A New Hindcast Archive for the North Sea, The Norwegian Sea and the Barents Sea*

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* *The project is funded by The Norwegian Deep Water Programme (NDP), a consortium of oil and gas producers*

Objective

- Main objective:
  Build a new high-resolution archive of wind and wave fields for Norwegian waters for the period September 1957 – August 2002 using ERA40 boundary values
- Sub-goals:
  - Attempt to resolve polar lows found in the Barents Sea and the Norwegian Sea
  - Improve wind and wave climatology for coastal locations influenced by local topographic effects
- Deliverables:
  - archived weather and wave fields as well as monthly and annual statistics
  - hindcast archive accessible via web map service

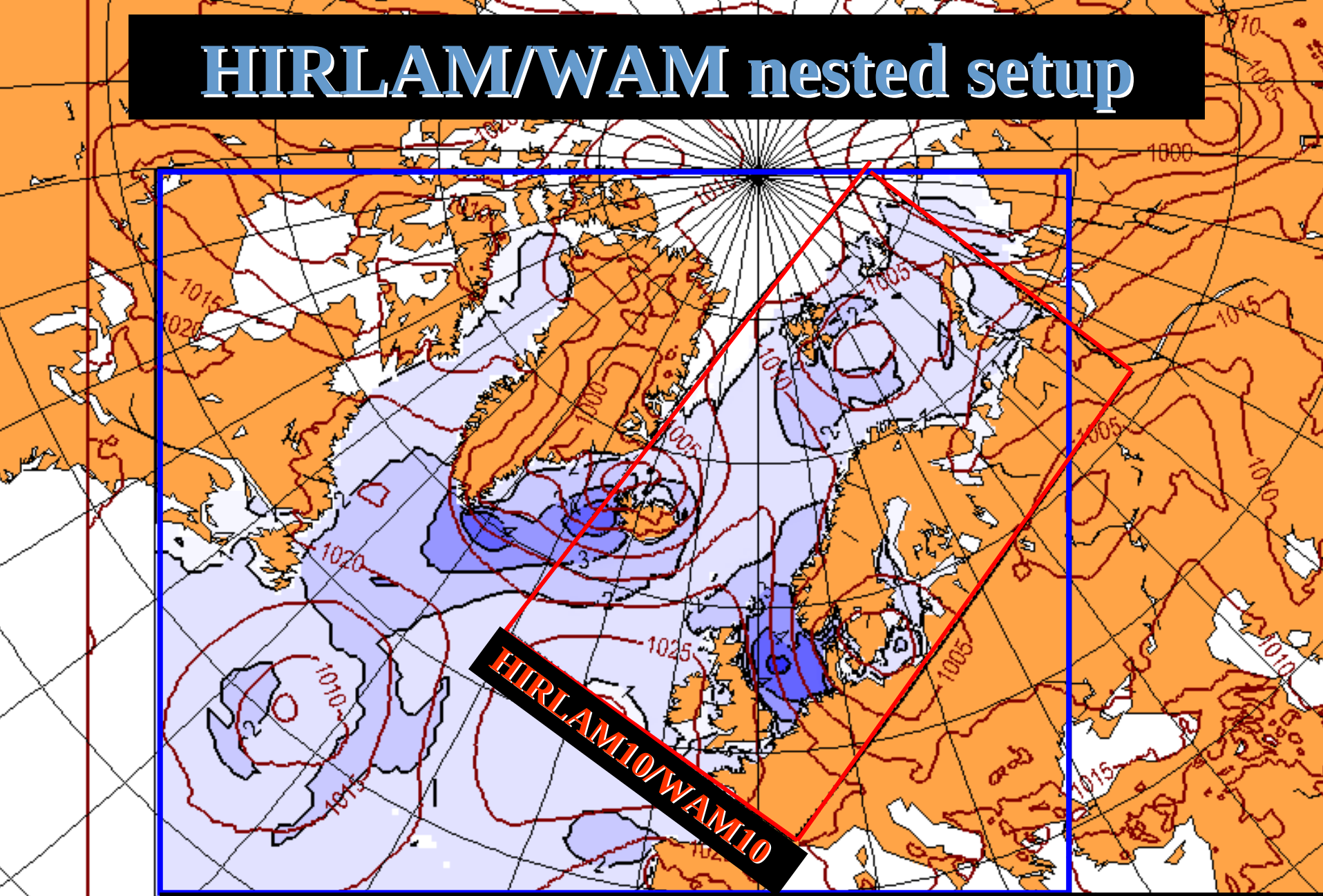
Methodology

- Method:
  - Run atmospheric model HIRLAM on 10km res to scale down ERA40 fields
  - Run WAM on 10km res with wind from HIRLAM10 and boundary values from WAM 50km res. WAM50 is forced with ERA40 wind.
- Output:
  - Atmospheric fields from HIRLAM10 (wind, temperature, humidity, precipitation, etc)
  - Sea state from WAM10 & WAM50 (integrated wave parameters stored as fields, 2D spectra stored for selected grid points)

Conclusions

- Preliminary results for the period 1990-2002 suggest that the new hindcast archive yields significantly better sea state statistics compared with ERA40. Correlations range from 0.92-0.97 for individual stations.
- The extreme tail of the wave height distribution (90, 95, 99 percentiles) is also better reproduced than ERA40.
- Improvements to the wind field are particularly pronounced at coastal stations, but small-scale features in the open ocean such as polar lows are also better resolved.

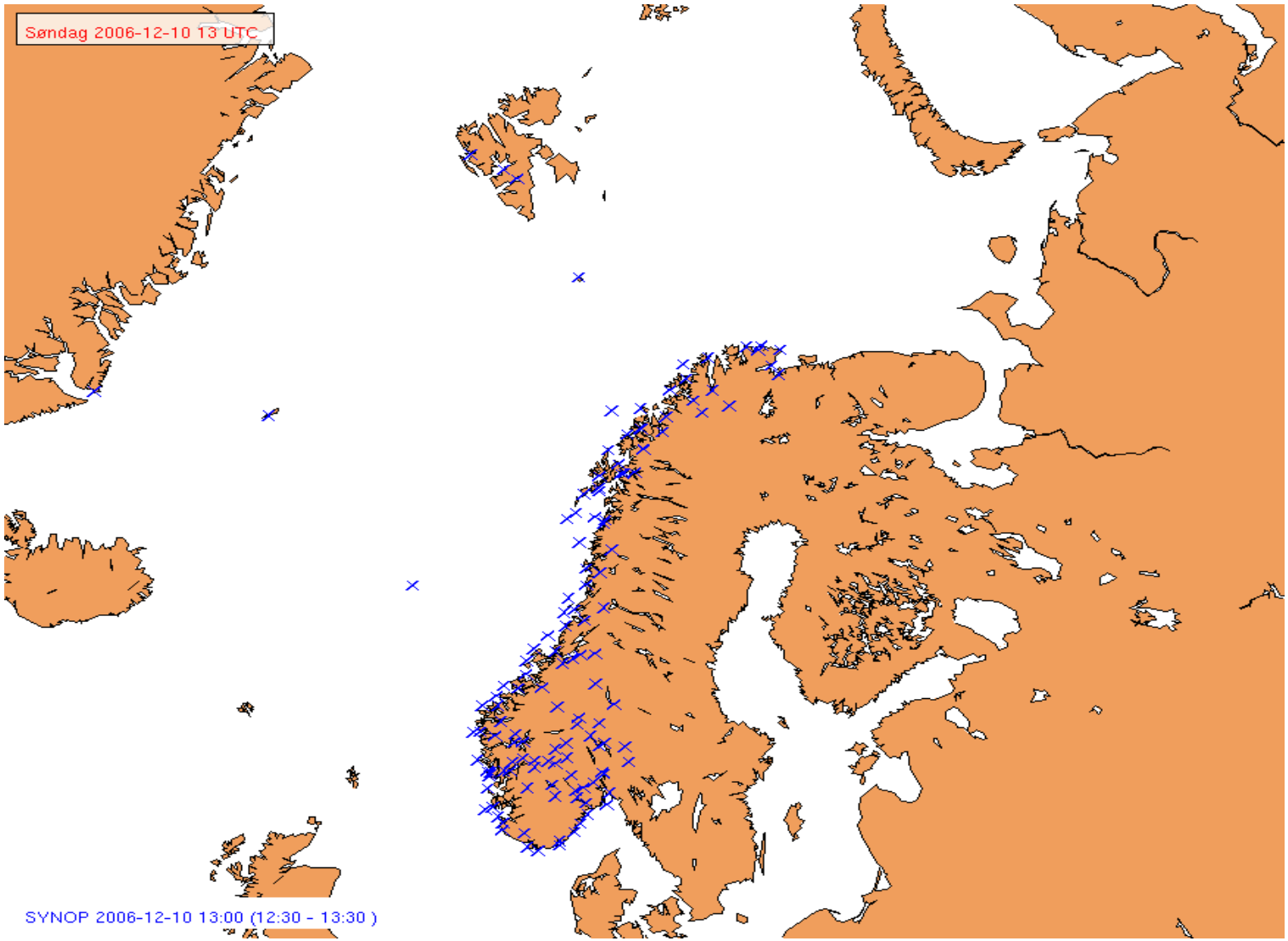
HIRLAM/WAM nested setup



WAM50 on ERA wind

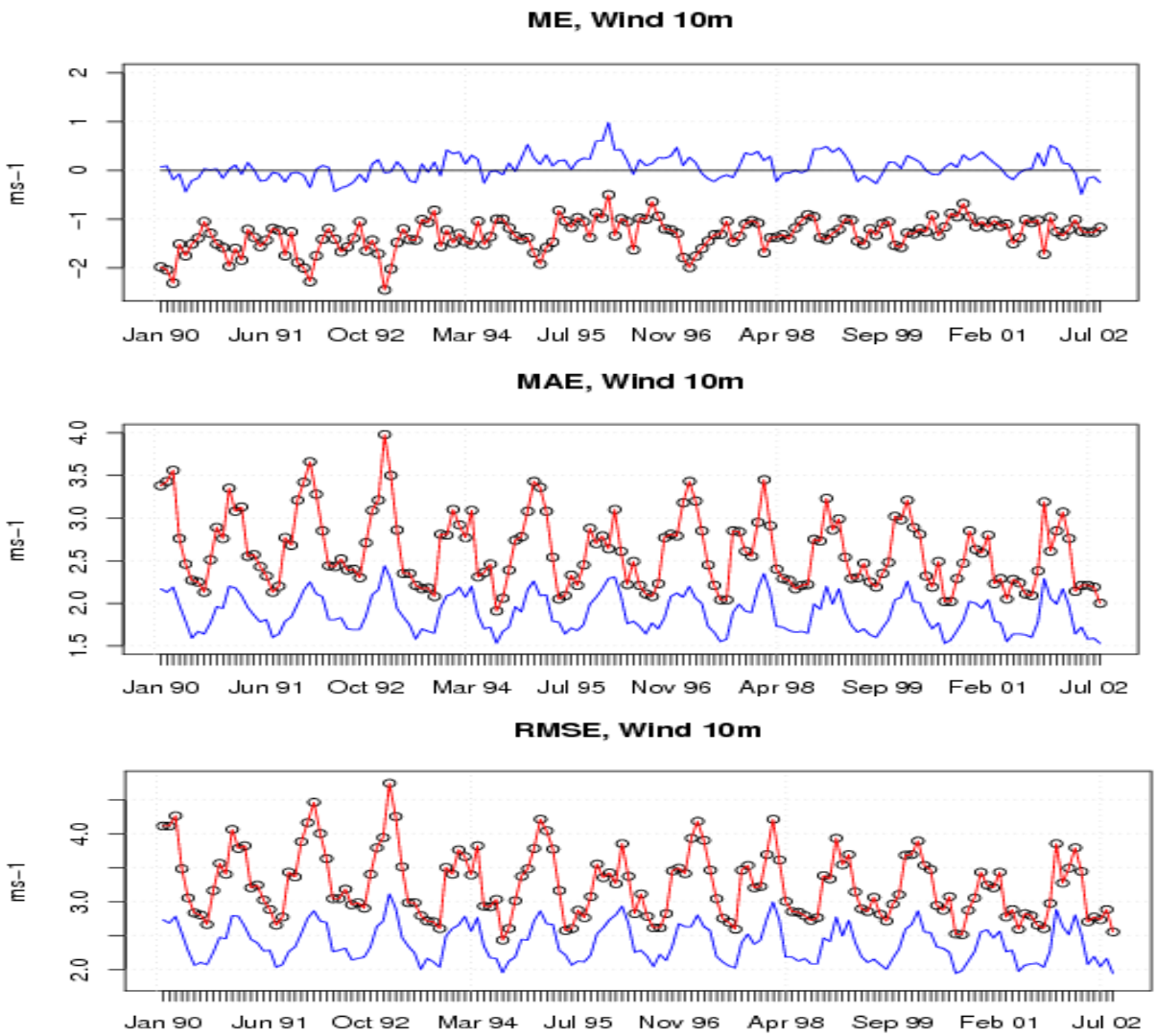
- 3-hourly wind fields
- Ice edge updated every 10 days

Meteorological observing stations



Wind error statistics for coastal stations

BLUE: HIRLAM10 RED: ERA40



Coastal stations Periode: 1990.01–2002.08 Blue Lines: H10 Red Lines: ERA40

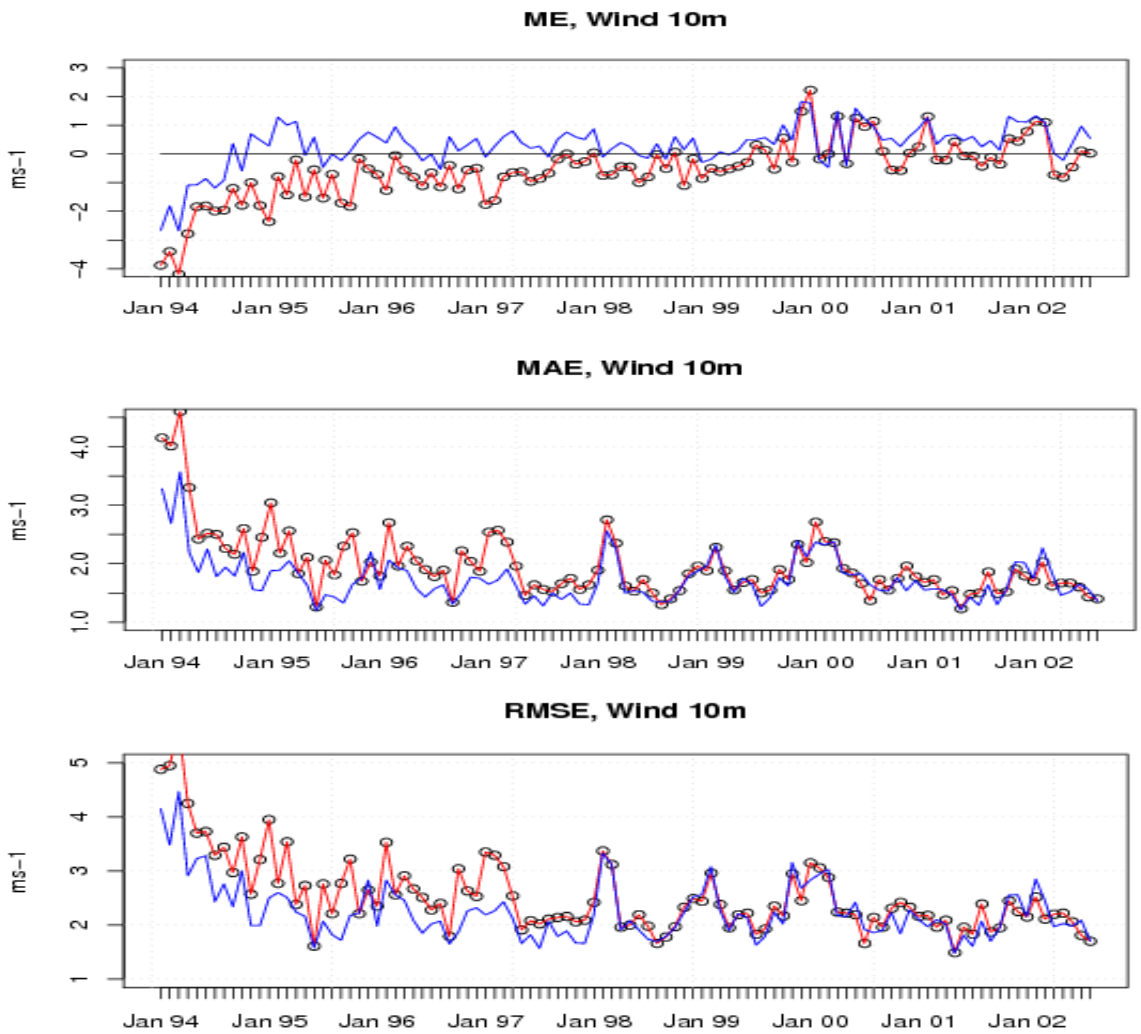
The timeseries for the coastal stations are showing an even larger difference between HIRLAM and ERA.

HIRLAM performs very well also at coastal stations, while ERA40 tends to underestimate the wind speed.

The underestimation of wind speed in ERA40 is considerably worse in winter time.

Number of stations:
1990-01: 22 stations
2002-01: 28 stations

Stations in the Norwegian Sea



Stations in the Norwegian Sea Periode: 1990.01–2002.08 Blue Lines: H10 Red Lines: ERA40

Number of stations:

1994: 1 station

1996: 2 stations

1999: 3 stations

2000-: 2 stations

The high uncertainty in the beginning of the period has to be a consequence of uncertainty in the observations, which seem to be calibrated during the first year.

Station	latitude	longitude
DRAUGEN	64.30	7.80
HEIDRUN	65.30	7.30
NORNE	66.00	8.10

Wind speed (m/s) Ekofisk 2000-2001

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	5526	7.4	3.9				12.9	14.5	17.1
Model	5526	8.7	4.0	1.6	2.1	0.91	14.4	16.1	18.5

Wind speed (m/s) Sleipner 2000-2001

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	5709	7.5	3.9				13.0	14.6	17.1
Model	5709	8.7	4.3	1.6	2.0	0.93	14.9	16.5	19.0

Wind speed (m/s) Gullfaks 2000-2001

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	5712	8.1	4.4				14.2	15.9	19.2
Model	5712	9.0	4.5	1.5	1.9	0.93	15.3	17.0	19.8

Wind speed (m/s) Draugen 2000-2001

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	5636	7.5	4.3				13.3	15.7	20.3
Model	5636	8.4	4.3	1.7	2.2	0.88	14.4	16.6	20.3

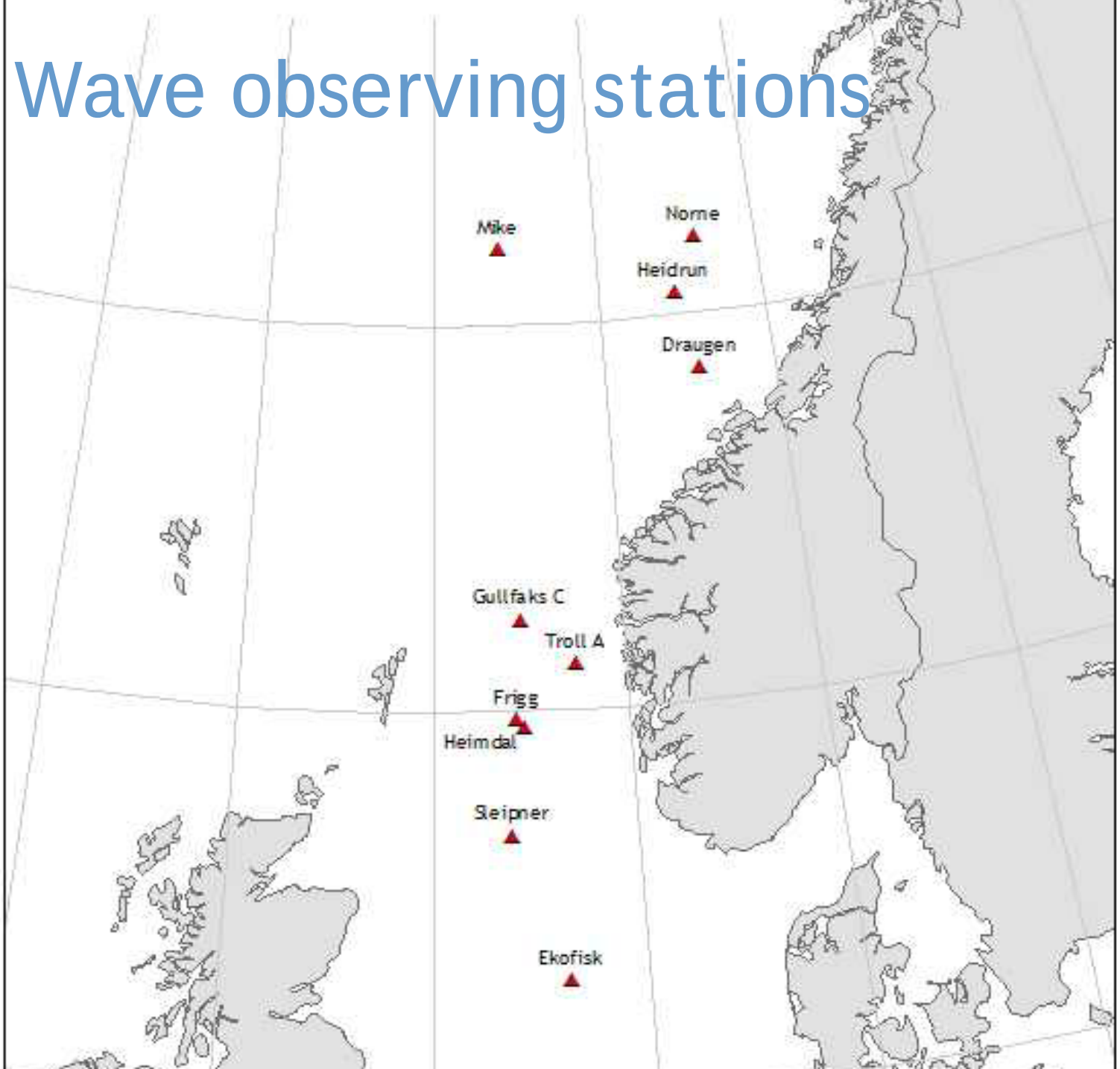
Wind speed (m/s) Heidrun 2000-2001

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	5762	7.2	3.9				12.4	14.4	18.2
Model	5762	8.5	4.2	1.9	2.3	0.90	14.3	16.4	19.6

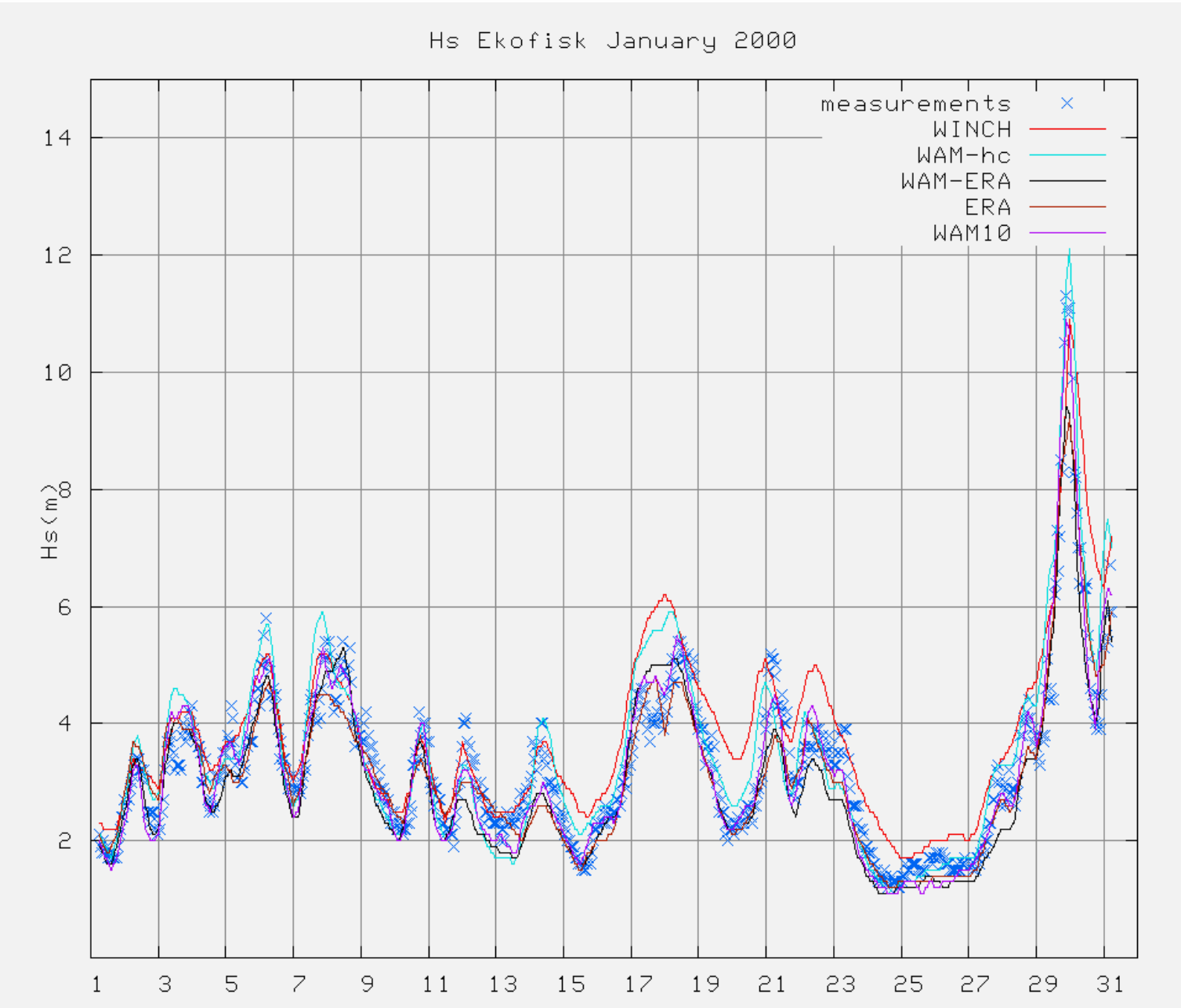
Wind speed (m/s) Norne 2000-2001

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	5557	8.3	4.2				13.9	15.8	19.6
Model	5557	8.6	4.1	1.4	1.9	0.90	14.2	16.2	19.7

Wave observing stations



Wave model intercomparison



Ekofisk January 2000. N=239

	Mean	St.d	RMS	Corr	P_{90}	P_{95}	P_{99}	Max.
Obs.	3.28	1.43			4.8	5.3	8.5	11.3
WINCH	3.85	1.54	0.83	0.92	5.5	6.3	9.7	10.9
WAM hc	3.51	1.70	0.67	0.93	5.6	6.2	10.6	12.1
WAM ERA	3.02	1.40	0.54	0.95	4.9	5.2	8.2	9.4
ERA	3.16	1.34	0.45	0.95	4.6	5.0	8.4	9.2
WAM10	3.21	1.54	0.43	0.96	4.9	5.5	9.2	10.9

Sleipner January 2000. N=230

	Mean	St.d	RMS	Corr	P_{90}	P_{95}	P_{99}	Max.
Obs.	3.21	1.35			4.9	5.5	7.1	8.5
WINCH	3.92	1.31	0.95	0.90	5.8	6.2	6.8	7.8
WAM hc	3.82	1.60	0.91	0.91	6.2	6.6	8.2	10.1
WAM ERA	3,27	1.22	0.49	0.93	4.9	5.3	6.0	8.3
ERA	3.44	1.19	0.61	0.91	5.0	5.3	6.0	6.6
WAM10	3.58	1.41	0.61	0.94	5.5	6.0	7.1	10.6

Hs Ekofisk 1990-1992

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	6345	2.18	1.26				3.8	4.6	6.2
Model	6345	2.16	1.33	0.25	0.34	0.97	4.0	4.7	6.4

Hs Frigg 1990-1992

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	8474	2.55	1.38				4.5	5.0	7.0
Model	8474	2.56	1.52	0.38	0.54	0.94	4.7	5.4	7.4

Hs Gullfaks 1990-1992

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	8379	2.71	1.58				5.0	5.7	7.5
Model	8379	2.81	1.65	0.38	0.54	0.95	5.2	6.0	8.0

Hs Haltenbanken 1990-1992

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	8677	2.76	1.82				5.4	6.4	8.6
Model	8677	2.86	1.81	0.48	0.67	0.93	5.5	6.5	8.6

Hs Ekofisk 2000-2001

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	5689	2.05	1.17				3.8	4.4	5.8
Model	5689	2.03	1.25	0.26	0.36	0.96	3.9	4.6	5.8

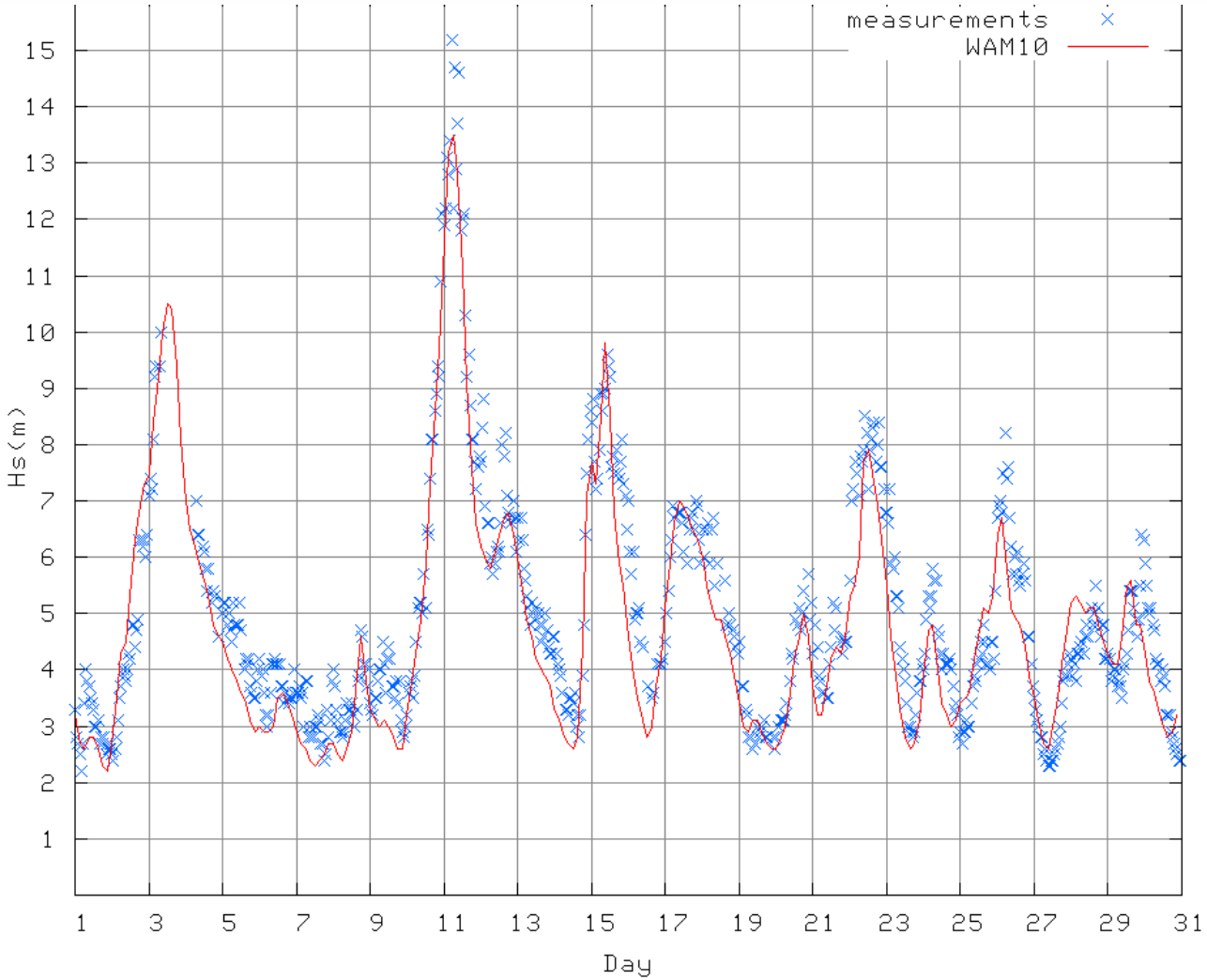
Hs Sleipner 2000-2001

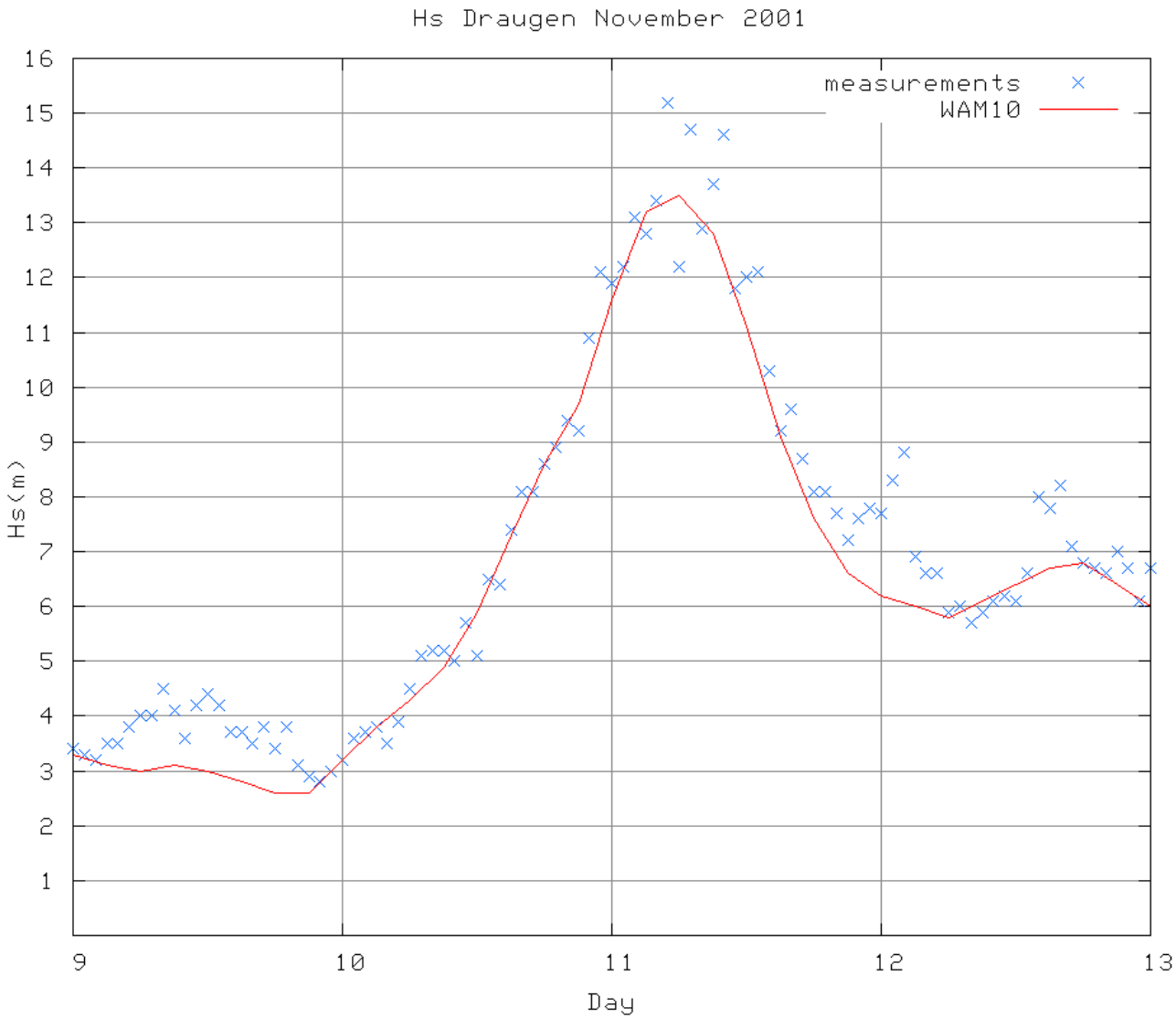
	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	4621	2.28	1.31				4.1	4.8	6.2
Model	4621	2.48	1.34	0.39	0.51	0.94	4.5	5.1	6.3

Hs Gullfaks 2000-2001

	N	Mean	St.dev.	Mean abs. difference	RMS difference	Corr. coefficient	P90	P95	P99
Obs.	5479	2.63	1.46				4.7	5.5	7.0
Model	5479	2.69	1.51	0.33	0.47	0.95	4.9	5.7	7.5

Case: 10-11 Nov 2001




Hs Draugen November 2001
measurements
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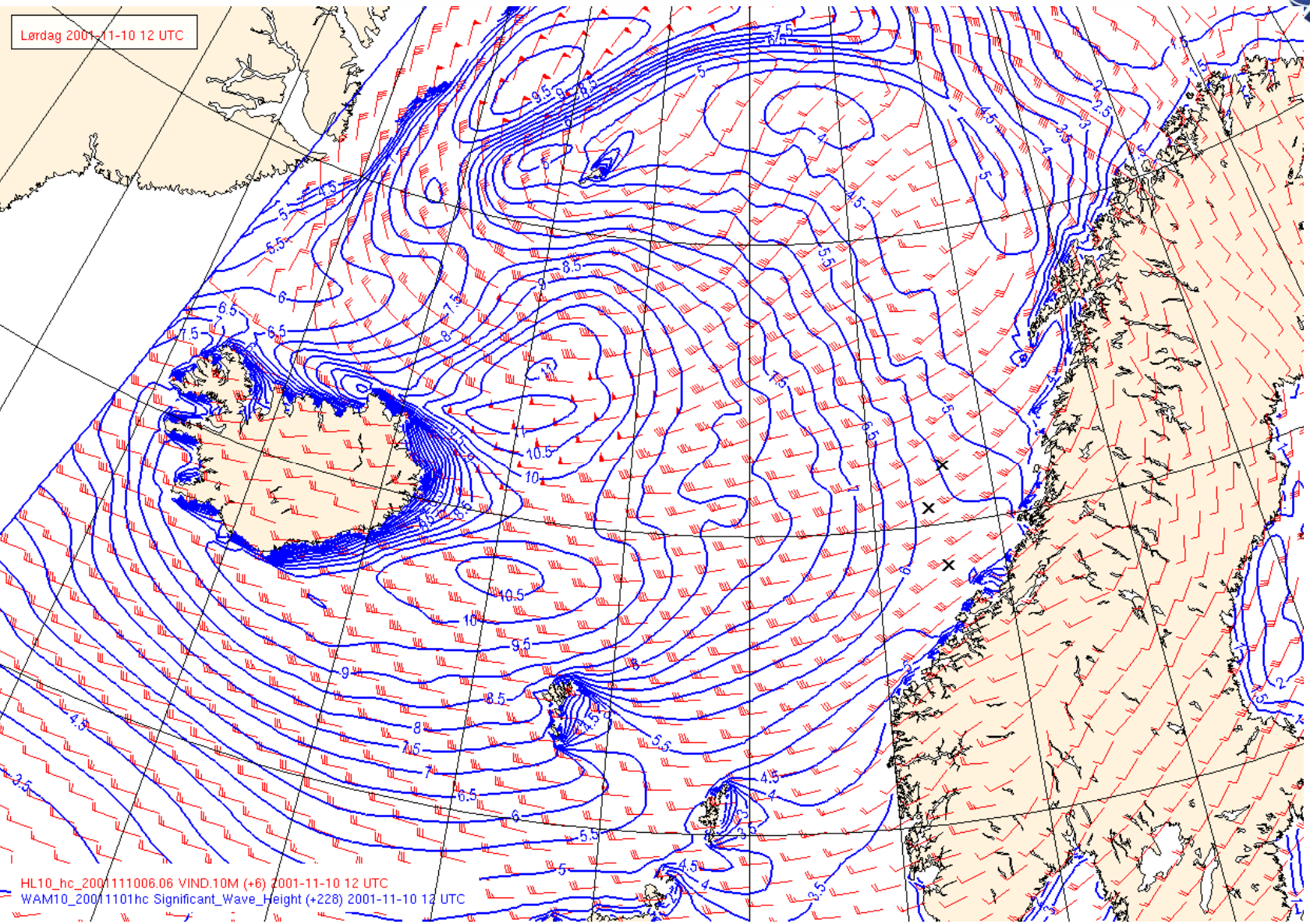
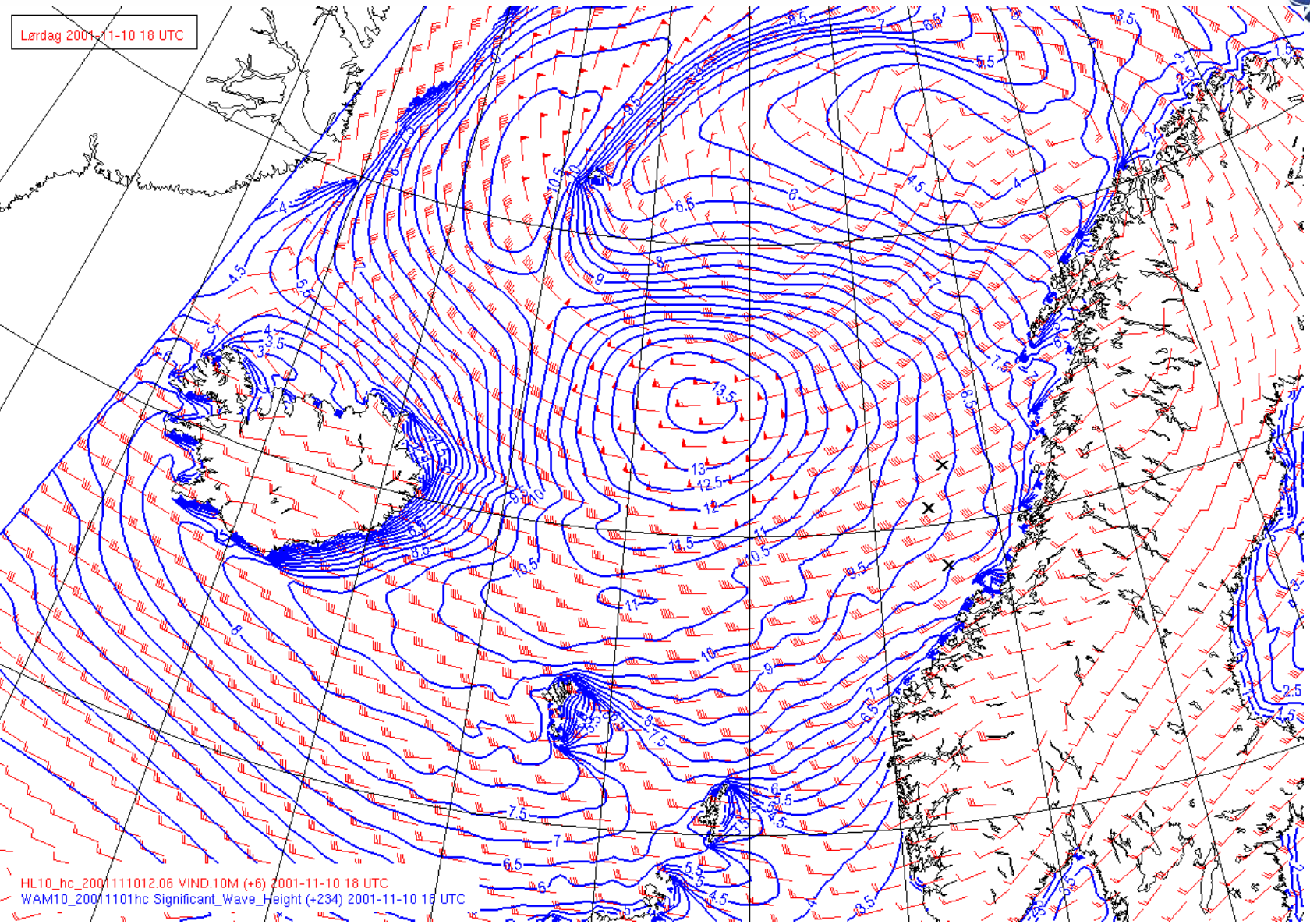
Wind and Hs 10 November 2001 12UTC



Wind and Hs 10 November 2001 18UTC



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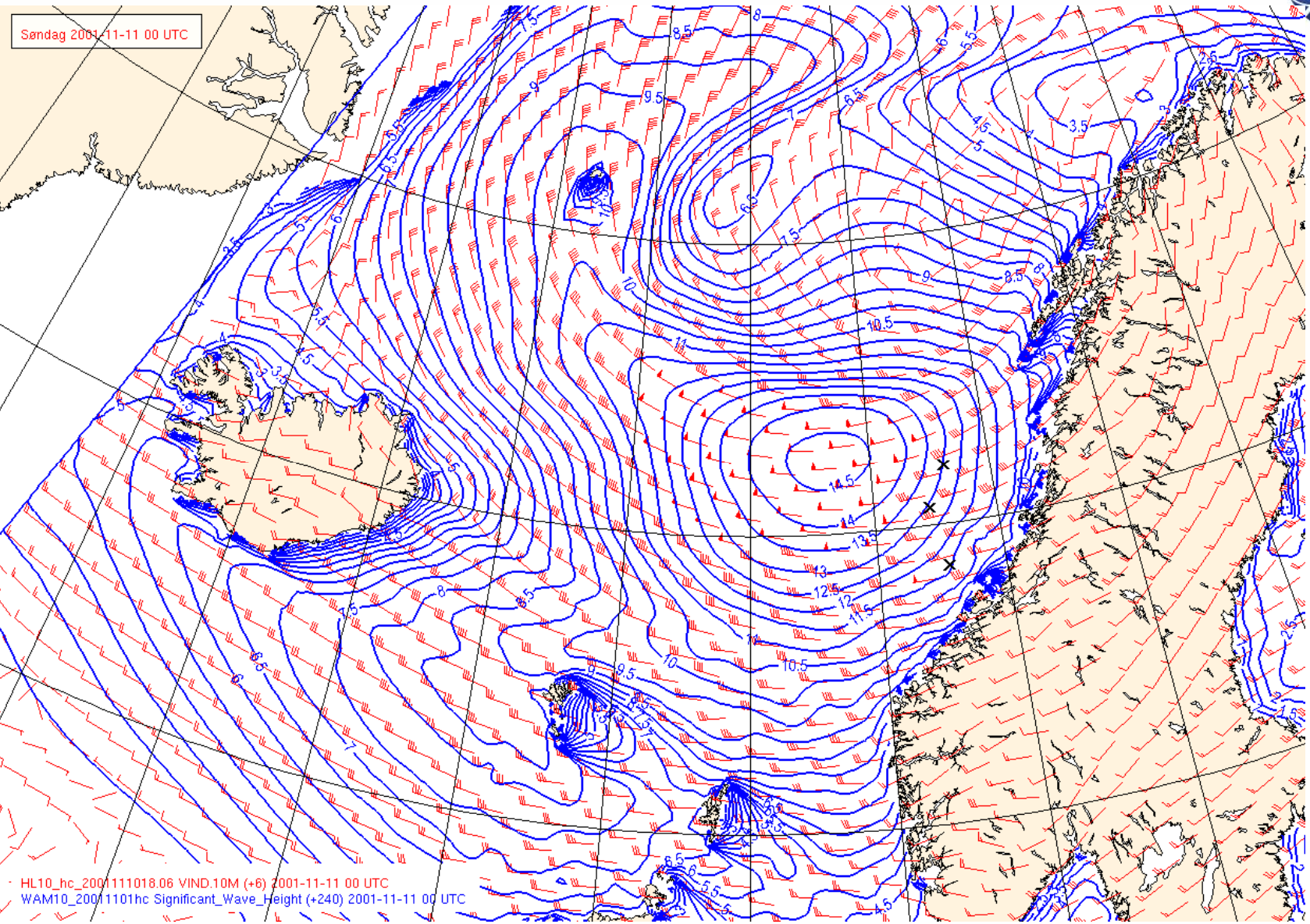

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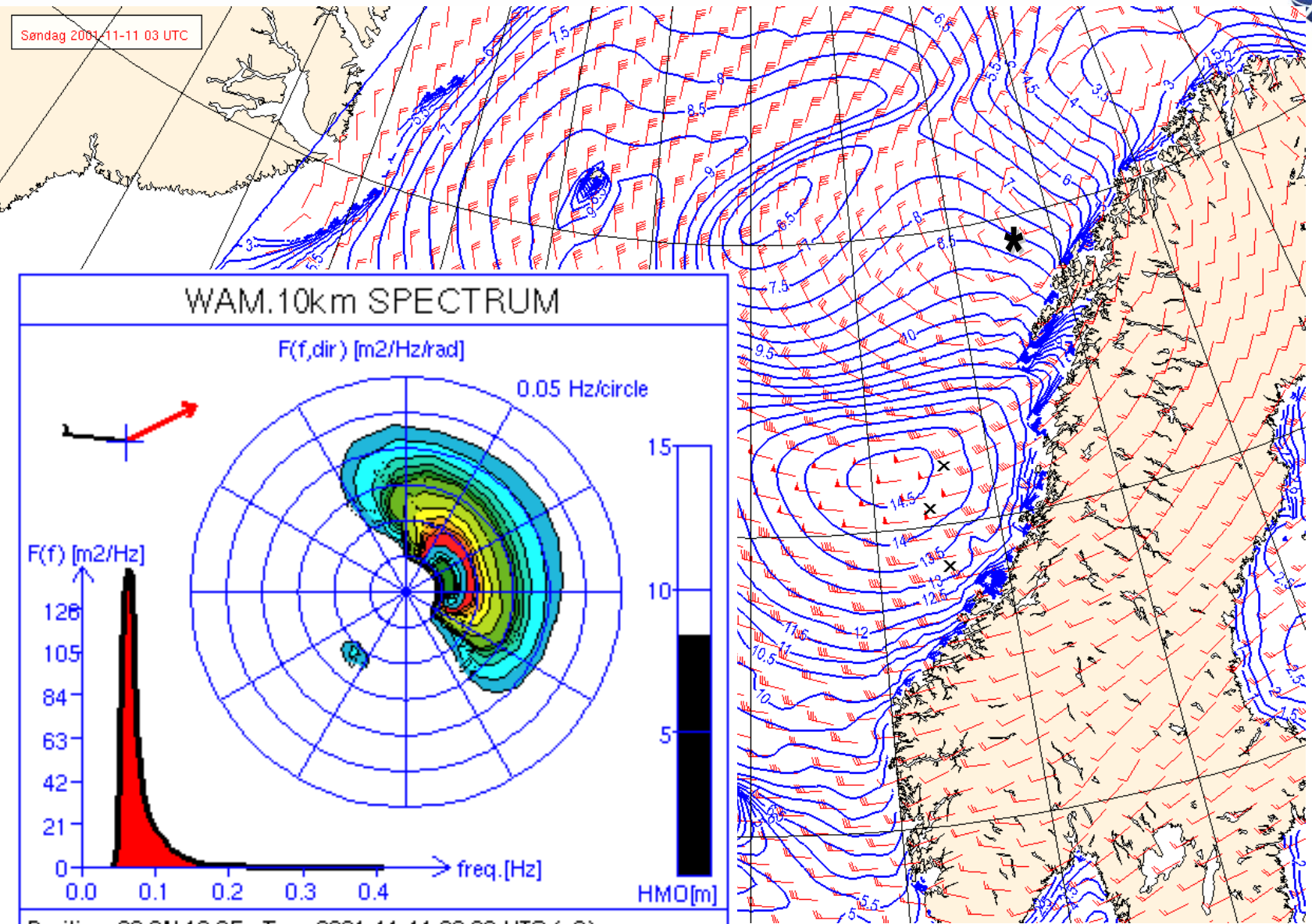

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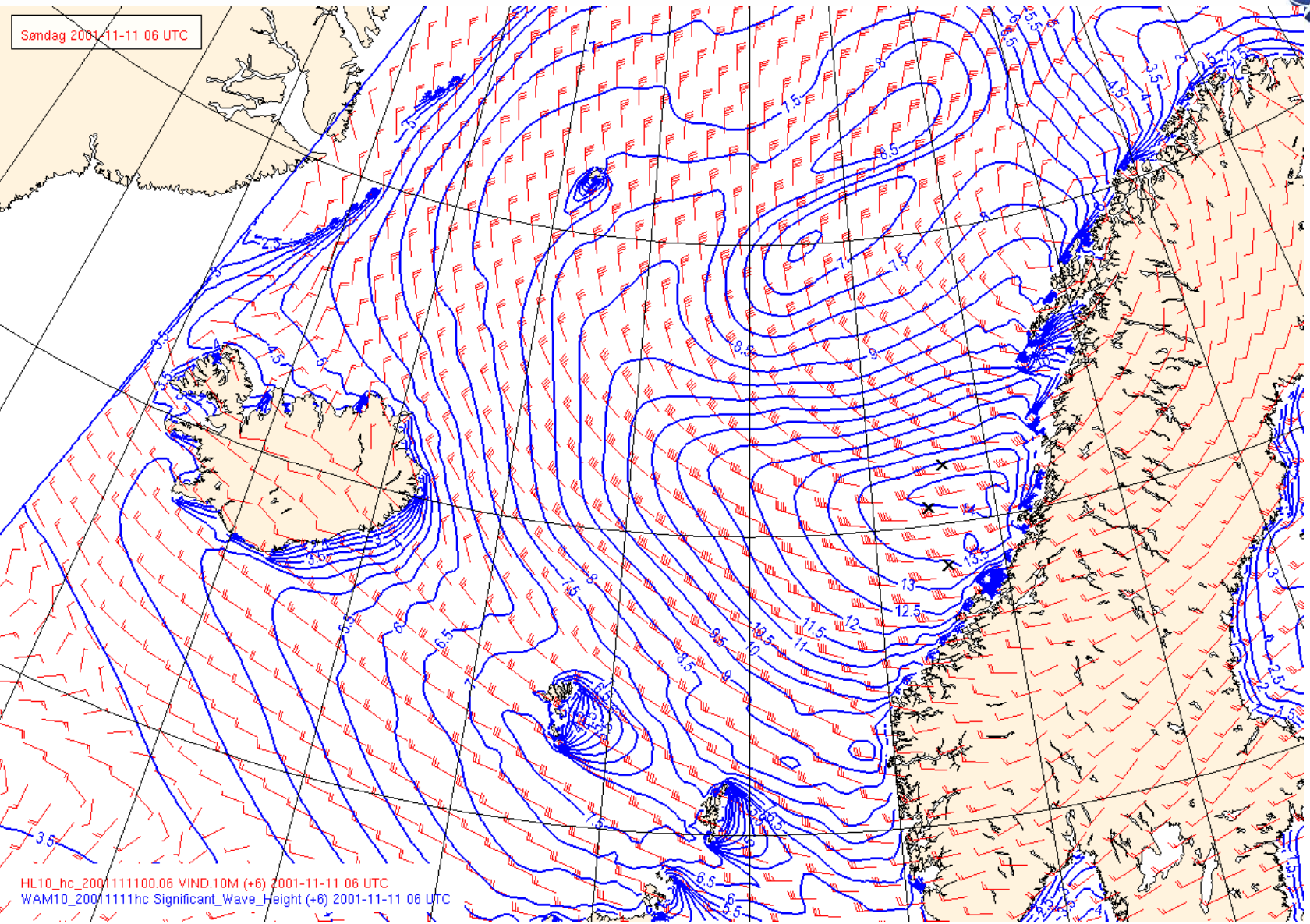

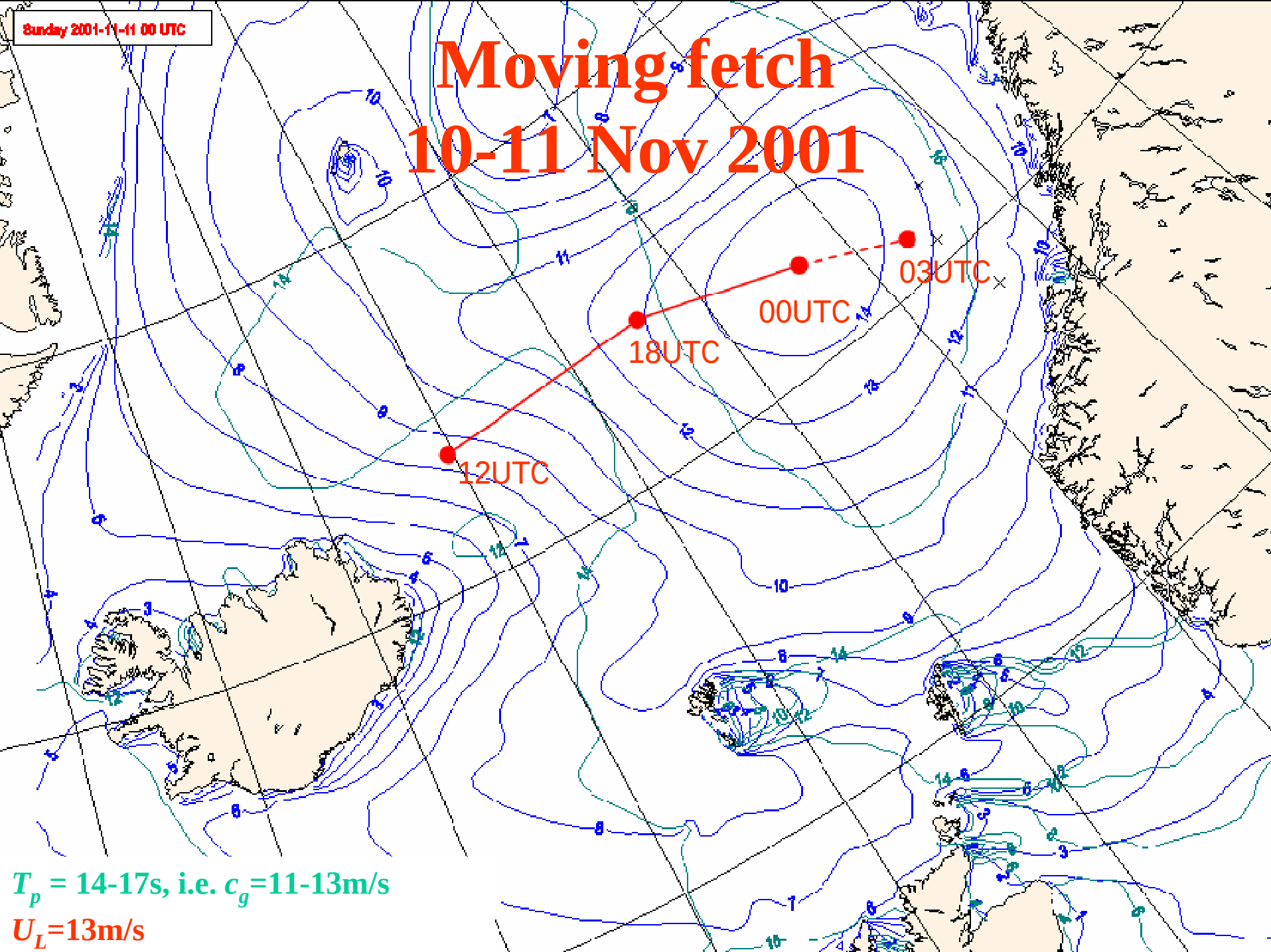
Sunday 2001-11-11 00 UTC
Moving fetch
10-11 Nov 2001
03UTC
00UTC
18UTC
12UTC
T_p = 14-17s, i.e. c_g=11-13m/s
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