Strong wind events in Iqaluit: model and observation

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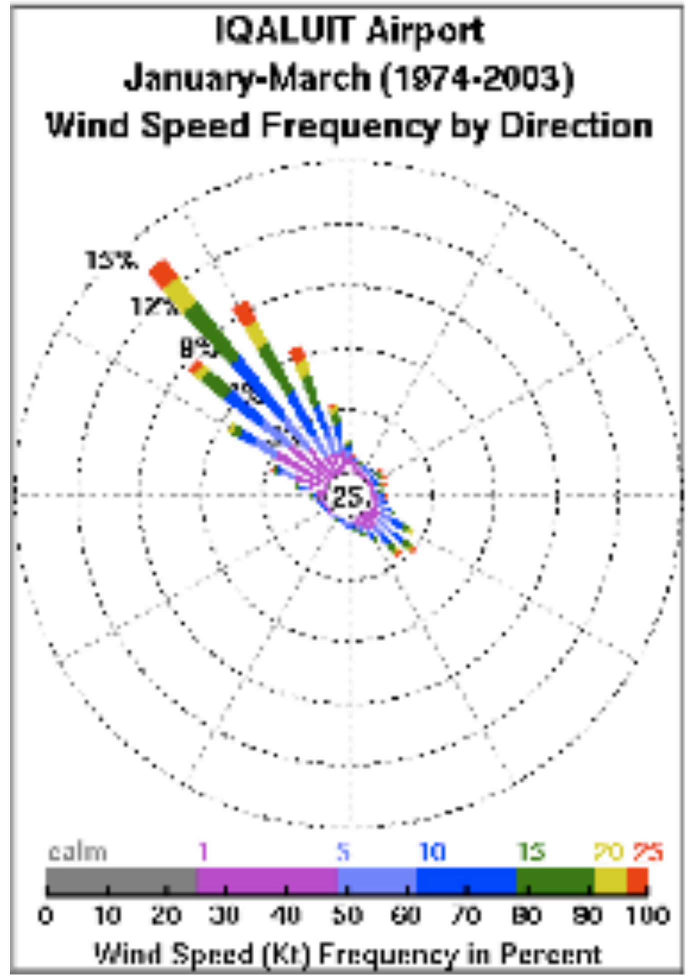
Outline

- Motivation
- General synoptics of the northeasterly
- Model output and comparison
- Summary and conclusions

Motivation

- Northeasterly winds at YFB are rare, but when they occur they're strong
- What causes the wind to shift from NW to NE?
- In general the GEM LAM can have difficulties getting the strong winds to the surface (downslope flow)



February 4, 2007 blizzard

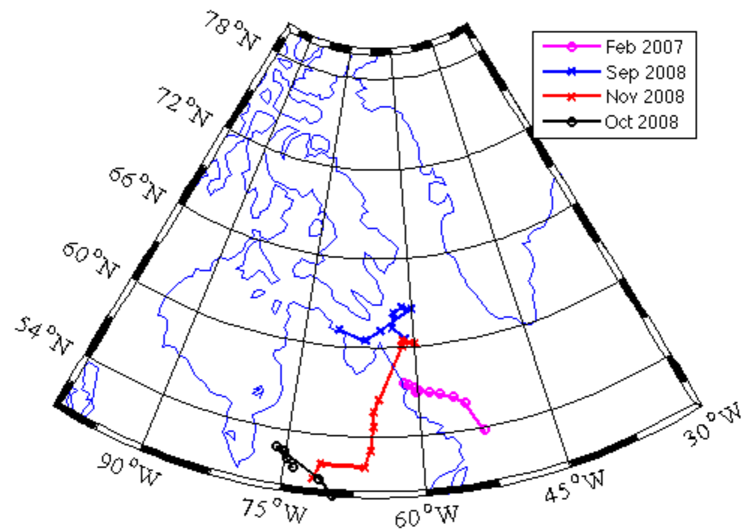
A significant severe weather event in February 2007 was a northeasterly storm.

Video from youtube: http://www.youtube.com/watch?v=esOa-w53e8o

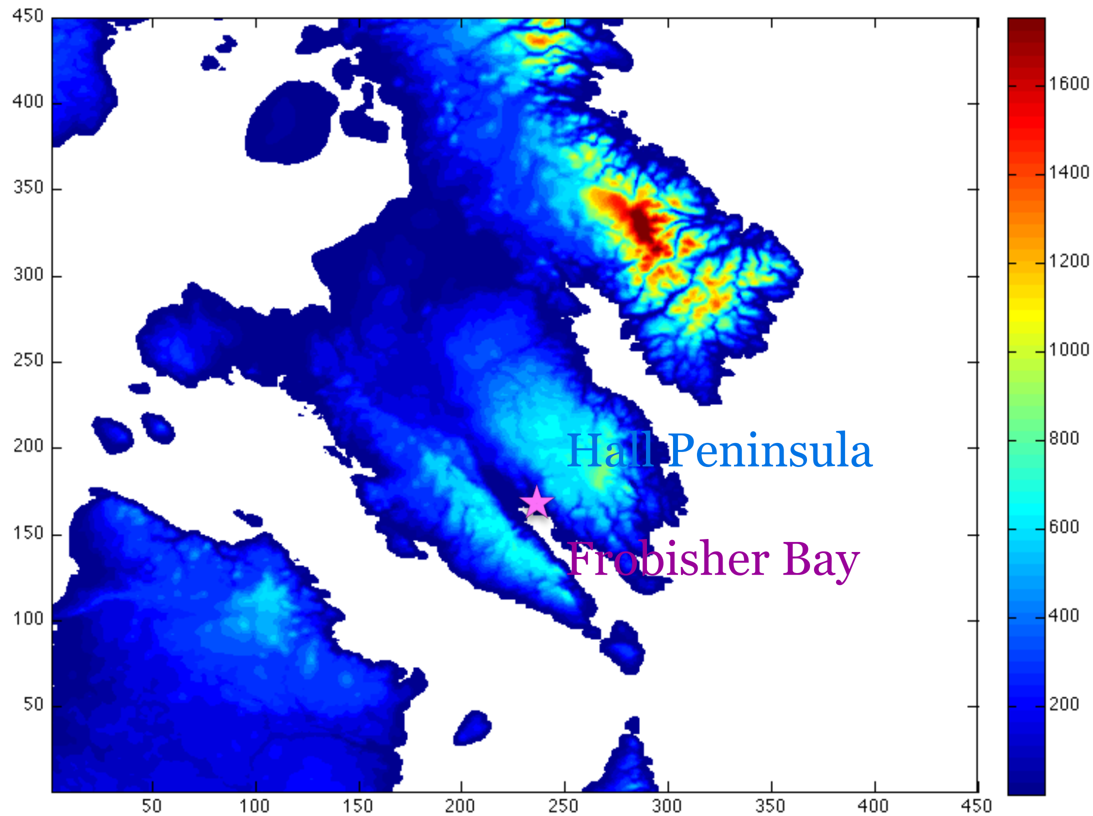
Winds gusted to 130 km/h

Synoptic Overview

- Looking at 4 cases:
  - 12Z 4 February 2007
  - 0Z 17 November 2008
  - 0Z 2 October 2008
  - 12Z 20 September 2008
- In general a pressure gradient is set up along Frobisher Bay and strong downslope winds occur off the Hall Peninsula

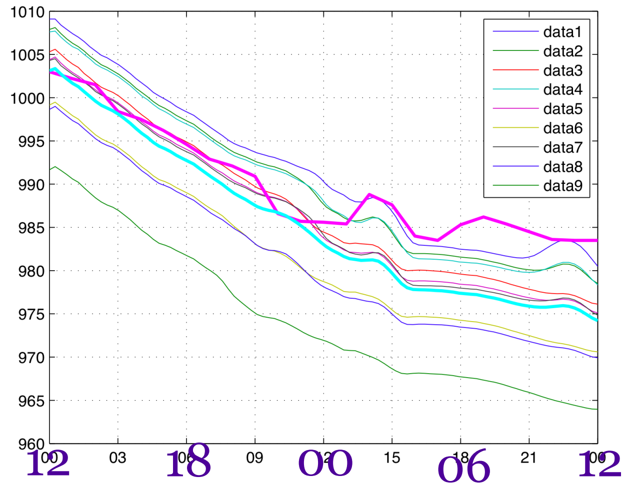


Topography and Model Area

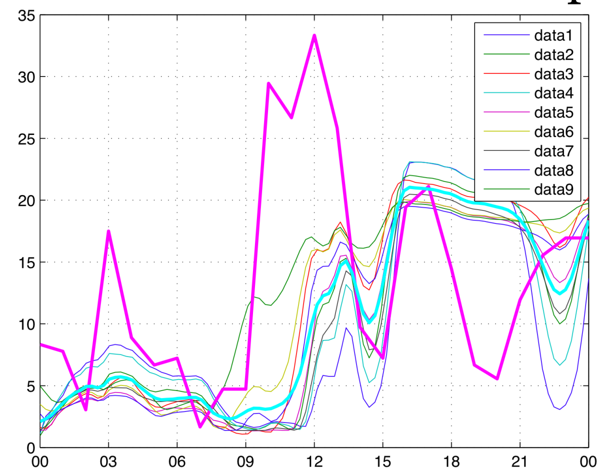


February 2007 YFB Comparisons

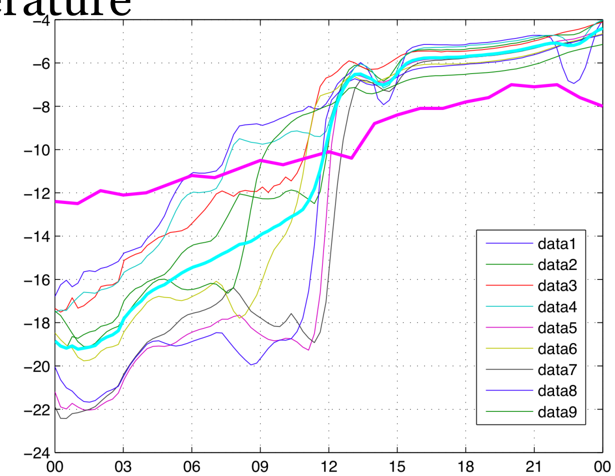
Surface Pressure



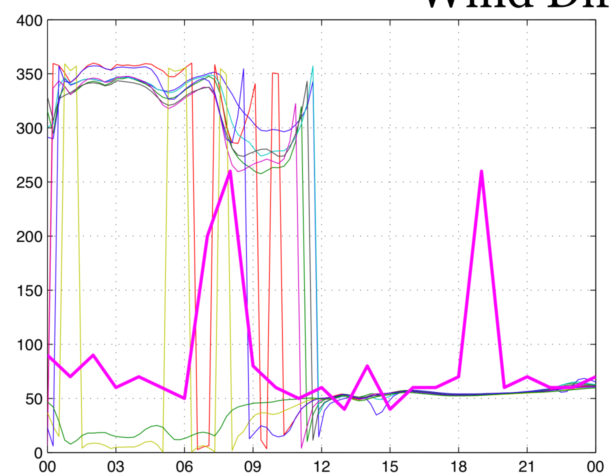
Wind Speed



Temperature



Wind Direction



Surface Feb 2007

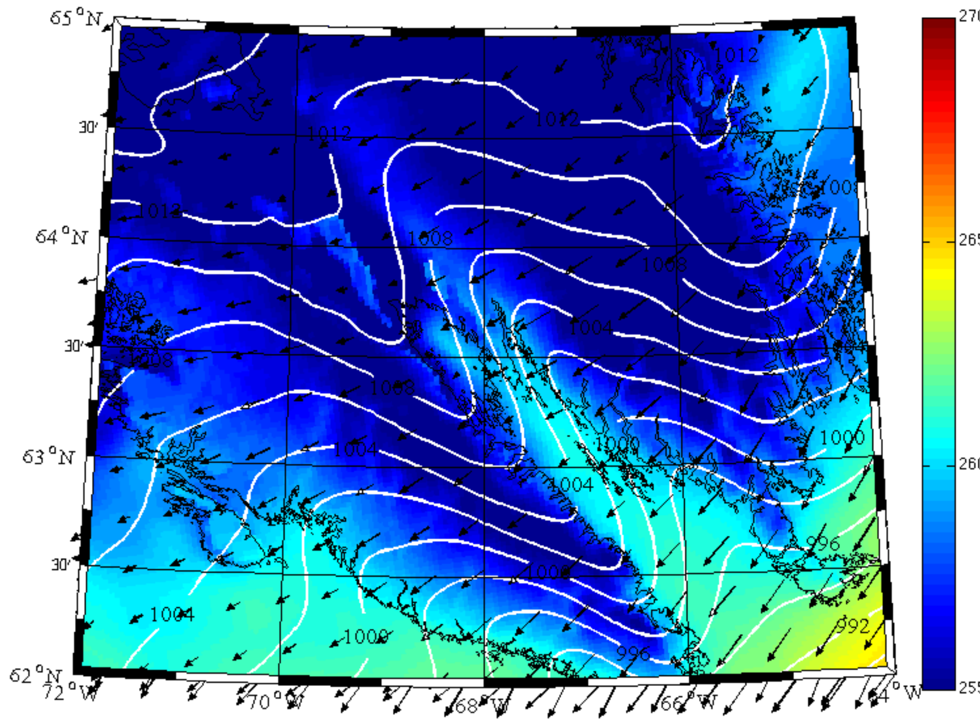
12Z 4 Feb

Eta = 1.0

Potential temperature (shaded, K)

Sea level pressure (contour, 2hPa)

Wind vector



18Z 4 Feb

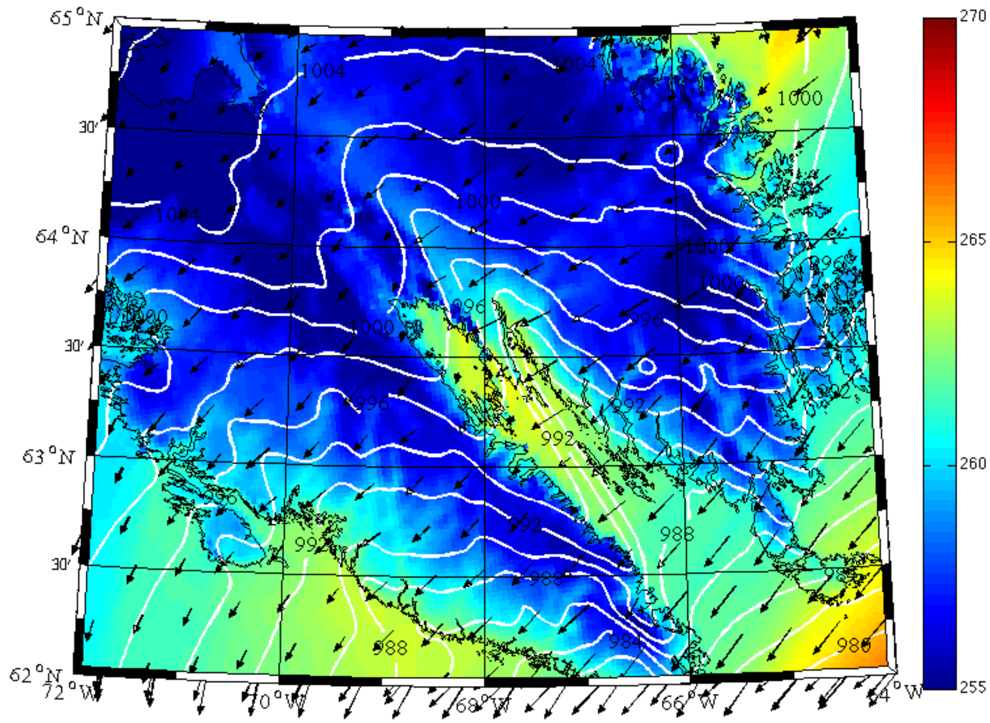
Eta = 1.0

Potential temperature (shaded, K)

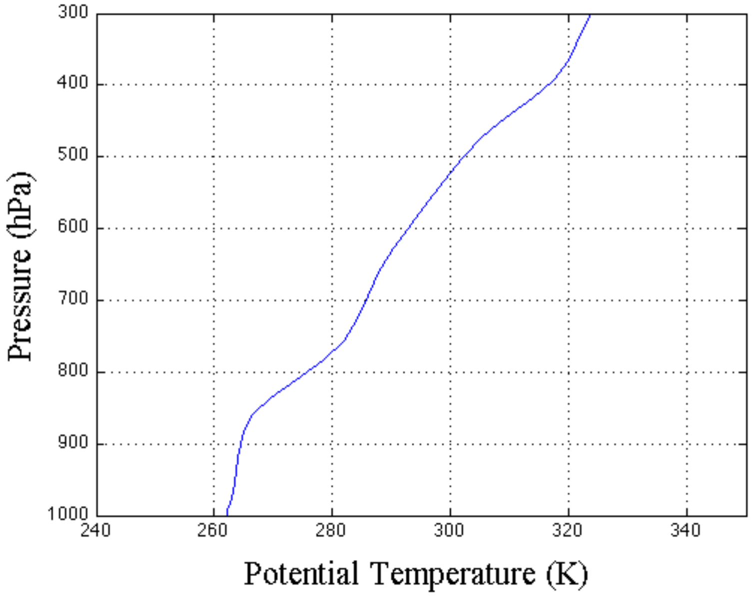
Sea level pressure (contour, 2hPa)

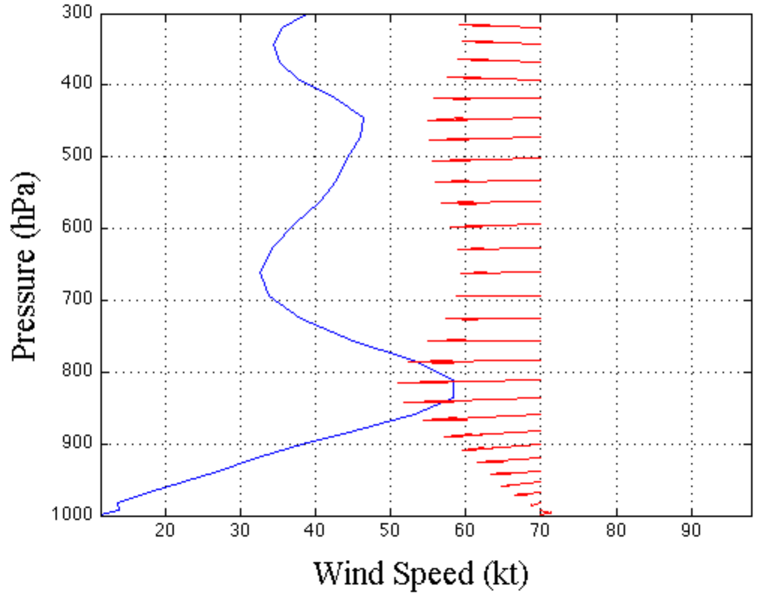
Wind vector

Heating over Frobisher Bay



Profiles 18Z 4 Feb





0Z 5 Feb

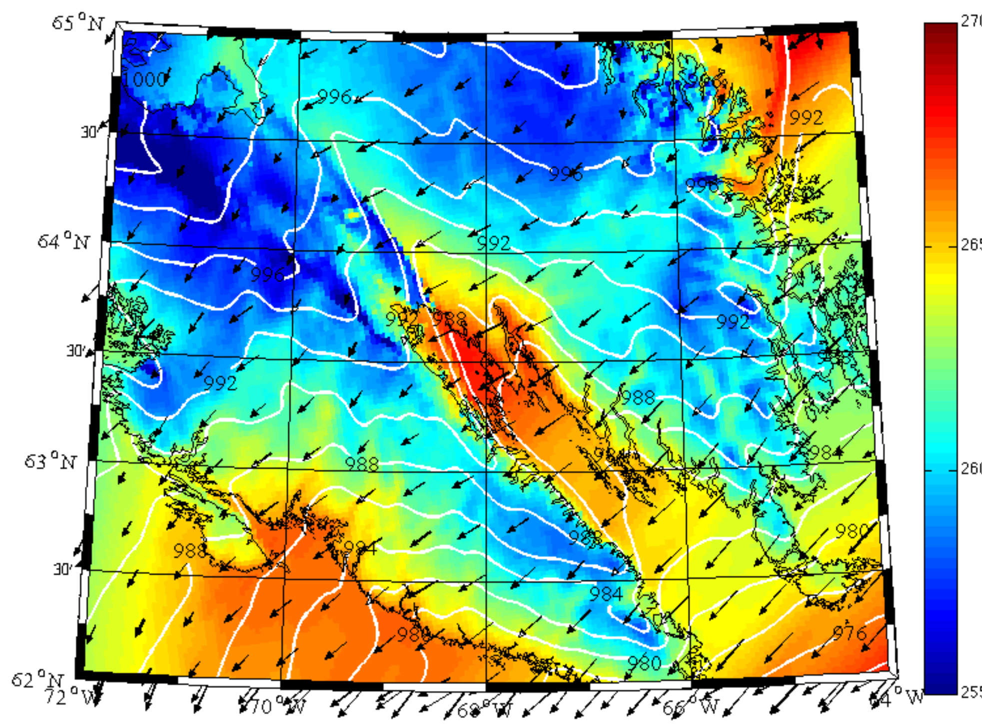
Eta = 1.0

Potential temperature (shaded, K)

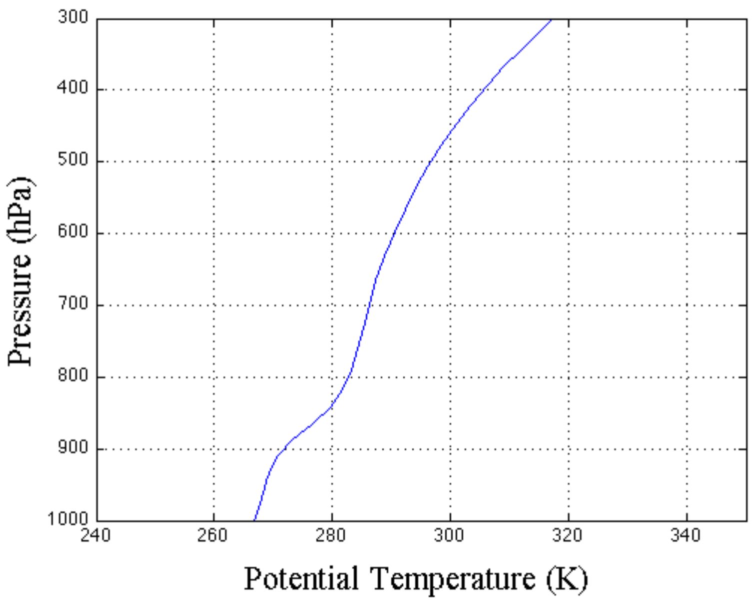
Sea level pressure (contour, 2hPa)

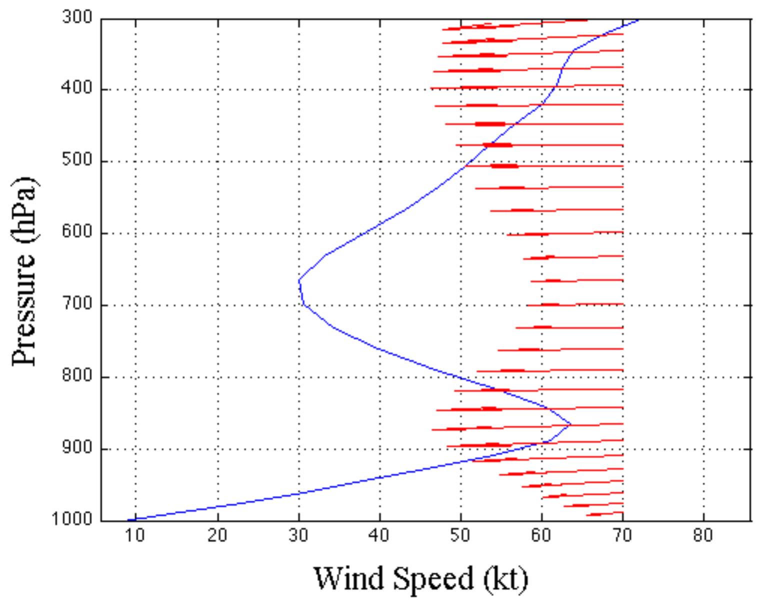
Wind vector

Time of maximum observed winds



Profiles 0Z 5 February





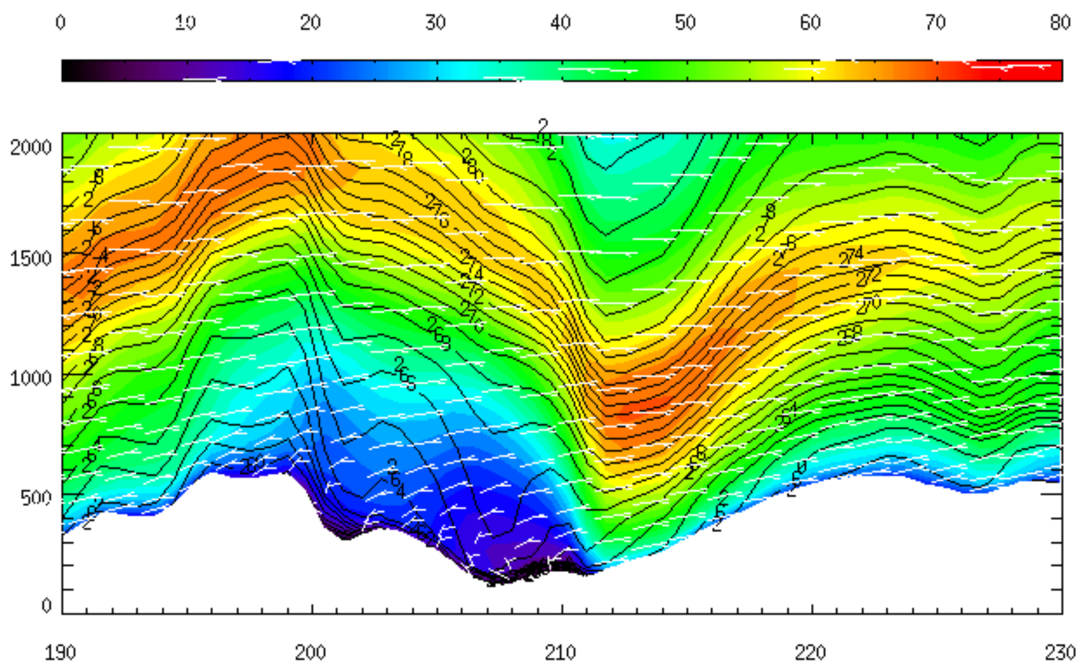
Cross Section 0Z 5 Feb

Cross section over Iqaluit

Winds (shaded, kts)

Potential temperature (contour, K)

Wind direction



5Z 5 Feb

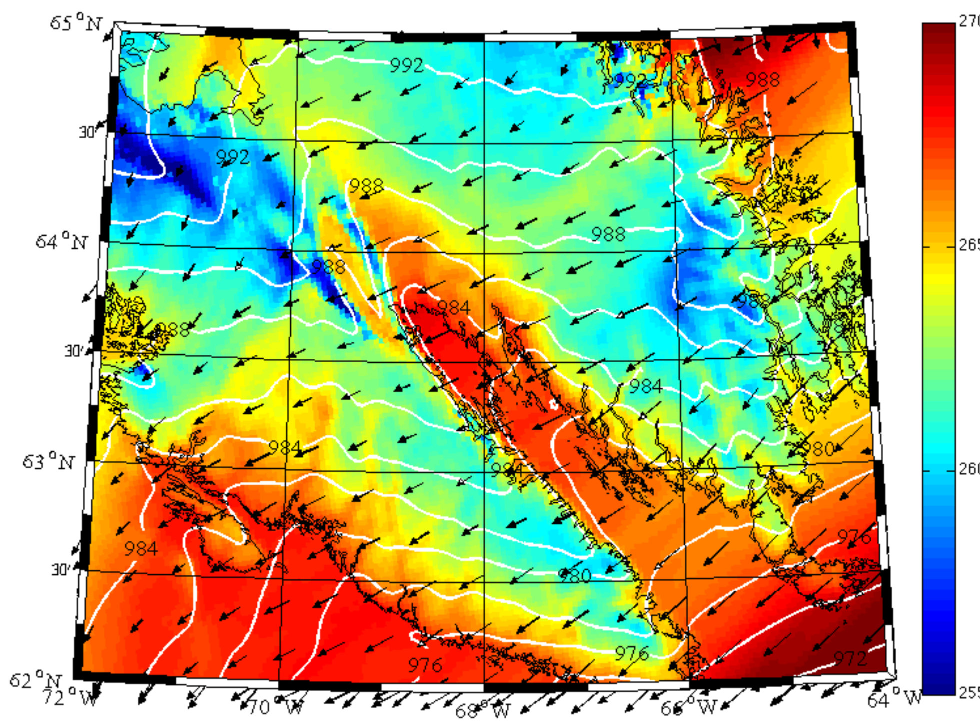
Eta = 1.0

Potential temperature (shaded, K)

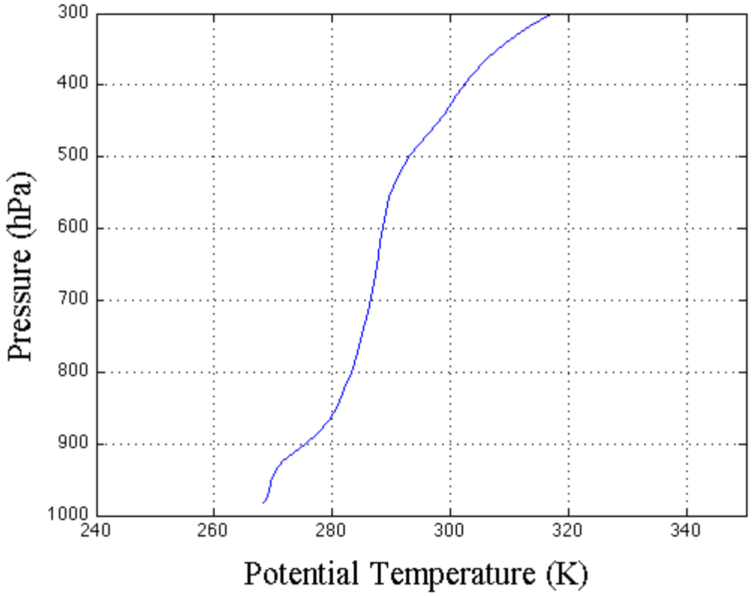
Sea level pressure (contour, 2hPa)

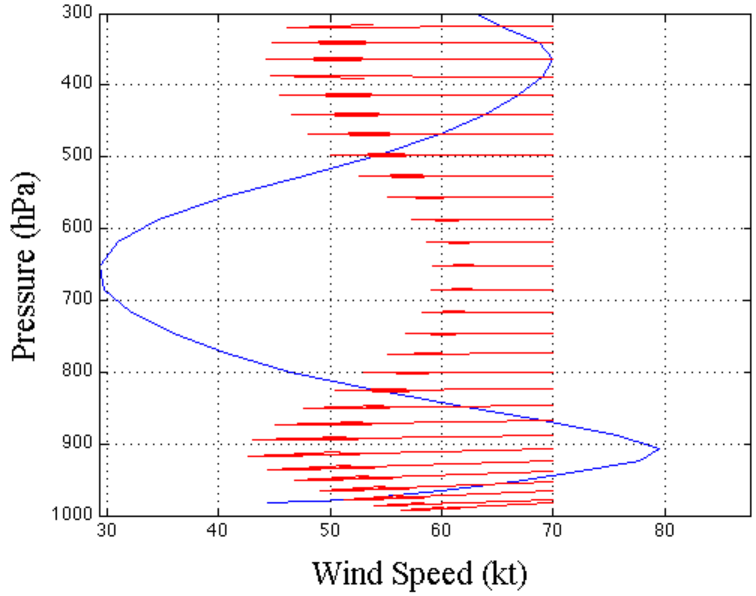
Wind vector

Time of maximum model winds



Profiles 5Z 5 February





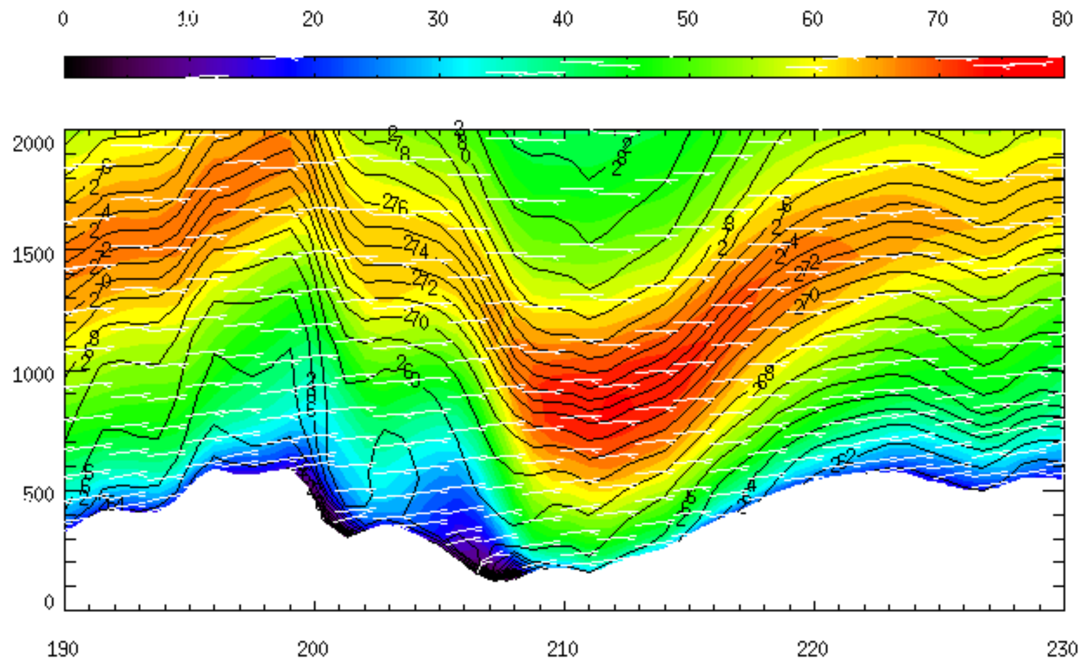
Cross Section 5Z 5 Feb

Cross section over Iqaluit

Winds (shaded, kts)

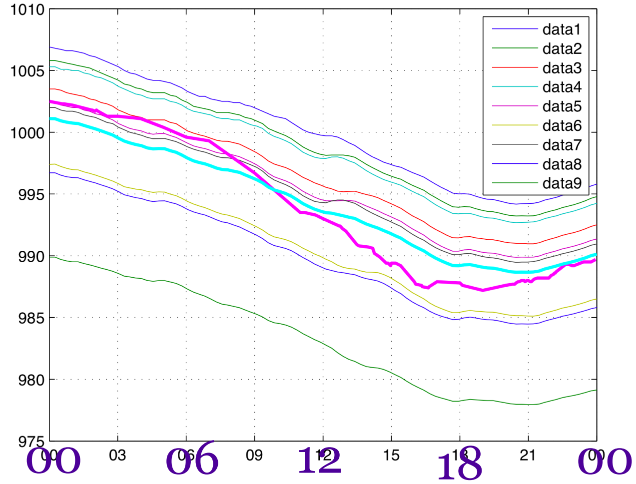
Potential temperature (contour, K)

Wind direction

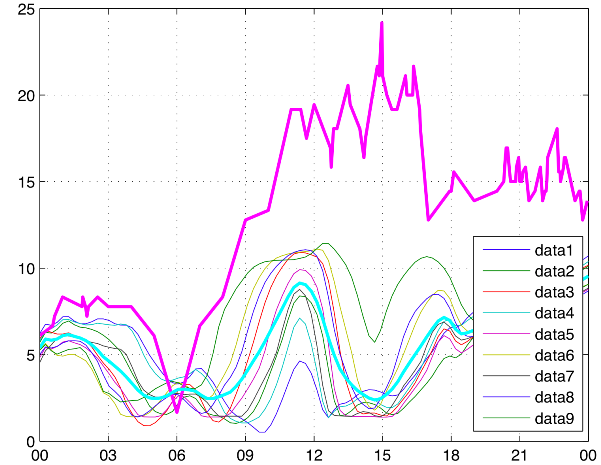


November 2008 YFB Comparison

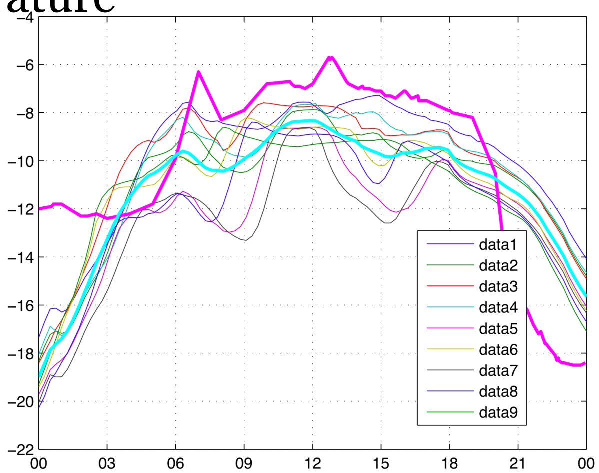
Surface Pressure



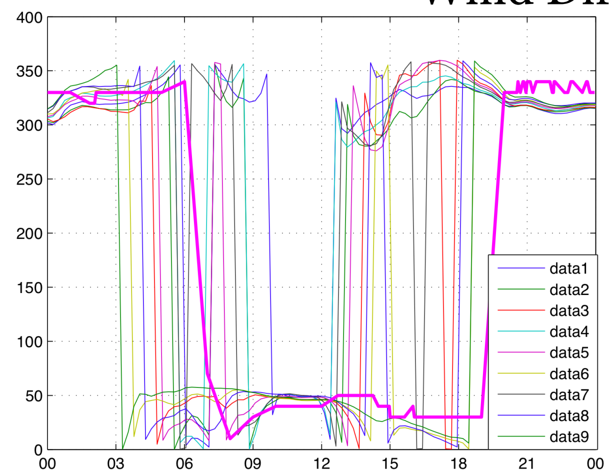
Wind Speed



Temperature



Wind Direction



Surface Nov 2008

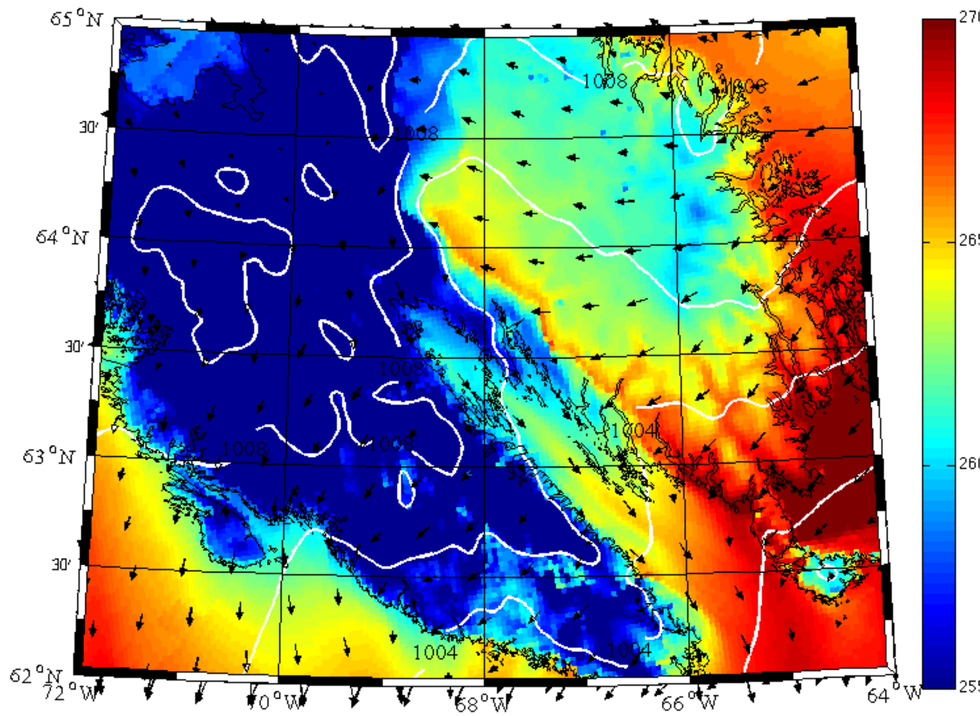
0Z 17 Nov

Eta = 1.0

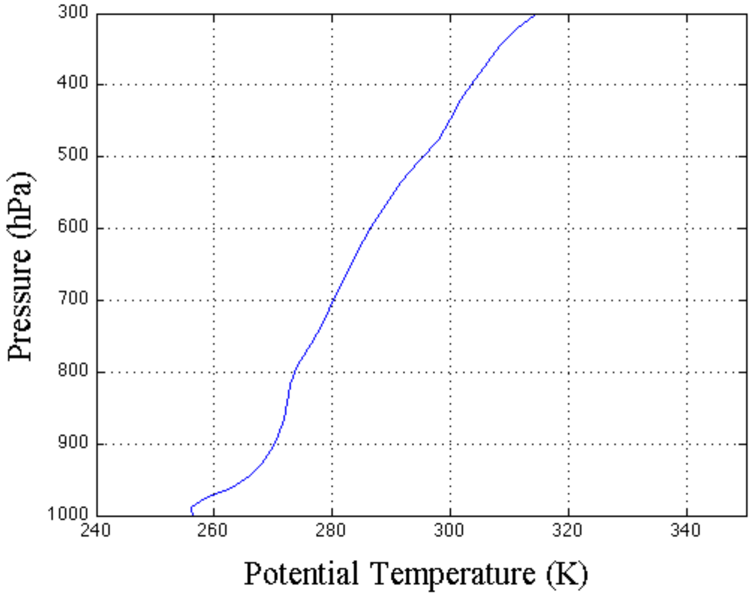
Potential temperature (shaded, K)

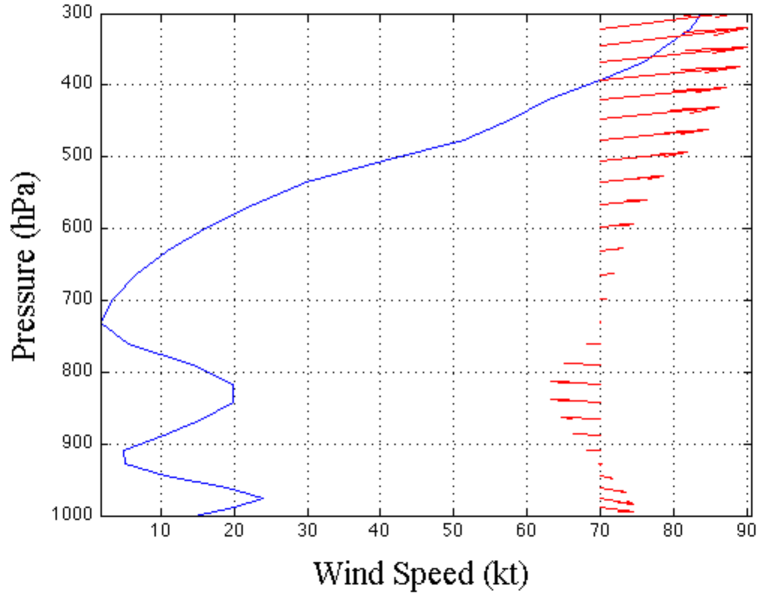
Sea level pressure (contour, 2hPa)

Wind vector



Profiles 0Z 17 November 2008





3Z 17 Nov

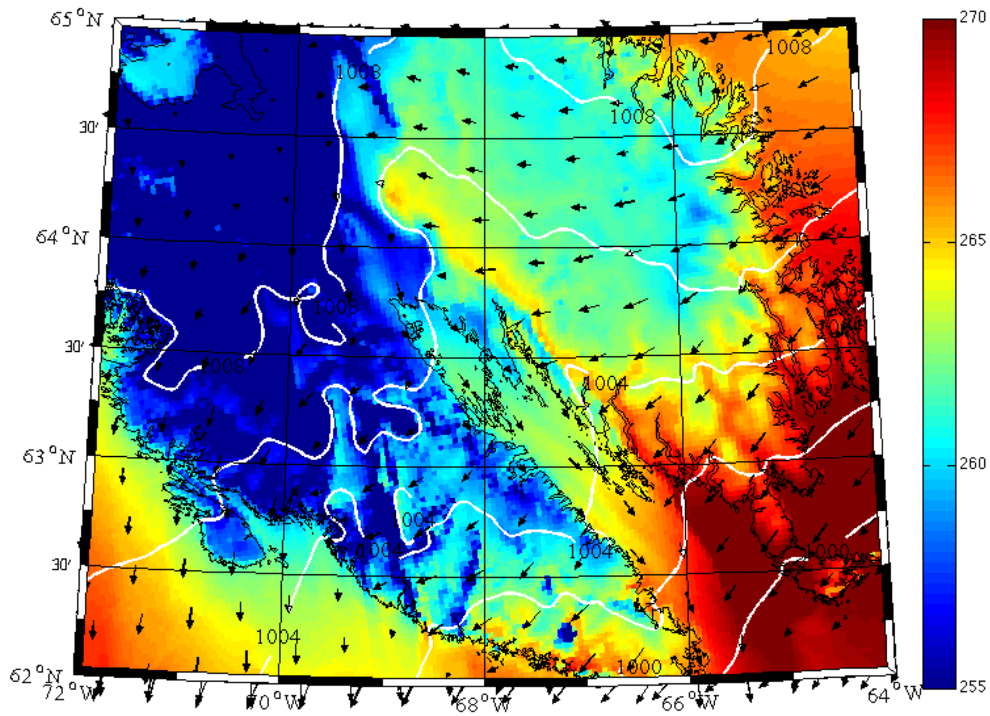
Eta = 1.0

Potential temperature (shaded, K)

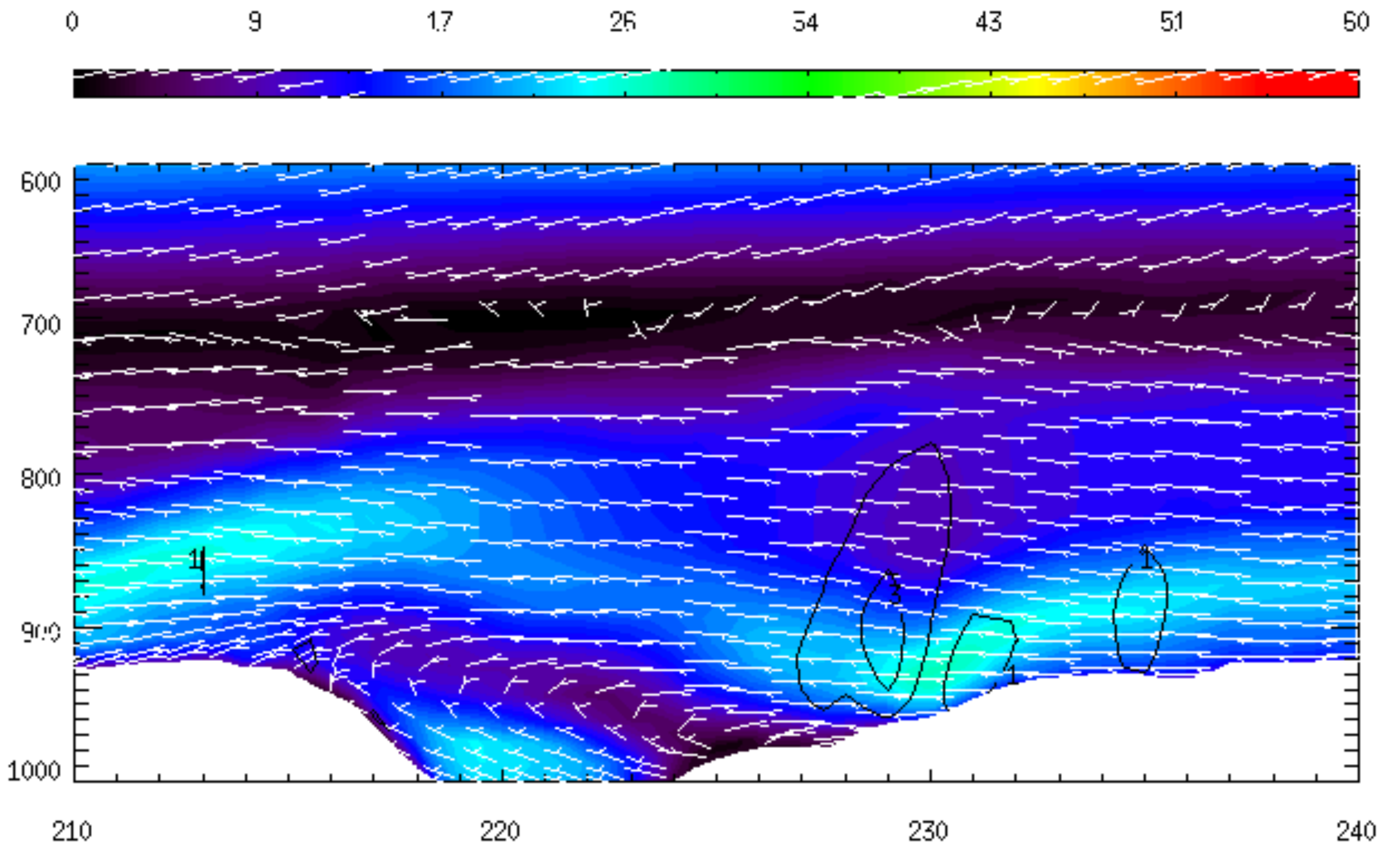
Sea level pressure (contour, 2hPa)

Wind vector

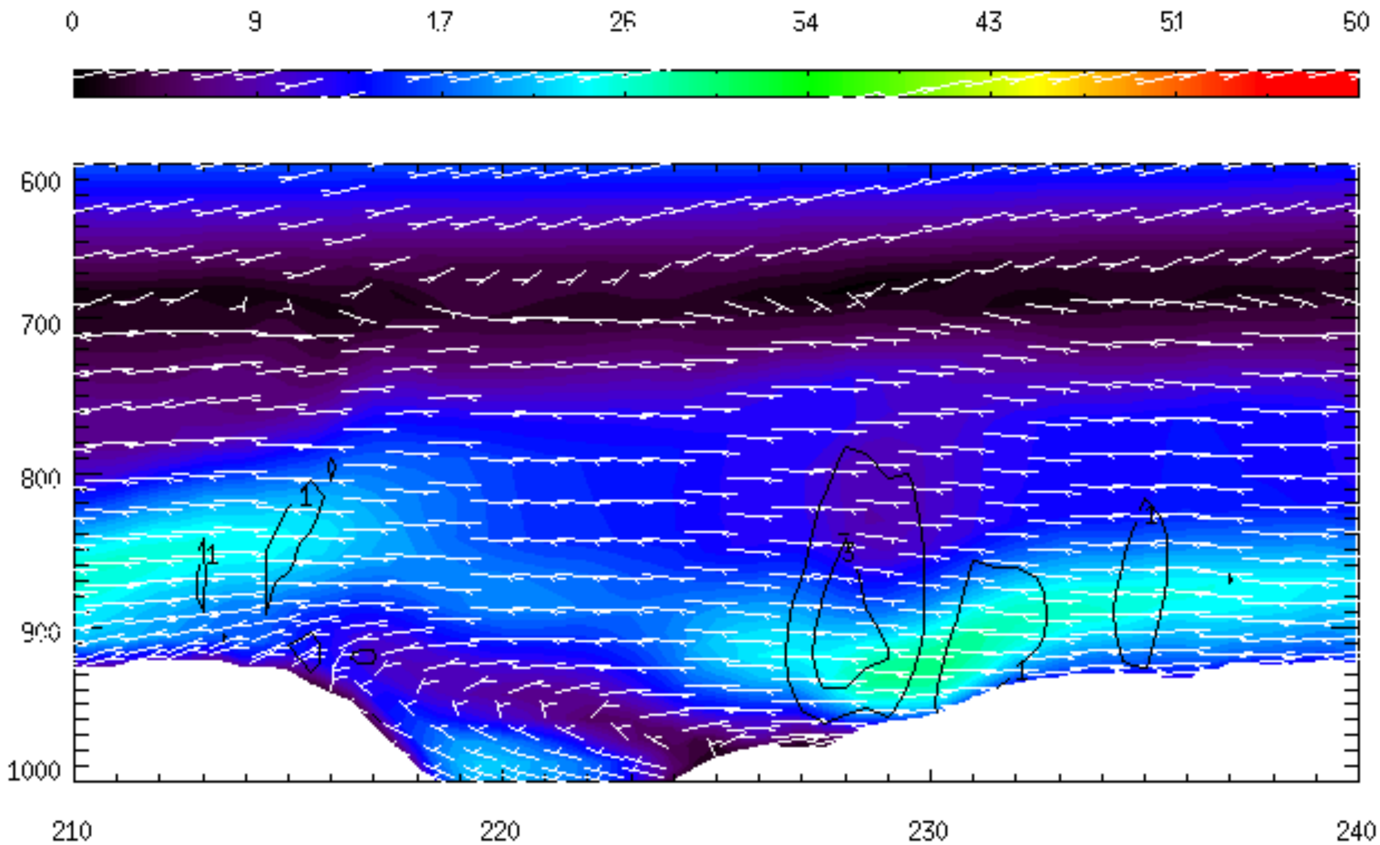
Wind shift starts at some model points



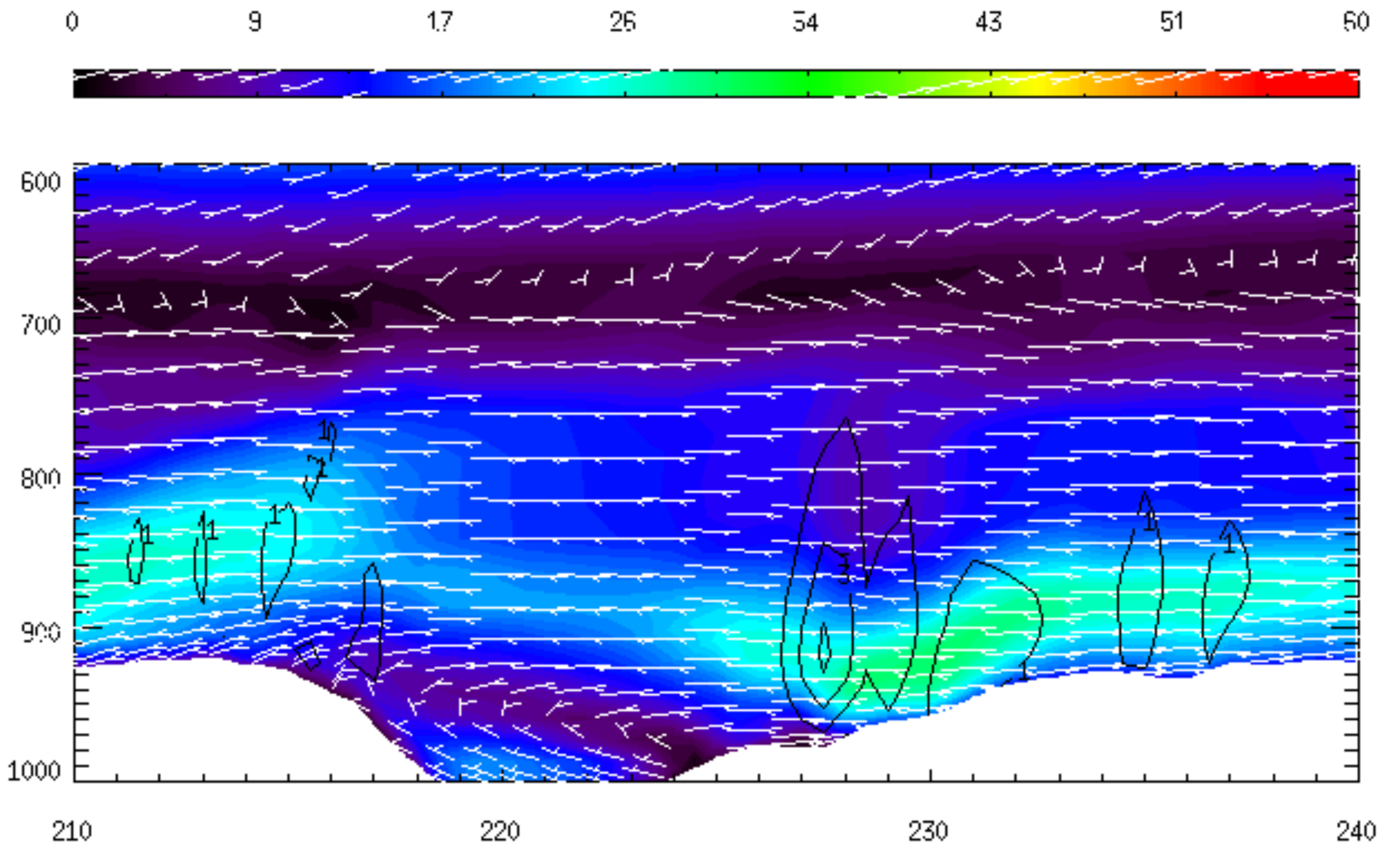
Cross section: 3Z 17 Nov



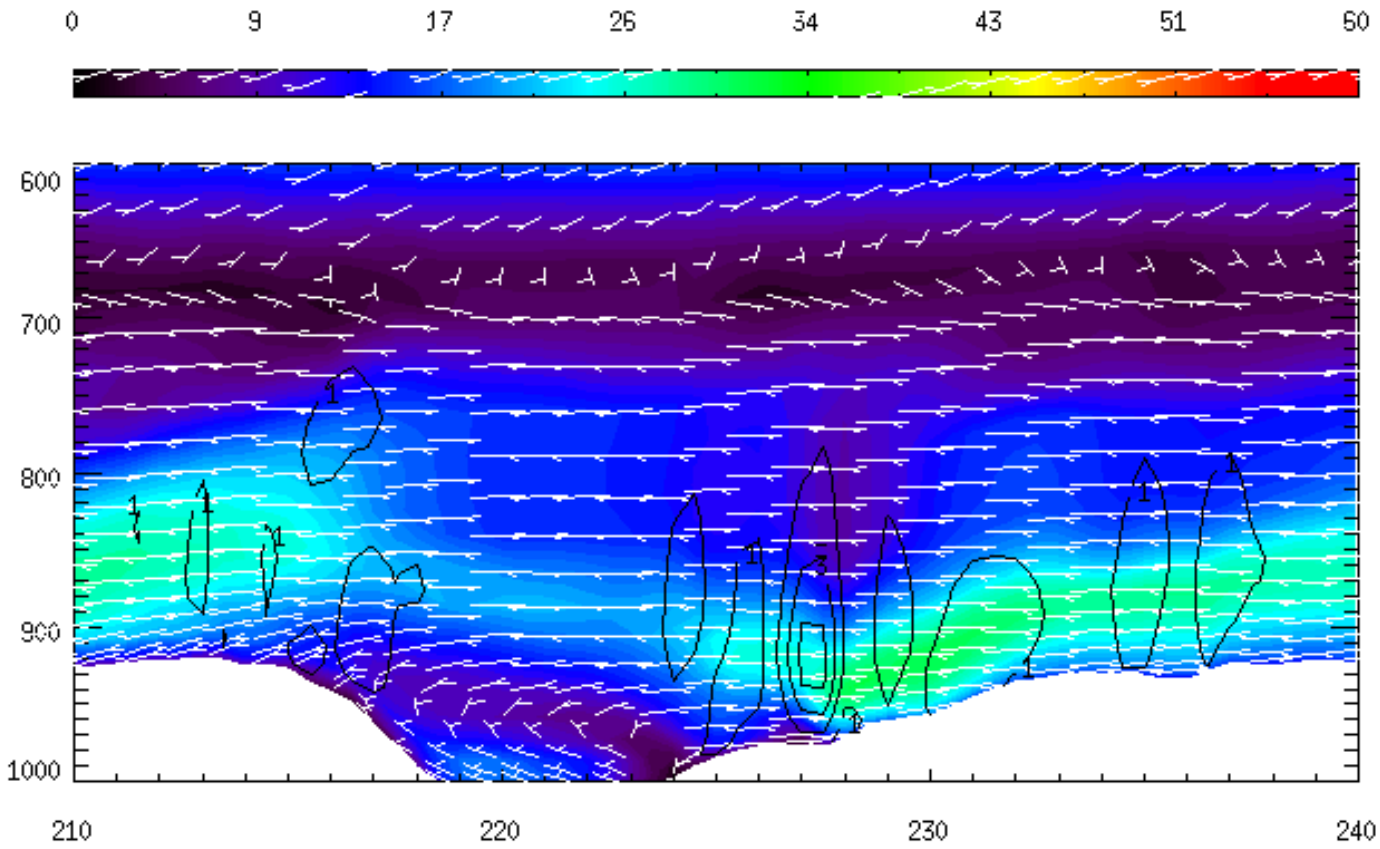
Cross section: 4Z 17 Nov



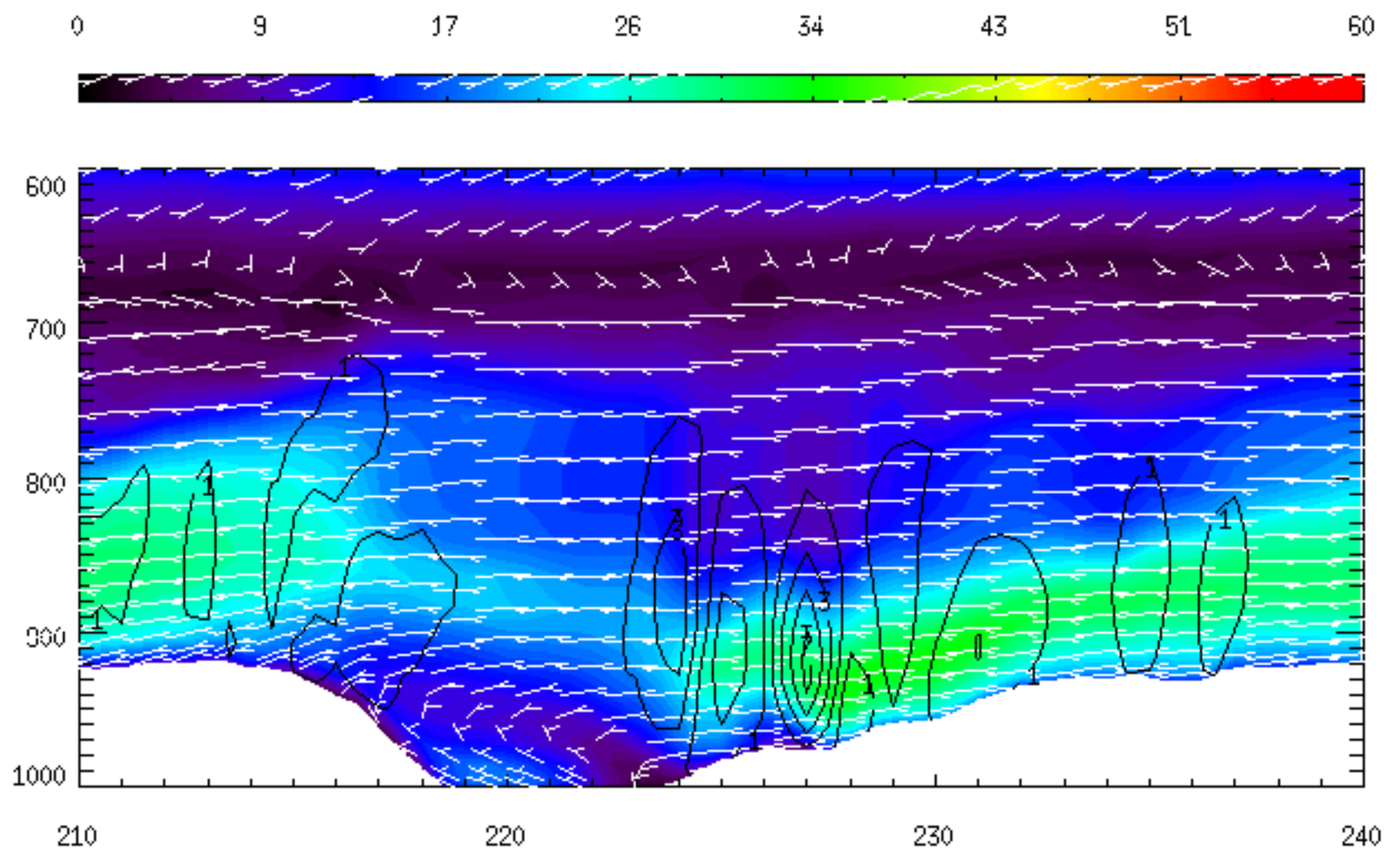
Cross section: 5Z 17 Nov



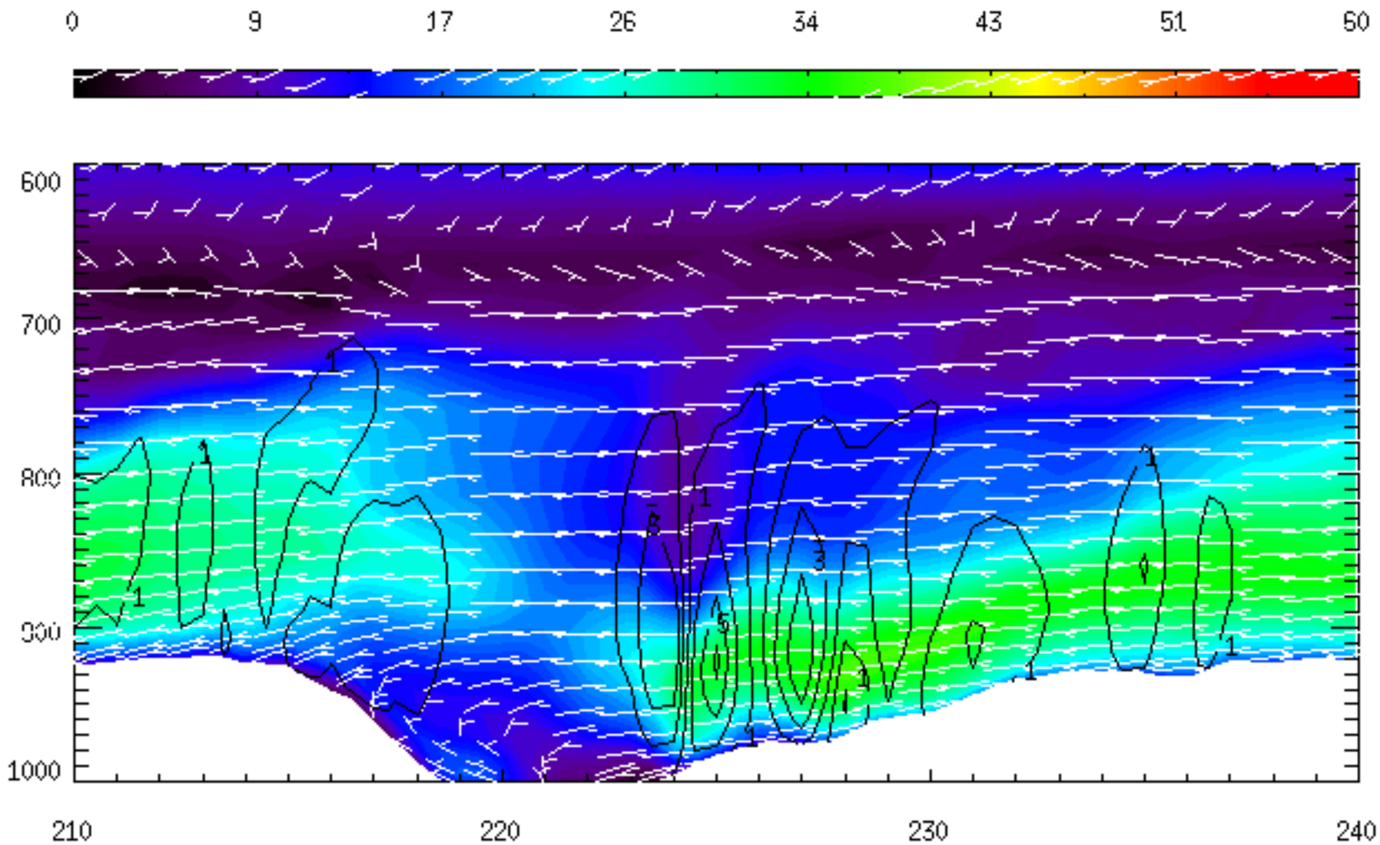
Cross section: 6Z 17 Nov



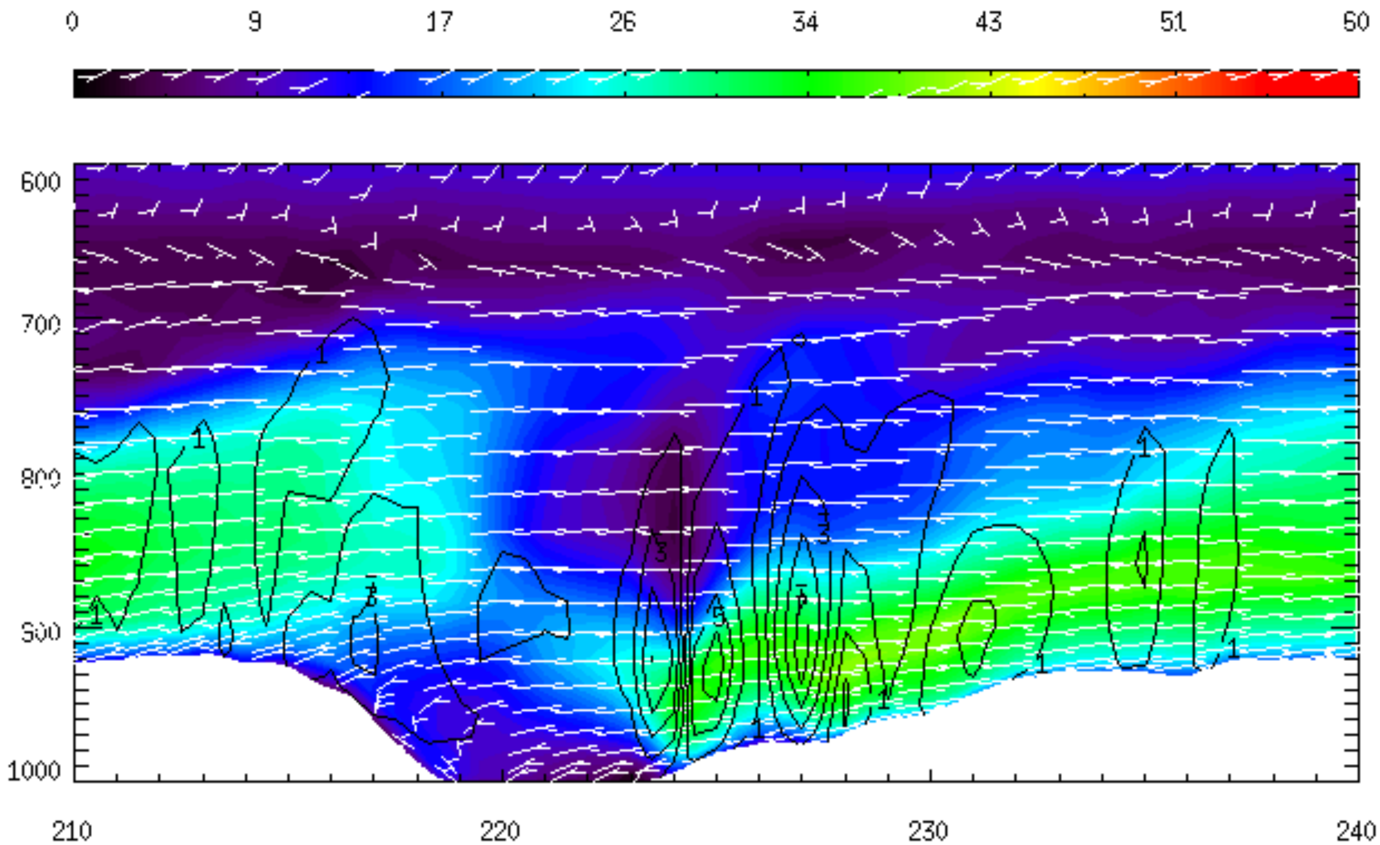
Cross section: 7Z 17 Nov



Cross section: 8Z 17 Nov



Cross section: 9Z 17 Nov



6Z 17 Nov

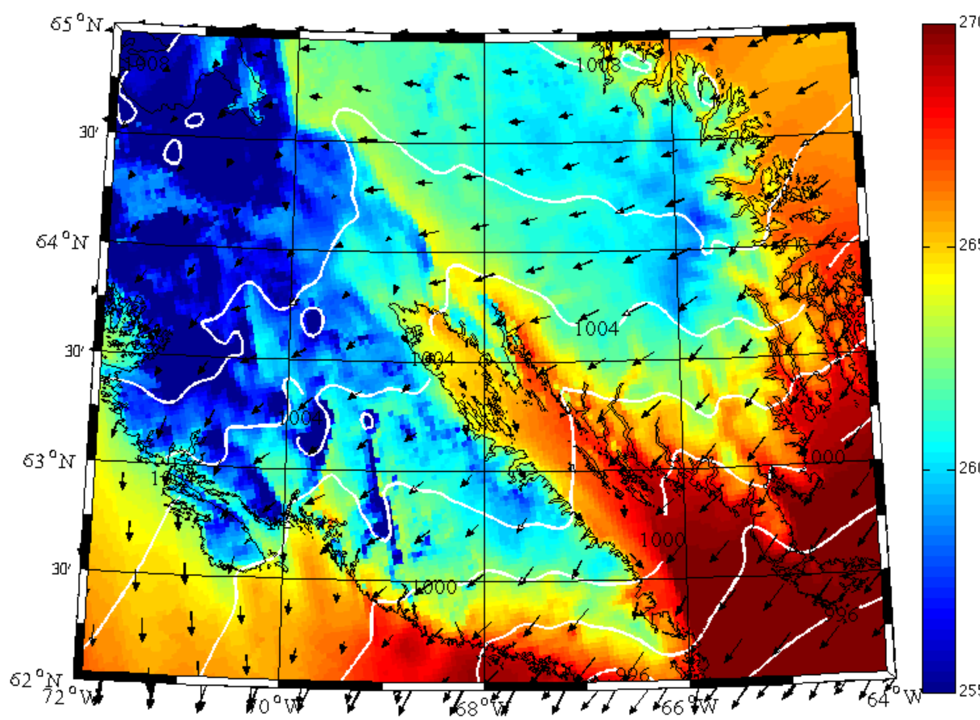
Eta = 1.0

Potential temperature (shaded, K)

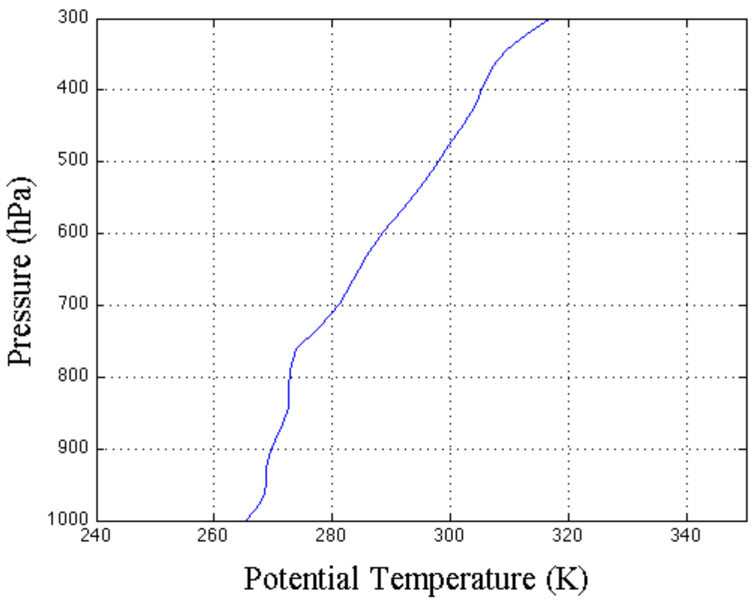
Sea level pressure (contour, 2hPa)

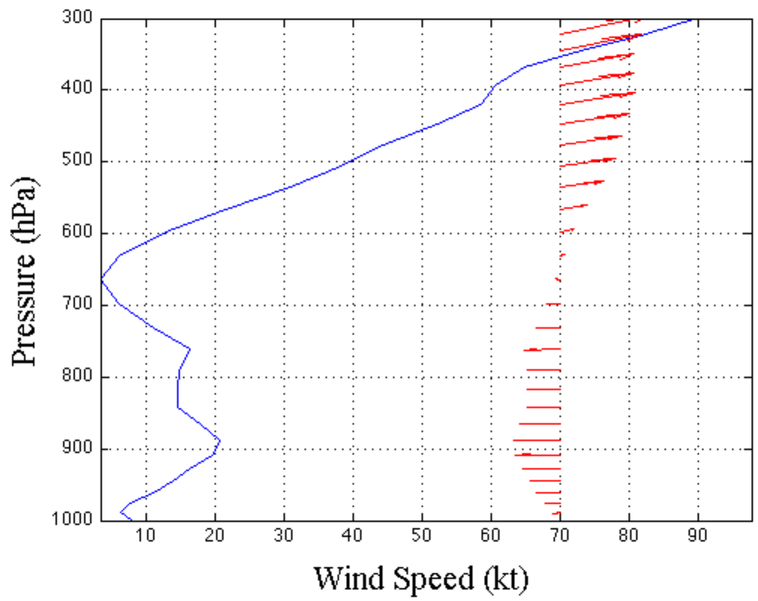
Wind vector

Time of observed wind shift



Profiles 6Z 17 November 2008





12Z 17 Nov

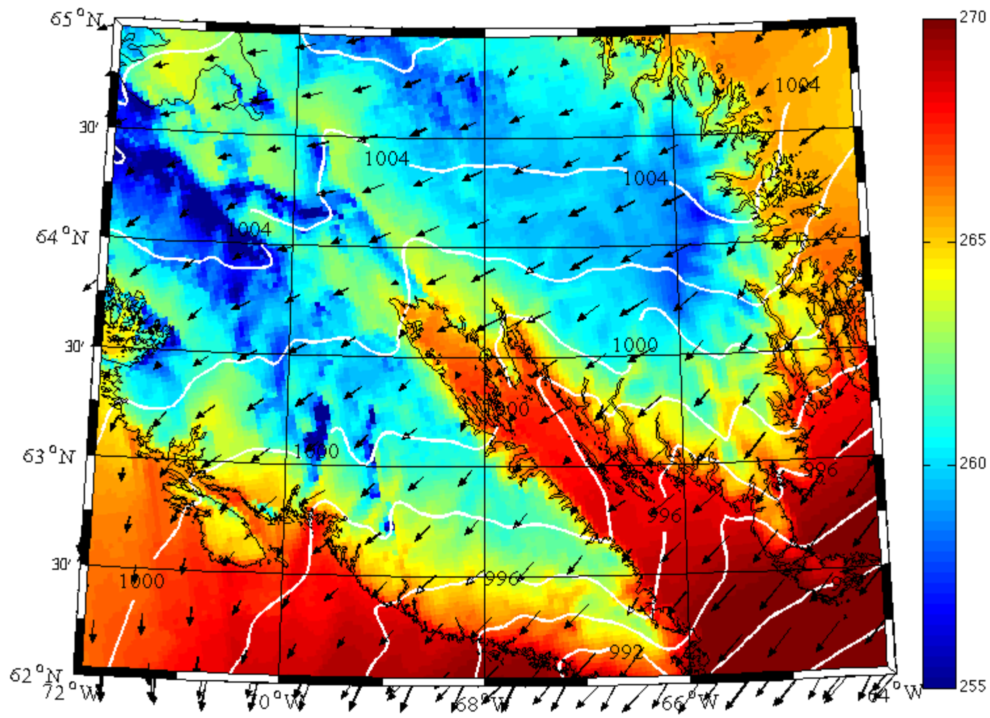
Eta = 1.0

Potential temperature (shaded, K)

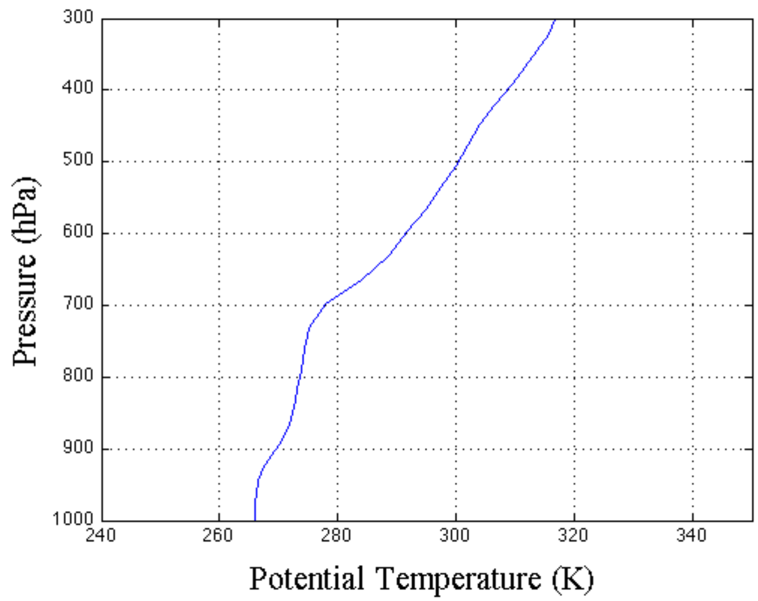
Sea level pressure (contour, 2hPa)

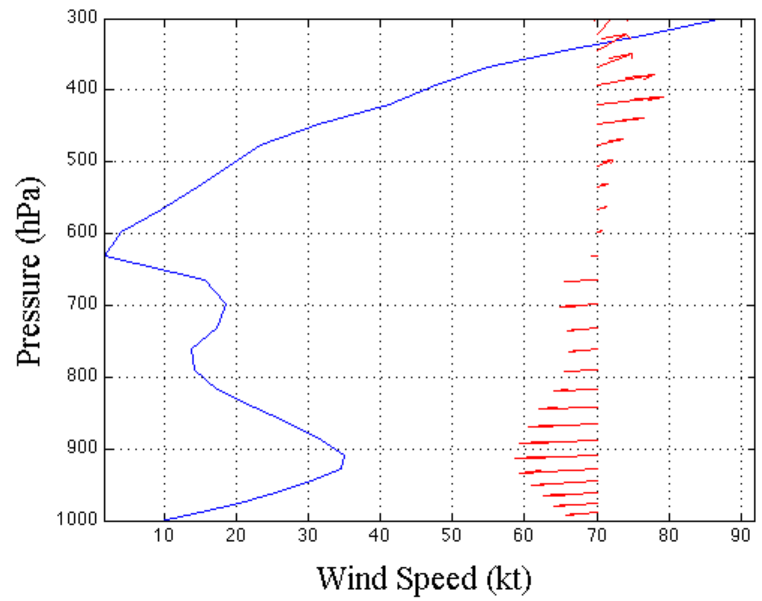
Wind vector

Maximum model winds



Profiles 12Z 17 November 2008



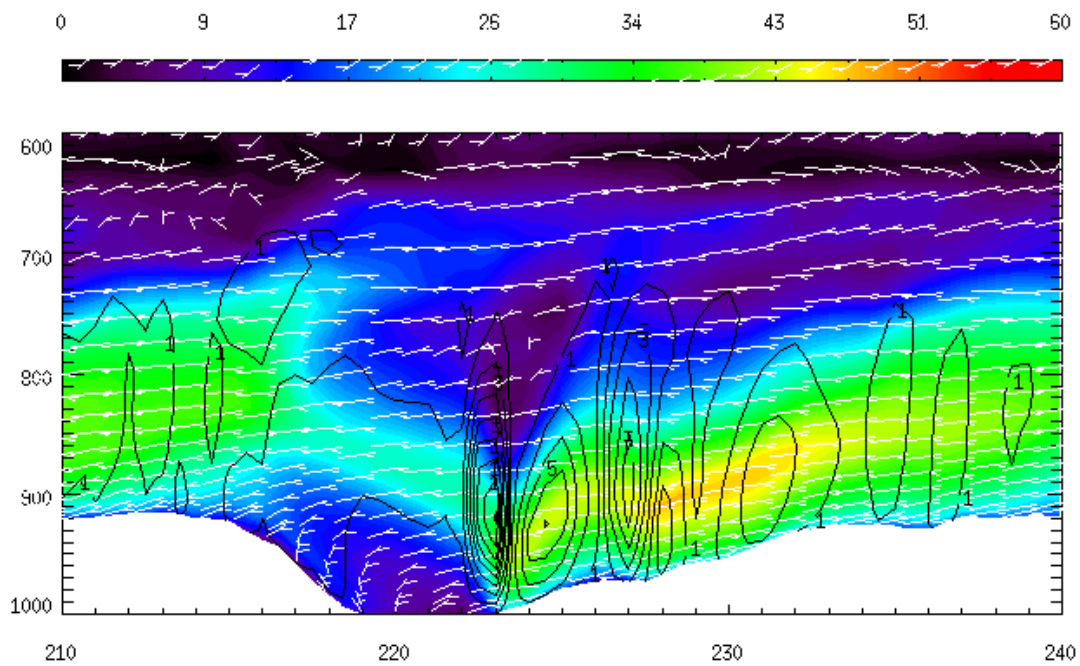


Cross section 12Z 17 Nov

Wind speed (shaded, kts)

Vertical velocity (contour, hPa s^{-1})

Wind direction



18 Z 17 Nov

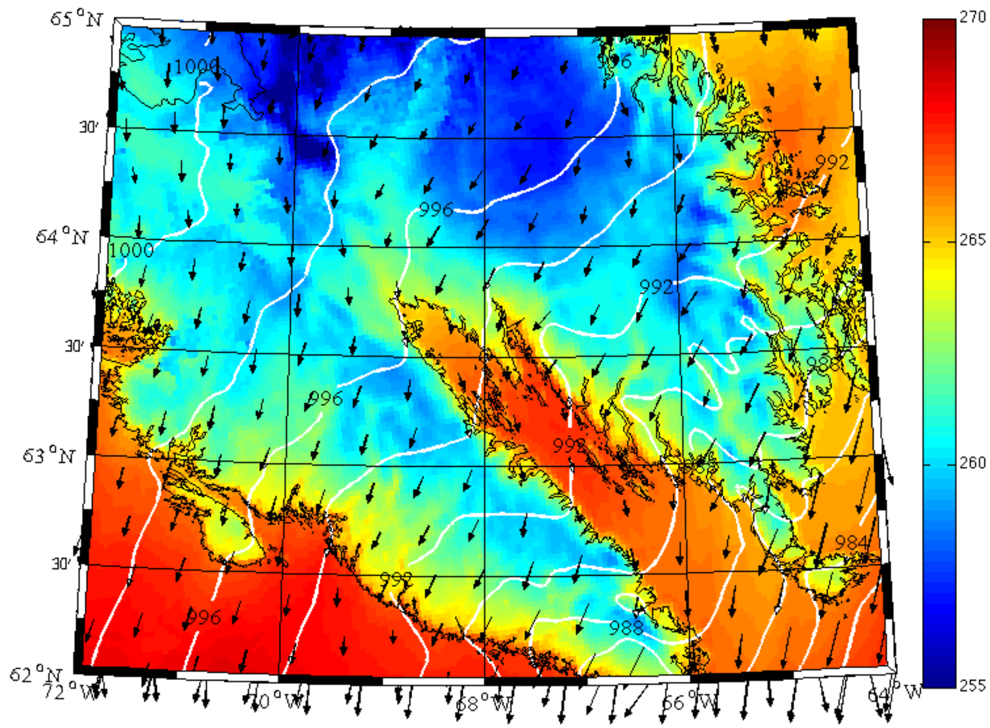
Eta = 1.0

Potential temperature (shaded, K)

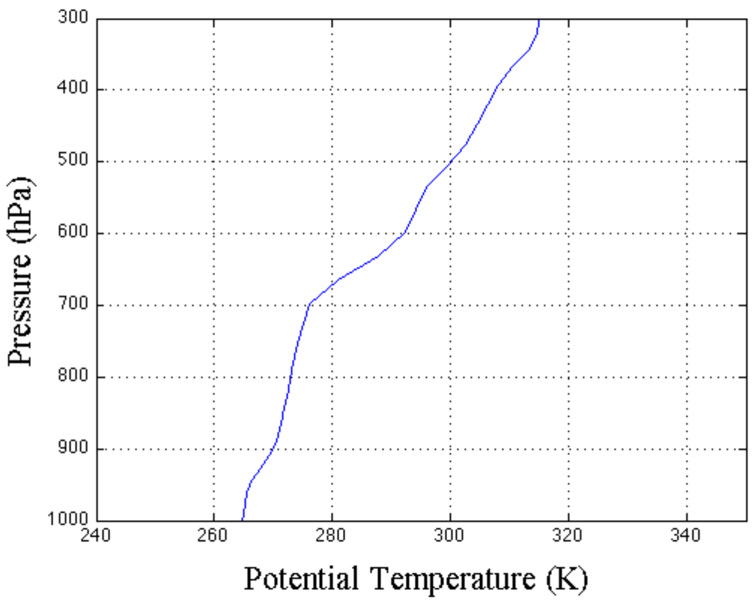
Sea level pressure (contour, 2hPa)

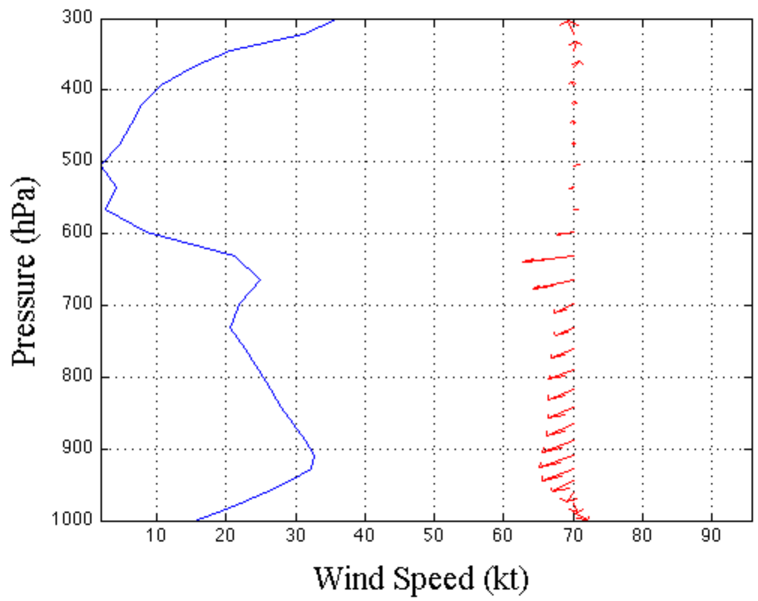
Wind vector

Observed wind shift back to NW

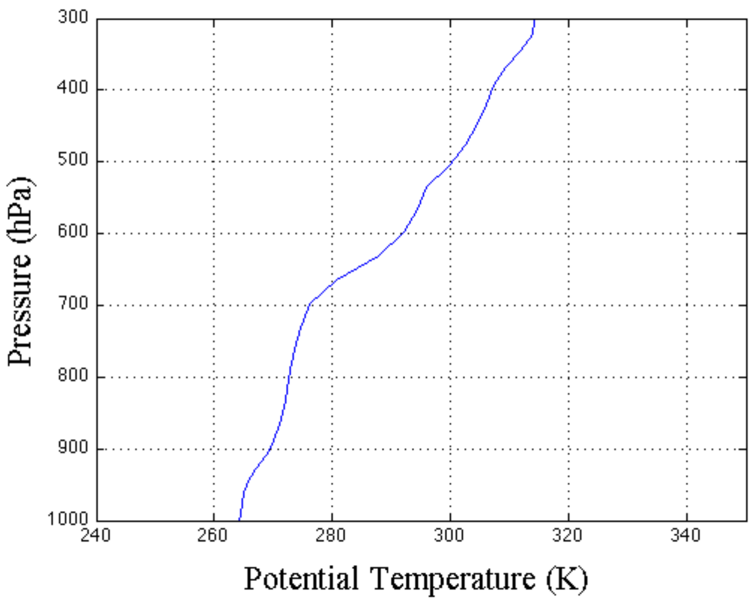


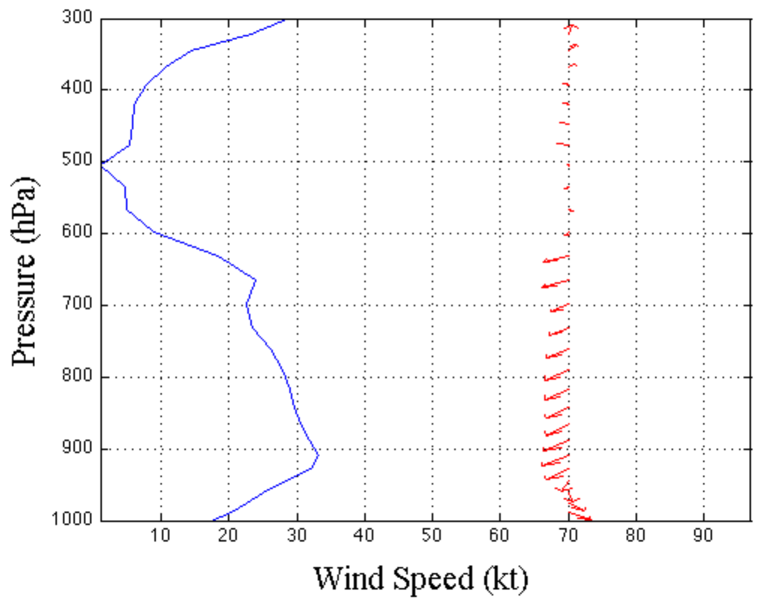
Profiles 18Z 17 November 2008



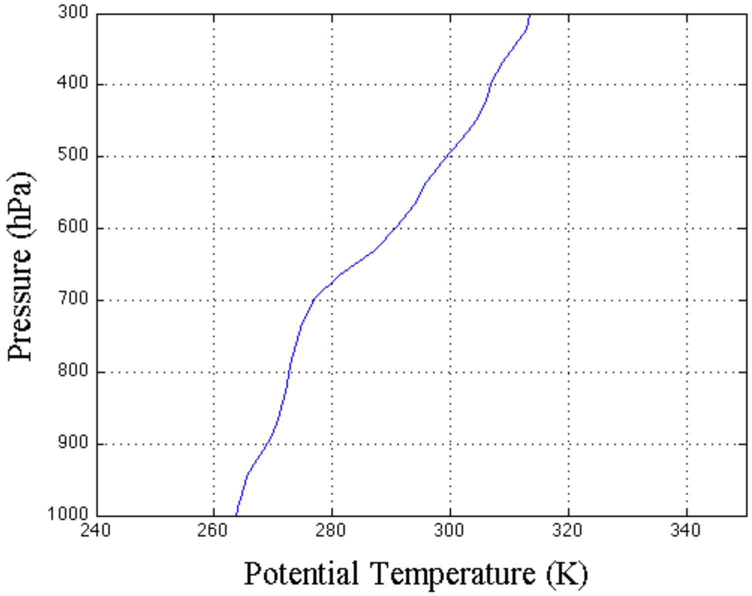


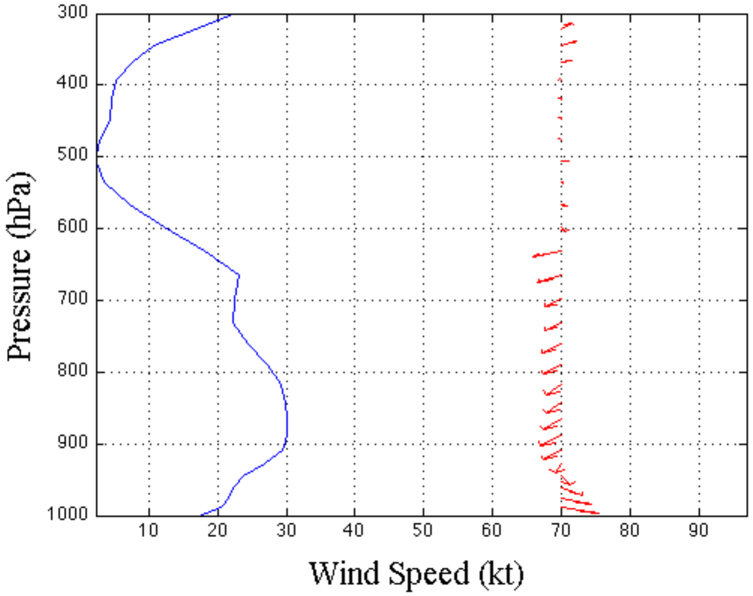
Profiles 19Z 17 November 2008



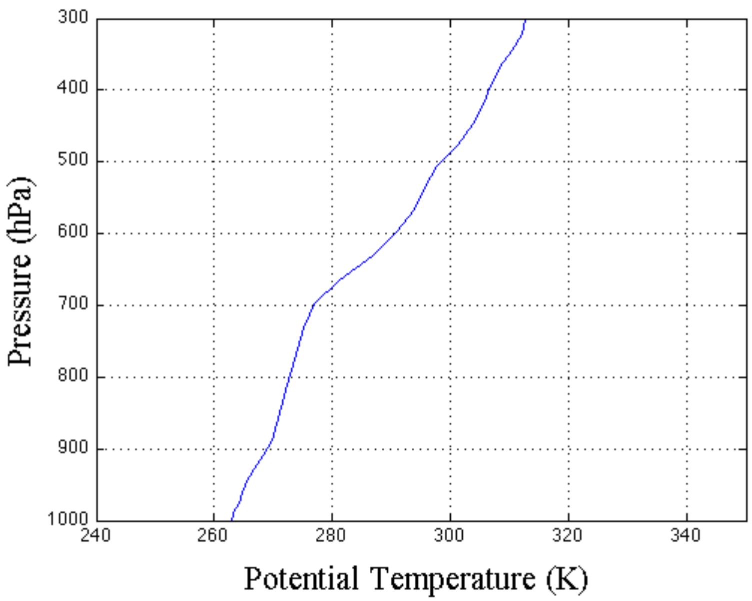


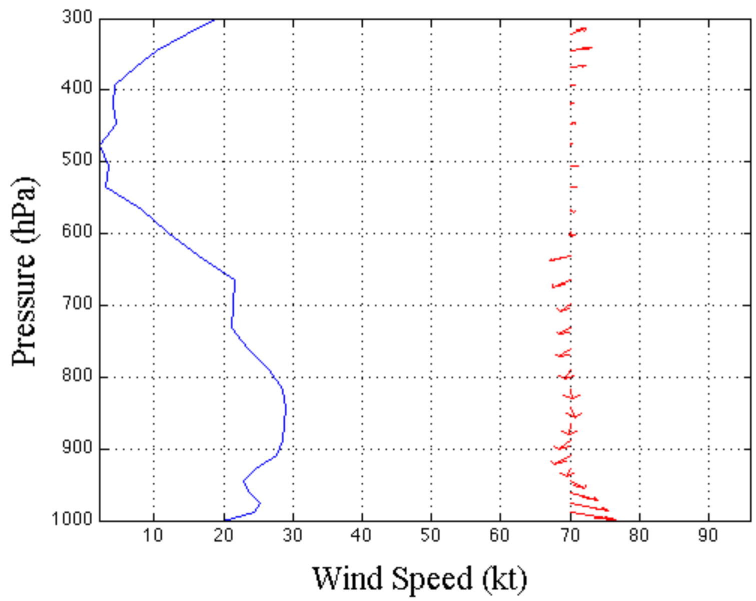
Profiles 20Z 17 November 2008



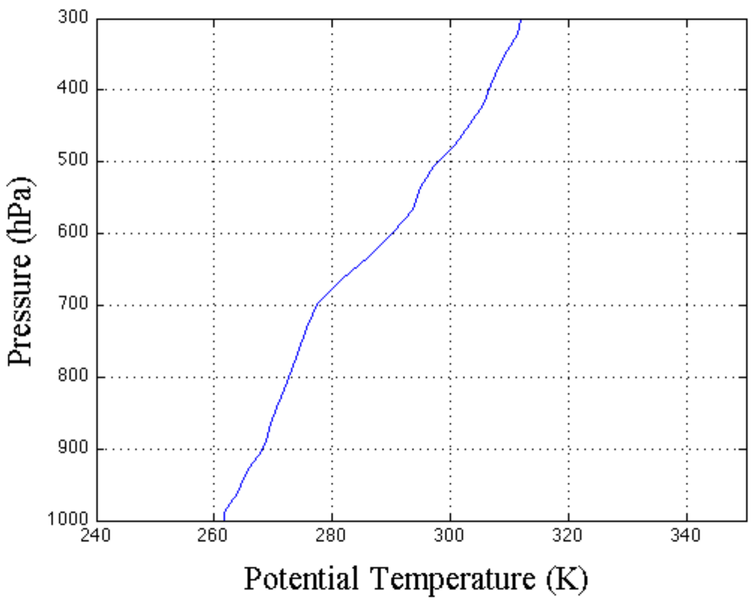


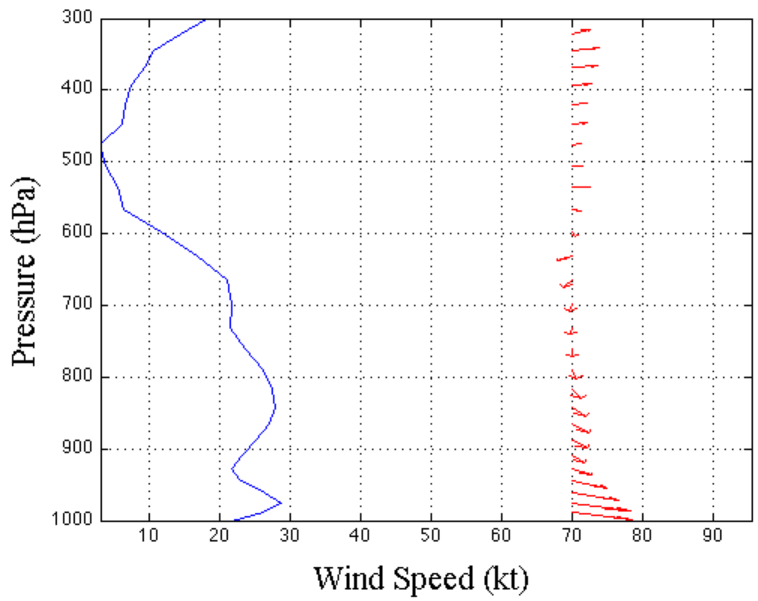
Profiles 21Z 17 November 2008





Profiles 22Z 17 November 2008





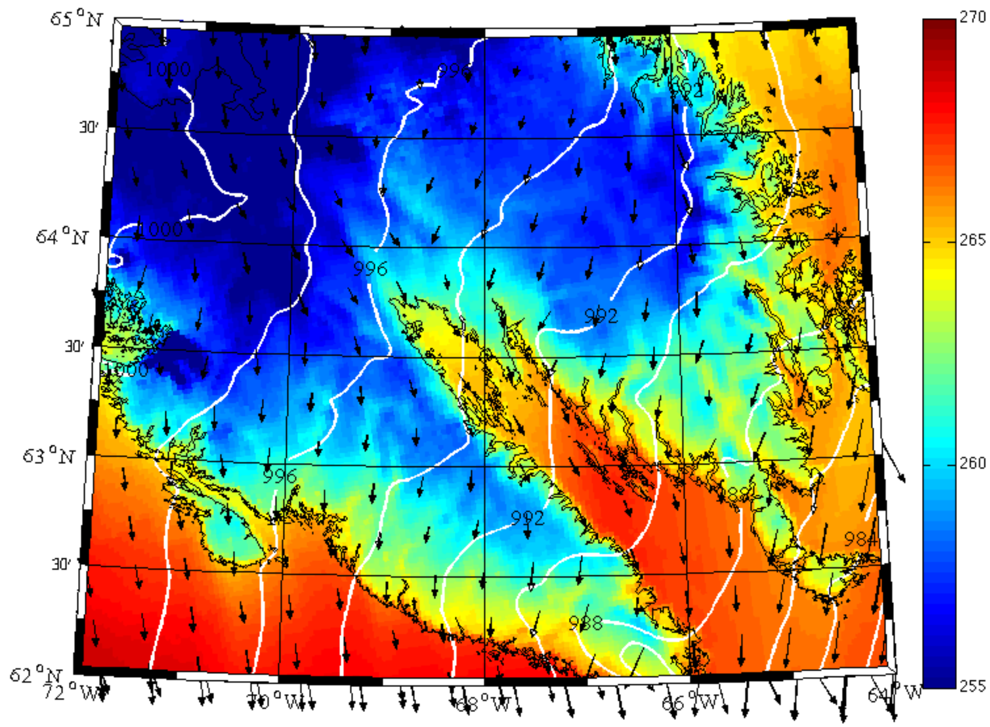
21Z 17 Nov

Eta = 1.0

Potential temperature (shaded, K)

Sea level pressure (contour, 2hPa)

Wind vector

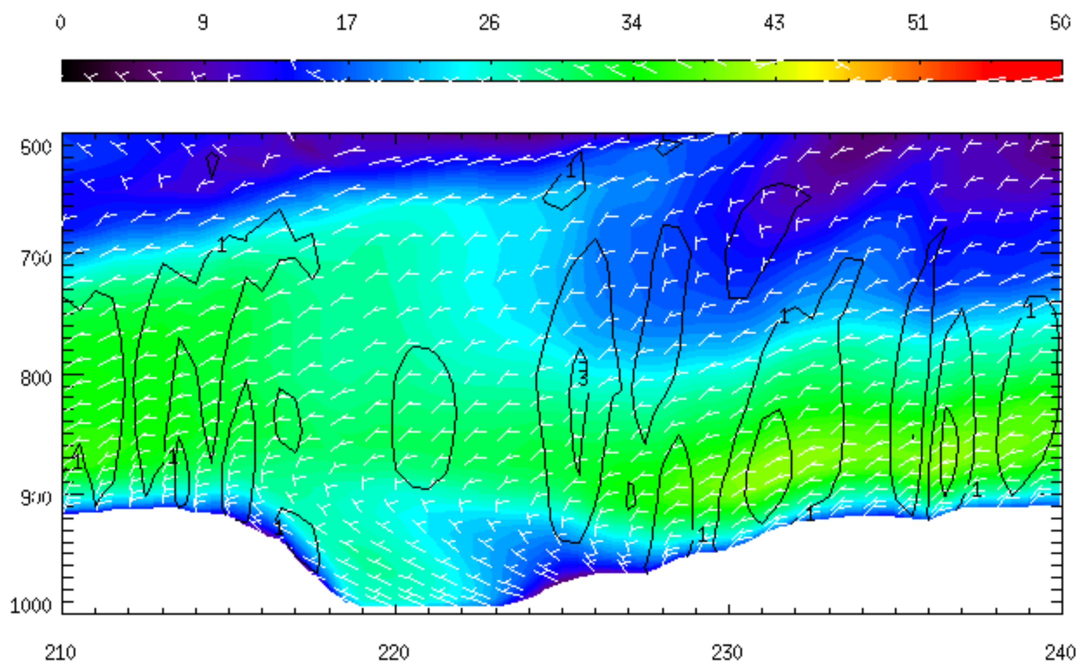


Cross section 21Z 17 Nov

Wind speed (shaded, kts)

Vertical velocity (contour, hPa s^{-1})

Wind direction



0Z 18 Nov

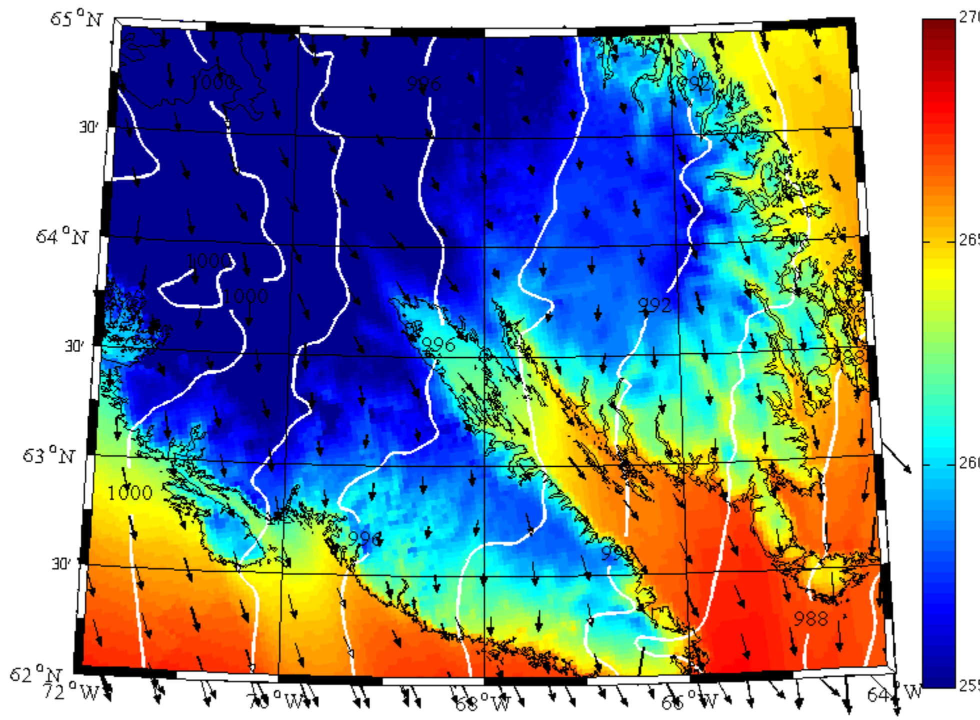
Eta = 1.0

Potential temperature (shaded, K)

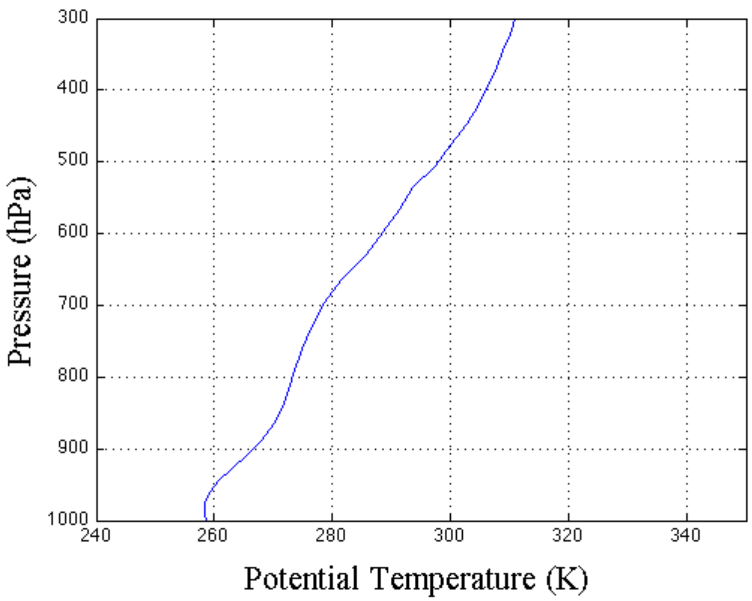
Sea level pressure (contour, 2hPa)

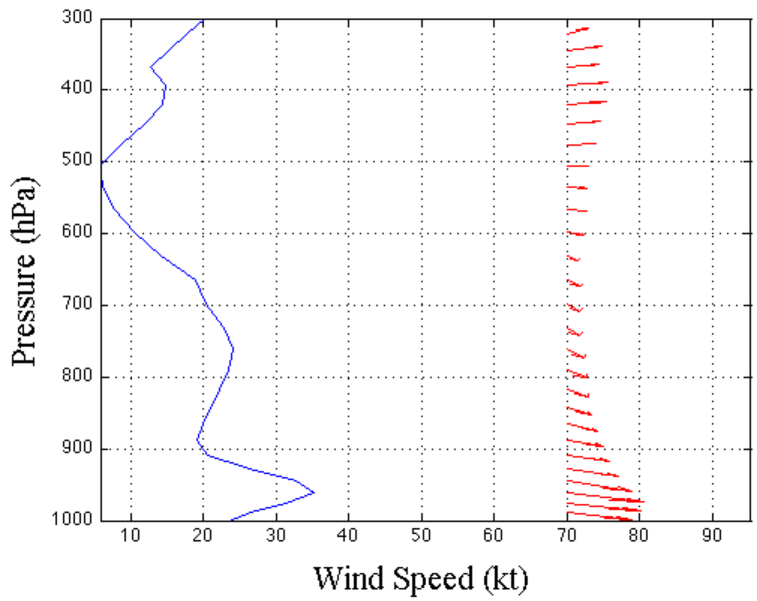
Wind vector

Winds NW again at end of simulation



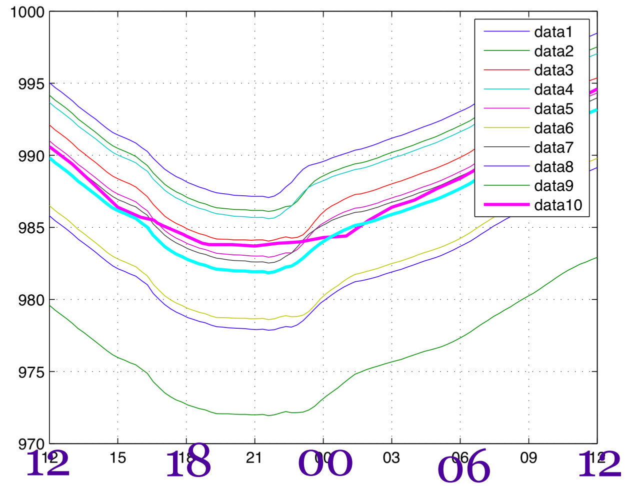
Profiles 0Z 18 November 2008



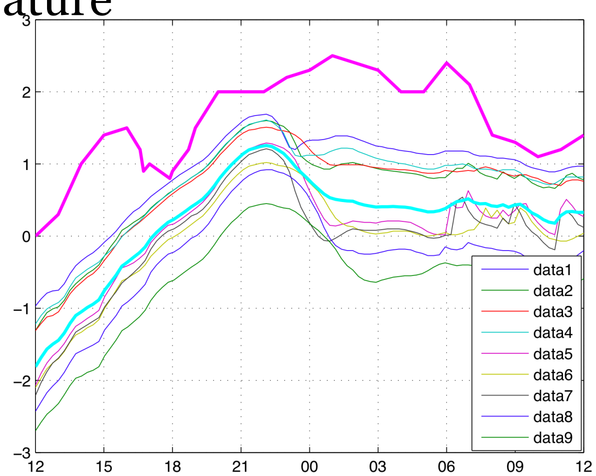


September 2008 YFB Comparison

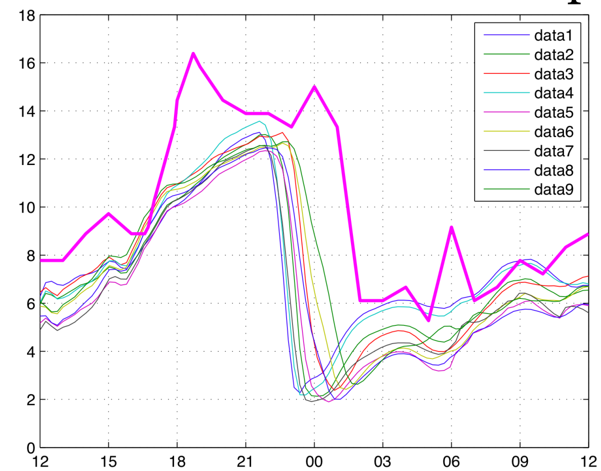
Surface Pressure



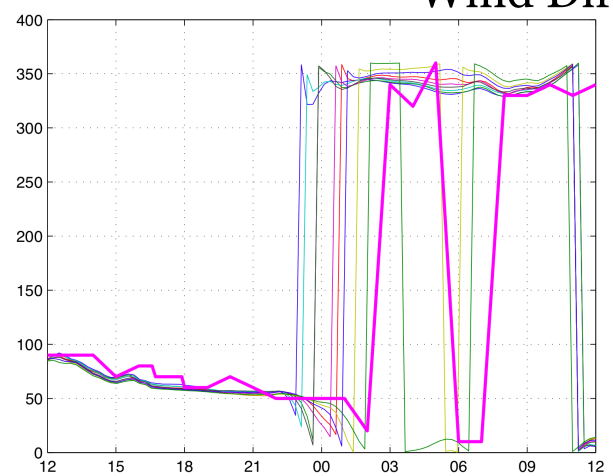
Temperature



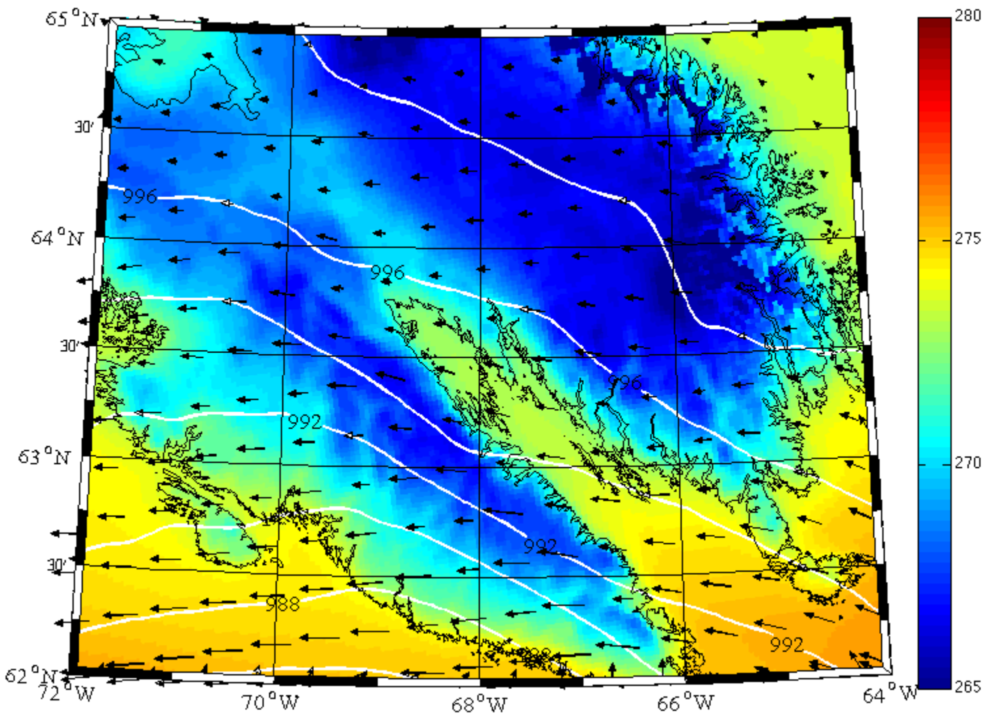
Wind Speed



Wind Direction

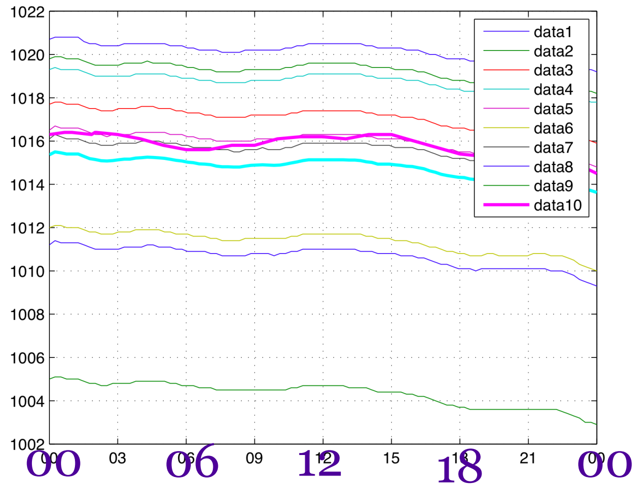


Surface September 2008

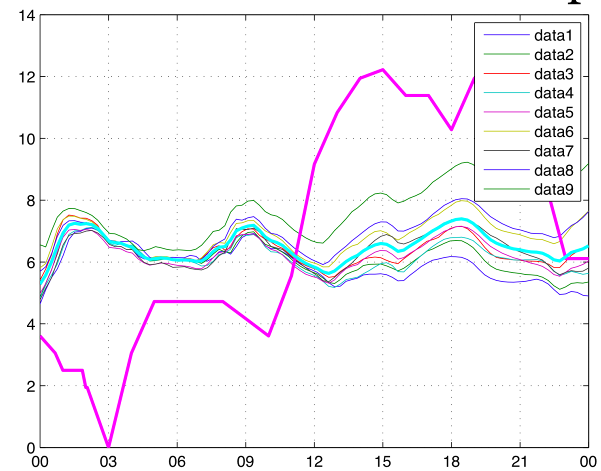


October 2008 YFB Comparison

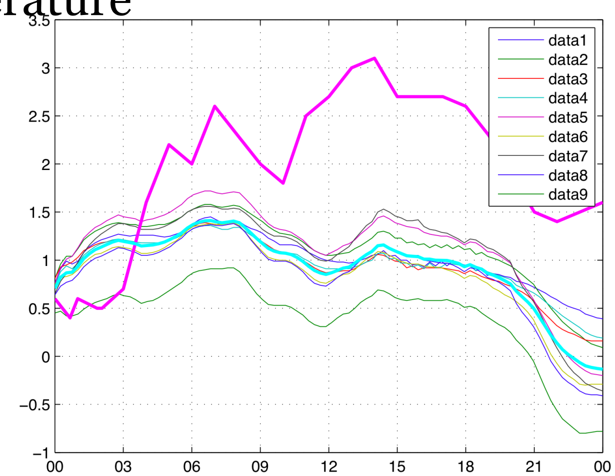
Surface Pressure



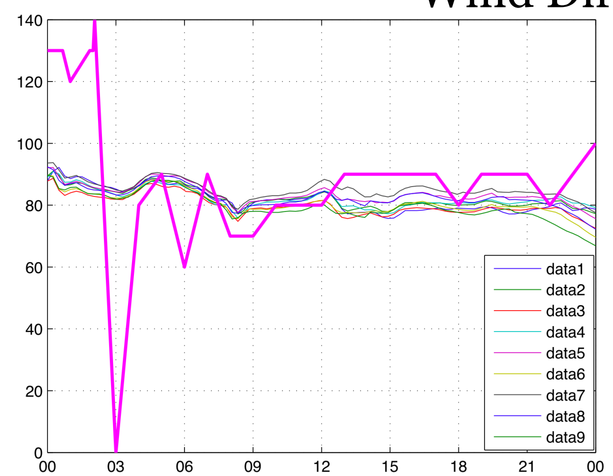
Wind Speed



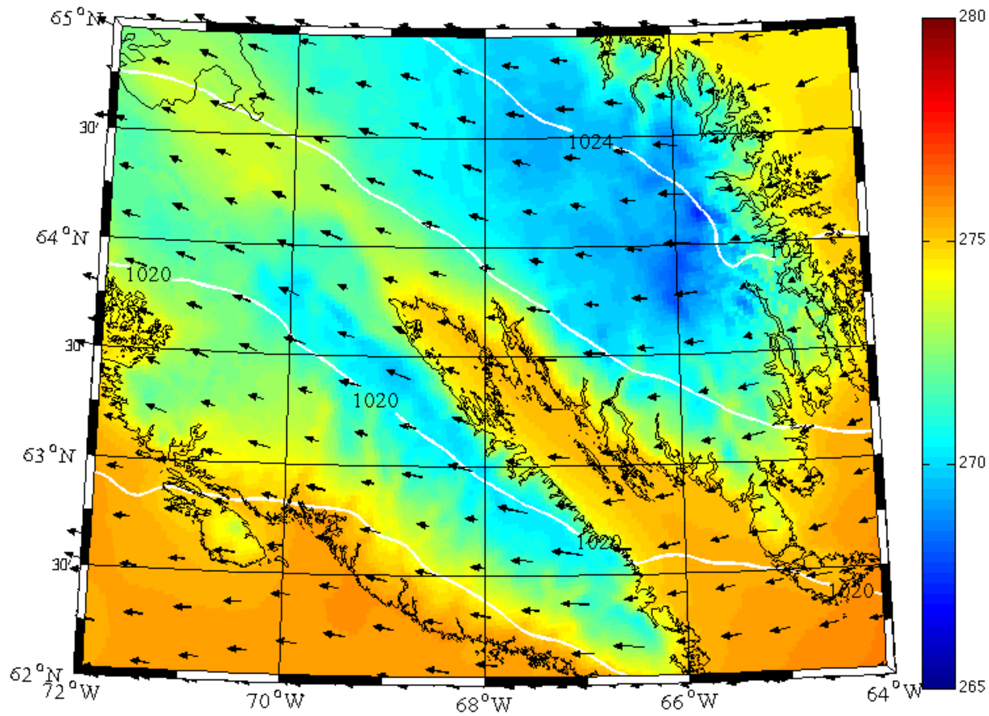
Temperature



Wind Direction



Surface Oct 2008



Case Summary

	Feb 2007	Nov 2008	Oct 2008	Sept 2008
Max Wind (obs)	33 ms^{-1} 0Z 5 Feb	24 ms^{-1} 15Z 17 Nov	13 ms^{-1} 21Z 2 Oct	17 ms^{-1} 19 Z 20 Sept
Max wind (model)	24 ms^{-1} 4Z 5 Feb	11 ms^{-1} 13Z 17 Nov	13 ms^{-1} 21Z 2 Oct	13 ms^{-1} 22Z 20 Sept
Direction	NE with NW swings	NW -> NE -> NW	E -> NE	NE -> NW
Shift Time	18Z-21Z, 4 Feb 6Z-9Z, 5 Feb	6Z-8Z 17 Nov 19Z-20Z	2Z-4Z, 2 Oct	2Z, 21 Sept
Temp Trend	Increasing	Increasing with NE	Increasing	Increasing

Conclusion

- There is a definite 'regime change' from NW to NE marked by
  - Rising temperatures
  - NE or E winds throughout the troposphere
- Heat fluxes over Frobisher Bay?
- Some sensitivity studies to study physics
- Difficulties arise when
  - Winds don't reach the surface (surface roughness?)
  - Winds may be positioned a little off to the east of YFB
  - The jump may move north of YFB earlier than it should