# Current observations at the Jan Mayen Ridge

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Bjerknes Centre for Climate Research

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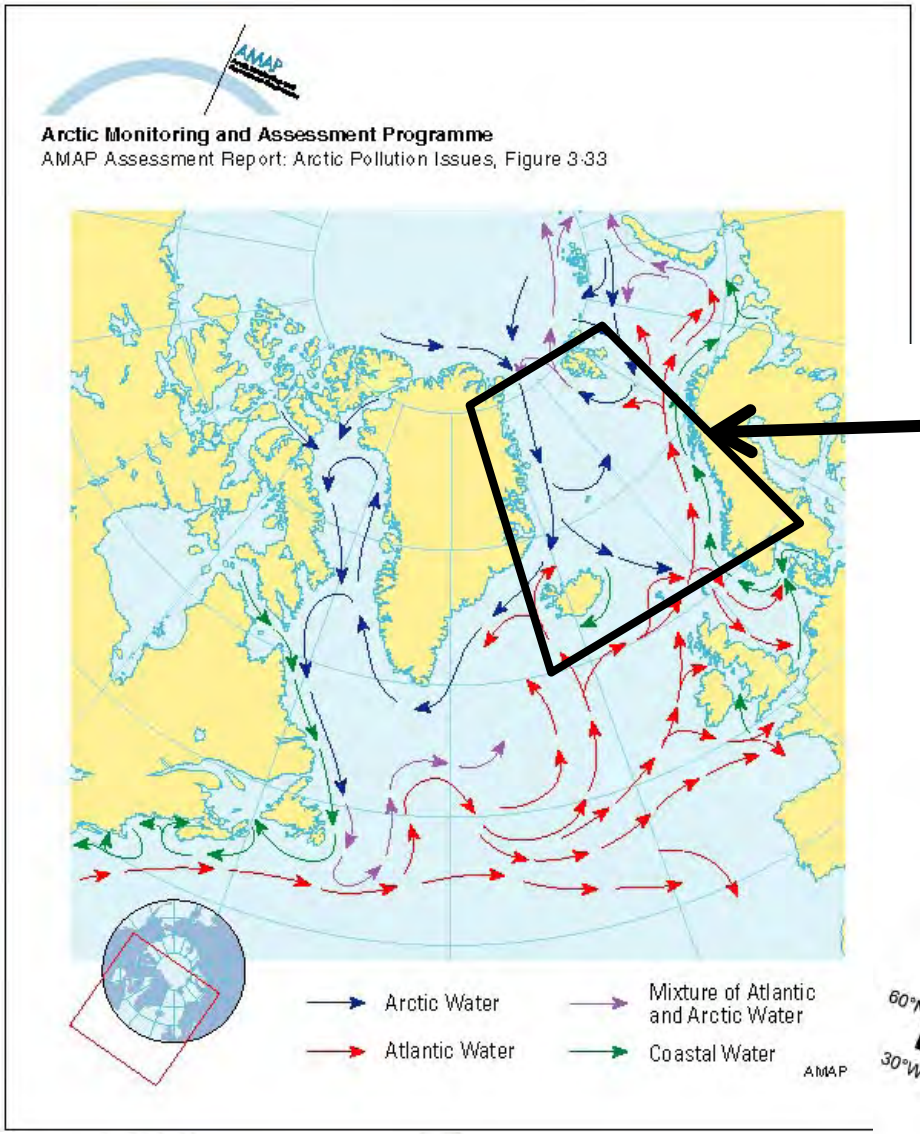
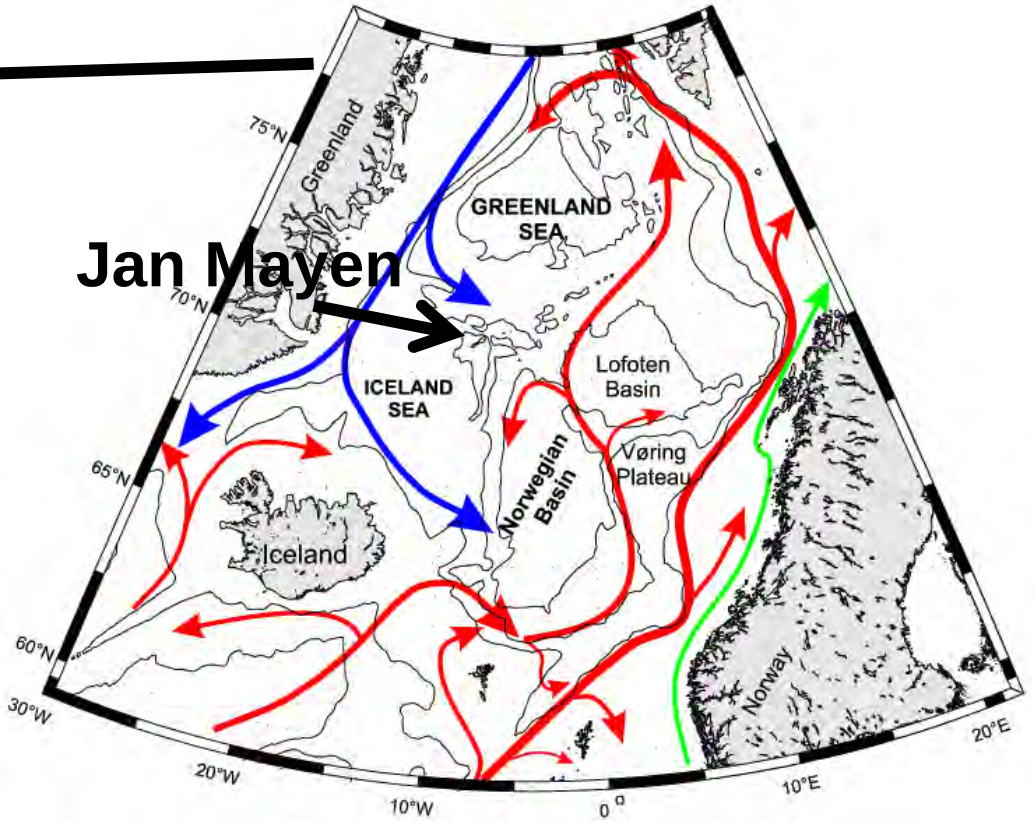
**ESSAS Open Science Meeting**
**Seattle 2011**

# The main surface currents in the Nordic Seas



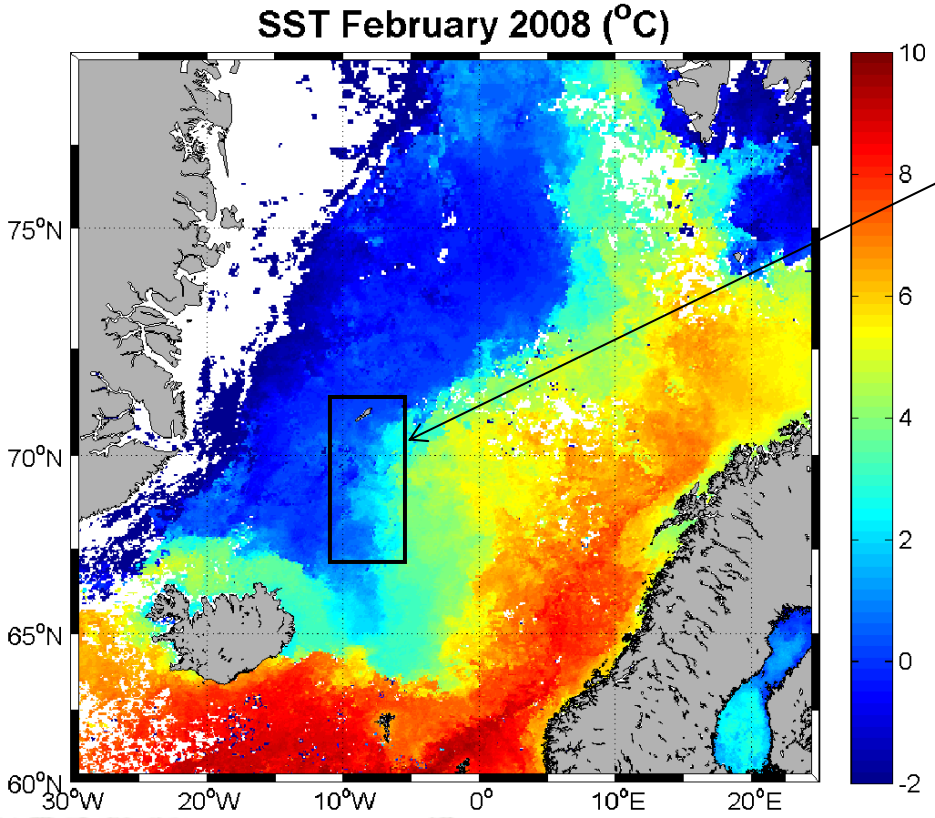




The main surface currents in the North Atlantic

Atlantic water →

Arctic water →

# IPY-NESSAR



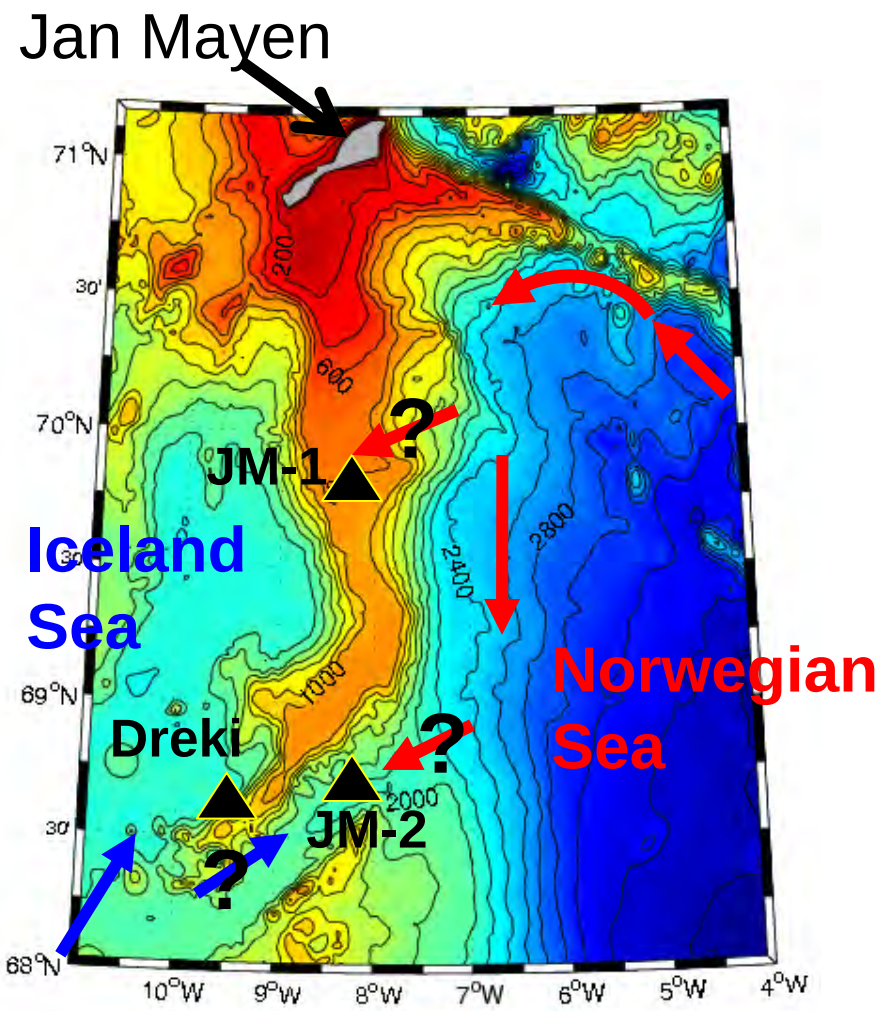

Sharp fronts where the warm and saline Atlantic water meets the cold and fresher Arctic water

**IPY-Nessar: Focus on the ecosystem at the front**

**Field work:**
June 2007 & June 2008

IMR (Norway) and MRI (Iceland) deployed two and one mooring, respectively, which included several instruments for current measurement

# Three moorings deployed at the Jan Mayen Ridge




**Purpose:**
To investigate water exchanges between the Norwegian and Iceland Sea

**Measurement period:**
JM-1 and JM-2: 2007-2009
Dreki: 2007-2008

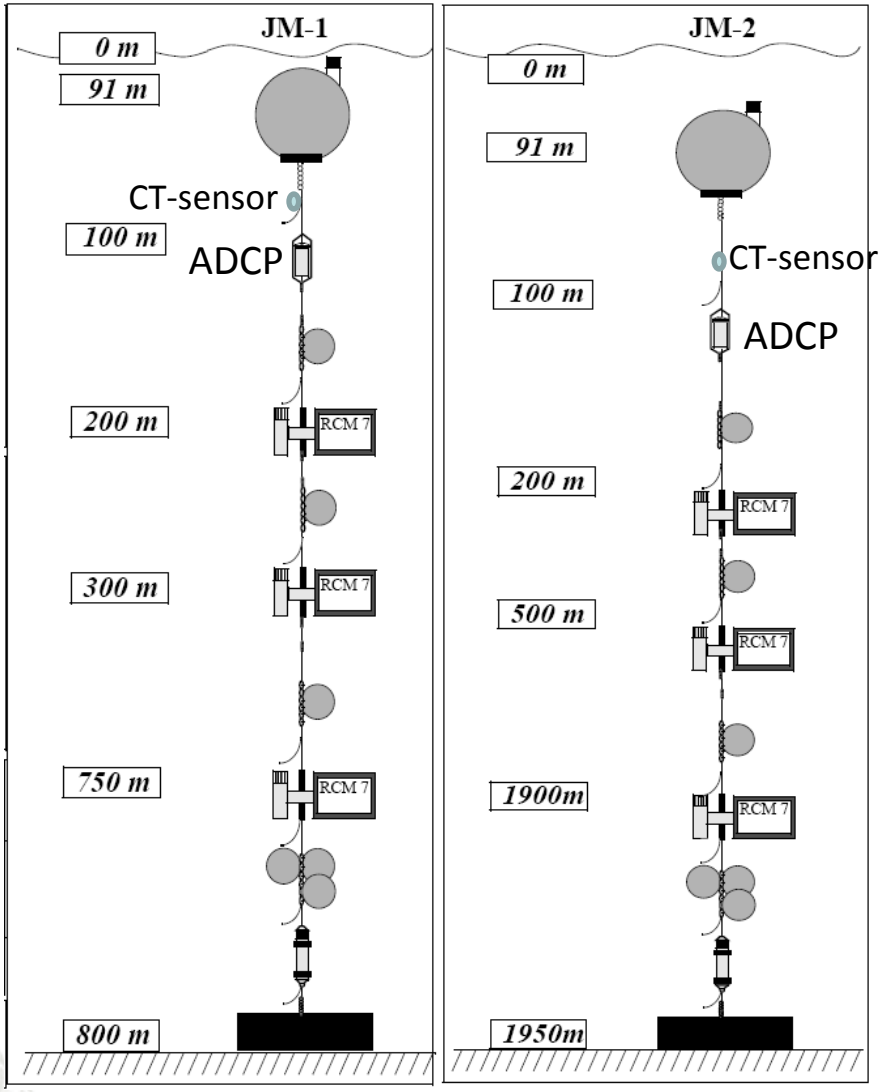
Atlantic water

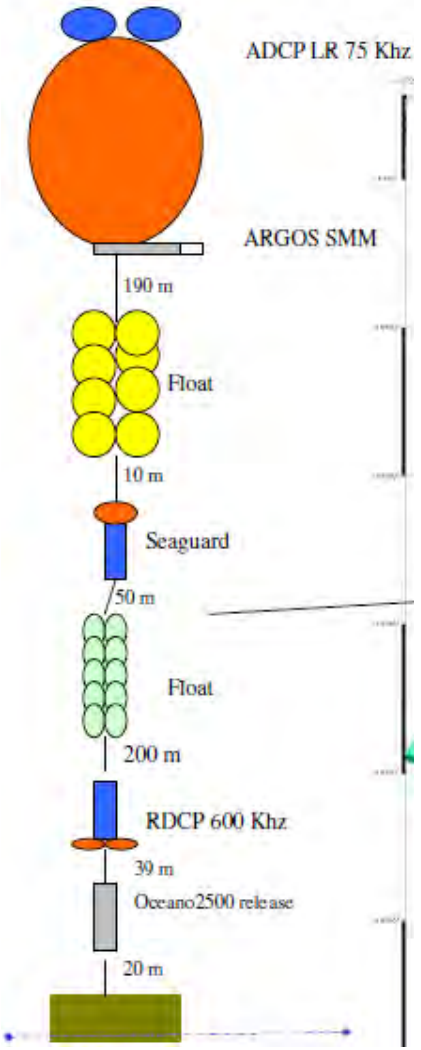
Arctic water

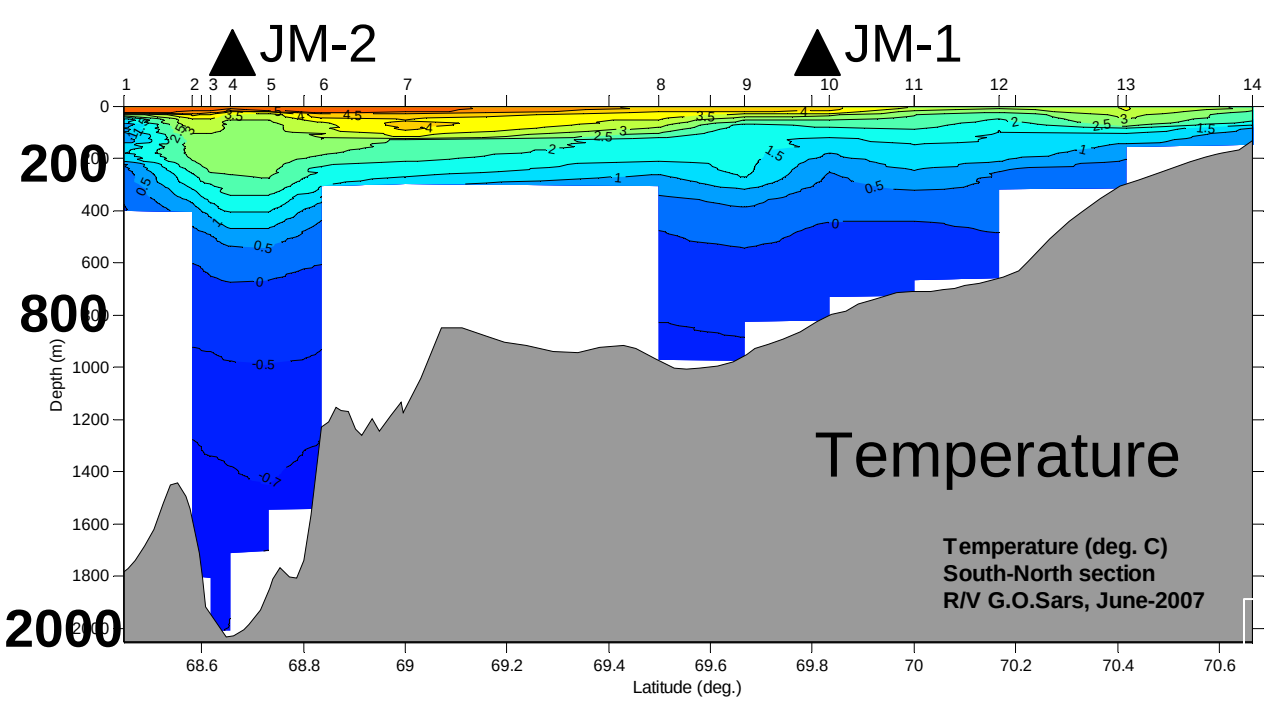
# The moorings had several different instruments for current measurements

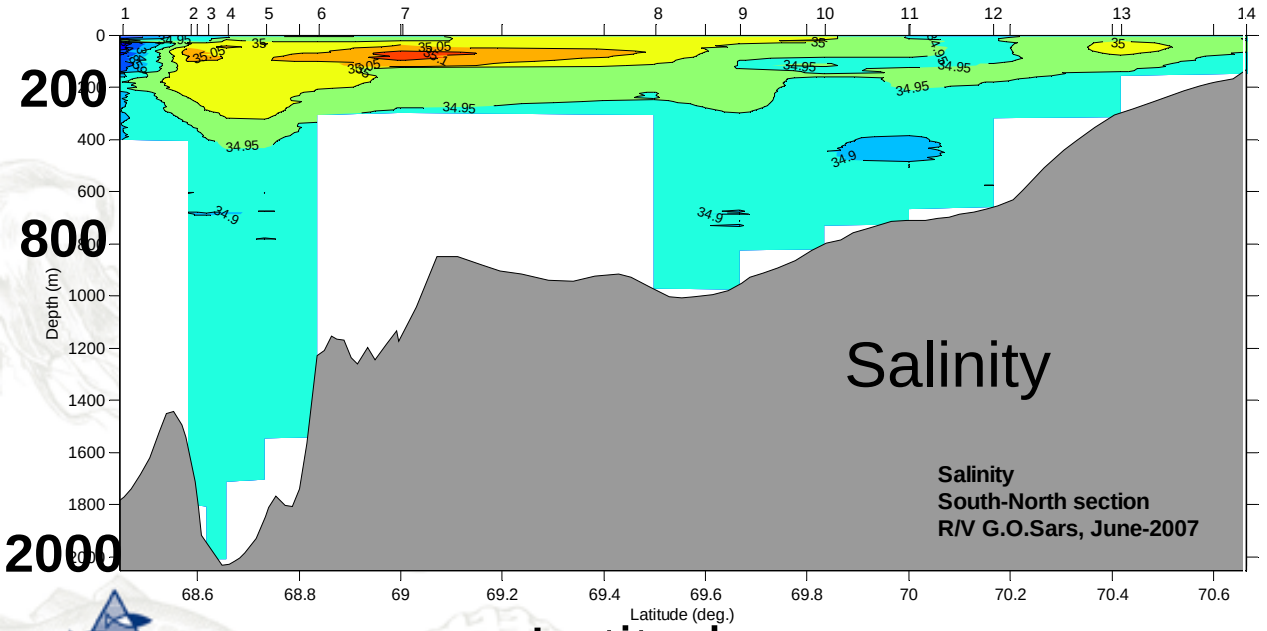
ADCP, RDCP, RCM

Tor Villy with the Nortek ADCP



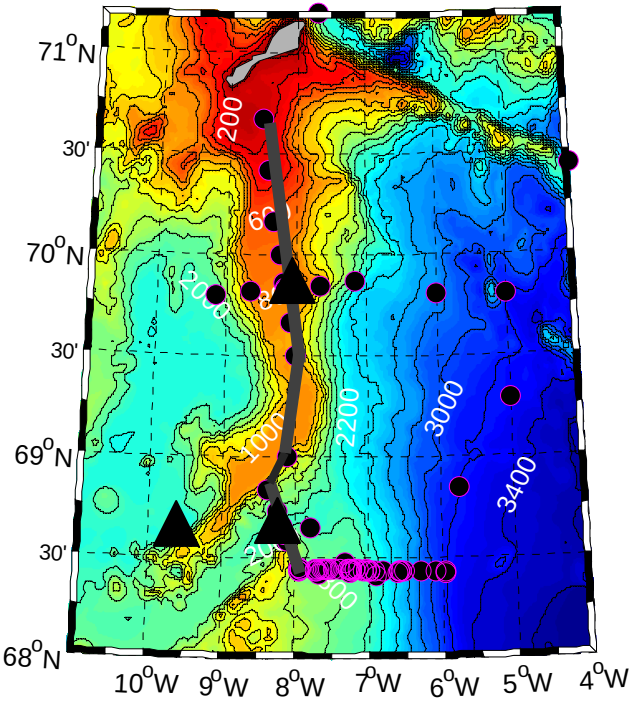


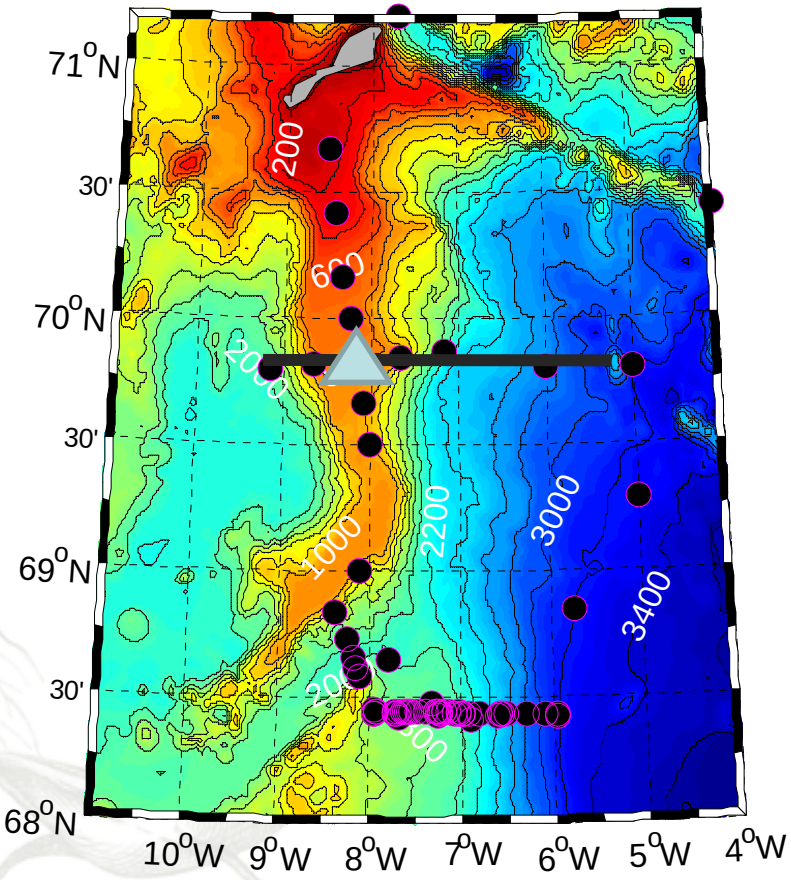

Latitude

Jan Mayen

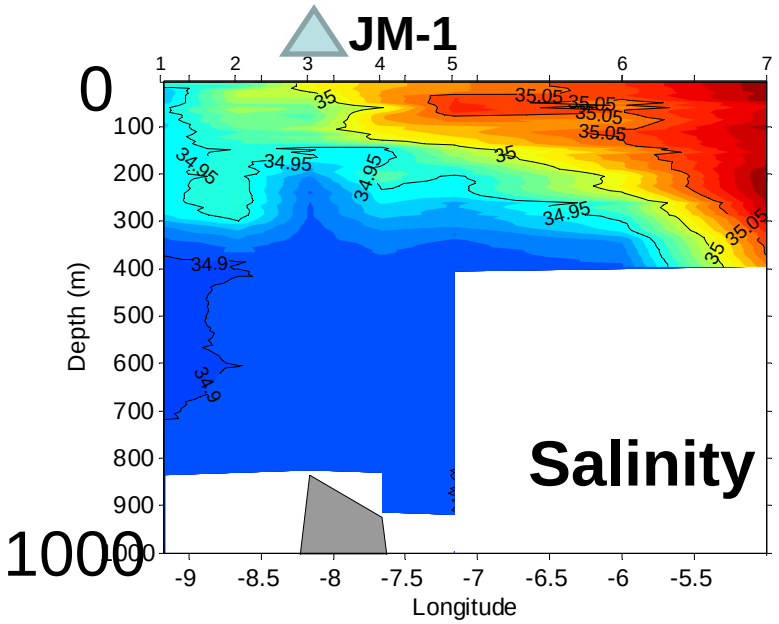
# South-North section

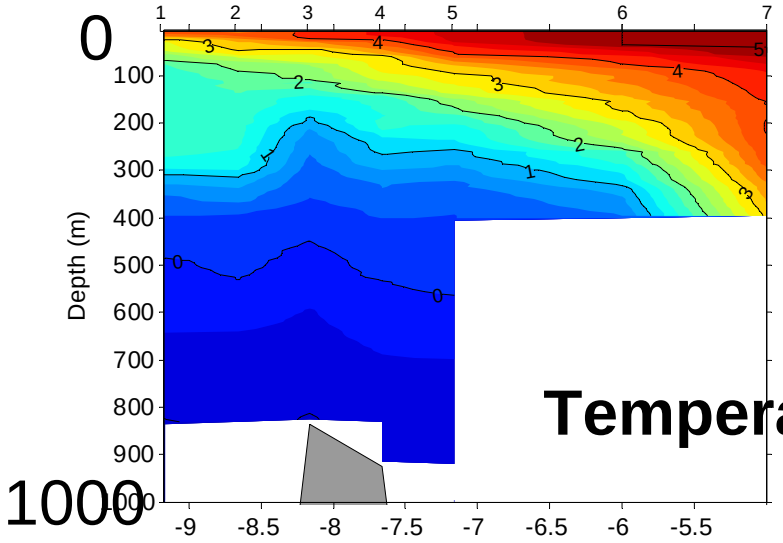


# Temperature and salinity across the Ridge



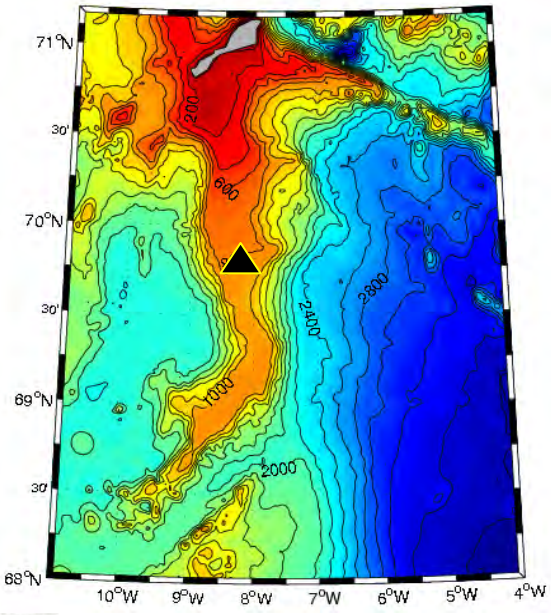

CTD-station

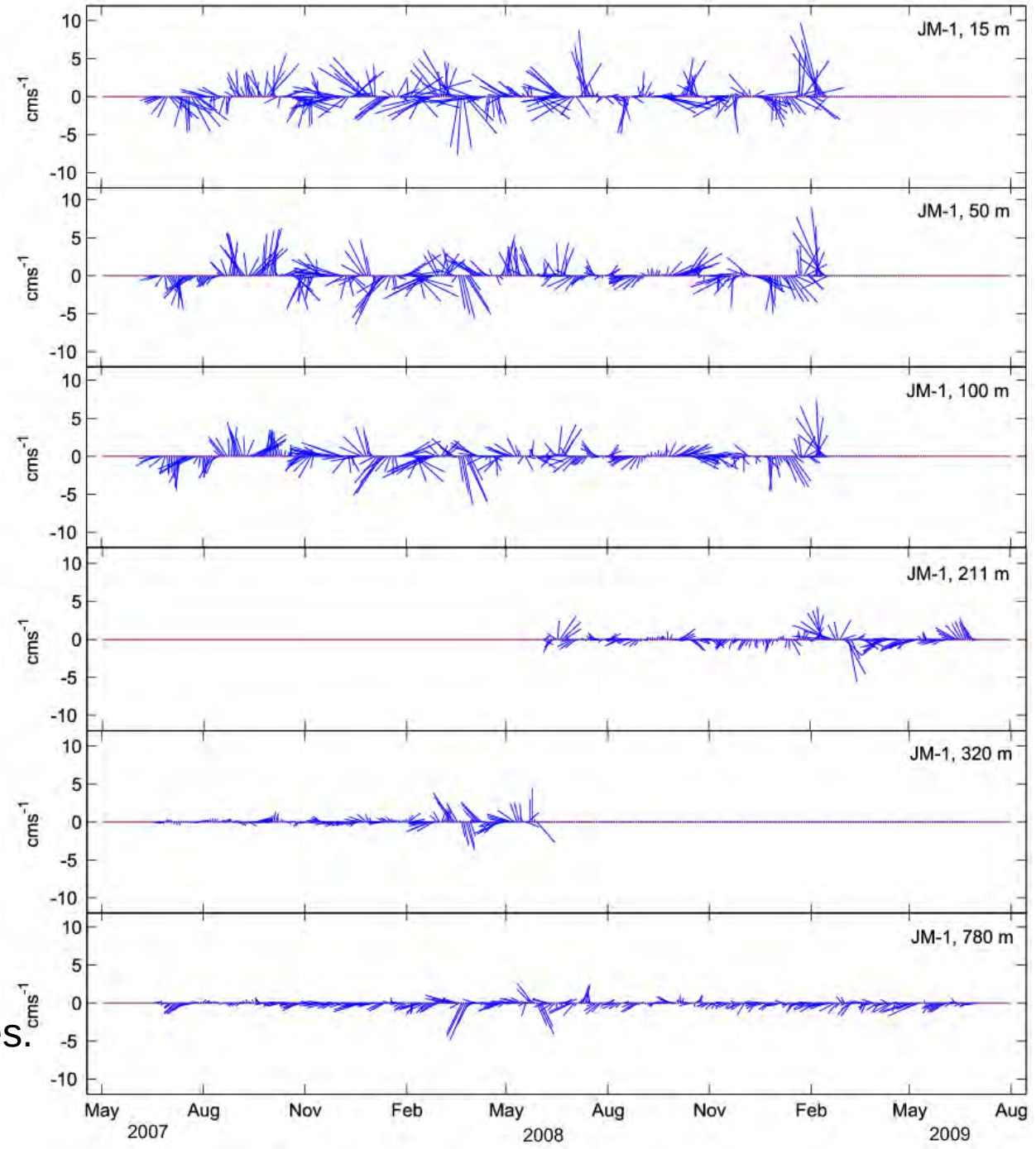



Longitude

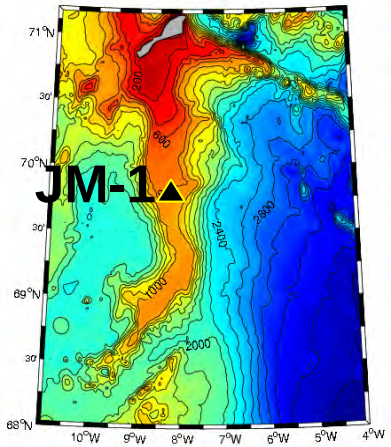
# JM-1

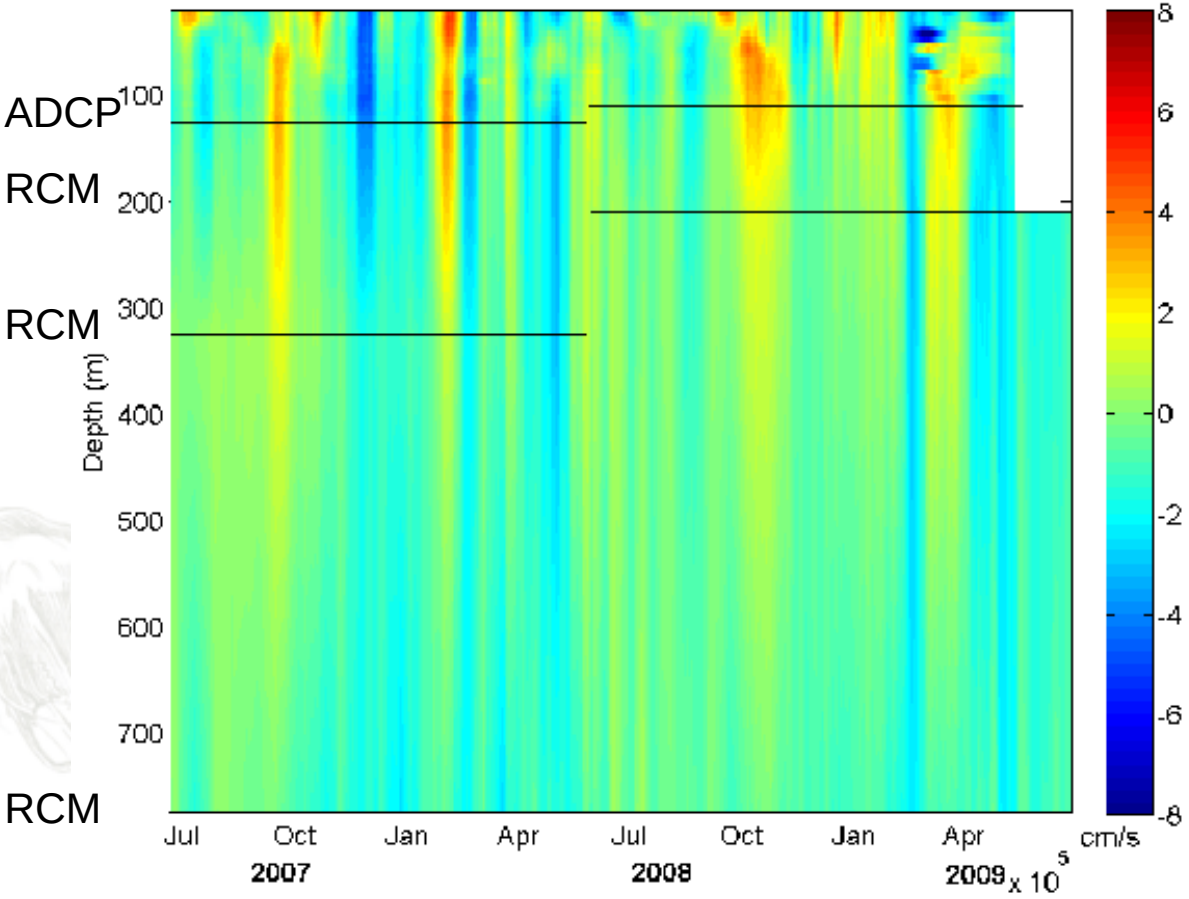



7 days moving averages. Every second day is presented.

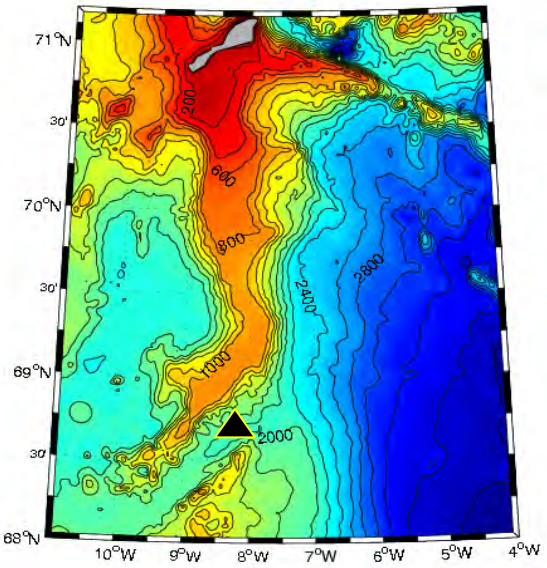
# JM-1, eastward velocity

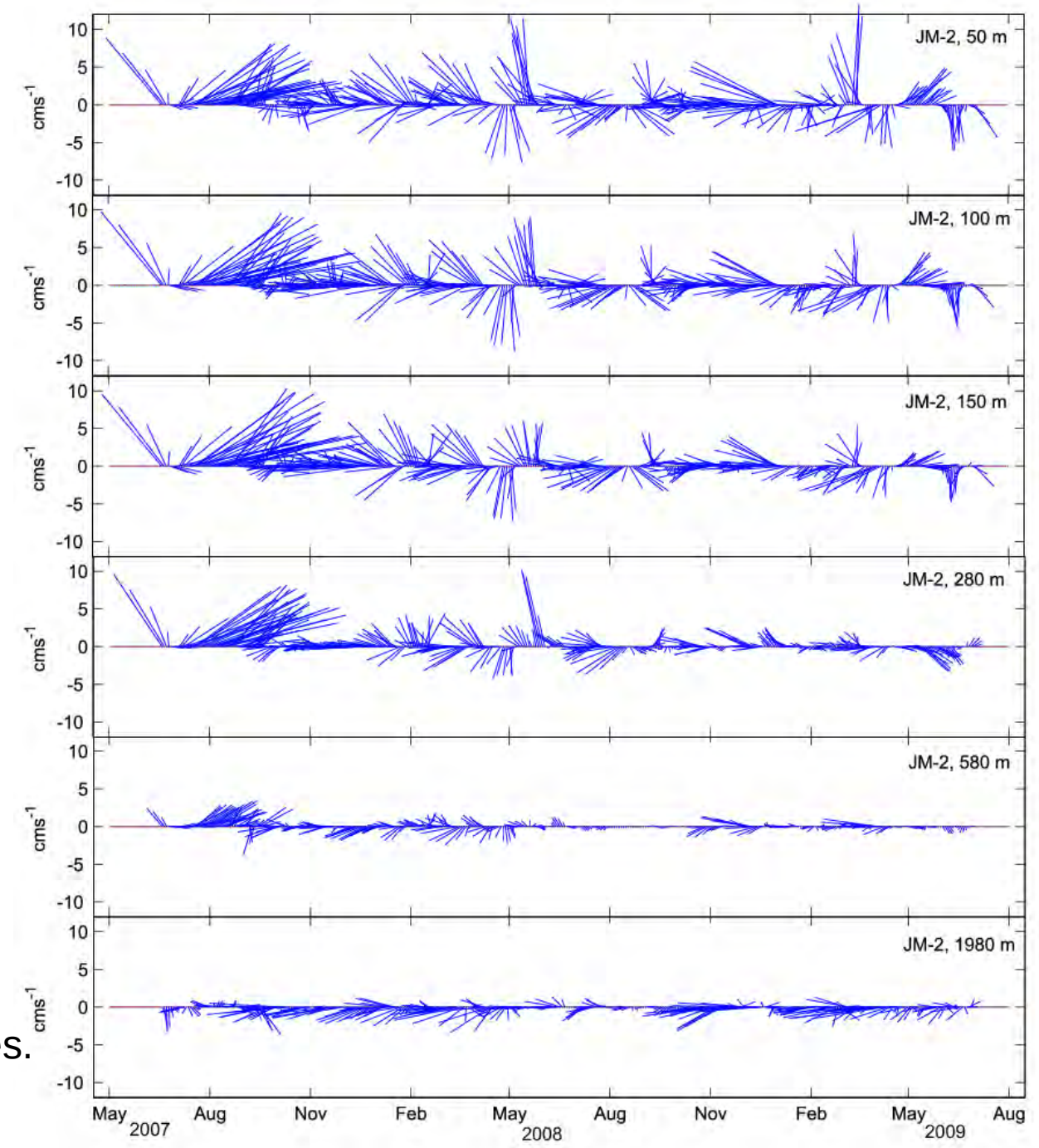



Blue color indicates flow into the Iceland Sea.
Data are 14 days moving averages.

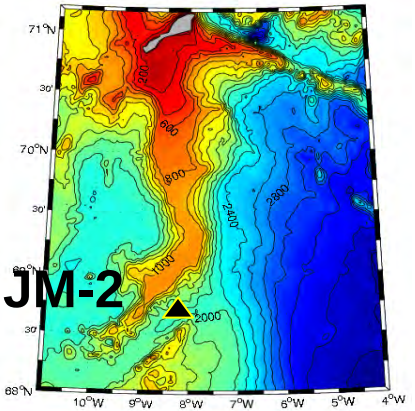
# JM-2

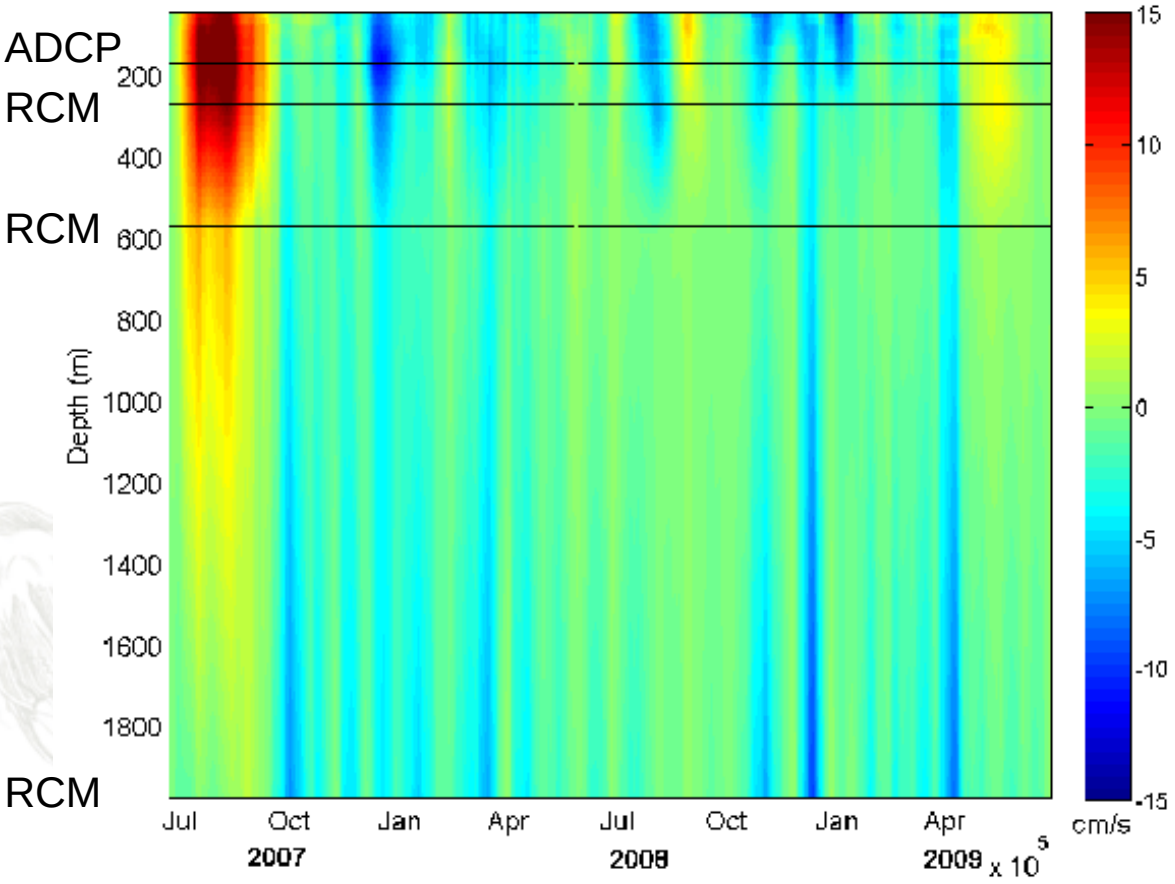



7 days moving averages. Every second day is presented.

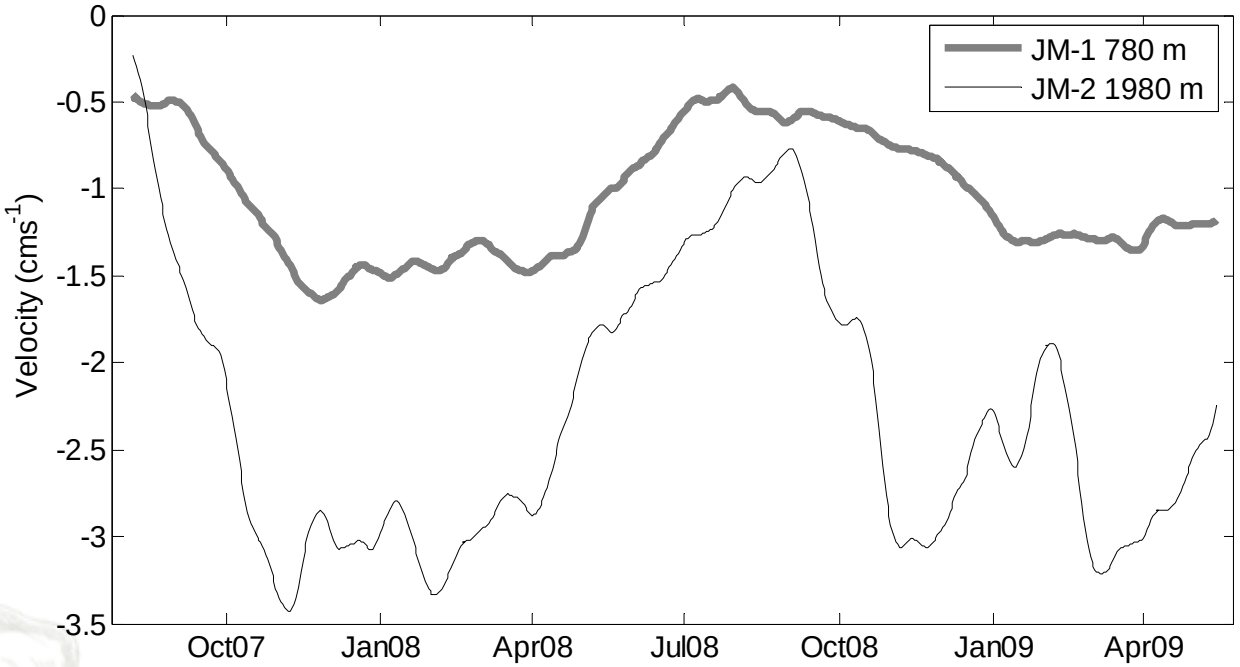
# JM-2 (velocity rotated 20º)

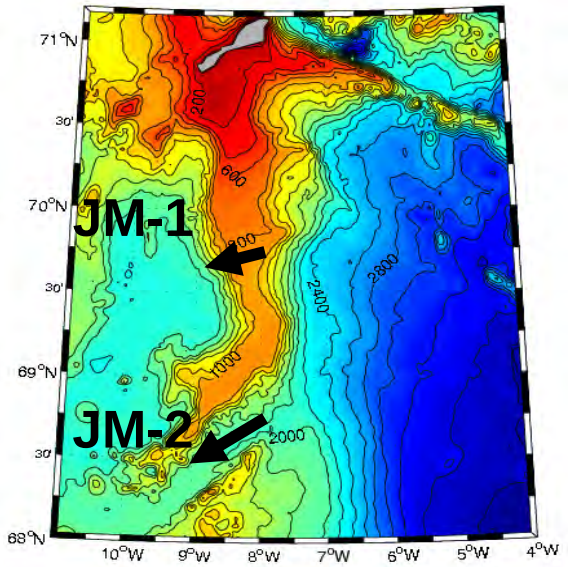



Blue color indicates flow into the Iceland Sea.
Data are 14 days moving averages.

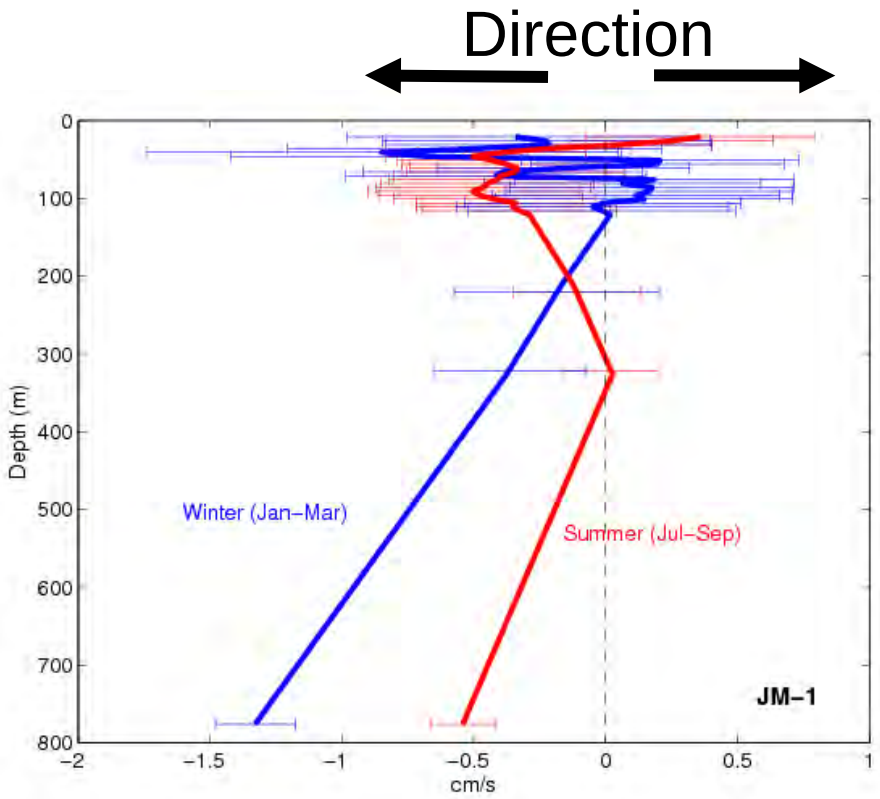
# Bottom current

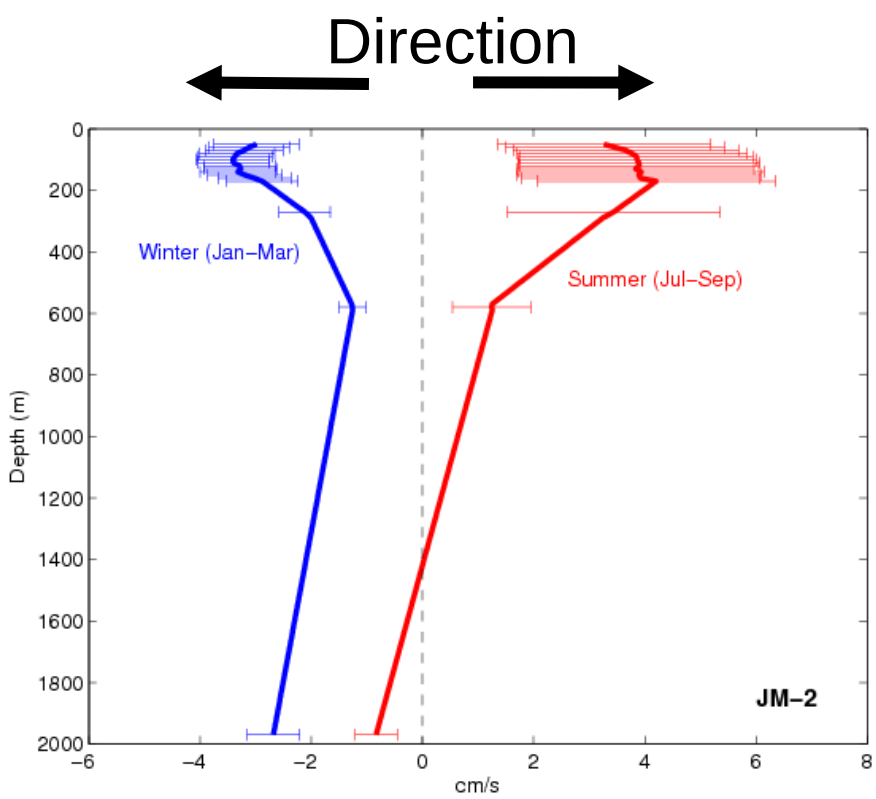



Velocity across the Jan Mayen Ridge near the bottom at JM-1 and JM-2. The velocity at JM-2 is rotated 20 degrees CCW. The velocity are three months moving averages.

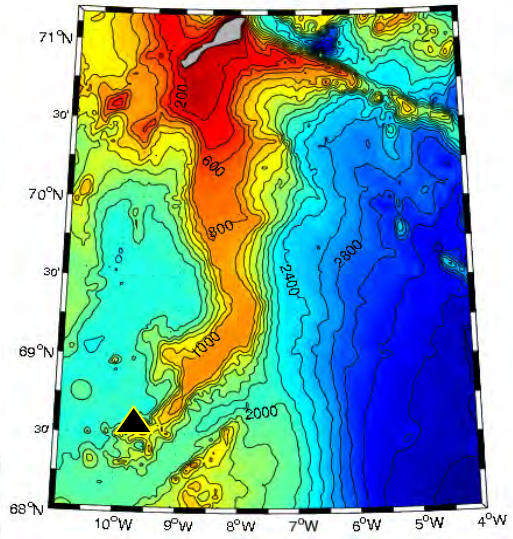
# Seasonal variation

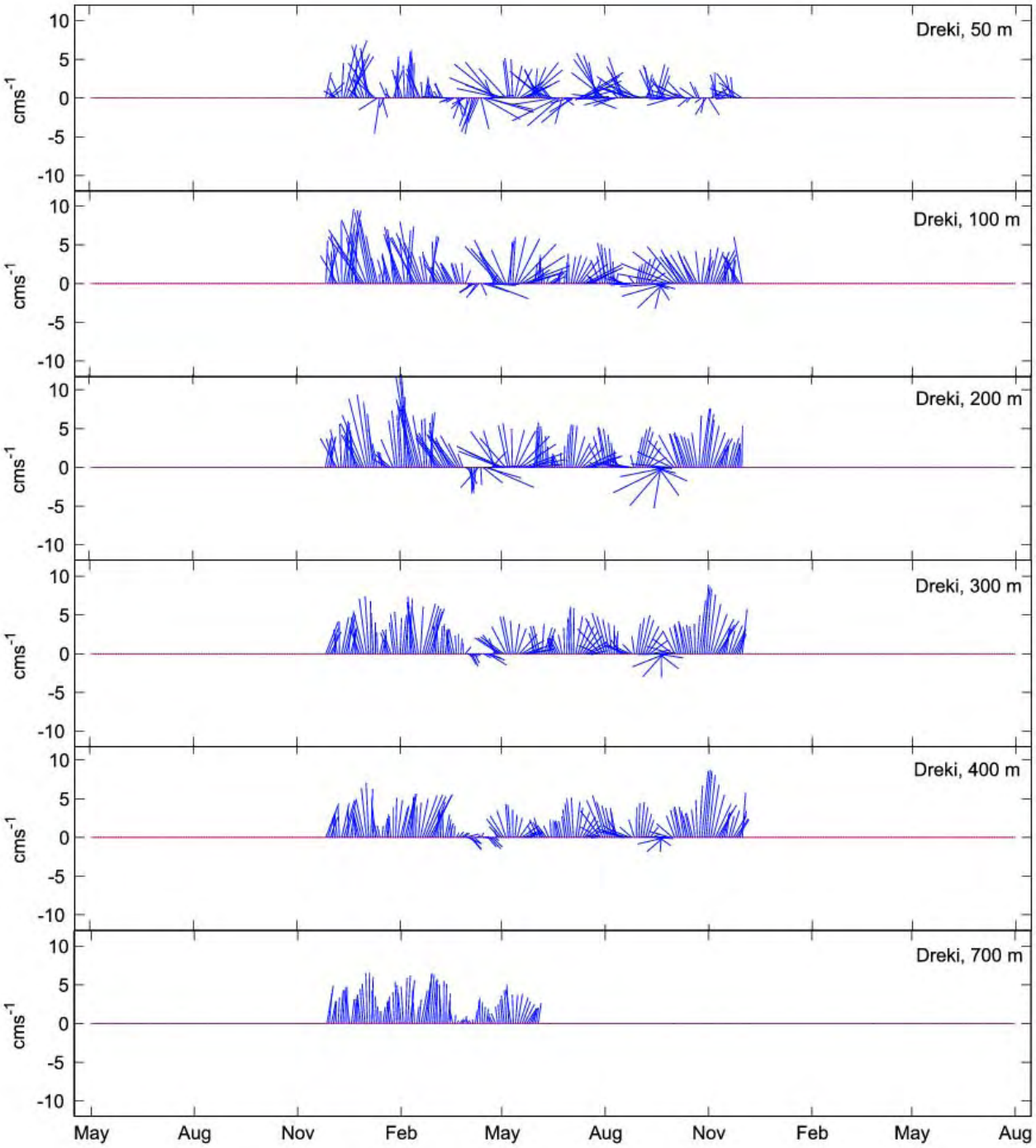


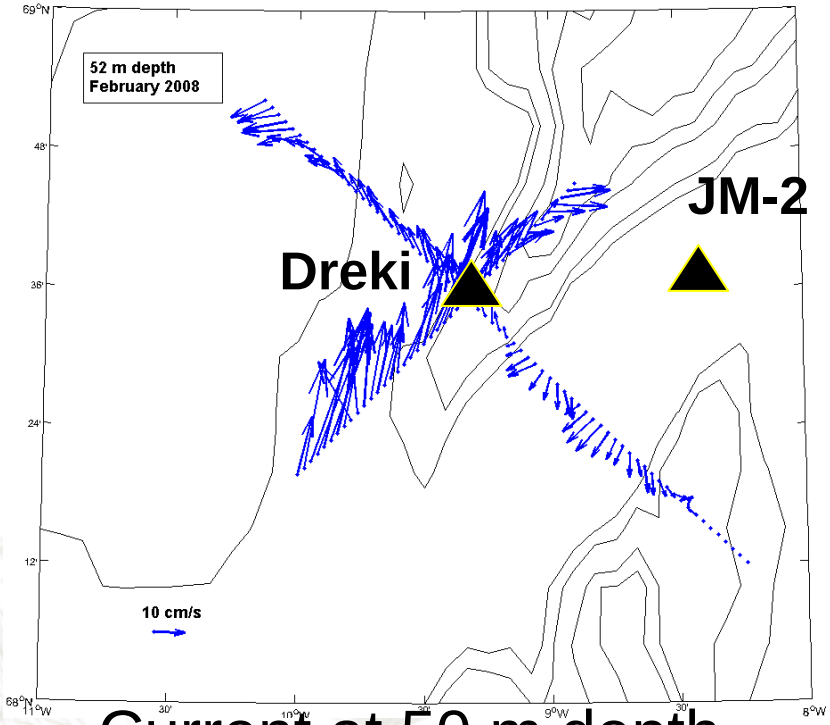

Seasonal averaged velocity with standard error. Red color: eastward (directed to the Norwegian Sea), blue color: westward.

# Dreki

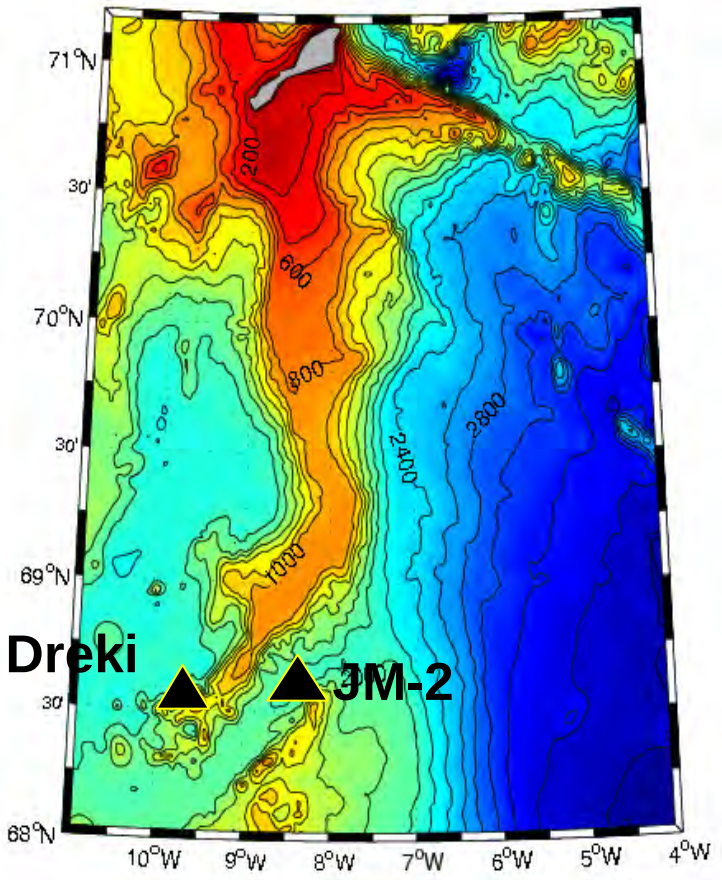

71°N
30'
70°N
30'
69°N
30'
68°N
10°W
9°W
8°W
7°W
6°W
5°W
4°W
200
600
800
2400
2800
1000
2000


Dreki, 50 m
Dreki, 100 m
Dreki, 200 m
Dreki, 300 m
Dreki, 400 m
Dreki, 700 m
cms-1
10
5
0
-5
-10
May
Aug
Nov
Feb
May
Aug
Nov
Feb
May
Aug

# Currents from vessel mounted ADCP (Feb-2008)

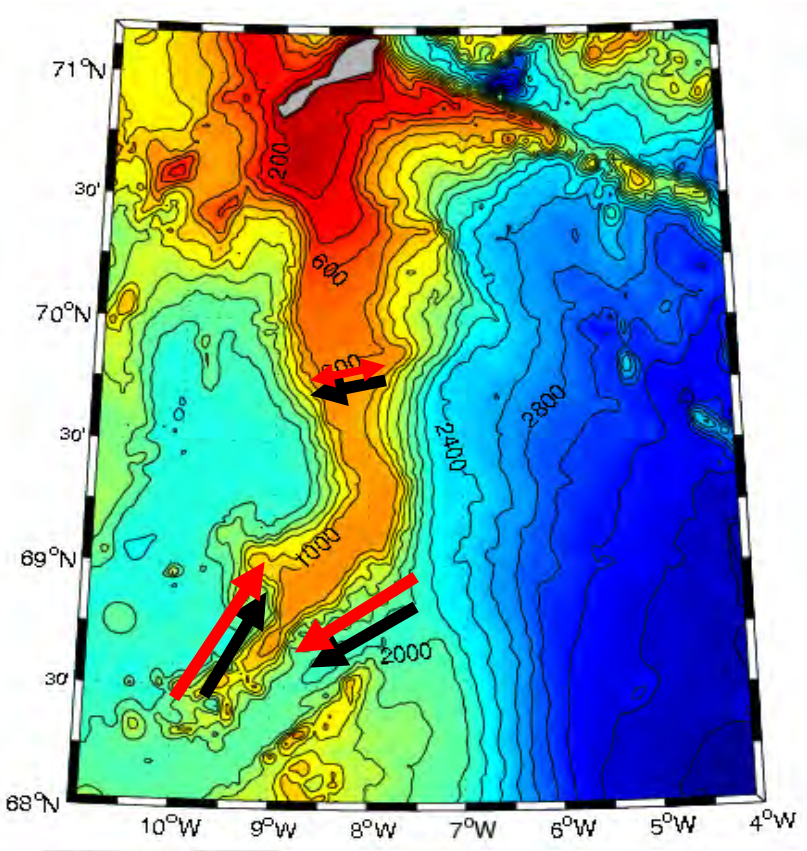



Current at 50 m depth

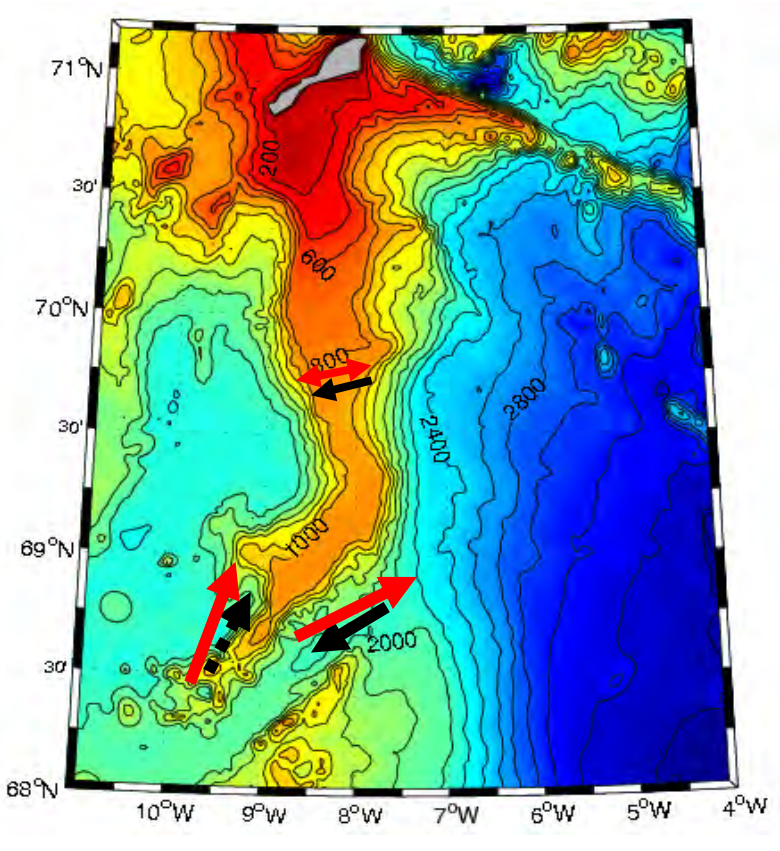


# Mean current field (schematic)

**Winter**




**Summer**



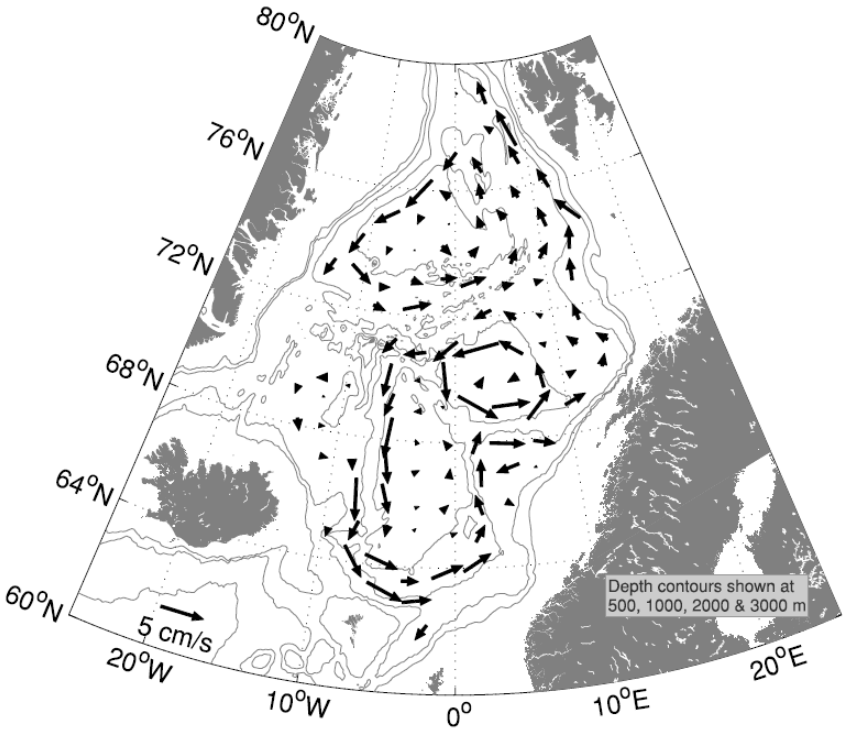

Current at the upper layer (0-200 m)

Bottom current

# Forcing?

- The deep/depth averaged circulation in the Norwegian Sea and Nordic Seas are largely influenced by the wind stress curl (e.g., Isachsen et al., 2003; Nøst and Isachsen, 2003; Voet et al., 2010)

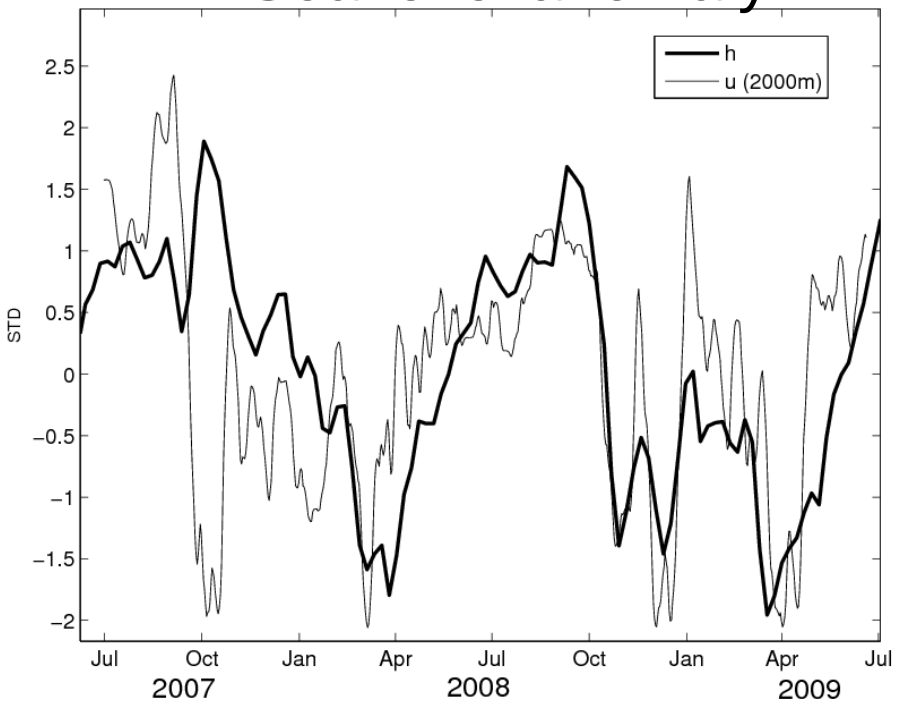
- The deep circulation is stronger during winter compared to summer (Voet et al., 2010; Mork and Skagseth, 2005).




Deep circulation (~1000 m) from Argo floats (Voet et al., 2010).

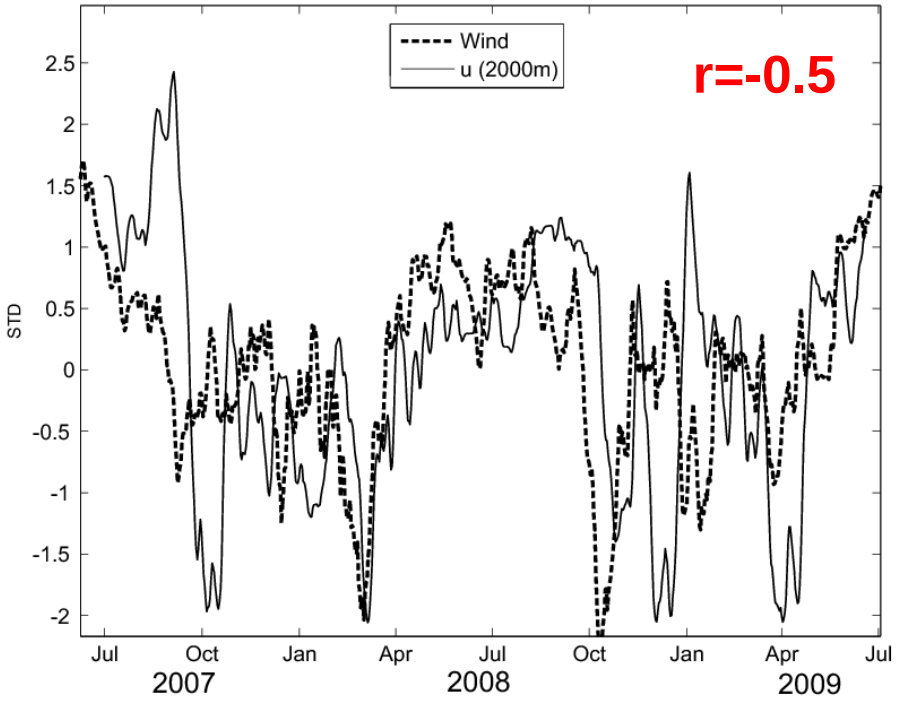
# Bottom current vs sea level height and wind

## Sea level anomaly



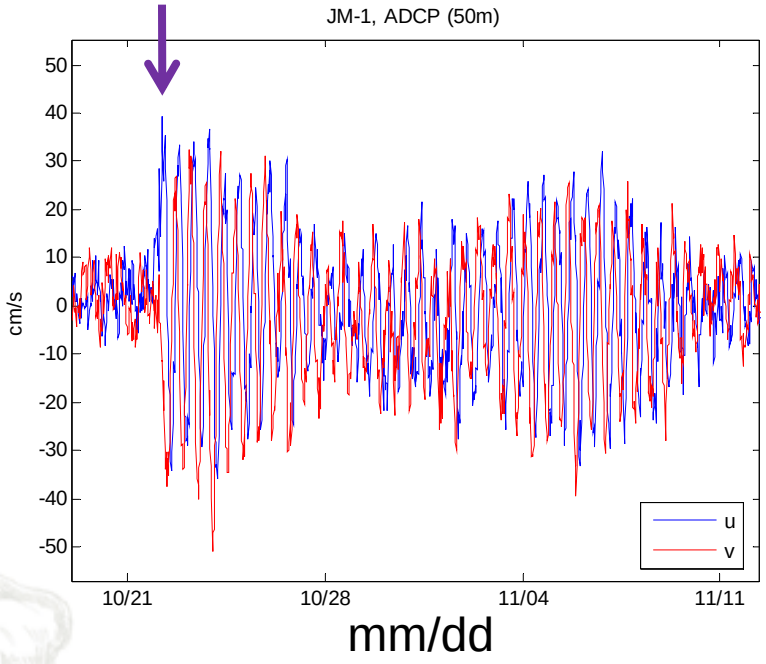

Normalized time series of sea level height at the Jan Mayen Ridge and bottom current at JM-2

## Wind stress curl

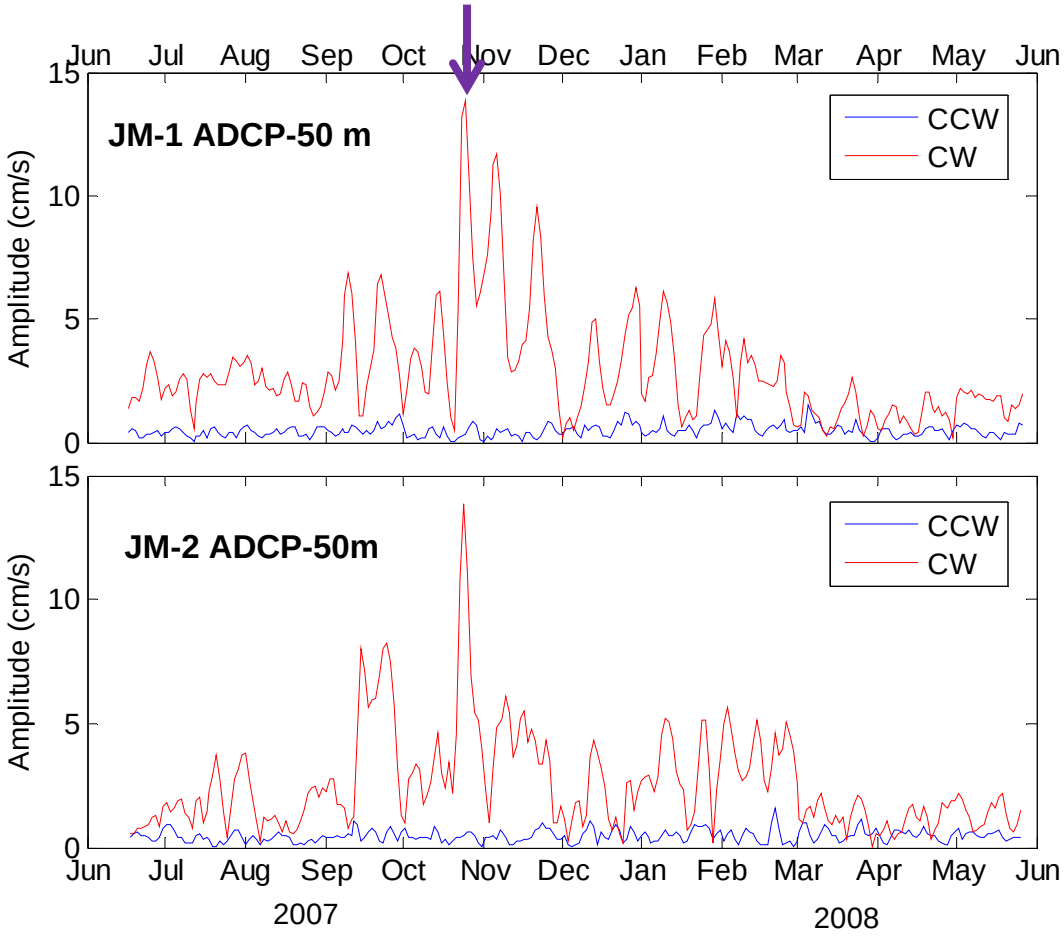



Normalized time series of bottom current at JM-2 and wind stress curl in the Norwegian Sea (opposite directed).

# Strong semi-diurnal oscillation




Velocities (u,v) at JM-1 from 50 m depth during October-November 2007



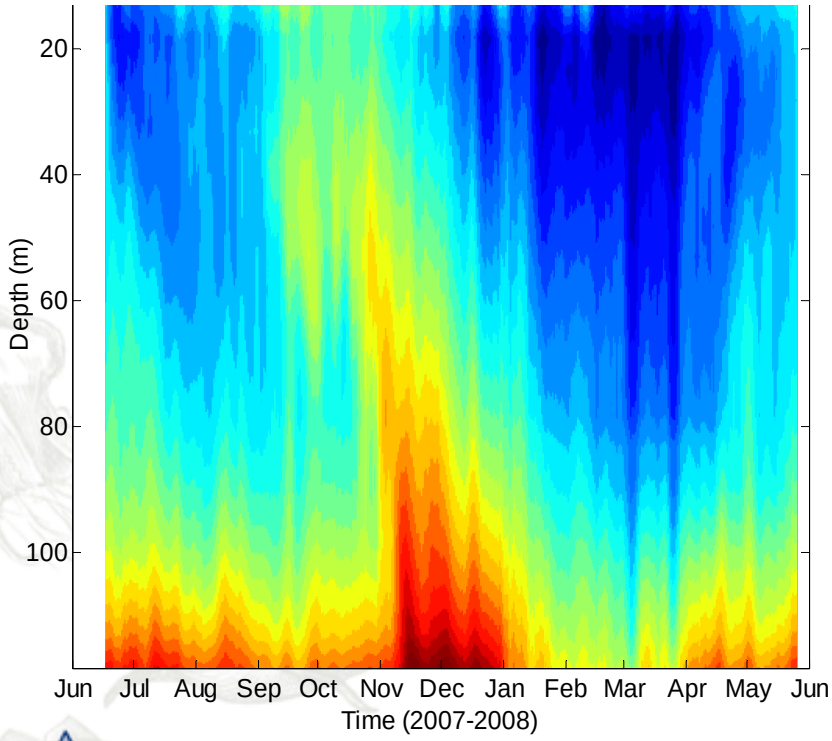

Amplitude of rotation direction (instead of u and v) for the semi diurnal period.
CW=Clock Wise, CCW=Counter Clock Wise

# Zooplankton migration?

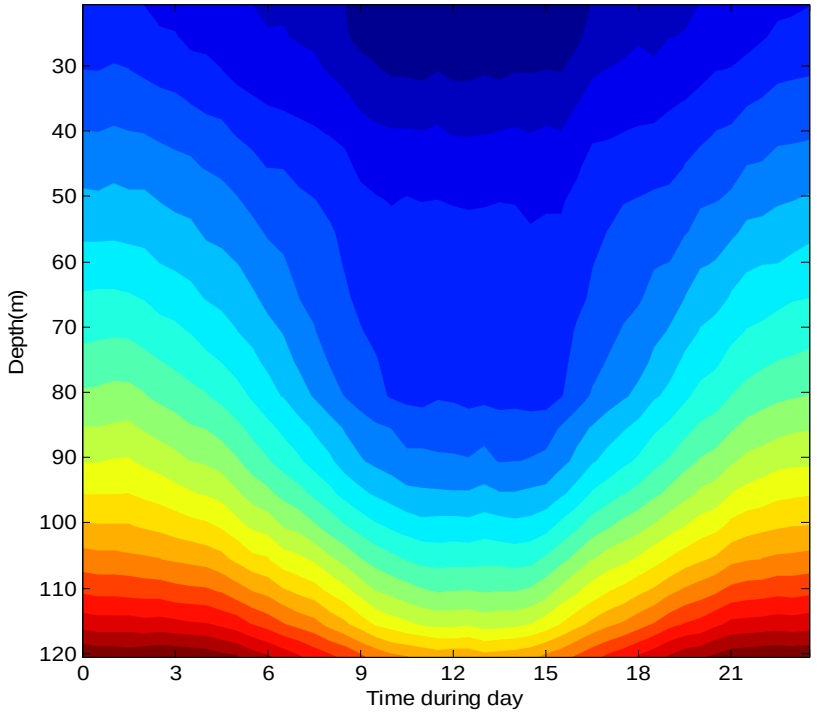
Using signal (backscatter) from ADCP (190 kHz)

## Seasonal migration

JM-1 Amplitude (counts)




## Daily migration



# Main results

- Weak flow (low stability) from the Norwegian Sea to the Iceland Sea at JM-1. Seasonal changes in the bottom current.
- Seasonal variation at JM-2 (in the deep channel):

  Upper layer, winter: flow to the Iceland Sea, summer: opposite

  Deep water, from the Norwegian Sea into the Iceland Sea both summer and winter
- Link to the wind stress curl in the Norwegian Sea
- Northwards (barotropic) current at Dreki
- Strong semi-diurnal (inertial) oscillation