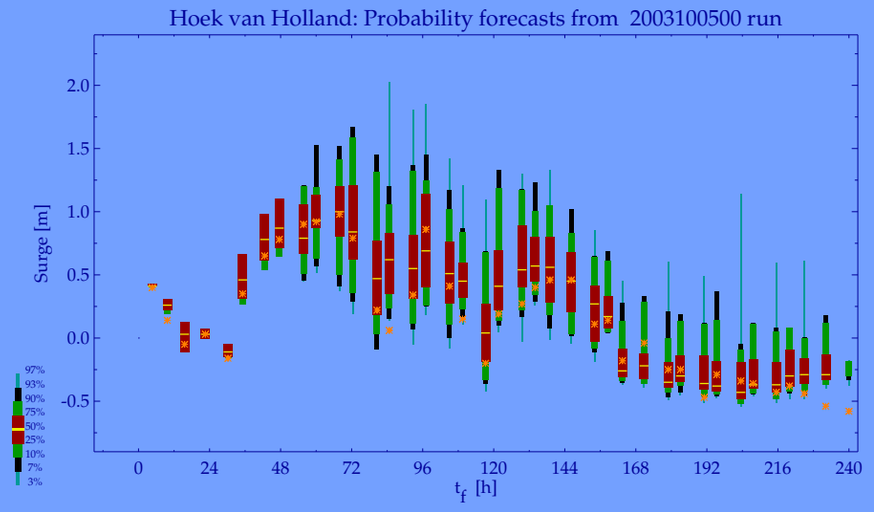
Probability forecasts for storm surges



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Storm surge forecasts

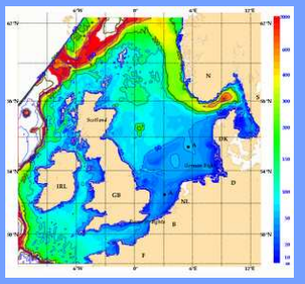
Observations

Atmosphere

Water levels

Global

Hirlam



Europe + Atlantic

North Sea

Storm surge forecasts

Organization

RIKZ WAQUA/DCSM model
water level observations

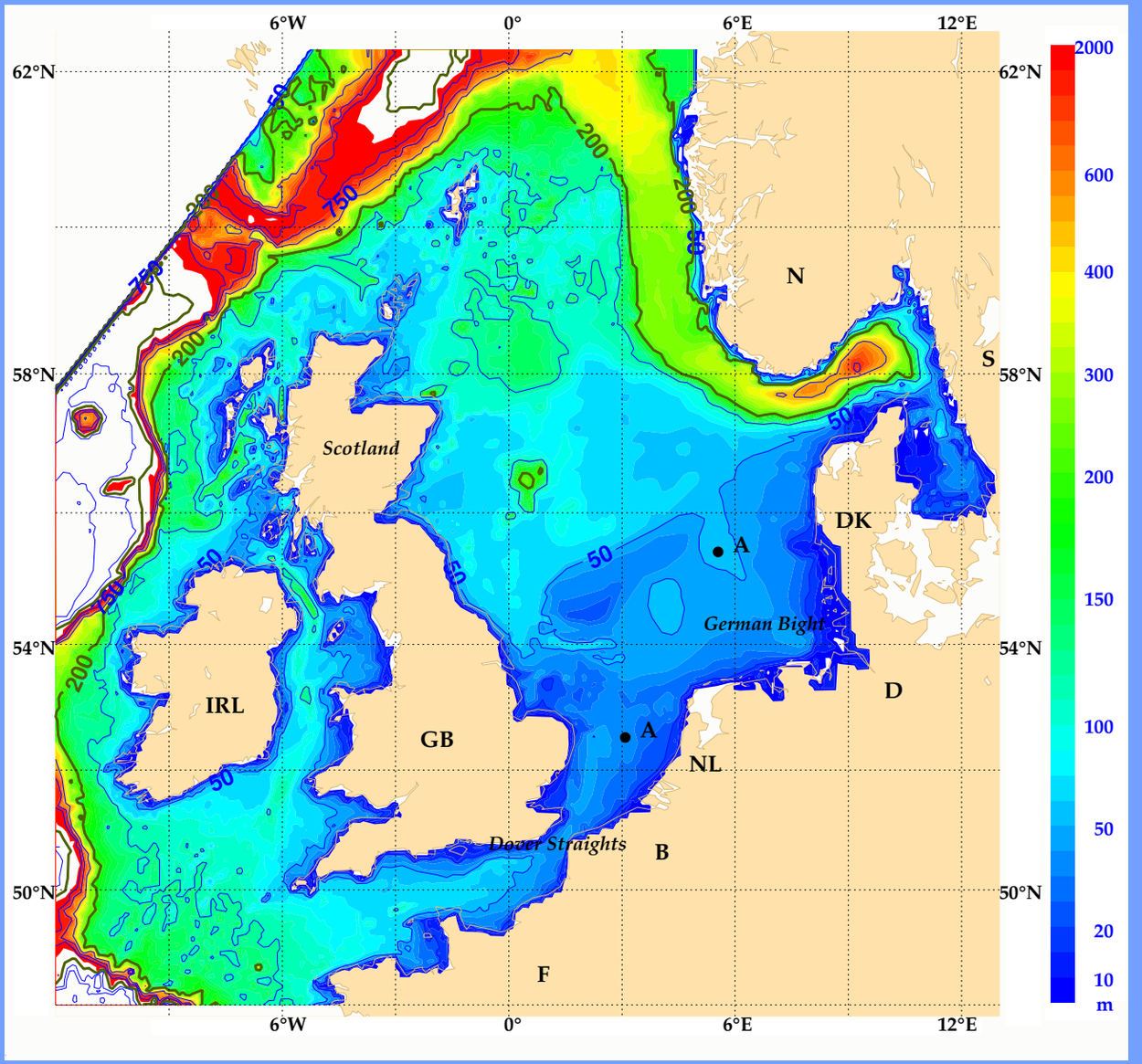
KNMI Meteorological input
7 × 24 operational service: models (automatic production line)
meteorologists

SVSD End responsibility for forecasts in case of a storm surge

Users

SVSD, DNZ, DZL, Water boards, KNMI

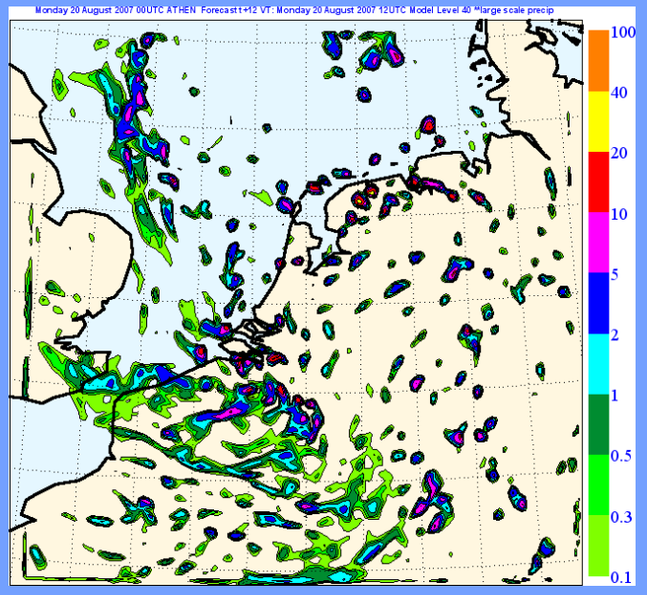
DCSM v5


6°W
0°
6°E
12°E
62°N
58°N
54°N
50°N
Scotland
IRL
GB
F
N
S
DK
D
NL
B
A
A
German Bight
Dover Straights
50
200
750
2000
600
400
300
200
150
100
50
20
10
m

Probability forecasts for sea levels

Options

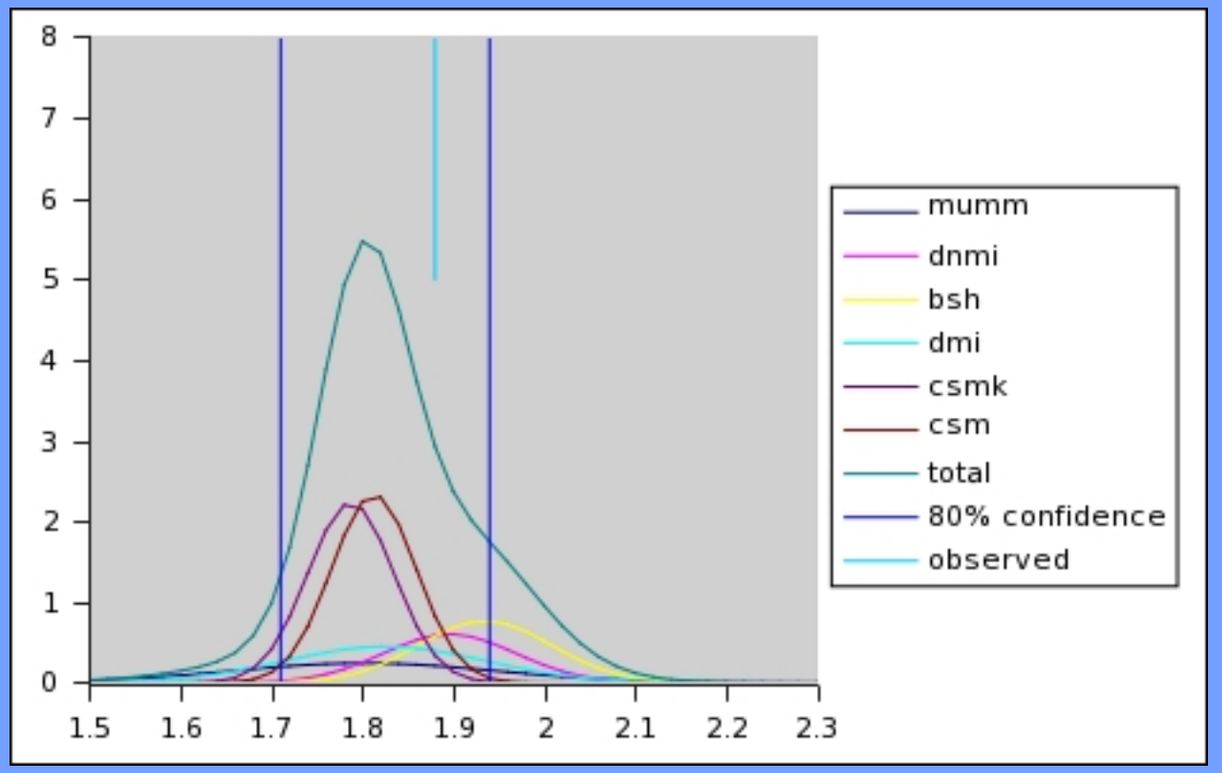
- NOOS-exchange of storm surge forecasts
- SRNWP-PEPS exchange of atmospheric forecasts
- High-resolution local area atmospheric model ensemble ($t_f \leq 48h$)



- ECMWF ensemble prediction system ($t_f = 48 - 240h$)

Probability forecast voor $t_f \leq 48h$

NOOS ensemble + BMA: Delfzijl, 27 October 2006 13:25, $t_f = 15h$



Probability forecasts for $48h < t_f \leq 240h$

WAQUA/DCSM on ECMWF deterministic

- Quality?
- Calibration?

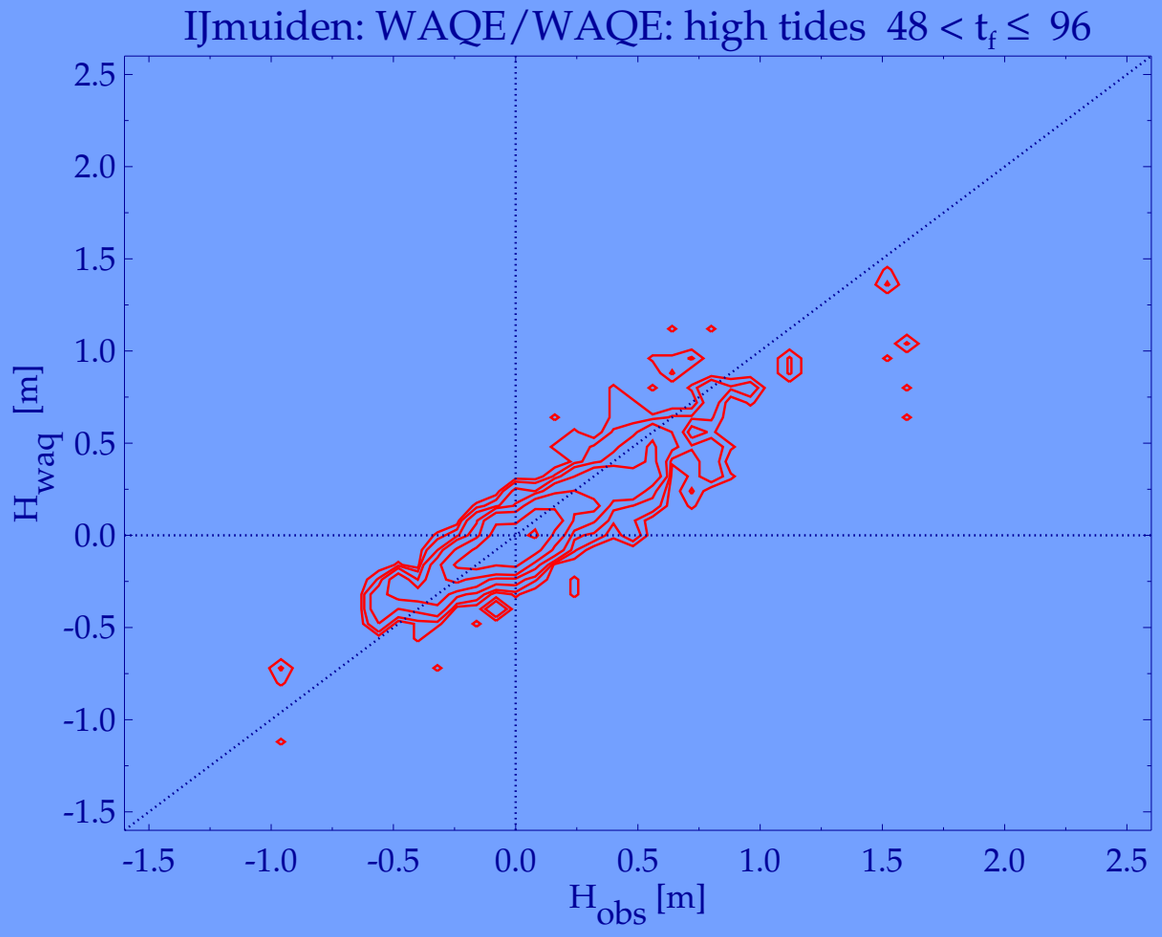
WAQUA/DCSM on ECMWF EPS

- Calibration?
- Interpretation?
- Skill?

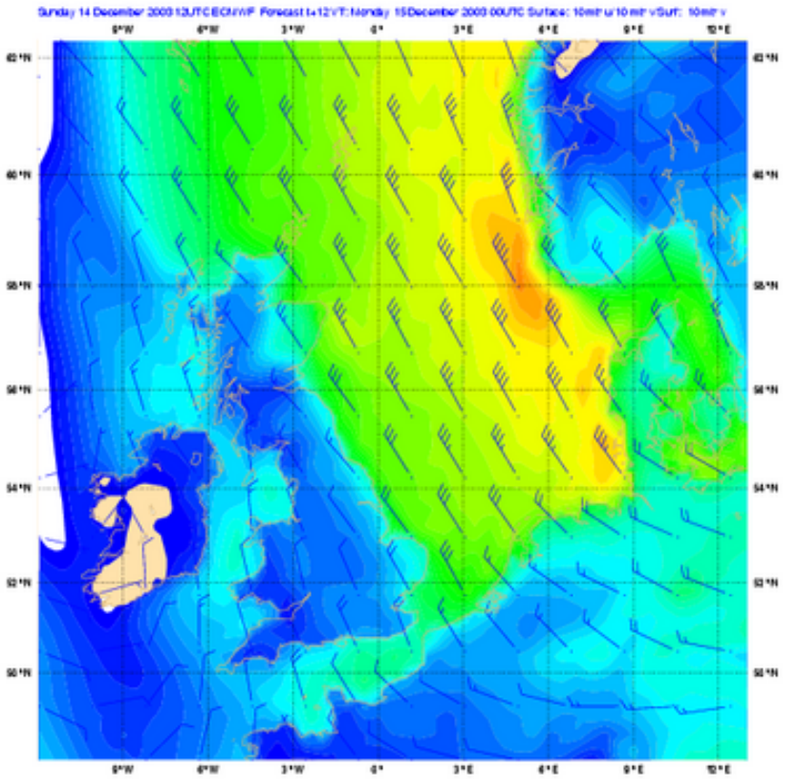
1 September 2003 – 30 April 2004
11 SVSD sessions, 4 × *normal surge*, 5 × *high surge*, 2 × *low storm surge*

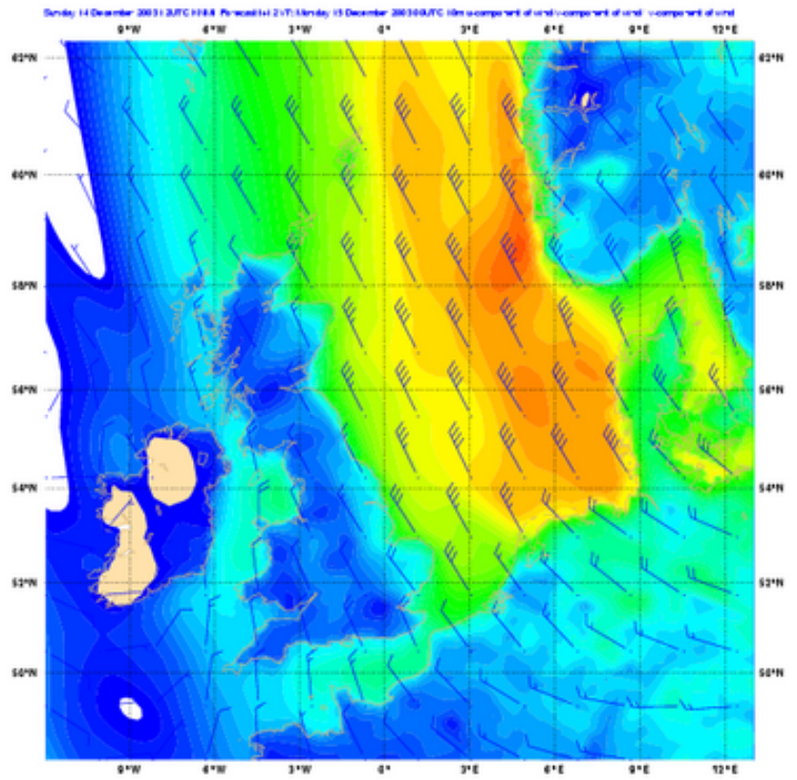
1 September 2006 – 31 March 2007
10 SVSD sessions, 6 × *high surge*, 3 × *low storm surge*, 1 × *medium storm surge*

WAQUA/DCSM on ECMWF deterministic

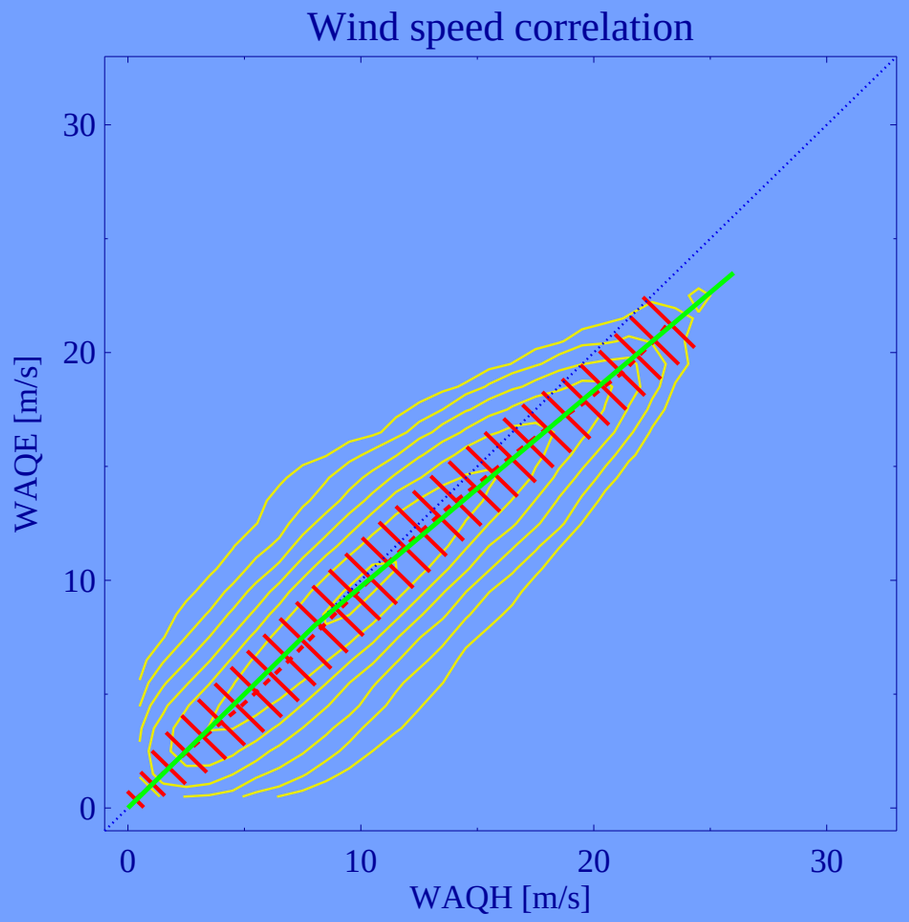


Comparison Hirlam wind and ECMWF wind



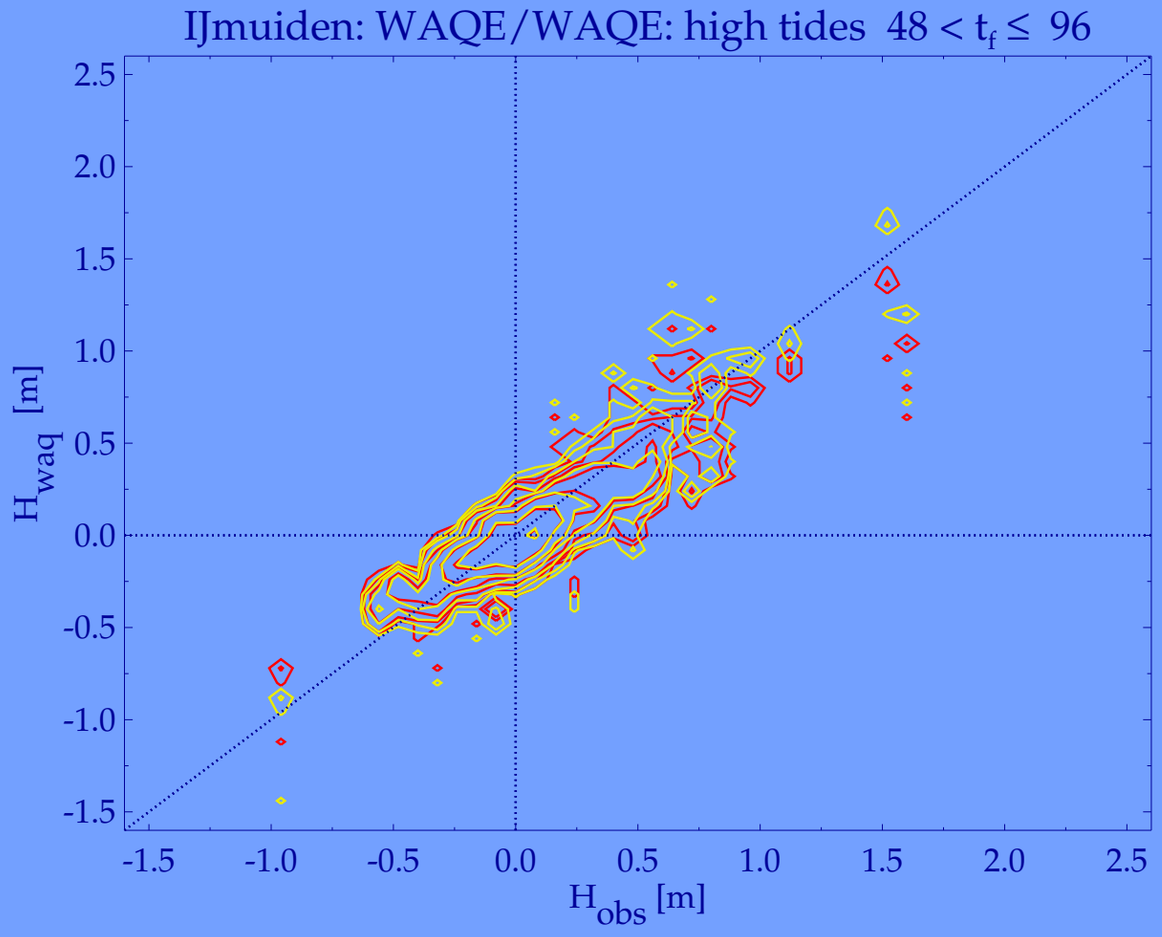


ECMWF wind correction

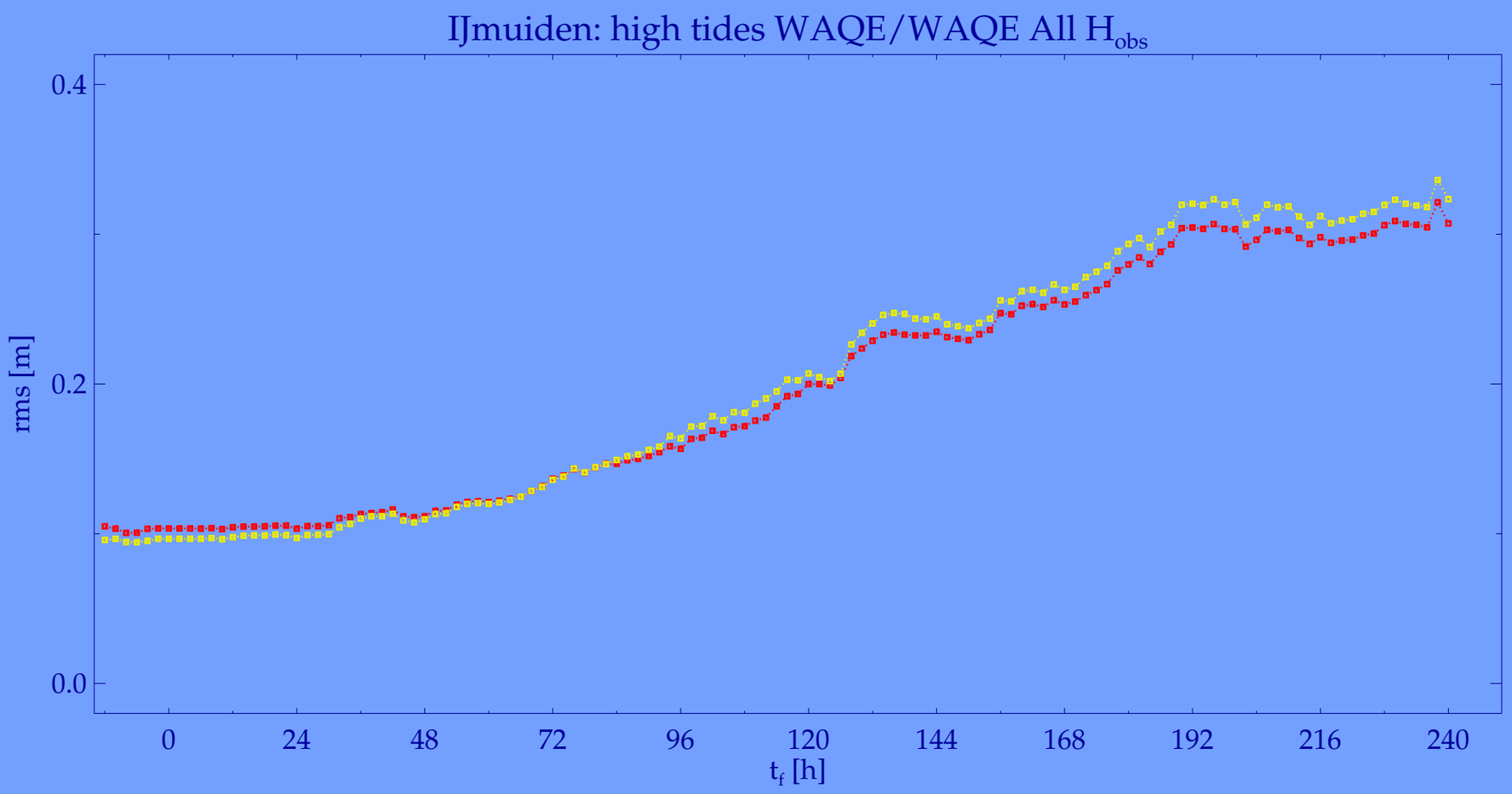


For $u_{10} > 8 m/s$: 14% extra

WAQUA/DCSM on ECMWF det improved



WAQUA/DCSM RMS with t_f

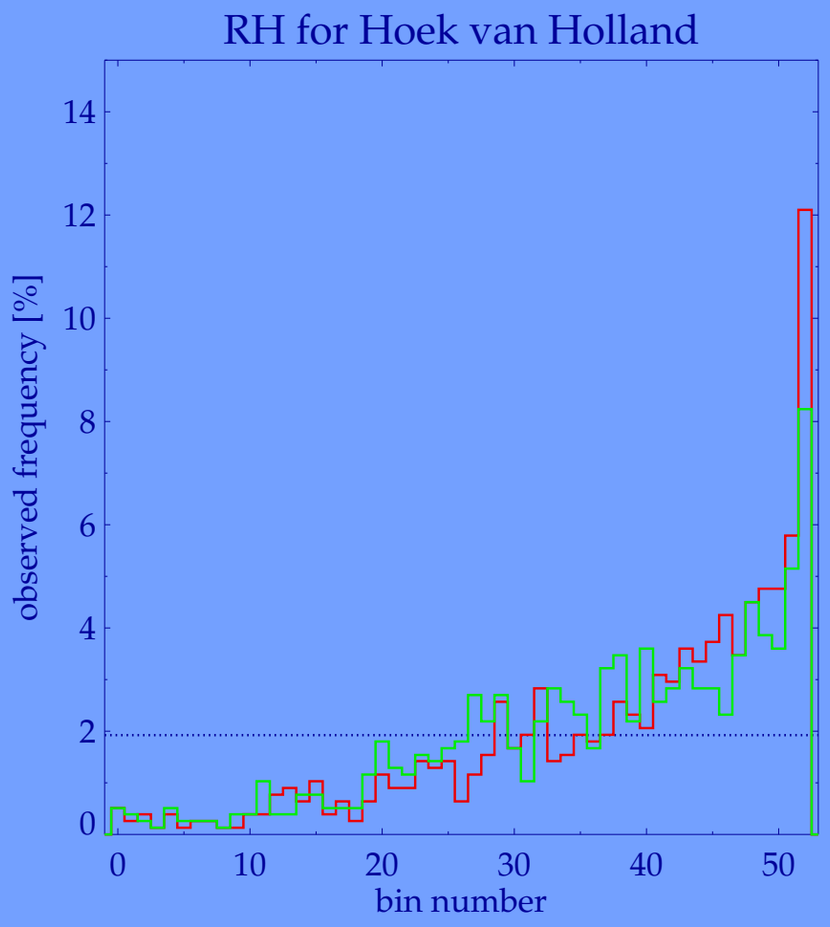


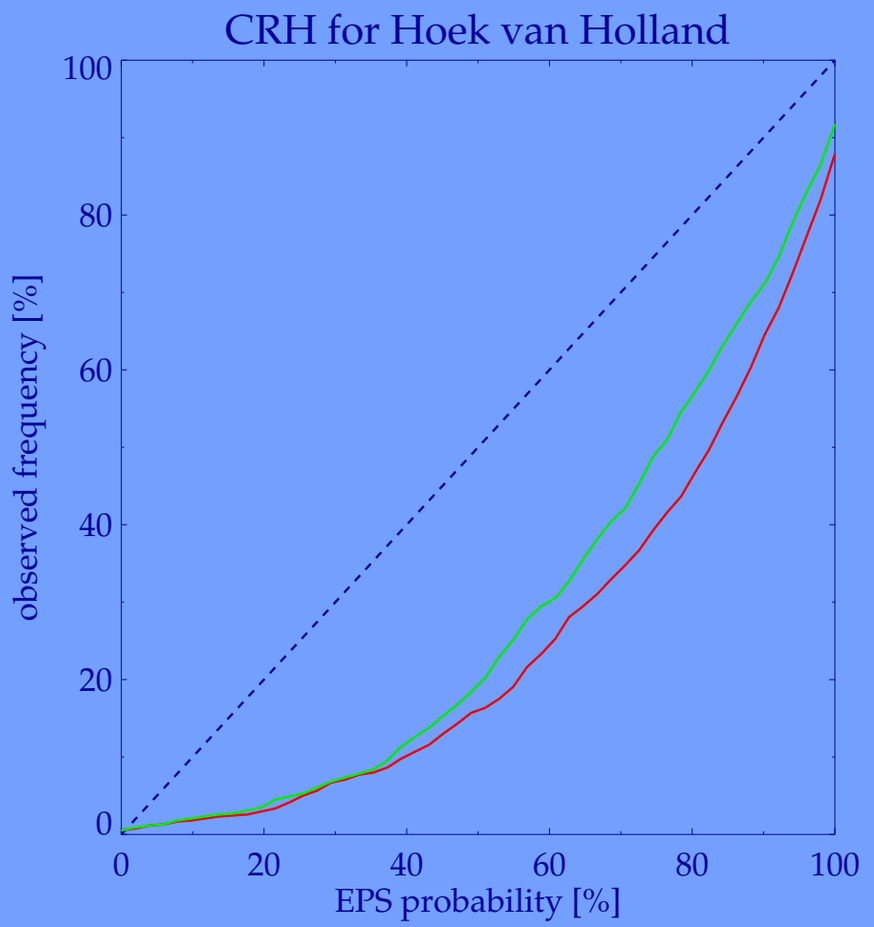
Ensembles

Data Volume

- 8 months (Sep 2003 – Apr 2004)
- $t_f \leq 240h$
- $\sim$ 19k ensembles
- $\sim$ 960k forecasts per location
- $\times$ 8 locations $\simeq$ 150k ensembles, 7.7M forecasts

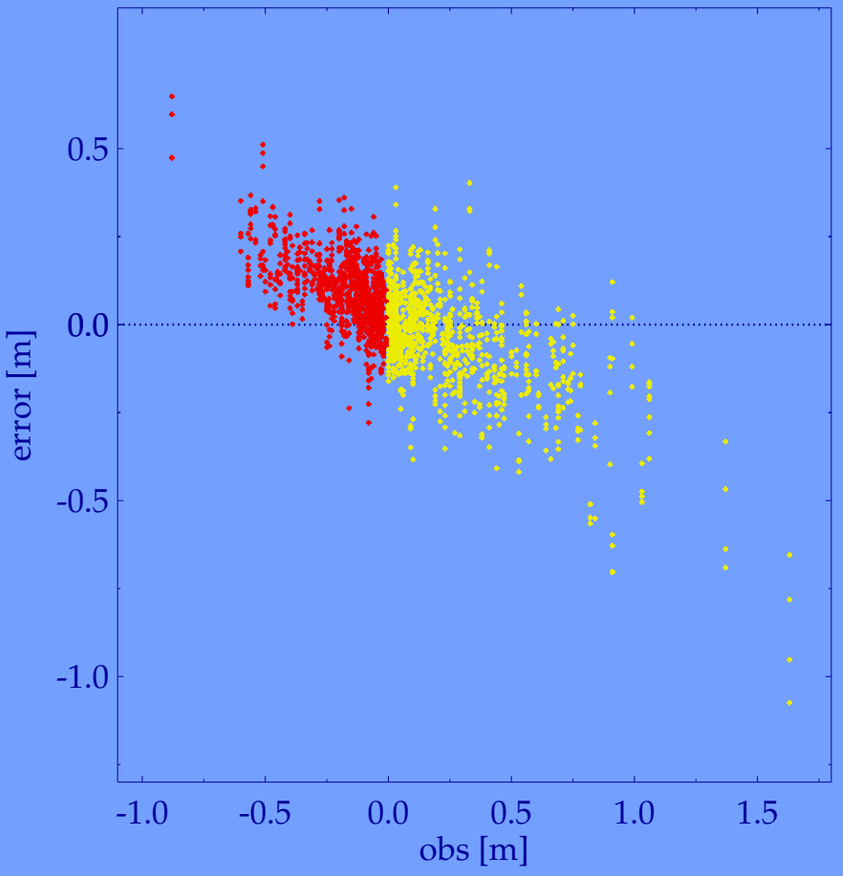
Validation: Rank histograms

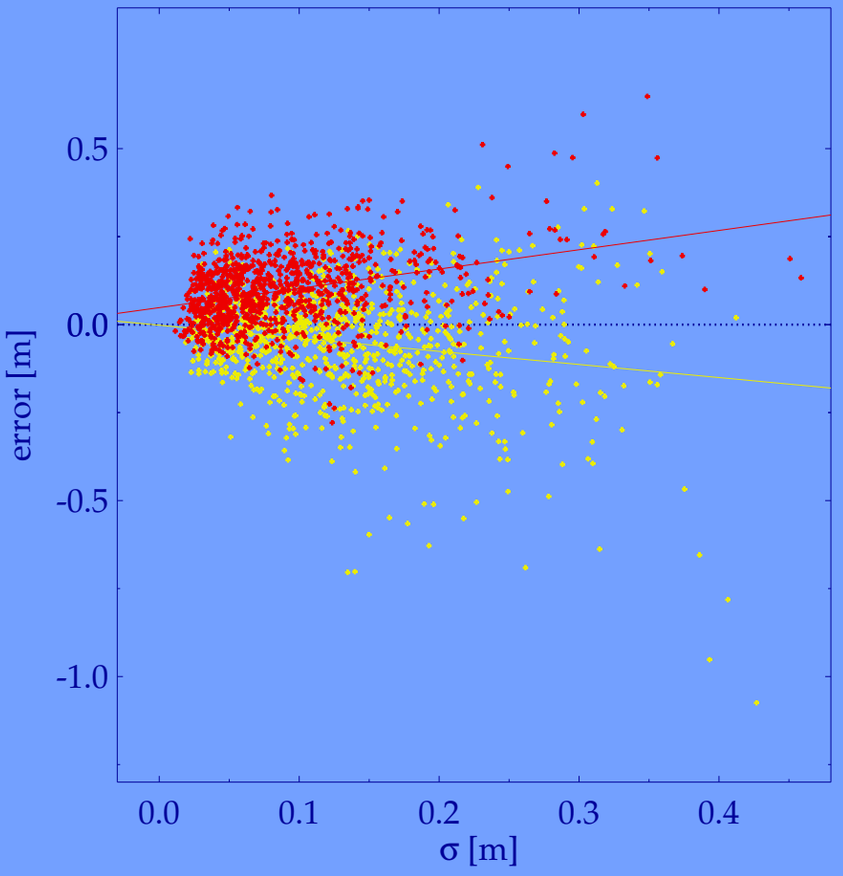




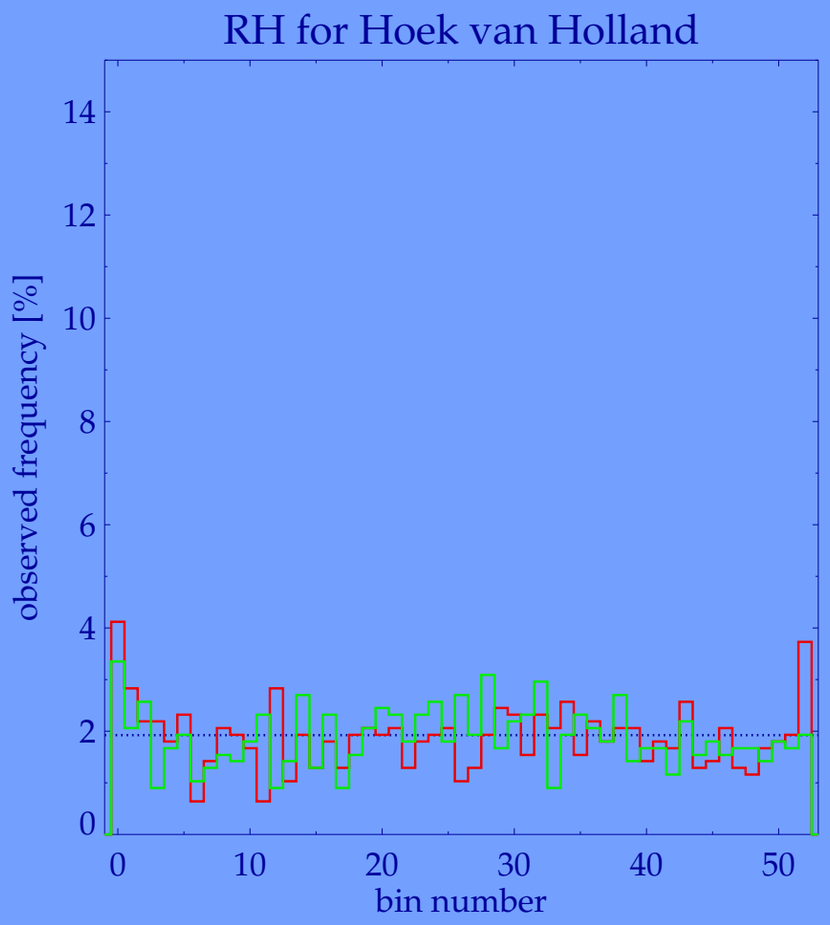
Validation: Correlation

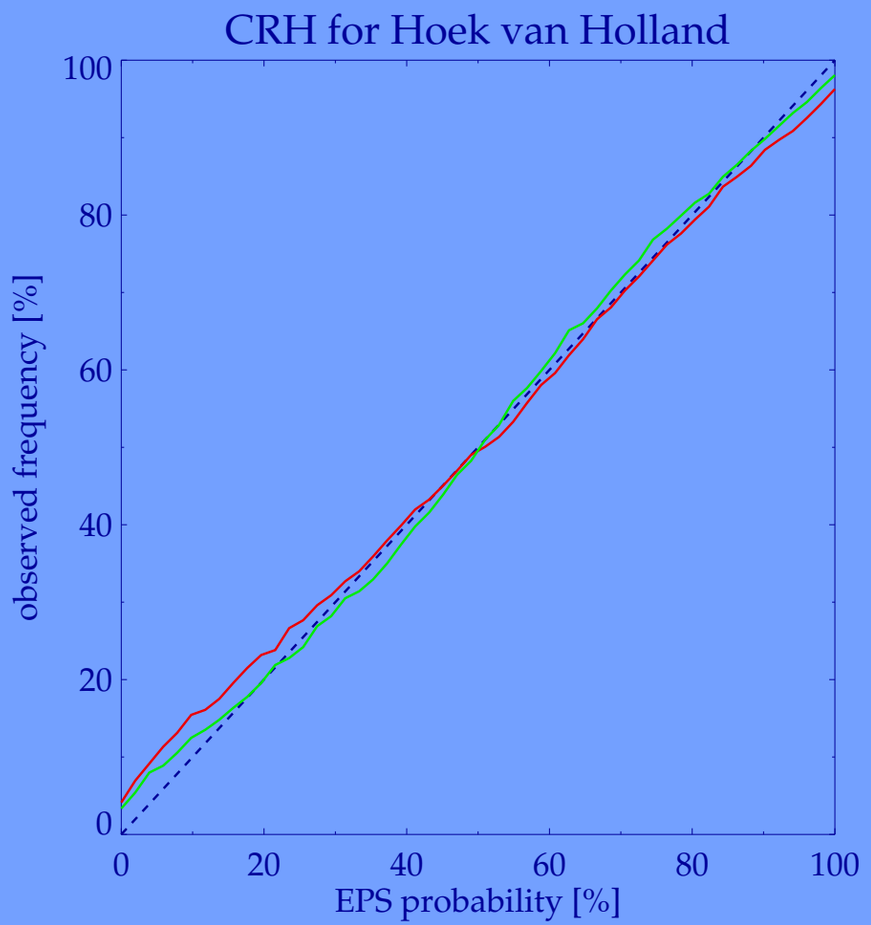
Den Helder





Validation: Rank histograms improved





Brier Scores

Application

Yes/no forecasts: exceedance of certain (surge) levels.

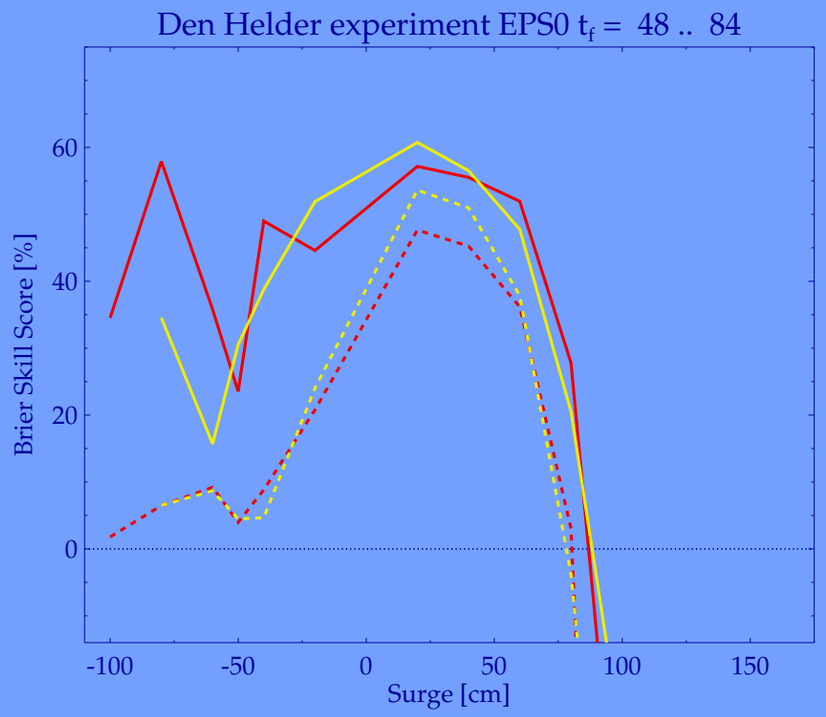
$$BS = \frac{1}{n} \sum_{k=1}^{n} (p_k - o_k)^2$$

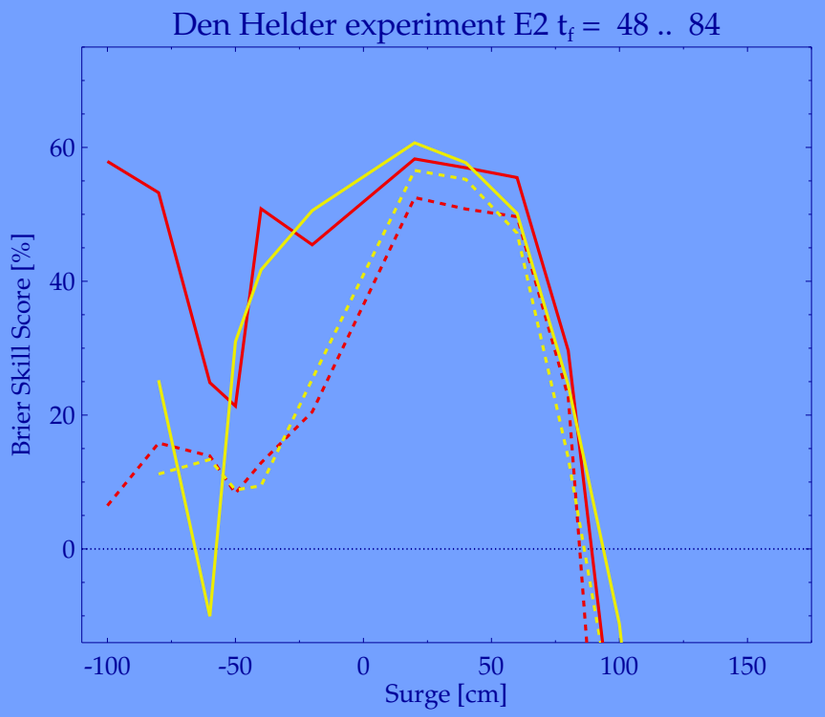
Skill score

$$BSS = 1 - \frac{BS}{BS_{ref}}$$

Brier Scores $t_f = 48..84h$

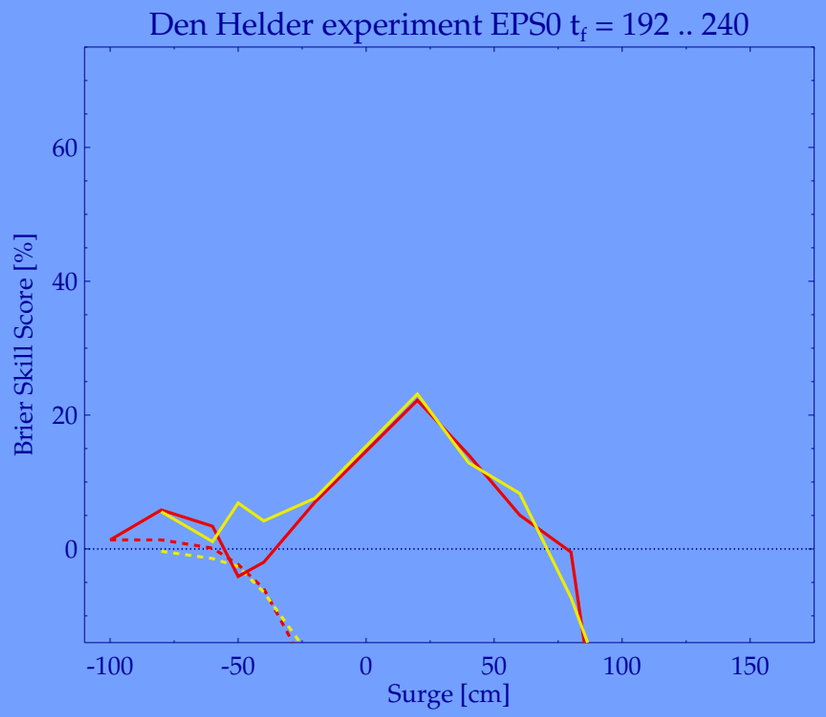
Exceedance probabilities p_k for surge, without and with u_{10} correction

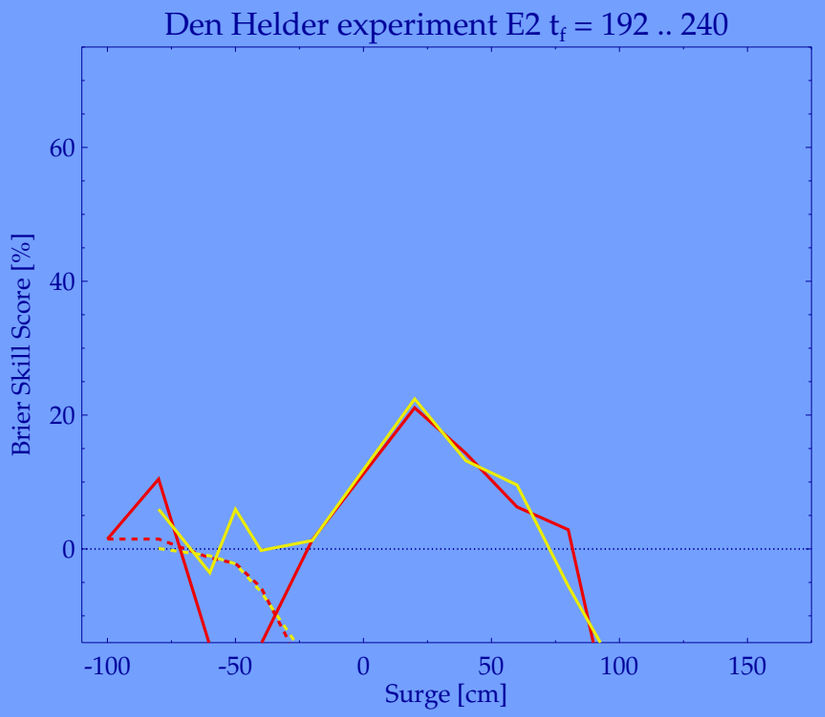




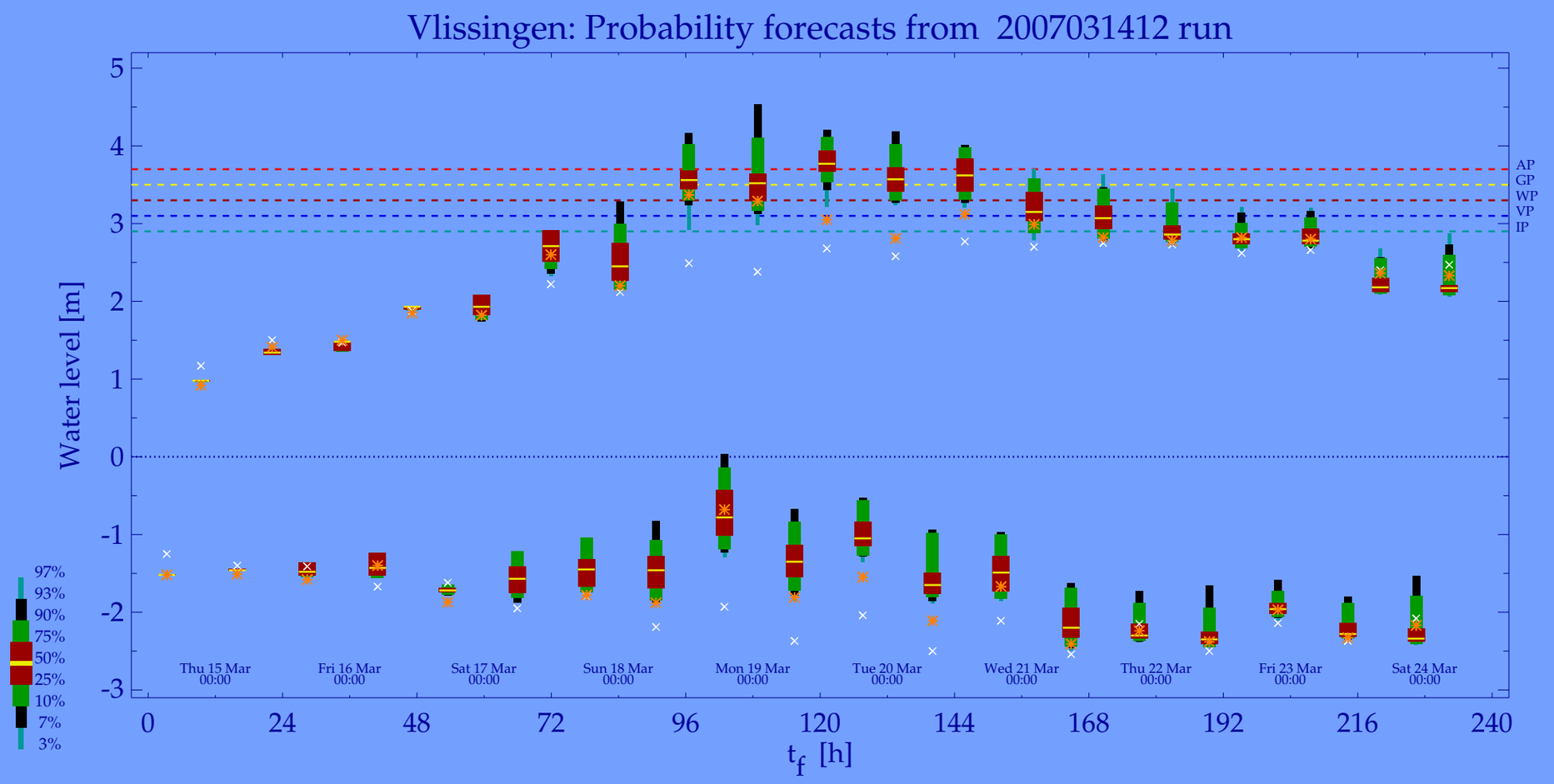
Brier Scores $t_f = 192..240h$

Exceedance probabilities p_k for surge, without and with u_{10} correction

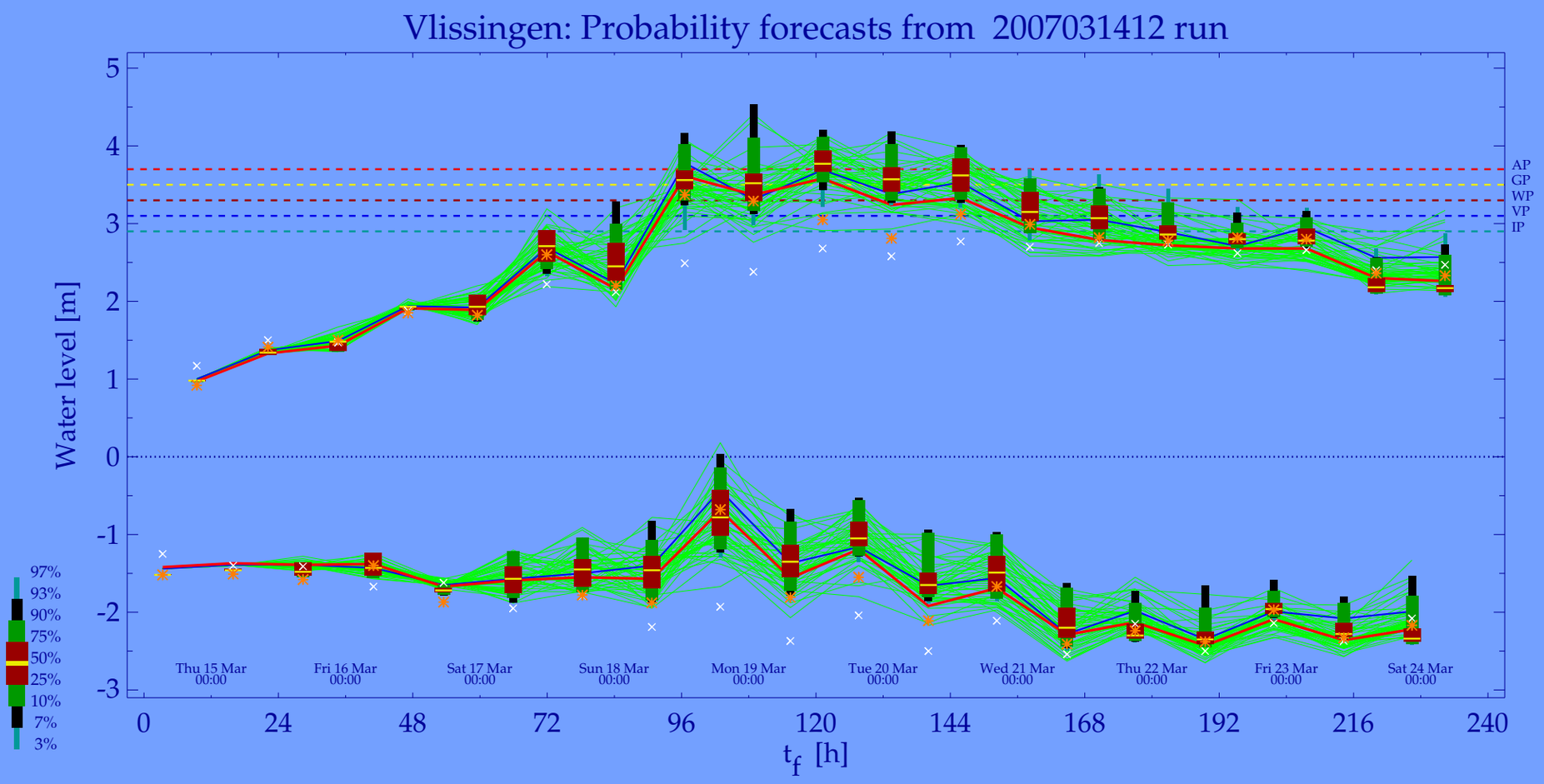




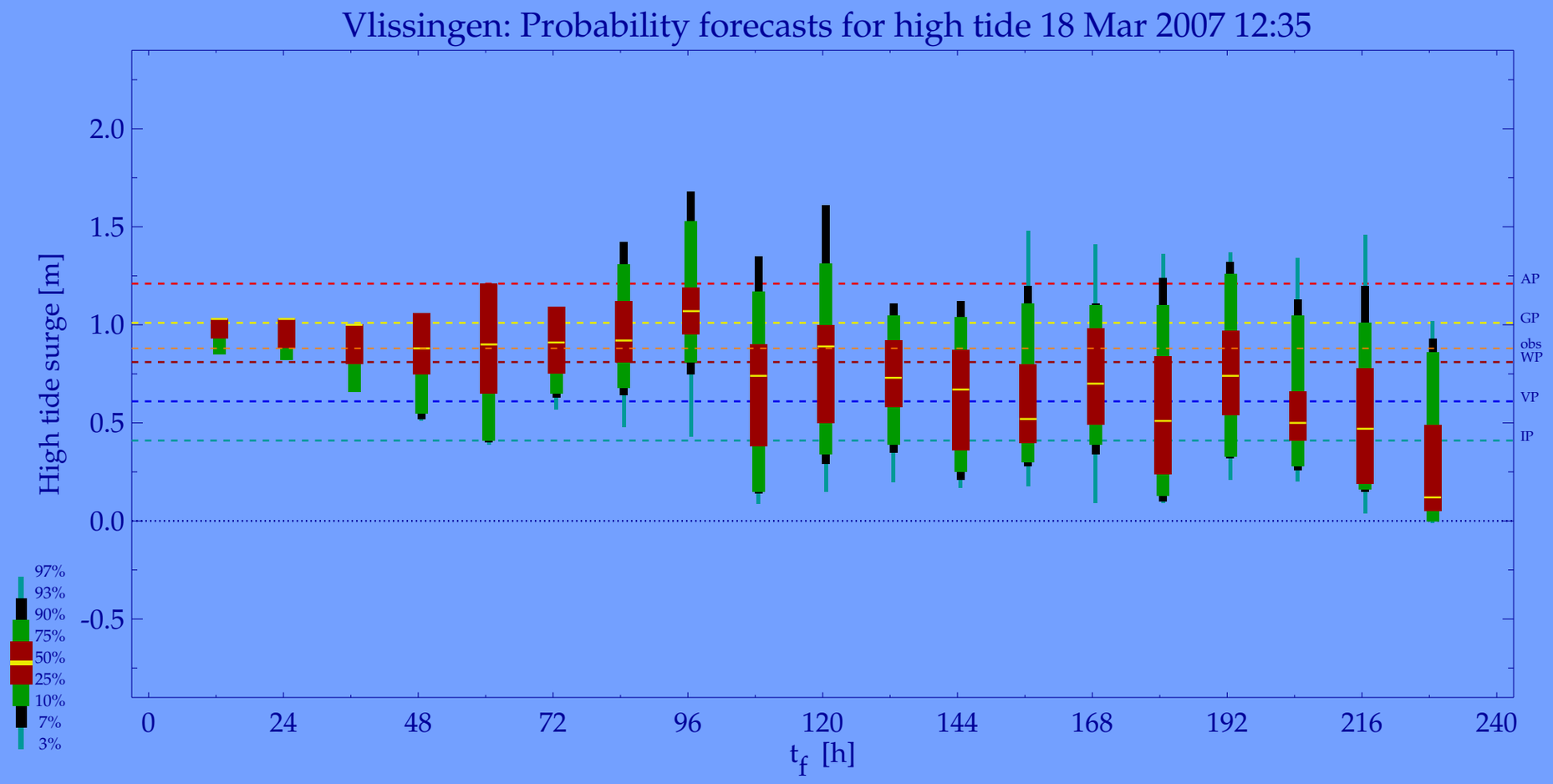
Example forecast



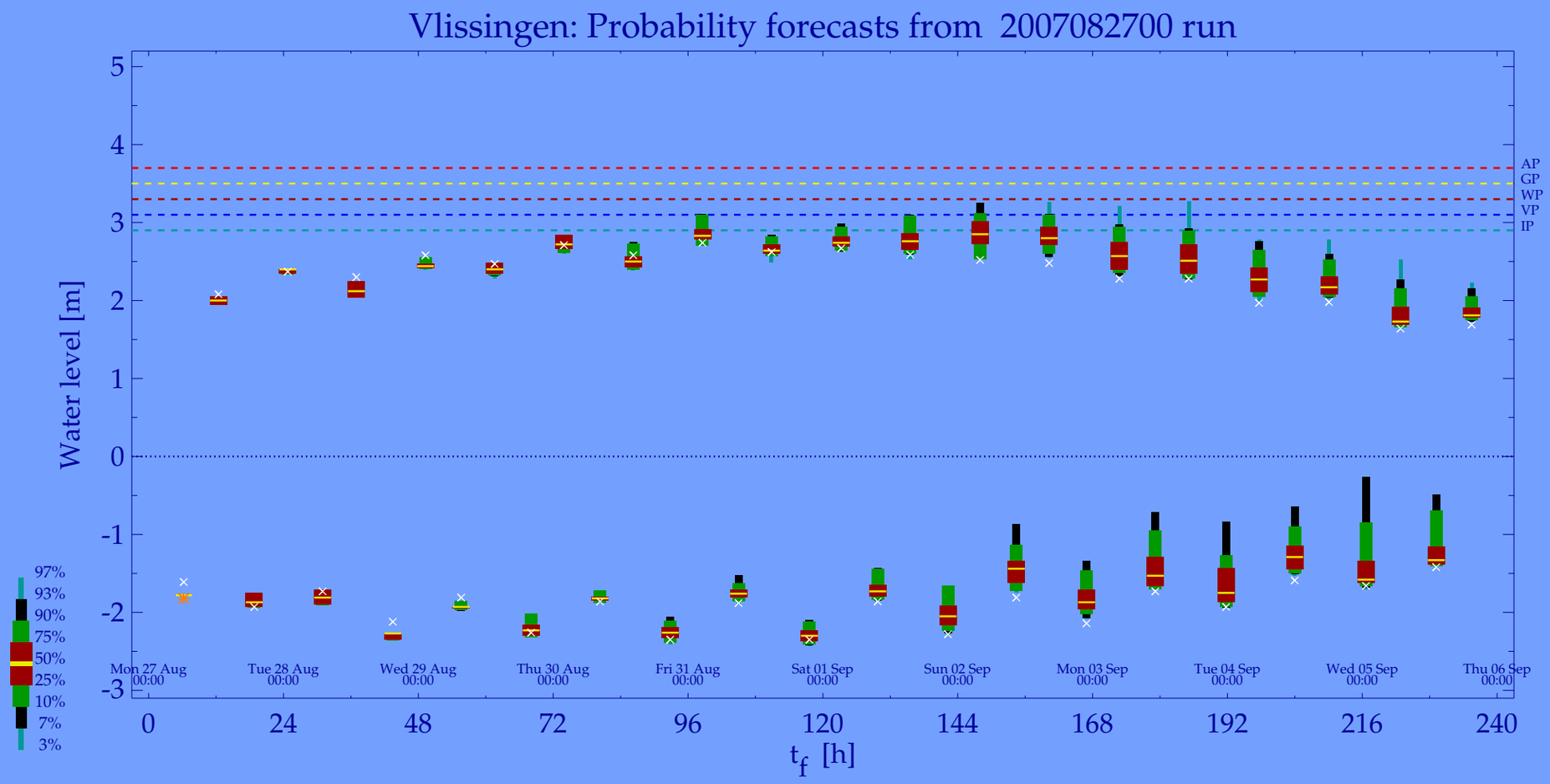
Example forecast



Example: forecasts for 1 tide



Yesterday's forecast



Actual forecasts

http://www.knmi.nl/~jwdv/WAQUA/EPS/forecasts.html

Thank you