



ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Experiences in Calibration of EPS forecasts

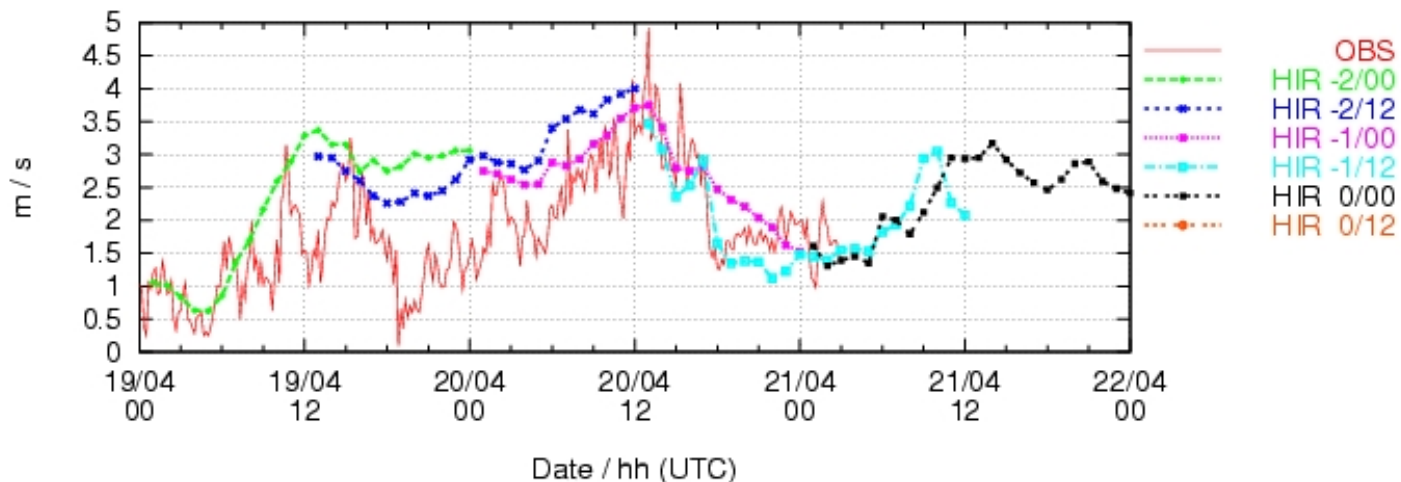
Juha Kilpinen





Different sources of uncertainty

- Observations (special focus on wind speed observations)
- Uncertainty associated coarse grid
- Model deficiencies
- Calibration of uncertainty (EPS forecasts)



Fri Apr 21 07:45:20 2006



Experiences in Calibration of EPS forecasts

- **Only ECMWF EPS and operational forecasts evaluated**
- **Parameters: 10m wind speed, 2m temperature and mslp**
 - Mismatch between observations and forecasts due to low model resolution
 - Wind speed observations are problematic (orography, environment)
 - Only (the difficult ?) surface parameters considered ->
 - Need of calibration

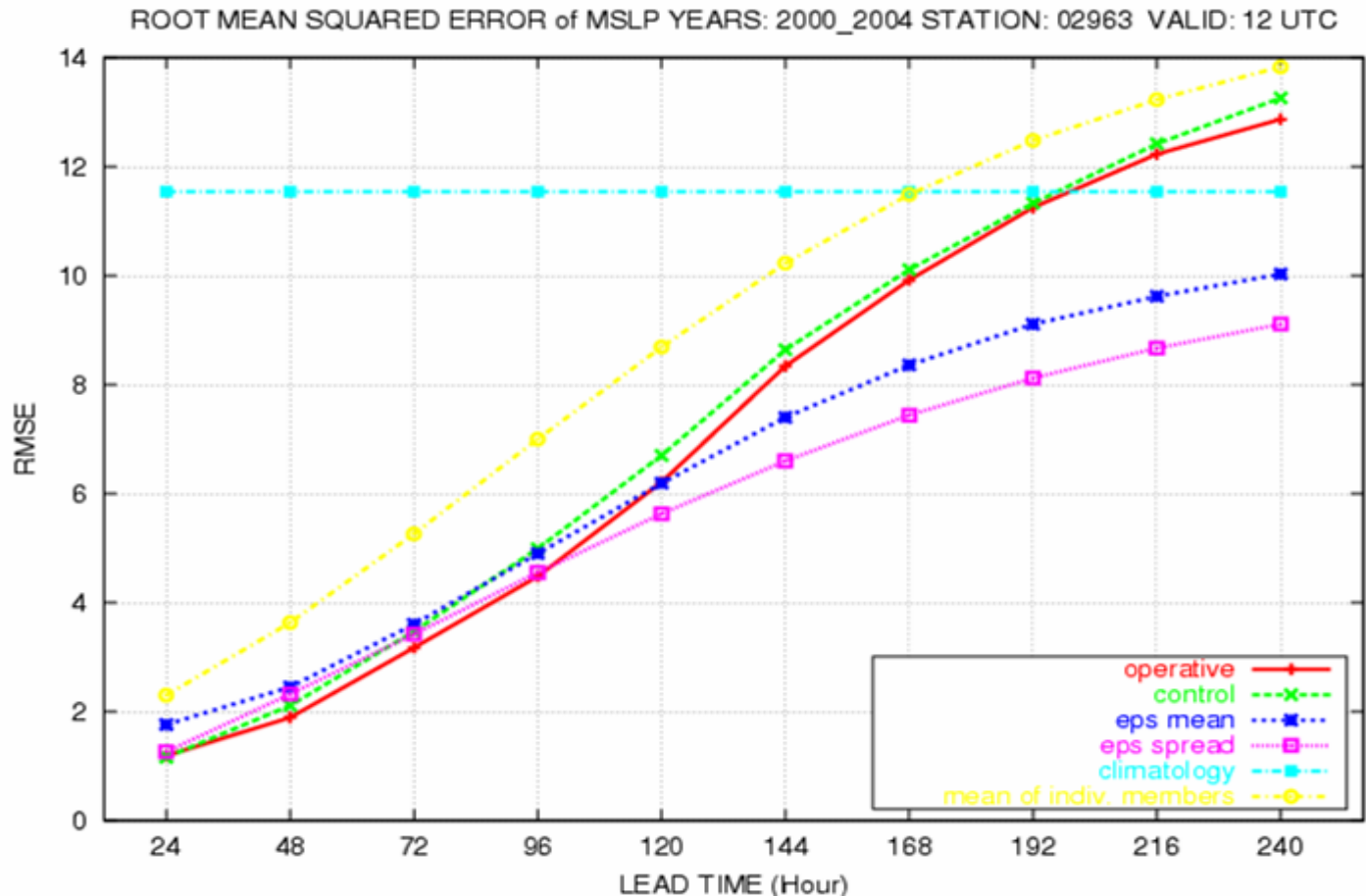


Verification results of deterministic mslp forecasts

RMS Error

ECMWF:

- operative
- control
- eps mean
- eps spread
- clim (4 years)
- mean of indiv. eps members





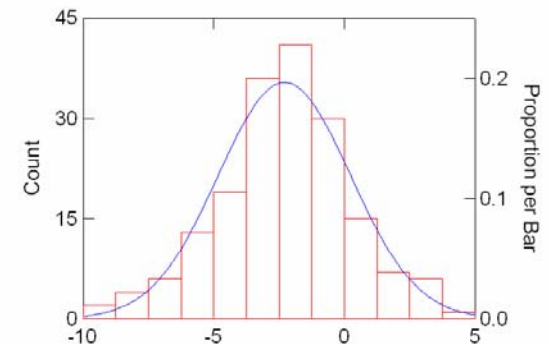
Comments for mslp forecasts

- **nice behaviour in lead time**
- **Spread is realistic compared to error distribution of EPS mean -> EPS provides a useful and almost optimum probability forecasts for mslp (no real need for calibration)**



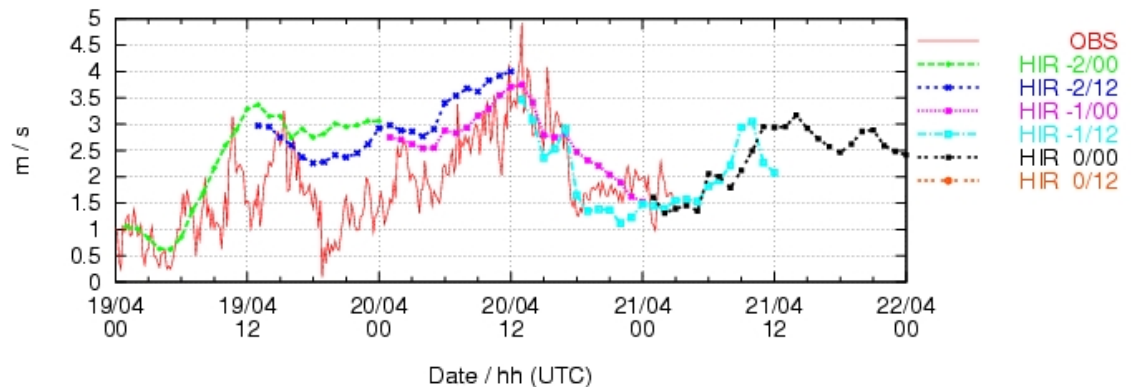
Temperature forecasts

- Both **OPERATIONAL** and **EPS** forecasts suffer from **biases** (stable stratification)
- **EPS** forecasts are under dispersive
 - -> need of calibration



EPS wind speed forecasts

More detailed examination



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Wind speed forecasts

- **Representation mismatch (grid)**
- **Height of the anemometer**
- **Stratification (stable conditions,)**

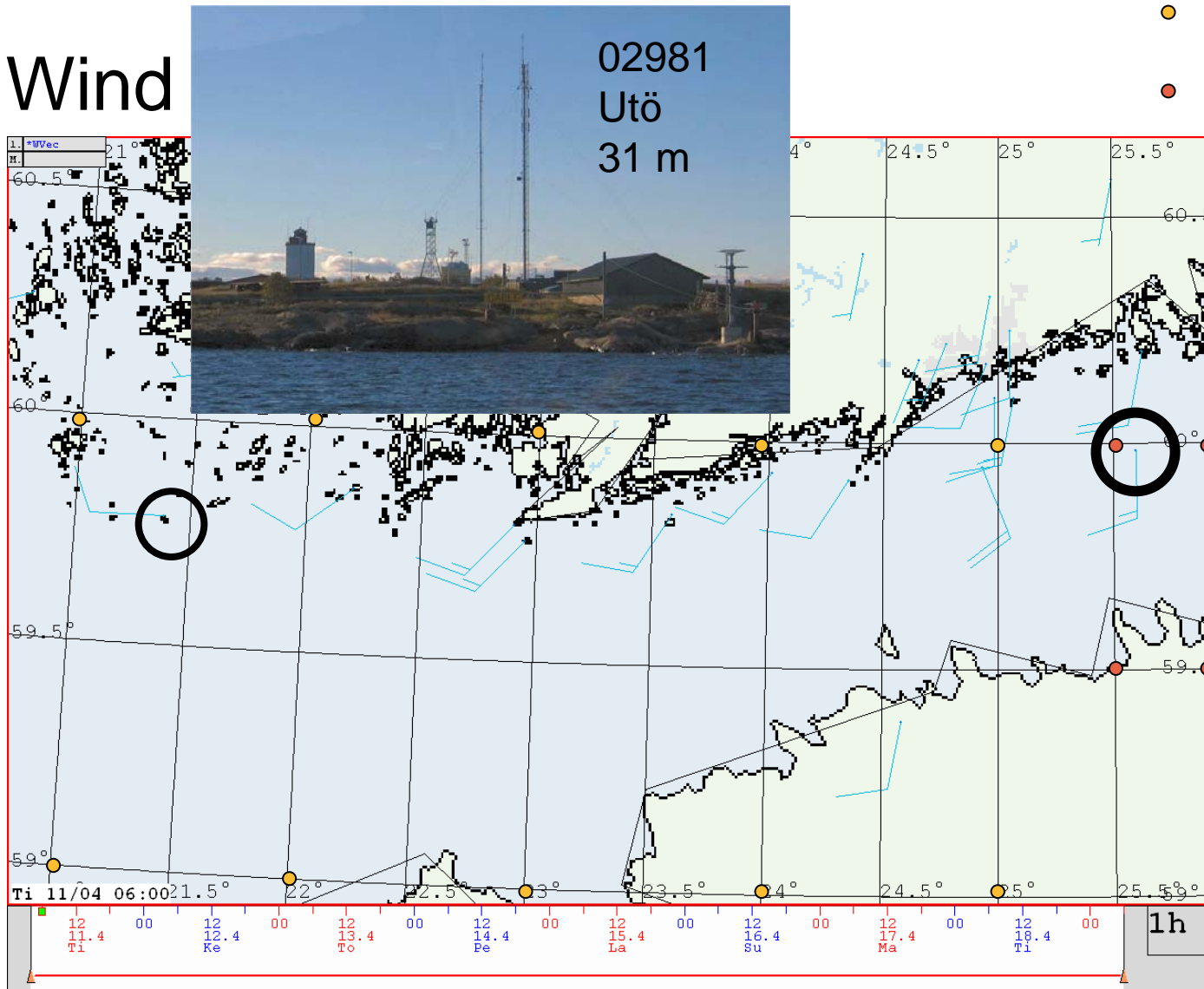
Verification scores:

- **Deterministic forecasts: ME, RMSE, (STDE)**
- **Probabilistic forecasts: ROC AREA, BRIER SKILL SCORE**



Wind

- 1 x 1 degrees
- 0.4 x 0.5 degrees





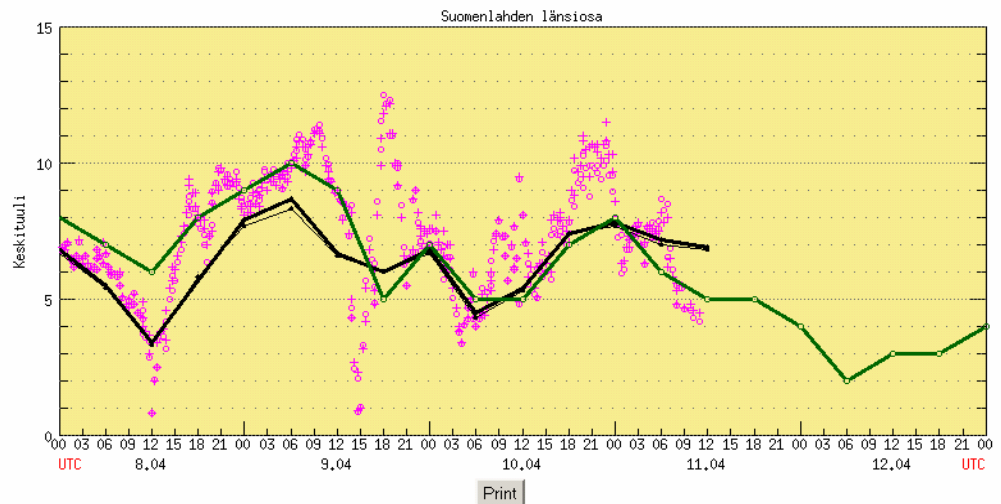
Operative forecasts and observations

FMI has a correction system for wind speed observations

Reduction of wind speed due to anemometer height (neutral stratification)

Correction of wind speed due to obstacles around the site (direction dependent)

station 02987 (Kalbådagrund)



Wdir Wspd Wmax

Yhtenäiset käyrät esittävät kullekin kuuden tunnin jaksolle laskettua keskiarvoa tai maksimia kaikkien asemien yli.

Yksittäiset pisteet esittävät yksittäisiä havaintoja, joko alkuperäisinä (ristit) tai korjattuna ympäristön esteiden mukaan (ympyrät).

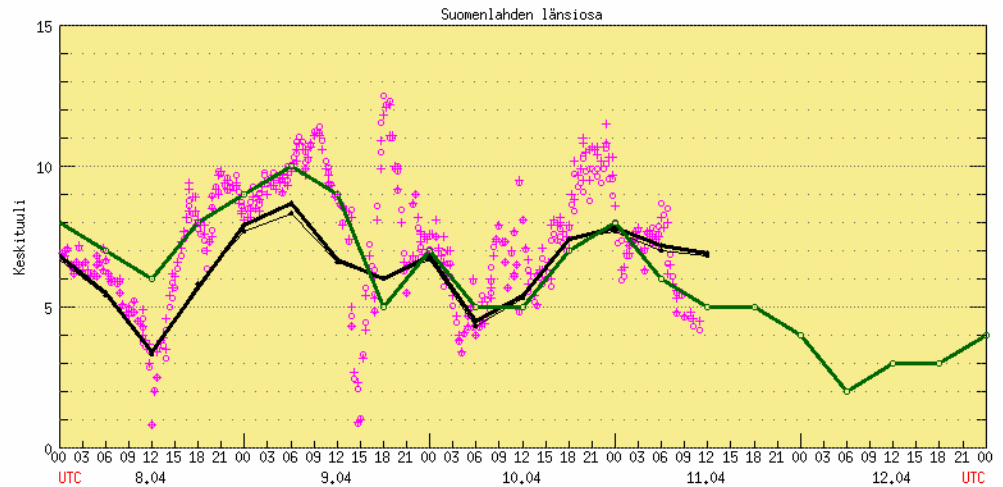
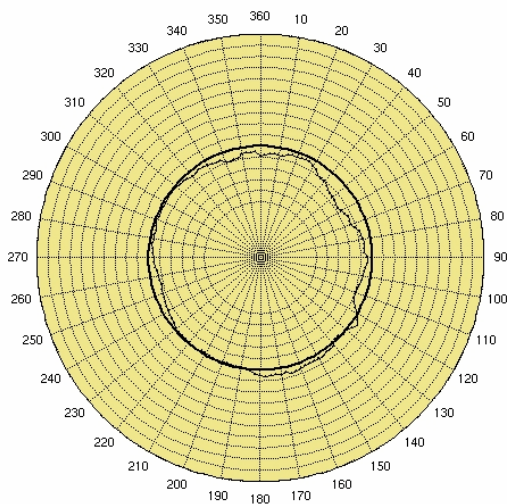
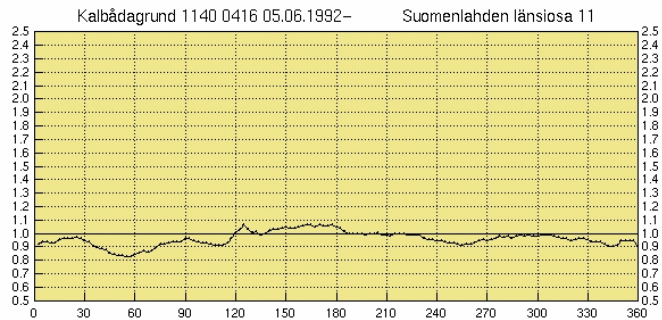
- havainto
- korjattu havainto
- ennuste (usin)

alkup. korj.

- [0215 Tammissaari Jussarö](#)
- [0302 Inkoö Bågaskär](#)
- [0330 Helsinki Harmaja](#)
- [0331 Kirkkonummi Mäkiluoto](#)
- [0416 Kalbådagrund](#)
- [0416 Kalbådagrund \(2\)](#)
- [0417 Porvoo Emäsalo](#)
- [0418 Helsinki Isoasaari](#)



Operative forecasts and observations (02987)



Print

Wdir Wspd Wmax

Yhtenäiset käyrät esittävät kullekin kuuden tunnin jaksolle laskettua keskiarvoa tai maksimia kaikkien asemien yli.

Yksittäiset pisteet esittävät yksittäisiä havaintoja, joko alkuperäisinä (ristit) tai korjattuna ympäristön esteiden mukaan (ympyrät).

- havainto
- korjattu havainto
- ennuste (uusin)

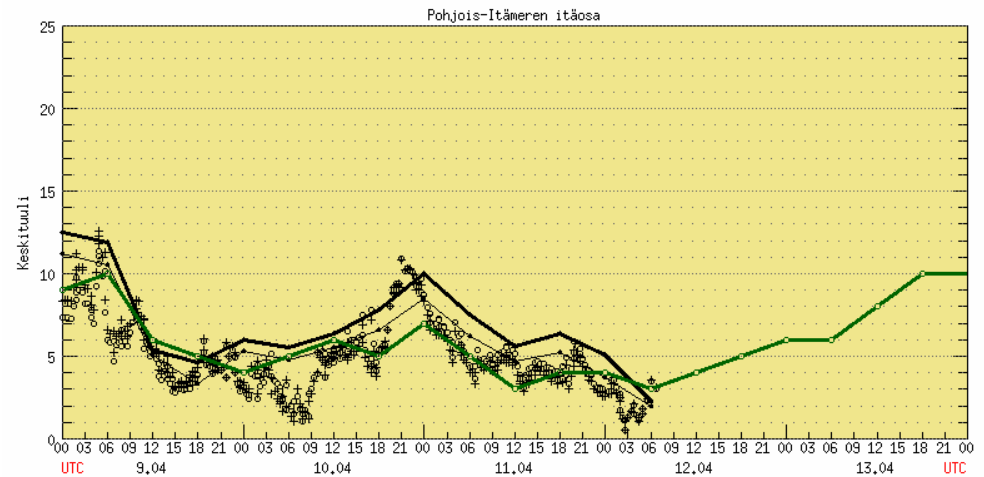
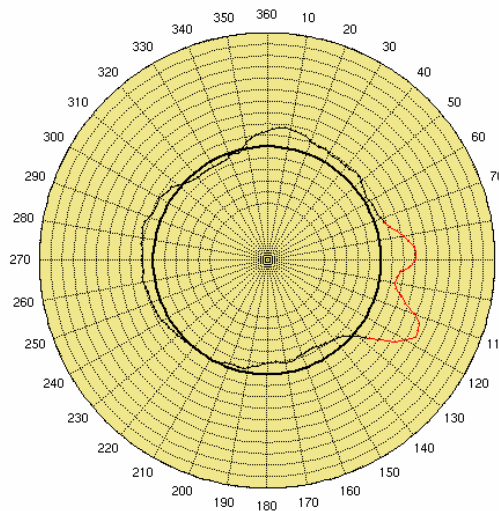
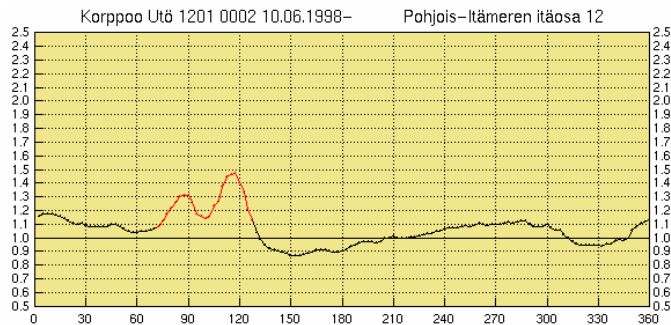
alkup. korj.

- [0215 Tammissaari Jussarö](#)
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Total correction as a function of direction



Correction coefficient of wind speed as function of direction (02981)



- 10 Suomenlahden itäosa
 - 11 Suomenlahden länsiosa
 - 12 Pohjois-Itämeren itäosa
 - 13 Pohjois-Itämeren länsiosa
 - 14 Ahvenanmeri
 - 15 Saaristomeri
 - 16 Selkämeren eteläosa
 - 17 Selkämeren pohjoisosa
 - 18 Merenkurkku
 - 19 Perämeren eteläosa
 - 20 Perämeren pohjoisosa
- havainto
 - korjattu havainto
 - ennuste (uusin)
 - ennuste (+6h)
 - ennuste (+12h)
 - ennuste (+18h)
 - ennuste (+24h)
 - ennuste (+30h)
 - ennuste (+36h)
 - ennuste (+42h)
 - ennuste (+48h)
- 0002 Korppoo Utö
 - 0002 Korppoo Utö (2)
 - 0101 Hanko Russarö
 - 0115 Hanko Tulliniemi



Next some verification results

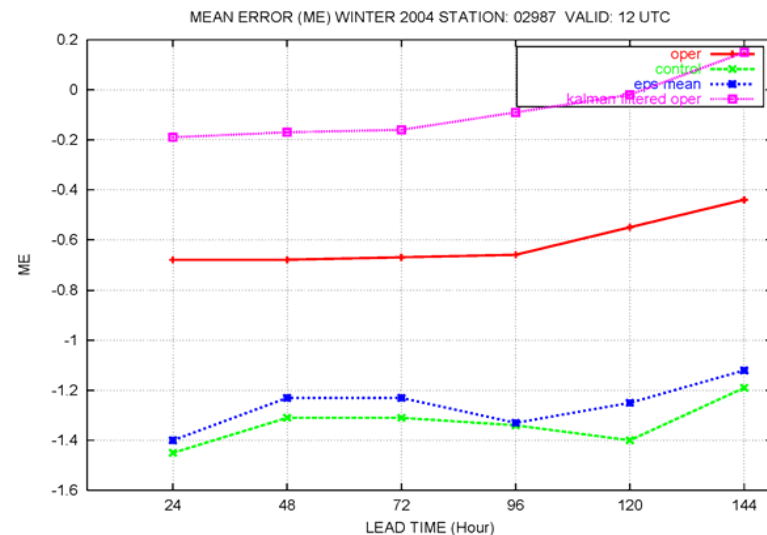
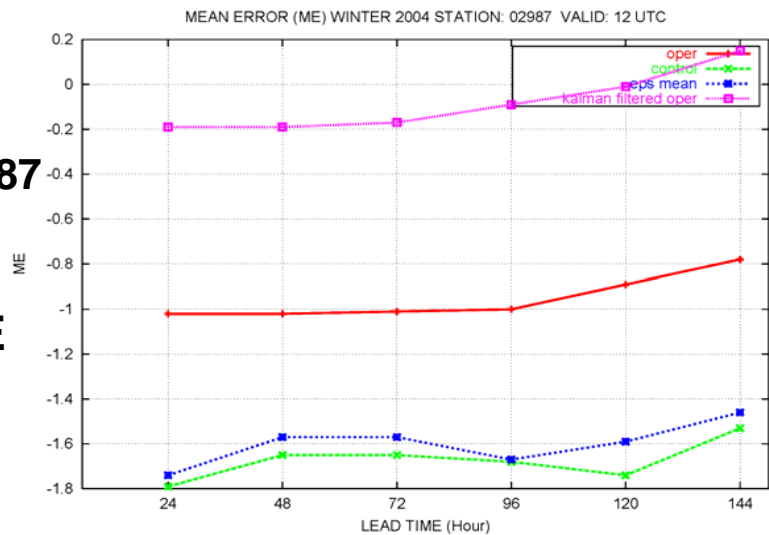


Original observations

"Corrected" observations

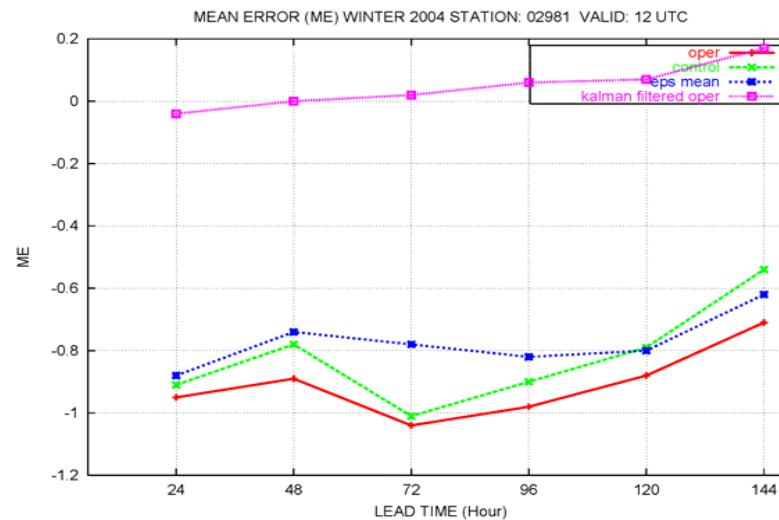
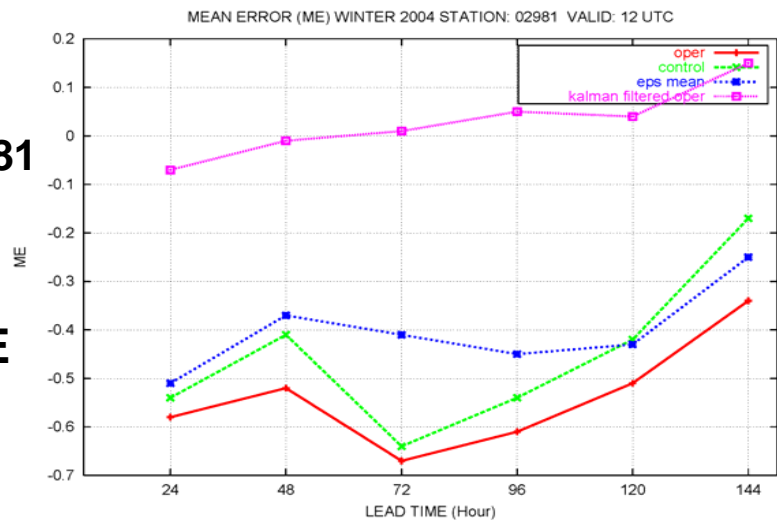
02987

ME



02981

ME





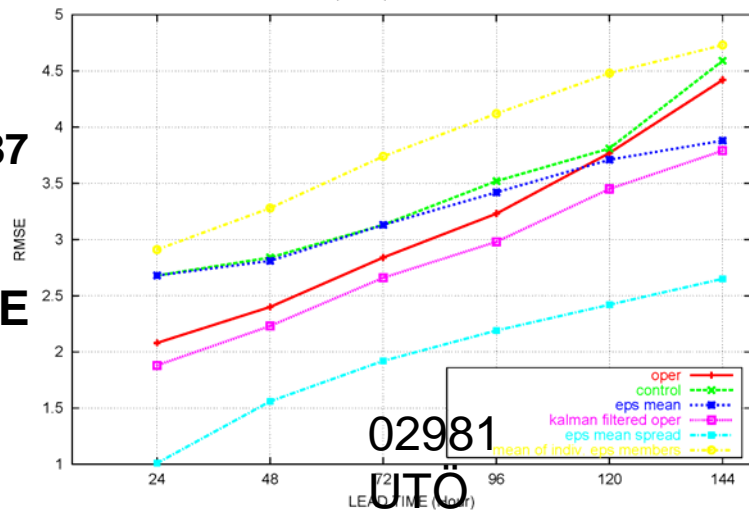
Original observations

"Corrected" observations

02987

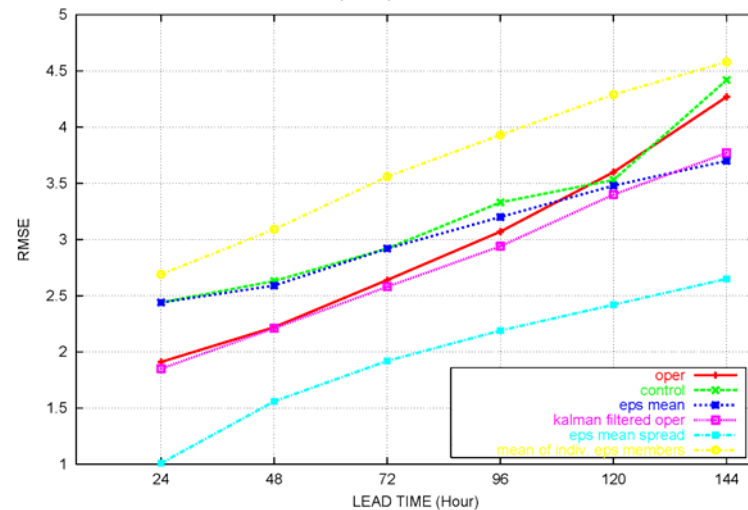
RMSE

ROOT MEAN SQUARED ERROR (RMSE) WINTER 2004 STATION: 02987 VALID: 12 UTC



02981
UTC

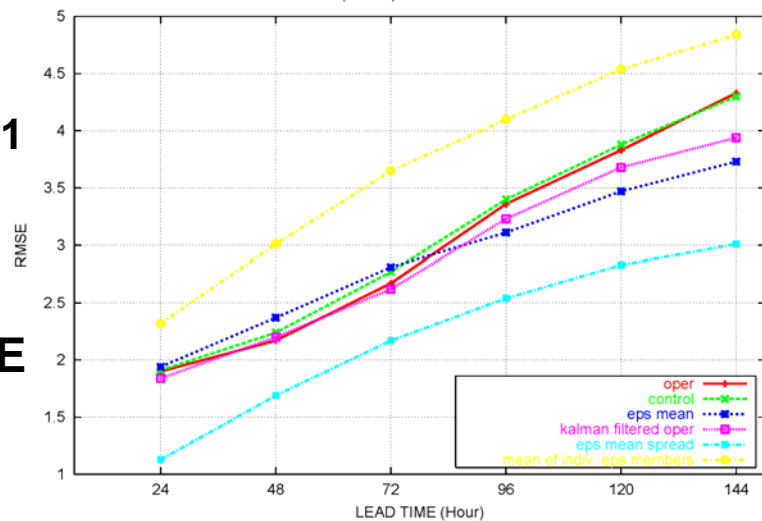
ROOT MEAN SQUARED ERROR (RMSE) WINTER 2004 STATION: 02987 VALID: 12 UTC



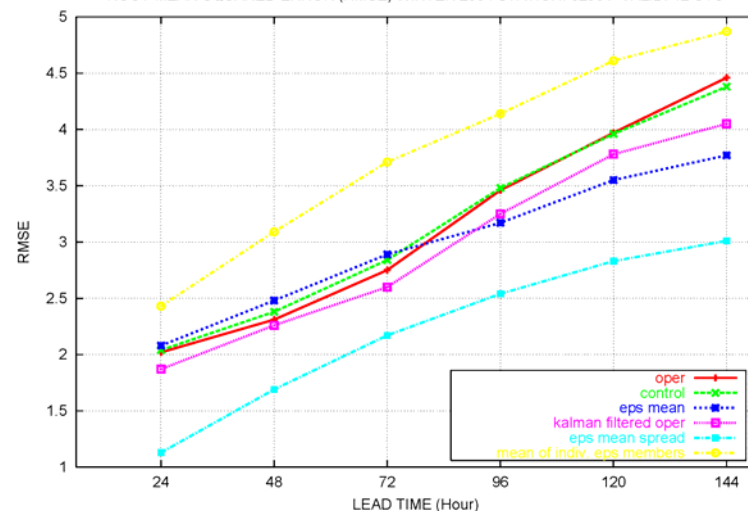
02981

RMSE

ROOT MEAN SQUARED ERROR (RMSE) WINTER 2004 STATION: 02981 VALID: 12 UTC



ROOT MEAN SQUARED ERROR (RMSE) WINTER 2004 STATION: 02981 VALID: 12 UTC





Conclusions 1:

- **Corrected observations for station 02987 give better verification results than original**
- **But for station 02981 the situation is opposite**
- **What is the reason for that?**



02981
UTÖ



UTÖ / September 04 Upper picture E-SE Lower picture SE-S sector





02981
UTÖ



New radar mast south to wind mast. Antennas remain partly under anemometers.



Red line indicates the level of anemometers



Conclusions 2:

- **What is the reason for that?**



- **The correction was update in 2002**
- **After summer 2004 a new mast was built to southern sector very near to anemometer and no update for correction has made**

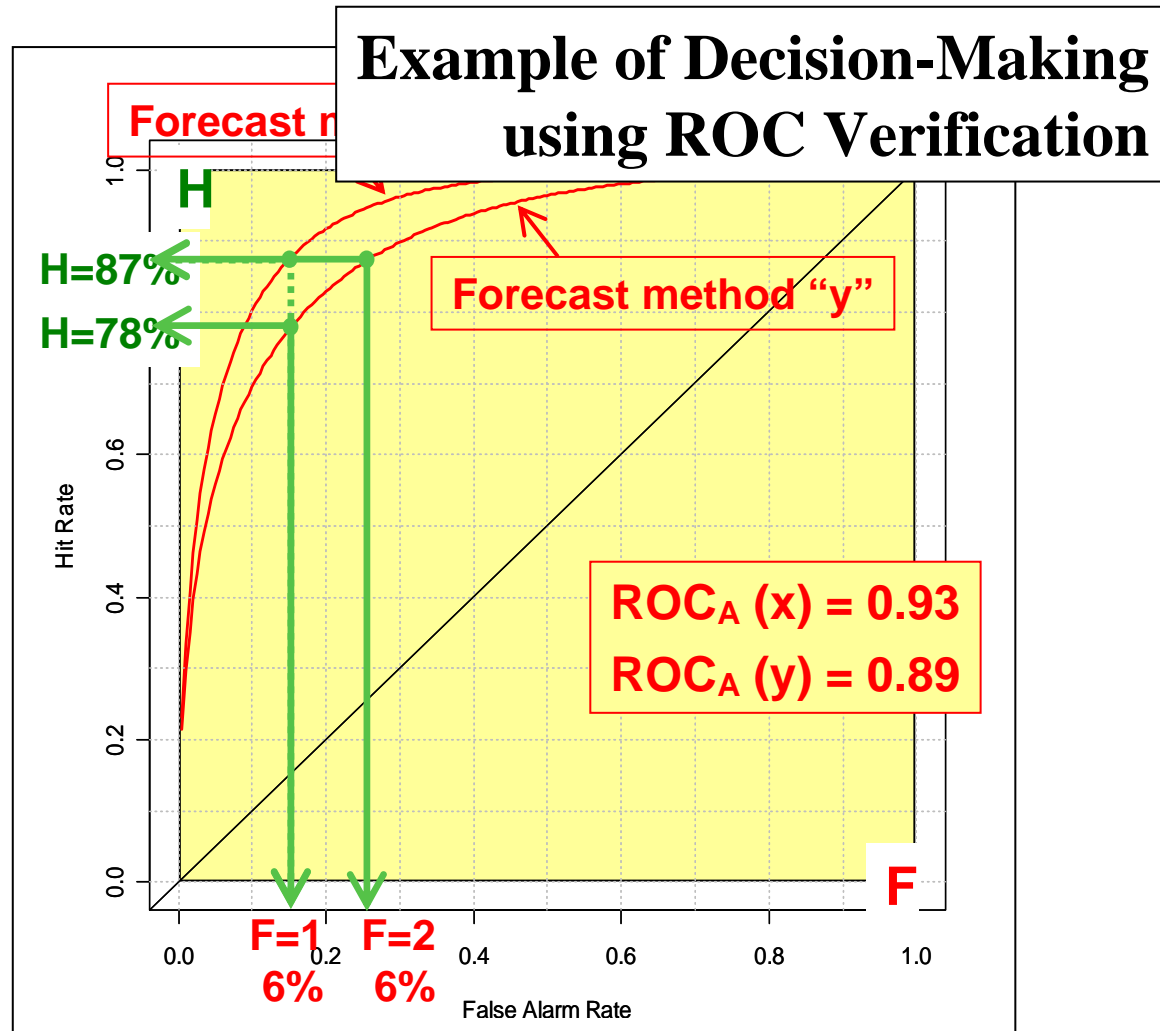
Anemometers

->corrections should be updated



Verification of probability forecasts

- **Brier Skill Score (BSS)**
- **ROC (Relative Operating Characteristic) curve**
- **ROC Area (Area under ROC curve)**





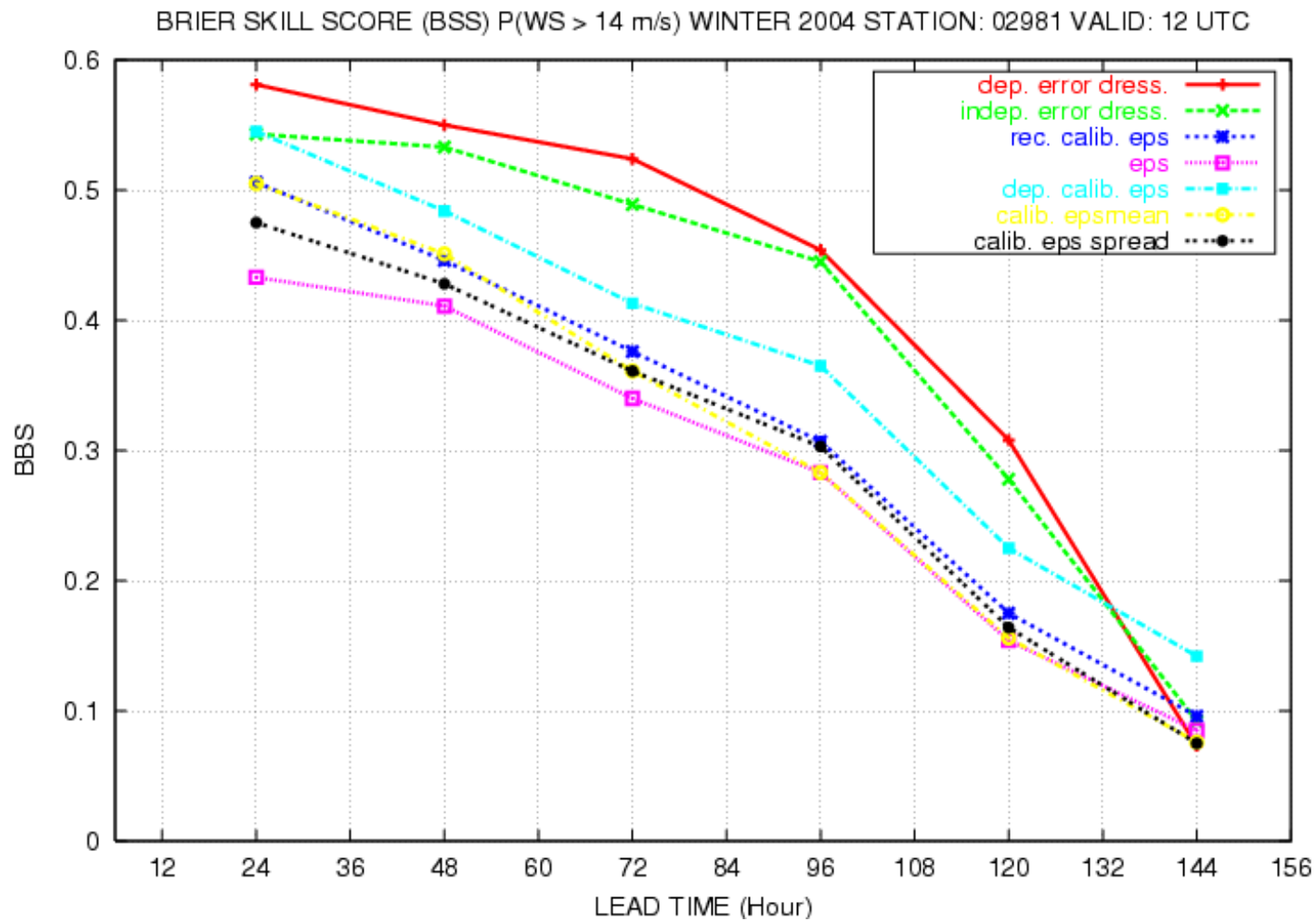
Calibration of EPS forecasts

- **Production of probability forecast from deterministic input (as reference)**
 - Different versions of error dressing method
 - Kalman filtering (results not shown)
- **Different methods for calibration of EPS wind speed forecasts**

NEXT SOME RESULTS (BBS, ROC Area)

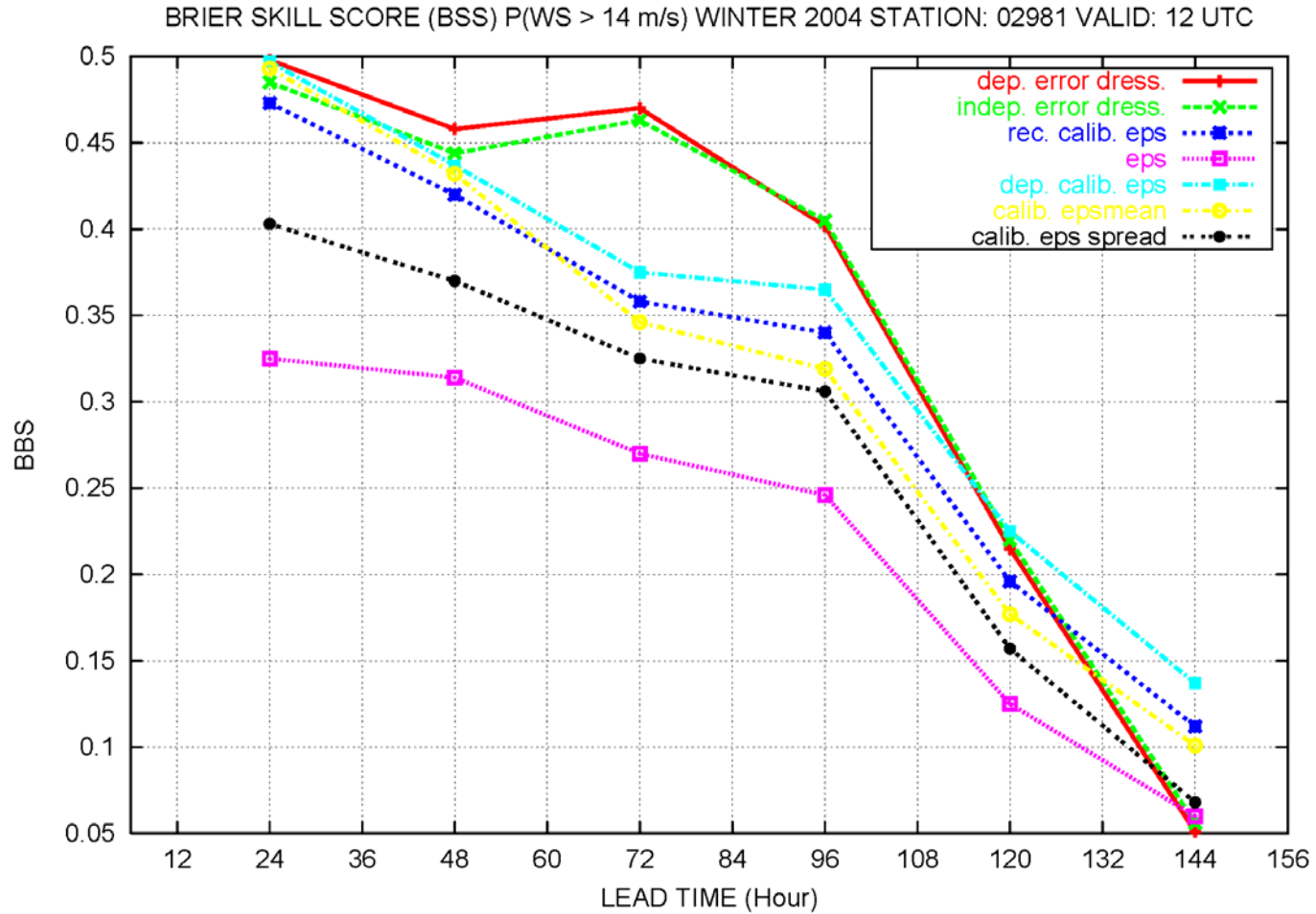


Uncorrected observations



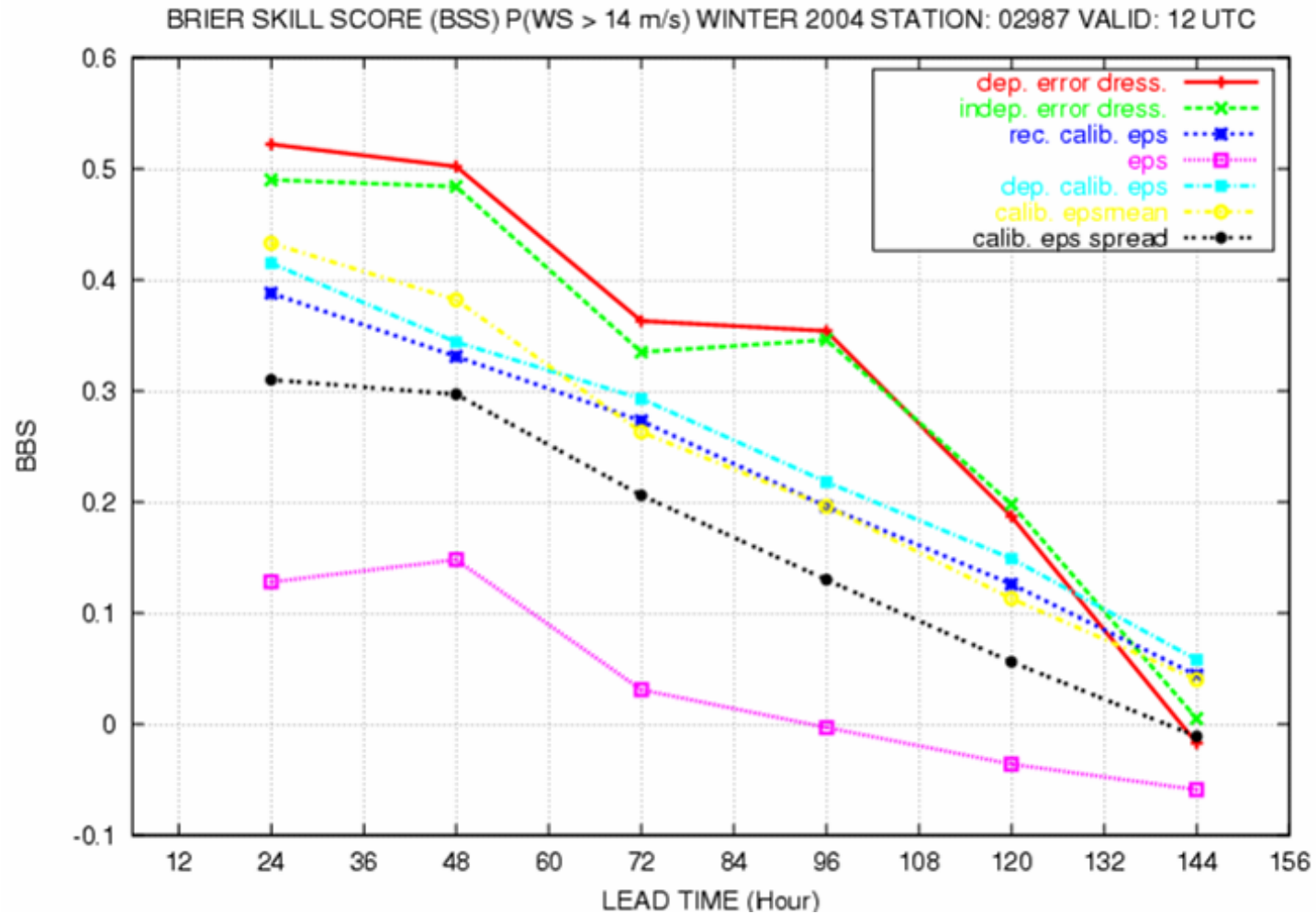


Corrected observations



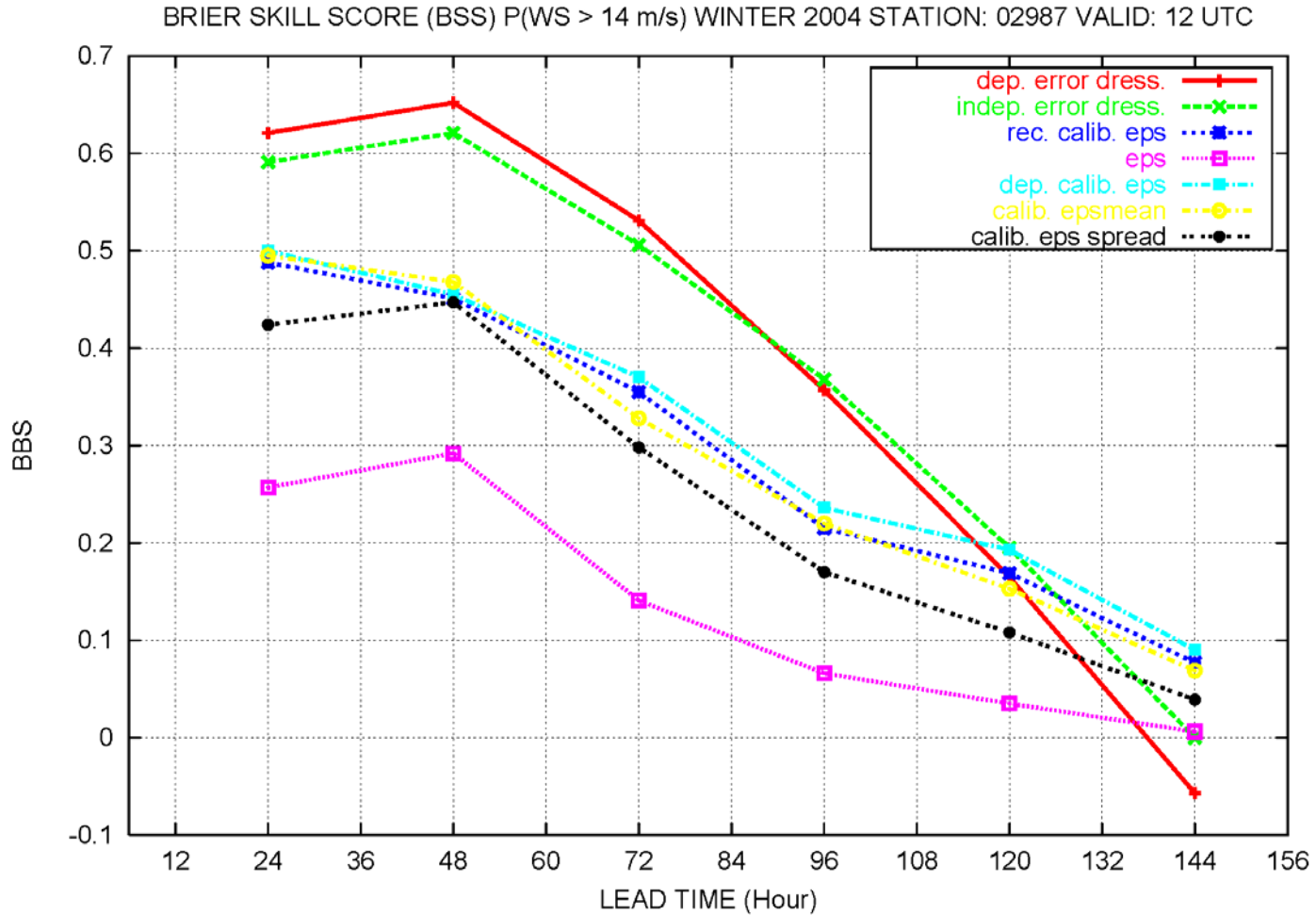


Uncorrected observation



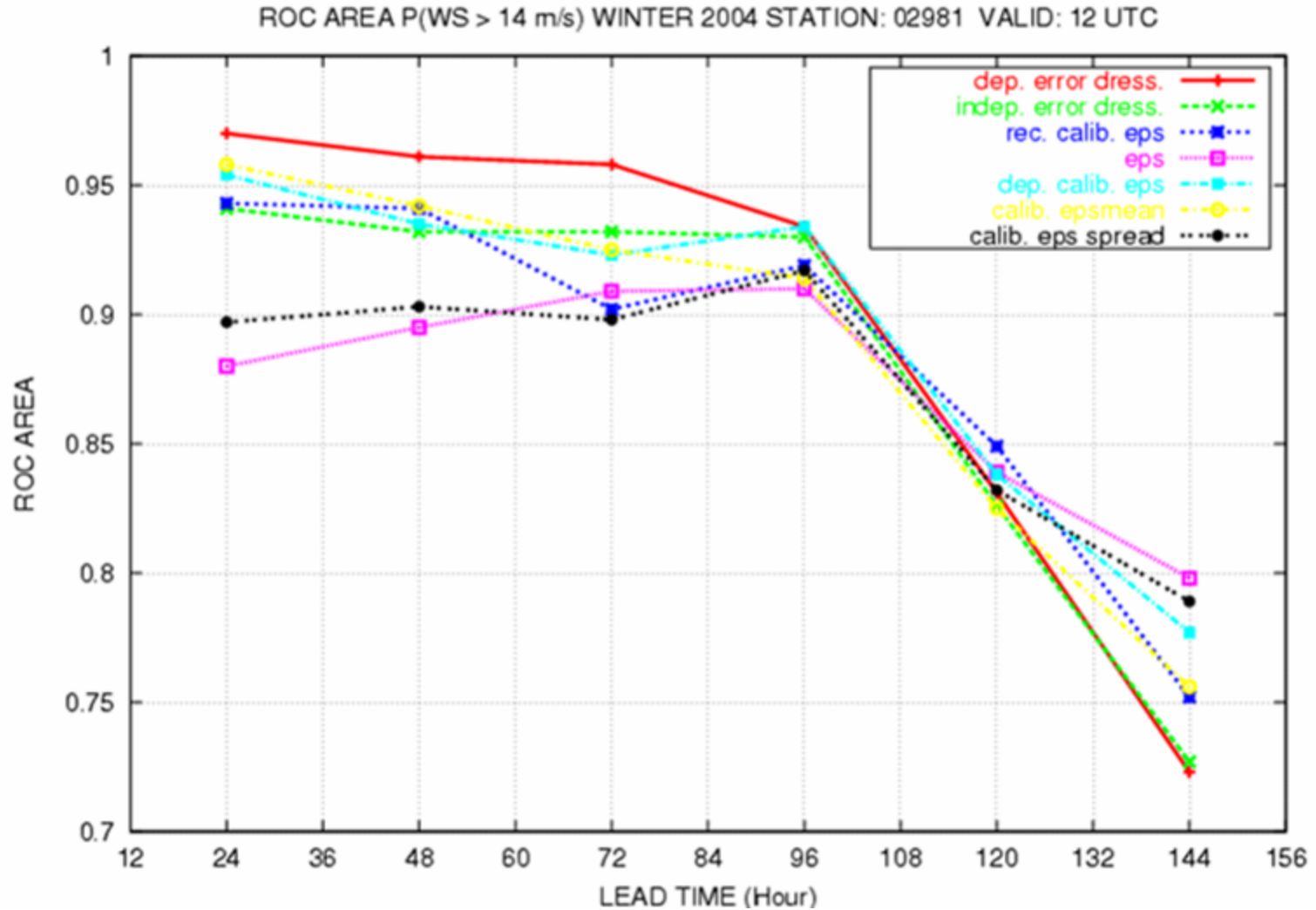


Corrected observation



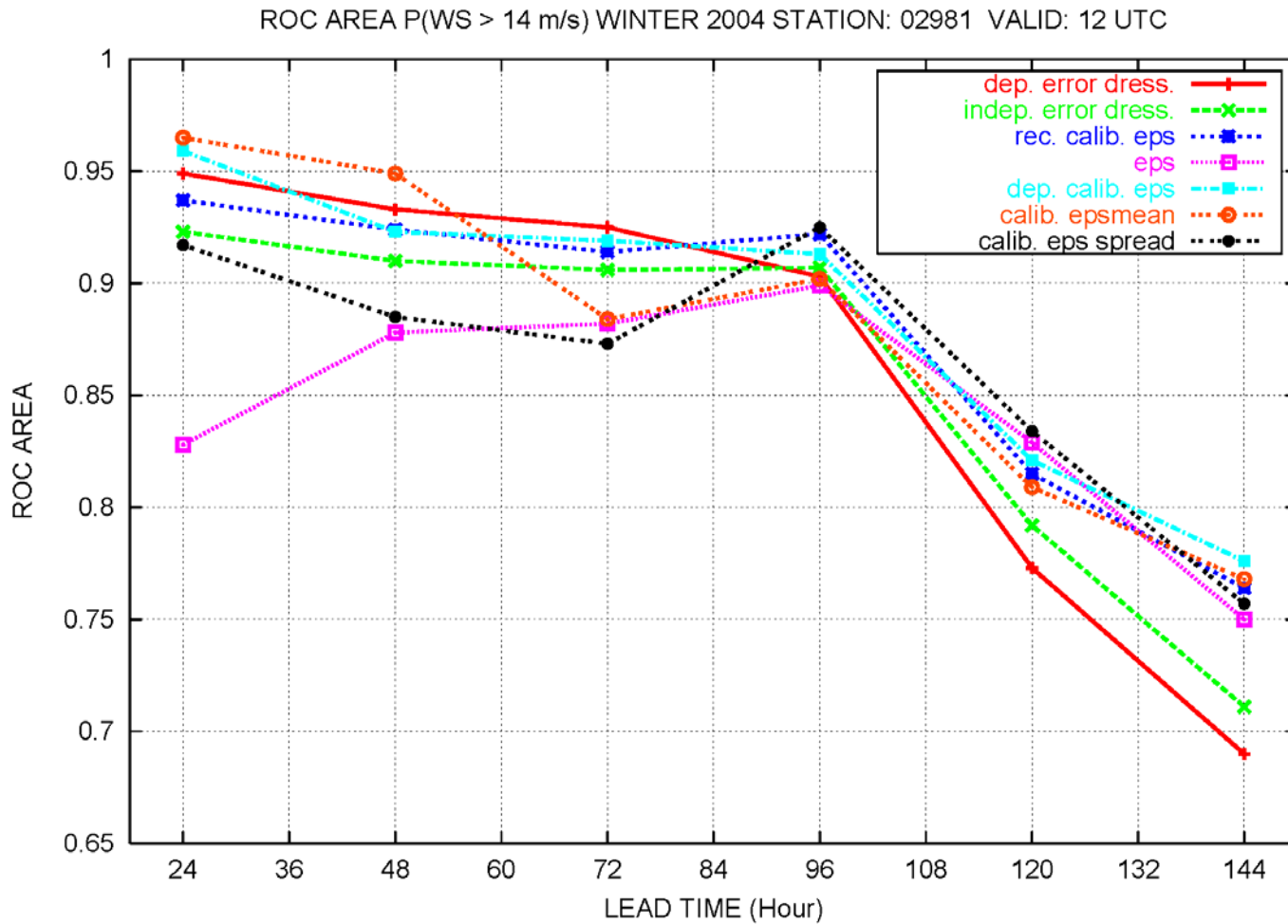


Uncorrected observations



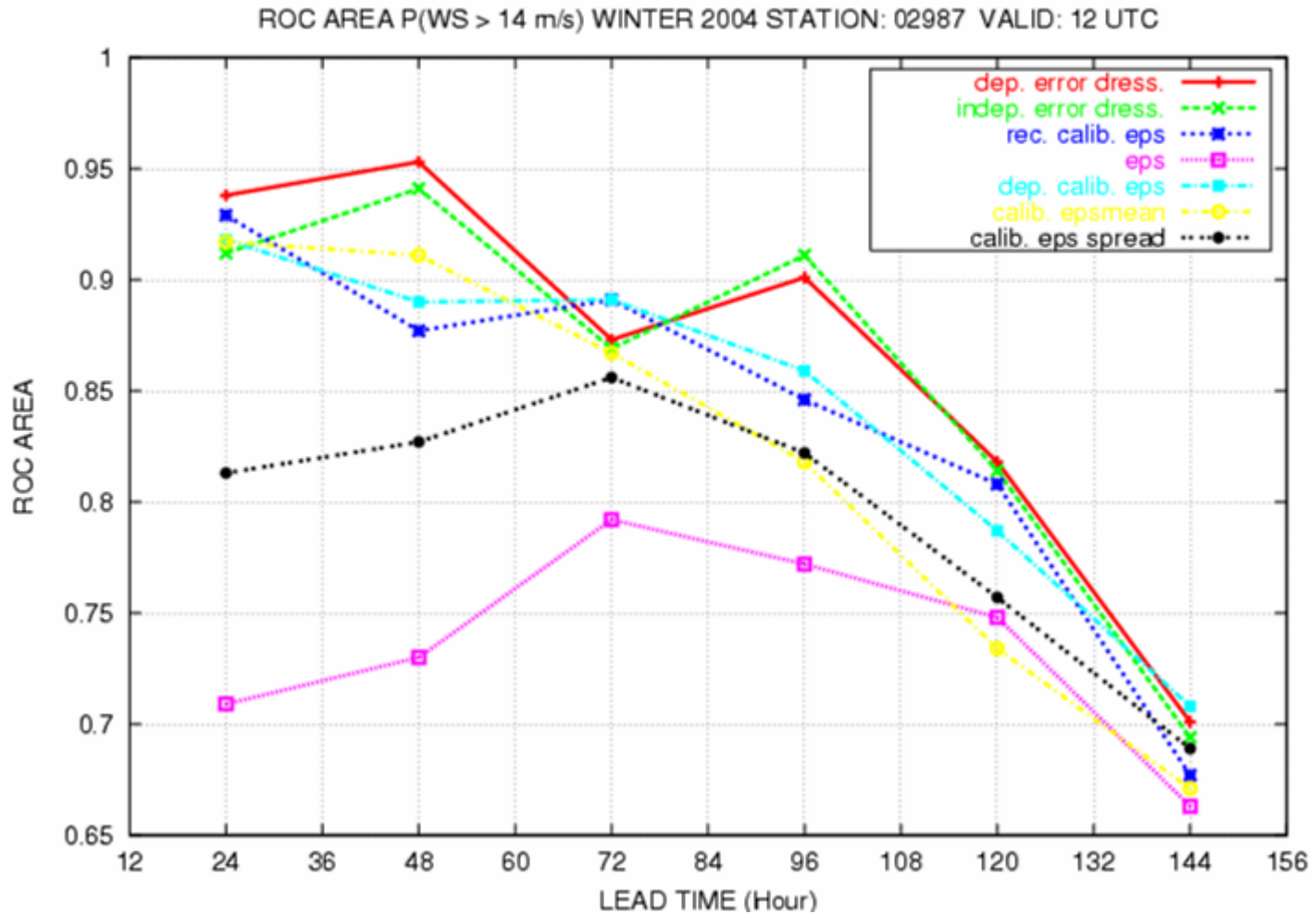


Corrected observation



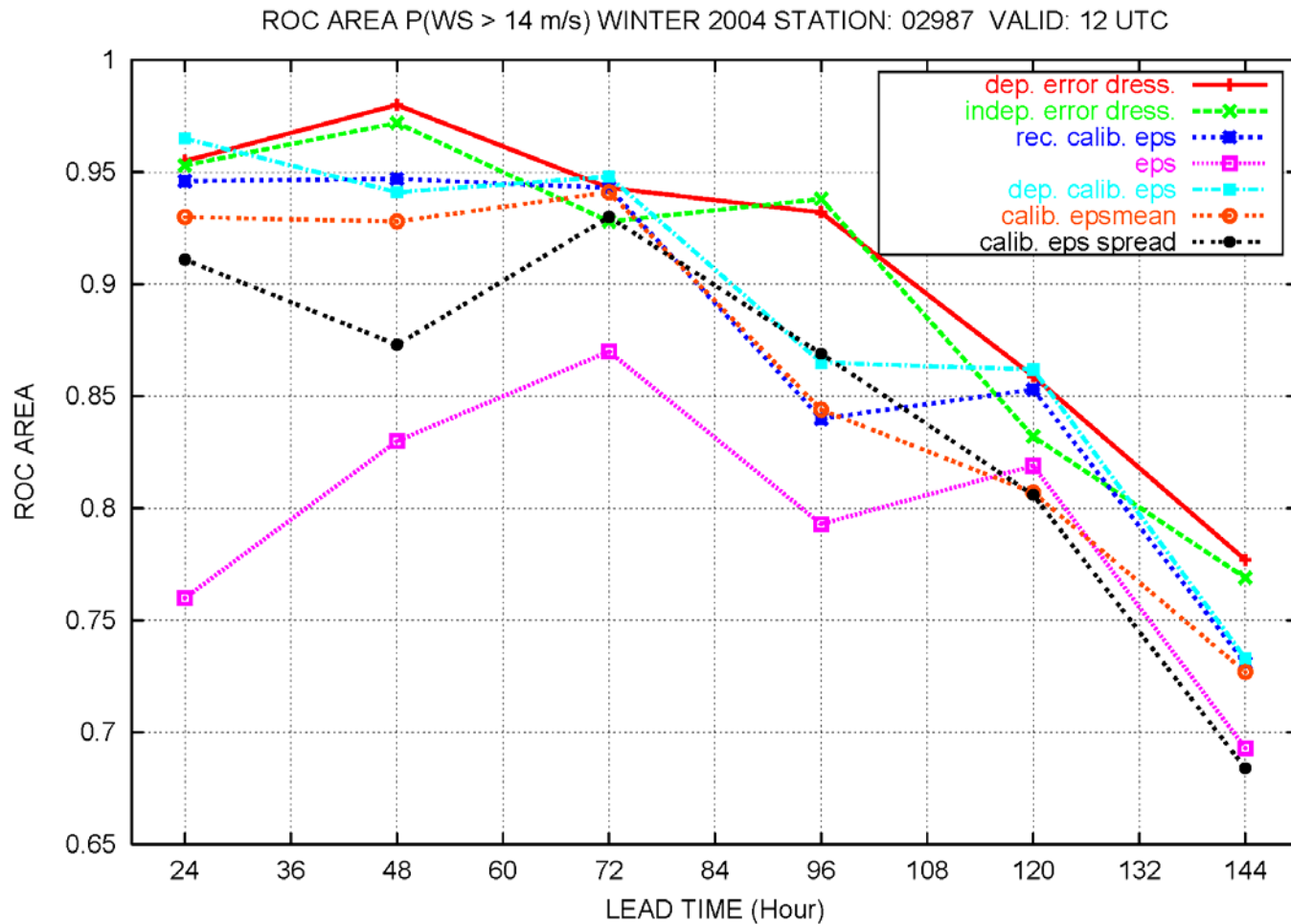


Uncorrected observation





Corrected observation

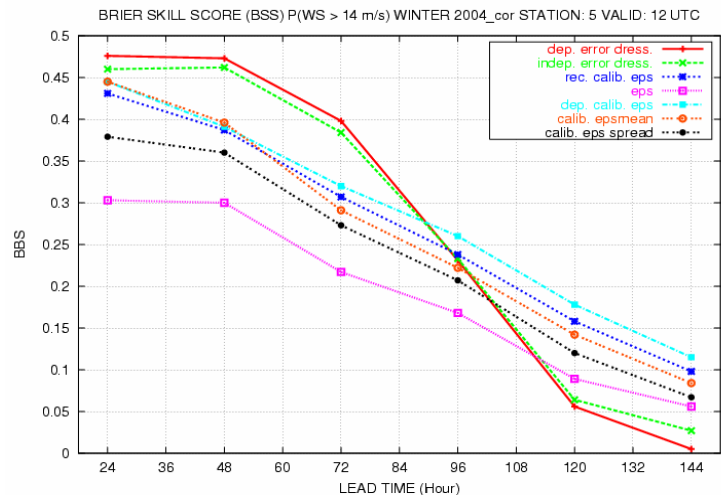
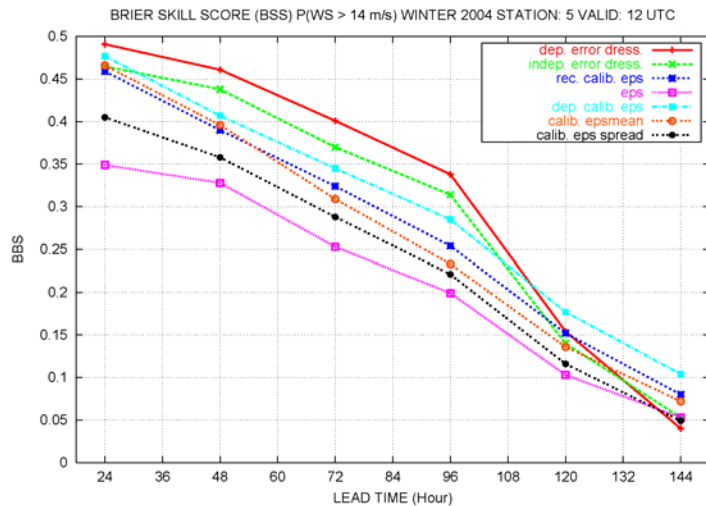




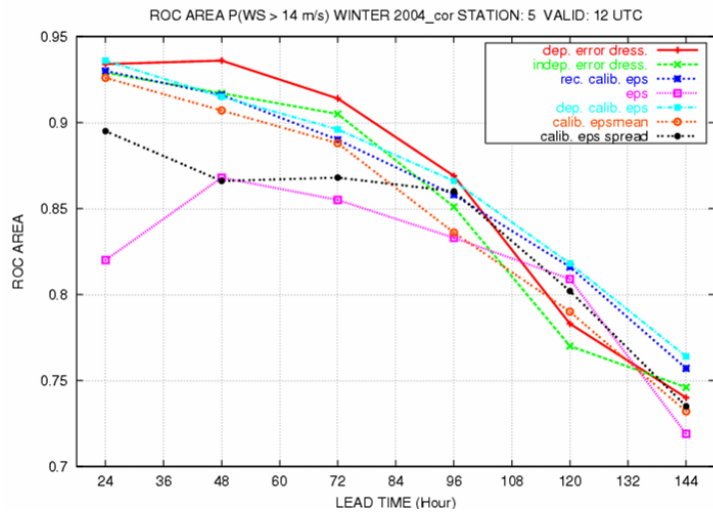
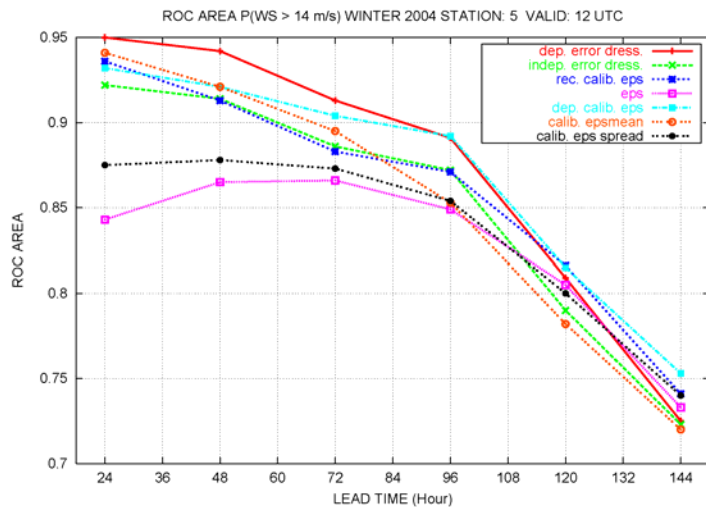
Original observations

"Corrected" observations

BBS



ROC Area





Conclusions 2:

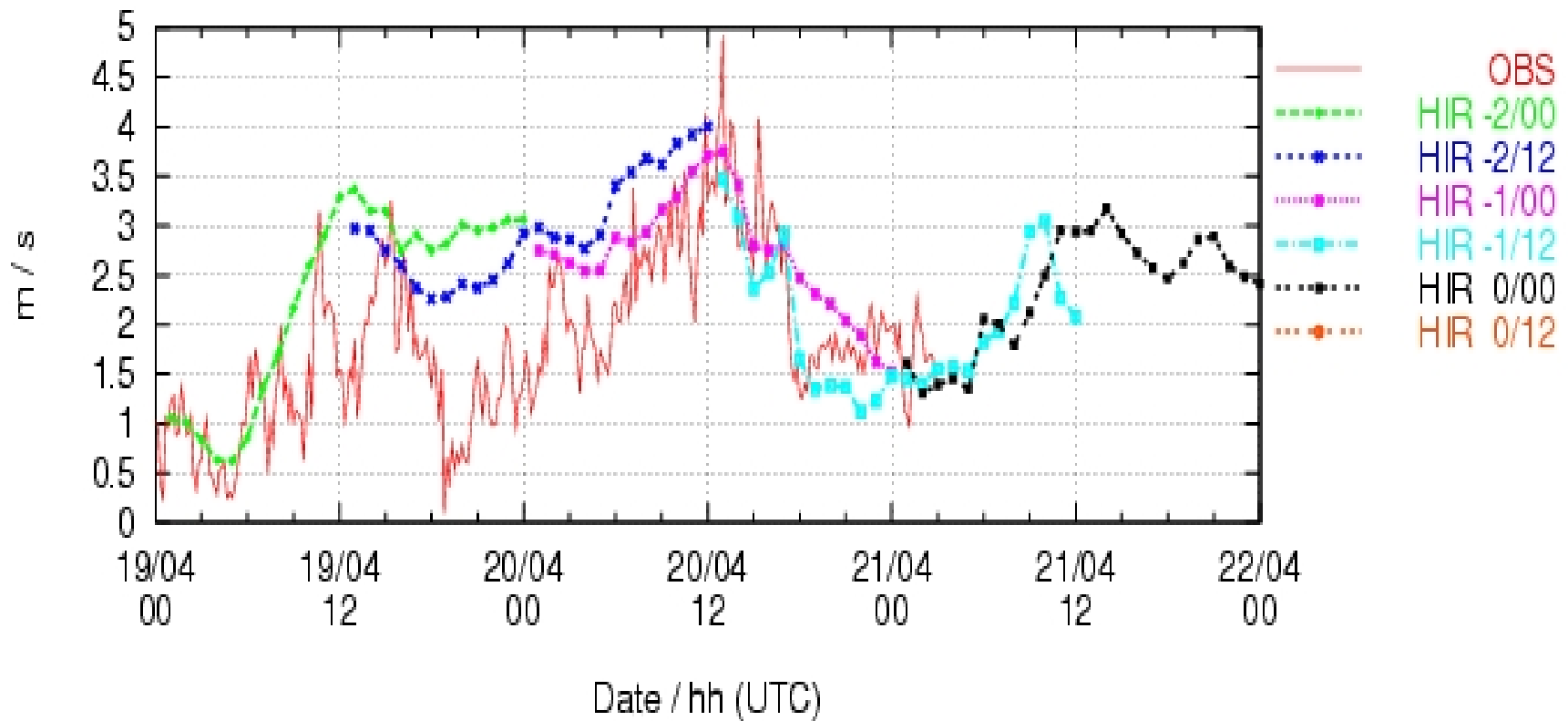
- **Verification of probability forecasts give similar results as deterministic verification**
- **Calibration of EPS forecasts increases the general skill of EPS wind forecasts**
- **Error dressing of deterministic forecasts better than calibrated EPS before day 5. After 5 day calibrated EPS is better.**



Thank you



Observation noise

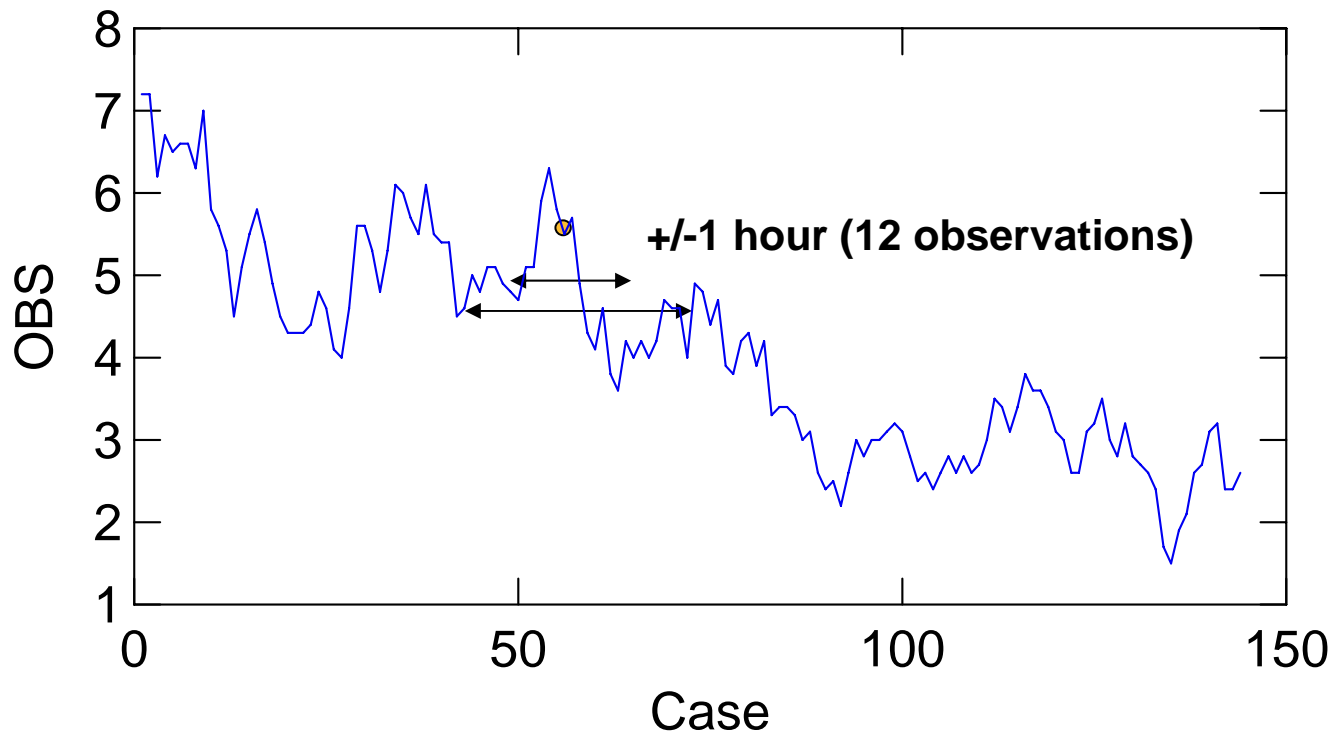


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Uncertainty in wind observations: example station 06041 (Skagen, Denmark)

Series Plot (observations every 10 min)

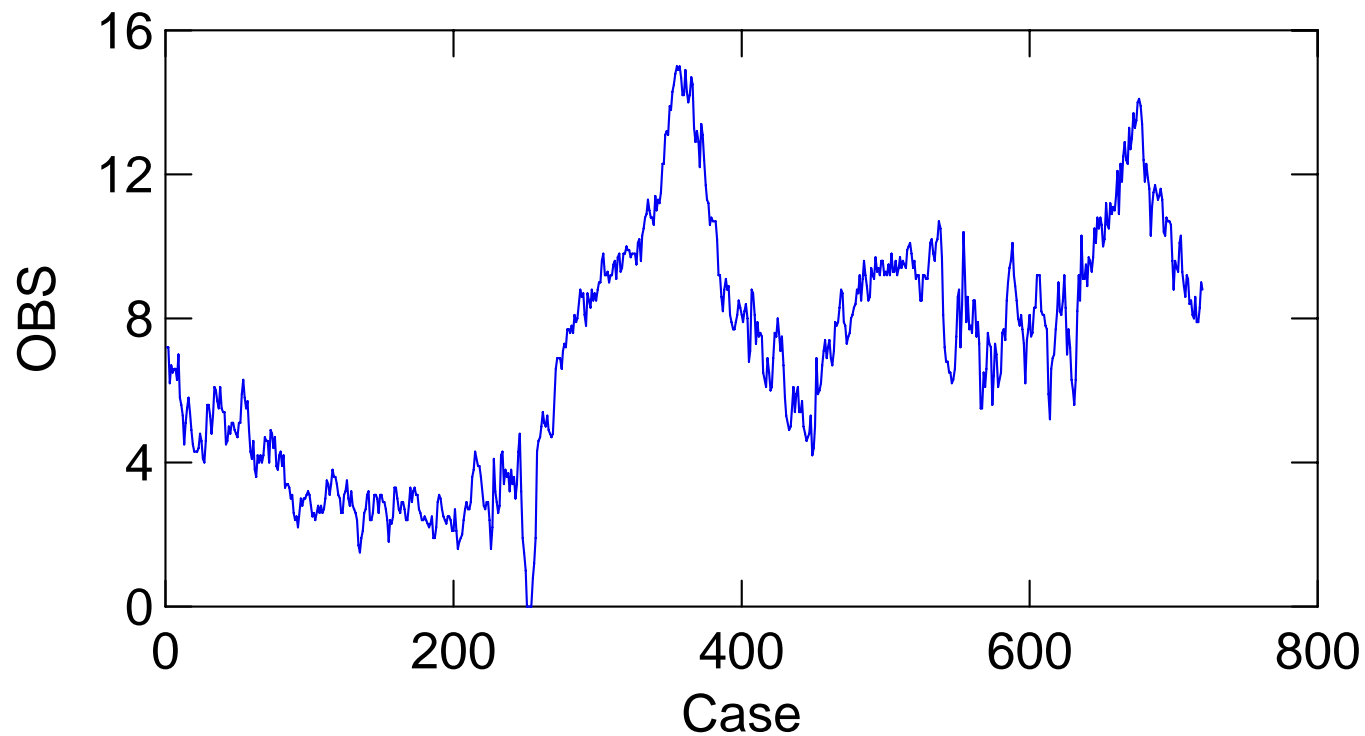


Mean of 12 observations around 12 UTC: comparison with 12 UTC observation



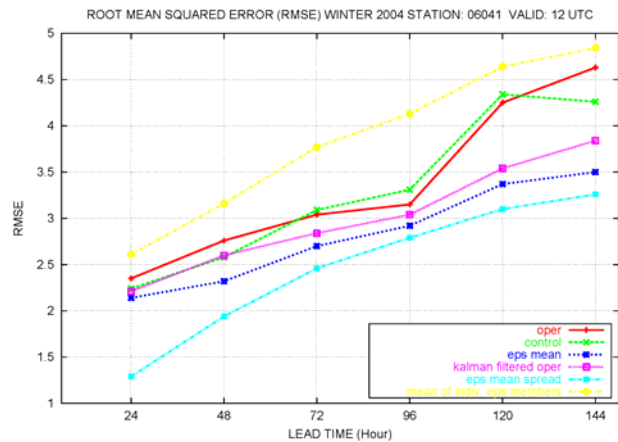
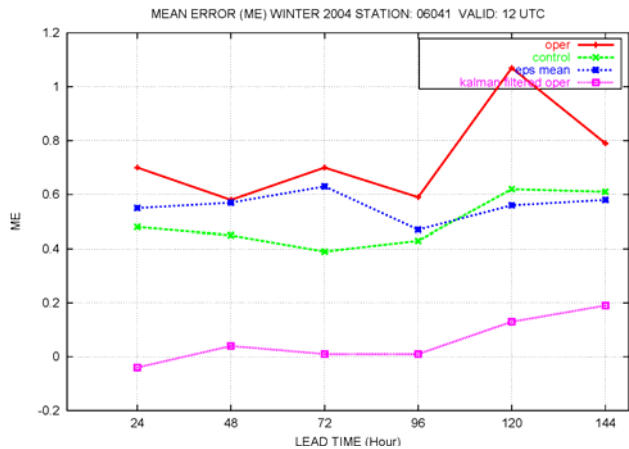
Uncertainty in wind observations: example station 06041 (Skagen, Denmark)

Series Plot (observations every 10 min)





Uncertainty in wind observations: example station 06041 (Skagen, Denmark)

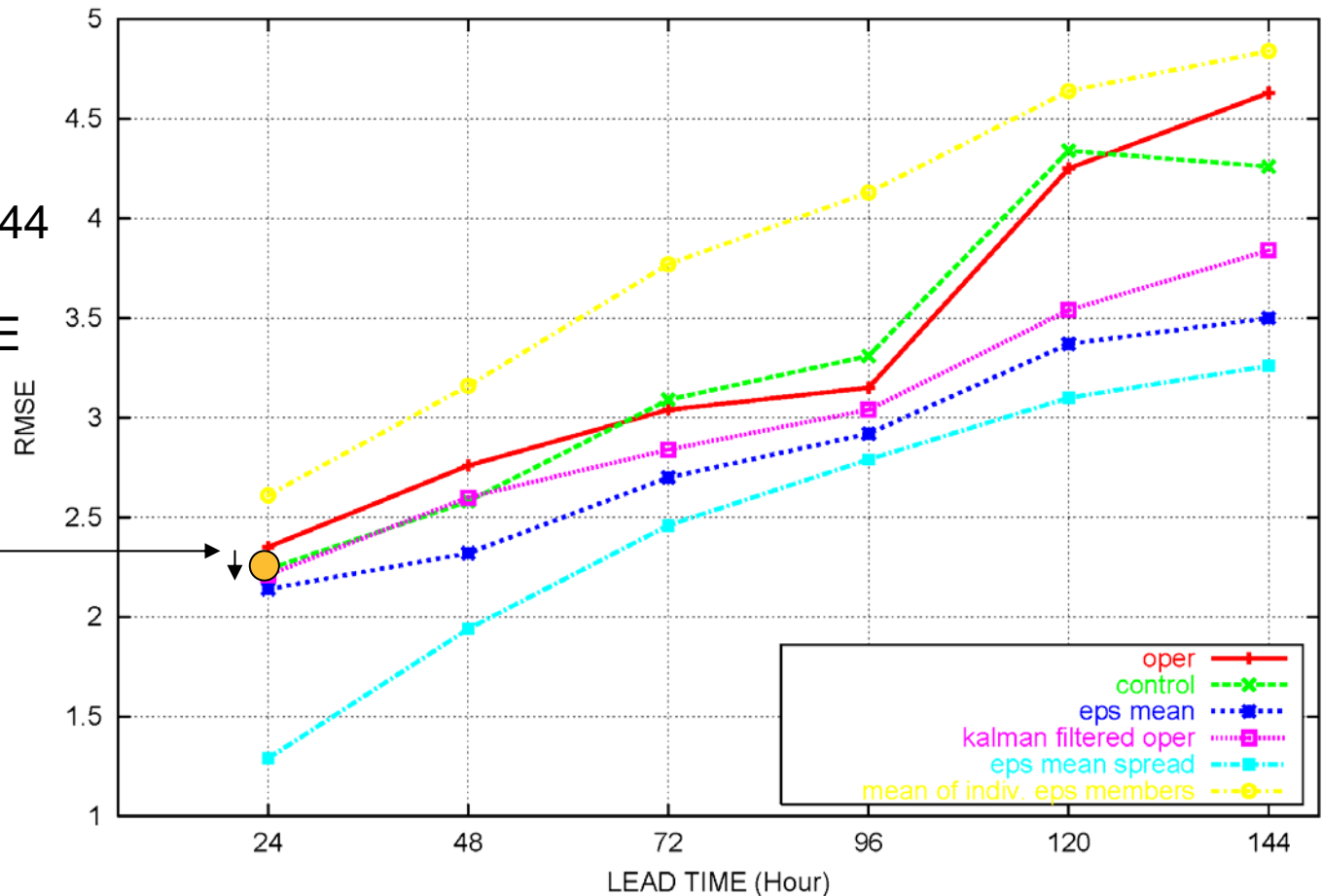


	OBS 12	Mean	STD1	STD2
N of cases	151	151	151	151
Minimum	1.600	1.425	0.002	-1.825
Maximum	17.000	17.067	0.777	2.008
Range	15.400	15.642	0.775	3.833
Sum	1177.000	1173.667	28.367	3.333
Median	7.300	7.158	0.149	0.017
Mean (std within sample)	7.795	7.773	0.188	0.022
95% CI Upper	8.414	8.394	0.214	0.093
95% CI Lower	7.176	7.151	0.161	-0.049
Std. Error	0.313	0.315	0.013	0.036
Standard Dev (between 12 UTC obs and mean obs)	3.849	3.865	0.165	0.441
Variance	14.814	14.940	0.027	0.195
C.V.	0.494	0.497	0.876	19.986
Skewness(G1)	0.498	0.494	1.314	0.247
SE Skewness	0.197	0.197	0.197	0.197
Kurtosis(G2)	-0.642	-0.732	1.611	3.927
SE Kurtosis	0.392	0.392	0.392	0.392
SW Statistic	0.956	0.951	0.877	0.950
SW P-Value	0.000	0.000	0.000	0.000



Uncertainty in wind observations: example station 06041 (Skagen, Denmark)

ROOT MEAN SQUARED ERROR (RMSE) WINTER 2004 STATION: 06041 VALID: 12 UTC



Observation noise=0,44

RMSE of OPERATIVE
 forecast = 2,35

Forecast noise =
 $\sqrt{\text{RMSE}^2 - \text{obsnoise}^2}$
 =2,30

This part of observation noise is fairly small



Observation noise: std1 and std2

