West storm moving east → south of Iceland and a case where forecasts and observations seem contradictory

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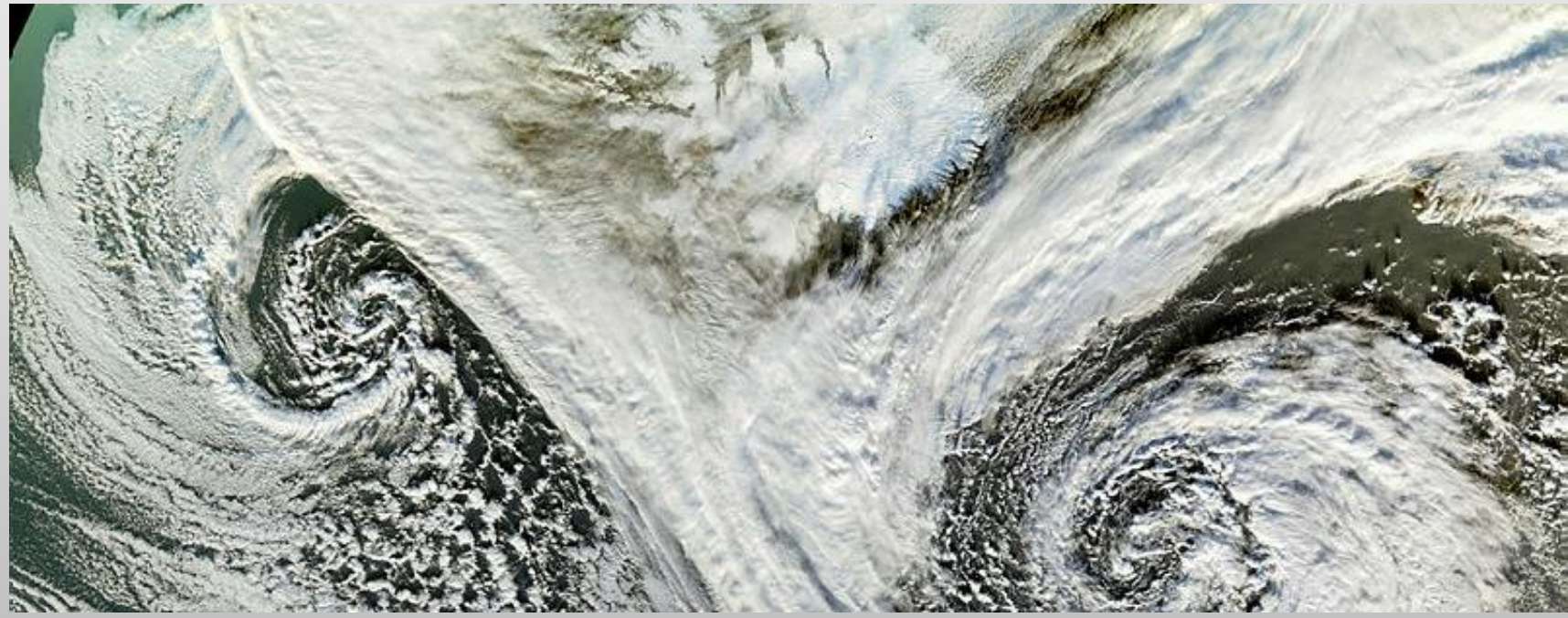
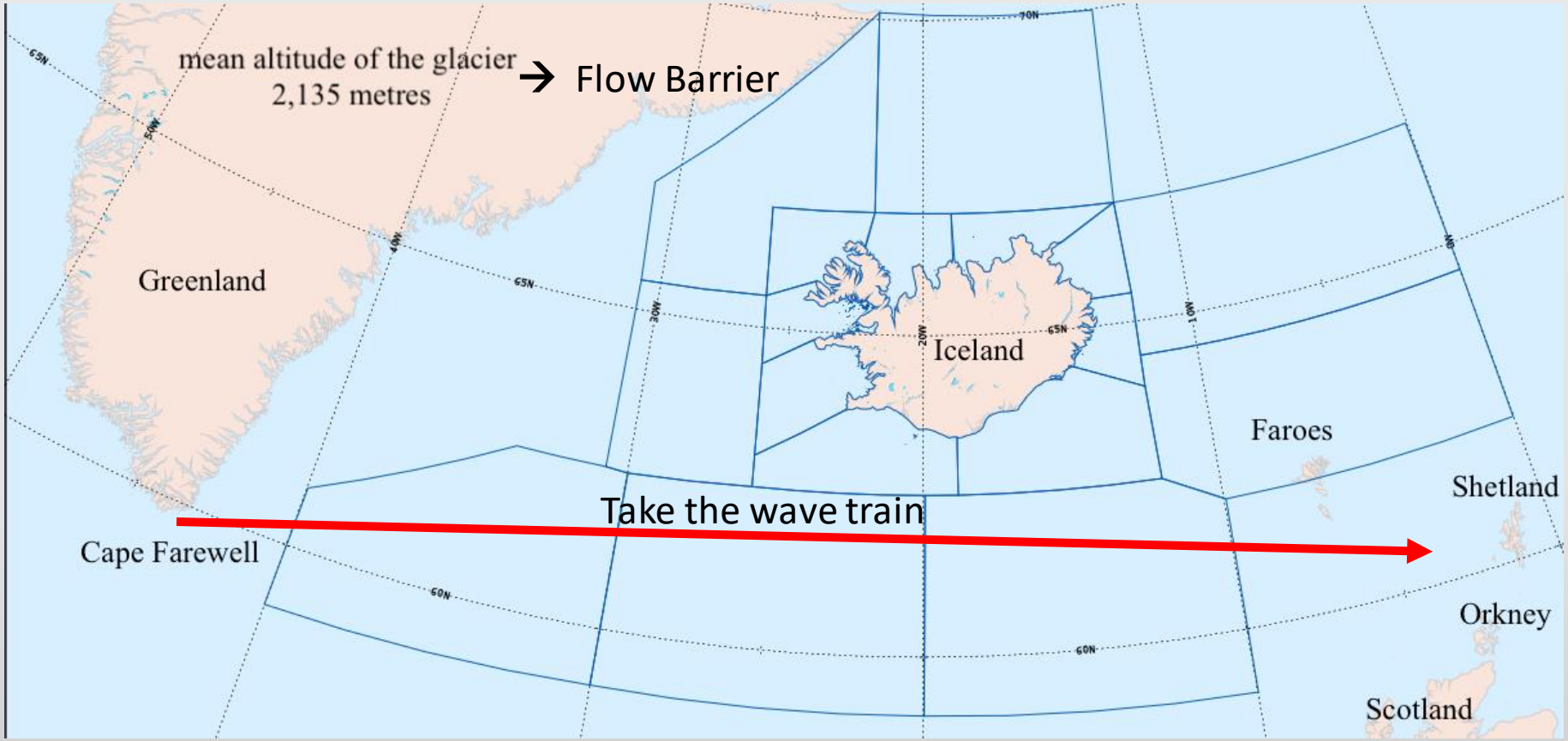
Instructor - Maritime Meteorology

School of Navigation

(20 years this semester!)



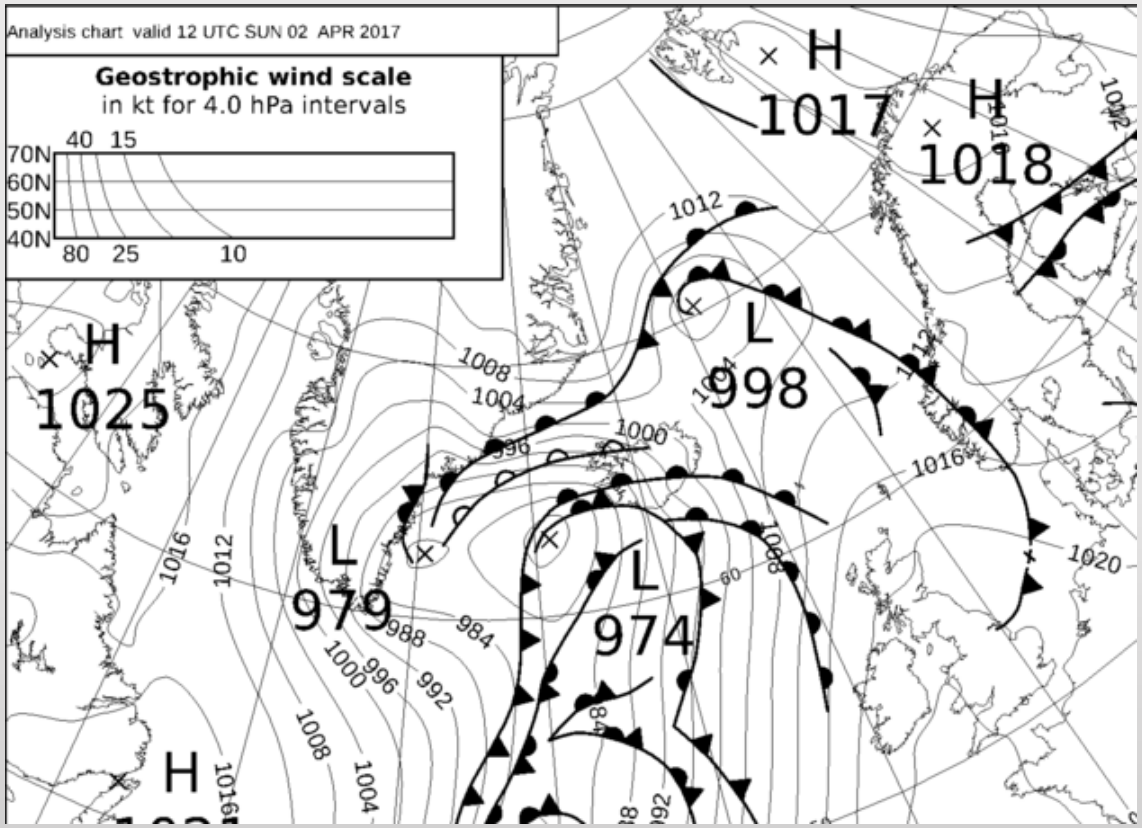
Case 1 West storm

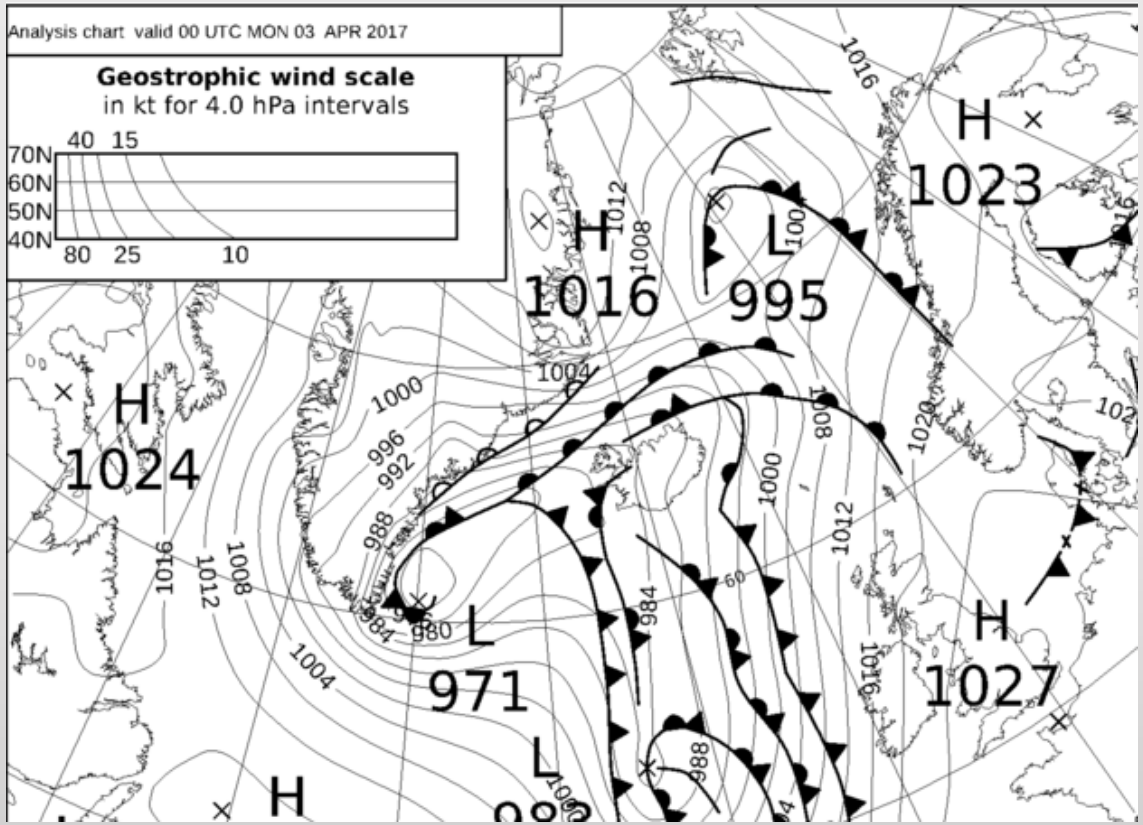


Between April 2. and April 4. 2017 gale to storm force winds from the west propagated from Cape Farewell, the southernmost point of Greenland over 1000 nautical miles across the Atlantic towards and past the Faroes Islands with high waves.

West storm Sunday afternoon 2. April 2017 (12Z + 00Z)

Veðurstofa Íslands



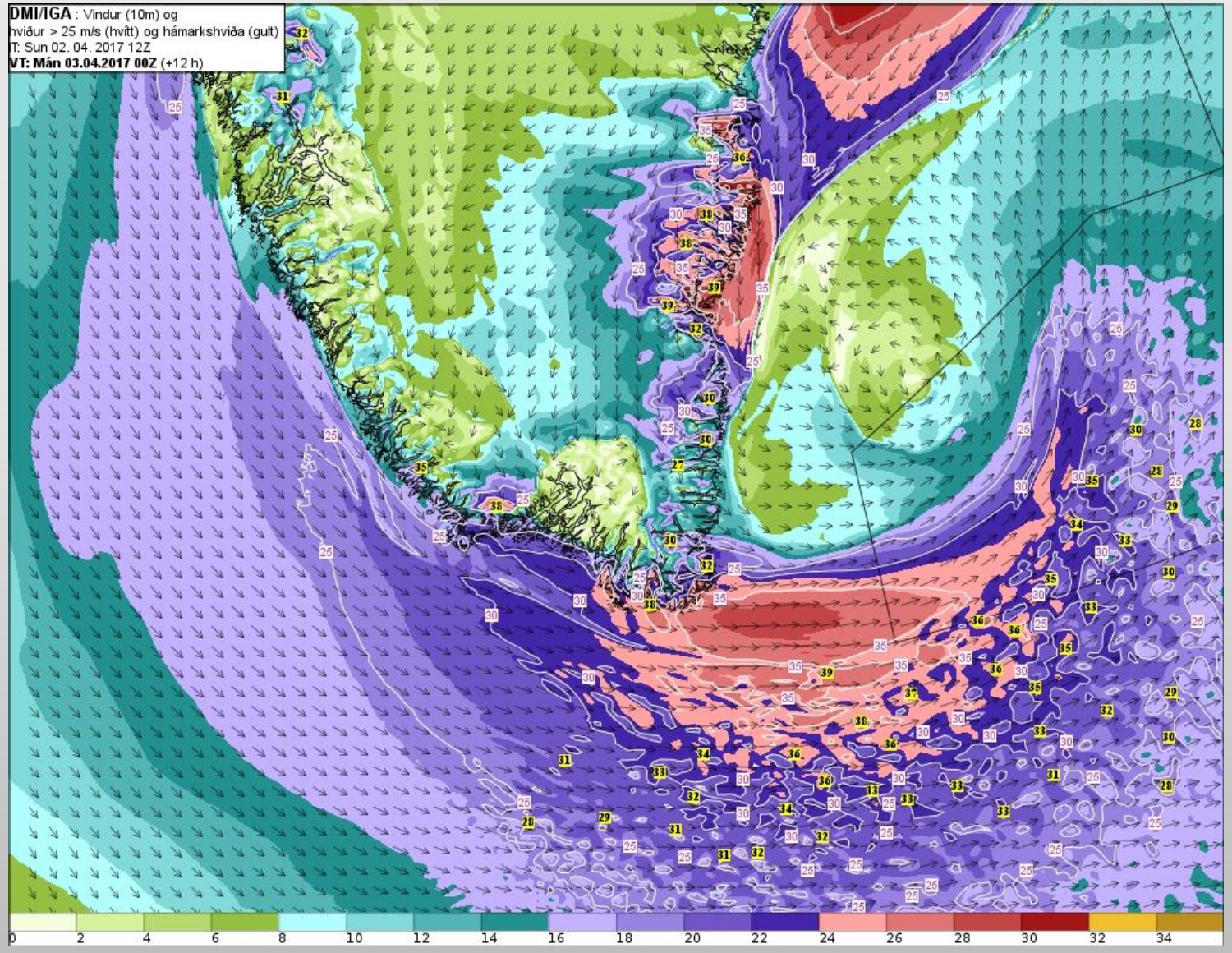


Greenland is a high continuous mountain/glacier barrier

Lee side of Greenland (here east of) changes the synoptic flow

The westerly Greenland tip jet - Cape Farewell

DMI/IGA +12T forecast at 00Z 03.04.2017. HARMONIE model at DMI, 2.5 km resolution.
10 m wind (m/s) White lines + white and yellow numbers are wind gusts above 25 m/s.



The westerly and easterly Greenland tip jets

Mesoscale features forced by synoptic cyclones;

In a westerly tip jet there is a cyclone over the Irminger sea (East of south Greenland)

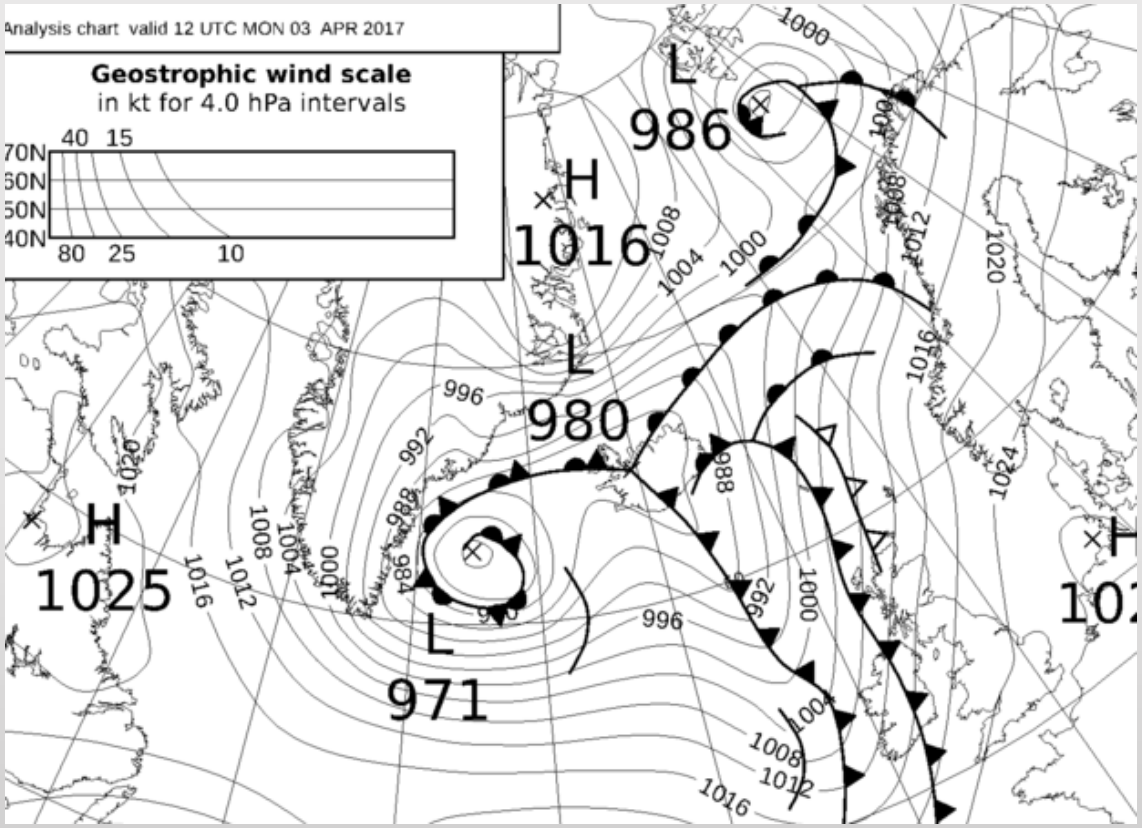
In a easterly tip jet there is a cyclone to the south of Greenland.

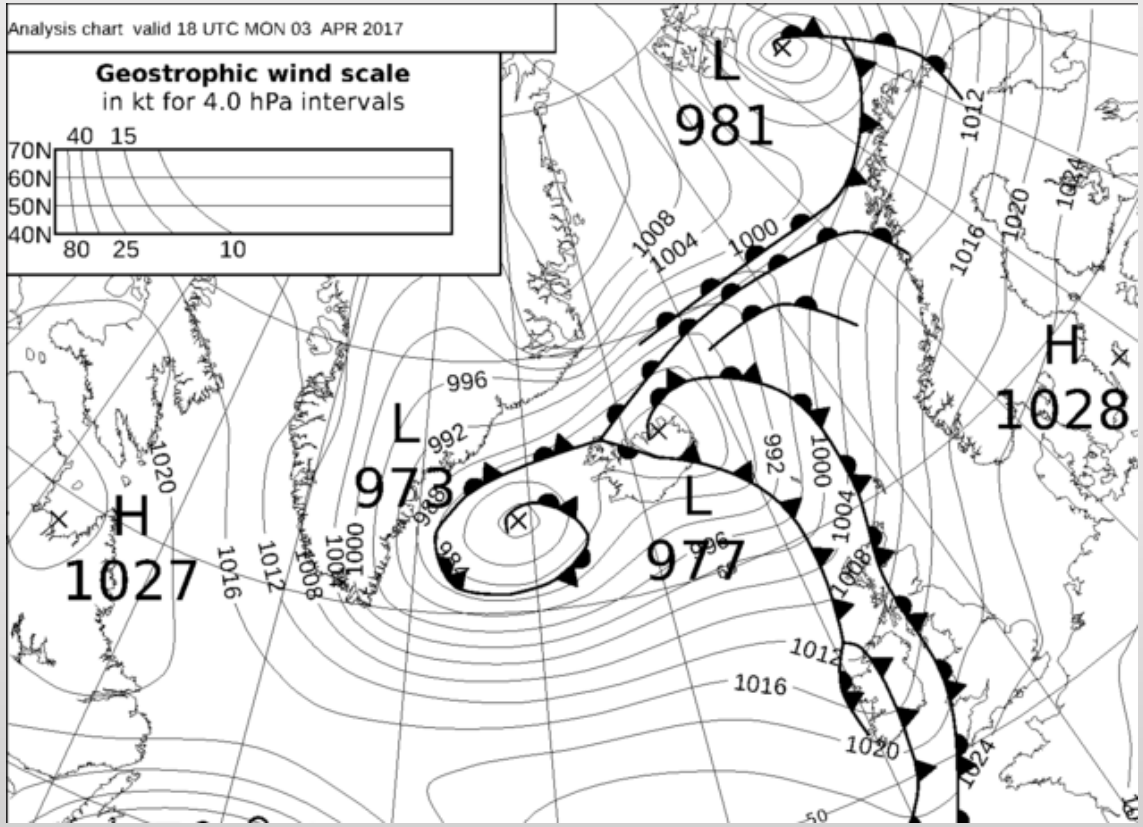
In both cases air flow is enhanced at the tip of Greenland (Cape Farewell) as the majority of the surface flow is around the mountain (southern bit of Greenland) and little or none is forced over the mountain.

The flow is blocked.

West storm 12Z + 18Z Monday 3. April 2017

Veðurstofa Íslands

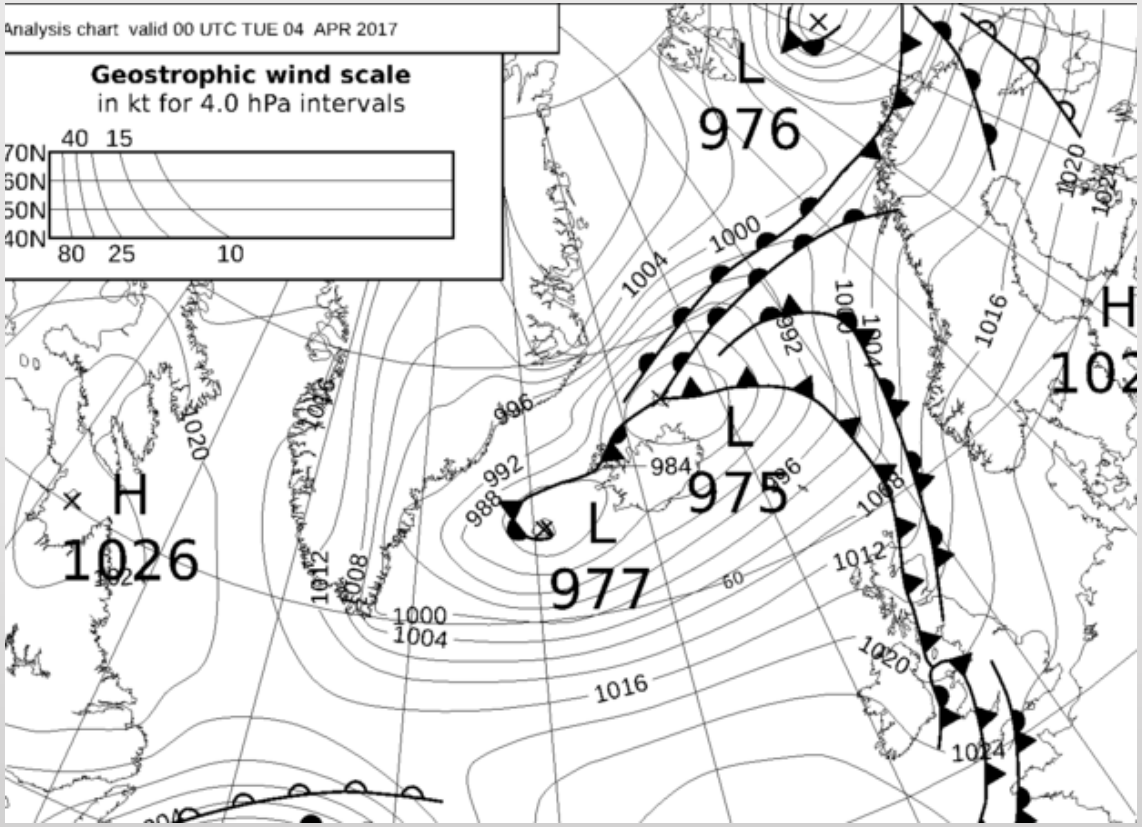


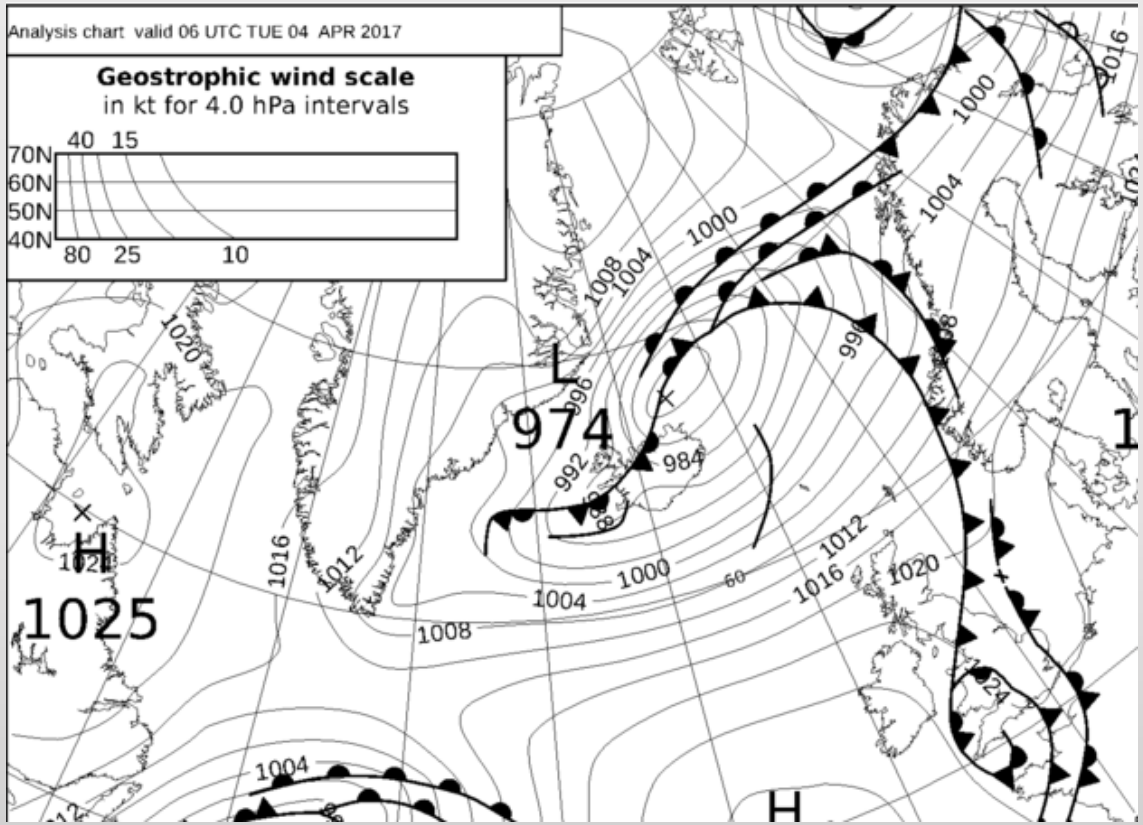


The low and the tip of Greenland are creating the wind and waves south of the center of the low

West storm 00Z + 06Z Tuesday 4. April 2017

Veðurstofa Íslands

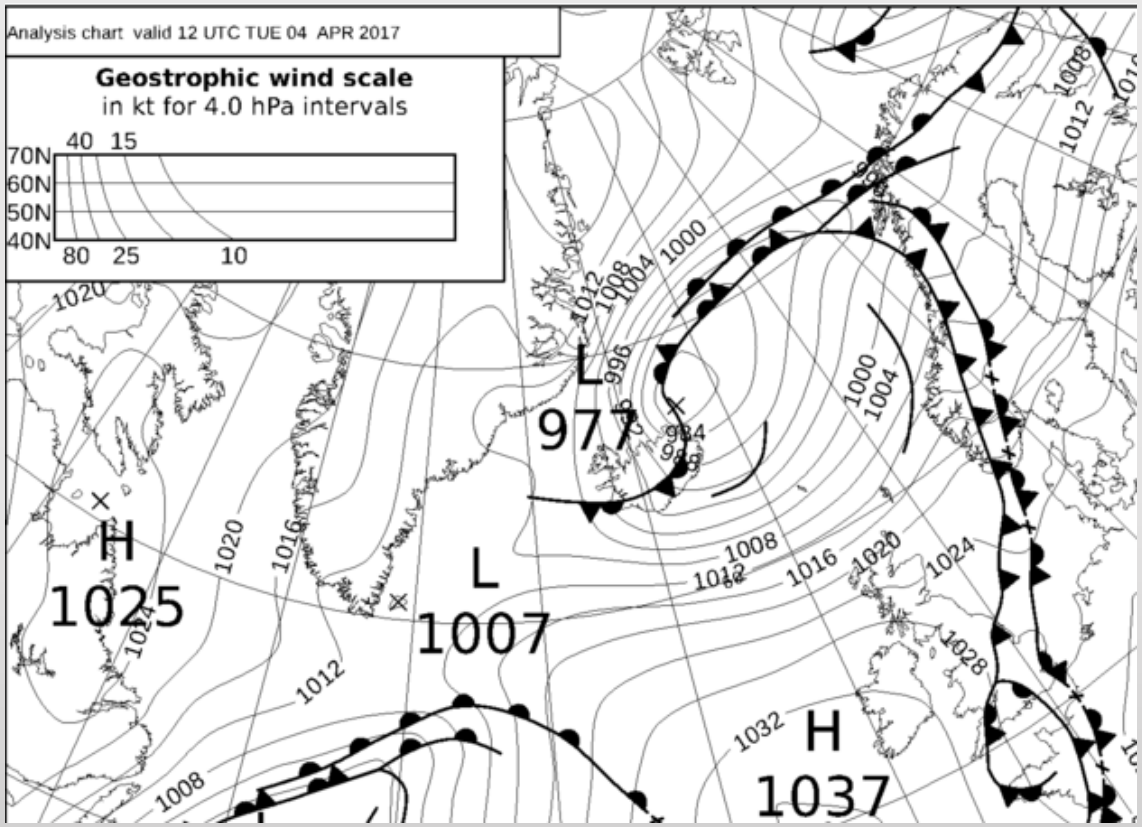


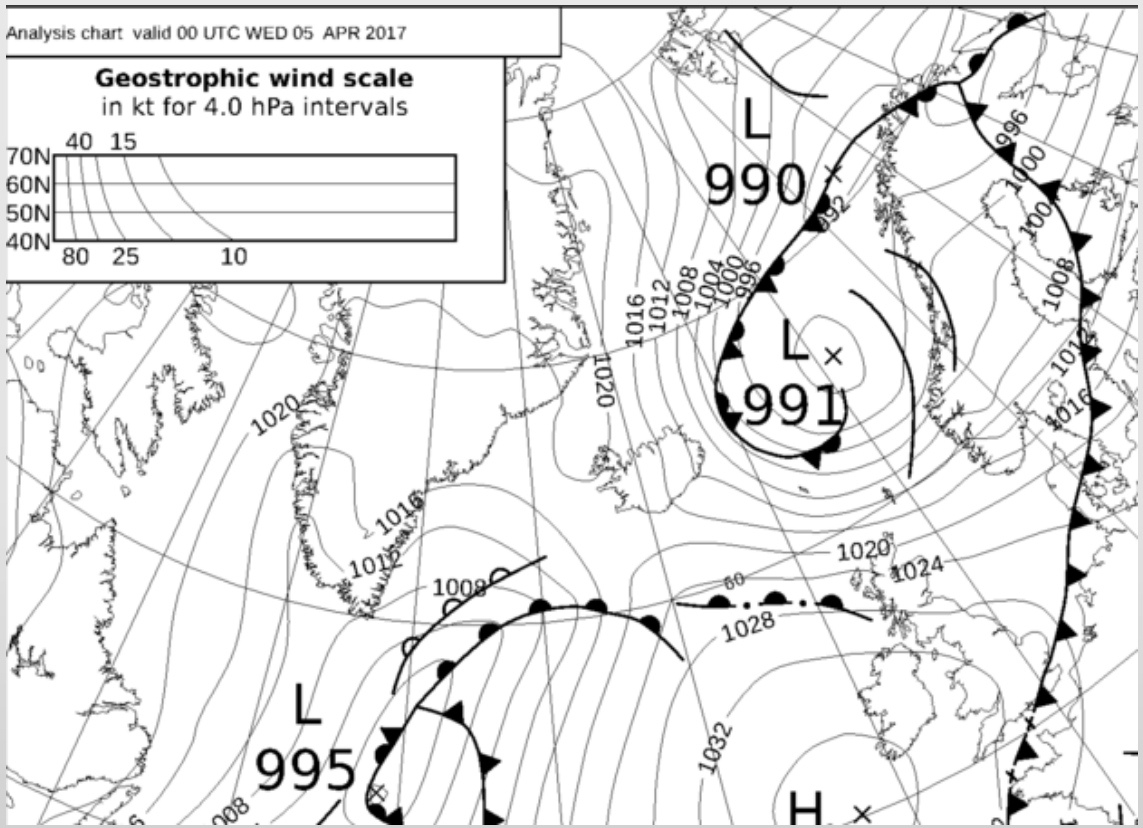


Low is moving quickly to the ENE and filling up

West storm 12Z Tues. 4. April + 00Z Wed. 5. April 2017

Veðurstofa Íslands

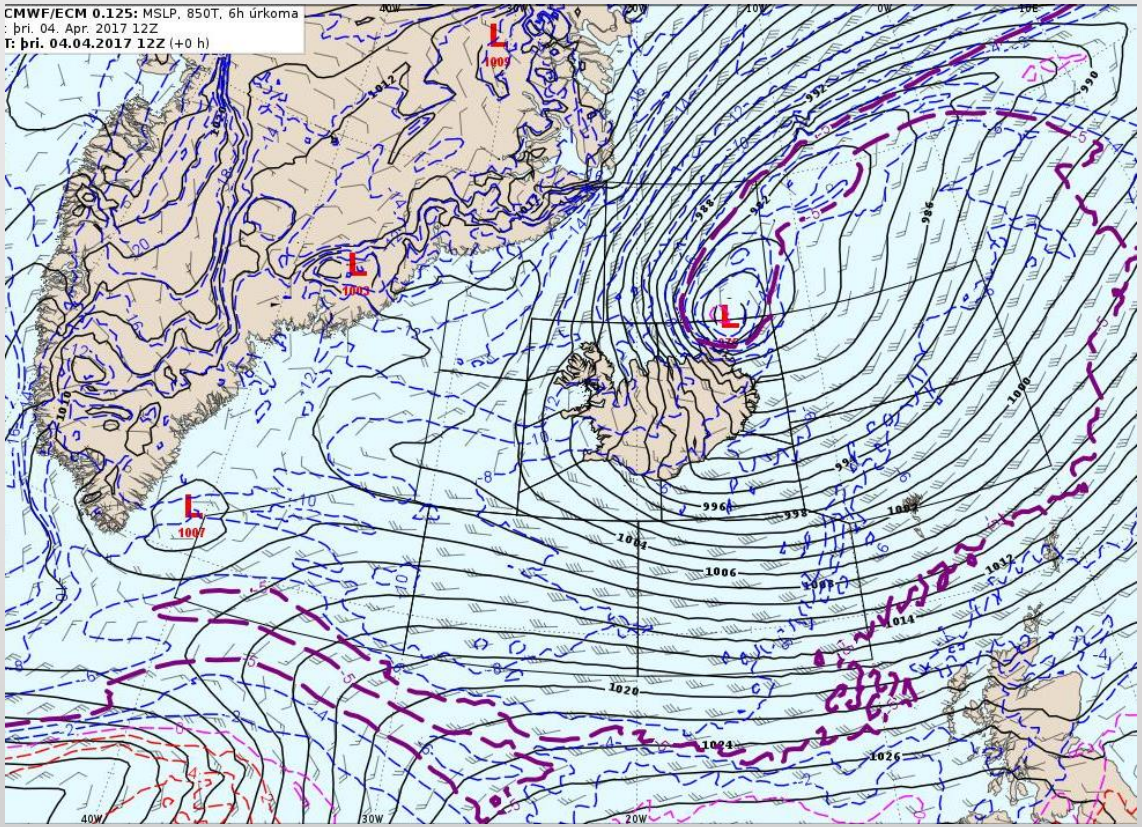




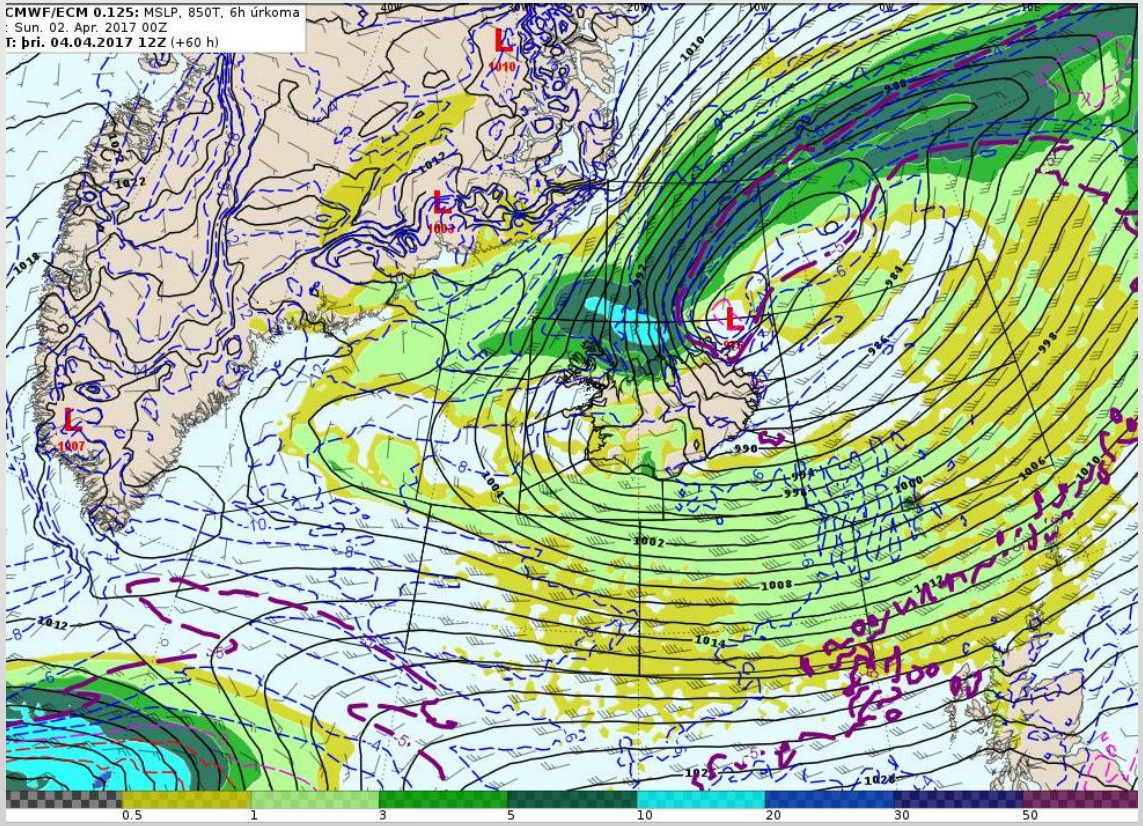
Tuesday afternoon/evening – the wind and waves move past the Faroes

West storm 12Z Tuesday 4. April 2017 MSLP +10m wind

EC analysis

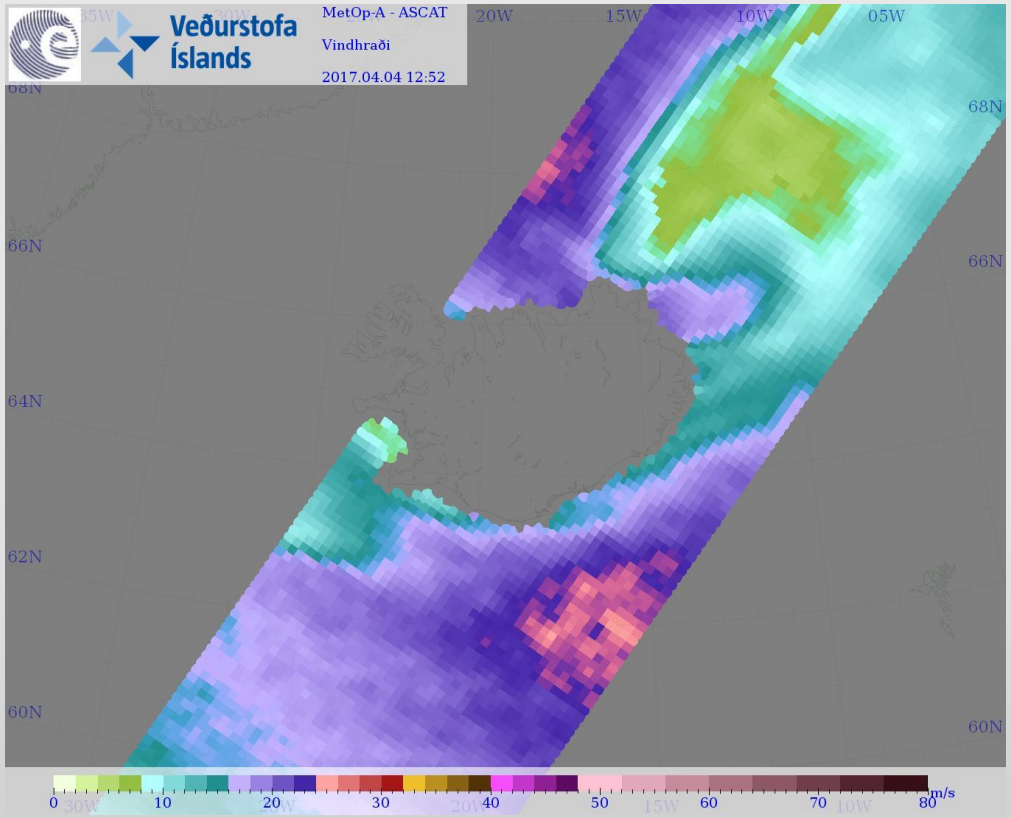


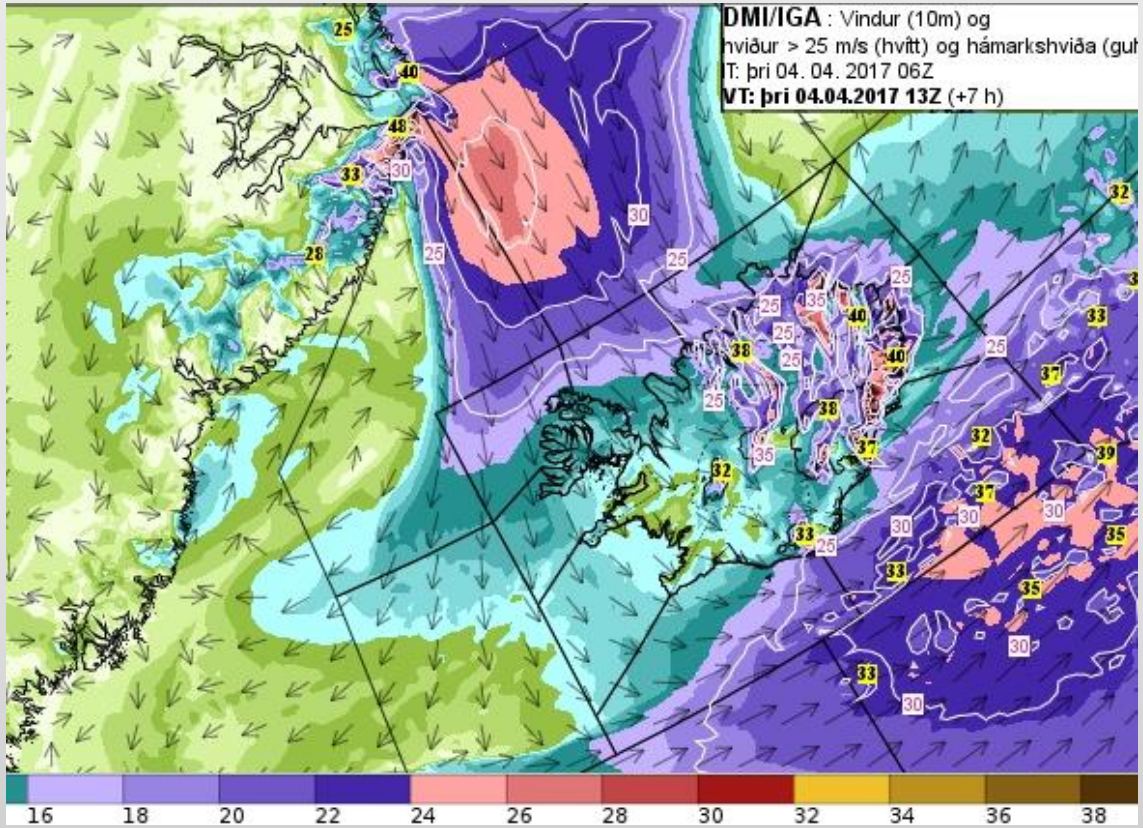
EC +60H forecast



Great +60H forecast!

West storm 12Z Tuesday 4. April 2017
ASCAT at 12:52Z

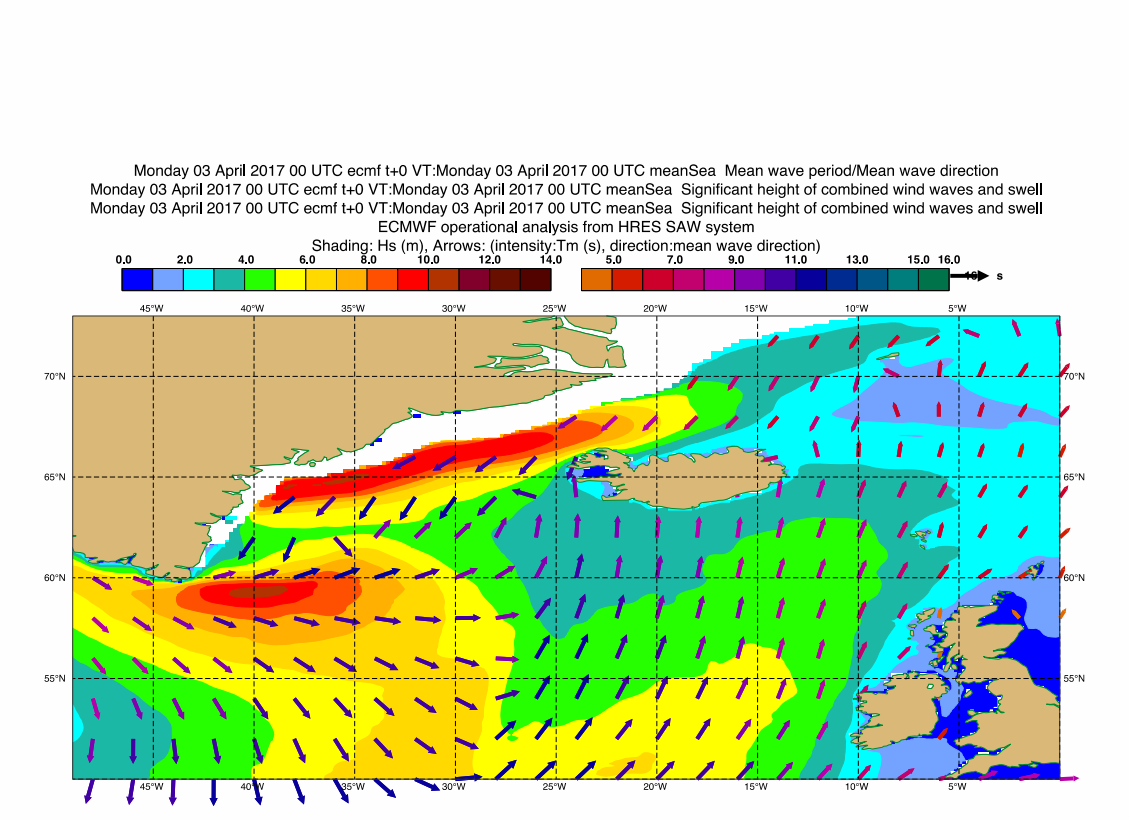


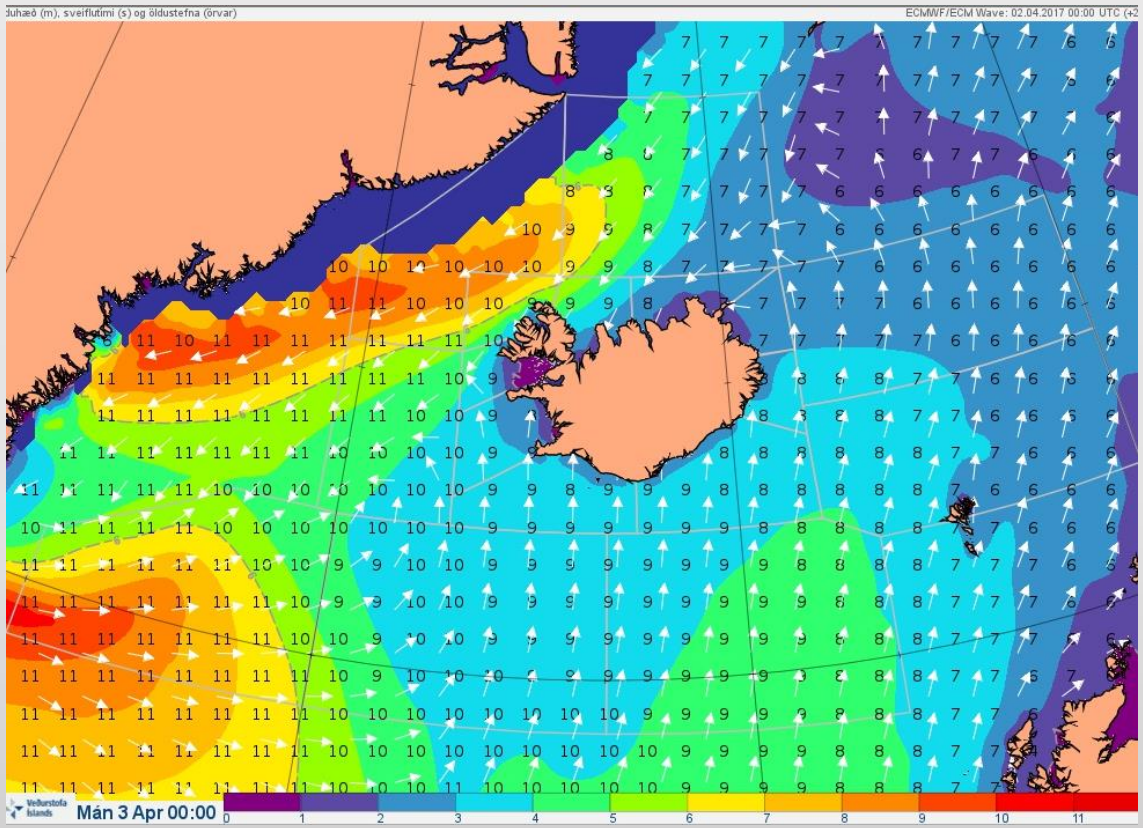


OK, mostly great!
ASCAT: 25 m/s!

DMI/IGA 2.5km forecasts (+07H) 24-26 m/s

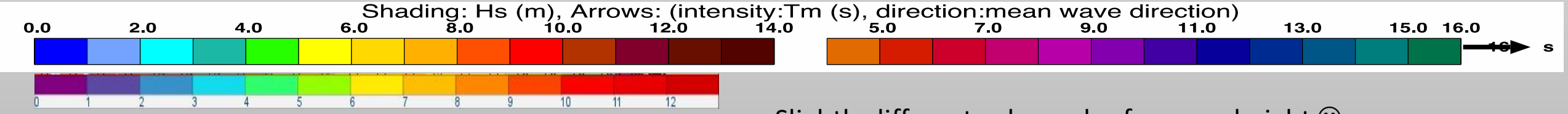
West storm 00Z Monday April 2017 - Waves





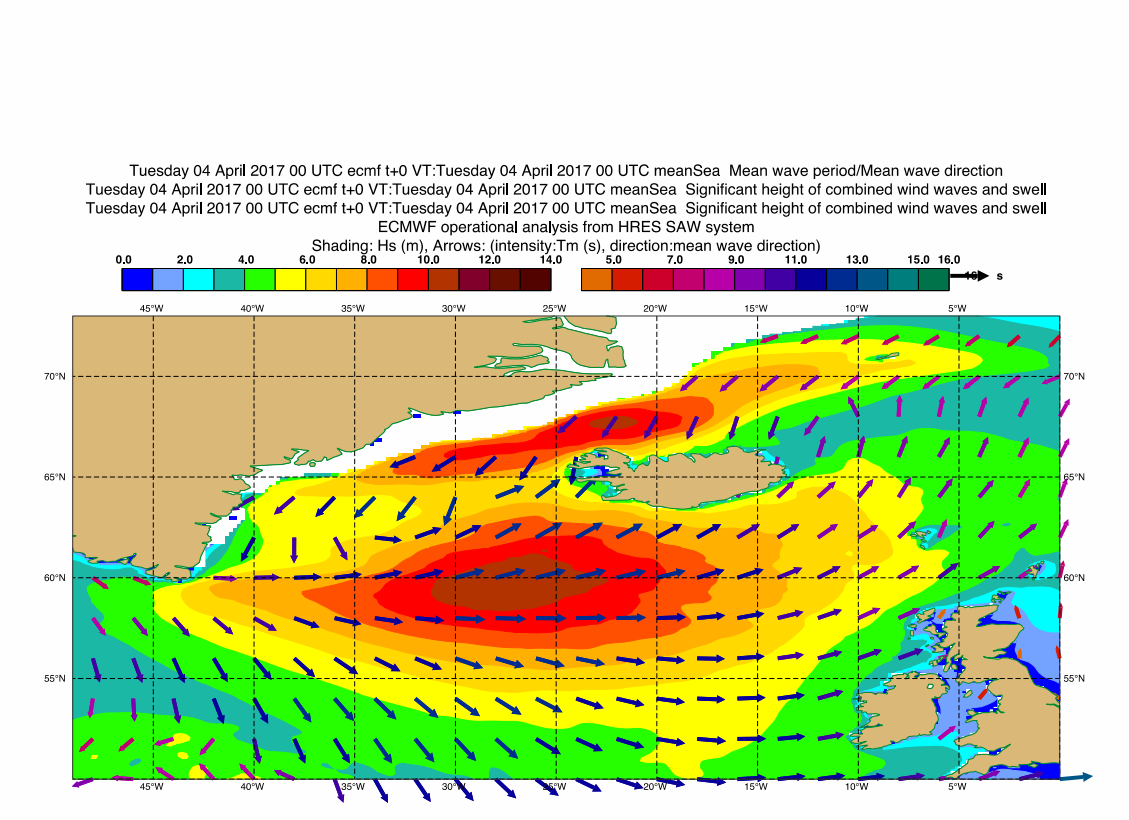
EC wave analysis - Max 10-11 meters round 40W

EC +24H wave forecast Max 10-11 meters round 40W

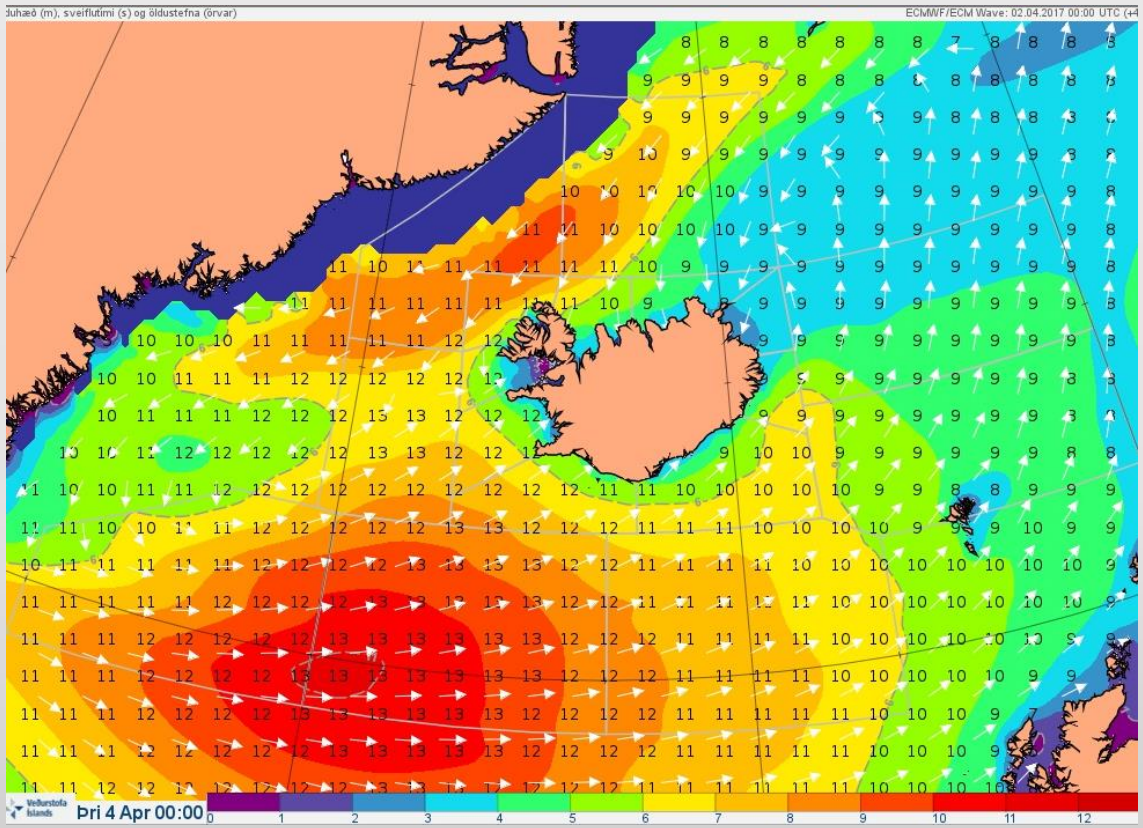


Slightly different color scales for wave height ☺

West storm 00Z Tuesday April 2017 - Waves

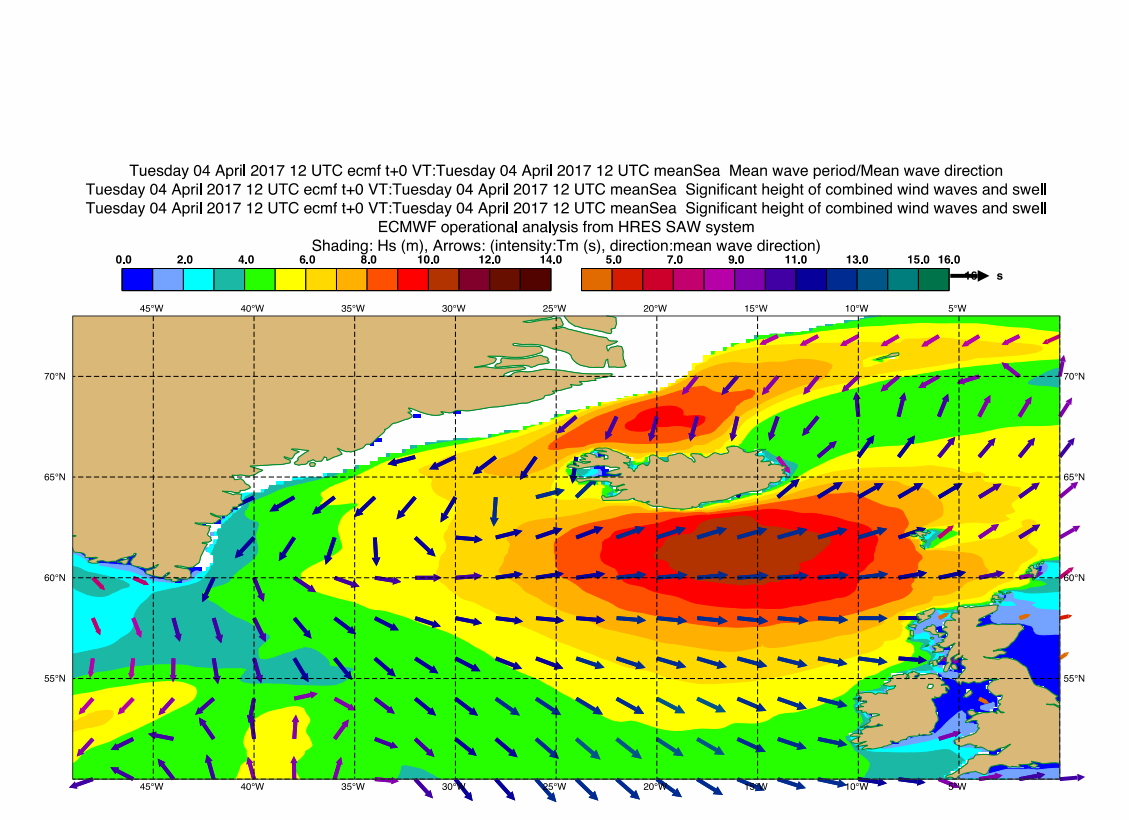


EC wave analysis - Max 10-11 meters btw 25-30W

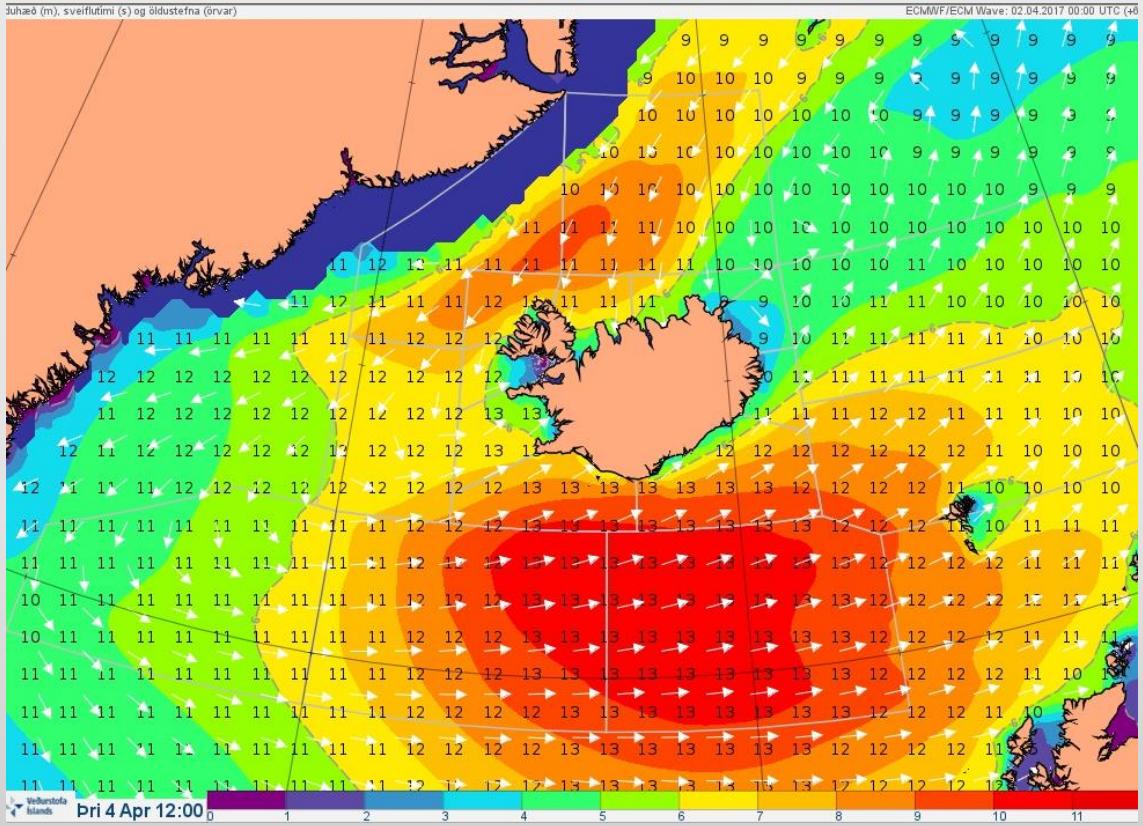


EC +48H wave forecast Max 11-12 meters round 29W

West storm 12Z Tuesday April 2017 - Waves

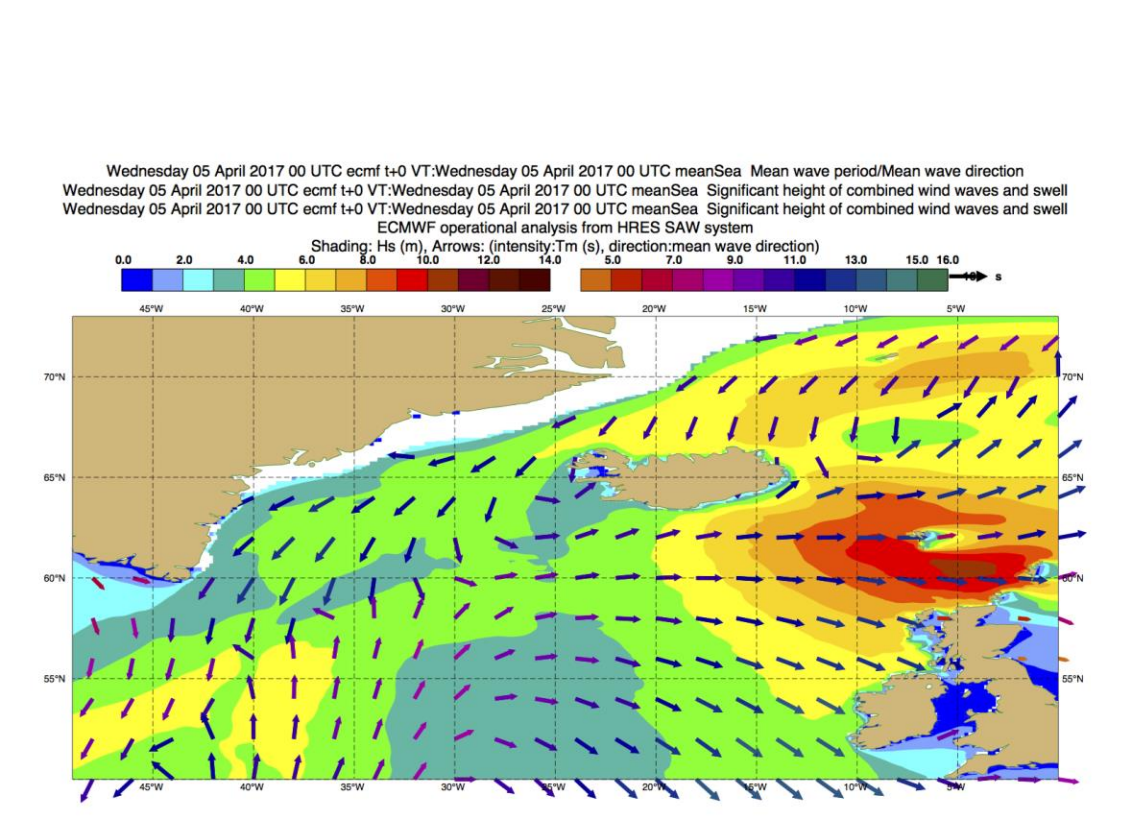


EC wave <u>analysis</u>
Max 10-11 meters btw 12-20 W

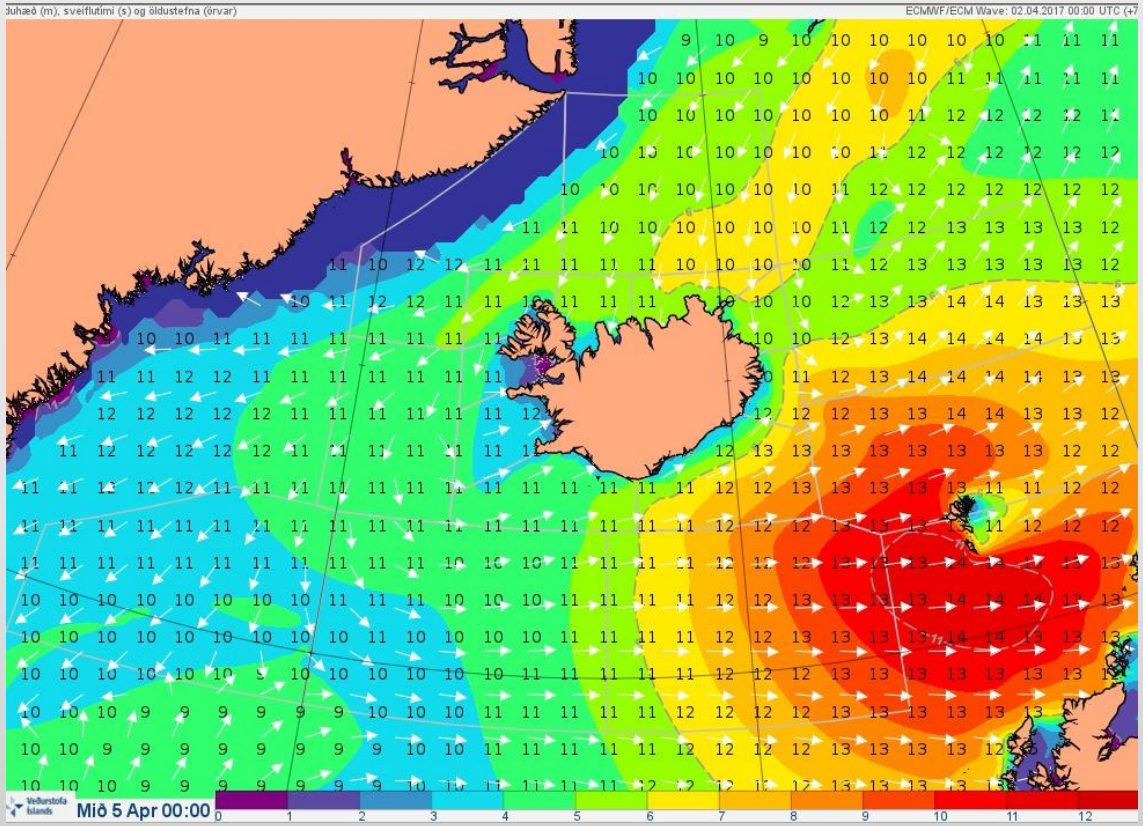


EC +60H wave <u>forecast</u>
Max 10-11 meters btw 12-25W
Max period 13s

West storm 00Z Wednesday April 2017 - Waves

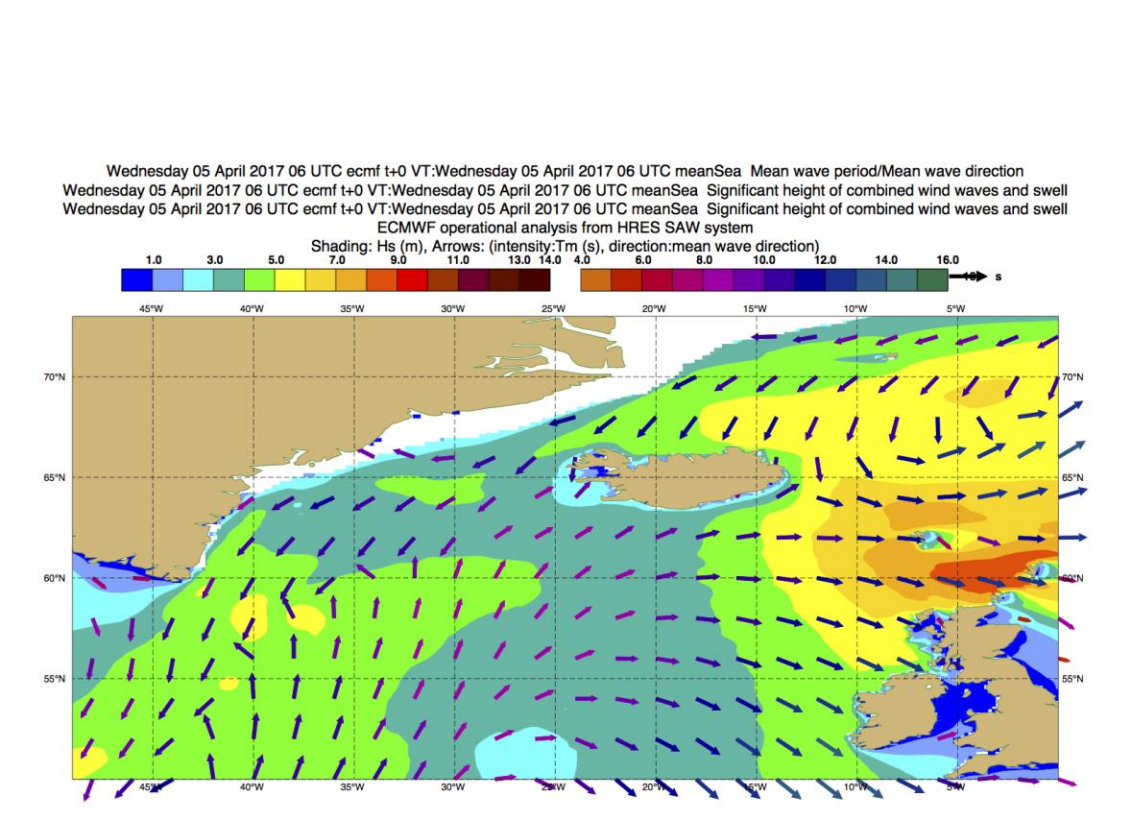


EC wave <u>analysis</u>
Max 10-11 meters btw Faroe and Orkney islands
Max period 11-13 s



EC wave <u>forecast</u> +72H
Max 11-12 meters SW and S of Faroe islands
Max period 14 s

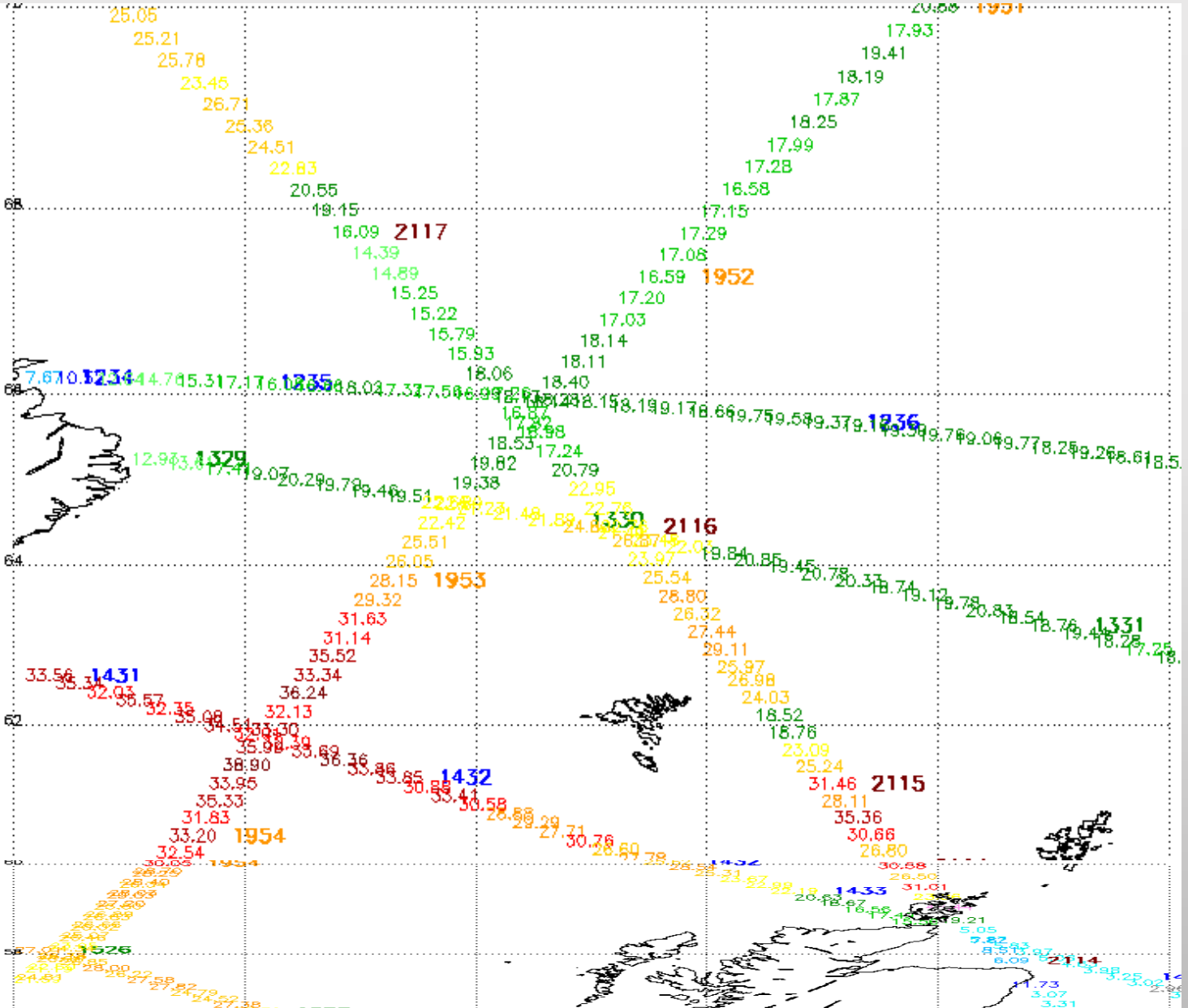
West storm 06Z Wednesday April 2017 - Waves



EC wave analysis
Early Wednesday morning
– moved past the Faroes

West storm ~20Z Tuesday 4. April 2017

Altimeter SWH



Tuesday evening. Faroes below center.

Maximum SWH value 38.9 feet (11.85m) near 12W at 19:54Z.

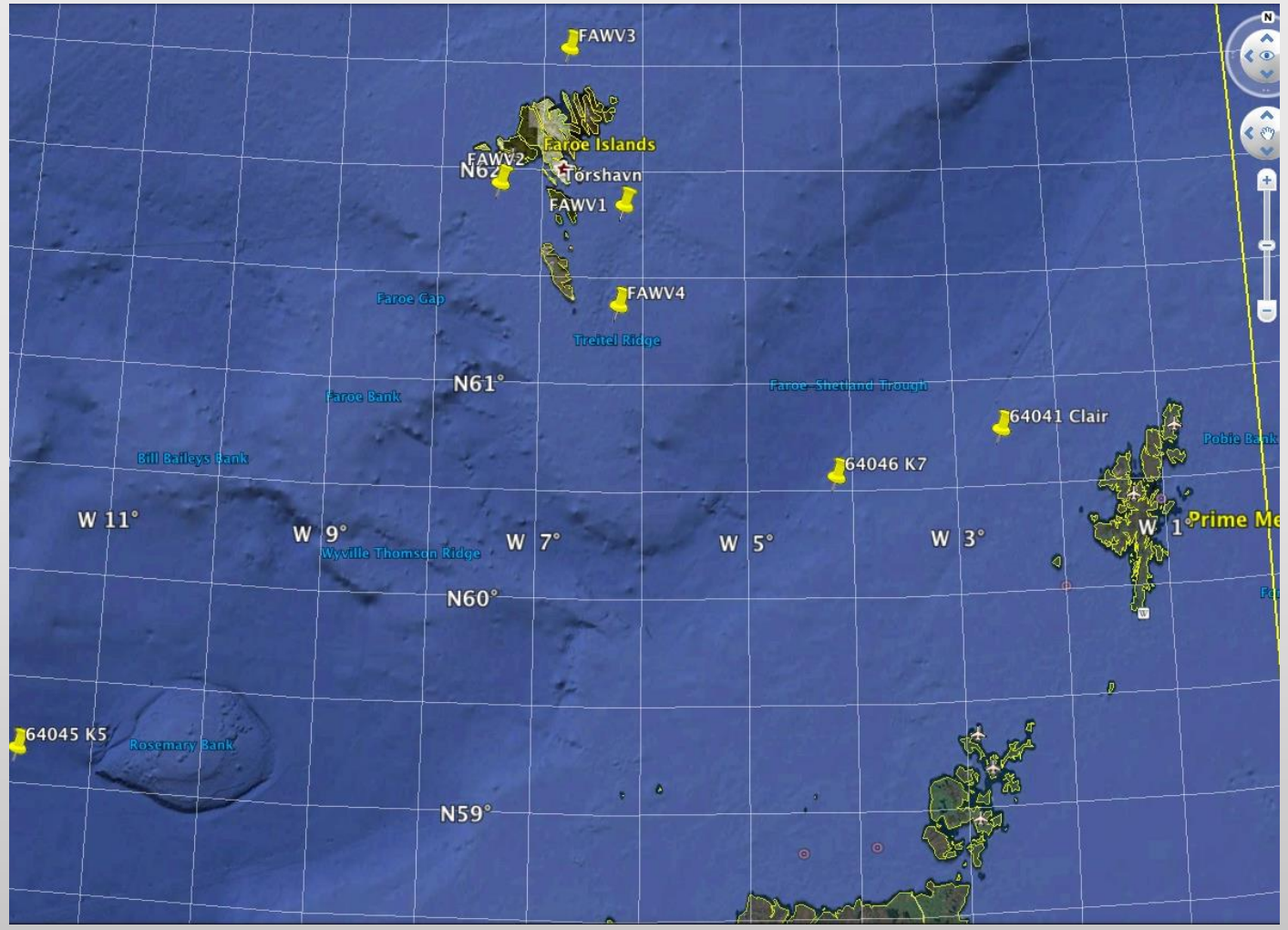
The 21:15 run shows 25 to 35 feet (7.6 to 10.7 m) between Faroes, Shetland and Orkney.

Northeast of Faroes 20 to 29 feet (6.1 to 8.8 m)

Note the lee effect east of the Faroes, only 19 feet (5.8 m)

Pretty close to EC analysis and forecast.

West storm – Buoy data



Location of wave buoys around the Faroes and west of Shetland

and

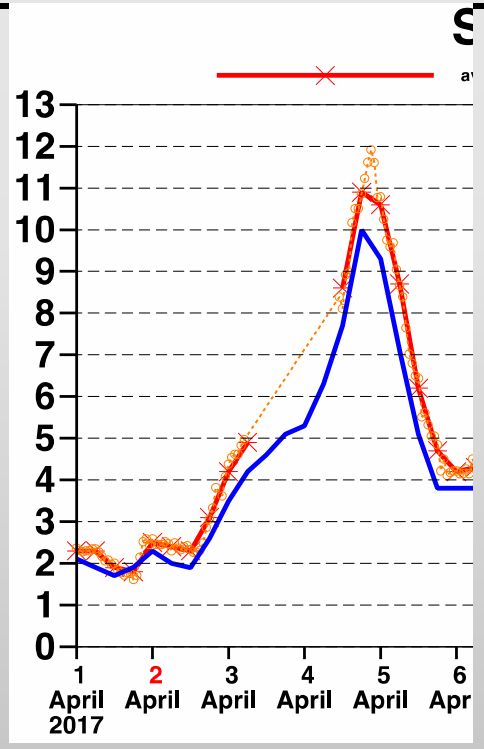
The famous K5 buoy.

FAWV2 buoy obs VS EC analysis (blue)

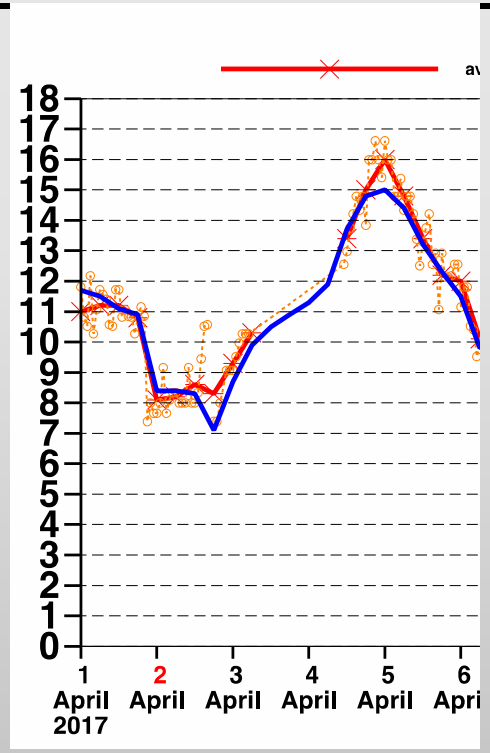
Veðurstofa Íslands

Buoy **FAWV2** 61.865 -7.455 West Faroe Islands (WV2)

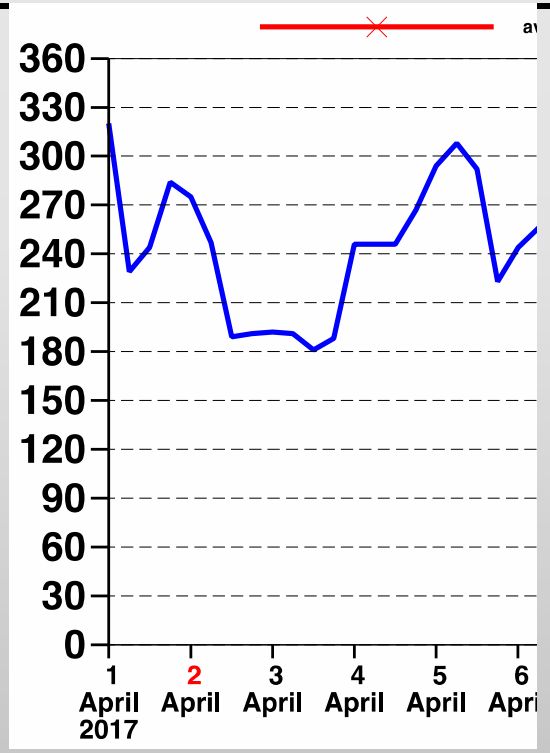
West of the Faroes the SWH is 1 meter higher than analysis and the period is 1 s longer, 16 s. Note that the wind speed is only above 20 m/s for several hours. These high waves are travelling in from the west – not only created locally.



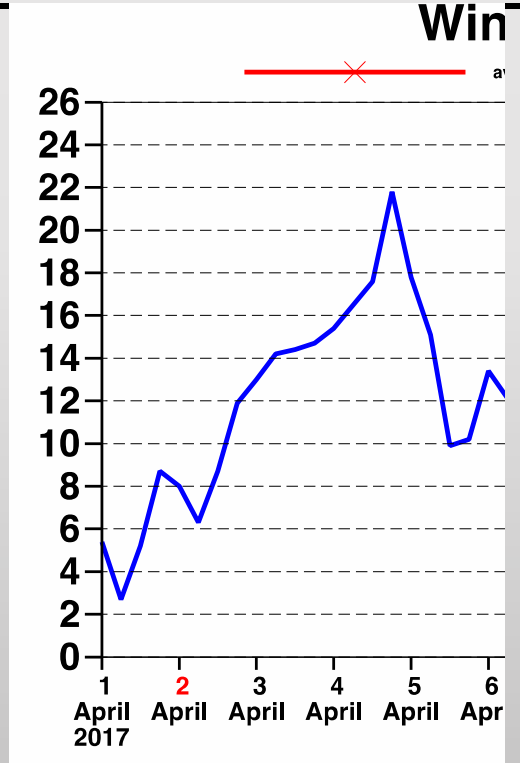
SWH & averaged buoy data – model analyzed (blue)



Period (as on GTS) & ave. buoy data – model analyzed (blue)



Wind direction model analyzed



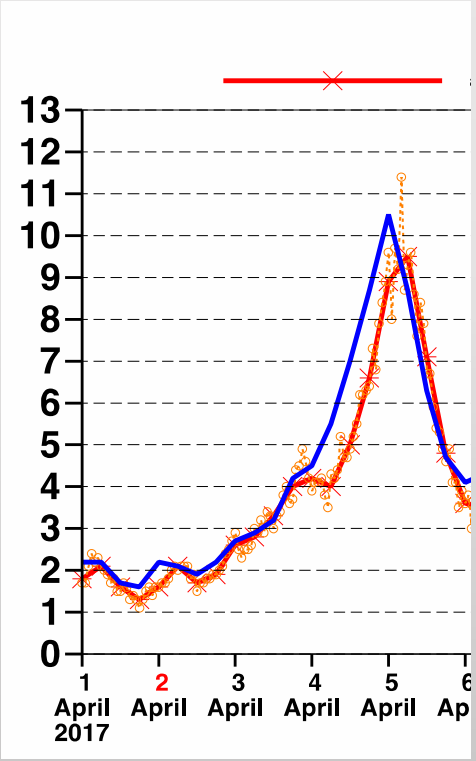
Wind speed model analyzed

K7 buoy obs VS EC analysis (blue)

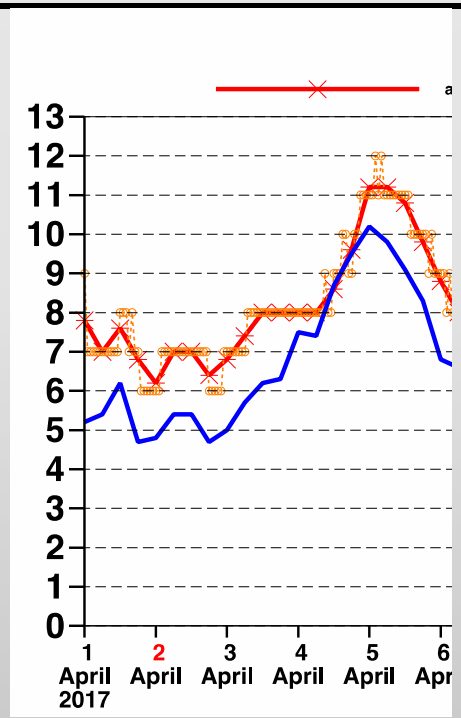
Veðurstofa Íslands

Buoy 64046 60.500 -4.200 UK North-East Atlantic (**K7**)

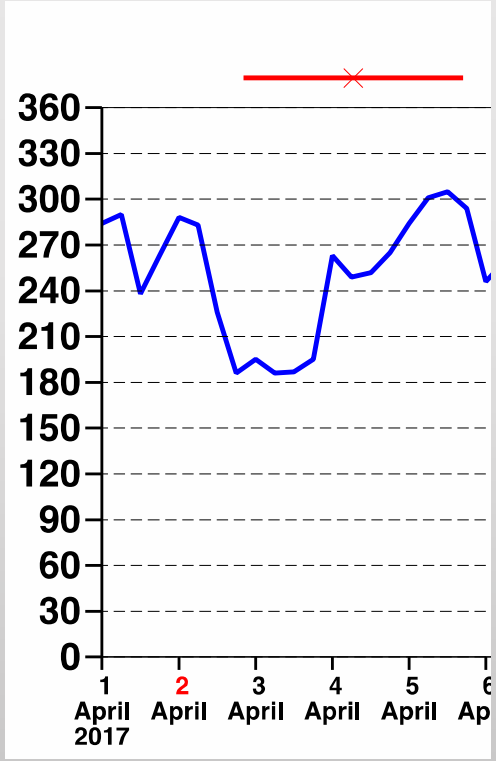
K7, west of Shetland, the SWH is similar to the analysis but the period is 1.4 s longer. Both SWH and period maximum are few hours later than analysis.



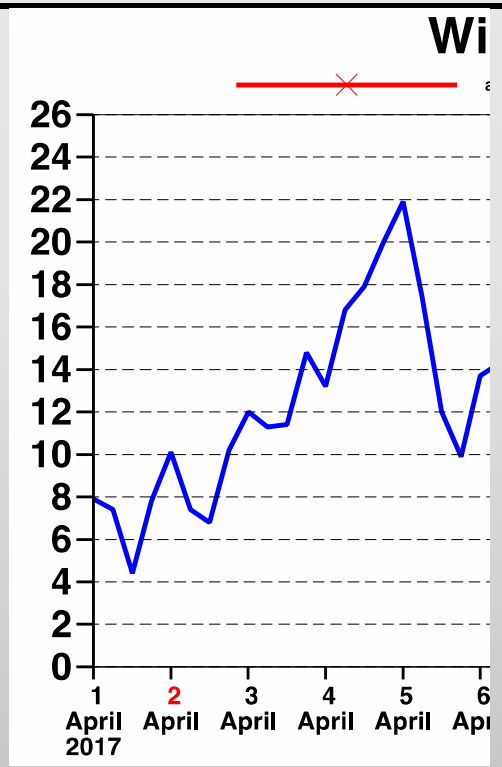
SWH & averaged buoy data – model analyzed (blue)



Period (as on GTS) & ave. buoy data – model analyzed (blue)



Wind direction model analyzed



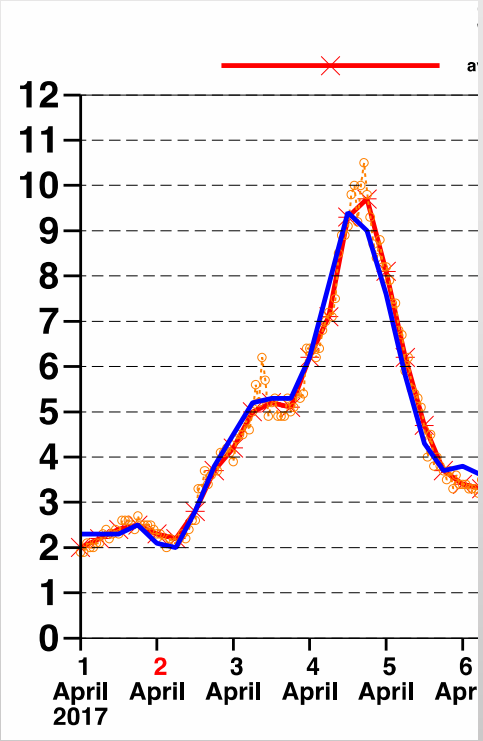
Wind speed model analyzed

K5 buoy obs VS EC analysis (blue)

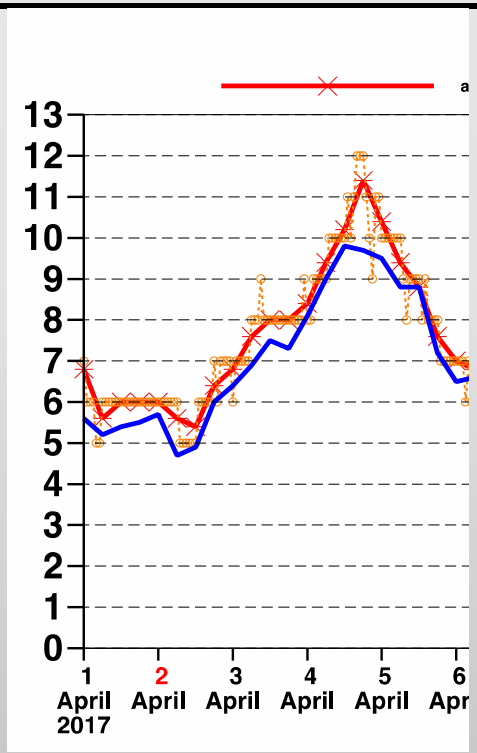
Veðurstofa Íslands

Buoy 64045 59.100 -11.700 UK North-East Atlantic (**K5**)

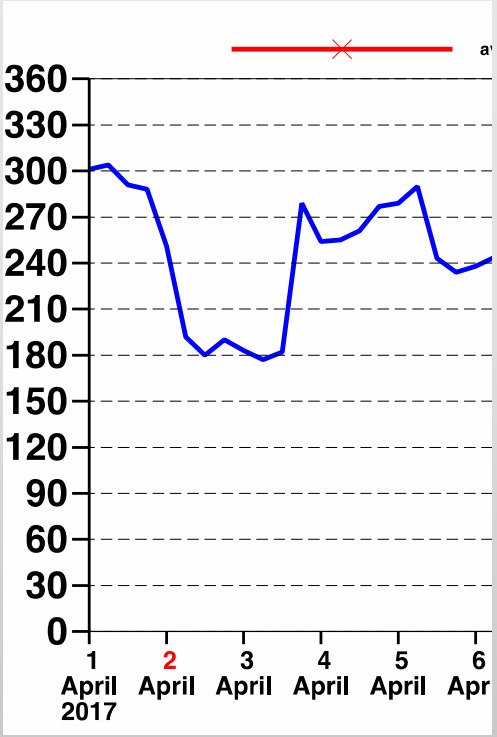
At K5, the southernmost buoy and also further to the west, the SWH is 1 meter lower than the analysis and is a few hours later but the period is 1 s longer and the maximum lasts longer.



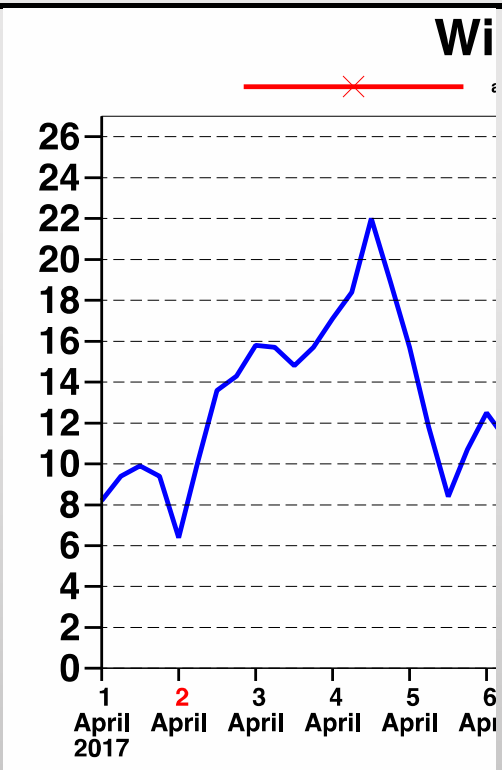
SWH & averaged buoy data – model analyzed (blue)



Period (as on GTS) & ave. buoy data – model analyzed (blue)



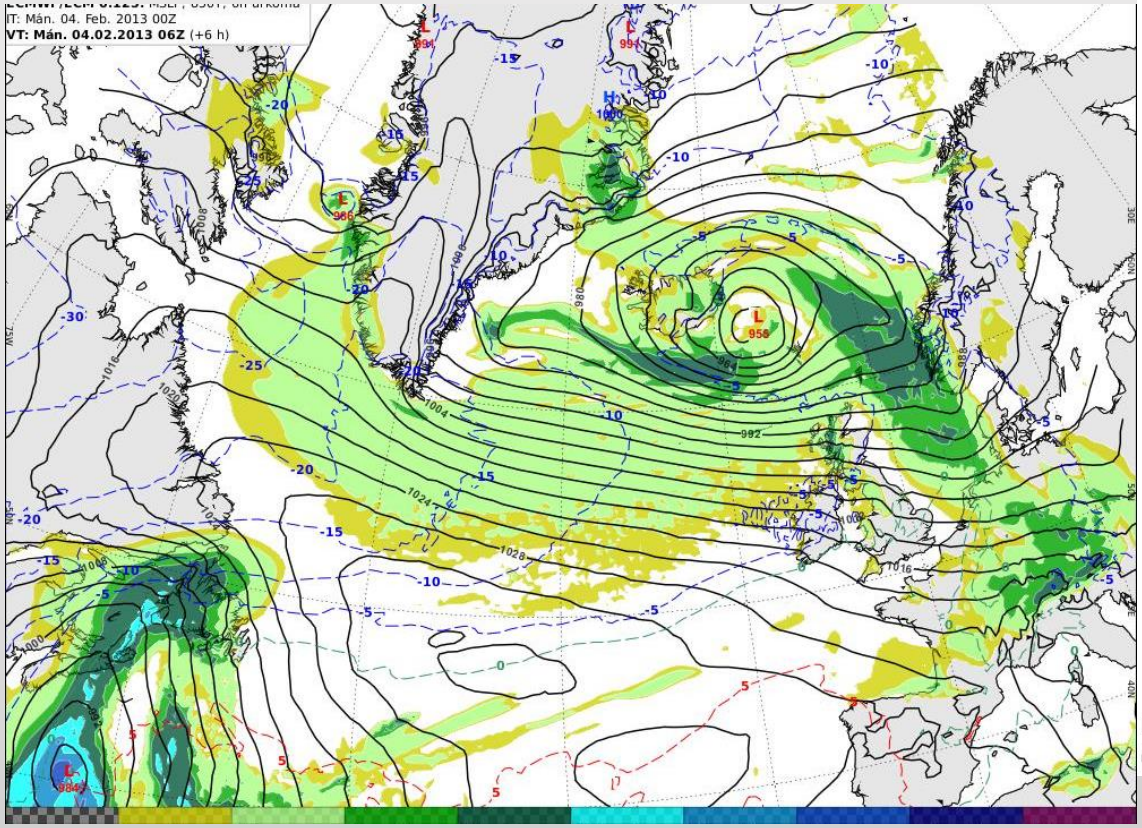
Wind direction model analyzed



Wind speed model analyzed

K5 buoy – World record holder!

19.0 m (62.3 ft) SWH new record – measured by a buoy – 0600 UTC 4/02/2013



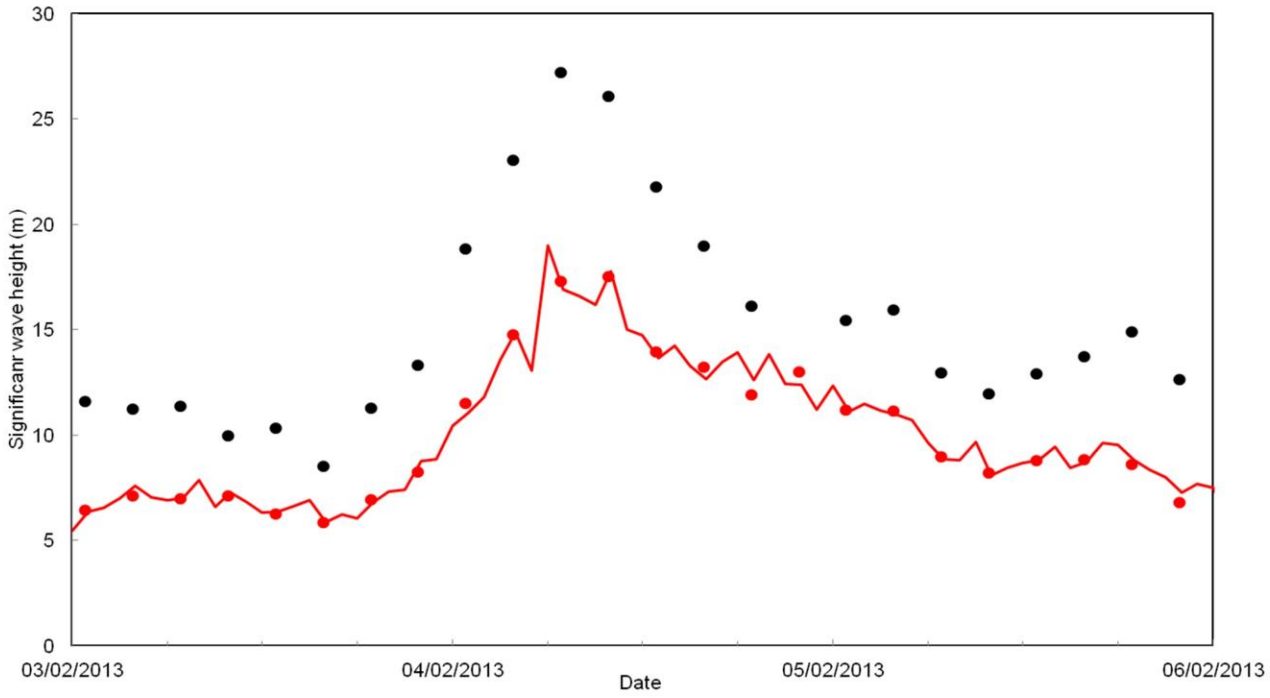


Figure 1. Hourly significant wave height measurements from the Datawell heave sensor, together with 3-hourly significant (●) and maximum (●) wave height measurements from the Triaxys sensor on the K5 buoy.

35-43 KT for over 12 hours at K5 – not enough wind to create such monster waves!

WMO https://public.wmo.int/en/media/press-release/19-meter-wave-sets-new-record-highest-significant-wave-height-measured-buoy

ASU https://wmo.asu.edu/content/World-Highest-Wave-Buoy

ASU https://wmo.asu.edu/content/world-meteorological-organization-global-weather-climate-extremes-archive

Case 1 West storm

Pretty good 60 to 72 hour forecast by ECMWF

But EC 10 wind analysis on Tuesday 12Z is lower than the ASCAT obs
2.5 km HARMONIE model winds closer to the ASCAT – higher resolution

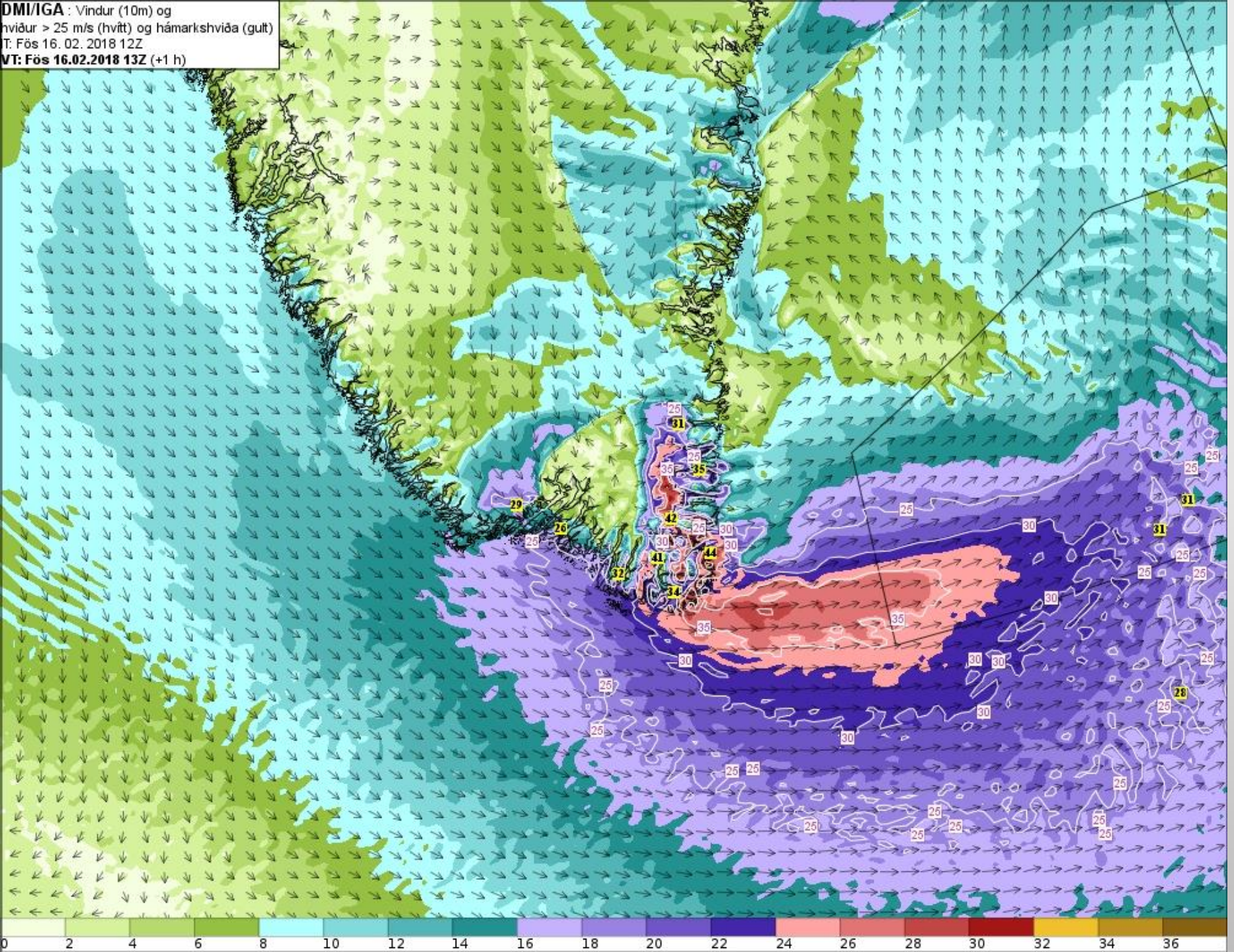
EC wave analysis at buoys vs observations:

Look at Ad Stoffeln lecture last Monday for reflections on scatterometer winds, models and buoys observations

CASE 2 where forecasts and observations seem contradictory

Another westerly Greenland tip jet case

But here we look only at the forecasts +15H to +18H into the future
And they are giving us headaches
Even the +6H forecasts

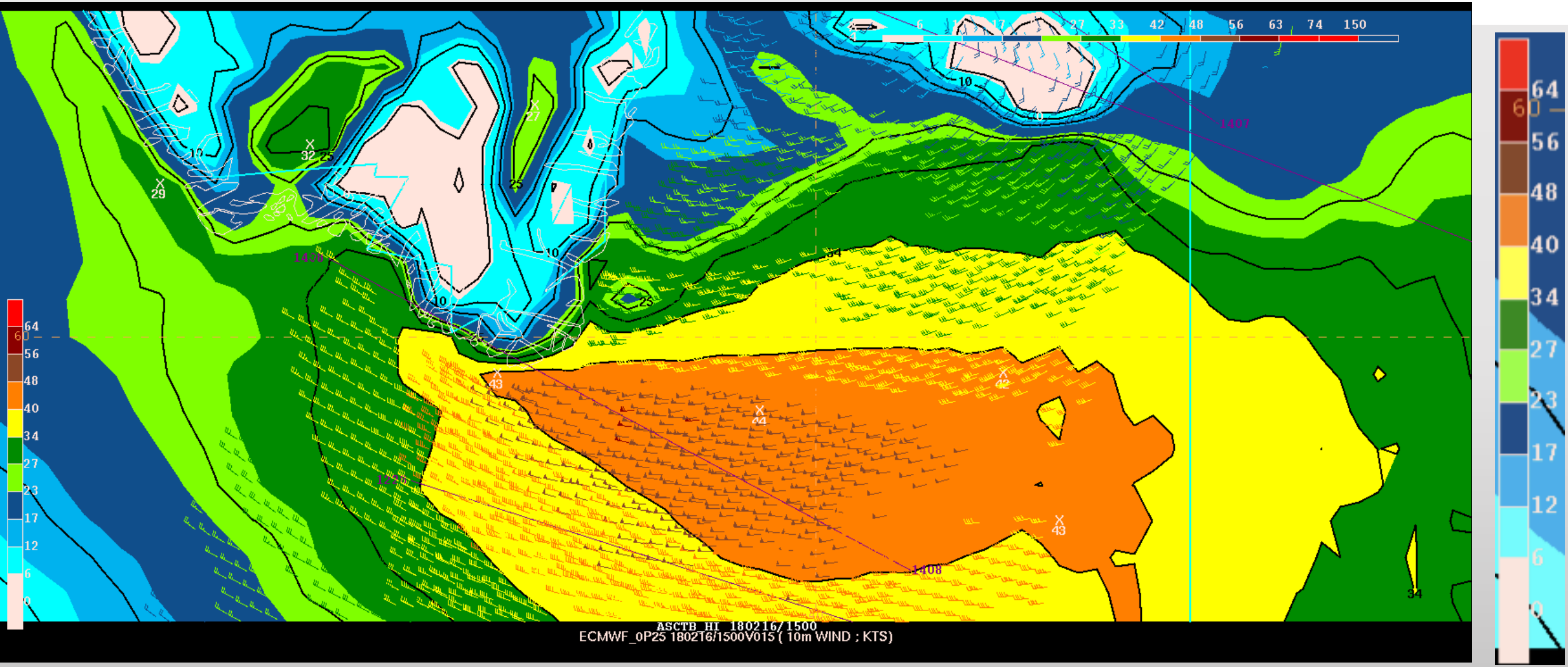


Veðurstofa Íslands

13Z 16. Feb. 2018
The westerly Greenland tip jet

Max winds 28-30 m/s

EC 16.02.2018 15Z +15H color field
ASCAT ~14Z wind arrows

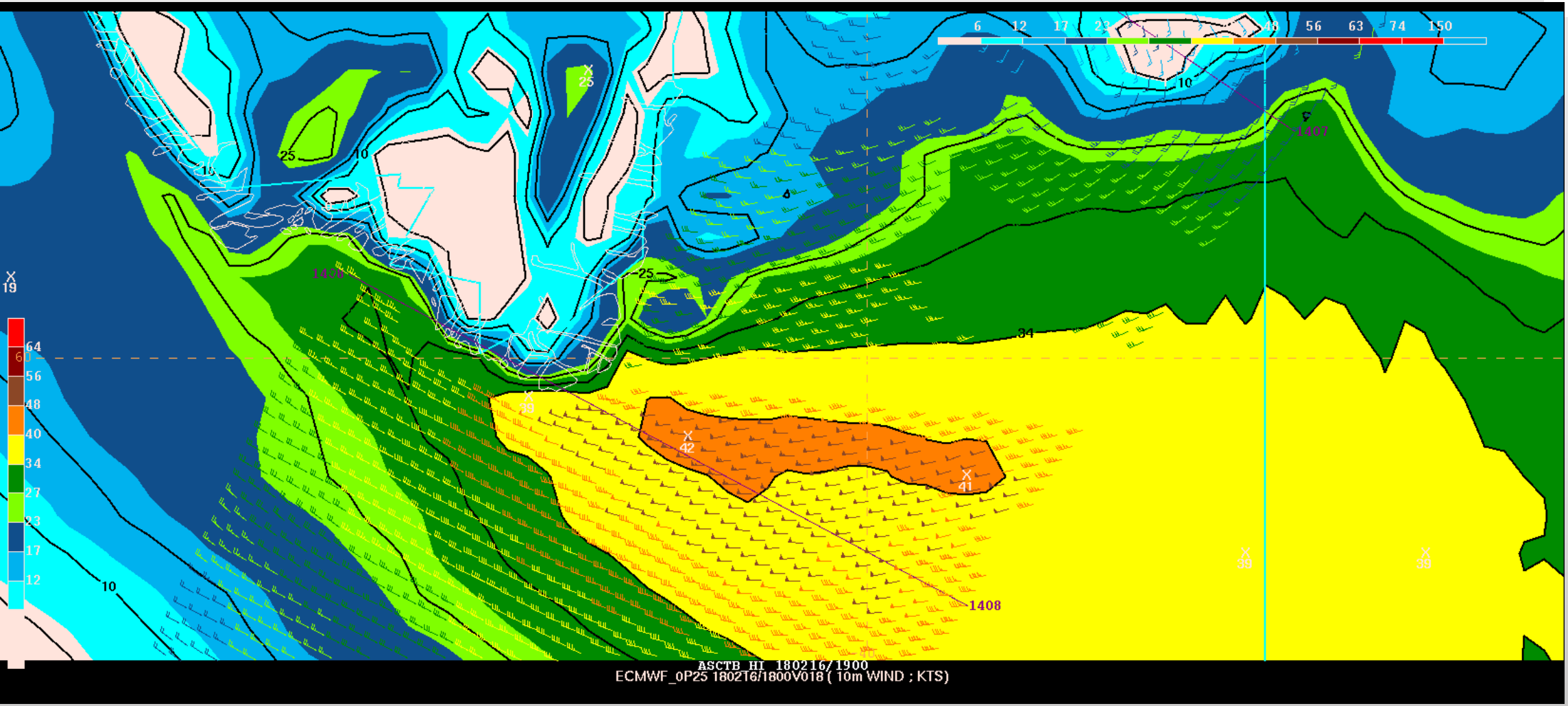


See color wind scale (Beaufort) –

Obs – over 50KT – “flag waving” → Storm force

Over-forecast near 60N but widespread under-forecast in the main tip jet

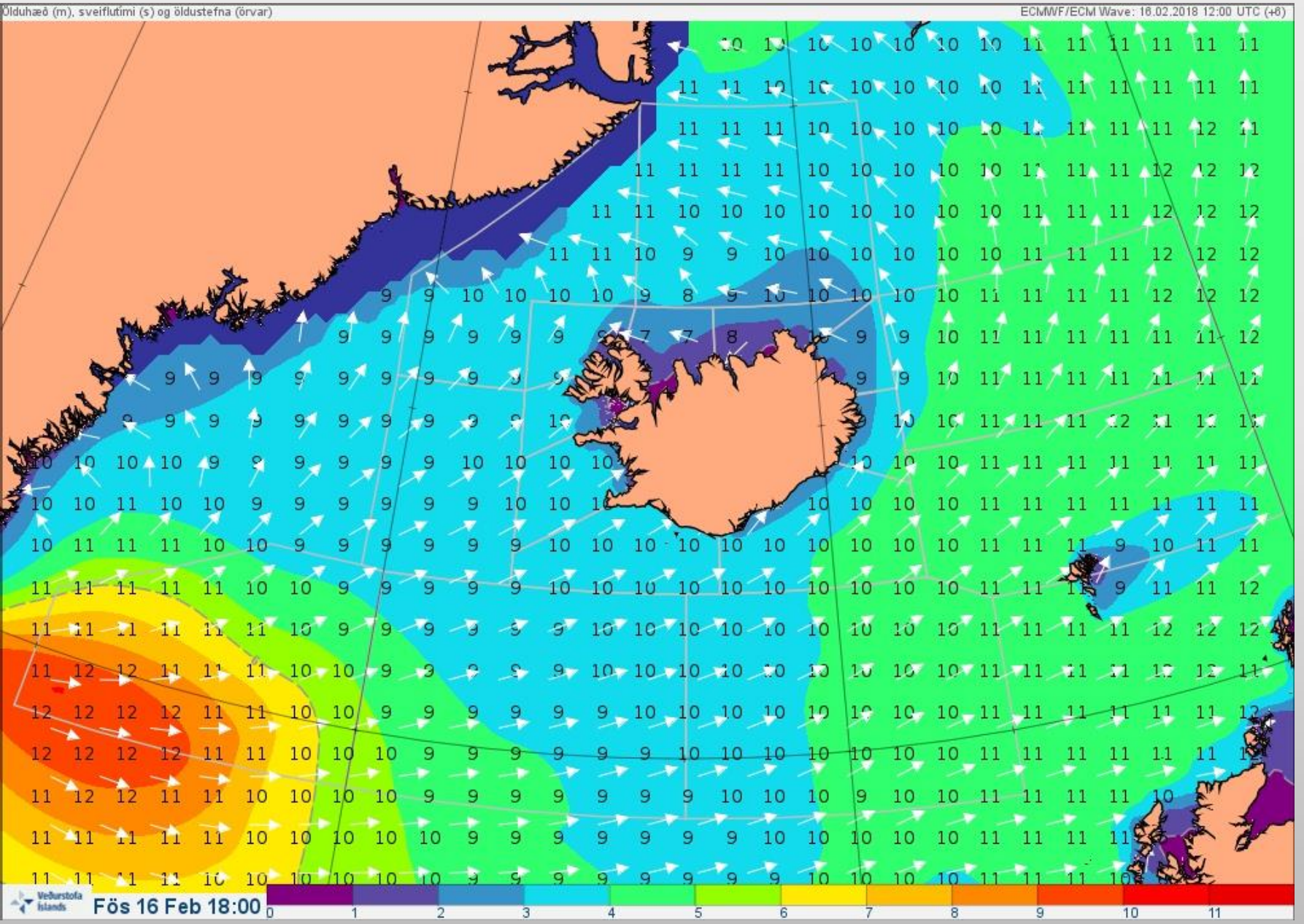
EC 16.02.2018 18Z +18H color field
ASCAT ? ~19Z ?? wind arrows



EC 10m winds decreasing

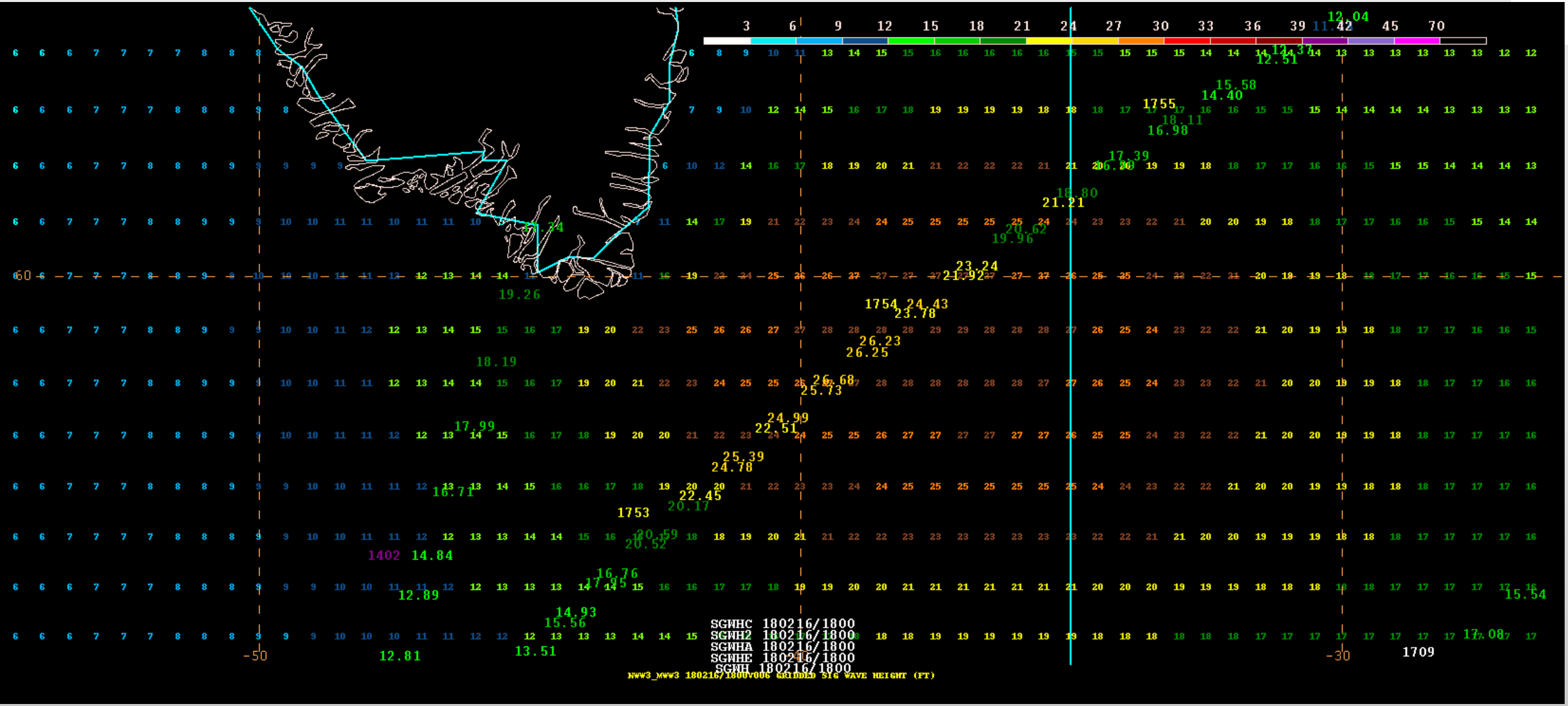
ASCAT – Data from 14Z?? possibility of time window for data set too wide? Human error?

EC 18Z +6H SWH



Forecast:
Max SWH 9 to 10 m
29.5 to 32.8 feet
(Small area with 10m+)

Altimeter around 19Z vs NWW3 model SWH forecast 18Z +6H



The obs SWH is lower than the forecasted SWH! E.g. forecast 27-29 feet – obs 22-24 feet --- 5 feet difference!

But obs winds are higher than forecasted winds!

Problem

First **expectation**: If we observe higher winds than forecast
then we expect higher waves observed than forecast.

Here: Observed winds are higher than forecasted winds!
But there is an area where the observed SWH is lower than the forecasted SWH !!! Reverse

Why is the EC model under-forecasting the wind? Resolution?
Why is the EC model creating higher waves from lower winds?
Or Why are observed higher winds creating lower waves then forecast?

Two other main parameters than windspeed for wave height:
Wind duration: The time with “same” wind speed and direction
Wind fetch: The length of sea surface with “same” wind speed and direction

Maybe the fetch is shorter in reality than in the model?
Or is the duration shorter? Or maybe both are shorter?

Forecasting dilemna!

We have the midnight EC run with under-forecast winds at +15H
We have both EC and NWW3 noon run with over-forecast SWH waves at **+6H!**

So how will you as forecaster proceed with forecasting the winds and waves when the models are wrong?
Also in the area to the east where these waves will propagate as **swell**.
How will you correct the forecast? Duration and fetch???

Maybe forecast lower waves than forecast by the model because the obs. SWH is lower?
And the model is forecasting decreasing winds.
Or just follow the model for wave heights reasoning the higher observed winds are generating higher waves?
Or???

When on forecasting duty just remember to resolve all this in like less than 5 minutes
And then remember to apply your decision throughout your forecast! And remember to

Good luck!