An increasing role of Argo floats in Arctic oceanographic observation

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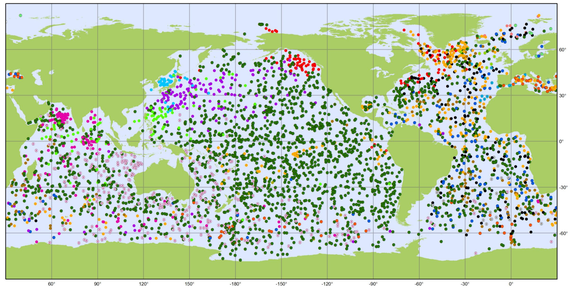
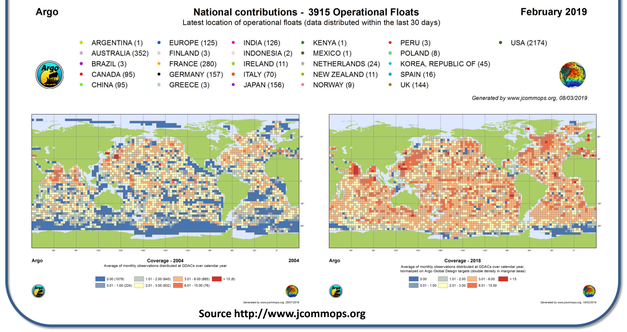
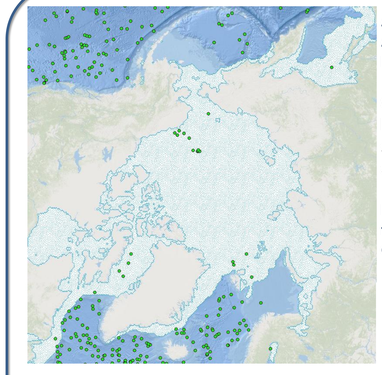
Photography encouraged

Location of operational floats in February 2019.





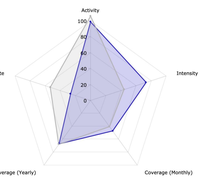
Source http://www.jcommops.org



Argo floats in the Arctic and sub-Arctic waters. February 2019
Ice extent is marked.

Coverage of the Arctic Ocean by Argo is improving, but it is still lower than in other water areas.

Key Performance Indicators (KPI) for the Arctic Argo (grey) versus Global Network (blue)



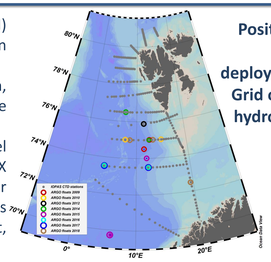
Coverage by the Argo float of the Arctic Ocean (% of planed coverage) –left, and in comparison with other regions (right)
Source http://www.jcommops.org

The Argo system has proved its utility in oceanographic observations by providing already more than 2 000 000 casts collected by profiling floats. The spatial coverage in the open ocean is satisfactory and the marginal seas, even so shallow as the Baltic Sea are slowly getting covered by the network of floats. The largest gaps in the Argo system are still found in the Arctic regions, where the network of floats is poorly developed. Scientific institutions are usually reluctant to deploy floats in the Arctic Ocean and even the Nordic Seas are weakly covered. This can be explained by the fact that the float life time in the midlatitudes can reach up to 4 years while in the northern regions event two years are considered as very optimistic estimate. For a standard Argo float, the close approach to the ice edge is usually mortal.

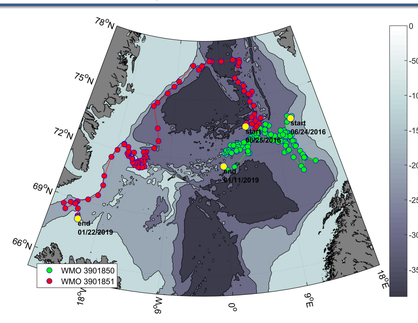
However even limited information from the Argo floats can provide extremely valuable contribution to the ocean observation system in the Arctic and sub-Arctic regions with capability to complement other observing methods and fill the gaps due to their limitation. The advantage of an Argo float is that it works year-round while the ship-borne measurements are performed usually during the spring to autumn season. The second important feature is that profiling Argo floats cover the whole water column from the surface down to 2000 m and deliver a continuous profile of measured variables.
Mooring-based measurements provide discrete data and in the Arctic regions where the sea ice is a risk factor, the surface layer is usually not covered. Fast-paced development of the Argo float technology, including the implementation of new biogeochemical sensors and progressing efforts on ice-sensing and ice-avoidance methods, increases robustness of Argo floats in the harsh Arctic environment and make them a promising source of the most demanded biogeochemical and biological data. The closer collaboration between the Argo and Euro-Argo programs and other Arctic-oriented research and infrastructure projects is of a highest importance, particularly in the context of shrinking sea ice cover and growing areas of open water where Argo floats can be fully operational. The Argo network can soon become an important part of the integrated Arctic Observing System, complementing a well-proven, yet expensive and limited in coverage network of ice-tethered instruments.

R/V Oceania

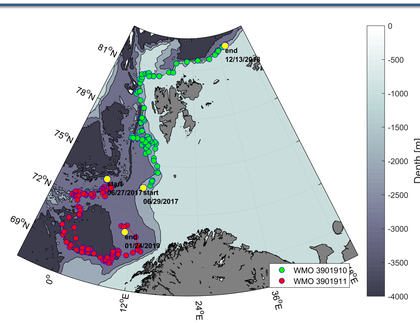
Institute of Oceanology Polish Academy of Sciences (IOPAN) investigate the Nordic Seas and European Arctic since 1988. Eastern part of the Norwegian and Greenland Sea are mainly explored.
Since 2009 the Argo floats are deployed by IOPAN in the Norwegian, Greenland and Barents Sea. We work in the Euro-Argo ERIC, all the data are forwarded to the Coriolis Centre.
The floats are deployed during the AREX cruises of the IOPAN vessel Oceania. Data from floats supplement data obtained from AREX cruises, which take place in the summer. Floats data are used for investigations of the West Spitsbergen Current pathways, dynamics and mesoscale activity. Changes of the water column heat content, mixed layer depth are investigated.



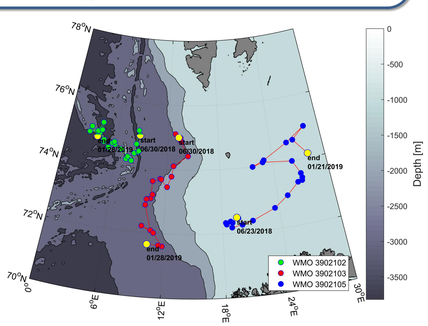
Positions of the IOPAN Argo floats deployments in 2009-2018. Grid of the AREX project hydrographic stations is marked.



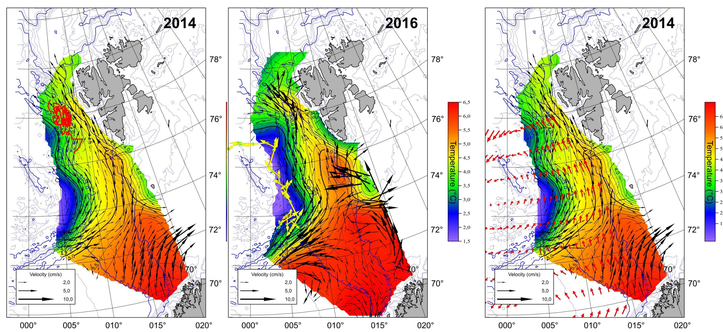
Trajectories of the Argo floats deployed by IOPAN in summer 2016



Trajectories of the Argo floats deployed by IOPAN in summer 2017

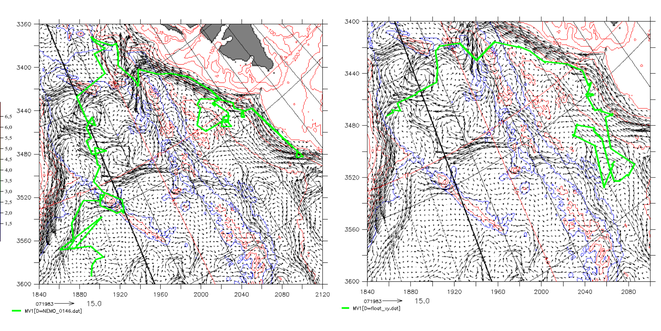


Trajectories of the Argo floats deployed by IOPAN in summer 2018



Trajectories of the Argo floats and AREX cruises results (temperature and baroclinic currents

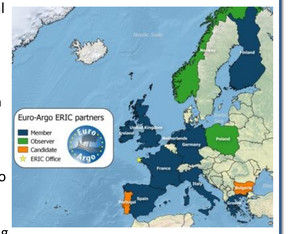
Arex cruise baroclinic currents and ANDRO currents

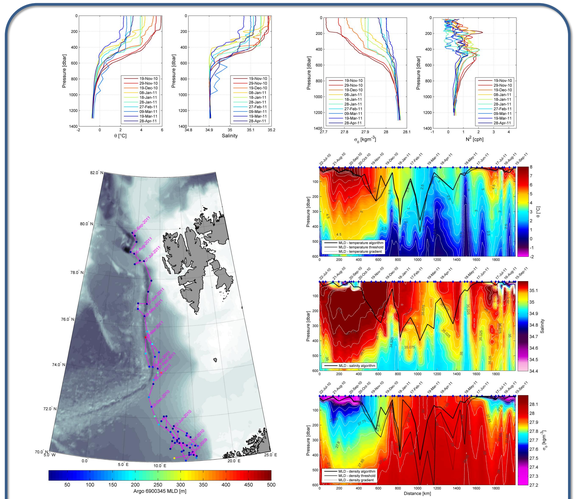


West Spitsbergen Currents recirculation – Argo floats trajectories and modeled curents

The **Euro-Argo ERIC** (European Research Infrastructure Consortium) allows active coordination and strengthening of the European contribution to the international Argo programme. Its aims are:

- to provide, deploy and operate an array of around 800 floats contributing to the global array (a European contribution of ¼ of the global array);
- to provide enhanced coverage in the European regional seas;
- to implement the new phase of Argo, with extensions towards biogeochemistry, greater depths and **high latitudes**;
- to provide quality controlled data and access to the data sets and data products to the research (climate and oceanography) and operational oceanography (e.g. Copernicus Marine Environment Monitoring Service - CMEMS) communities.





Example of Mixed Layer Depth calculations from the Argo data

Conclusions

Continuation of the Argo measurements in the Fram Strait and Arctic Ocean region is very important to understand the changes taking place in the Arctic during rapid climate change.
Argo floats are very useful in the water properties measurements as well as defining the currents pathways and velocities.
Results from the Argo floats confirm calculations of the mean baroclinic currents and signal propagation velocity in the West Spitsbergen Current 2-3 cm/s
Especially in the high Arctic Argo floats fill the gap in measurements.
In the future we need:
more floats;
cheaper, smaller floats;
…and more sophisticated floats with underwater navigation, active ice detection, smart firmware.
The second type needs better batteries than we use now and progress in underwater navigation.