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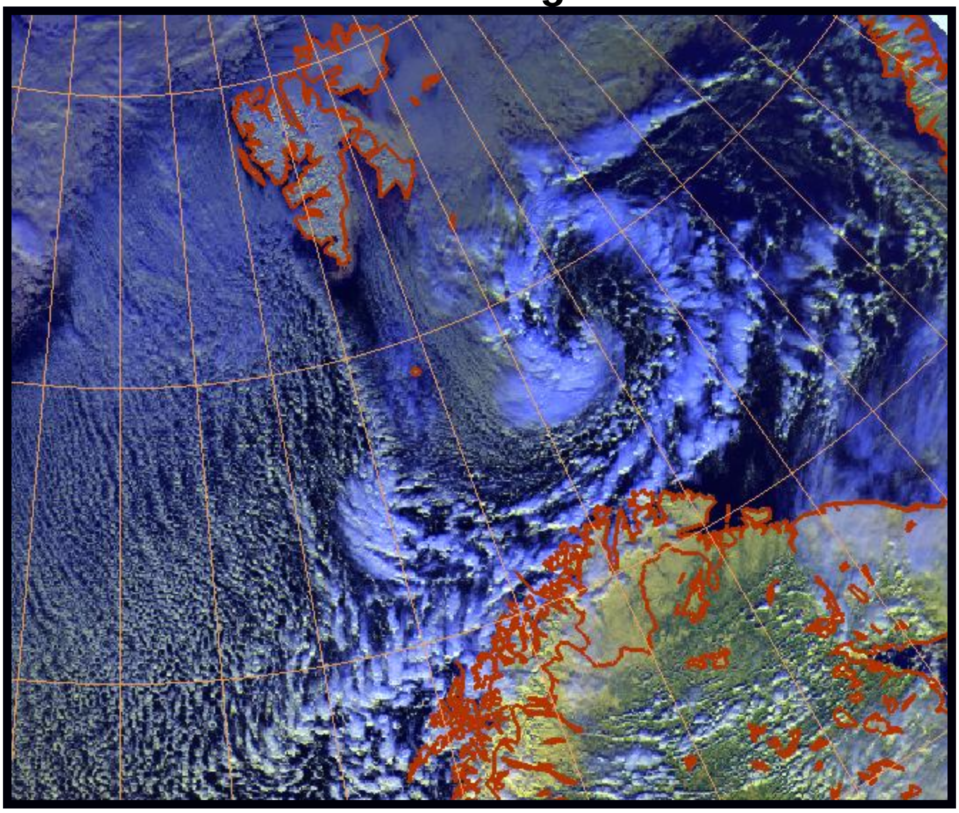
Validation of Weather Reports sent to Transocean Barents operated by NORECO at the EIK location in the Barents Sea (March-April 2012)

Anne-Mette Olsen
Gunnar Noer
Merete Øiestad
Anne Karin Magnusson



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Report

Title	Date
Validation of Weather Reports sent to Transocean Barents operated by NORECO at the EIK location in the Barents Sea (March-April 2012)	21st June 2012
Section 1: Meteorological division, Bergen 2: Meteorological division, Tromsø 3: R&D-section of Oceanography and Marine Meteorology	**Report no.** 12/2012
Author(s) Anne-Mette Olsen[1], Gunnar Noer[2], Merete Øiestad[1], Anne Karin Magnusson[3]	**Classification** Restricted **ISSN** 1503-8025
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Abstract

This report presents validation of forecasts sent by met.no, from Bergen and Tromsø, to Transocean Barents, a drilling rig operated by NORECO at the location EIK in the Barents Sea (N 72º51', E28º19'). An analysis of the Polar low forecasts and weather reports concludes with that except for the insufficiently forecasted polar low on the 5th (forecasted at 18m/s while it should have been 22 m/s), the route forecast of wind and precipitation was good throughout the period. The statistics of forecasts of wind speed, significant wave height and air temperature in the 'Offshore by met.no' reports compared to observations suffer from sparse observations and limited number of forecasts. From the data available we find that correlation for forecasts of wave height and air temperatures is better than for the wind. Not surprising for waves, since wave heights have slower response to large changes. Air temperature seems to be overestimated in the forecasts by 1 to 2 degrees. This may be due to too large influence from sea surface in the model predictions (at 2m level) used as basis for the forecasts. Compared to the average over the last 10 years of the daily means we can say temperatures during the operational period at Eik have been quite normal, at times 2 (up to 4) degrees cooler, at times 'normal', and at end warmer. We were told that the period of operation has been felt as more wintry than expected. This can be expected when weather situations give northerly air stream most of the time. The difference in temperatures compared to the last 10 years are though in the mean small. But this difference is in the range where there is little margin between having rain or snow….which presumably makes a lot of difference for operations.

Keywords

Wind, wave and temperature forecast validation. Polar Lows. 10 years daily mean from NORA10. NORECO. TransoceanBarents. EIK location, Barents Sea.

Disciplinary signature	Responsible signature
-- **Magnar Reistad** **Head of section for Oceanography and Marine meteorology**	-- **Karen Helen Doublet,** **Regional Director for western Norway**

Content

1 Introduction

Marine weather forecasts were sent for a period of approximately one month as support for operations related to drilling at the location EIK in the Barents Sea (N 72º51', E28º19'), see map Figure 1. The services included:

- Marine weather forecasts ('Offshore by met.no') for the Eik position including risk of vessel icing
- Sailing forecasts for the route Hammerfest- Eik, including risk of vessel icing
- forecasts for the helicopter routes Hammerfest-Eik and Mehamn-Eik
- warnings of Polar lows

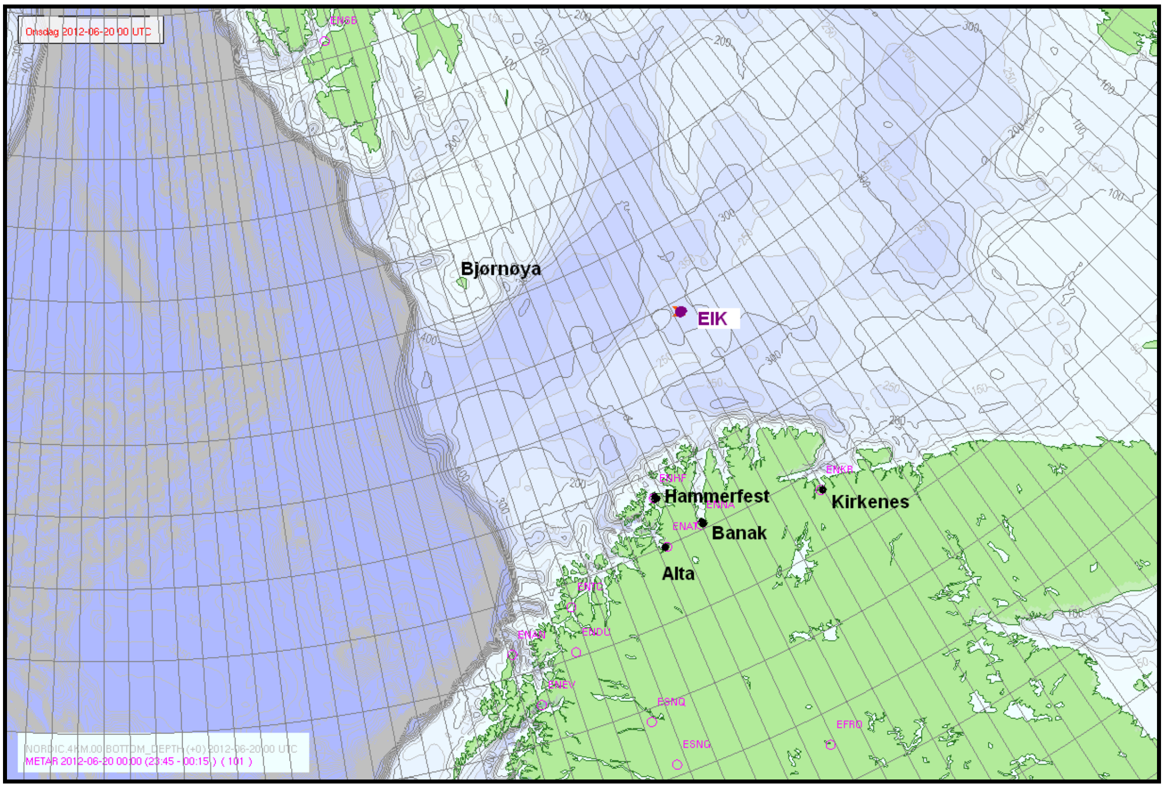

Figure 1 The Eik position in the Barents Sea (red cross) and location of nearby airports. Bottom topography as from the operational ocean forecasting model NORDIC 4km (at 4 km resolution).

We here present a validation of the forecast service performed. We were also asked to discuss if the weather was more wintry than à priori was expected, with reference to the statistical reports by Reistad and Hughes, 2011.

2 Typical weather conditions in period

In the period from the end of March to the end of April 2012, the weather situation was dominated by lows in the Barents Sea area. For a long time, the wind was coming from between northwest and northeast in the Eik area. These winds brought cold arctic air masses together with showers of snow or sleet, and in these situations polar lows can also develop. A typical situation is shown in Figure 2, where a synoptic low is situated over Novaya Zemlya.

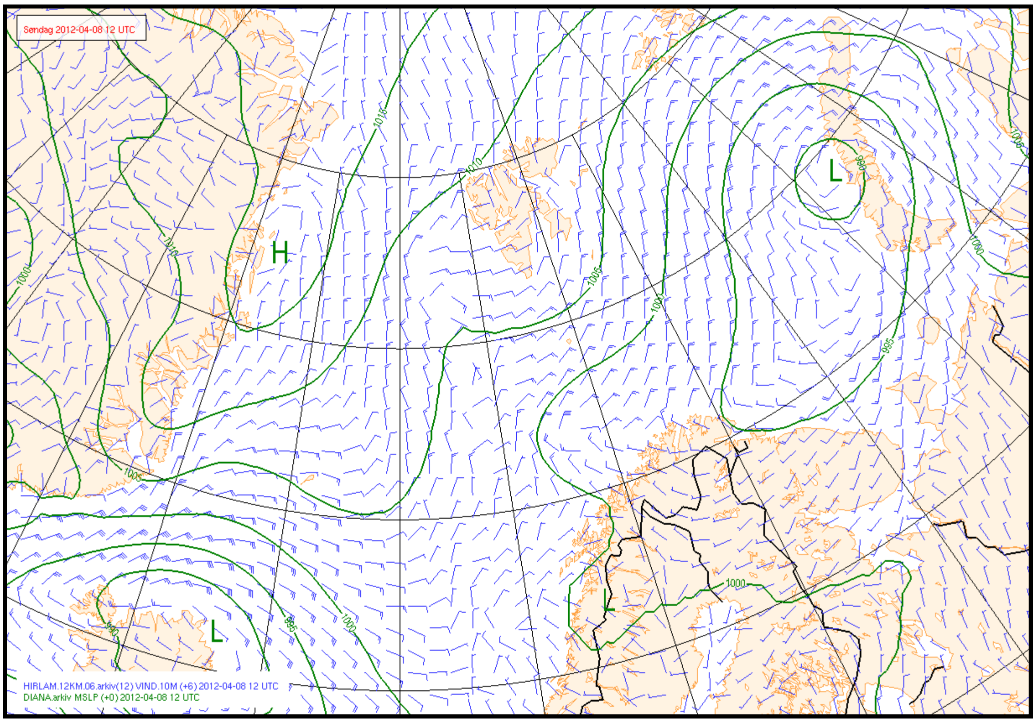

Figure 2 Winds from Hirlam8km and the analyzed mean sea level pressure at 8th of April 2012 at 12 UTC.

3 Forecasts vs observations from the Helideck Reports

3.1 Observations

Real time observations are only available from the wave sensor on board, a MIROS directional Doppler radar. Files with processed wave parameters have been transferred in real time from the rig to met.no approximately every 10 to 20 minutes since early 2011, in the file formats df037 and df038 (see www.miros.no for format description).

A number of other sensors provide real time measurements onboard but are not available for the forecasters in real time. Forecasting skill improves with availability in real time because in-situ measurements help making the best possible analysis of the weather situation. Before start of operations it was therefore agreed that the rig-personnel would fill and send copies of helideck reports at certain intervals during the day. They were sent by emails to met.no (Tromsø and Bergen) several times a day. Number of reports received varied, and interval in time could vary. An example of a helideck report is given in Figure 3 and 4. Wind speed, significant wave height and air temperature were digitized from these reports twice a day from reports received in the morning (4-5 UTC) and in the afternoon (16-17 UTC).

HELIDECK REPORT			
		Tel: 51206701	
		Fax: 74645501	
		Mob: 97034984	
From: TRANSOCEAN BARENTS	Position: N 72° 51' 03.283 , E 028° 18' 48.500	Email: radiooper.tbr@deepwater.com	
Flight Number: BHL061	Date: 04/26/12	Time UTC: 09:17:27	
Dynamic positioning: ☒Yes ☐No	Accurate monitoring equipment: ☒Yes ☐No		
WEATHER OBSERVATION			
Wind (Direction/Speed/Gust): 235° / 18 kts / - kts	Weather(Intensity/Description/Precipitation/Obscuration): light / - / rain / -		
Visibility: 20000 m	Clouds (few/sct/bcn/ovc in feet): 1500 ft FEW		
Temperature: 5 °C	QNH: 1011 hPa	Heading of helideck/vessel: 185° / 228°	
Other relevant weather info (fog banks, rapid changes, etc.):	METAR XTBR 260915Z 24019KT 9999 FEW015 05/01 Q1011=		
Sea spray observed over helideck: ☐Yes ☒No	Roll compensated helideck: ☐Yes ☒No		
HELIDECK MOVEMENT 20 MIN. INTERVAL			
MAX PITCH AND ROLL IN DEG. WITH REF. TO HORIZON		Max heave (top to bottom): 1.4 m	
Pitch max: 0.4° up	Pitch min: 0.4° down	Roll max: 0.1° port	Roll min: 2.2° port
		Heave period (if available): 42.8 s	
Max inclination: 2.3°		Max Avg. Heave Rate (if available): 0.1 m/s	
LOG INFO (If available)			
Fuel available: ☒Yes ☐No		Return load: 16 Passenger	
Helifuel amount: 6364 Litre		Total weight: 1745 kg	
NDB: 544 MHz		Luggage (incl. in total): 209 kg	
VHF: 129.650 MHz		Cargo (incl. in total): 0 kg	
Routing 1: HFT	2: TBR (AKB)	3: HFT	4:
Is Safety Video on Helicopter available and shown to passengers prior to this flight? ☒Yes ☐No			
Remarks: Rig preparing for transit approx. 1600 hrs local time. Elevation of helideck 130-140 ft above sea-level at time of arrival of heli (est 1345 local time).			
		Sign:	

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Figure 3 Example of Helideck report (page 1)

Vesselname: TRANSOCEAN BARENTS

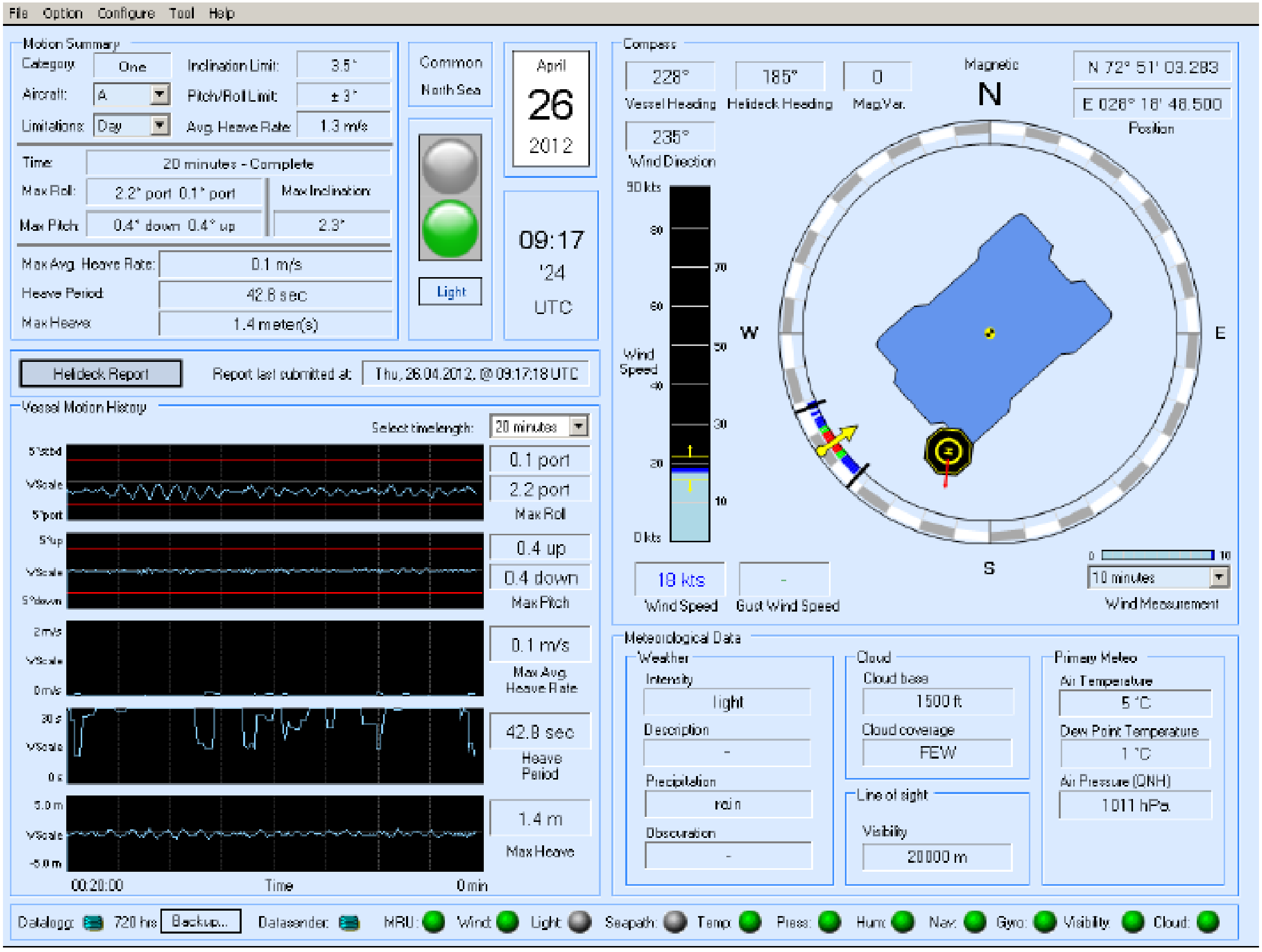

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Figure 4 Example of Helideck report (page 2)

3.2 Validation method

Forecasted values of wind speed (m/s), significant wave heights (m) and air temperature (°C) are plotted and analyzed in section 3.3.1 against measurements that were digitized from the Helideck reports. Only observations from morning and evening Helideck reports are used here. Only 'lead time' of 10-11 hours is used in section 3.3.1. 'Lead time' is number of hours ahead in time that the forecast is valid for. The observations from around 4-5 UTC every day are compared with the forecast issued the day before at 18 UTC, and the observations from around 16-17 UTC every day are compared with the forecast issued at 6 UTC the same day.

In section (3.3.2) observations are from data files sent in real time from the MIROS wave system onboard. Then a comparison is made for lead times of +12, +24, +48 and +72 hours. Some statistics are evaluated from this small database and presented shortly in tables following the figures. Some standard values are evaluated, as well as 'Hitrate' which here is:

Hitrate= (number of hits / total number of forecasts) * 100

A forecast is a hit if absolute error between forecast and observation is less than or equal to a given threshold. For wind speed this is 5m/s, for significant wave height: 0.5m, and for air temperature: 2 °C. The threshold for wind is unusually large, taking presumably into account the high variability when dealing only with two 10 minutes values per day. It is also uncertain if the wind speeds are averaged over 10 or 2 minutes, which is usual to report within aviation. The threshold for waves and air temperatures are more usual.

3.3 Results

3.3.1 Forecasts vs Helideck reports

Figure 5 shows time series and scatter plot of observations vs forecast of wind speed, significant wave height and air temperature. The time series of daily 10-year mean from 2002 to 2011 from the NORA10 hindcast database (Reistad et al, 2011 (a)) is also shown in the same plot. The daily 10-year means are evaluated from the 3 hourly data in a given day and averaged over data from the last 10 years.

There is relatively good agreement between observations and forecast of wind speed. However, for the three situations with wind speed around 20 m/s, the forecasts are about 5 m/s lower than what is observed at the given times of observation. It is not known whether the wind speed observed is for sensor level or reduced to 10m, which is the level forecasted for. If the observed value is at sensor height it is believed the observed value should be reduced by 2-3 m/s.

The 10-11 hours forecasts of significant wave height are in general in good agreement with observations, but a little bit lower than observed for the last of the three situations, on 13th of April, when the forecast is 3m while the observed value at that time is 4m.

Air temperatures seem to be overestimated in the forecasts by about 1.5 to 2 °C.

Some statistics for the time series of observations and forecasts of wind speed, significant wave height and air temperature is given in Table 1 and 2. Table 1 shows minimum, mean, maximum, standard deviation and number of samples in the two different time series of each parameter, while Table 2 shows different errors, correlation and Hitrates between the two time series.

Mean wind speed of the period from 29th of March to 25th of April 2012 was 9.4 m/s. This is only 0.4 m/s stronger than the daily mean wind speed of the 10-year period from 2002 to 2011. The mean wave height for the same period is 2.2 m, only 0.2 m lower than the 10-year mean. The air temperature on the other hand, is about 2 degrees lower in average than the 10-year daily mean from 2002 to 2011. The daily 10-year means in this period vary between -2 to +3 °C, while observations are mostly under these values, ranging from -4 to +1 °C, except at end of period, where observed temperatures are 2-3 degrees above the daily 10-year mean. That the period of operation is more wintry than expected may be true, but the difference is very small. But most important is that the difference is in the range where there is little margin between having rain or snow….which makes a lot of difference for operations.

The Hitrates are 81 % for wind speed and 74 % for significant wave height and air temperature. Since there are uncertainties in both observations (some time averaging is usual to do) and validation method, Hitrates of 74-81 % are relatively good. The correlations for waves and air temperature are relatively good (0.83 and 0.87), while less for wind. The maximum error is also 15.6 m/s for wind speed, which relates to an observation from 13th April 2012 in morning around 20m/s. This event was forecasted as a maximum of 15 m/s at 2 hours later.

Mean absolute error between forecasted and observed air temperature is 1.9 degrees. The forecasted value is given for a temperature 2 m above sea level and may be causing this large discrepancy (the observed value is certainly from a higher level).

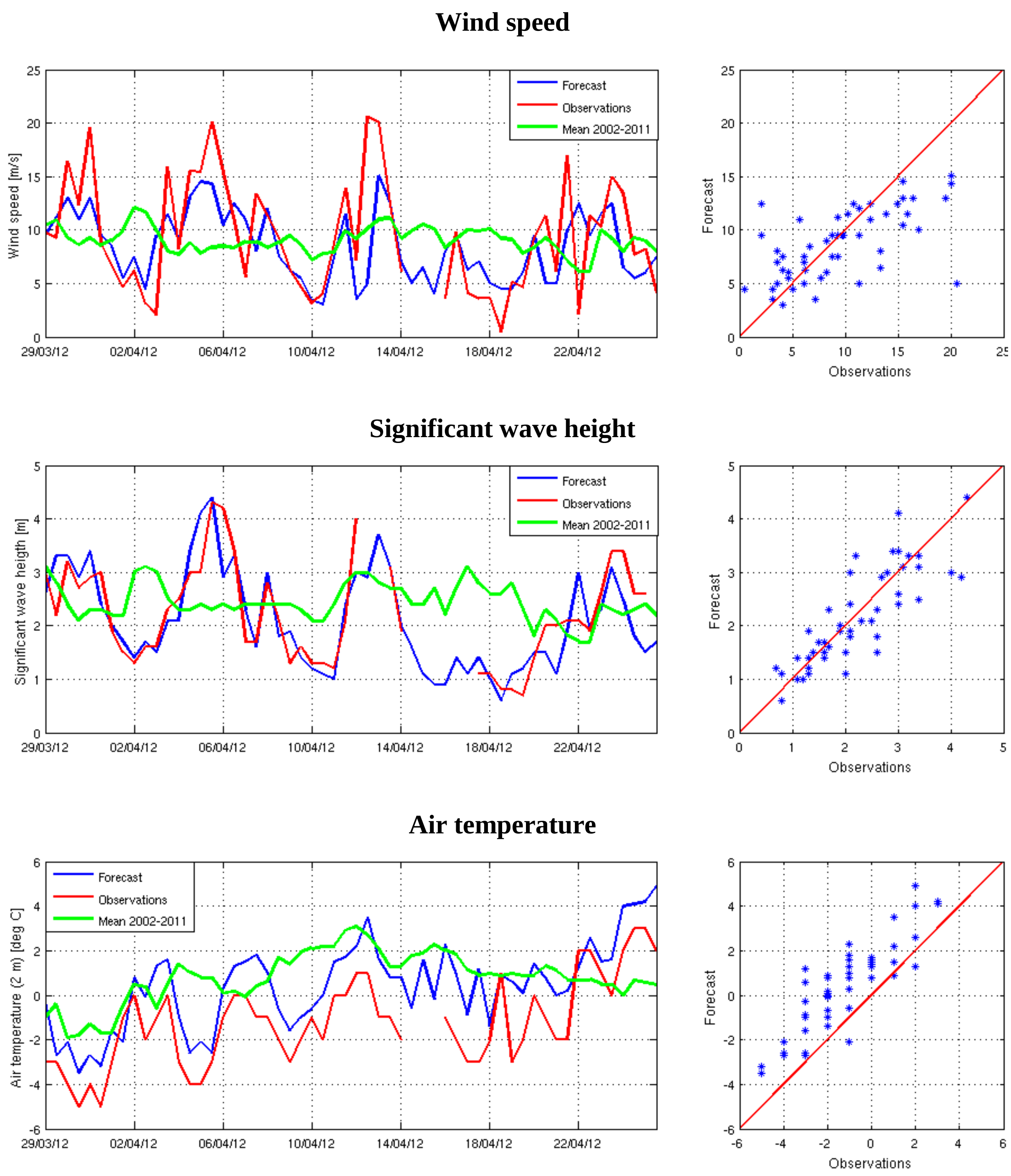

Figure 5 Time series and scatter plot of observations, forecast and daily 10-year mean (2002-2011) of wind speed (top), significant wave height (middle) and air temperature (bottom) from 29th of March to 25th of April 2012 at Eik.

Table 1: Statistics from the time series of observations and forecast of wind speed, significant wave height and air temperature. The statistical parameters shown are minimum, mean, maximum, standard deviation and the number of elements in each time series. The mean of the daily 10-year means of the period from 2002 to 2011 are also shown for comparison.

	Minimum	Mean	Maximum	Std	Number
Wind speed					
Observations	0.5	9.4	20.6	5.3	53
Forecast	3	8.5	15.1	3.3	56
Mean 2002-2011	-	9.0	-	-	56
Wave height					
Observations	0.7	2.2	4.3	0.9	47
Forecast	0.6	2.1	4.4	0.9	56
Mean 2002-2011	-	2.4	-	-	56
Air temperature					
Observations	-5	-1.2	3	2.0	53
Forecast	-3.5	0.4	4.9	1.9	56
Mean 2002-2011	-	0.8	-	-	56

Table 2: Hitrate, correlation, mean error, standard error, root-mean-square error, mean absolute error, and max absolute error between observations and forecast of wind speed, significant wave height and air temperature.

	Hitrate	Correlation	Mean Error	Std Error	RMSE	MAE	Max abs error
Wind speed	81.13	0.63	0.74	4.04	4.11	2.93	15.60
Wave height	74.47	0.83	0.06	0.52	0.52	0.39	1.30
Air temp.	73.58	0.87	-1.63	0.98	1.90	1.70	4.20

3.3.2 Forecast vs observations from the MIROS Wave radar

Figure 6 shows time series and scatter plot of observations from the wave radar vs forecast of significant wave height for different lead times; +12, +24, +48 and + 72 hours. The time series plot show only values used in the scatter plot, and only forecasts issued at 6 and 18 UTC are included, since the forecast at 0, 12 were issued just for a short while. There are more wave observations here than in the previous section, because wave heights were missing in some Helideck reports.

There are two situations with observed significant wave height above 4 meters. The first one was at 5th of April and the second one at 12th of April 2012. In the first case wave heights were underestimated 2 and 3 days before, then well captured at lead times +12 and +24 hours. In the second case significant wave height was well predicted 2 and 3 days ahead (lead times +48 and +72 hours), but underestimating 1 day before. The forecast was correct again at lead time +12 hours. On 23rd April significant wave height were forecasted to increase to 4 meter at a lead time of +72 hours, while the observed became 3.3m. As observation time approaches, forecasted max value is correct at lead time +48 hours, is underestimated at +24hours, then approaches correct value again at +12 hours.

Table 3 and 4 show some statistics for the time series of observations and forecasts of significant wave height for different lead times. Table 3 shows minimum, mean, maximum, standard deviation and number of elements in the different time series, while Table 4 shows different errors, correlation and Hitrates between the observations and forecasts.

The Hitrate between the observations and forecast are 81 %, 76 %, 61 % and 53 % for the lead times 12, 24, 48 and 72 hours respectively. As the lead time increases, the Hitrates and correlations decrease, and the errors between the observations and forecast increase, as expected. Results are highly influenced by the poor forecast on the 5th of April (at lead times +48 and +72 hours).

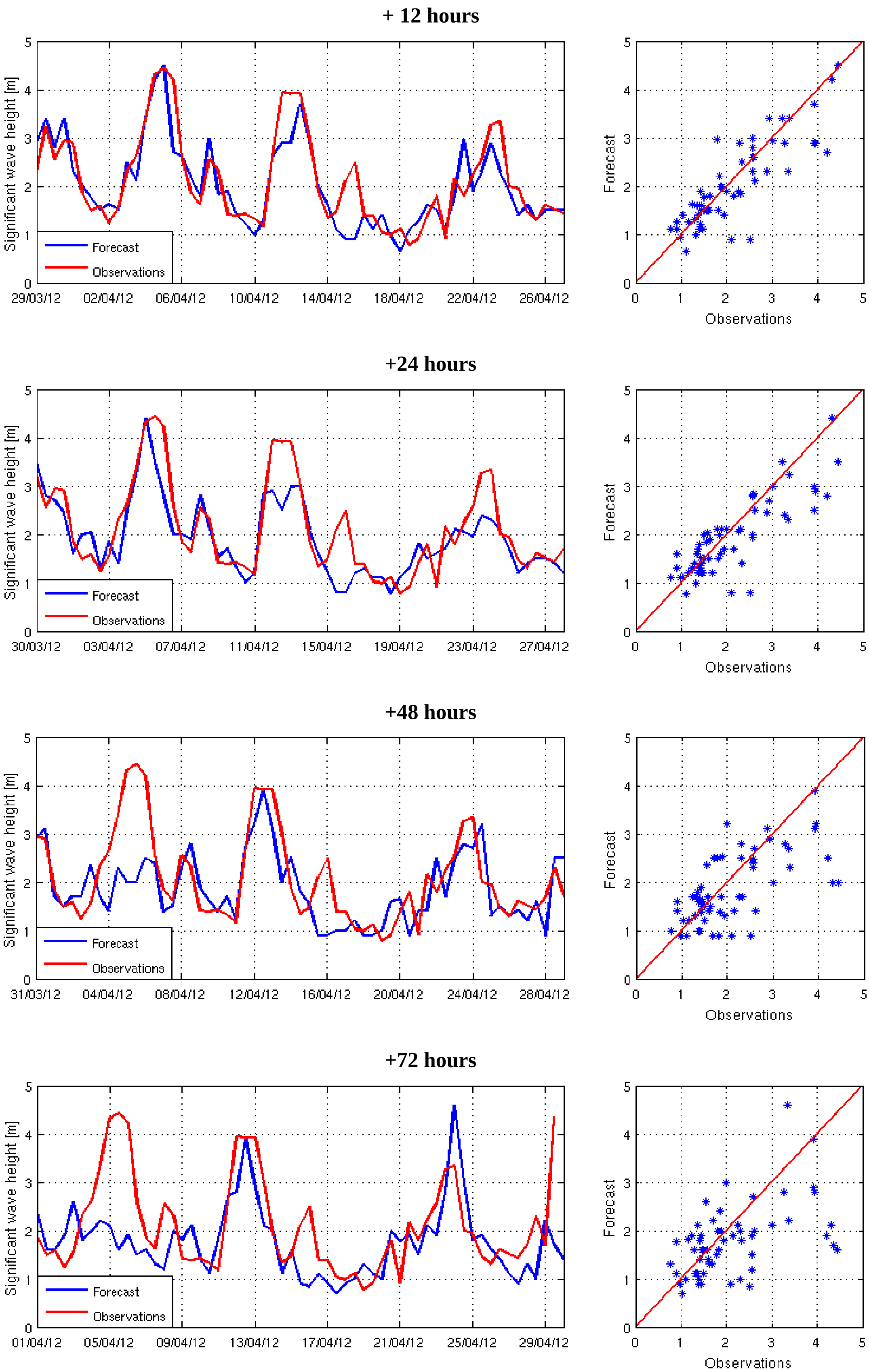

Figure 6 Time series and scatter plot of significant wave height from observations from the wave radar and forecasts issued between 29th of March and 27th of April 2012 at Eik for lead times +12, +24, +48 and + 72 hours.

Table 3: Statistics from the time series of significant wave height from observations from the MIROS wave radar and forecasts issued between 29th of March and 27th of April 2012. The statistical parameters shown are minimum, mean, maximum, standard deviation and the number of elements in each time series.

	Minimum [m]	Mean [m]	Maximum [m]	Std [m]	Number
Observations	0.8	2.1	4.4	0.9	59
Forecast +12	0.6	2.0	4.5	0.9	59
Forecast +24	0.8	1.9	4.4	0.8	59
Forecast +48	0.9	1.9	3.9	0.7	59
Forecast +72	0.7	1.8	4.6	0.7	59

Table 4: Hitrate, correlation, mean error, standard error, root-mean-square error, mean absolute error, and max absolute error between observations from the MIROS wave radar significant wave height and forecast issued between 29th of March and 27th of April 2012.

Leadtime	Hitrate	Correlation	Mean [m] error	Std error [m]	RMSE [m]	MAE [m]	Maxabserror [m]
+12	81.36	0.84	0.10	0.50	0.51	0.36	1.60
+24	76.27	0.83	0.19	0.53	0.56	0.40	1.70
+48	61.01	0.65	0.22	0..72	0.75	0.54	2.45
+72	53.45	0.52	0.32	0.86	0.92	0.66	2.84

4 Weather types and forecasts of polar lows at Eik

4.1 Introduction

Observations from the Transocean Barents Rig are considered against the polar low probability forecast and the route forecast as issued by the Norwegian Meteorological Institute in Tromsø. Stored model fields, synoptic observations and NOAA AVHRR images are used for further case descriptions.

The wind conditions at the Eik location in the period from 29th of March 2012 till 25th of April can be coupled to a series of distinct weather patterns. Six wind maxima stands out, the first two were associated with convective weather, the strongest being a polar low on the 5th of April that gave 22 m/s winds (max recorded) at the Transocean Barents rig. A short description is given below.

Reference to the various events is given in Figure 7 which shows a time series of observations of wind speed from 29th of March to 25th of April 2012. An overview of the situation, observations, route forecast and polar low probability for all six events are shown in Table 5.

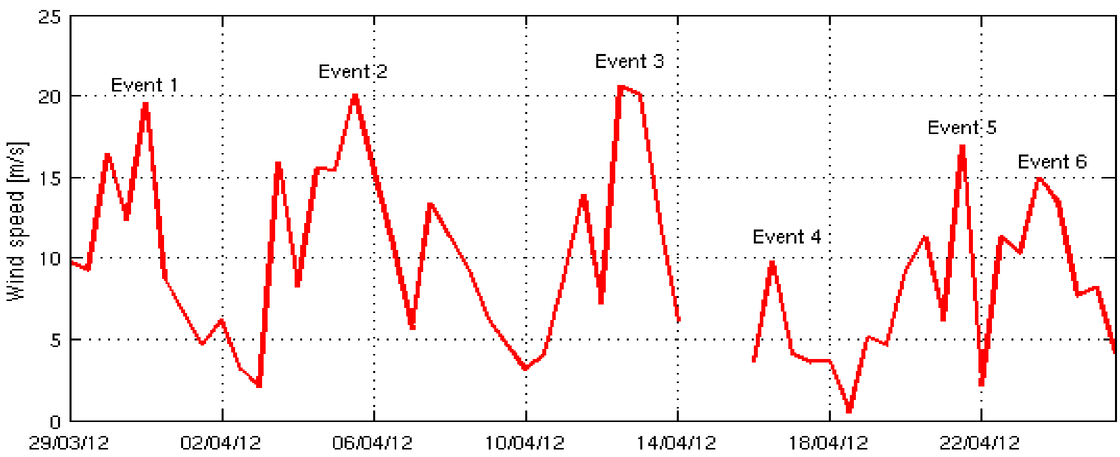

Figure 7 Time series of observed wind speed from the Helideck reports from 29th of March to 25th of April 2012 (same data as used in section 3, observations from 4-5 UTC and 16-17 UTC). Six different wind events are localized.

Table 5 The six wind events, including the polar low on the 5th of April, at Eik within the period 29th of March to 25th of April 2012, comparing observations, route forecast and polar low probability forecast.

Event	Date	Situation	Observation [m/s]	Route forecast [m/s]	Polar low probability
1	29-31.3	Cold air outbreak	N 15	N 10-13	Moderate to high
2	4-10.4	Convective airmass	8-15	10-15	Moderate
2	5.4	Polar Low	W 22	W-NW 7-18	Moderate
3	13.4	Synoptic low	NE 10	N-NE 13-18	Low/Moderate
4	16.4	Trough	SW 10	SW 5-13	Moderate
5	21.4	Meso circulation	NE 17	NE-E 7-10	Low/Very Low
6	22-25.4	SE/synoptic	E-SE 15	E 7-18	Low/Very Low

4.2 Event 1: 29th to 31st of March:

Three days of northerly winds of around 13 m/s, to the west of a stationary low in the eastern Barents Sea, gave a cold air outbreak and an increasingly convective air mass. On the 31st a series of minor troughs developed. Polar low probability was forecast initially to low or medium, at the 31st it was forecast to high.

4.3 Event 2: 4th of April to the 10th of April:

On the 3rd of April, a synoptic (large scale) low developed in the area between Bear Island and the Eik area, and remained here until the 5th of April (see Figure 8). This low was highly convective, with an unstable air mass to the west and south of the center. The Transocean Barents, being immediately to the south, was exposed to southwesterly to northwesterly winds of 15-18 m/s, with frequent troughs and dense snow showers. At Hammerfest, 400km to the southwest, the wind was less strong at 8-10 m/s, but the airport was hit by several snow showers with visibility reported down to 500 m.

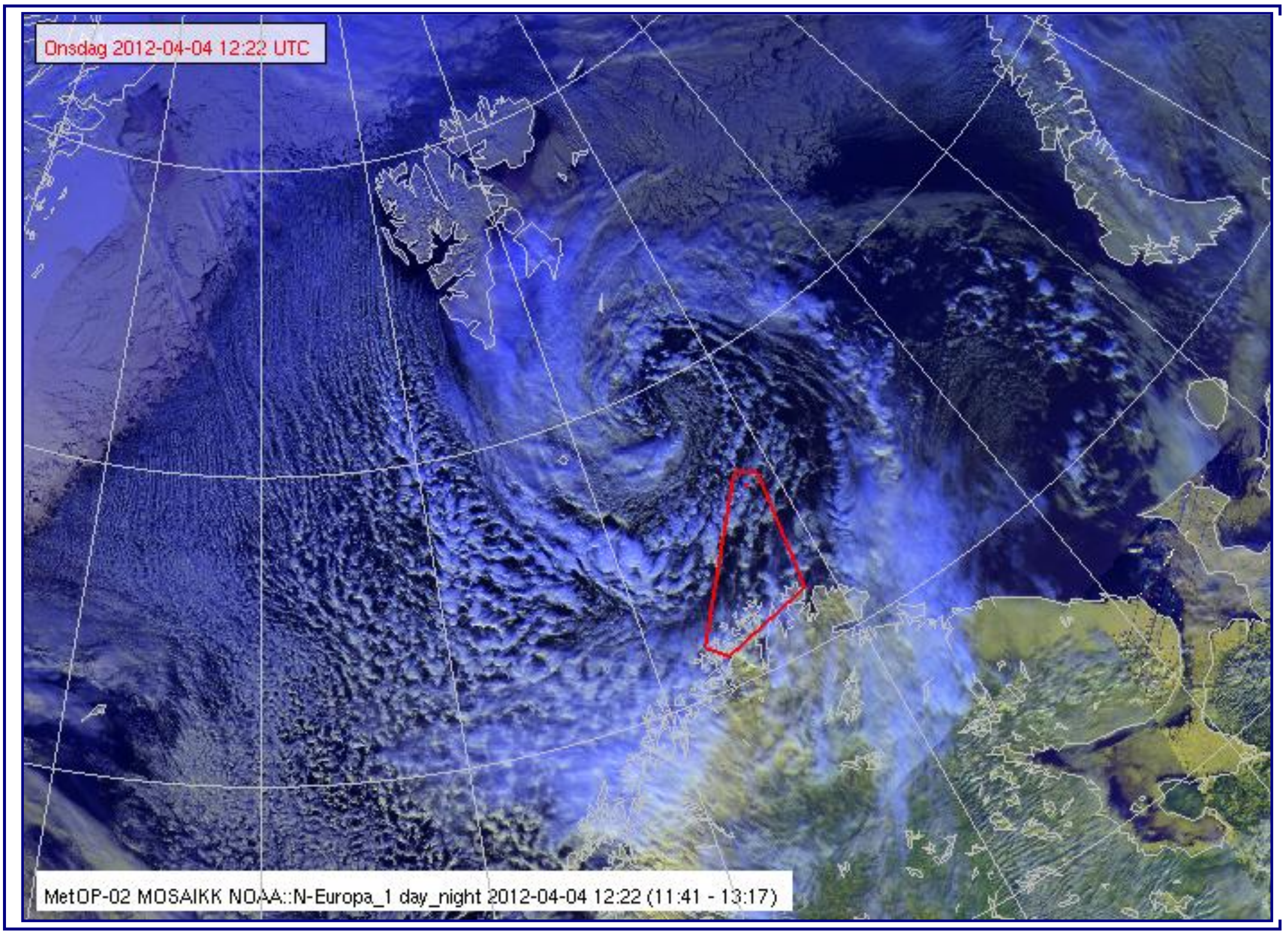

Figure 8 A synoptic low east of Bear Island on the 4th of April 2012. Cold, unstable air is advected southeastwards west and south of the center, and showers are moving towards the Eik area, marking the start of a 5 day period of wintry weather. The limits of the forecasting area are shown by the red line. Image: NOAA/met.no

On the 5th of April the center of the low intensified into a polar low, but remained almost stationary at approximately 73°30'N 27°30'E (see Figure 9). During this period, the wind peaked at the Transocean Barents at a west or southwest 22 m/s as the polar low passed immediately north of the rig. At noon on the 6th of April the low then moved southwards, slightly to the west of the Eik location, before it made landfall at the Honningsvåg area at around 21 UTC on the 6th of April. At Hammerfest, the wind was at most a westerly 11 m/s and gust of 19 m/s with showers and 300 m visibility 21 UTC on the evening of the 6th of April. Several lesser vortexes remained in the area, with gusty winds and dense snow showers dominating the weather on the 7th and the 8th of April. On the 9th of April a low center further west produced a trough with intense snow showers on the route between Hammerfest and the Eik area, but it did not affect the Eik area itself. The whole event ended on the 10th of April, with the change to a southeasterly to northeasterly flow and a more stable air mass.

This sequence of events is typical for a prolonged cold air outbreak in the Nordic Seas. The weather is dominated by dense and frequent snow showers, troughs, gusty winds, and at some point one or several polar lows. The weather at large is typical for a situation where a moderate probability of polar lows is forecast, i.e. .where both the low level cold air outbreak and the upper cold trough are present.

The polar low from the 5th and 6th of April was throughout the event classified as a synoptic low, since this was seen as the original state of the low (personal communication with duty forecaster), and also since this was how it appeared in the model prognosis. The triggering conditions according to established methodology were present to justify moderate probability of a polar low, and it was thus kept at this level. This was clearly an error on part of the forecaster, who did not correctly identify the polar low when it formed. If the polar low had been identified correctly, the probability should have been forecast to 'High'.

This error in classification is common in the case of synoptic lows developing into polar lows. The transition from one state to the other is not well known, as it falls outside the 'classical' pattern of development associated with polar lows, i.e. a formation in a cold air outbreak on the western side of the main synoptic lows. Historically, the shear size and the presence of fronts and shifting air masses have been seen as the defining characteristics of the common synoptic low. The transition from this into a more convective low and then further into a polar low is often a gradual and complex process, and the differentiation of one from the other is often difficult and subjective. For these reasons, forecasters are often reluctant or too slow to identify a polar low with this formation pattern.

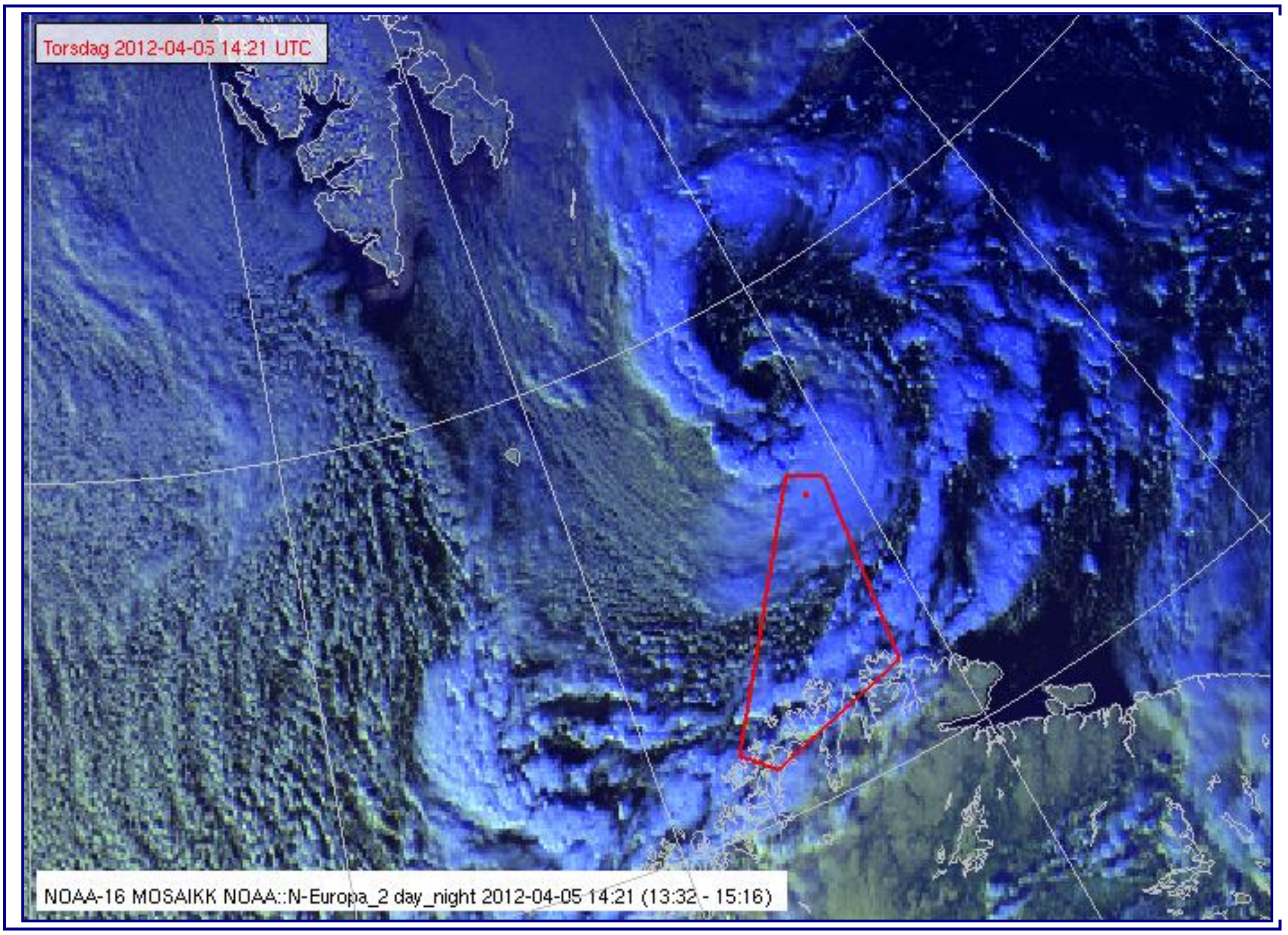

Figure 9 A polar low passing immediately north of the Eik field on the 5th of April 2012. Several other troughs and showers are seen in the area, typical of highly convective Arctic winter weather. Image: NOAA/met.no

4.4 Event 3: 13th of April:

A synoptic low passing eastwards along the coast of Finnmark into the Barents Sea, gave a brief period of northeasterly gale force winds at the Eik location, and periods of snow showers. The instability in this event was enough to justify a moderate probability for polar lows, but none materialized.

4.5 Event 4: 16th of April

A moderately cold upper core passed an area of otherwise calm air, resulting in one single moderately strong trough passage through the area. The winds at Transocean Barents briefly peaked at 8-13 m/s. Polar low probability was set at moderate.

4.6 Event 5: 21st of April:

A mesoscale circulation (similar to a polar low, but less deep and convective) passing north of a frontal zone gave briefly northeast 18 m/s at the location (see Figure 10). The event was not forecasted by the forecaster on the route forecast (11 m/s). Conditions dictated a low probability of polar lows.

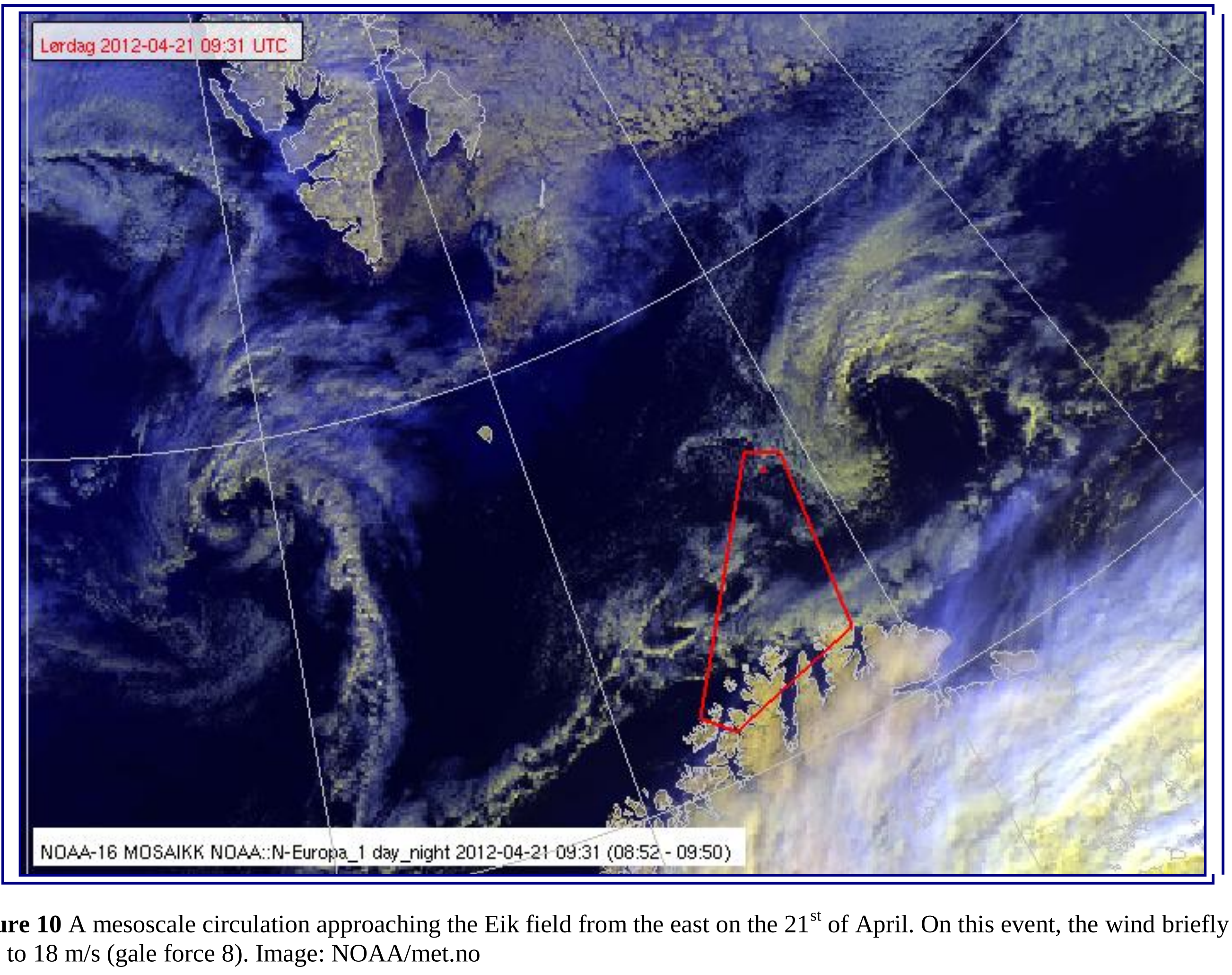

Figure 10 A mesoscale circulation approaching the Eik field from the east on the 21st of April. On this event, the wind briefly rose to 18 m/s (gale force 8). Image: NOAA/met.no

4.7 Event 6: 22-25th:

A stationary high over the Novaya Zemlya area gave a prolonged period of easterly winds, with maximum east or southeast 15 m/s on the 23rd of April. This weather pattern gave a stable air mass, and a low probability of polar lows.

4.8 Day by day forecasts

The day by day summary shows that standard methodology has been followed.

Table 6 Day by day summary of the period 29th of March to 21st of April, with an assessment based on stored data files and observations.

Date	Wind(kt)	WX	Forecast probability of polar lows	Assessment of probability of polar lows
29.3	N25	Snow showers	-	
30.3	N25	Snow showers/TCu	L/M	
31.3	N25	Snow showers/trough	M/H	
1.4		Snow showers/trough	-	
2.4	Variable 05	Scattered snow showers/occational Cb	M	M
3.4	Variable 10, becoming W/30	Scattered snow showers/occational Cb	M	M/H
4.4	SW-NW30	Snow showers/troughs	M	M/H
5.4	W41	PL	M	H
6.4	W42	PL/synoptic low	M	H
7.4	NE/20-35	PL later stages	M	H
8.4	20-25		M	M
9.4	N-NE/15-25	Scattered snow showers, but trough enroute	M	M
10-4	NE/10	Scattered snow showers, becoming clear	M/L	M/L
11.4	NE/15-20	Light rain, frontal,	VL	VL
12.4	NE30-40	Frontal	VL	VL
13.4	N-NE/30-40	Convective/synoptic low	M	M
14.4	Calm		L	L
15.4	Calm		L	L
16.4	S-W-N/15-25	Trough	M	M (briefly)
17-20.4	Calm	Convective airmass	L/M	L/M
21.4	E/34	Meso circulation	L	L

5 Conclusions

The first part of the period from 29th of March to 9th of April was dominated by a highly convective air mass, with frequent and dense snow showers and gusty wind throughout the forecast area. The weather was at its most intense on the 5th of April, when a polar low hit the Transocean Barents rig. This low was not fully forecasted either by models or by the forecaster.

From the 10th of April, the weather was dominated by a more stable air mass, with periods of calm winds in between isolated events associated with synoptic scale lows or highs.

Except for the insufficiently forecasted polar low on the 5th (forecasted in the route forecast at 18 m/s while it should have been 22 m/s), the forecast of wind and precipitation was good throughout the period.

Validation of forecasted wind at lead time 10-11 hours from the site forecasts ('Offshore by met.no') shows some large discrepancies at the three cases with speed around 20 m/s, but the height of wind sensor and time averaging may cause this discrepancy. Statistics also suffer from sparse observations and limited number of forecasts. From the data available we find that correlation of forecasts of significant wave height and air temperatures are better than for the wind. Not surprising for waves, since wave heights have slower response to large changes.

Air temperature seems to be overestimated in the forecasts by 1 to 2 degrees. This may be caused by the fact that the model value used as basis to the forecast is from the 2m level in the atmospheric model. This value is expected to be more influenced by sea temperature that the one observed (presumed measured at a higher level above mean sea level).

Compared to the average over the last 10 years we can say temperatures during the operational period considered at Eik have been quite normal, at times 2 degrees cooler, at times 'normal', and at end warmer.

We were told that the period of operation has been felt as more wintry than expected. The dominating wind direction was northerly, so weather was wintry most of the time. The differences in air temperature compared to the last 10 years are seen to be in the mean very small. But this difference is in the range where there is little margin between having rain or snow….which makes probably a lot of difference for operations.

6 References

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