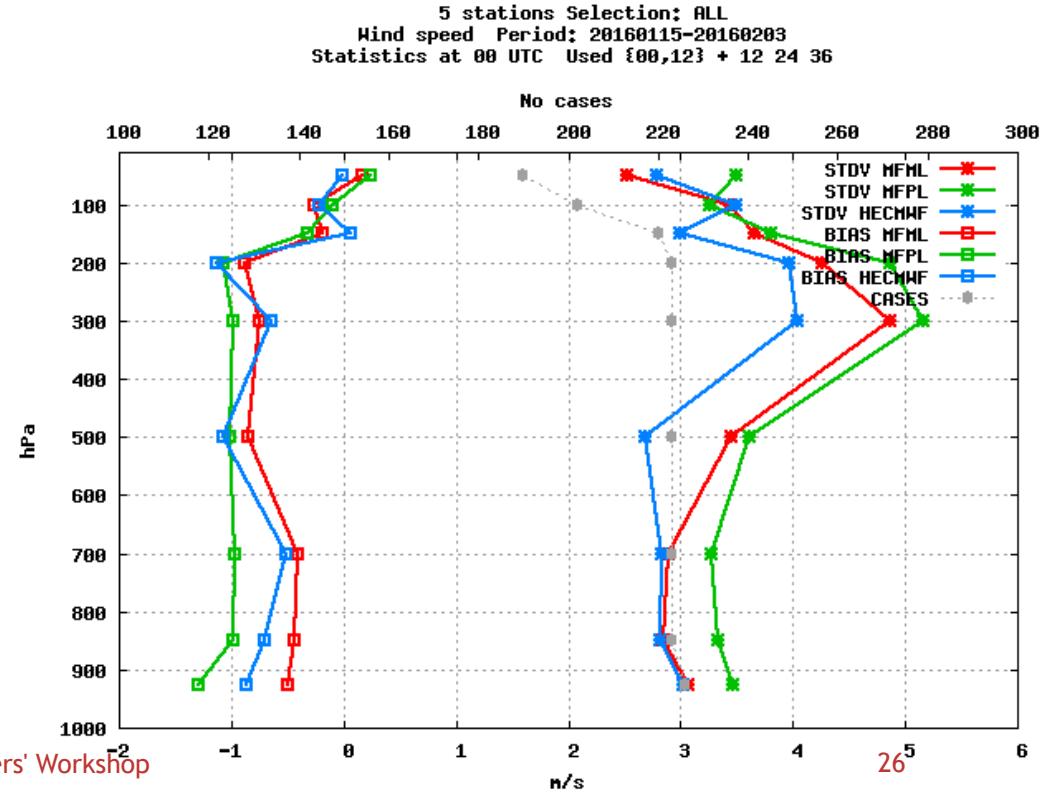
HECMWF - blue

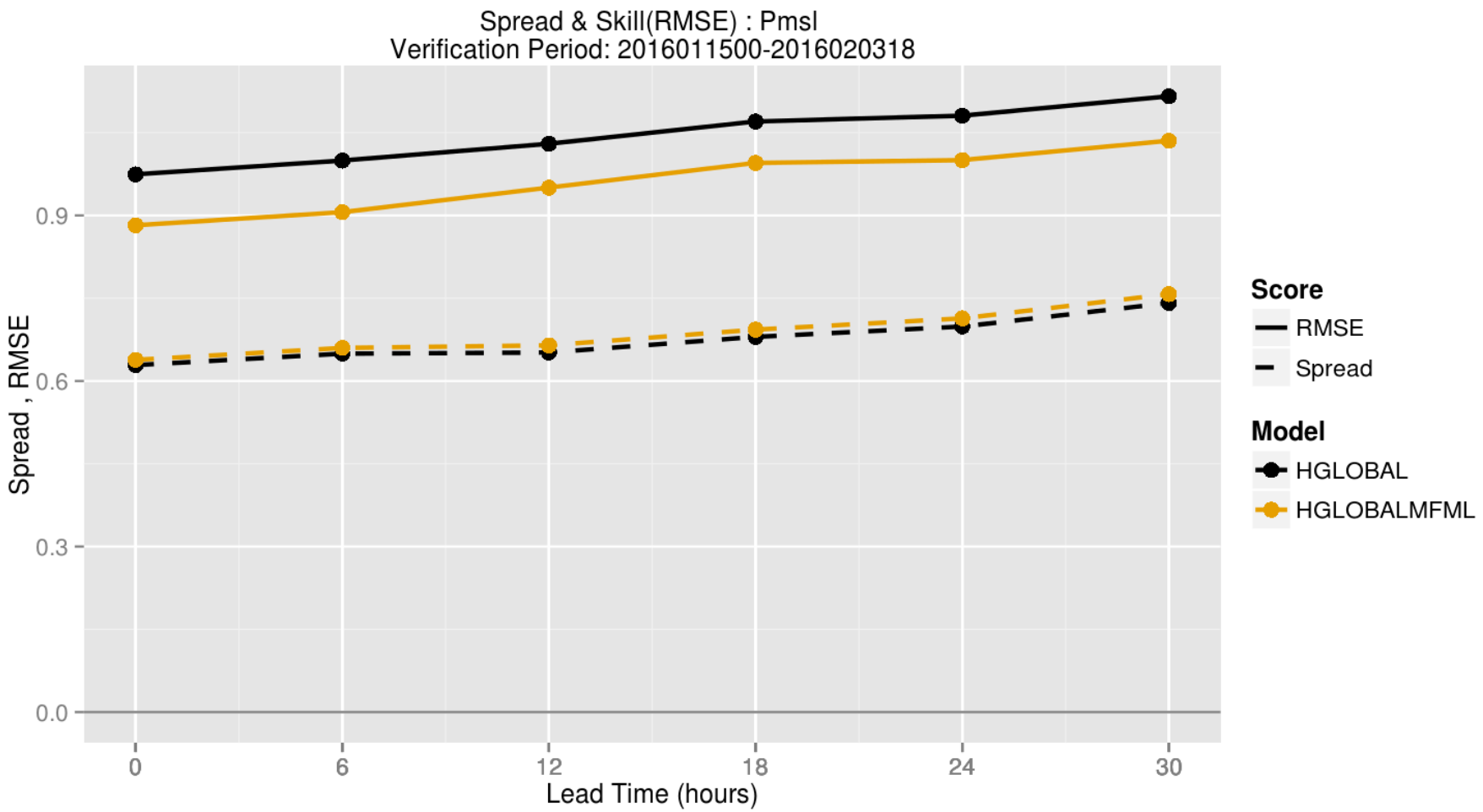
MFPL - green

MFML - red

Wind Speed



Prob Verification



Probabilistic Verification

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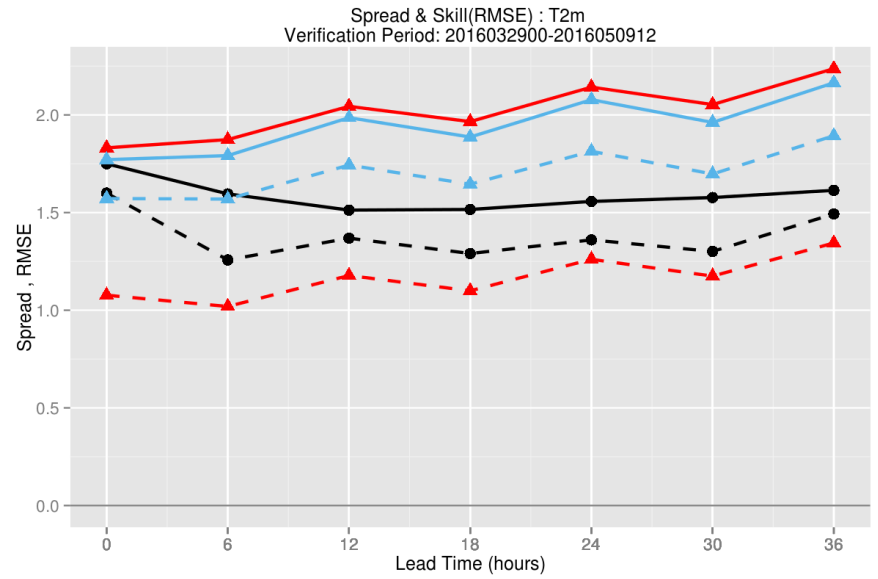
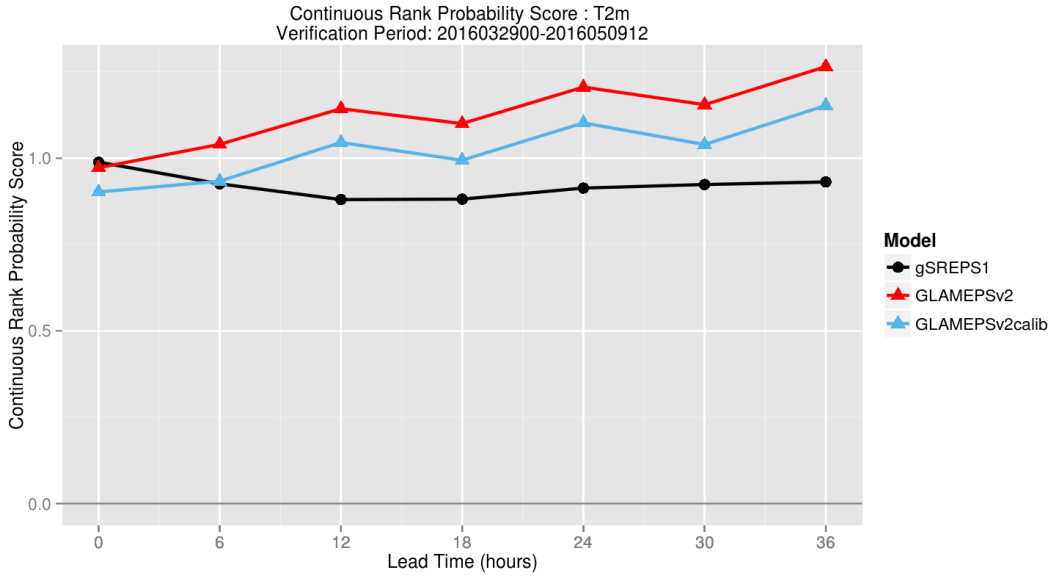
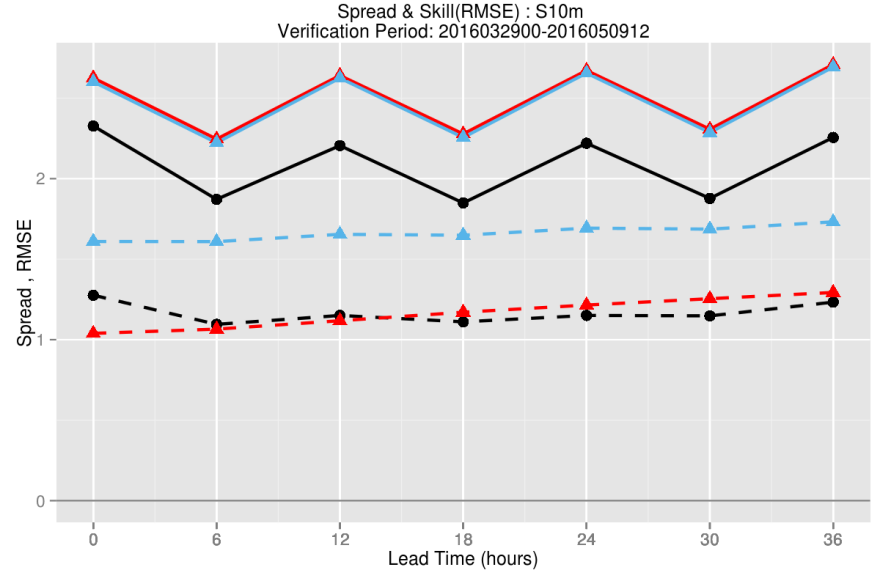
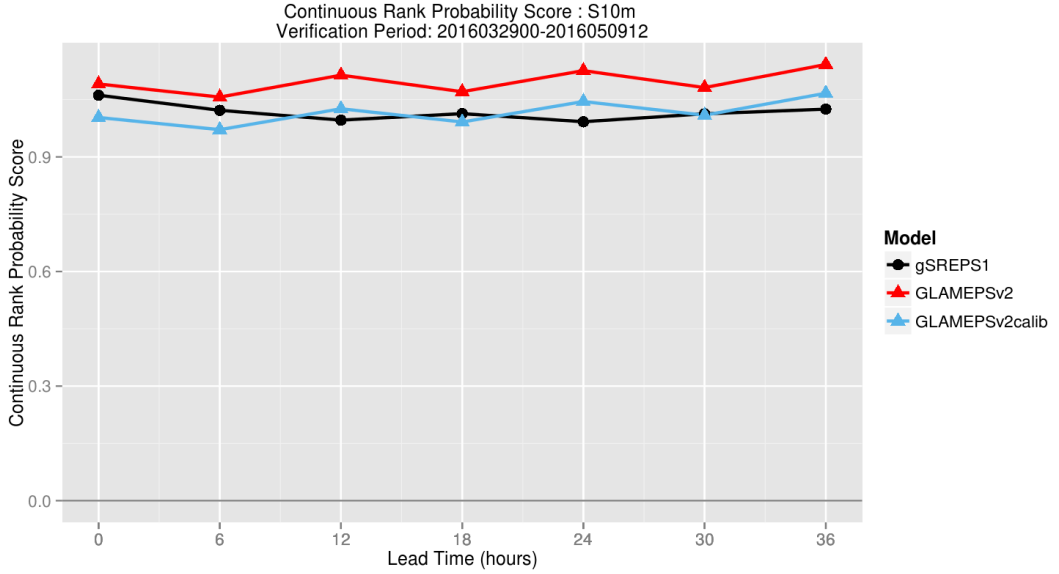


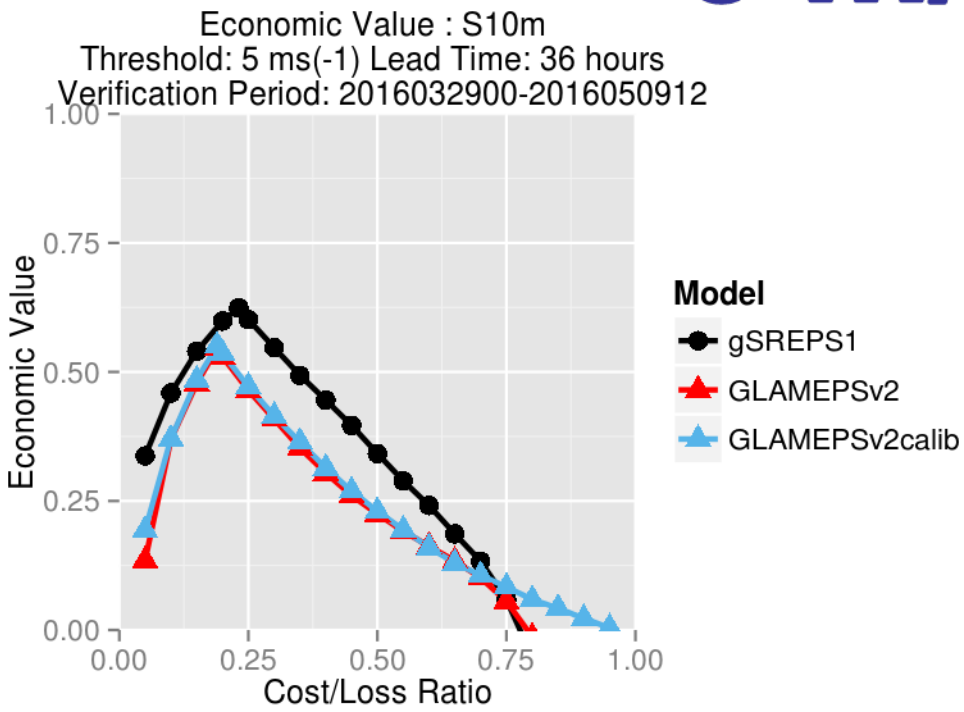


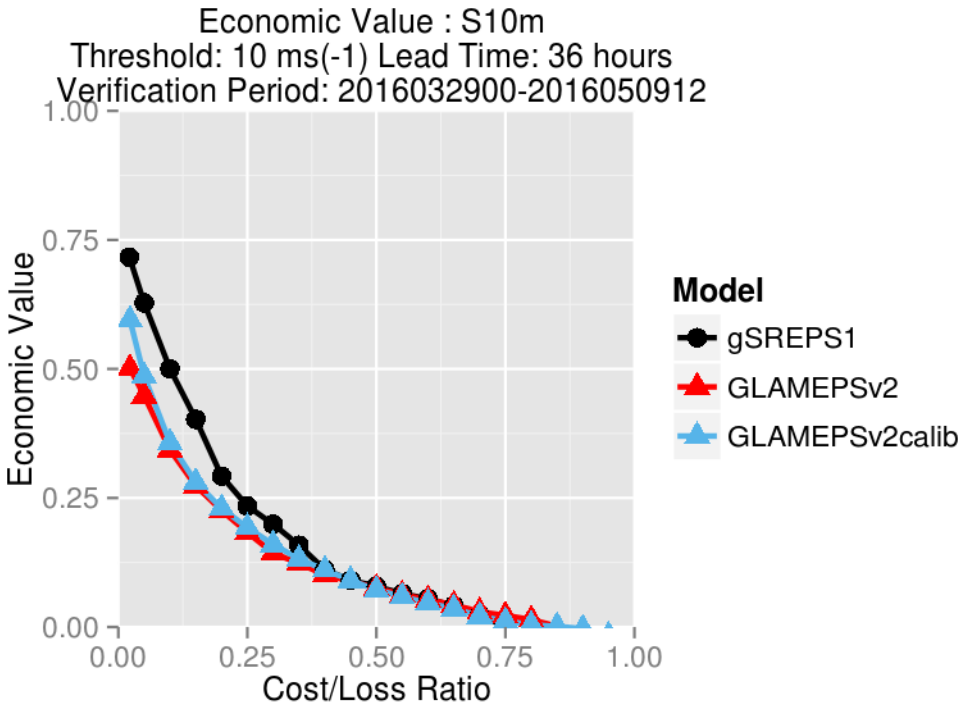




Prob Verif: u10m - Economic value

5 m/s





10 m/s