SRNWP-V programme: a comparison of regional European forecast models

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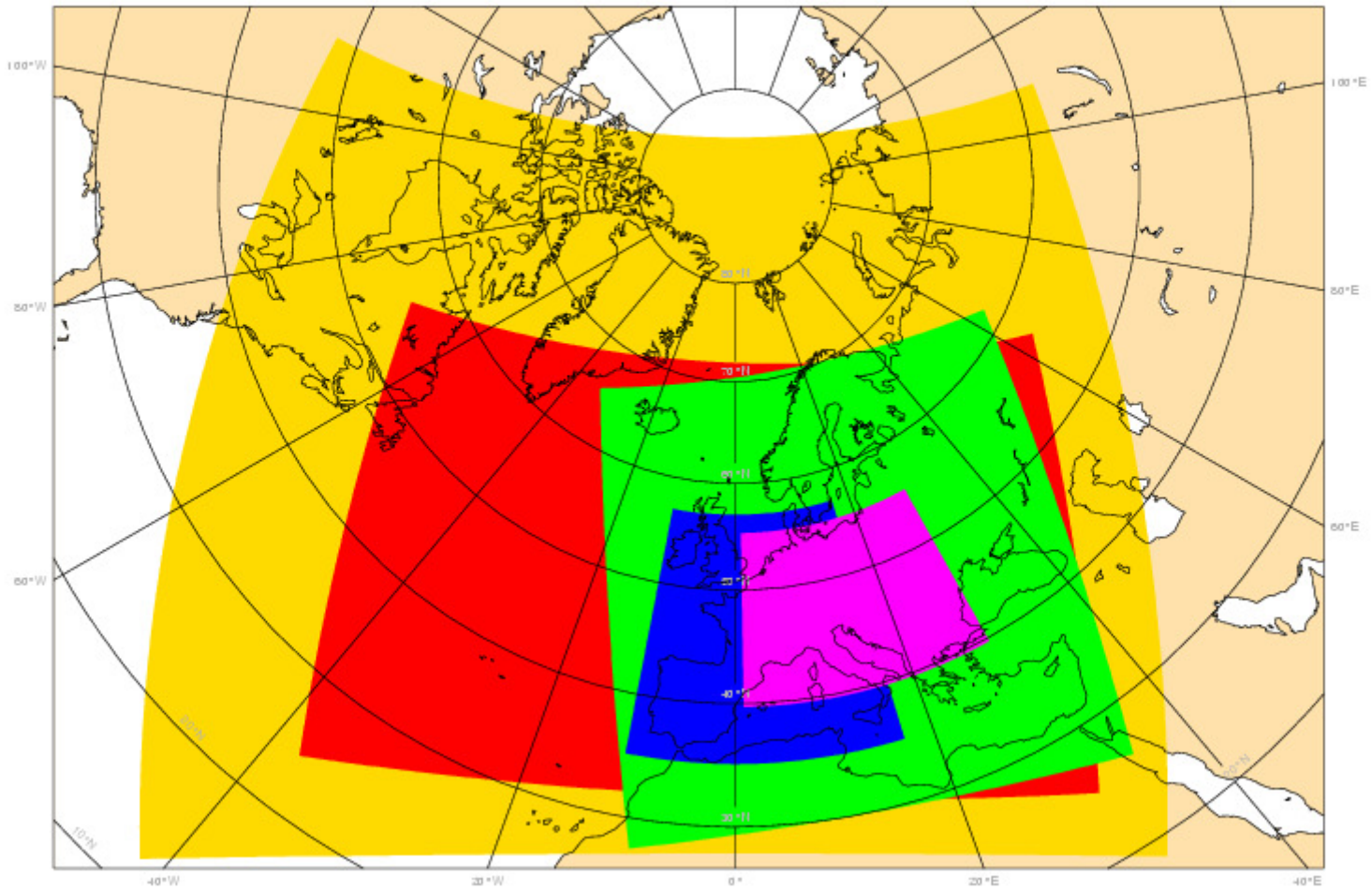
Outline & motivation

- Short Range Numerical Weather Prediction – EUMETNET programme
- Desire to benchmark operational models cf CBS global exchange
- Phase 1 2009-2010
  - Establish framework, recommend methods
- Phase 2 2011-2012
  - Continue comparison, more parameters
  - Use radar/extra observations
  - Extremal measures

EUMETNET/SRNWP programme - Deliverables

- **D1: Operational verification comparison of deterministic forecasts from one version of each of the 4 regional models of Europe (available for all the participating members)**
- **D2: Additional intercomparison of other versions of the consortia models including high resolution models**
- **D3: Inventory and recommendations of "new" scale-selective verification methods.**
- **D4: Catalogue of sources of non-GTS data**
- **D5 Exchange methods and code for verification of severe weather forecasts**

Domains of 5 consortia reference models



15km

12km

7km

10km

5 km

(10km)

Hirlam UM COSMO ALADIN Aladin-Lace

Parameter	Scores
Mean sea level pressure	mean bias and root mean square errors
2m temperature	Bias, rmse
2m relative humidity	Bias, rmse
10m winds	mean bias speed error and root mean square vector wind error
6 hourly total precipitation	equitable threat score and frequency bias for 0.5, 1.0 and 4.0 mm $6h^{-1}$

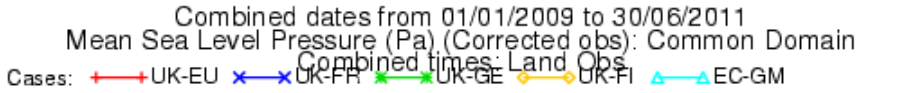
Key

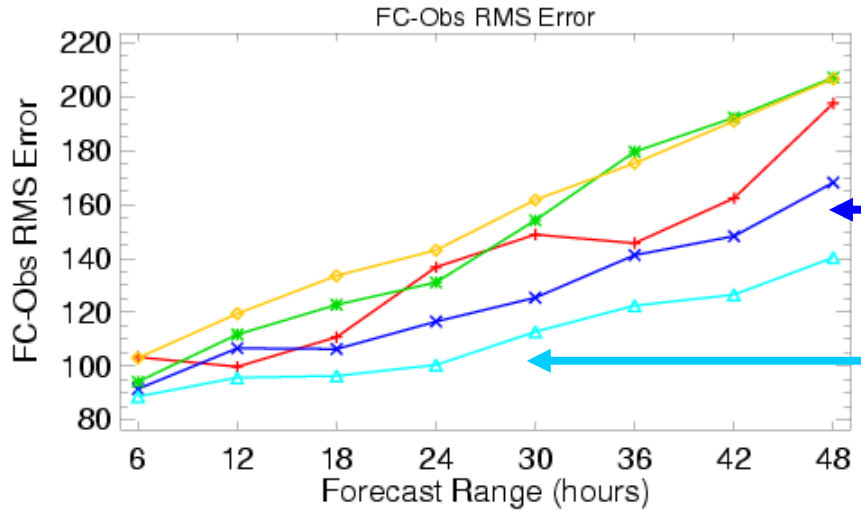
Model	Label
Hirlam reference run by FMI	UK-FI
Aladin-France run by Meteo-France	UK-FR
COSMO Europe run by DWD	UK-GE
The North Atlantic European configuration of the Unified Model run by the Met Office	UK-EU
Aladin-Czech (LACE) run by CHMI	*UK-LC*
ECMWF high resolution global model	EC-GM

Comparison over ALADIN-France domain unless otherwise stated

Sea level Pressure

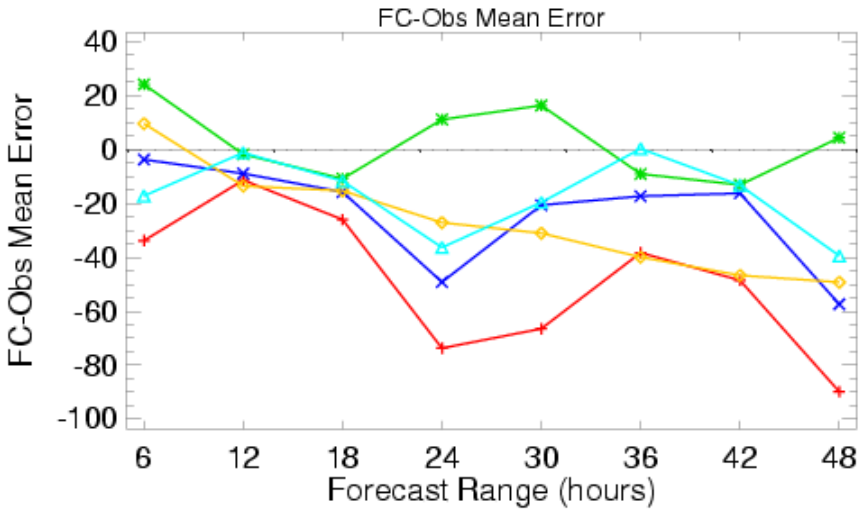
Mean 01/2009-06/2011



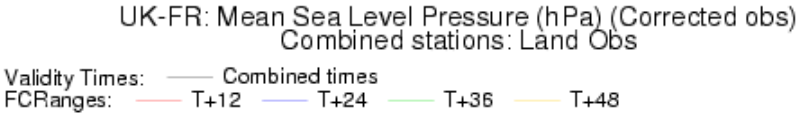


FR

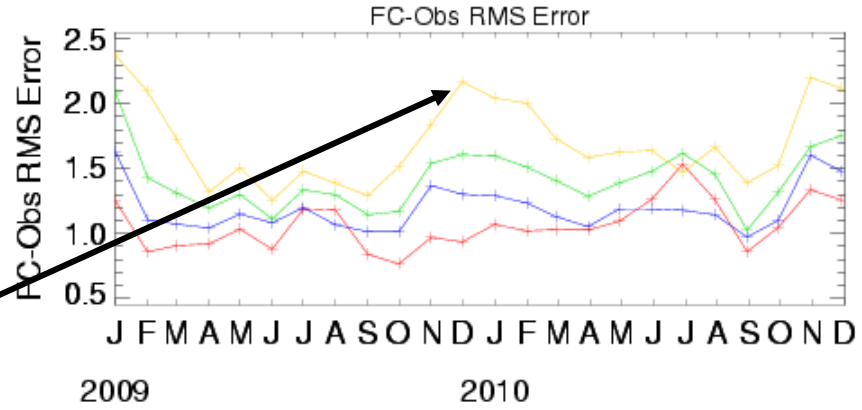
EC



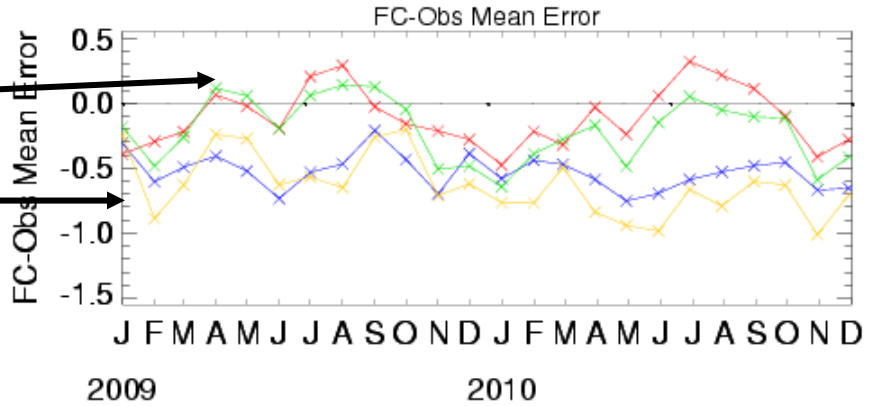
Sea level Pressure



ALADIN-FR



- ONLY 00Z forecasts exposes diurnal variation
- Winter errors larger

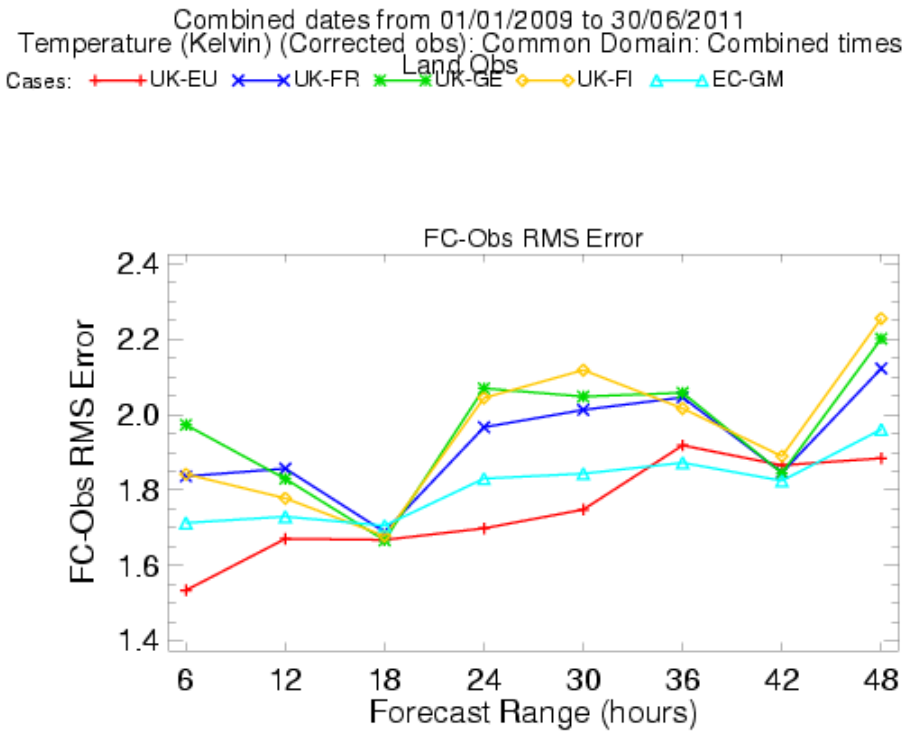


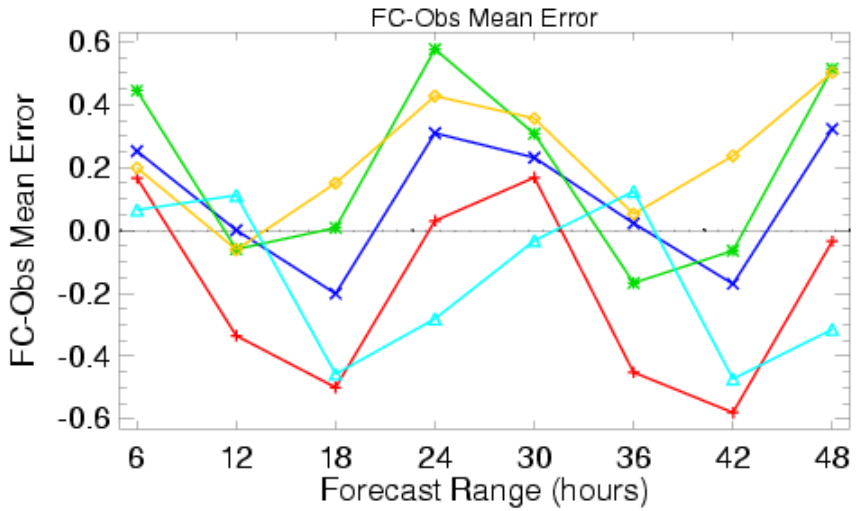
- Smaller daytime bias summer
- Larger bias at night

Screen temperature

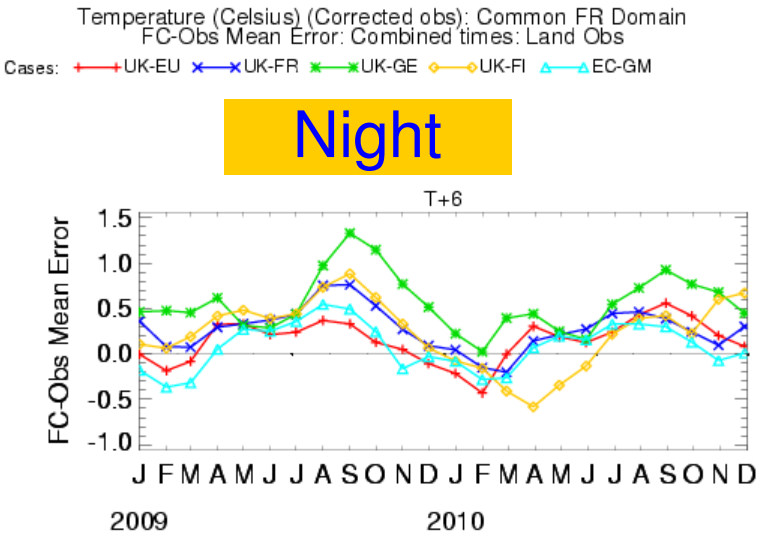
Mean 01/2009-06/2011

Warm night, cold day bias tendency

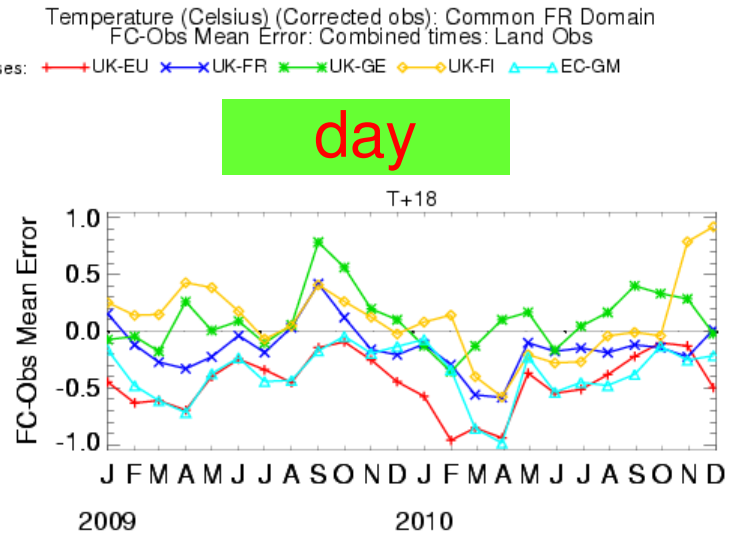




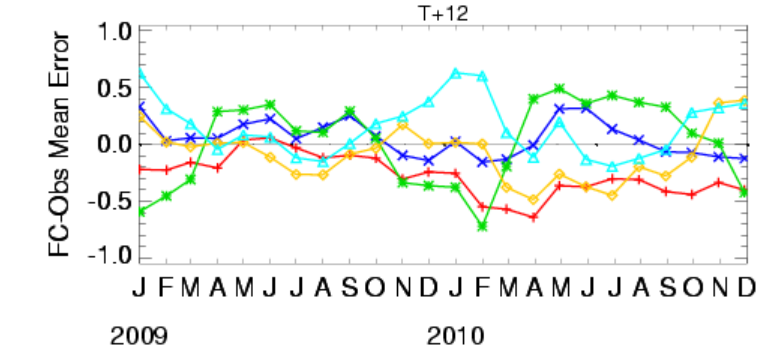
Night



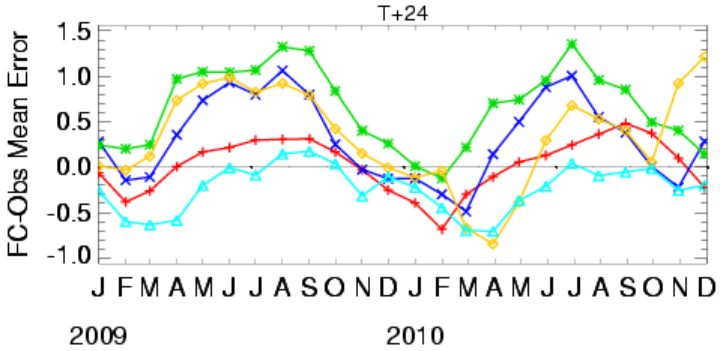
day



day



Night

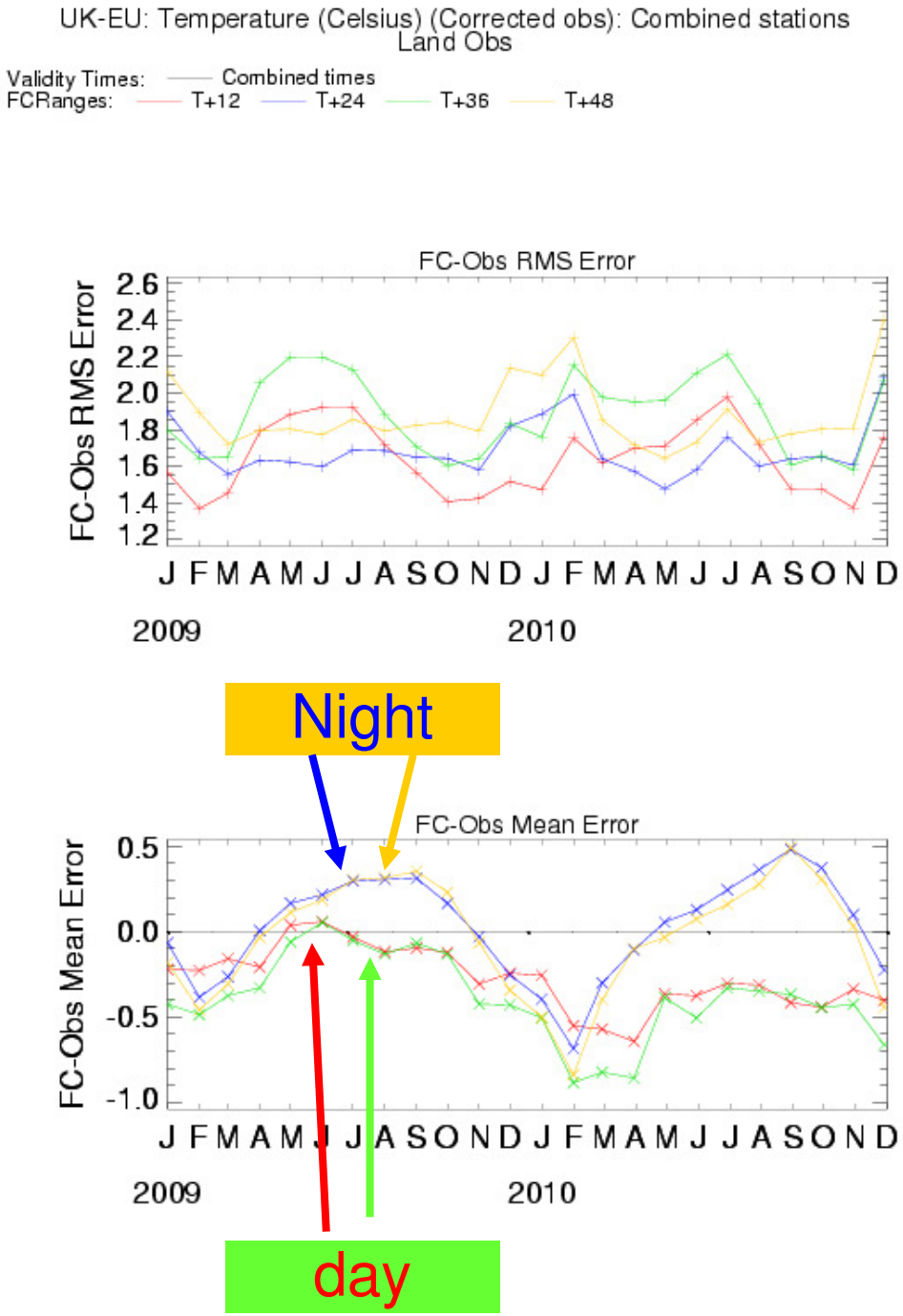


Screen temperature

Screen temperature

NAE

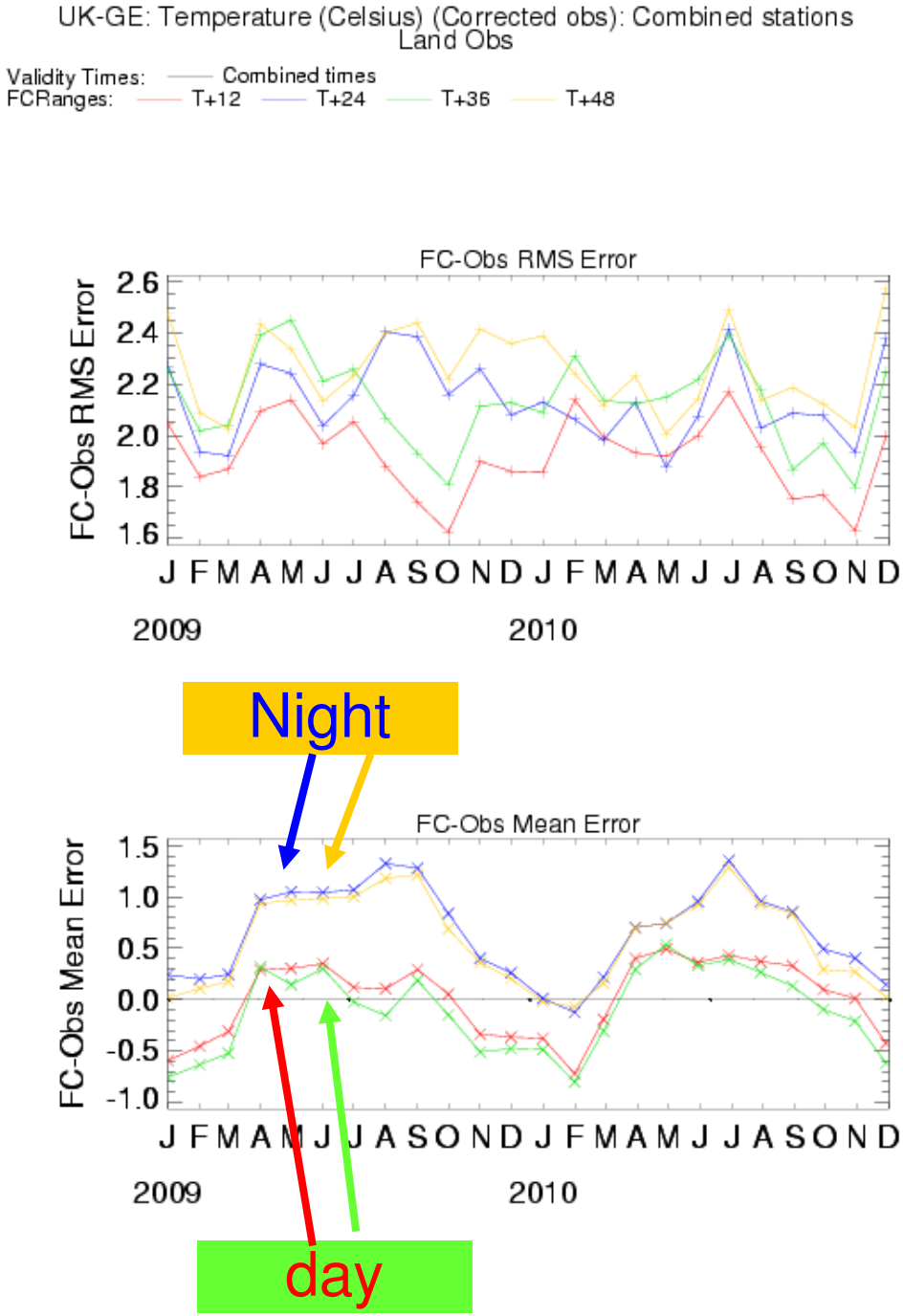
Warm night, cold day bias tendency more apparent in summer



Screen temperature

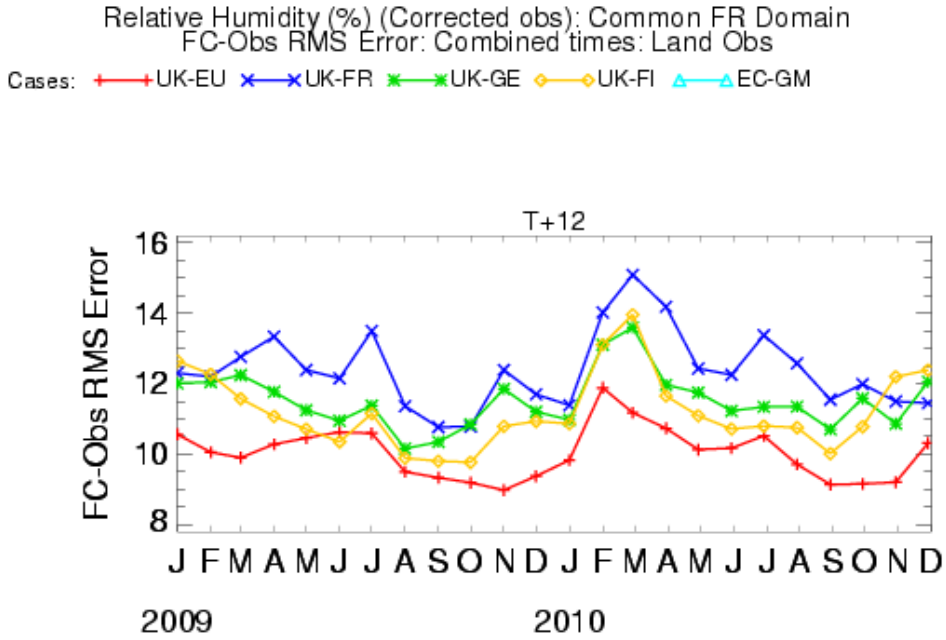
COSMO-EU

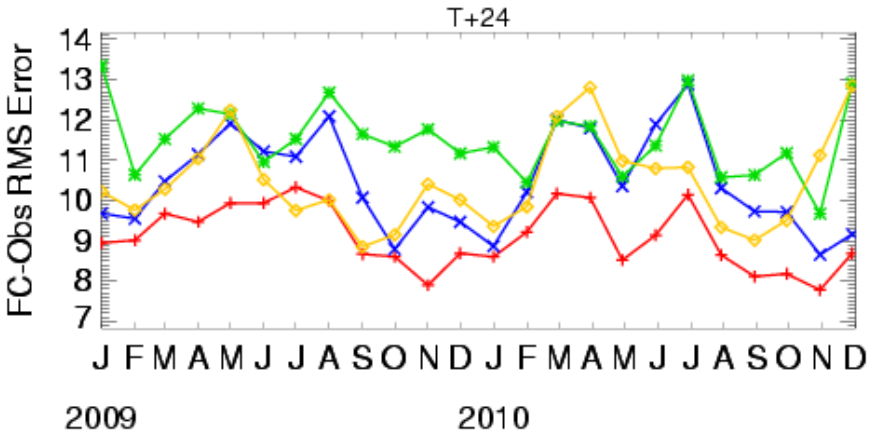
Warm night, cold day bias tendency more apparent in summer



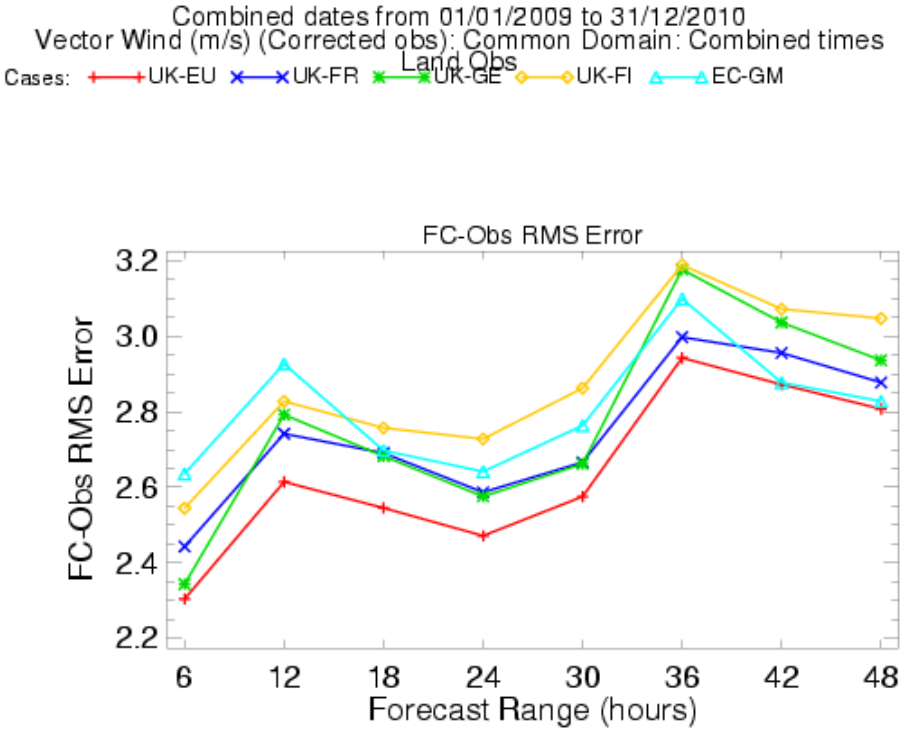
Relative humidity

NB screen temperature and humidity assimilated in NAE

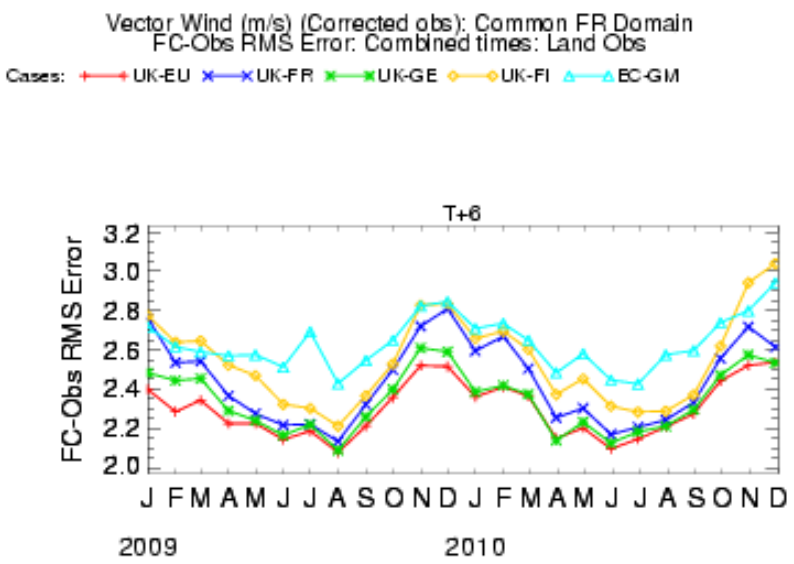


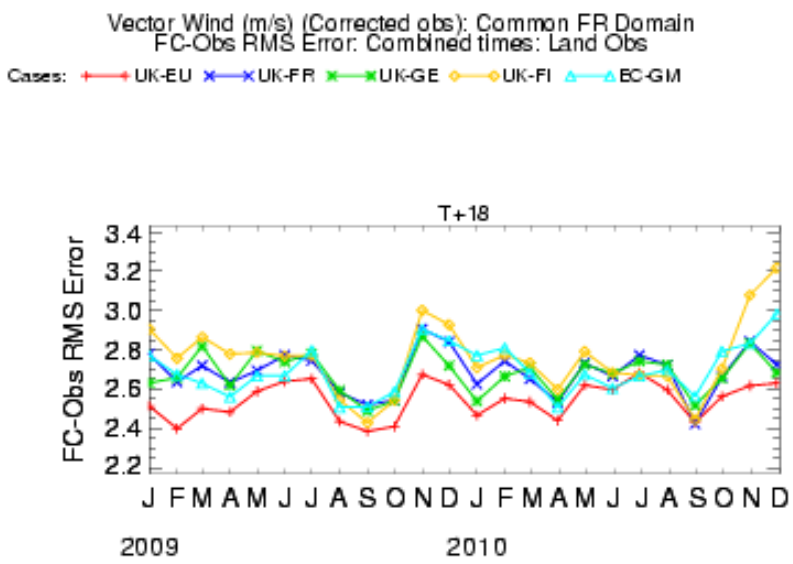


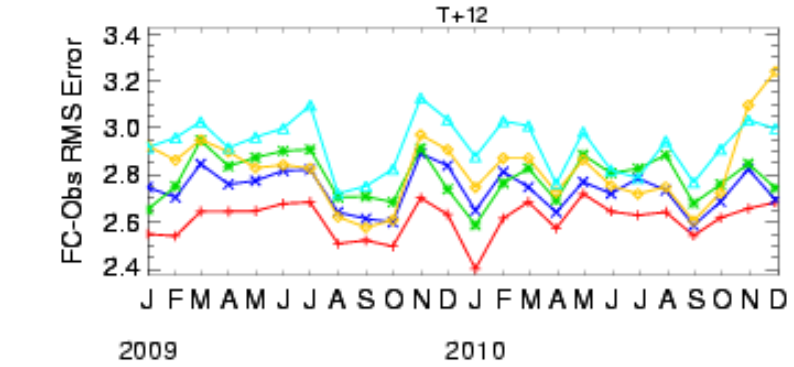
10m vector wind rmse

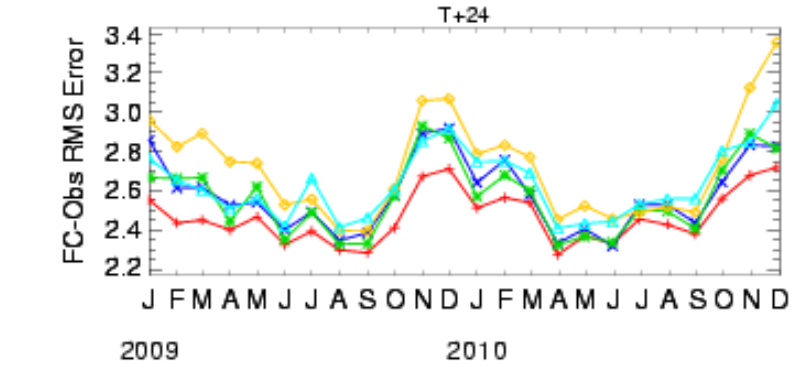


Regional models better than global especially shorter range

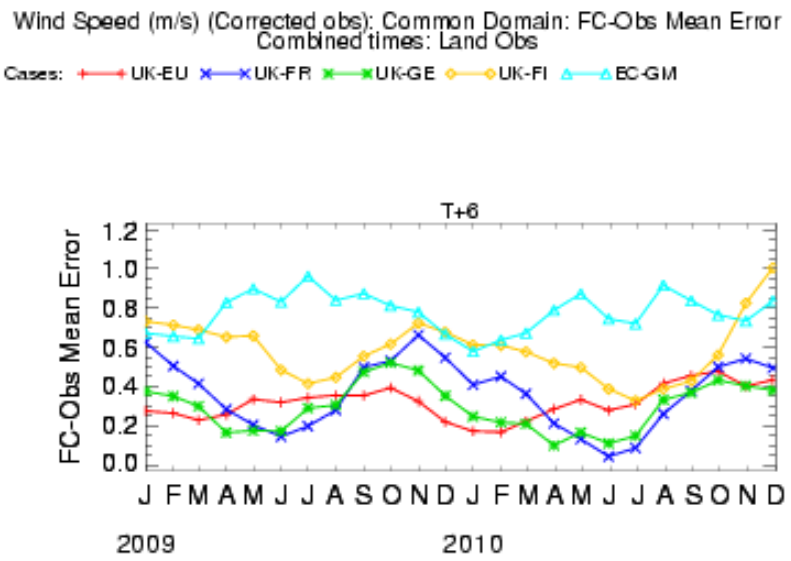


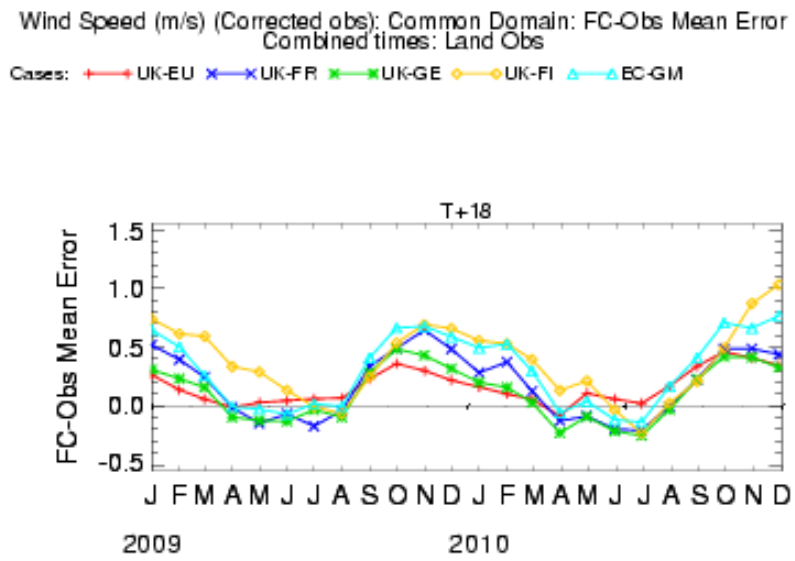


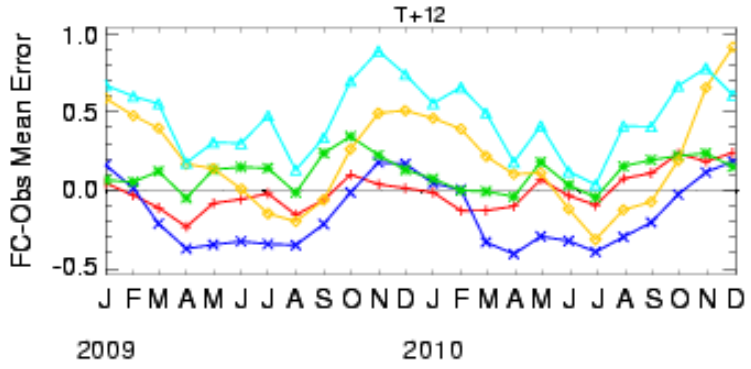


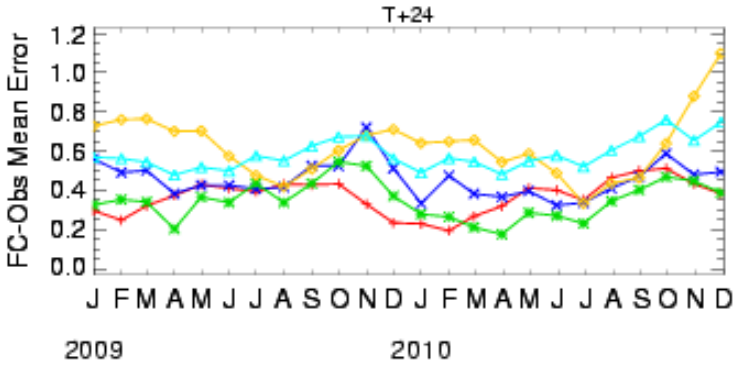


Seasonal variation more evident at night



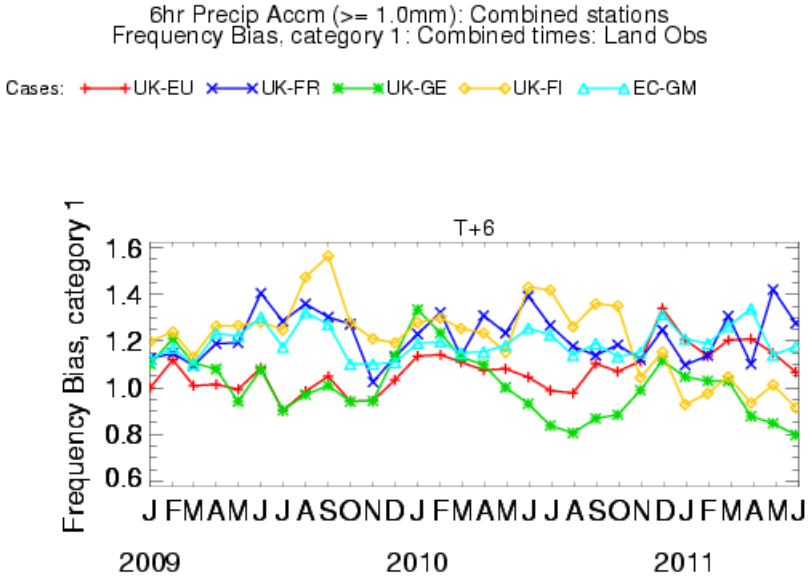


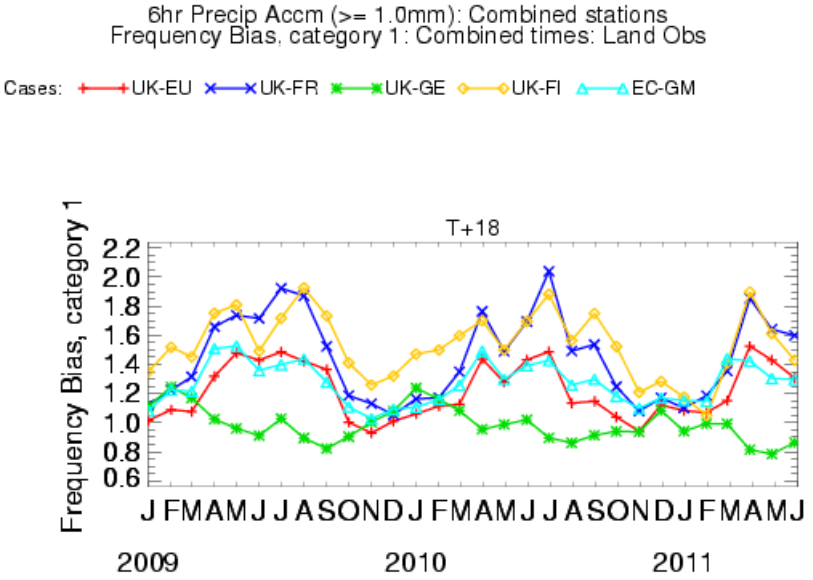


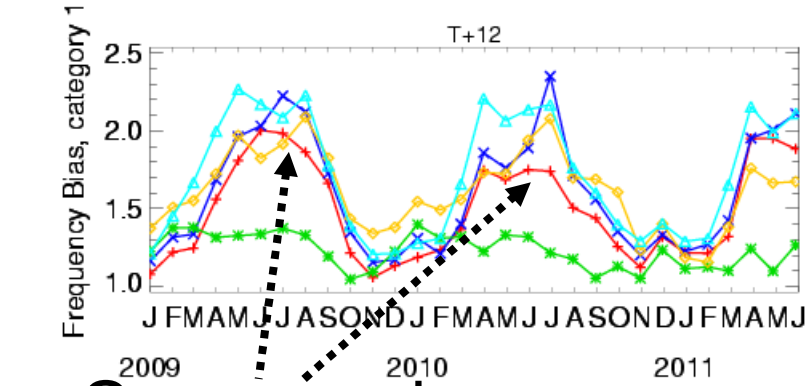


Mostly positive speed bias

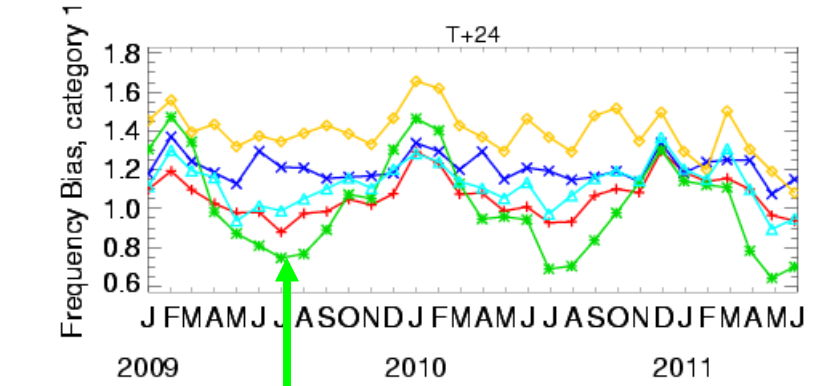
ppn frequency bias >1mm/6h





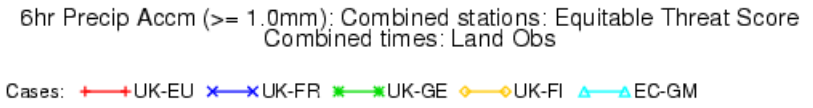


Summer day bias,convection

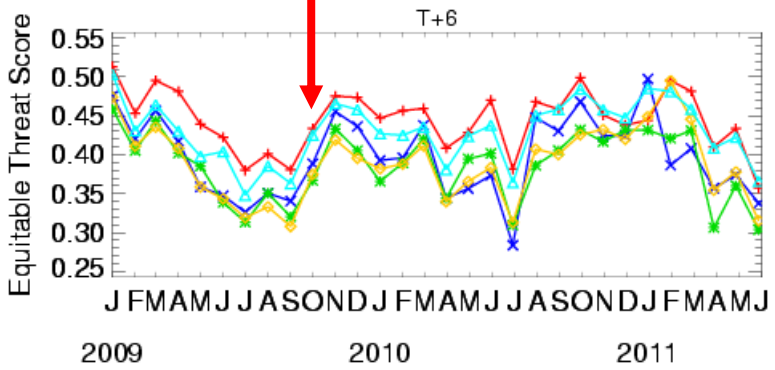


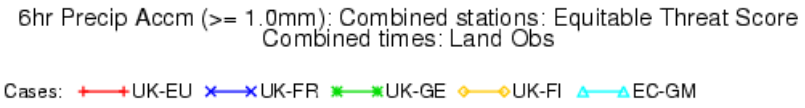
Night negative bias

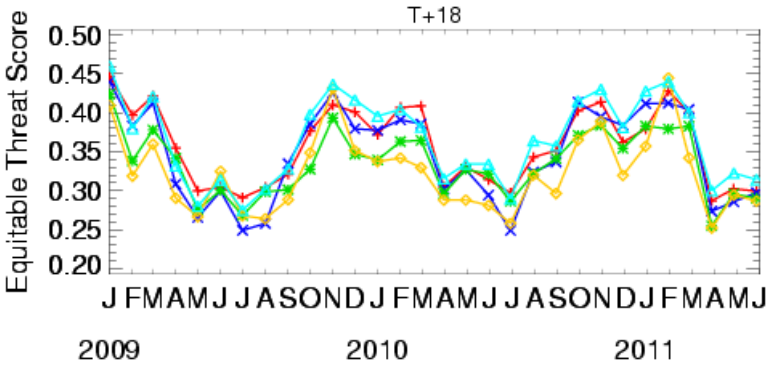
ppn ETS >1mm/6h

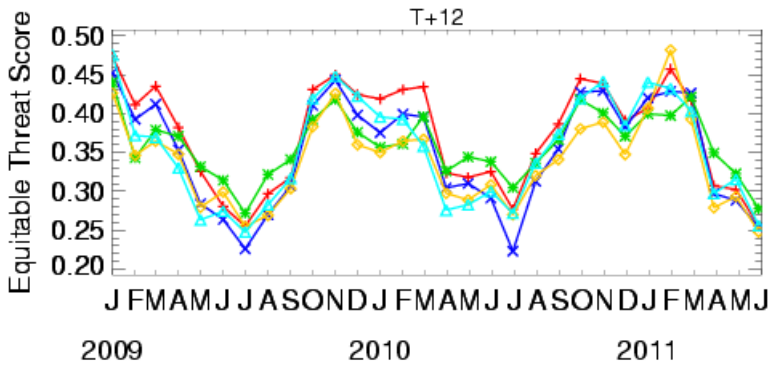


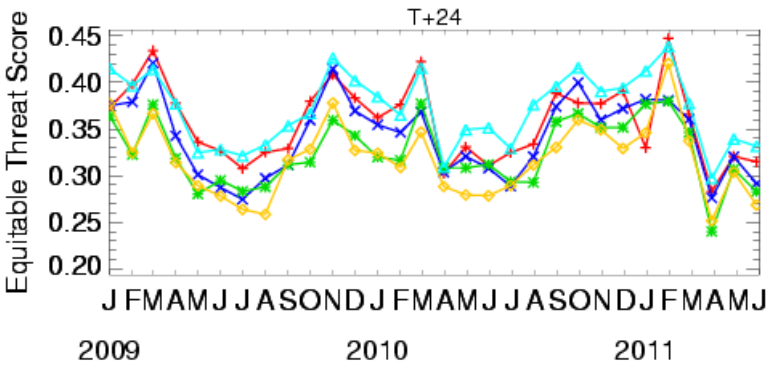
DA – radar/cloud







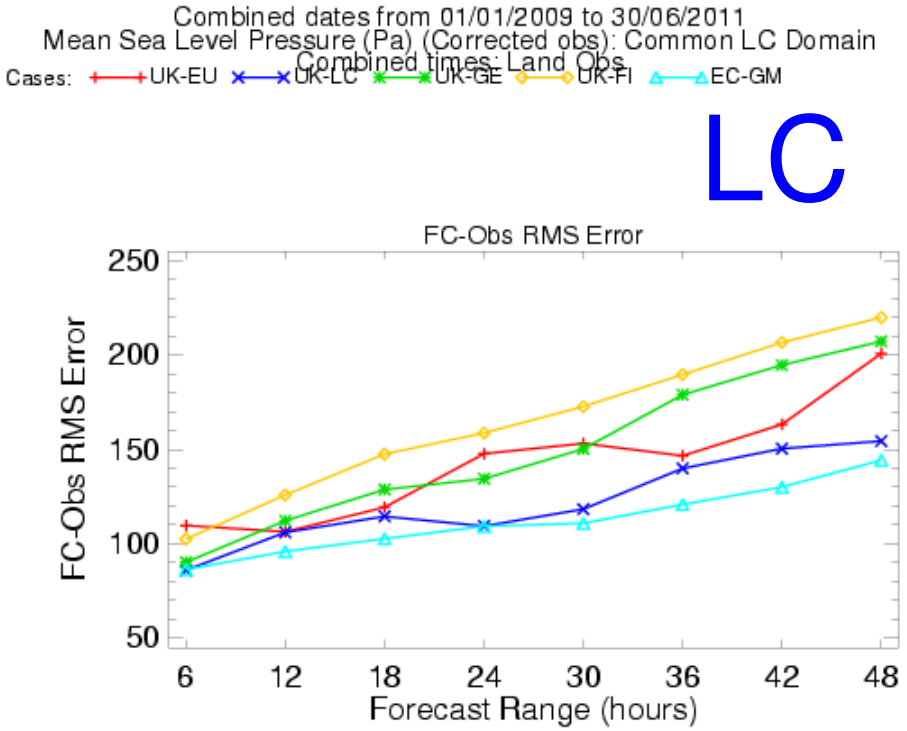


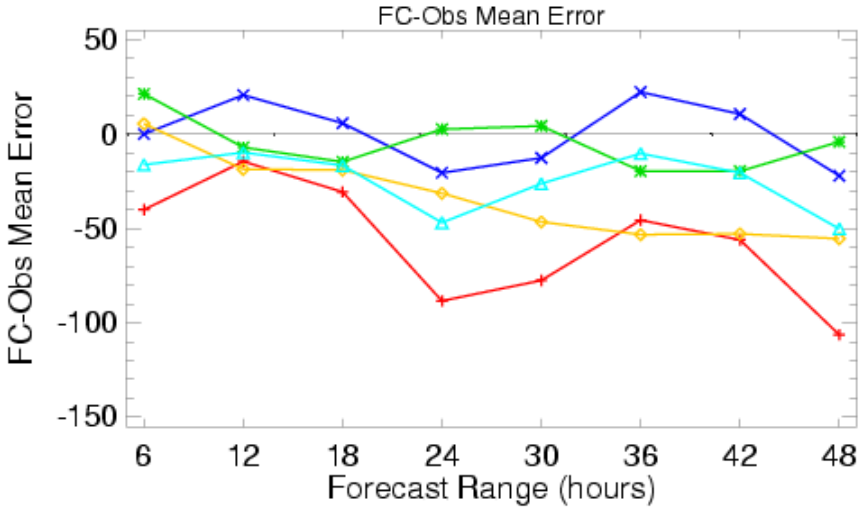


Sea level Pressure

ALADIN-LACE domain

Mean 01/2009-06/2011

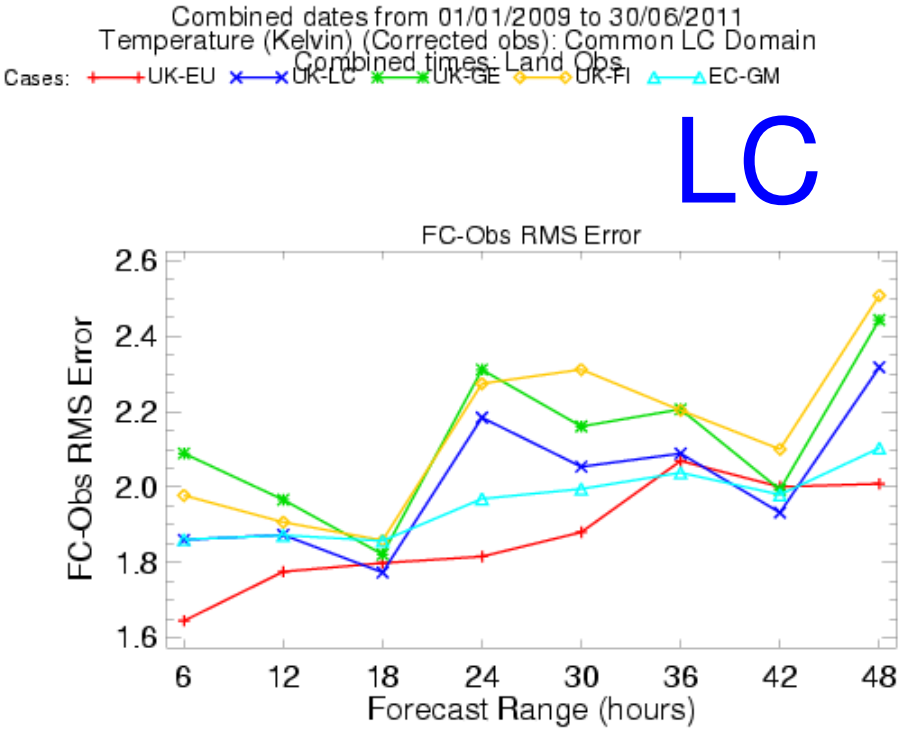


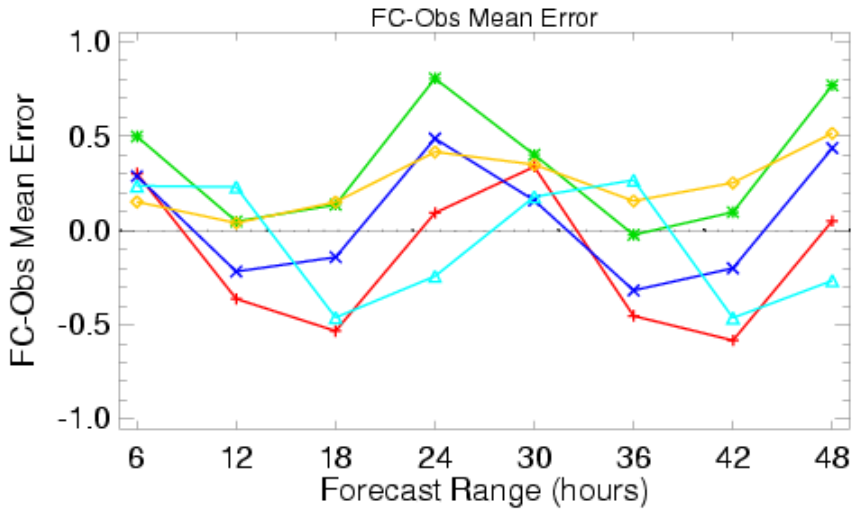


Screen temperature

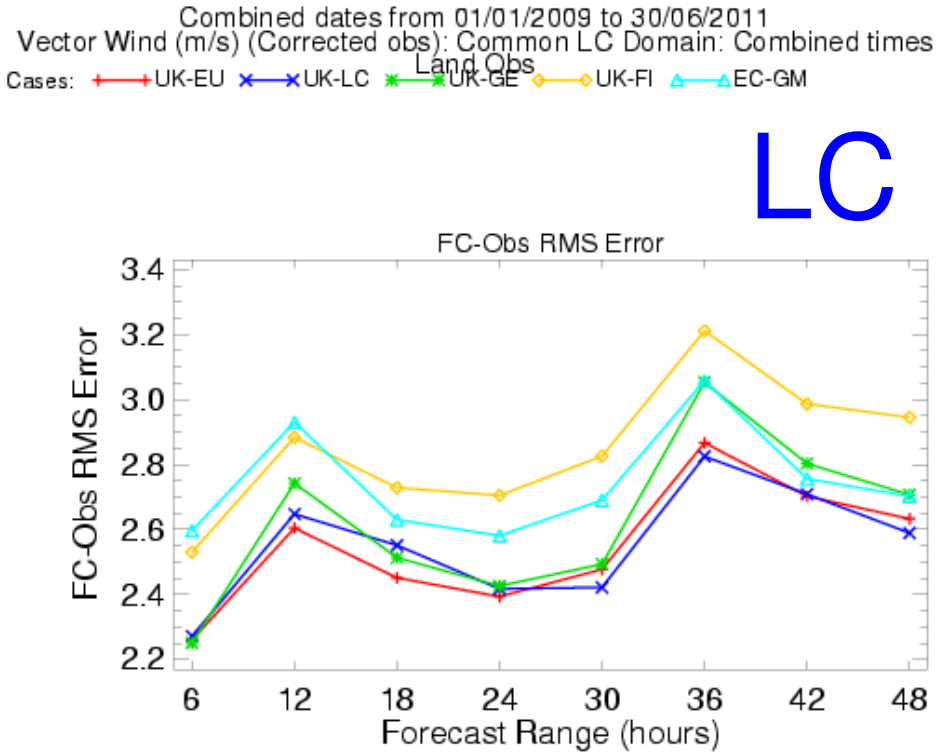
ALADIN-LACE domain

Mean 01/2009-06/2011





10m vector wind rmse ALADIN-LACE domain



Recommendations of “new” scale-selective verification methods.

- Studies/experience at Met Office, MeteoSwiss, DWD,Meteo-France
  - Fraction skill +variants (Roberts, Amodei & Stein)
  - Upscaling(+ETS etc)
  - Easiest to use & interpret

  - Structure/amplitude/location (Wernli et al)
  - Scale intensity (Casati)

  - Key aim of phase 2 to apply these to forecasts from reference/new higher resolution operational models

Met Office

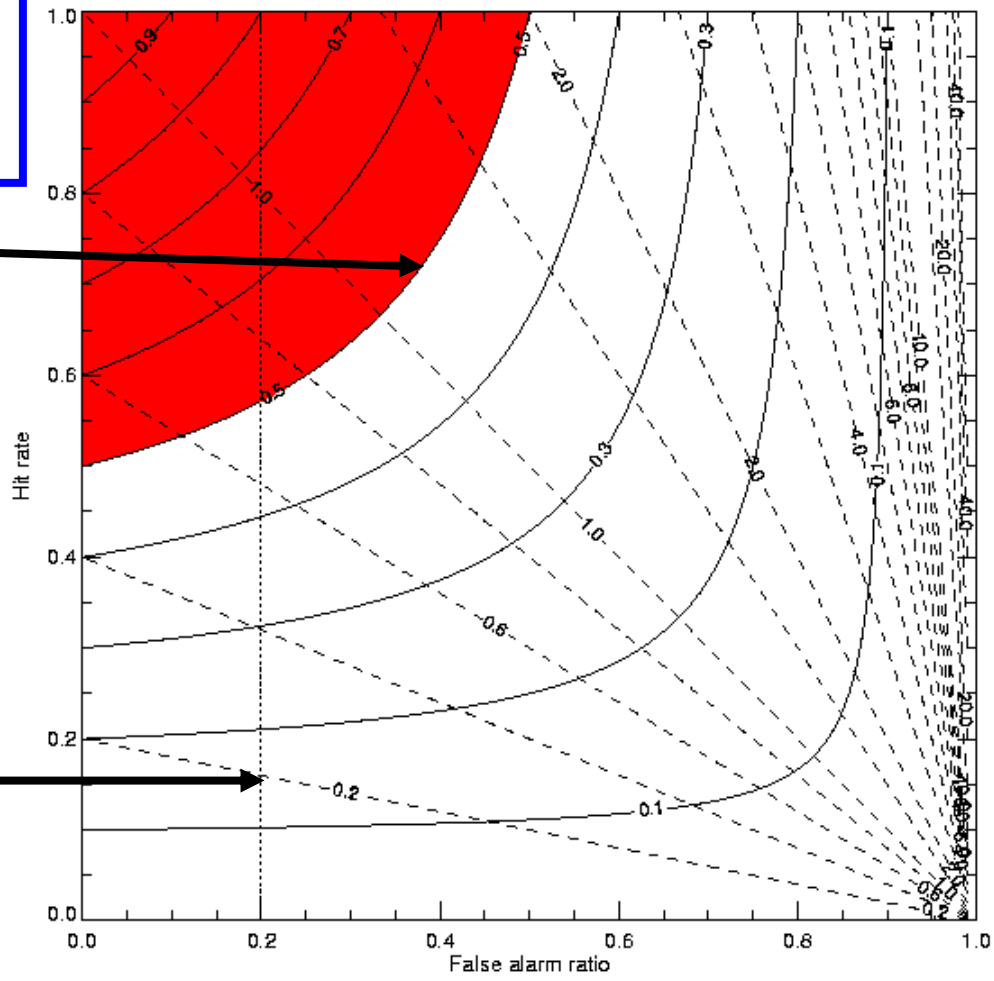
Hit rate v False alarm ratio-cf Roebber – WAF, 2009

$$TS = \frac{(1 - FAR)H}{1 - FAR(1 - H)}$$

$$B = \frac{H}{1 - FAR} \quad ---$$

Deterministic limit

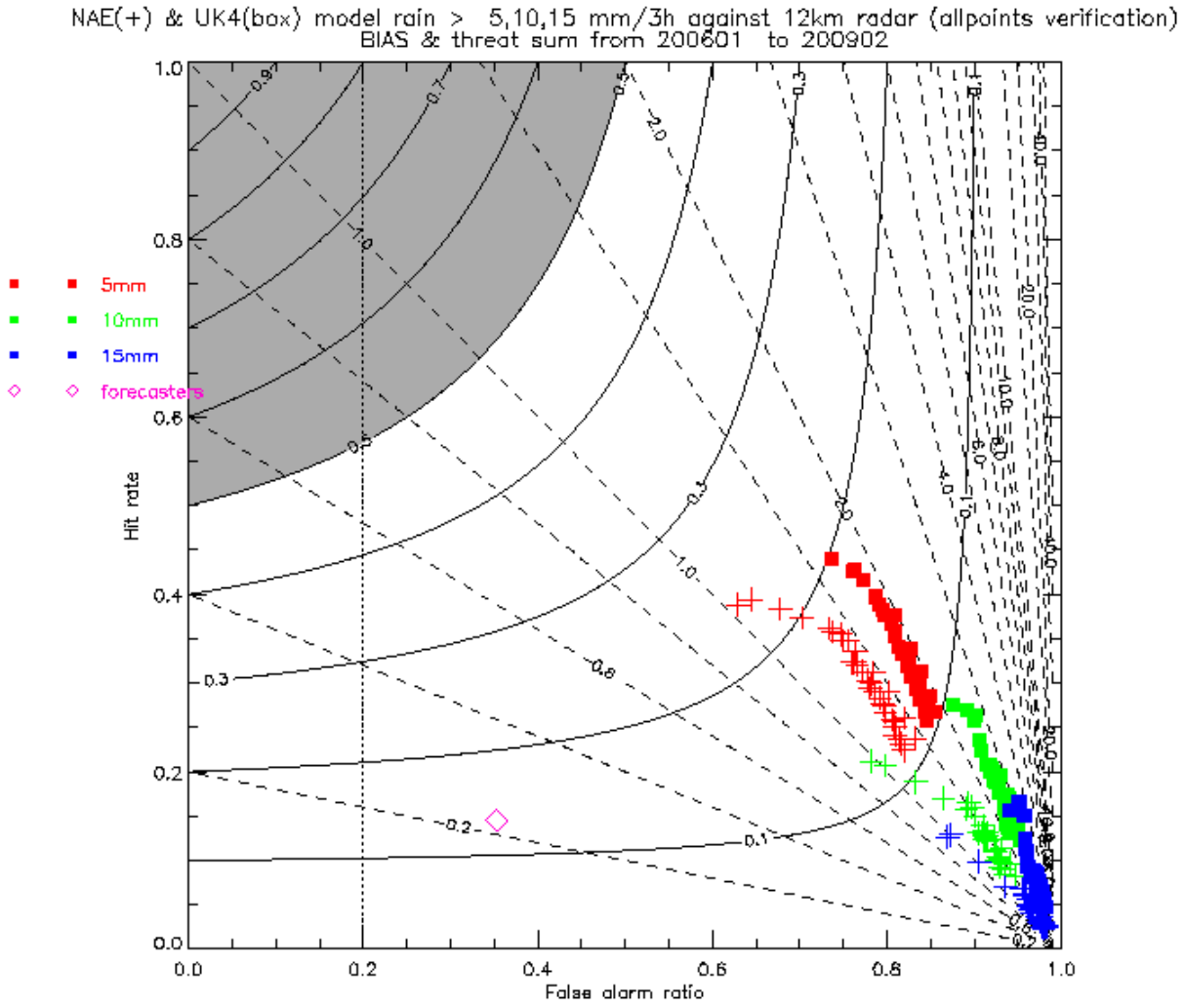
Confidence limit



NAE(12km) & UK 4km models (12km radar verification) 200601-200902

12km +

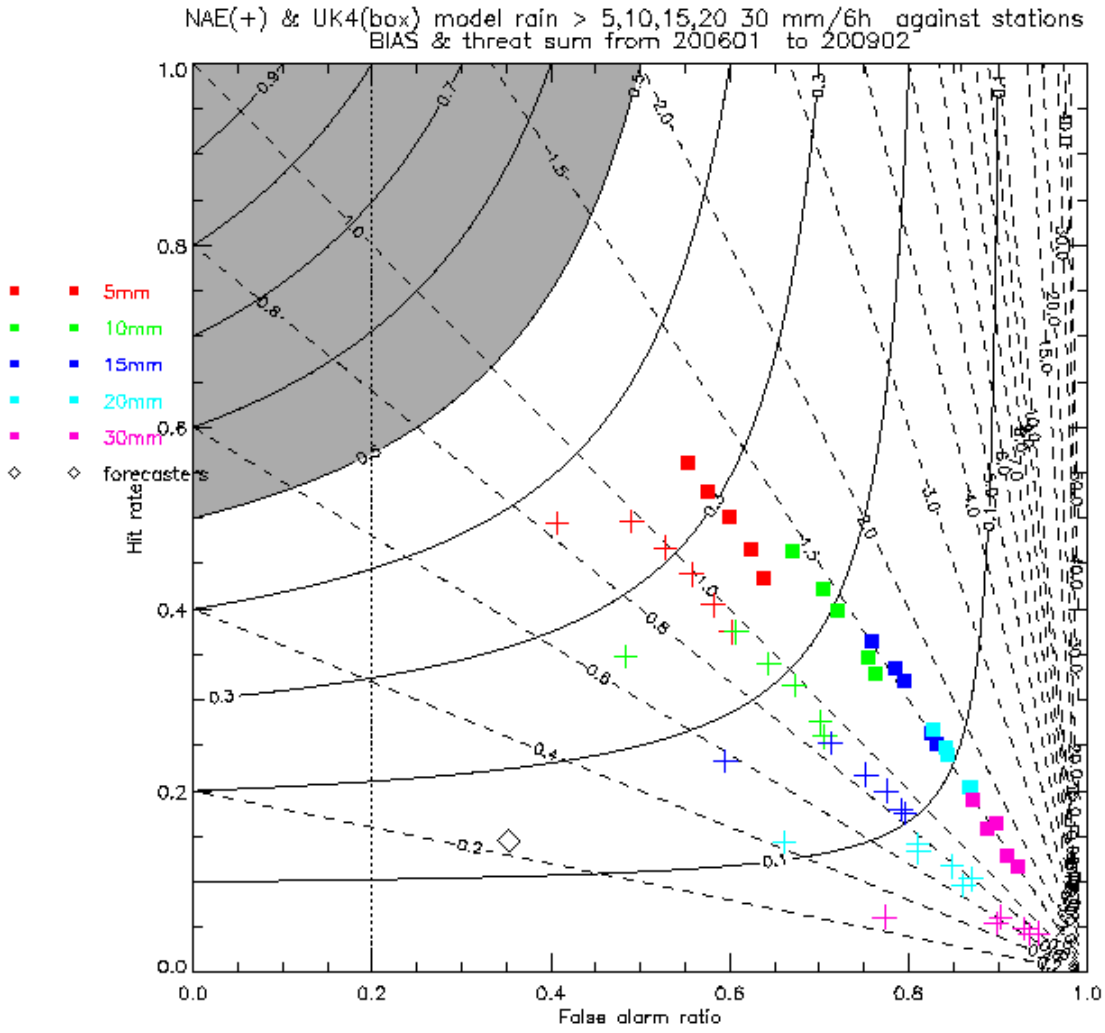
4km ■



NAE(12km) & UK 4km models (Nearest point to station verification) 200601-200902

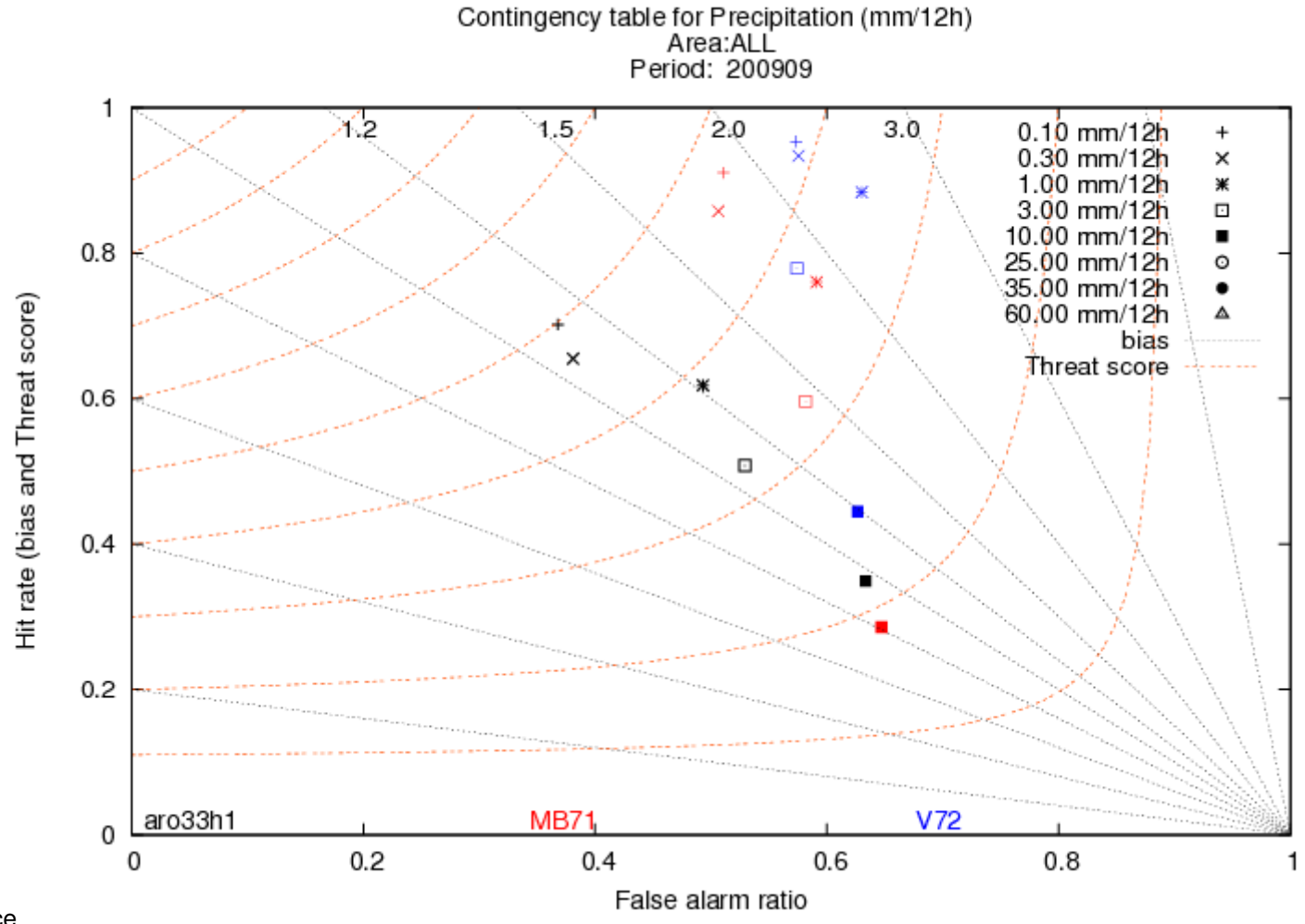
12km +

4km ■



FMI comparison

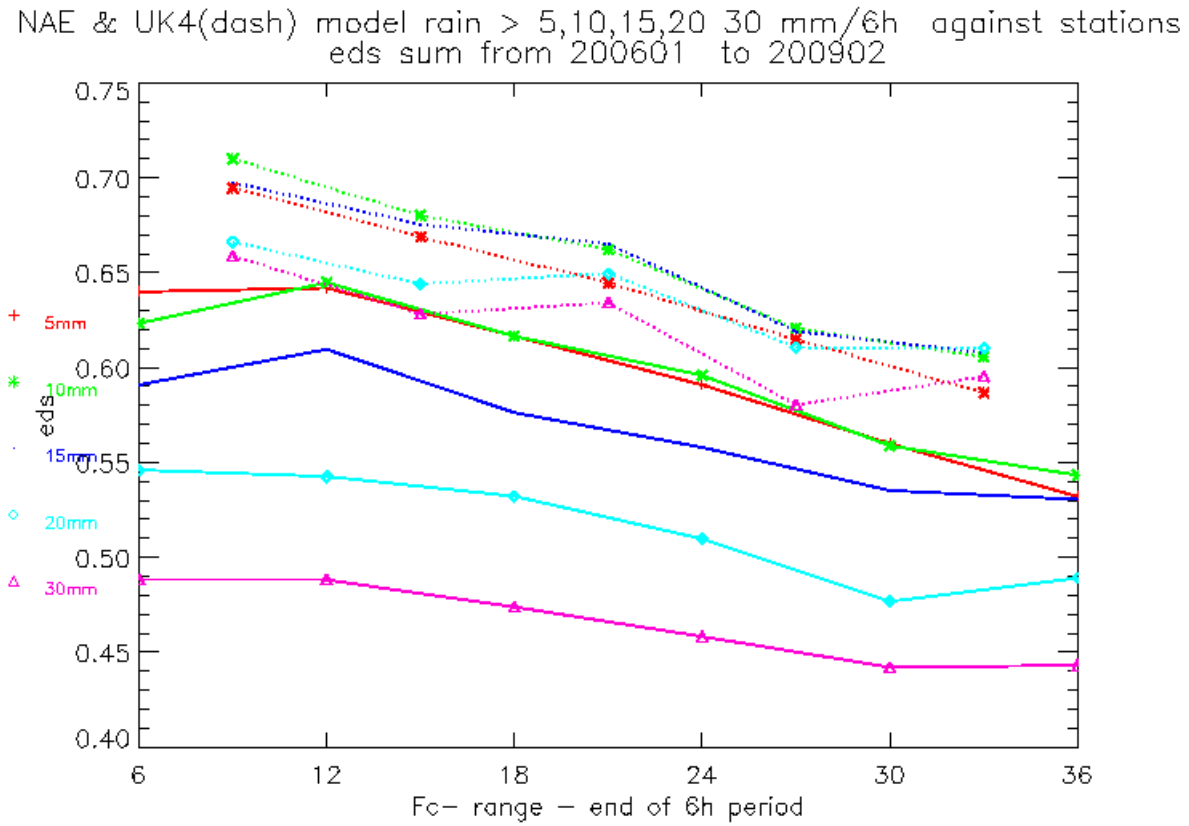
aro33h1: AROME 33h1 (2.5km L40)
MB71: HIRLAM 7.1.4 (7.5km L60)
V72 (RCR): HIRLAM 7.2 (16.5km L60)



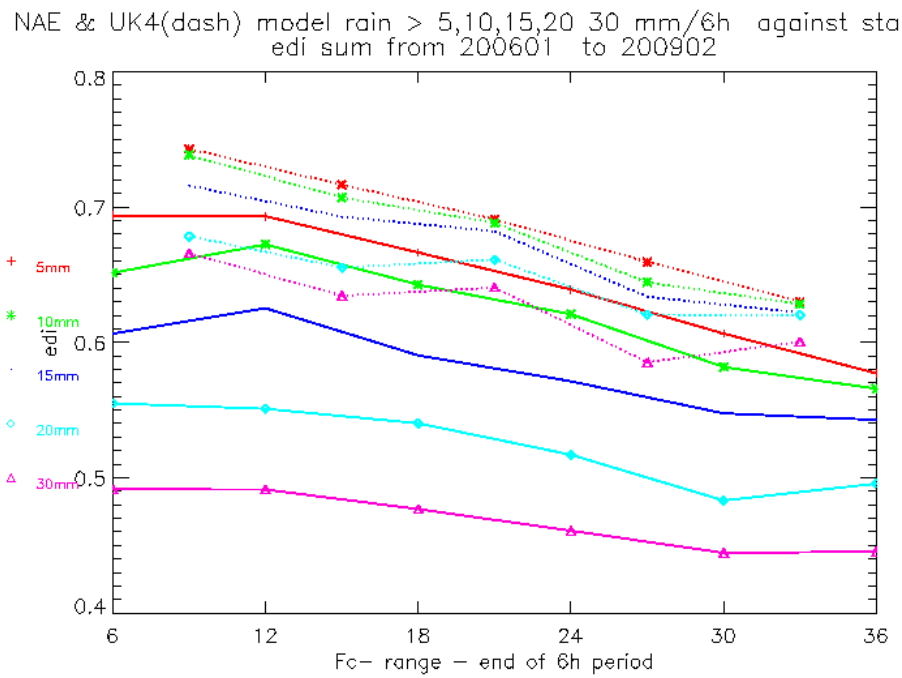
Extreme dependency score

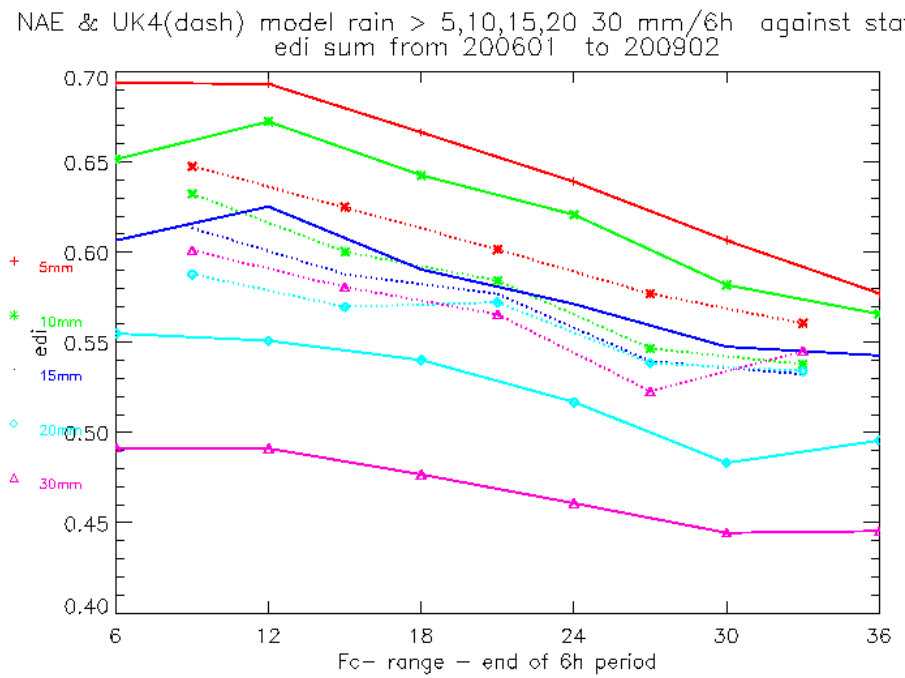
$$EDS = \frac{\log(p) - \log(H)}{\log(p) + \log(H)} \rightarrow EDI = \frac{\log(F) - \log(H)}{\log(F) + \log(H)}$$

$$\text{since } F = \frac{p(B-H)}{1-p} \rightarrow p, \text{ as } p \rightarrow 0, \text{ if } B = 1, \text{ie recalibrated}$$



Extremal dependency index





Bias correction 1

Bias correction 2

SRNWP-V 1 Conclusions

- Established framework comparison
  - No single model with clear large advantage
  - Continue with new higher resolution operational models
    - Identify benefits
  - Identified most promising methods for operational monitoring with spatial methods
  - Catalogue of useful data sets non-GTS
  - Warnings / extreme verification - started

SRNWP-V Phase 2 Programme

ND1 Continue & expand comparison ; ND2 Additional products

- Continue & expand comparison
  - Longer more robust results
  - higher resolution of future operational models
  - Overlap models in pairs
- Additional products verified
  - Cloud amount/base
  - Visibility
  - Wind gust
  - Others as suggested by Consortia

ND3: Spatial & scale selective verification of precipitation

- Verify against
  - Gridded analyses- ECMWF, Meteo-France, Met Office
  - High resolution radar (5 min,1-2 km)
  - OPERA radar composite

- Methods
  - Fractional skill (Roberts & Lean)
  - Upscaling
  - Intensity scale (Casati)
  - Structure,amplitude,location (SAL) (Wernli et al)
  - Contiguous rain areas (Ebert & McBride)

ND4 Inclusion of severe/high impact weather verification

- ND4 Methods as identified in SRNWP-V 1
  - Extreme dependency scores
  - Warnings verification
- Deliverable ND5:
  - Full documentation of the methods used in the intercomparison.
  - Newer spatial methods code to be portable.