Physical processes in the eastern Greenland Sea – observations from Argo floats accompanied by CTD surveys

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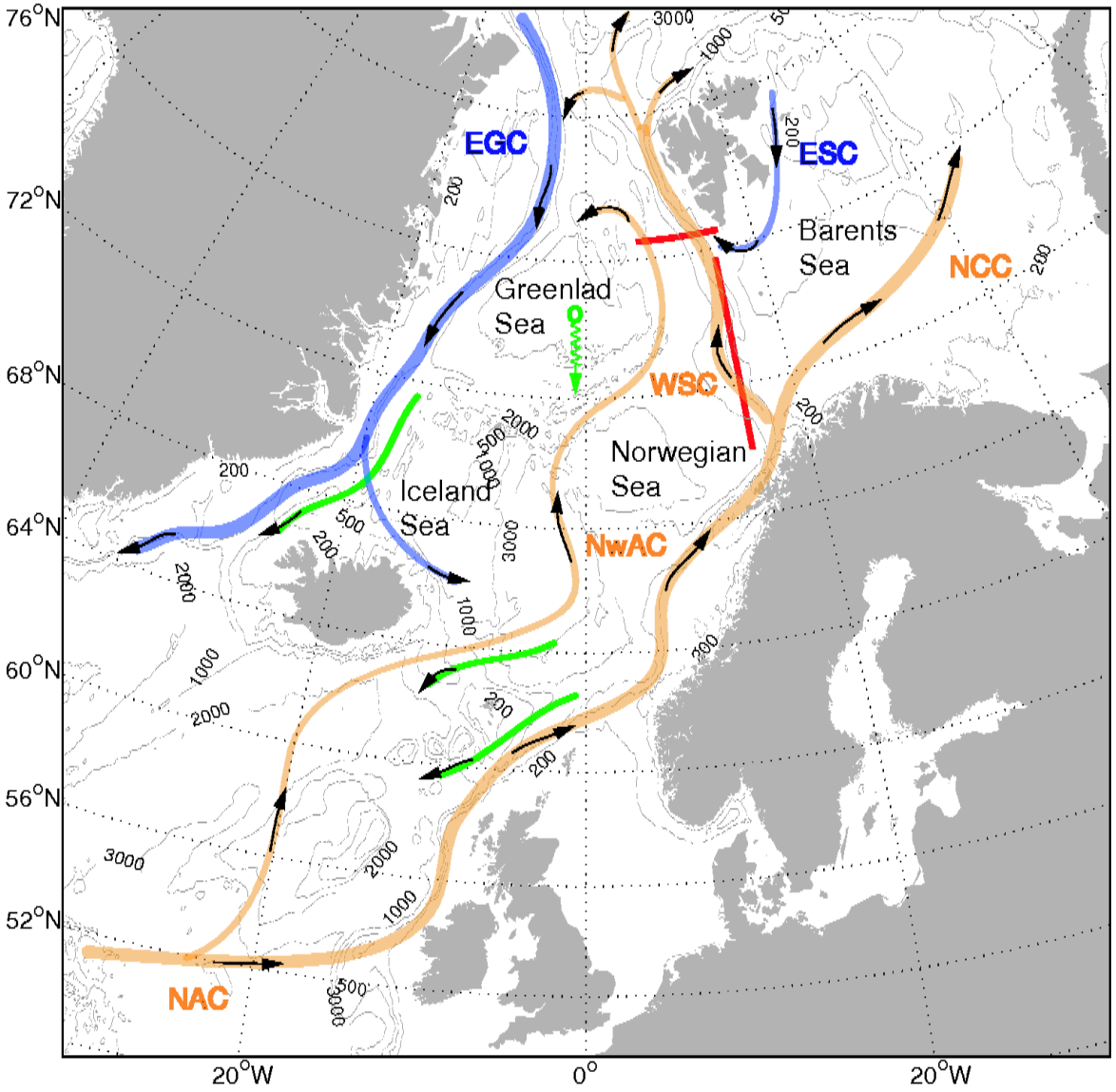
Overview

- The boundaries of the Greenland Sea – oceanographic perspective
- Complex physical environment:
  - Atlantic water advection, redistribution and recirculation
  - sea ice drifting and melting,
  - air-sea-ice interaction processes,
  - convection and deep water formation,
  - dense water cascading from the shallow shelf peripheries,
  - mesoscale features – eddies and fronts,
  - interleavings and intrusions
  - smal scale structures
- Exchange of properties and water masses transformation
- Hydrography based on the ship surveys
- Argo deployments, trajectories and results

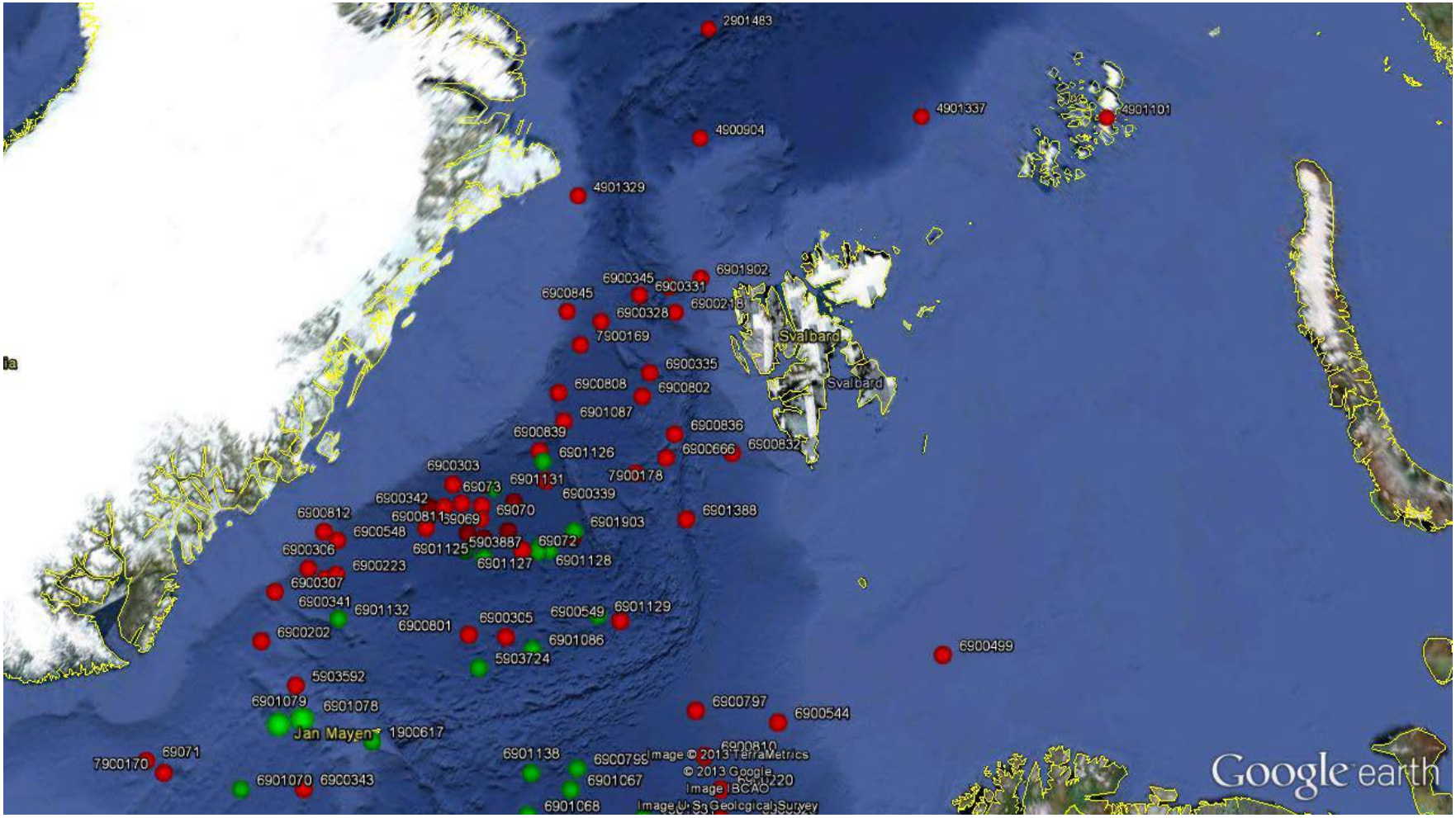
The Greenland Sea characteristic:

- is one of the Arctic Ocean constituent seas (IHO definitions: area 898 10^3 km^2, volume 1418 10^3 km^3 and mean depth 1580 m; Jakobsson, 2002),
- is at the moment a northern limit for all Argo floats deployment missions
- its northern limit - the Fram Strait is the only deep connection between Atlantic and Arctic Ocean (possible exchange in the deep and intermidiate layer)
- is covered by ice in the western side and free of ice in the eastern side due to Atlantic water inflow
- has a strong boundary currents – EGC and WSC
- is sorrounded by shallow shelves areas except deep Norwegian Sea on the south
- thus has a complicated water mass structure

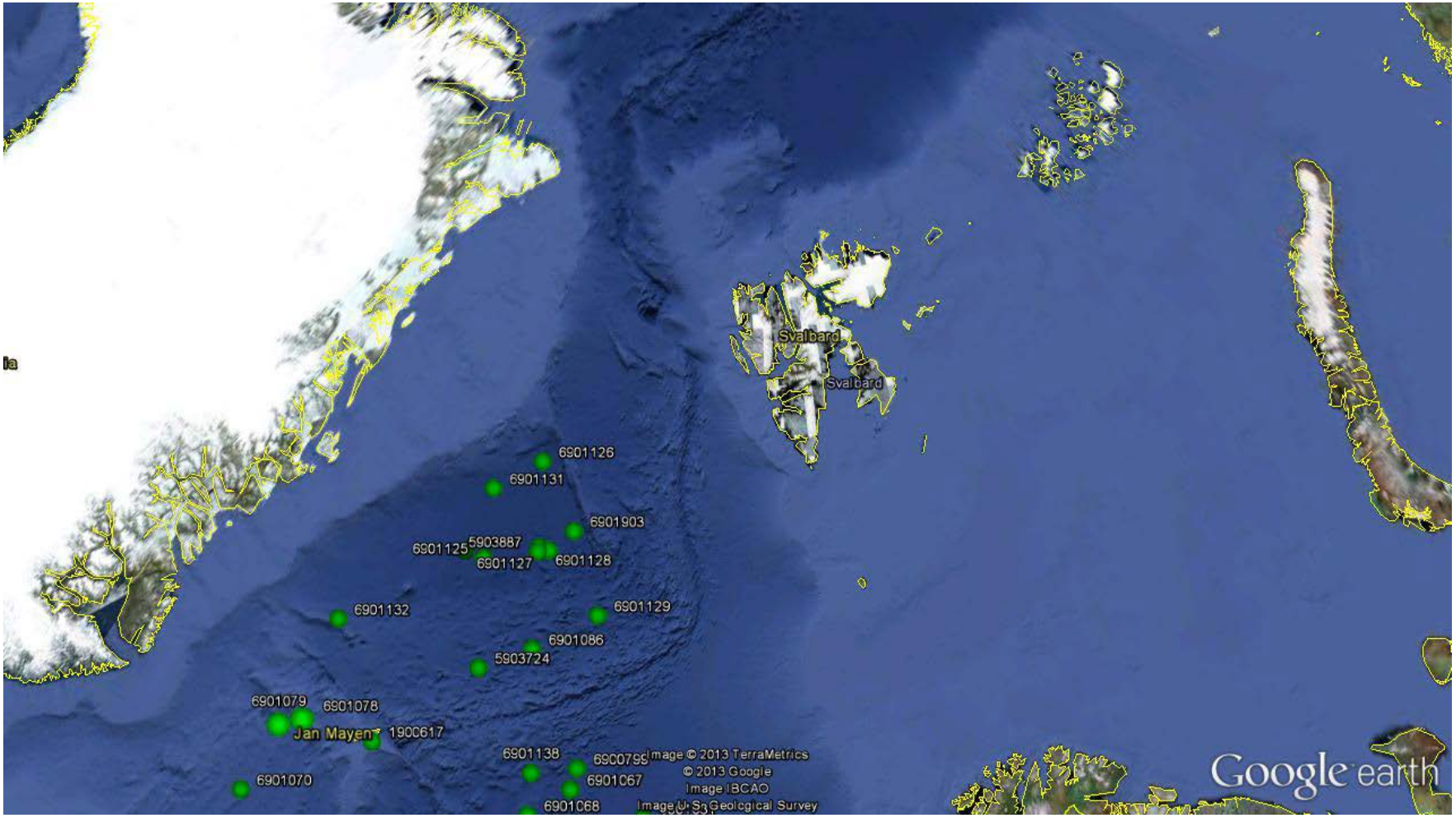
The scheme of the circulation pattern



All platforms (Argo and ITP) included these which finished its life in the area



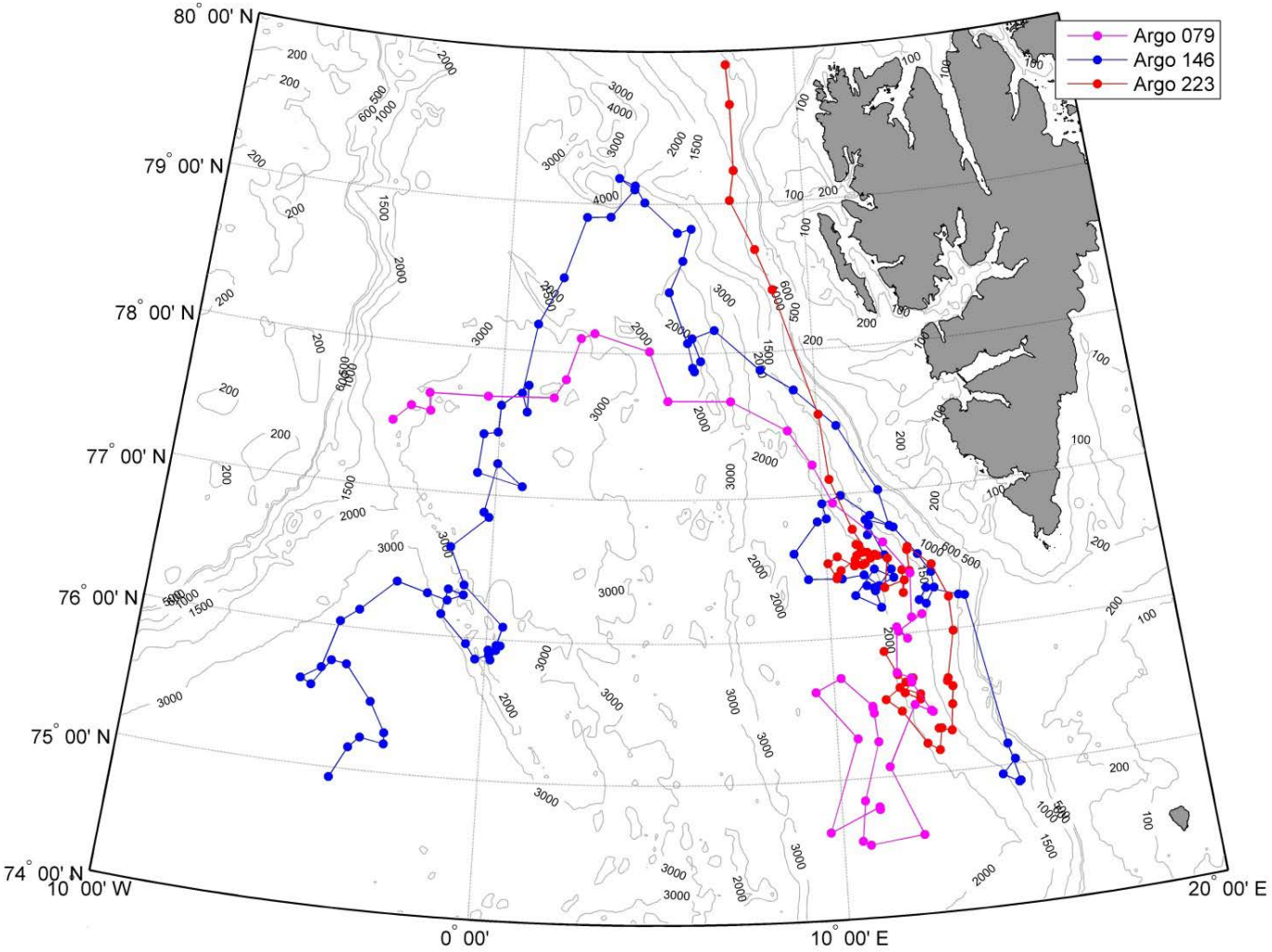
Active floats today



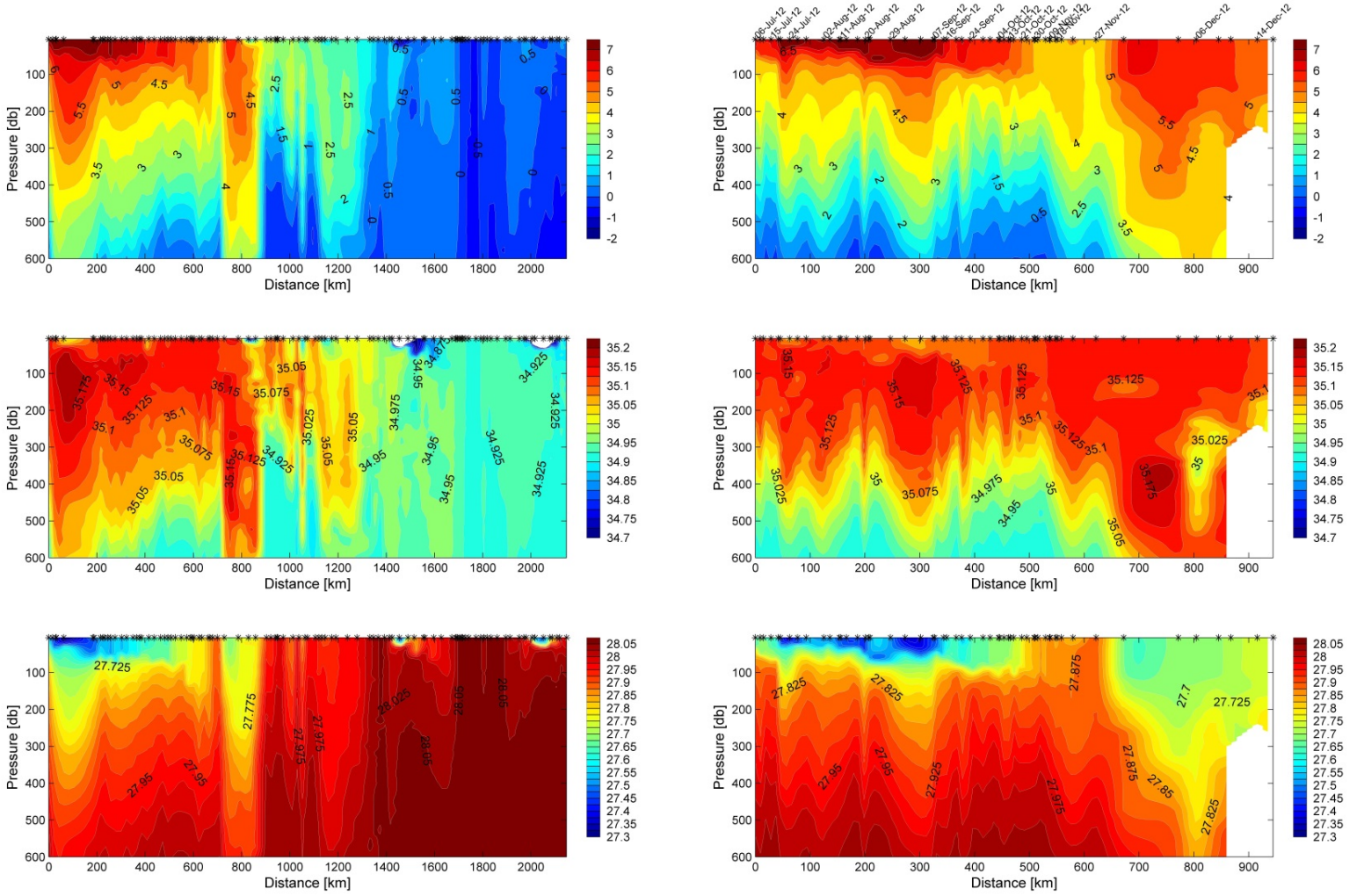
The Canadian 4901101 float, 1831 Days, 183 cycles achieved from 2008 to 2013

The IO PAS deployment of the Argo 223 in July 2012 from the rv „Oceania”

Trajectories of Argo Poland floats

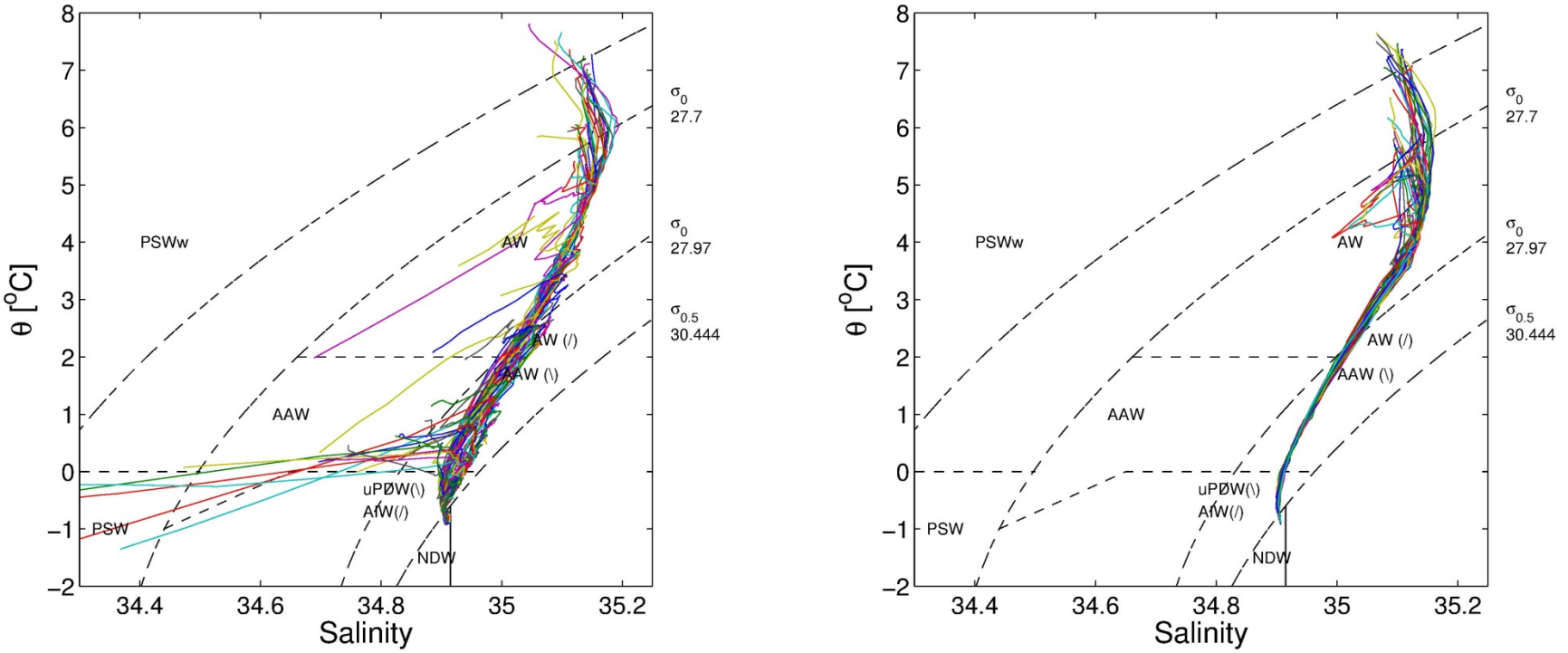


Structure of the Greenland Sea water masses in the 600 dbar upper layer



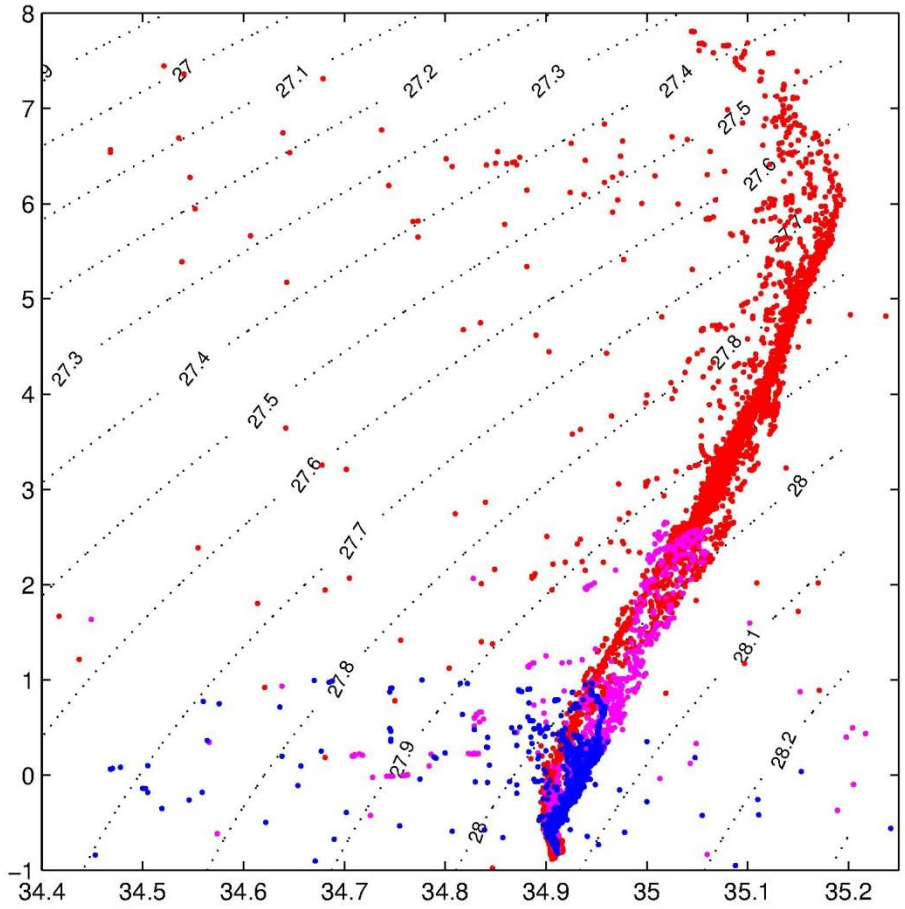
T, S and density distribution from Argo 146 (111 profiles) deployed in June 2010 and Argo 223 (56 profiles) deployed in July 2012

The water masses



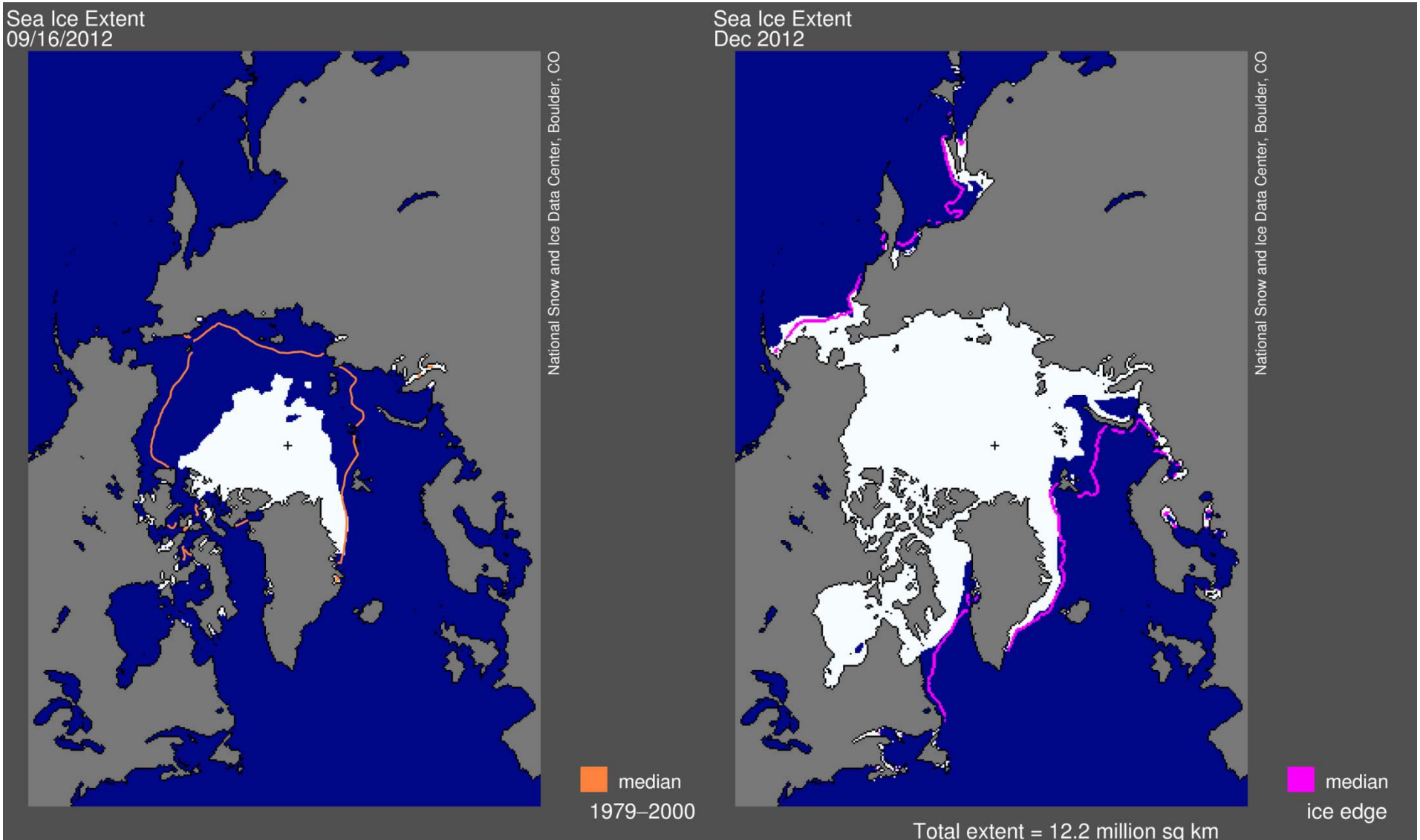
θS-diagrams based on data from two Argo floats deployed in 2010 and 2012 (Water masses classification based on Rudels et al, (2005): Polar Surface Water, Warm Surface Water, Atlantic Water, Arctic Atlantic Water, Arctic Intermediate Water, upper Polar Deep Water and Nordic Seas Deep Water)

θS-diagram based on Argo 146 float data divided for 3 periods/regions

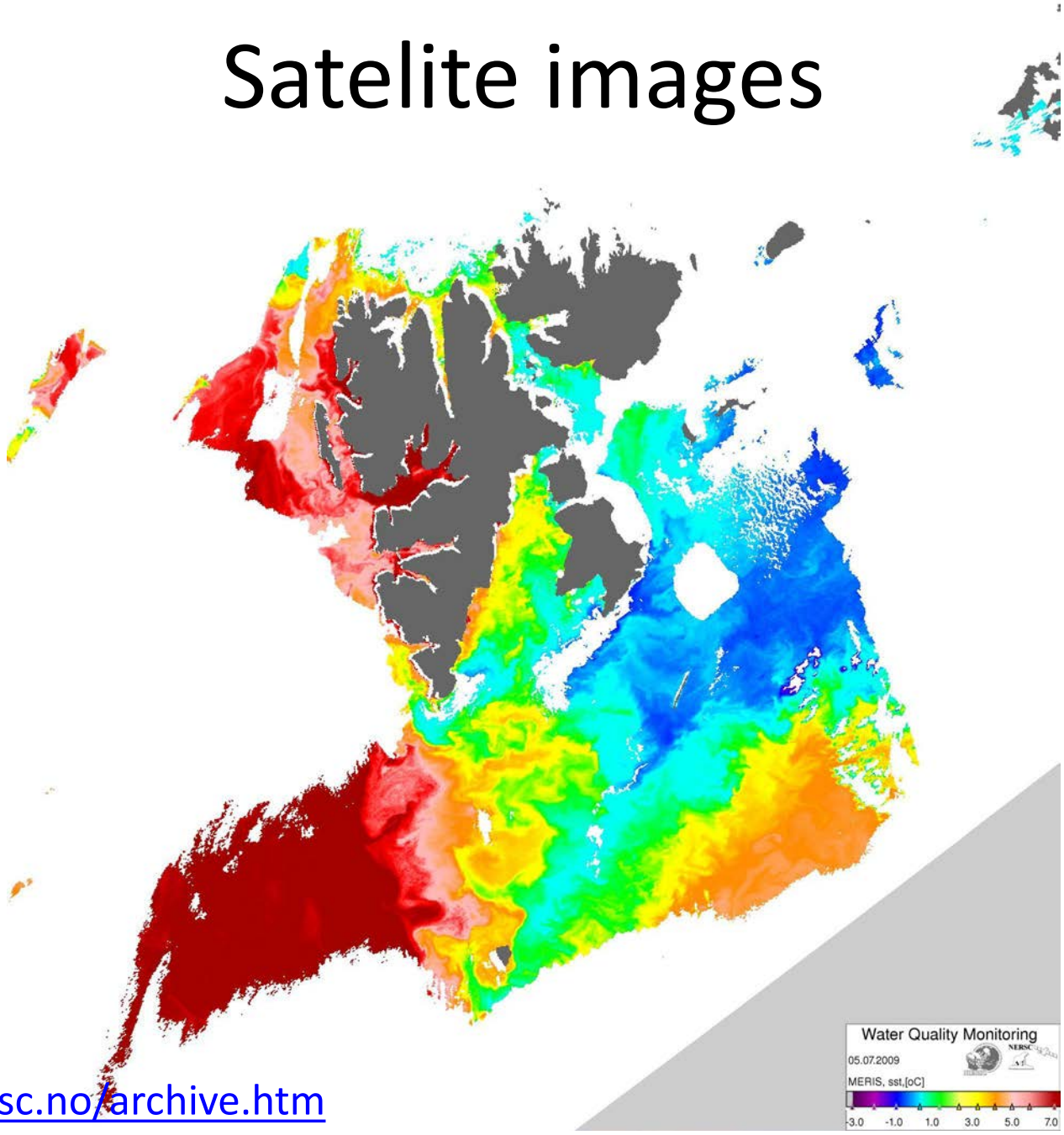


How much is due to transformation, how much due to changing location?

Arctic ice extent in Sept 2012 (min) and in Dec 2012 reached by Argo 146 in the Fram Strait

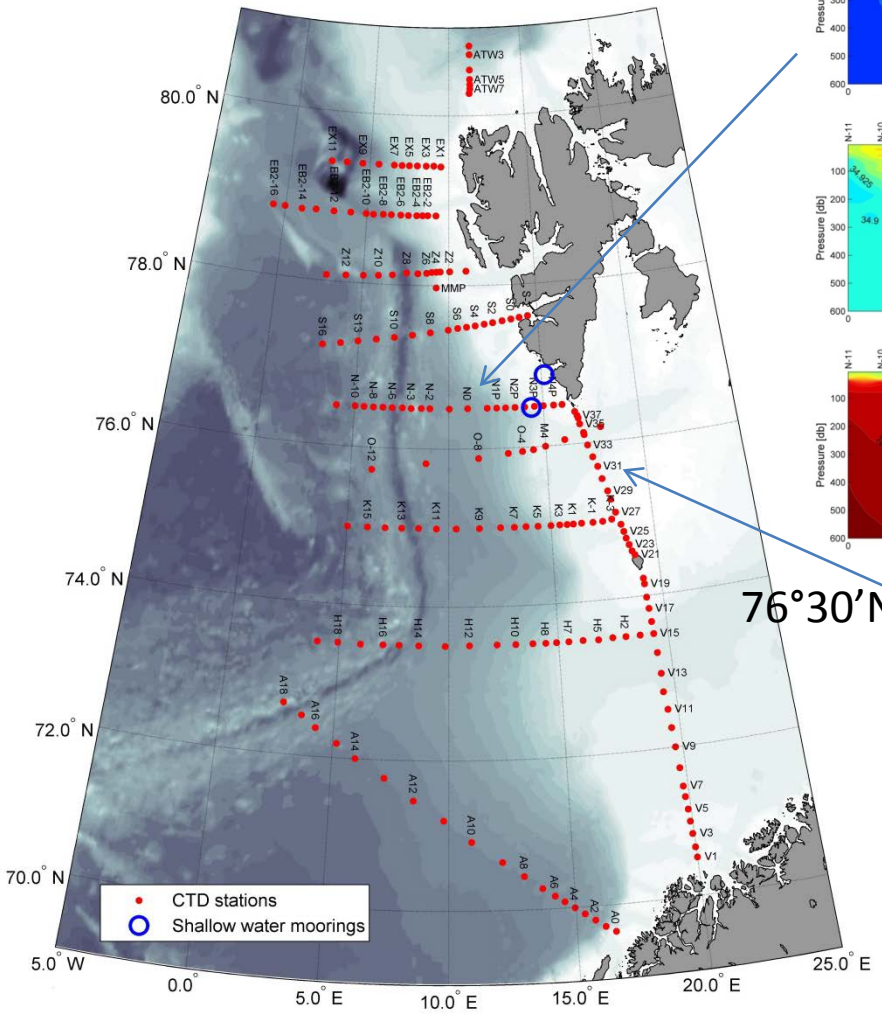


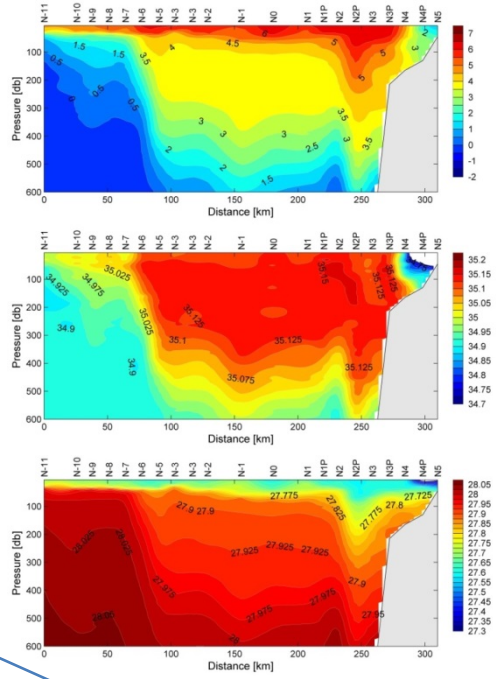
Satelite images



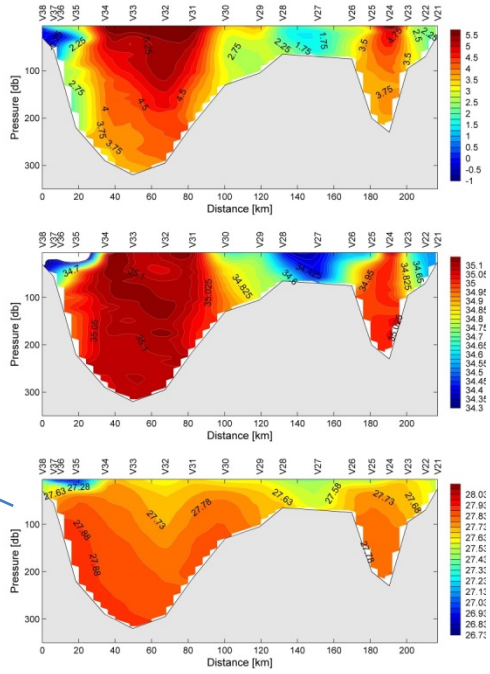
http://hab.nersc.no/archive.htm

The IO PAS AREX hydrographic stations



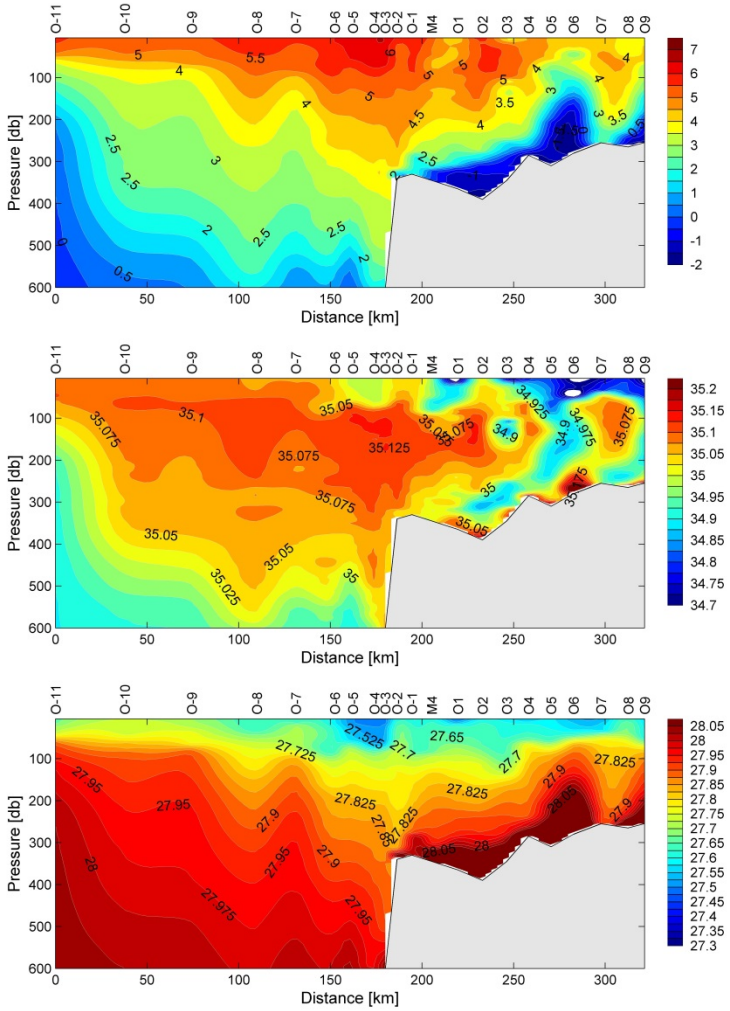


76°30’N - west of South Cape

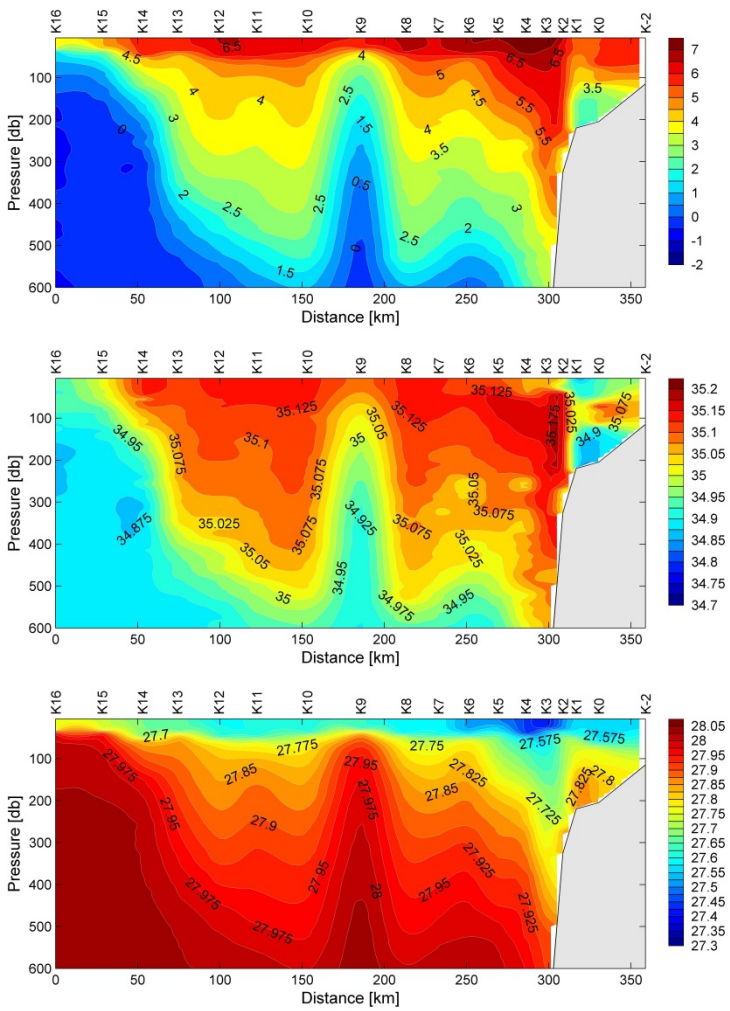


20°E – South Cape – Bear Island

Other interesting features

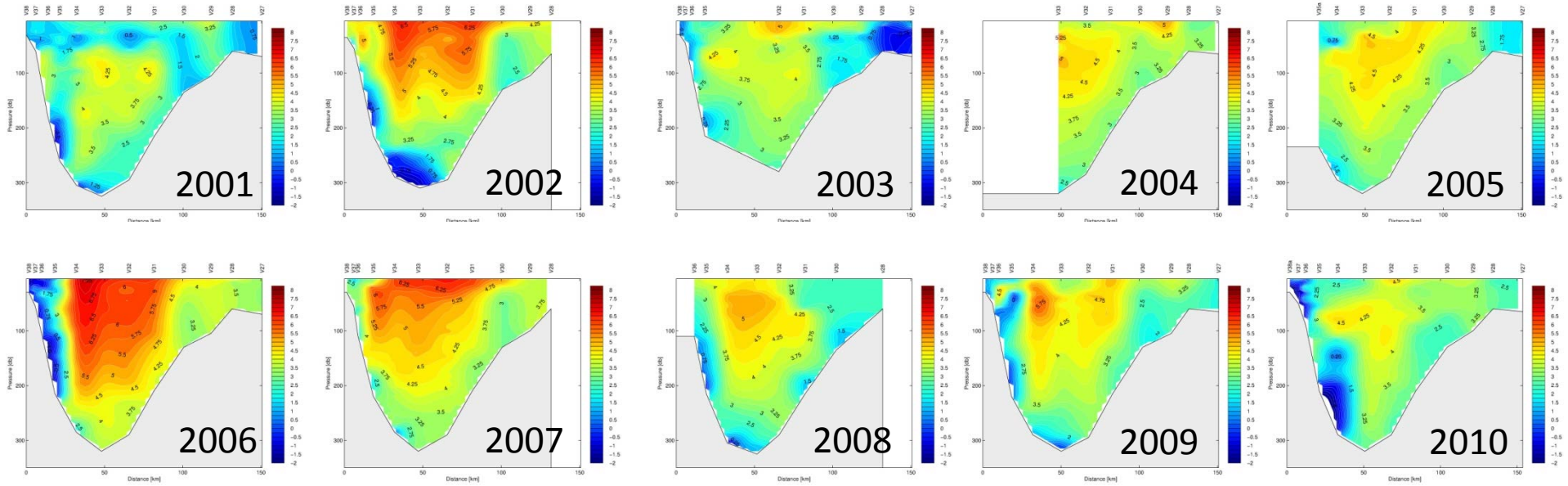


Section along and west of the Storfjordrenna (the 76°N), June 2008

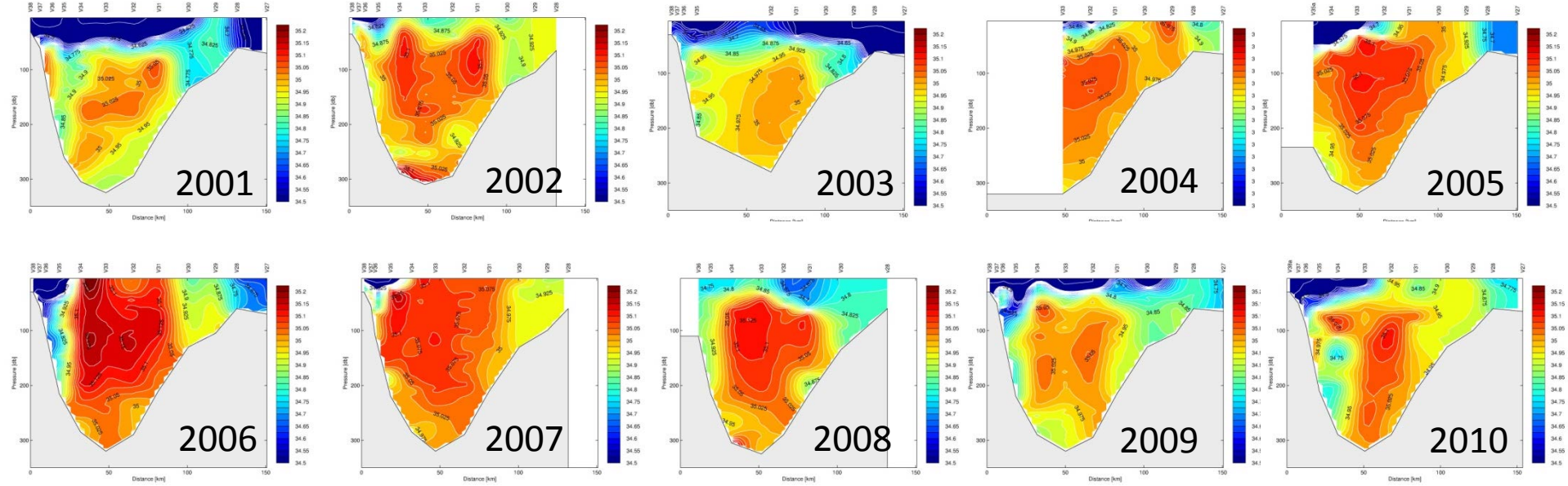


Section along the 75°N, west of the Barents Sea, June 2009

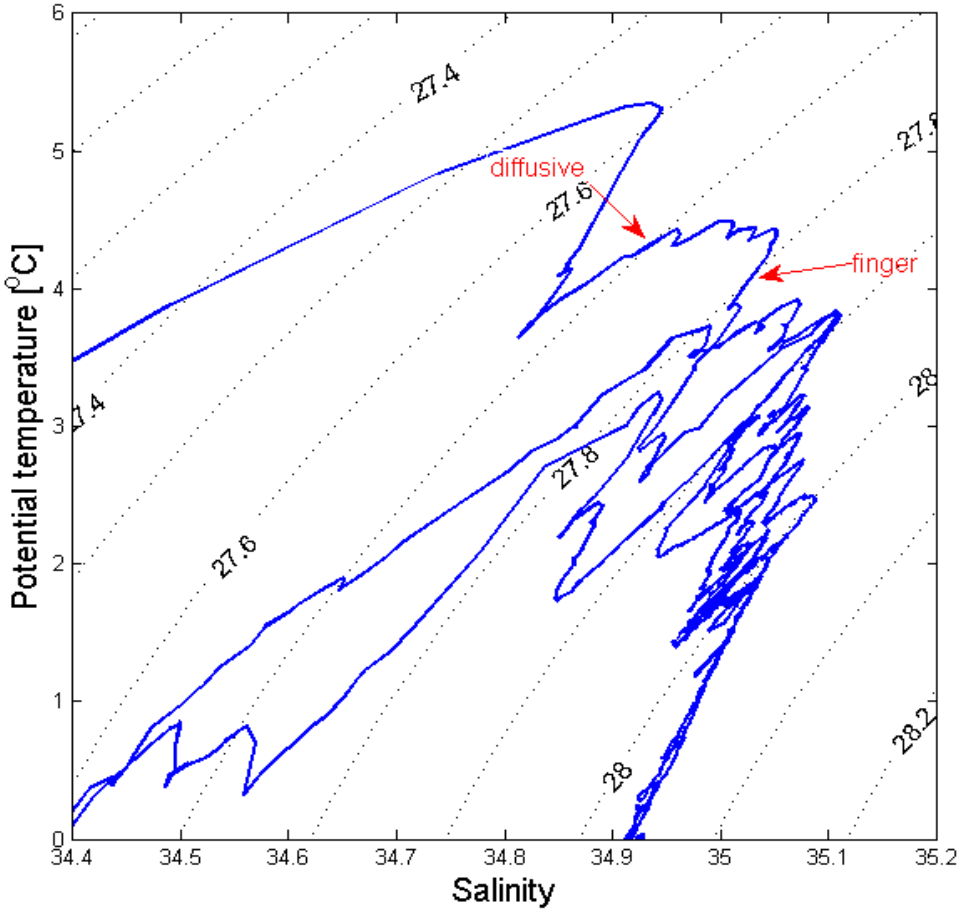
Potential temperature along section, 2001-2010



Salinity along section, 2001-2010

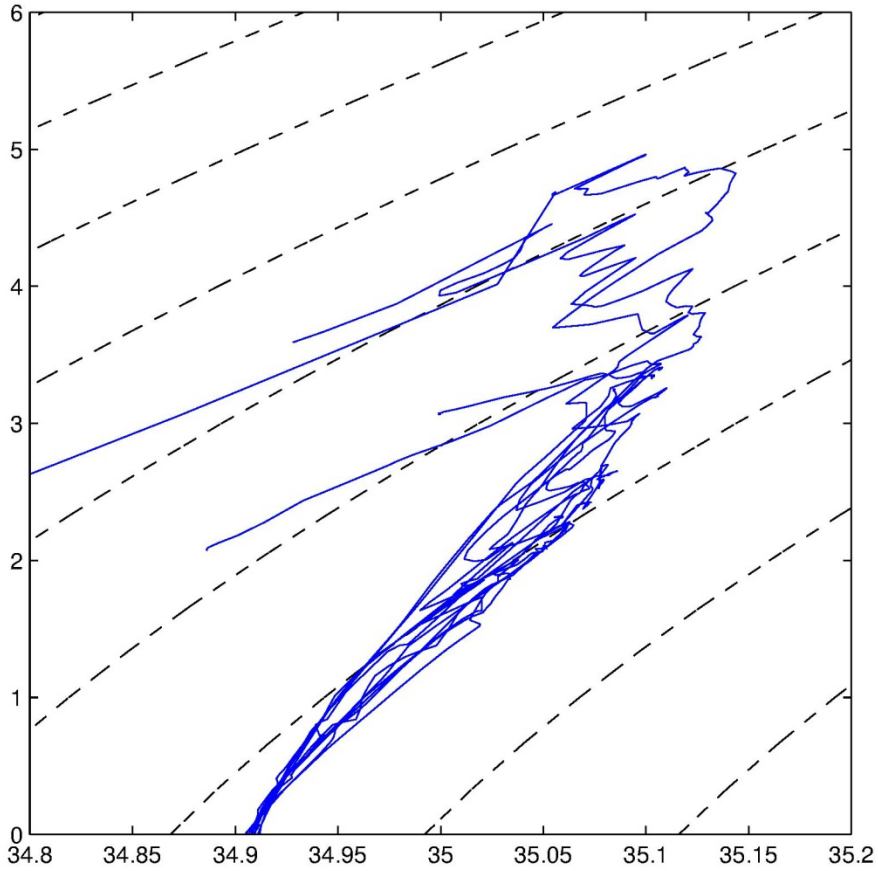


Small scale structures



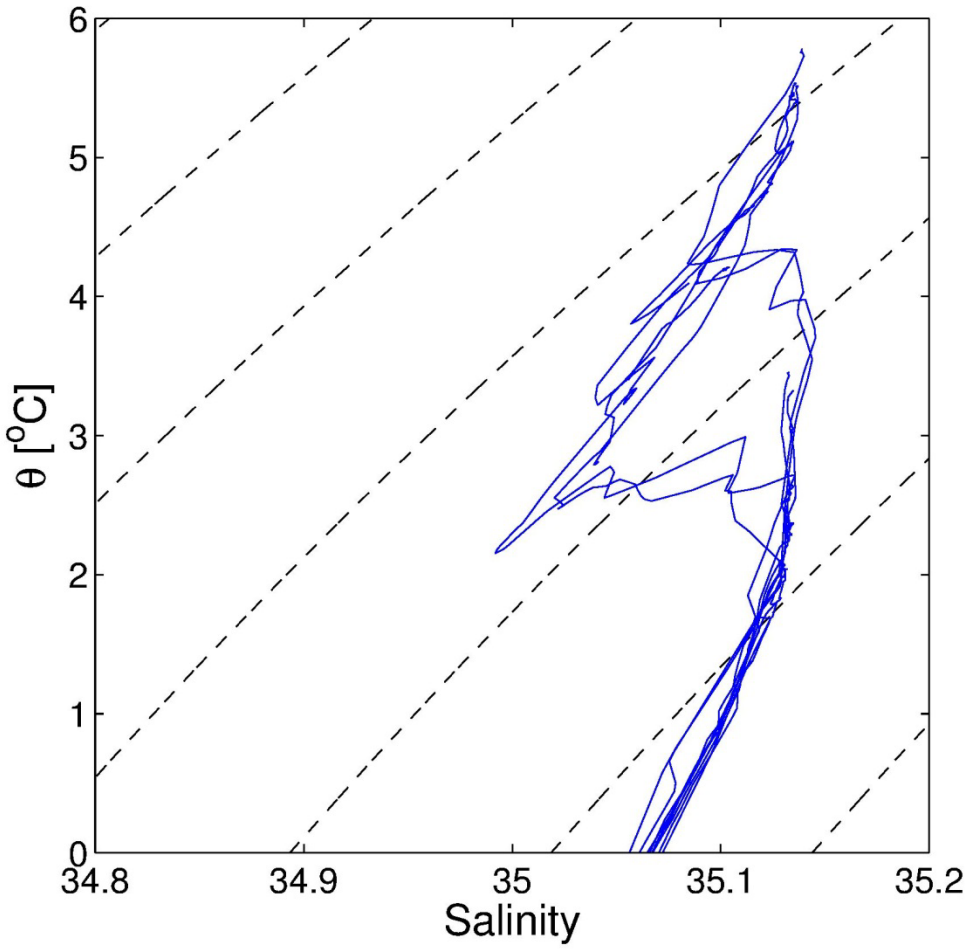
θ-S diagram showing AREX 2011 data collected at several stations with intrusive activity above the Atlantic water. Cusps are signature of intrusions

Argo 146 float data in the Fram Strait



θ-S diagram showing Nemo 146 data collected after float recirculated

Argo 223 last 10 profiles



θ-S diagram showing Nemo 223 data collected just before it was gone under the ice

Summary

- Argo floats deployed in the Greenland Sea allow to track several possible pathways and transformation processes of the Atlantic Water along its south-westward recirculation.
- Specific phenomena such as warm eddies, fronts, intrusions and meandries (also bathymetricly steared) of the main currents can be derived from Argo dataset.
- Until now not a single one Argo float has passed the Fram Strait - the Arctic Ocean’s gateway.

References and Acknowledgements

- Jakobsson, M., Hypsometry and volume of the Arctic Ocean and its constituent seas, Geochem. Geophys. Geosyst., 3(5), 10.1029/2001GC000302, 2002.
- Rudels B., Bjork G., Nilsson J., Winsor P., Lake I., Nohr C., The interaction between waters from the Arctic Ocean and the Nordic Seas north of Fram Strait and along the East Greenland Current: results from the Arctic Ocean-02 Oden expedition, Journal of Marine Systems 55, 1-30, 2005.
- Walczowski W., Piechura J., Goszczko I., Wieczorek P., Changes of the Atlantic Water properties as an important factor of the European Arctic marine climate, ICES J. Mar. Sci., doi: 10.1093/icesjms/fss068

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