Why was the March 16-17 2008 Polar low poorly predicted?

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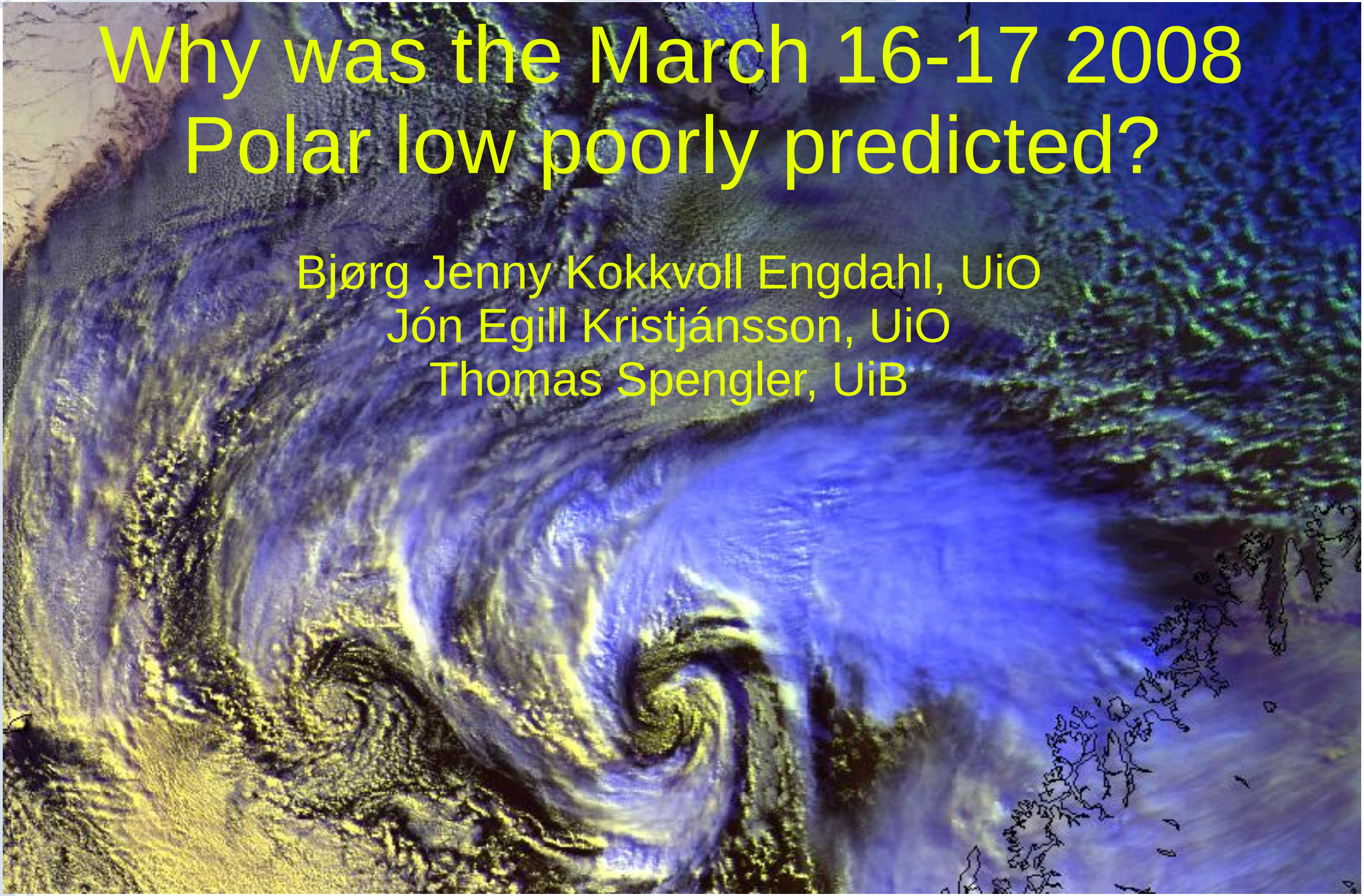
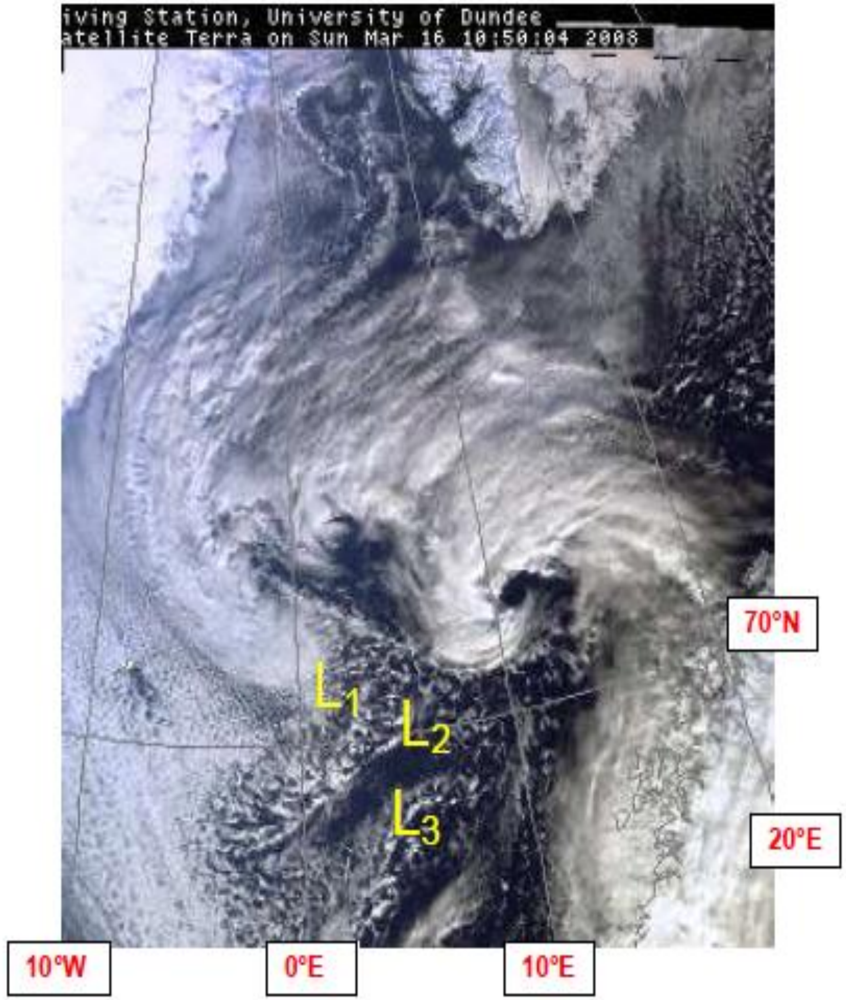


NOAA-16 (SAF_NE)day_night 1508 UTC March 16 2008

The March 16-17 polar low

- Occurred at the end of the IPY-THORPEX Andøya field campaign.
- Developed rapidly during the night of March 15-16.
- Poorly forecasted by the operational models.
- Made landfall at the coast of Trøndelag (63.5N, 10E), around 1200 UTC on March 17.

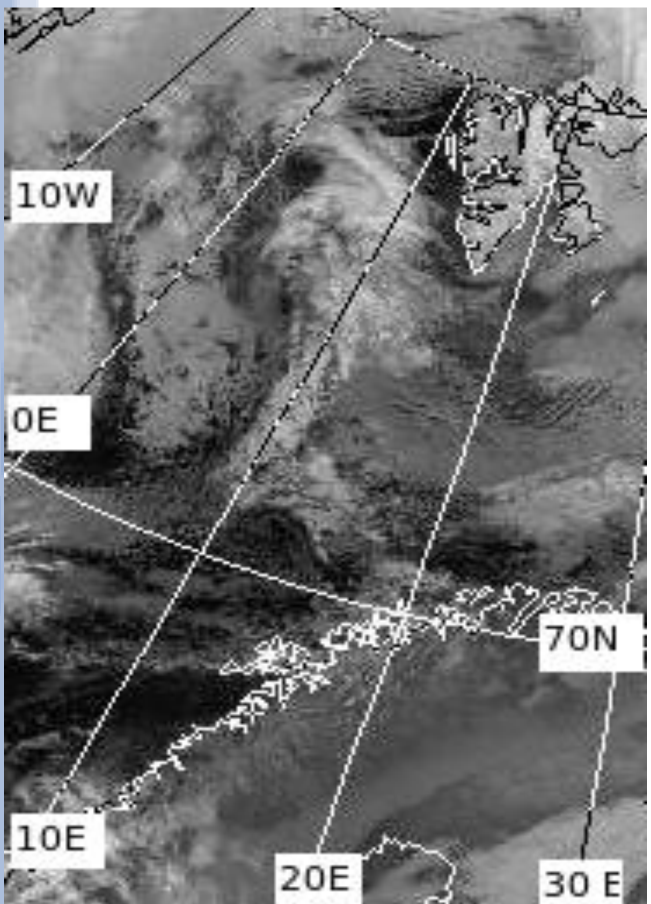


From Kristjánsson et al. (2011): BAMS

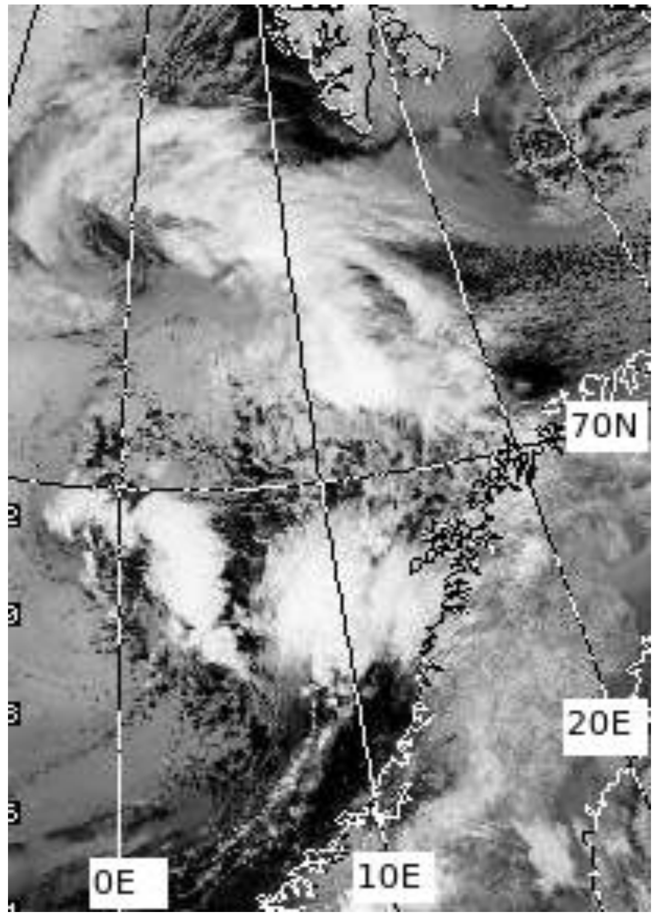
Methodology

- Analyse the weather conditions prior to and during cyclogenesis
- Discuss possible trigger, propagation and forcing mechanisms
- Use the Weather Research and Forecasting (WRF) model to simulate the low: Perform several sensitivity experiments considering the importance of initial times, resolution and different parametrization options for physics, as well as the role of latent heating and contribution from surface fluxes.

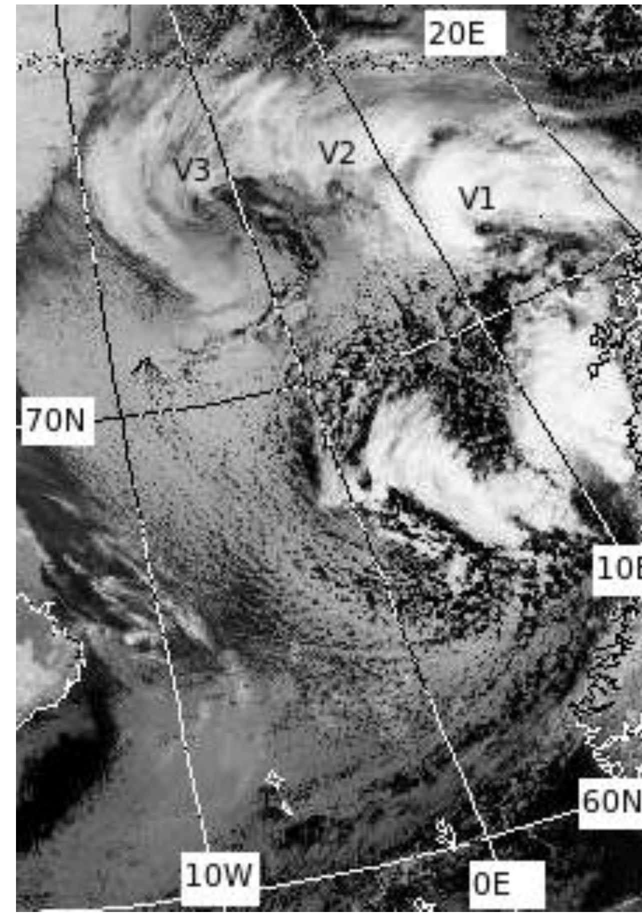
NOAA IR-satellite images



1112 UTC March 15

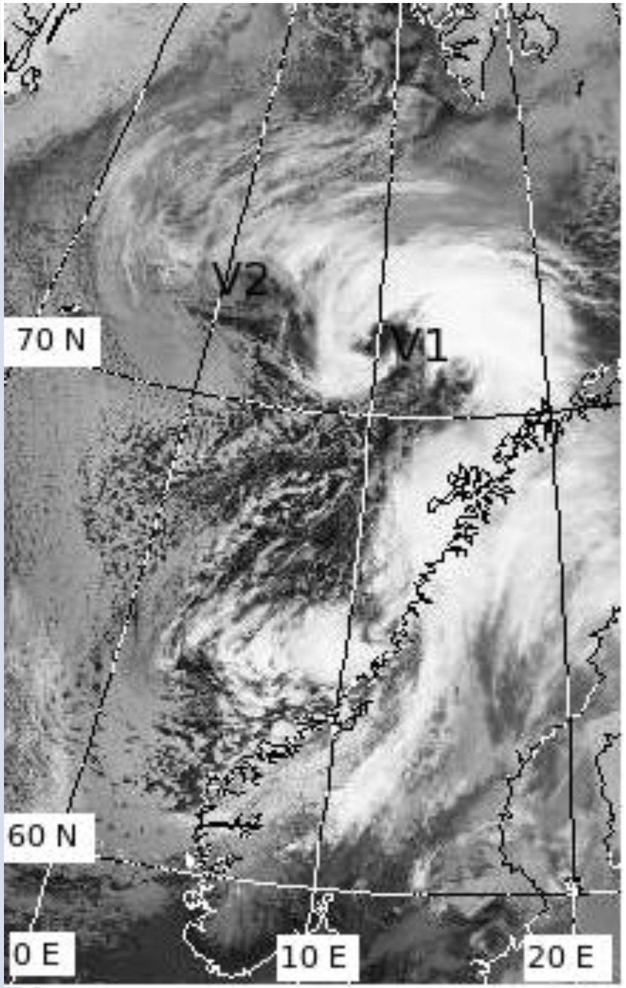


0115 UTC March 16

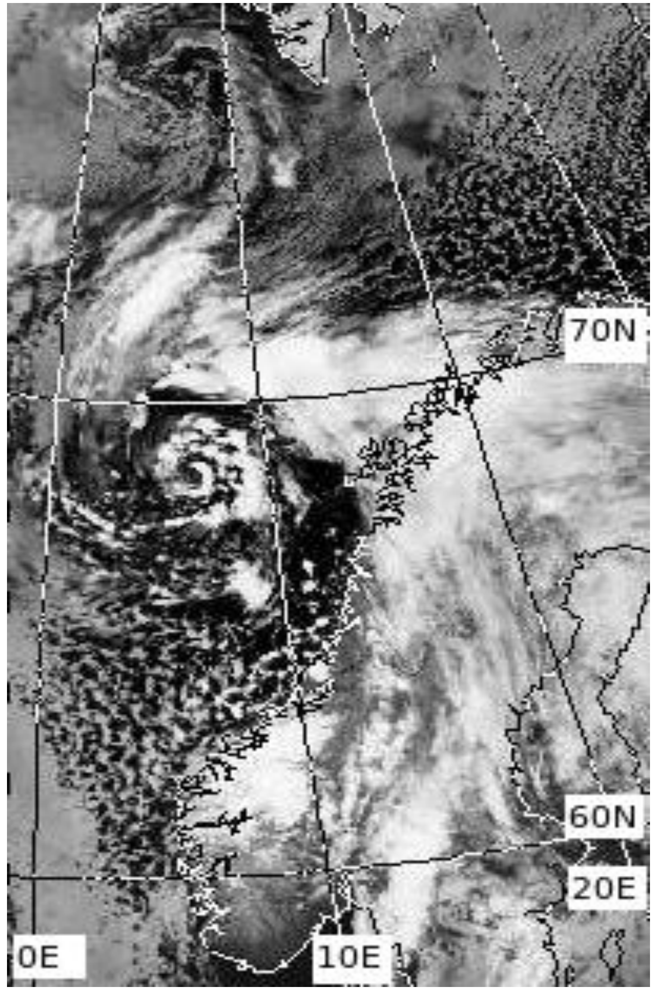


0608 UTC March 16

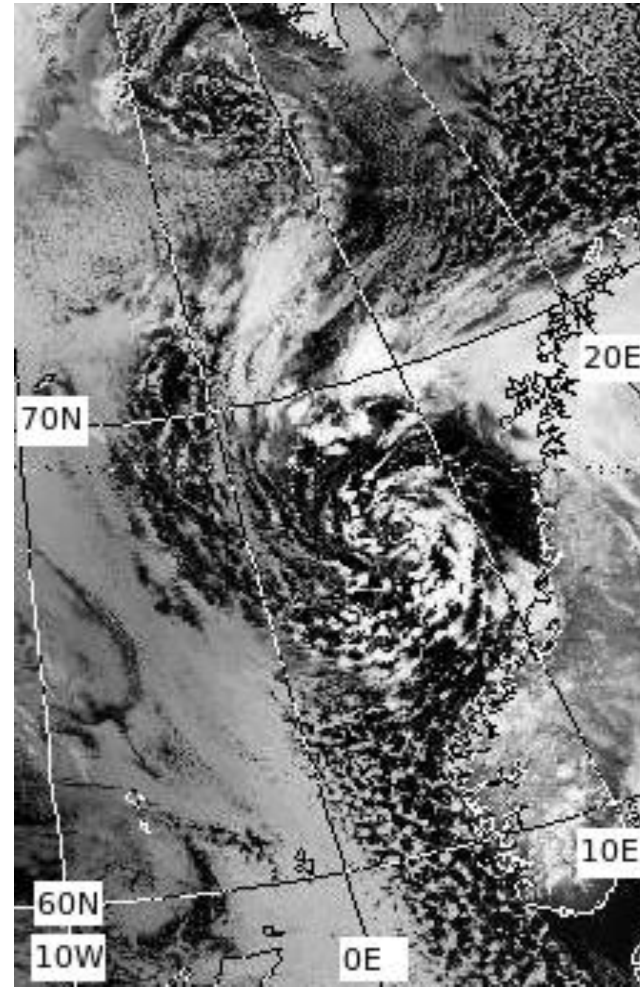
NOAA IR-satellite images



1110 UTC March 16

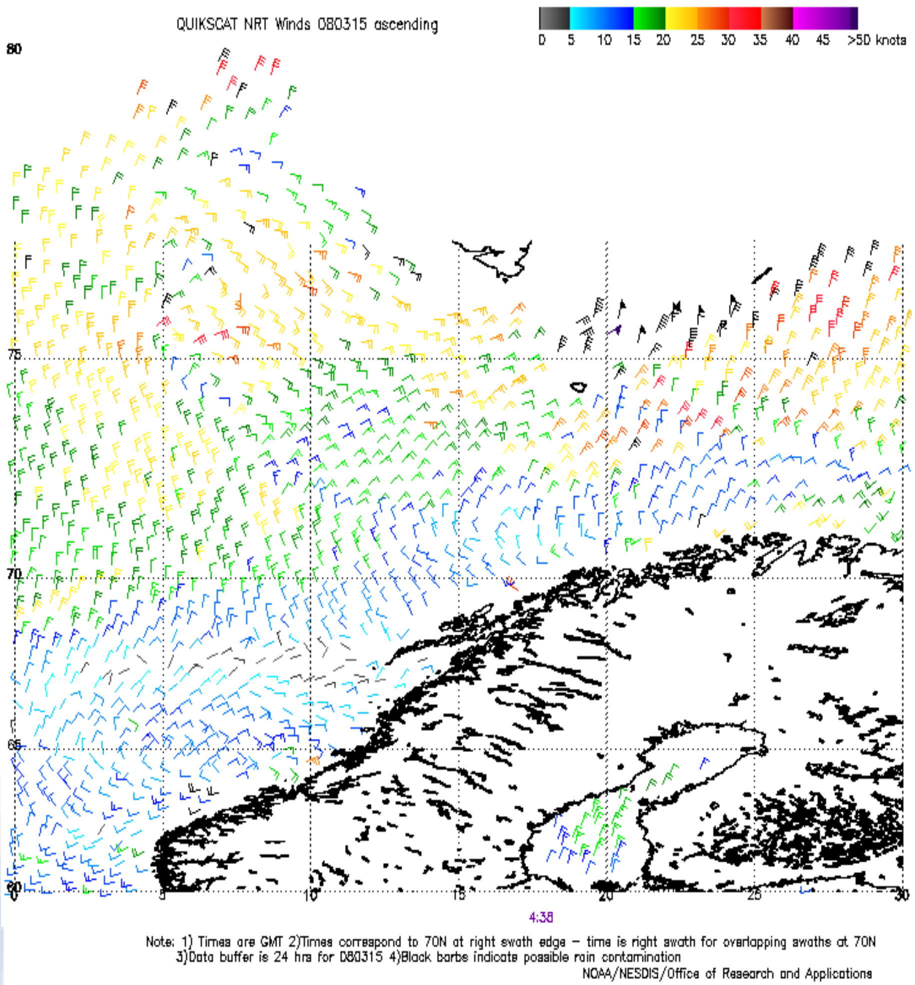


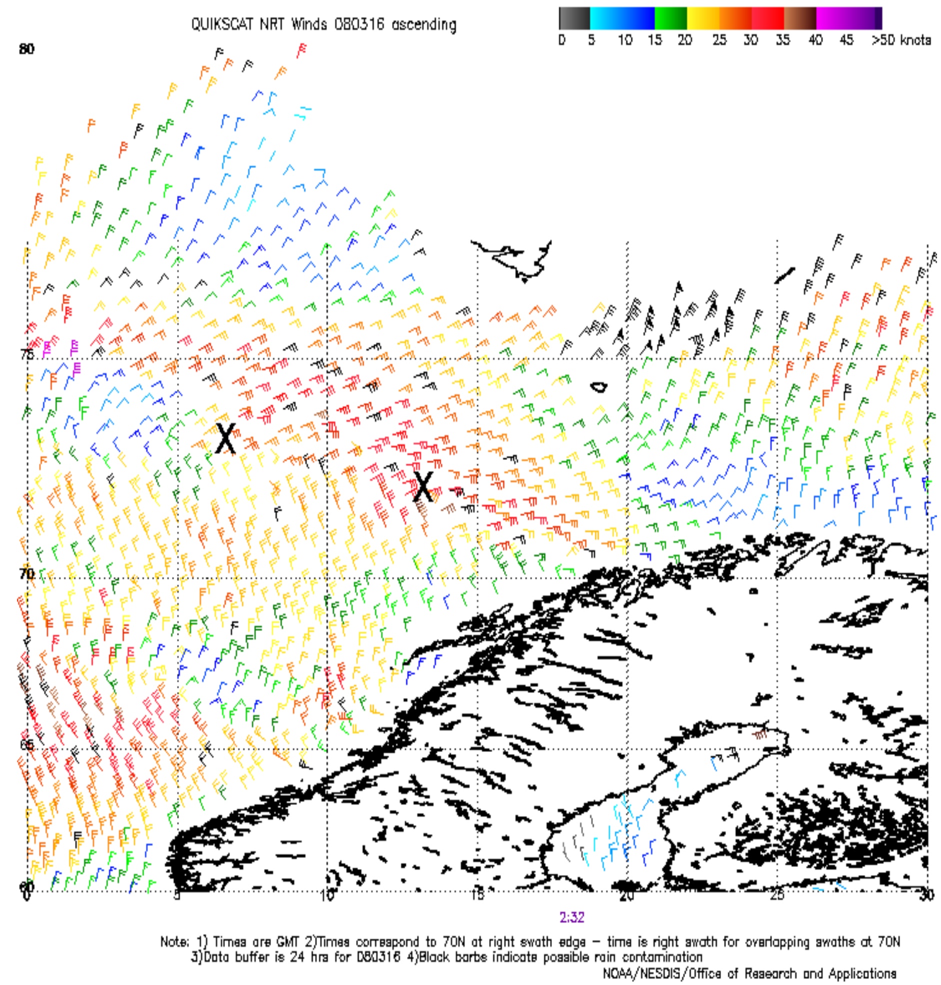
0104 UTC March 17



0544 UTC March 17

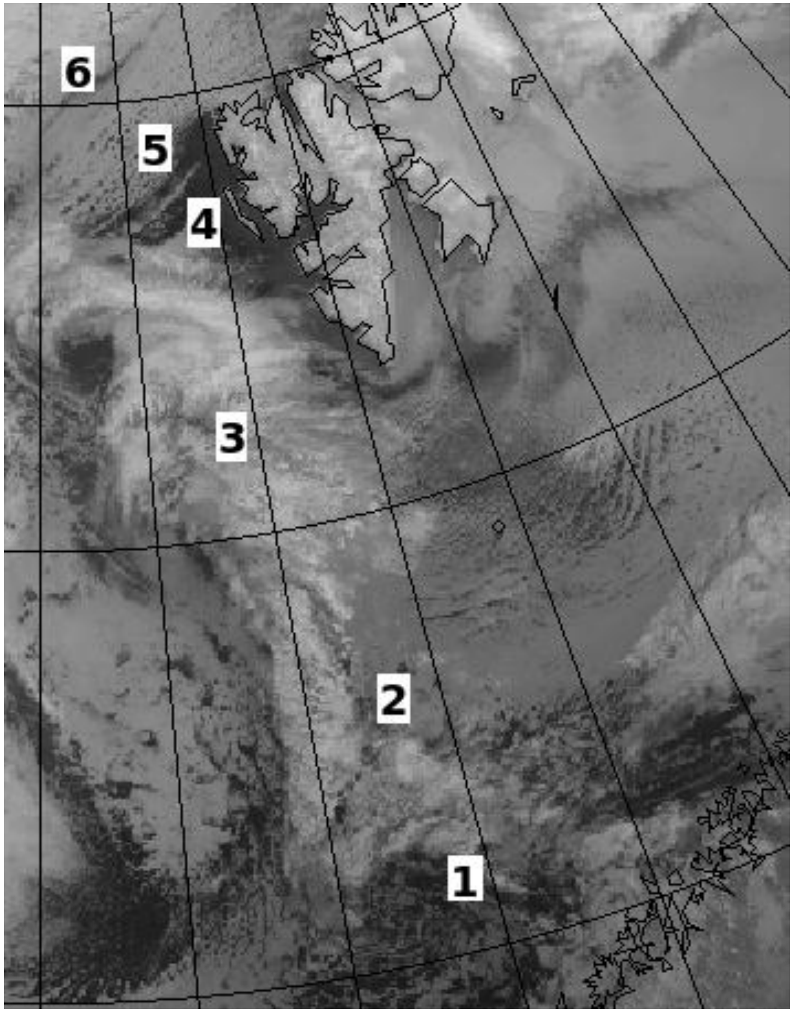
Scatterometerdata





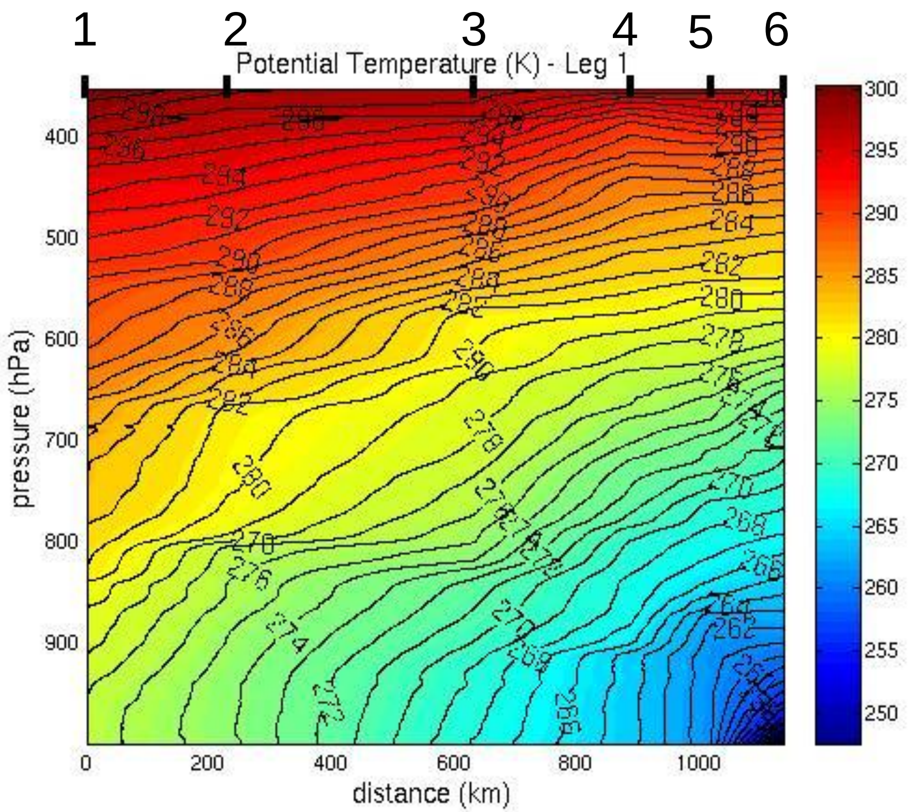
QuickScat SeaWinds data from March 15 (left) and 16 (right)

Dropsondes from March 15

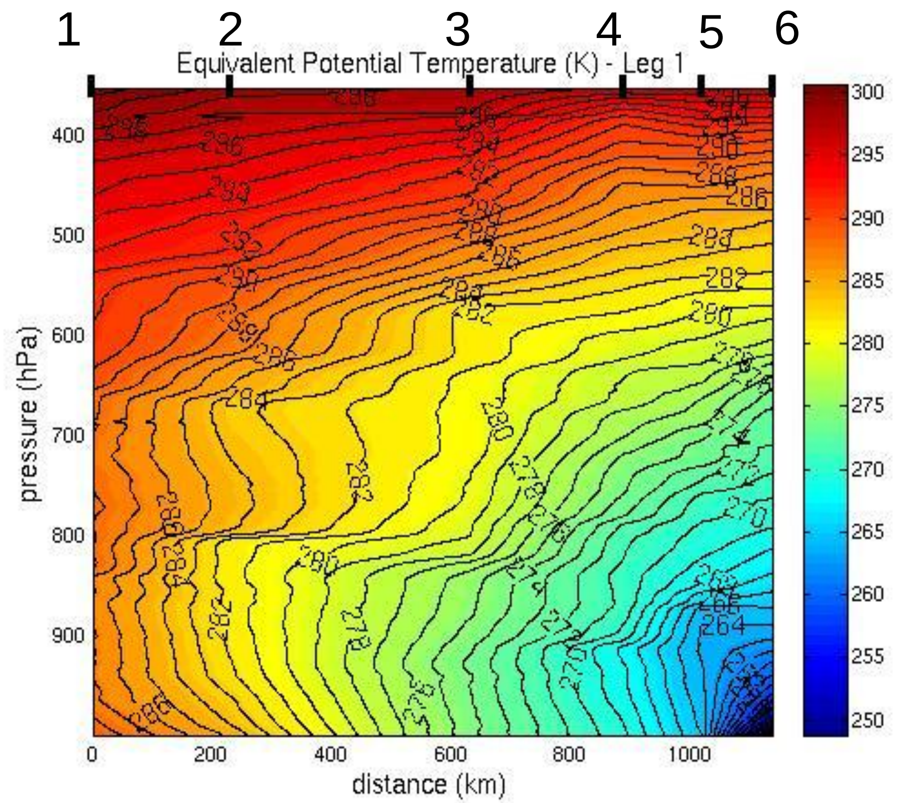


- Positions of the dropsondes. NOAA 4 IR-satellite image from 1113 UTC March 15.

Dropsondes from March 15

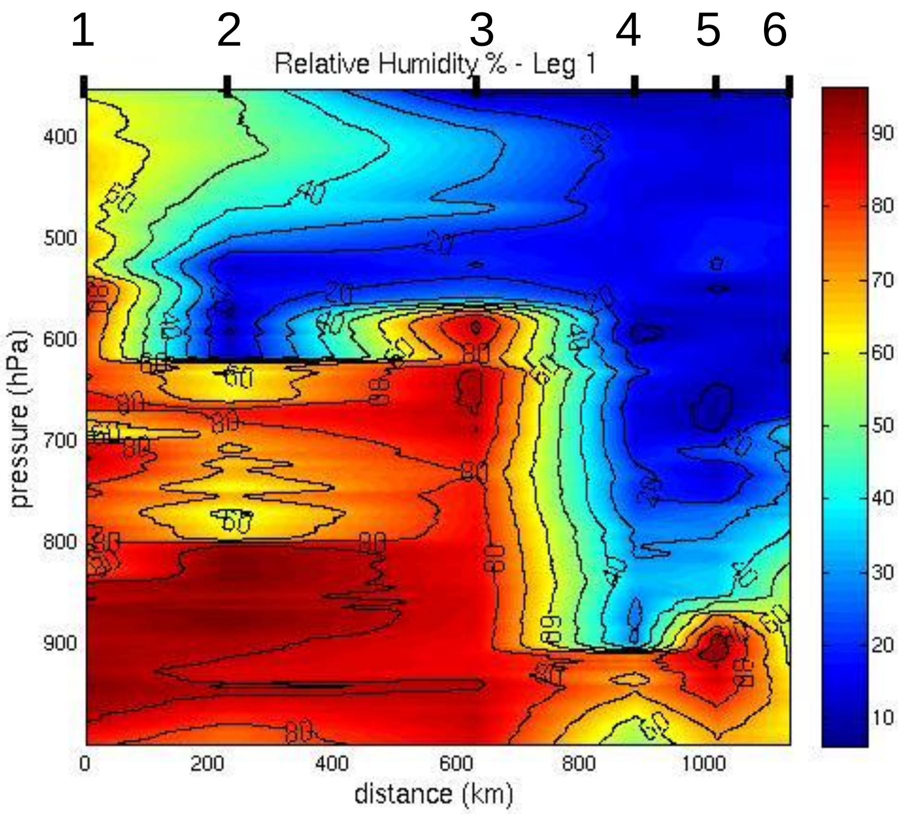


Potential temperature

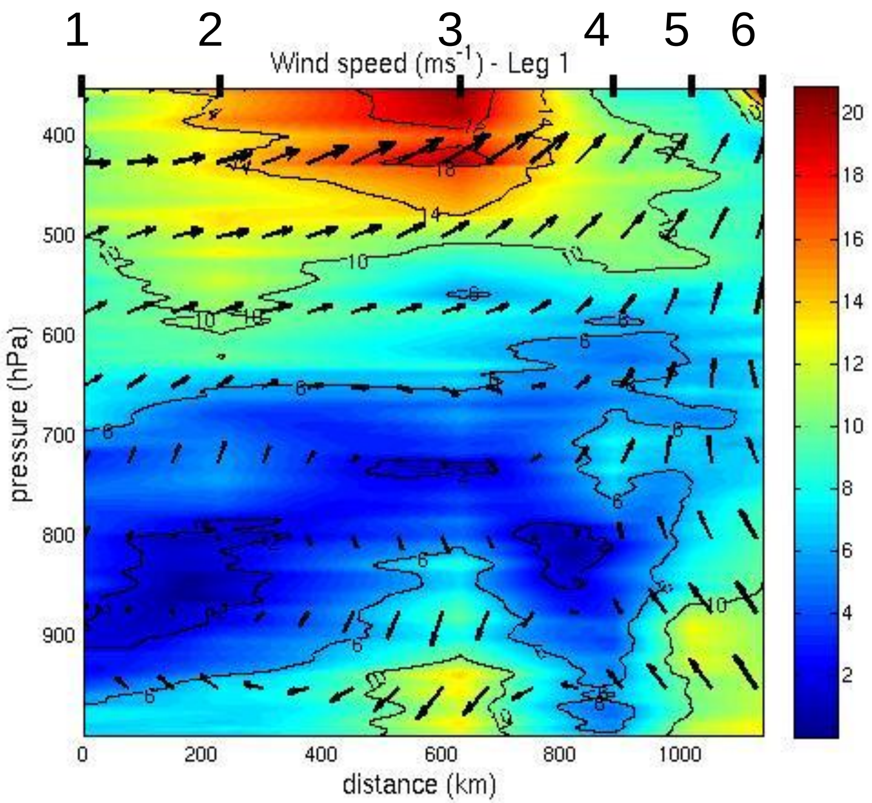


Equivalent potential temperature

Dropsondes from March 15

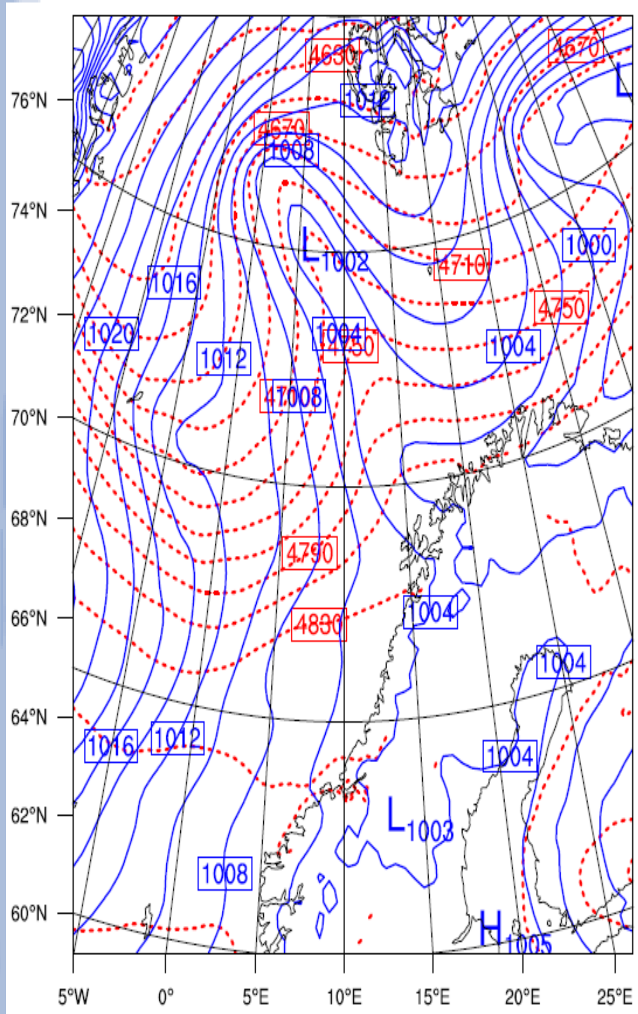


Relative humidity RH

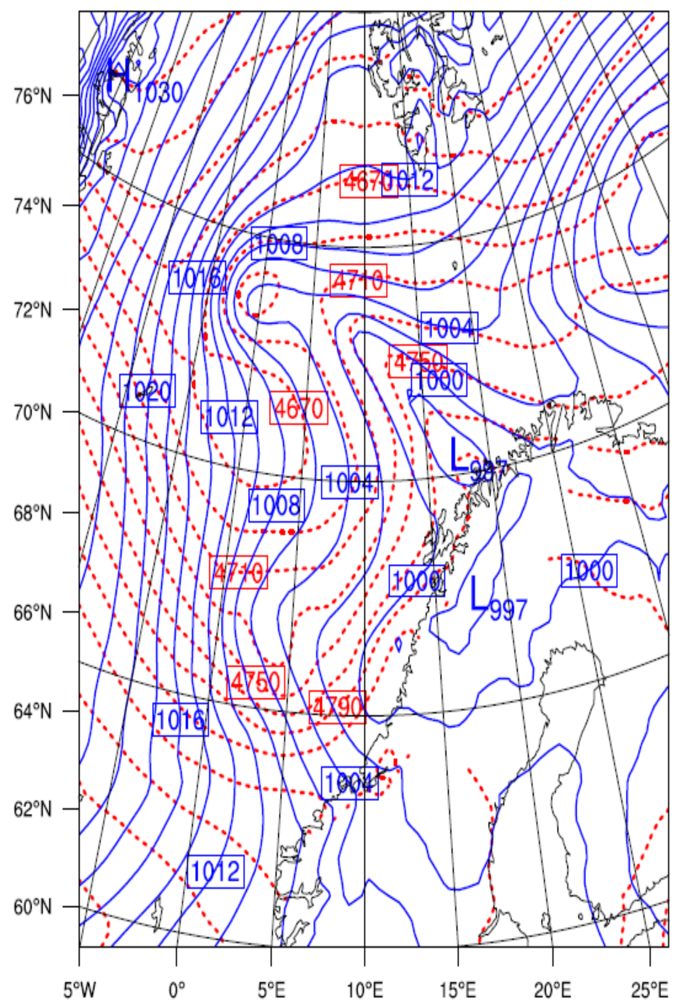


Horizontal wind

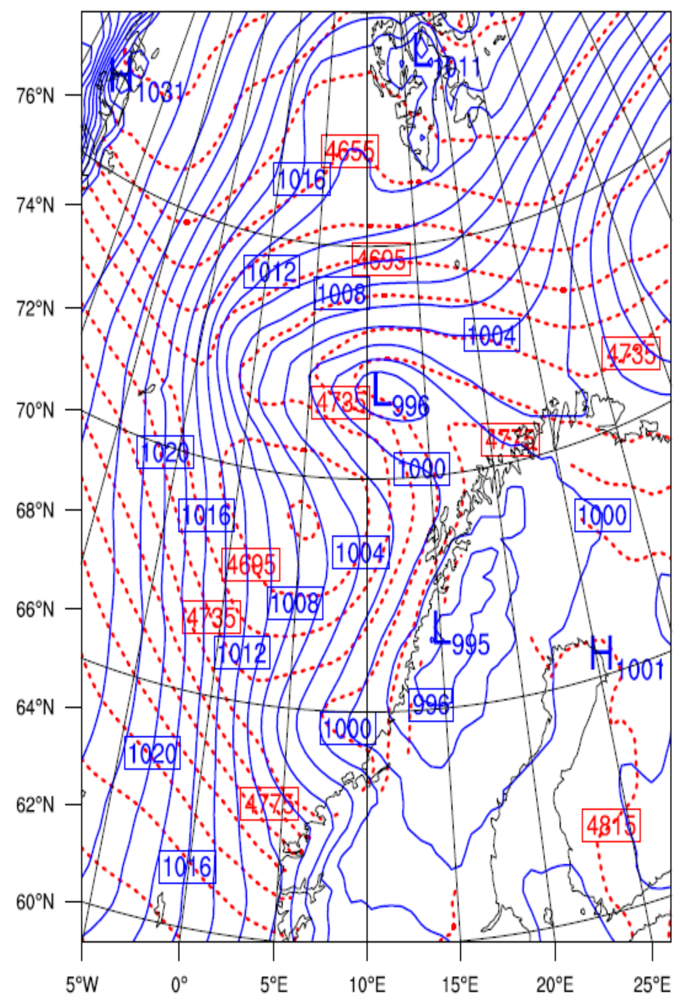
ECMWF-analysis: 950-500hPa thickness (red) and surface pressure (blue)



1800 UTC March 15

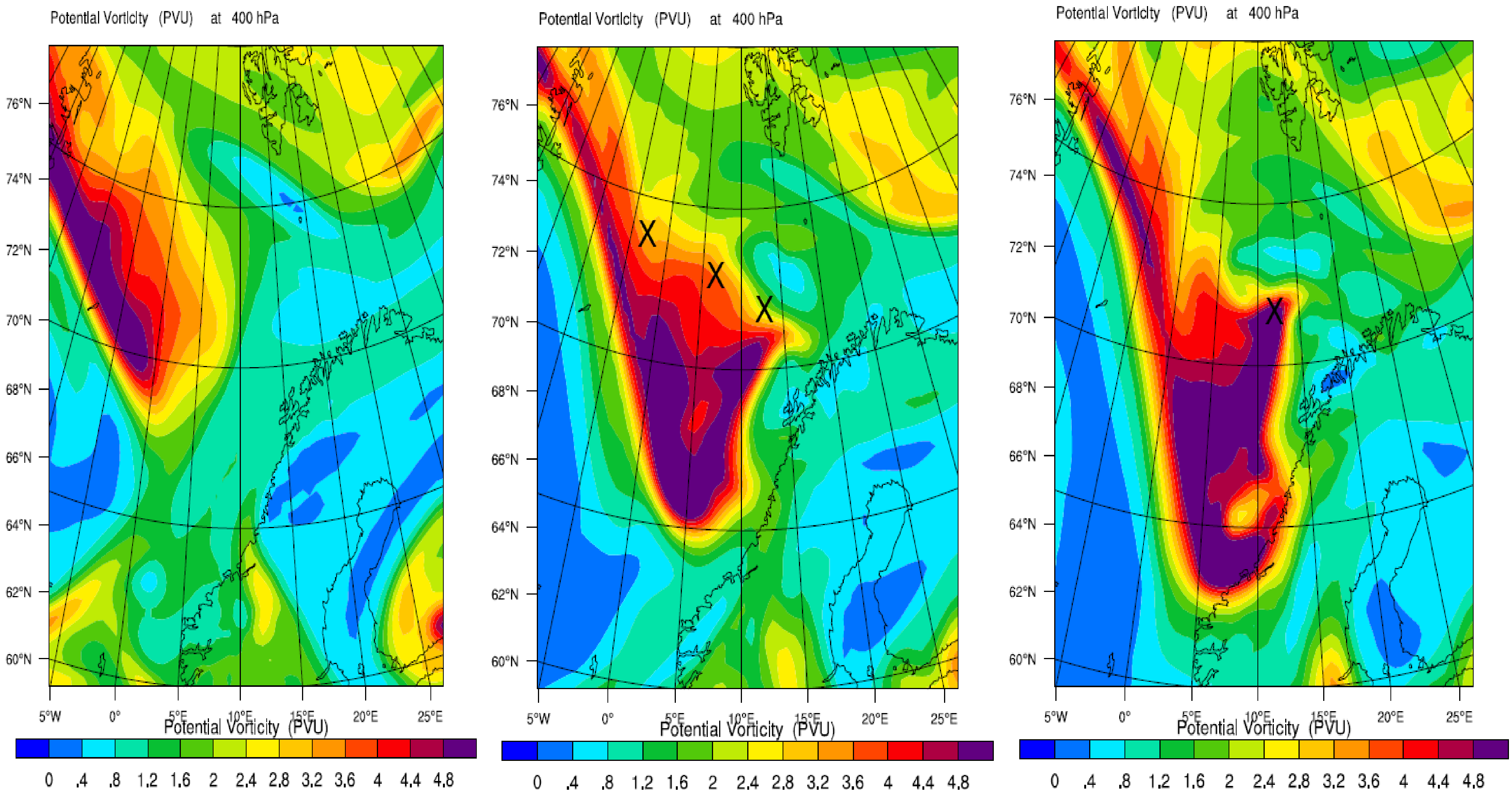


0600 UTC March 16



1200 UTC March 16

ECMWF-analyses: Upper-level PV (400hPa)

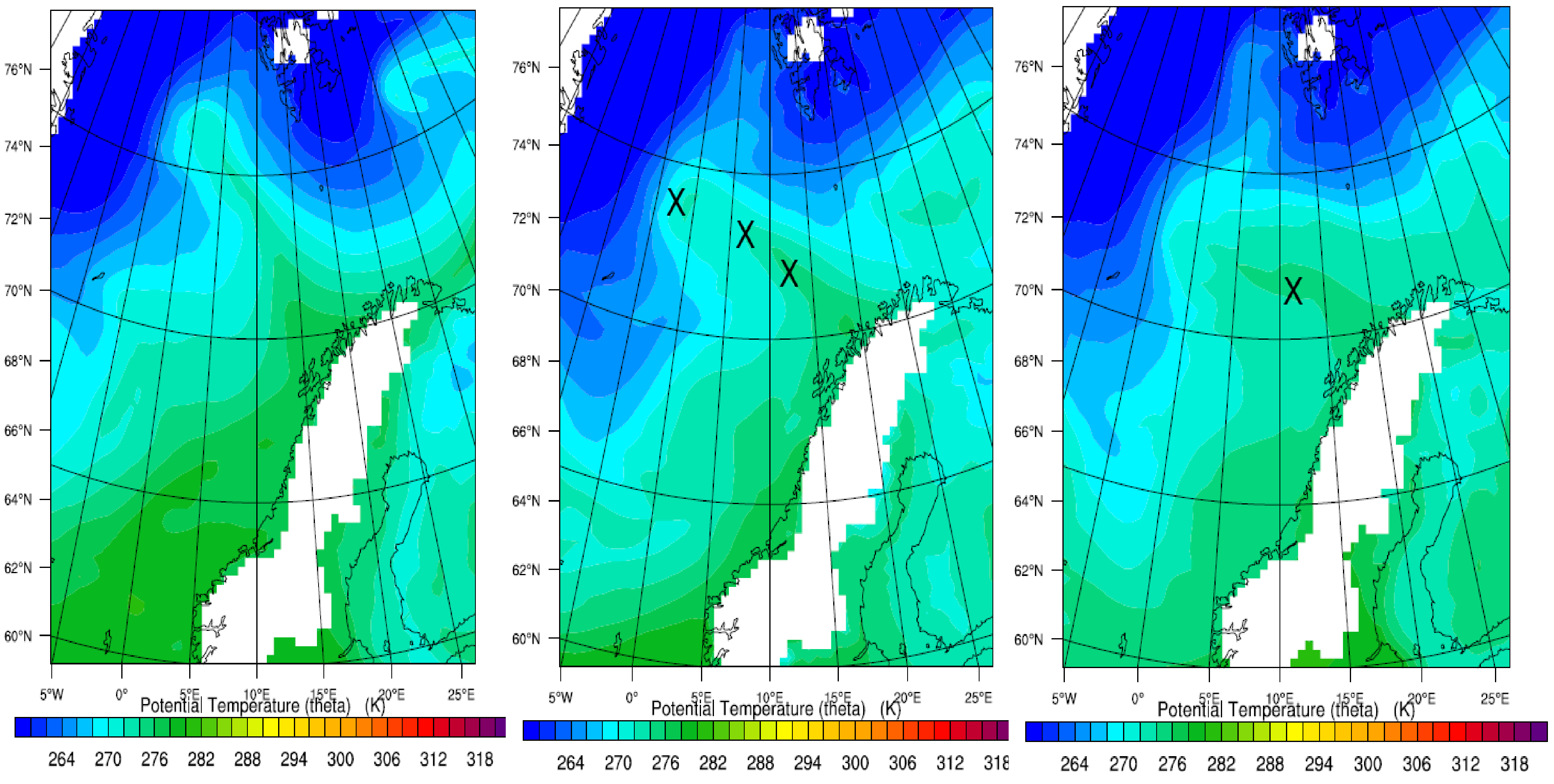


1800 UTC March 15

0600 UTC March 16

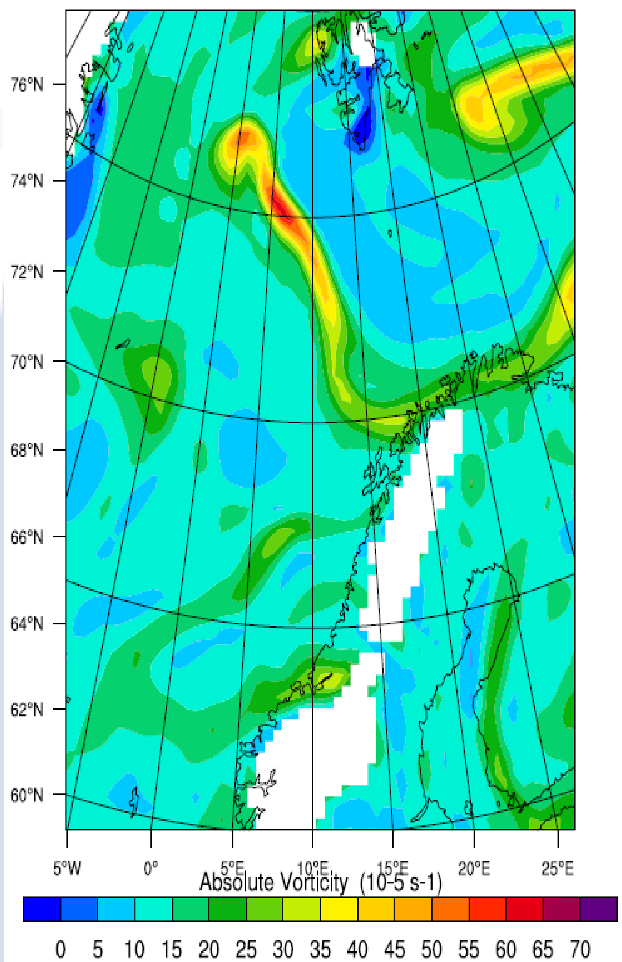
1200 UTC March 16

Low-level pot. temperature (950hPa)

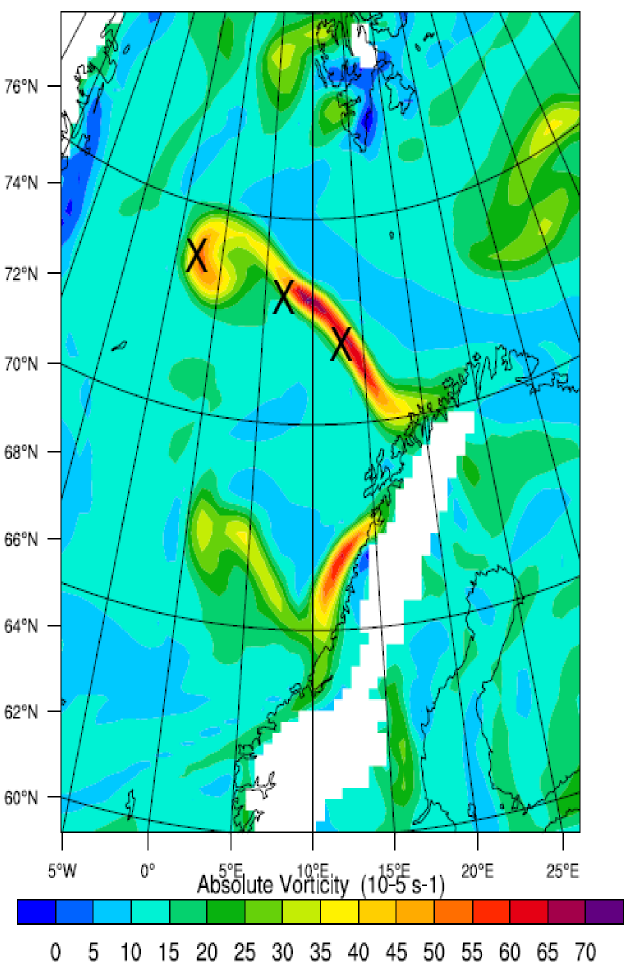


1800 UTC March 15 0600 UTC March 16 1200 UTC March 16

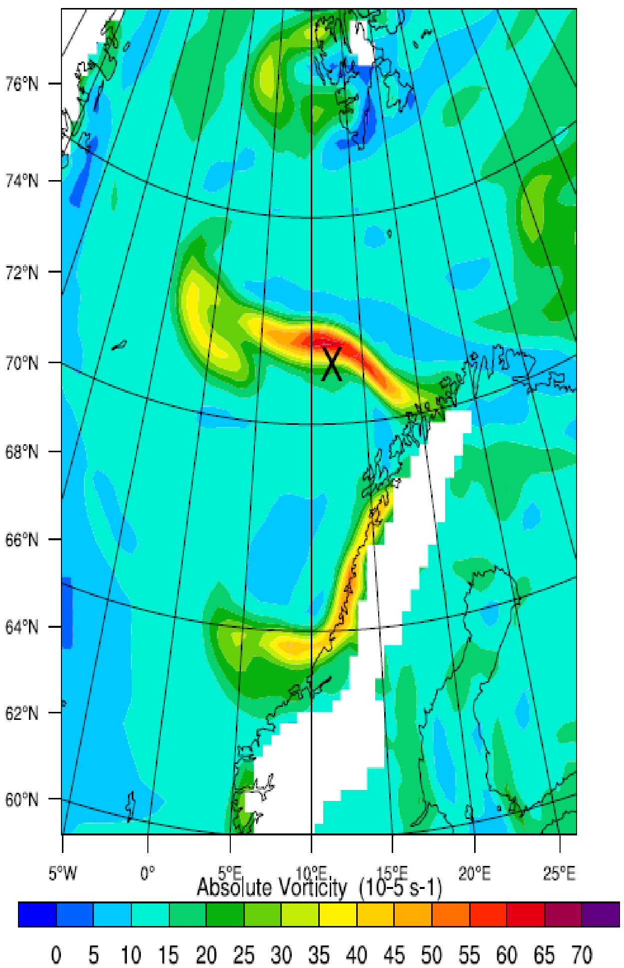
Absolute Vorticity at 925 hPa



1800 UTC March 15



0600 UTC March 16

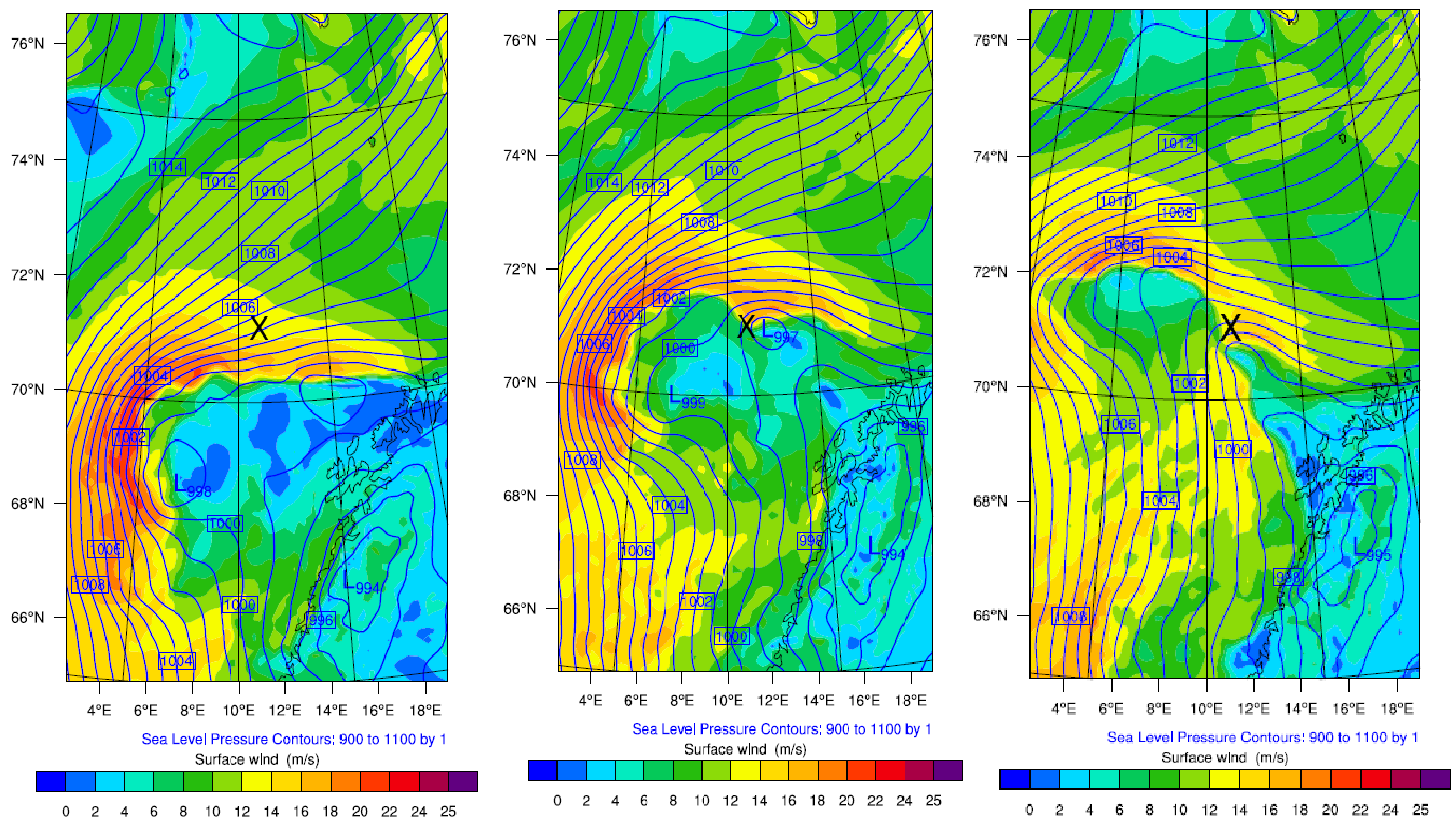


1200 UTC March 16

Simulations

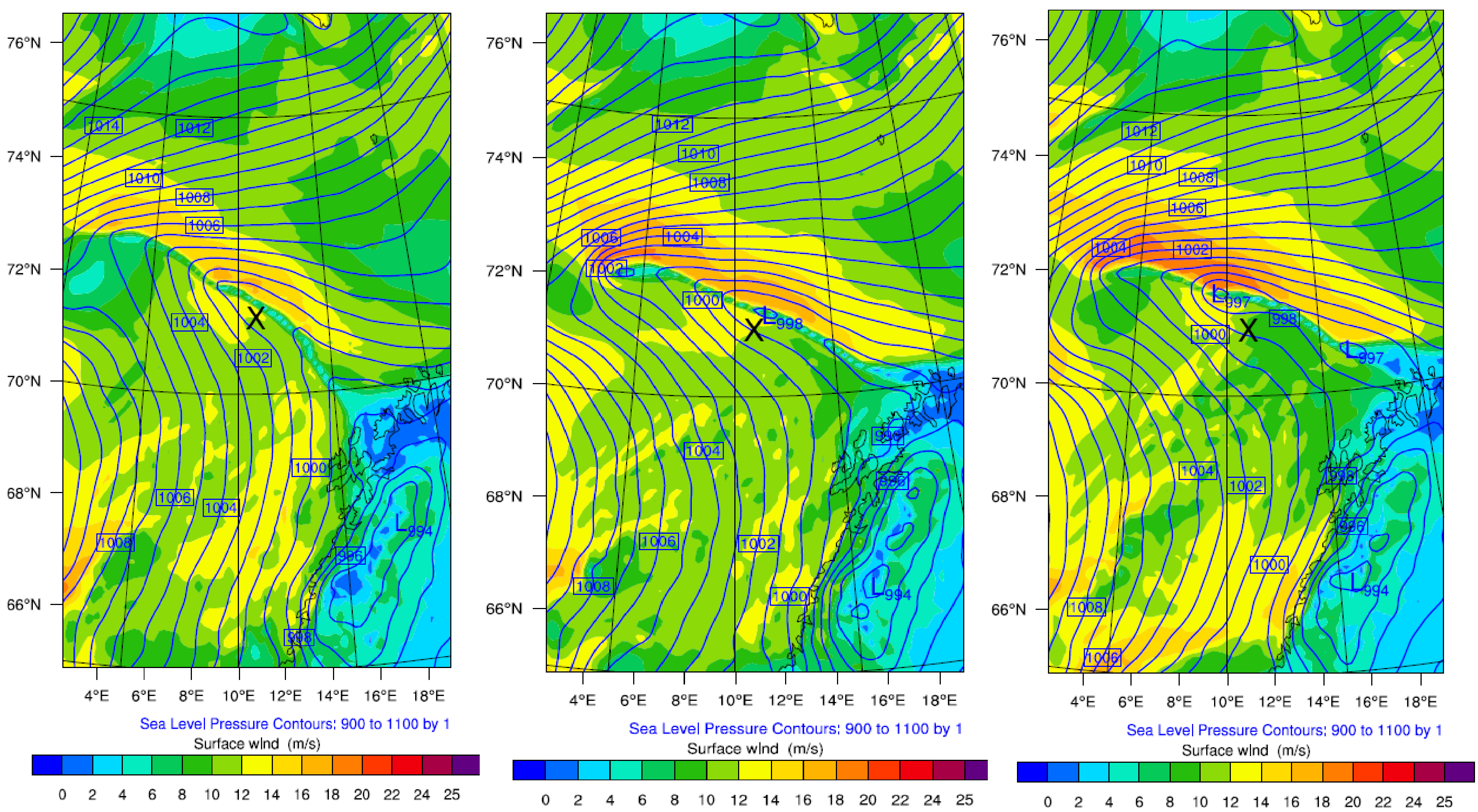
Configuration	Initialisation	Grid spacing d01, d02	Comments
1300	0000 UTC March 13	30km, 10km	
1412	1200 UTC March 14	30km, 10km	
1500	0000 UTC March 15	30km, 10km	
1506	0600 UTC March 15	30km, 10km	
1512	1200 UTC March 15	30km, 10km	
1518	1800 UTC March 15	30km, 10km	
1600	0000 UTC March 16	30km, 10km	
1612	1200 UTC March 16	30km, 10km	
1700	0000 UTC March 17	30km, 10km	
1500HR	0000 UTC March 15	9km, 3km	
1600HR	0000 UTC March 16	9km, 3km	
15MP	0000 UTC March 15	30km, 10km	WSM6 MP
15CU	0000 UTC March 15	30km, 10km	Kain-Fritsch CU
15PBL	0000 UTC March 15	30km, 10km	MYNN PBL
15LH	0000 UTC March 15	30km, 10km	In-cloud LH, off
15SF	0000 UTC March 15	30km, 10km	Surface flux, off

Different initial times: Long lead-times: SLP and Wind speed



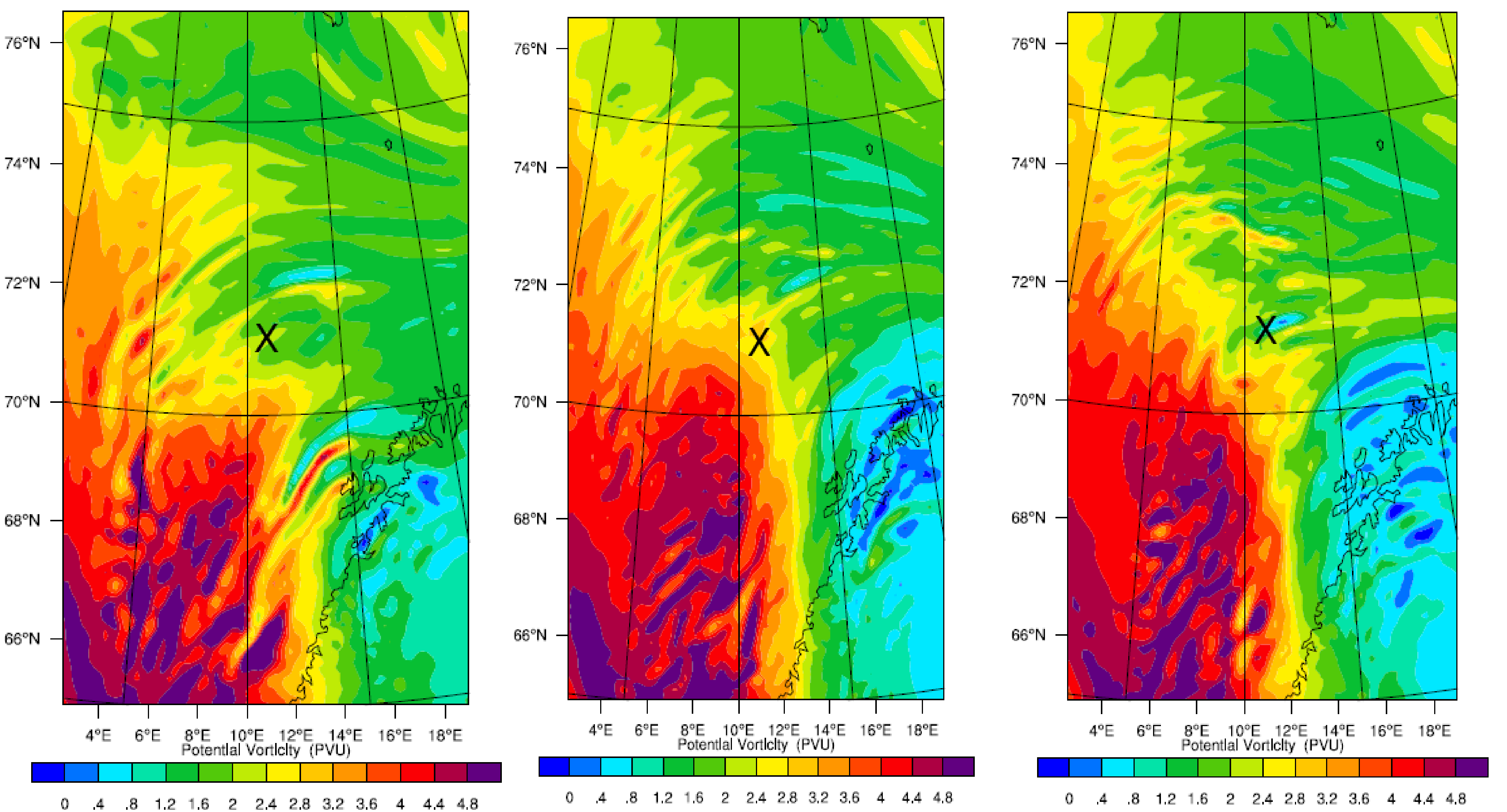
Simulations at 1200 UTC March 16: +48h, +36h and +30h

Different initial times: Short lead-times: SLP and Wind speed



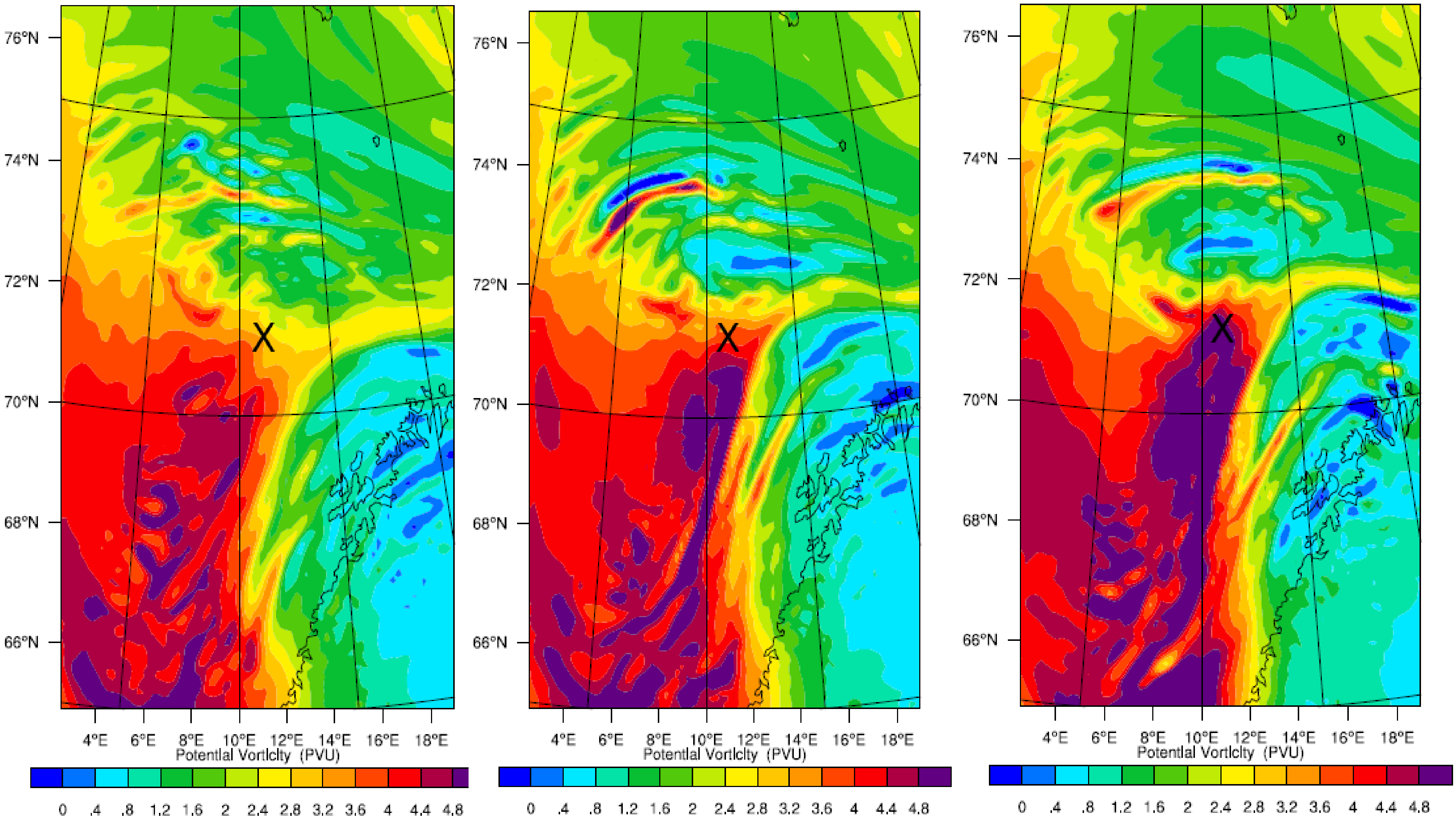
Simulations at 1200 UTC March 16: +24h, +18h and + 12h

Different initial times: Long lead-times: UPV



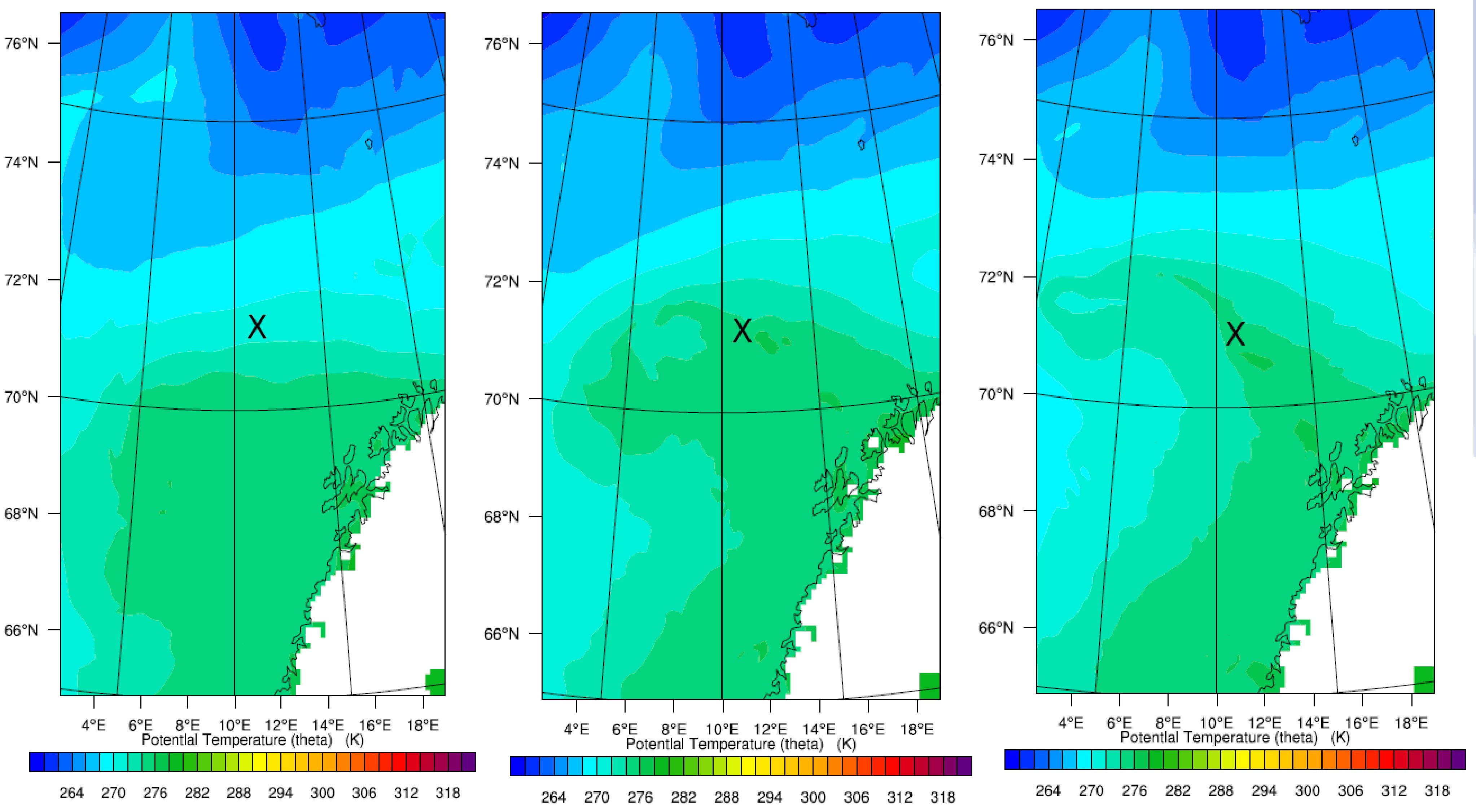
Simulations at 1200 UTC March 16: +48h, +36h and +30h

Different initial times: Short lead-times: UPV



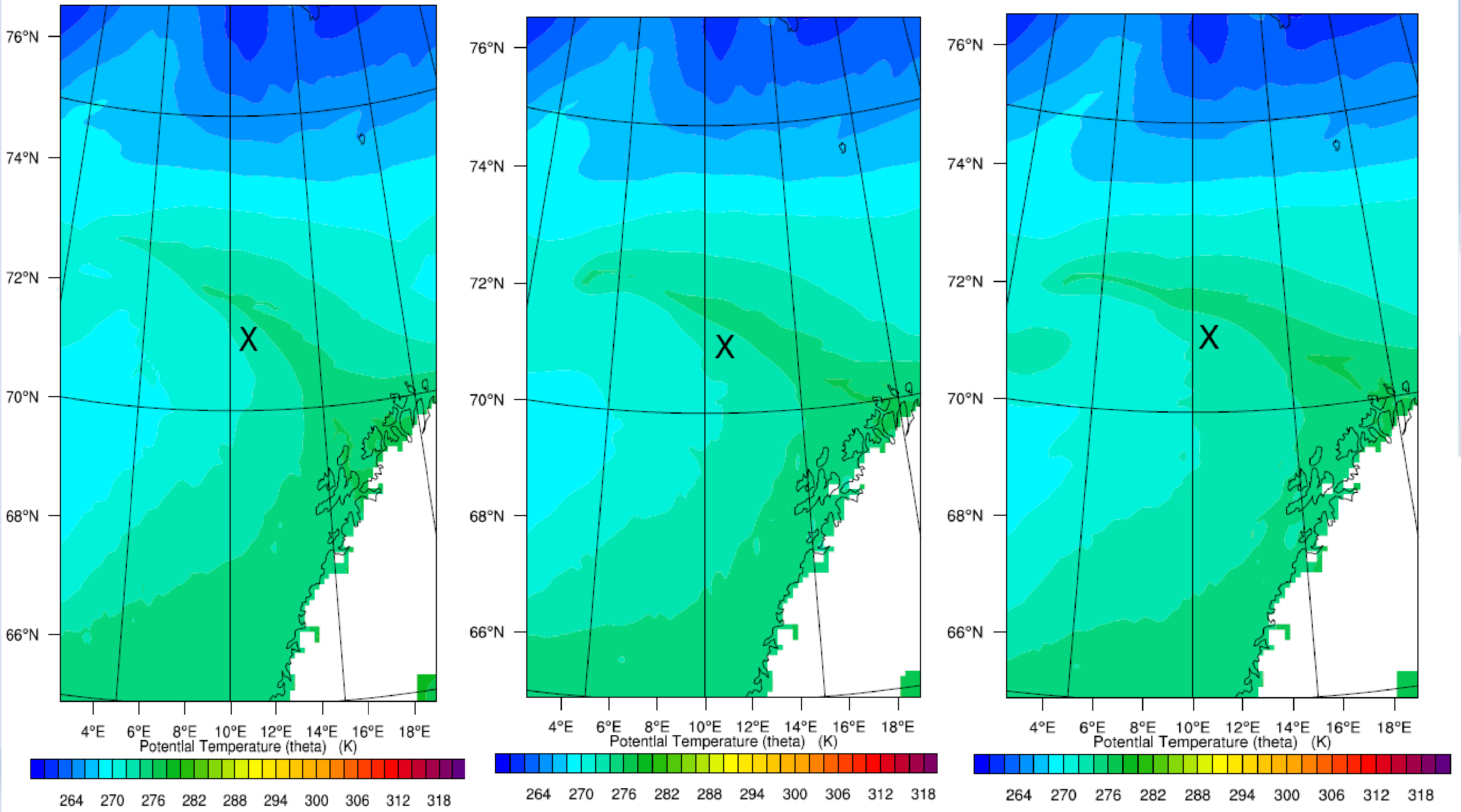
Simulations at 1200 UTC March 16: +24h, +18h and + 12h

Different initial times: Long lead-times: low-level pot.temp



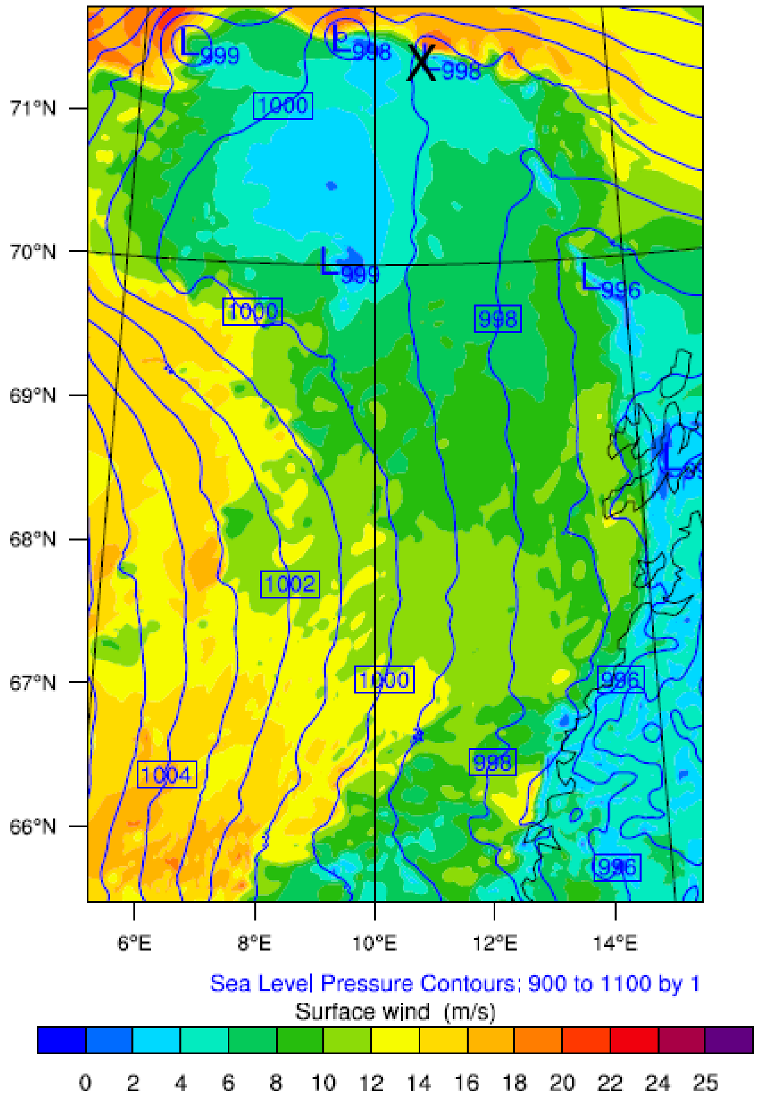
Simulations at 1200 UTC March 16: +48h, +36h and + 30h

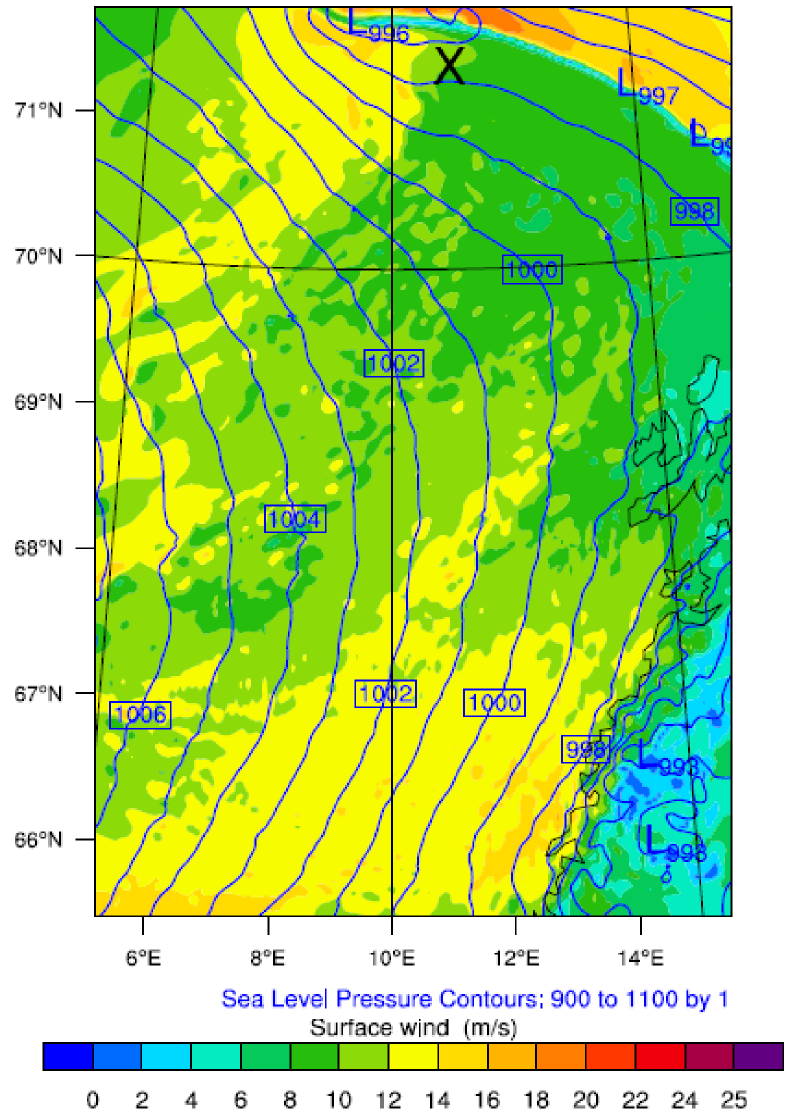
Different initial times: Short lead-times: Low-level pot.temp



Simulations at 1200 UTC March 16: +24h, +18h and + 12h

High resolution simulations

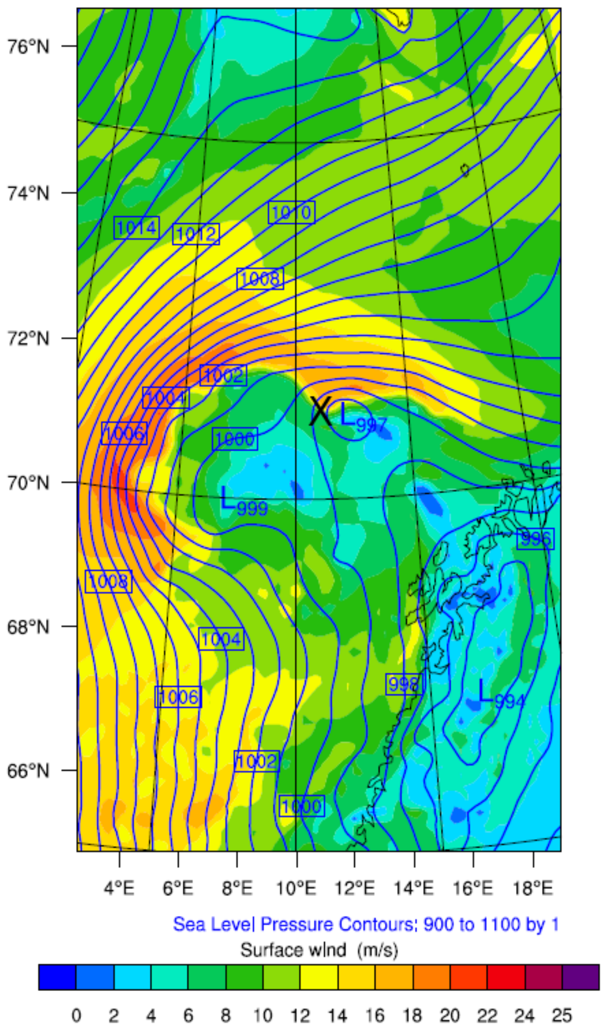




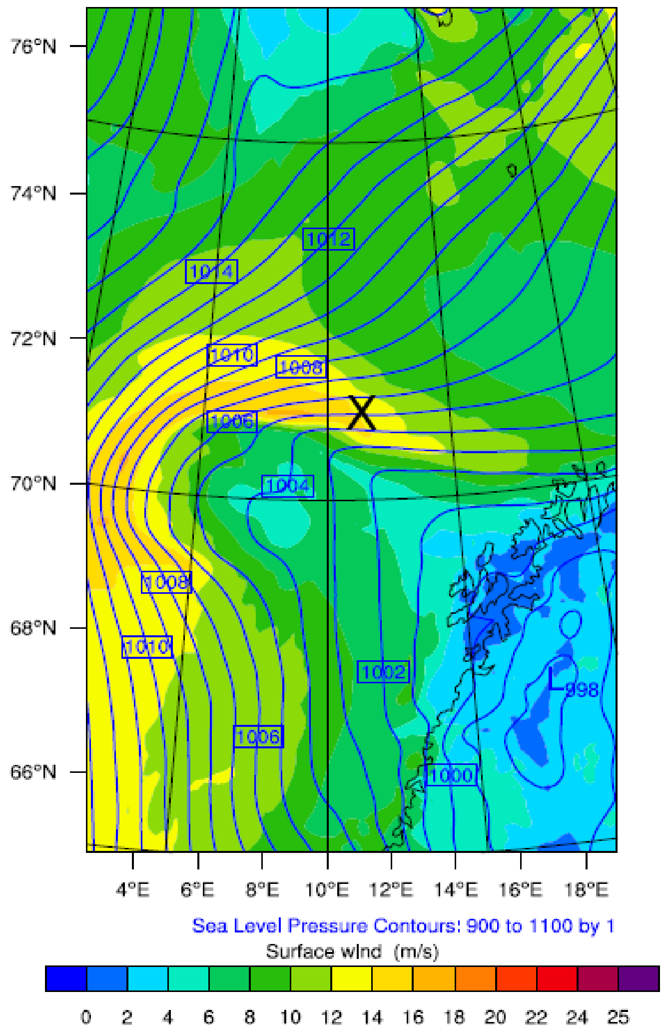
Simulations at 1200 UTC March 16: +36h and +12h

Different physical parametrizations

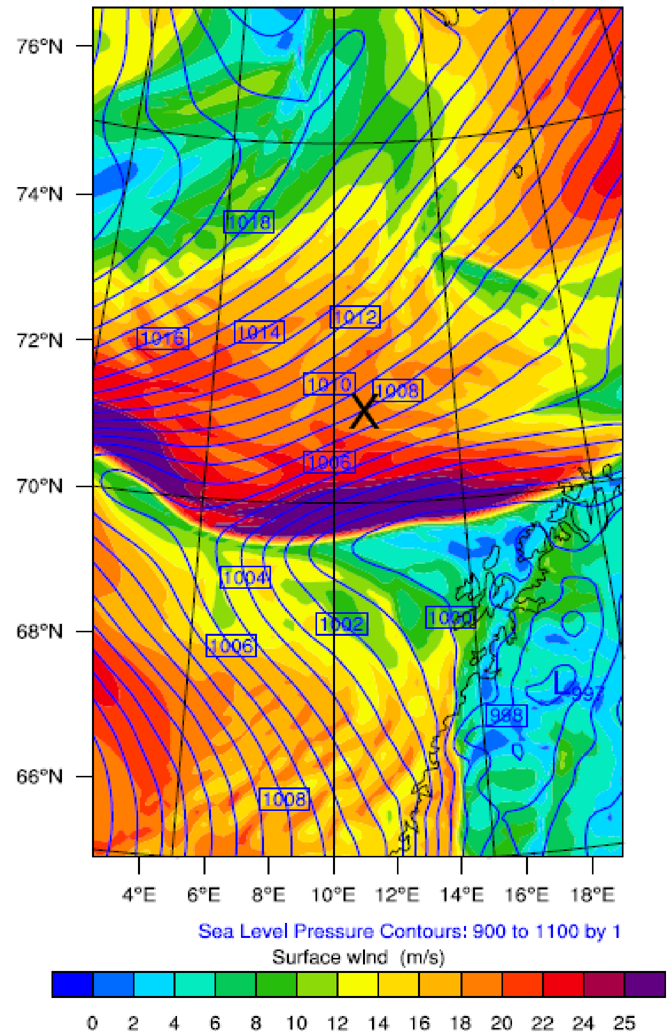
Control run



LH from microphysics turned off



Surface fluxes turned off



Simulations (+36) at 1200 UTC March 16: Control, LH and SF

Conclusions

- Polar low development involved multiple vortices alligned along a low-level absolute vorticity streak
- Convection alligned with high low-level temperatures
- Energy propagation along upper-level PV-gradient?
- Simulations starting after 06 UTC 15 March systematically better than those with longer lead time:

  => Due to dropsondes on 15 March?
- The WRF simulations showed that:
  - Initial conditions, in-cloud latent heating and contribution from surface fluxes are crucial
  - Higher resolution did not improve the results