On the Nature of the Atlantic Water Recirculation in Fram Strait

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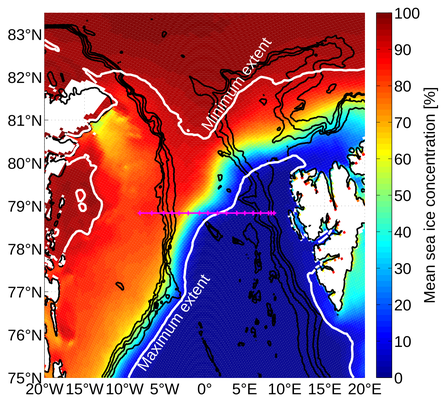
Poster # 739

Introduction

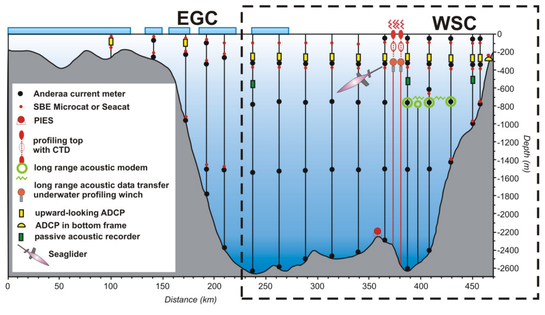
The Atlantic Water (AW) inflow is the major oceanic heat source of the Arctic Ocean and keeps the eastern Fram Strait ice-free year-round.



Mean sea-ice extent: AMSR-E and AMSR-2 2002-2013 mean sea-ice concentration. The maximum [minimum] sea-ice extent is defined as the line where the sea-ice concentration is 60% or less [or more] in 95% of the realizations.

Some the AW turns westward and then flows southward as part of the cyclonic gyre of the Nordic Seas. What is the nature of this AW recirculation and its variability?

AWI/NPI Mooring Array

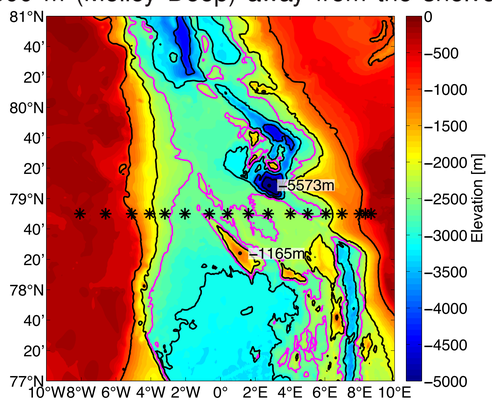


Mooring array during ACOBAR: Most comprehensive variant of the mooring array maintained by the Alfred Wegener Institute and the Norwegian Polar Institute.

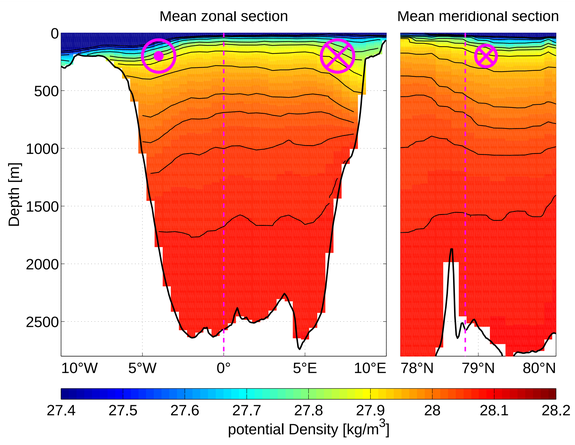
The array as shown has been maintained from 1997 to 2014 with the exception of moorings F15, F16, and F17 which were only added in 2002.
Starting in 2014, the array will be continued in a reduced form: Moorings F7, F8, F15, F16 are not redeployed. This is due to the fact that the northward fluxes in the recirculation area are insufficiently resolved by the array.
Additionally, glider activities in Fram Strait are not continued. Navigation of the gliders under sea-ice continues to be challenging and it is therefore impossible to substitute under ice mooring measurements to monitor the inflow/outflow.

Bathymetry

The barotropic component of the flow is strongly influenced ("steered") by the complex bathymetry ranging from 1200 m (Hovgaard Fracture Zone) to 5600 m (Molloy Deep) away from the shelves.

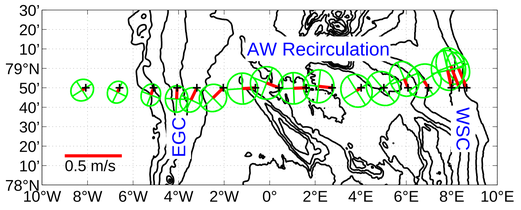


Geostrophic Flow



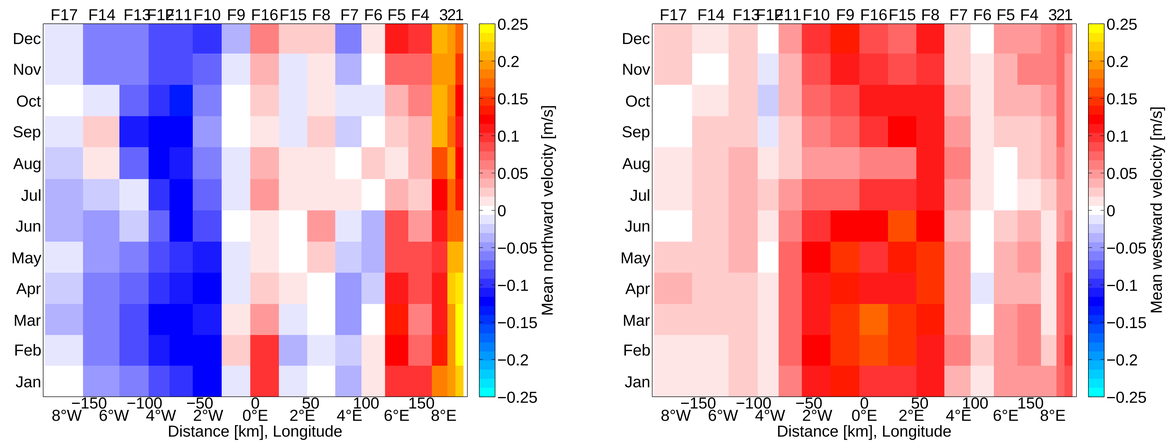
Mean CTD sections: Mean potential density from 16 (1997–2012) CTD sections in east-west direction (left) and from 4 (1997, 1998, 1999, 2001) CTD sections in north-south direction (right).
The baroclinic flow is proportional to the isopycnal tilt. The AW Recirculation and the EGC both have strong baroclinic flow while the WSC is mostly barotropic and has a weaker baroclinic signal.

Mean Currents

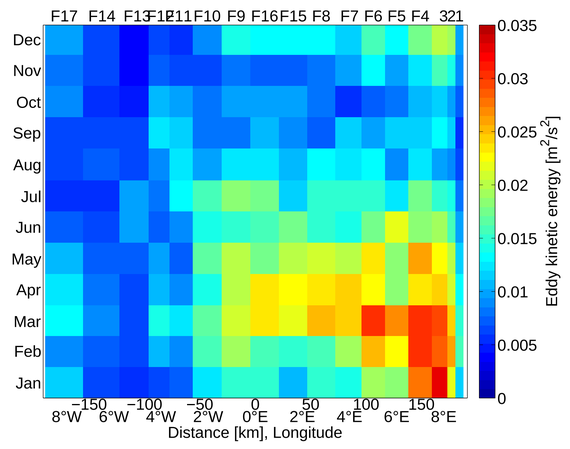


Mean currents in ≈50–100 m: The means are shown in red and the standard deviation ellipses around the means in green.
The mean velocity is larger than the variability only in the West Spitsbergen Current (WSC). The westward flow in the central strait is as strong as East Greenland Current (EGC).

Seasonal Cycle of AW Recirculation

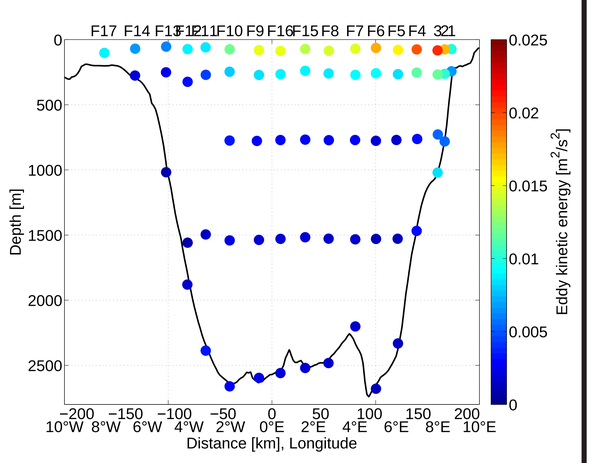


Mean velocities in ≈50–100 m: 1997–2012 monthly averages of the upper ocean velocity. The meridional velocity is shown on the left and the zonal velocity on the right; note that westward velocity is positive.



Left: Eddy kinetic energy in ≈50–100 m: 1997–2012 monthly averages of the upper ocean eddy kinetic energy: $\frac{1}{2}\left[(u-\bar{u})^2+(v-\bar{v})^2\right]$ where $\bar{u}$ and $\bar{v}$ are the three month lowpass filtered velocities indicative of the seasonal and interannual variability.
The flow in the Fram Strait is weaker in the summer months. The westward velocity maximum of the AW recirculation in the central strait coincides with the strongest eddy activity in the offshore branch of the West Spitsbergen Current. This suggests that the recirculation is related to eddy generation in the eastern Fram Strait.

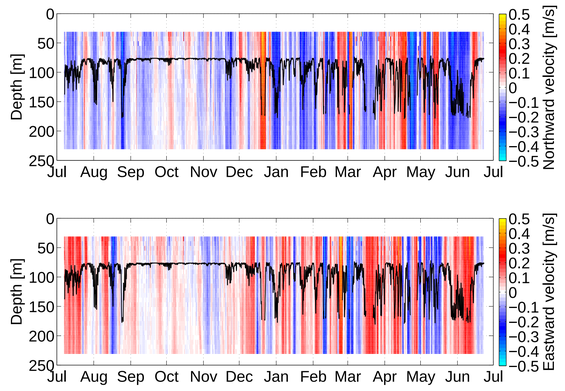
EKE Distribution with Depth



Section of eddy kinetic energy: The 1997–2012 mean EKE is shown at the horizontal and vertical locations of the moored current meters.

Most of the variability/instabilities is happening in the upper ocean suggesting that the eddy activity in the AW recirculation is mostly baroclinic.

Example of Eddy Activity



Mooring record at F6 in 2011-2012: The meridional and zonal (eastward positive) velocities are shown in color and the black lines show the vertical mooring motion which is proportional to the full water column mean speed.
There is significantly less eddy activity in the AW recirculation in September, October, and November 2011 than in the rest of the year consistent with the 1997–2012 mean. Events lasting several days to weeks are otherwise prevalent.