

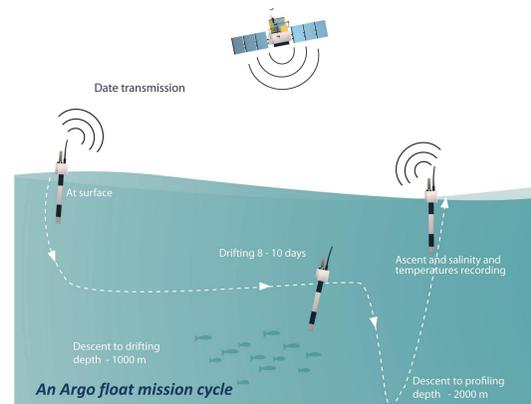
Development of ice sensing algorithms for Argo float deployments in the polar oceans



Katrin Latarius, Ingrid Angel Benavides and Birgit Klein

Bundesamt für Seeschifffahrt und Hydrographie, Hamburg, Deutschland

With the decline of sea-ice in the high northern latitudes the operation of Argo floats in the marginal ice zones becomes more feasible. To protect the floats from being crashed in ice they need to be equipped with an ice-sensing algorithm (ISA) that prevents their ascent to the surface. Ice-sensing algorithms have been used with success in the Southern Ocean and there basically use temperatures in the mixed layer to check if these are close to freezing point which could indicate sea ice formation. In the high northern latitudes the warm inflow of Atlantic water close to the surface make conditions more variable and the new threshold for the ISA have to be defined. This is tested for the Nordic Seas and Barent Sea based on hydrographic measurements and sea ice concentration maps.

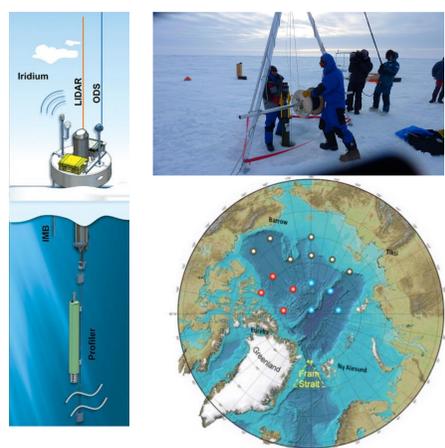


Integration of activities with existing observing strategies

Protecting Argo floats for measurements in ice covered areas

Present status of Argo observations in high latitudes

Ice-thethered profiles



Source: <http://www.iaos-equipex.upmc.fr>

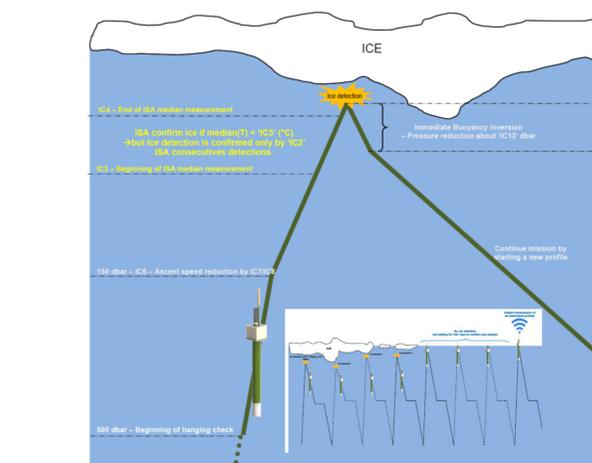


Fig. 1: Principles of an ice-sensing algorithm for a profiling float based on an Avor float.. Figure courtesy of Noe Poffa, SHOM, France

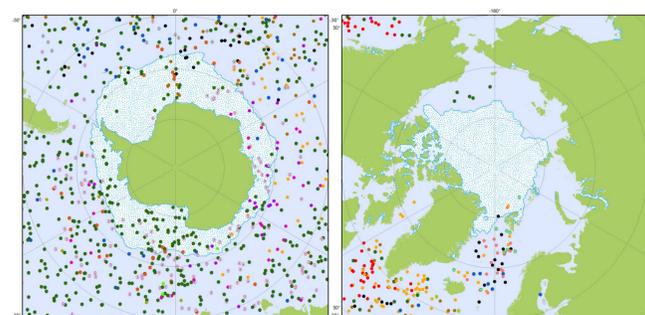


Fig. 2: Float observations in the Southern Ocean (left) and Arctic (right)

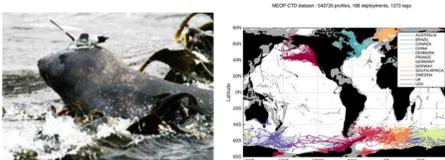
Argo floats may be damaged when encountering sea ice during ascent or while parking at the surface. Presence of sea ice above is forecasted by locally tuned Ice Sensing Algorithm (ISA). They use temperature data collected by the float during ascent to determine the presence of sea ice above. Ice detection (Fig. 1) triggers the interruption of the ascent, avoiding collision with and increasing the floats lifetime.

3 mechanisms to detect ice :

- ISA (using temperature thresholds)
- Satellite mask (using ice edge information at float position)
- Ascent hanging (pressure is no longer decreasing ascent phase)

At present very few Argo float observations are reported from the Arctic, while float measurements are more abundant in the Southern Ocean. (Fig. 2). The few existing Arctic observations are from pilot experiments of US and Canadian colleagues in the Chucki and Beaufort Seas who have adapted the Ice Sensing Algorithms (ISA) locally. An ice sensing algorithm for the Southern Ocean was published by Klatt et al. in 2007, making use of the fact that mixed layer temperatures are close to freezing point during sea ice formation. Conditions in the Arctic are more complicated by a warmer subsurface tongue of Atlantic water.

MEOP (Marine Mammals Exploring the Oceans Pole to Pole) Network



Source: <http://www.meop.net/>

Adaptation of the Ice Sensing Algorithm to the Arctic (European Sector) and first results from pilot experiments

Results from Barent Sea deployment

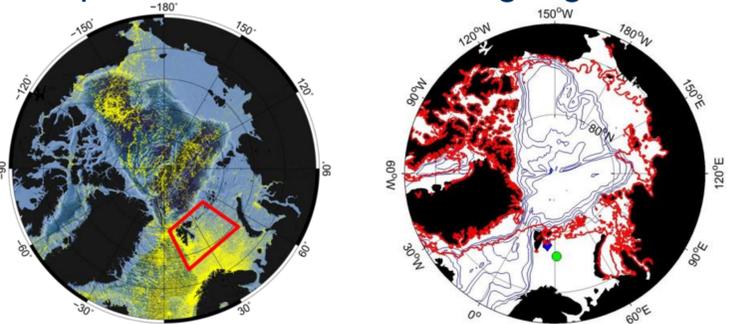


Fig. 3 left: Distribution of CTD data in the UDASH data base in yellow. The red box highlights the Barent sea investigation area. On the right is an example of the ice edge information provided by MASIE (Multisensor Analyzed Sea Ice Extent) from NSIDC (<https://nsidc.org/data/masie>).

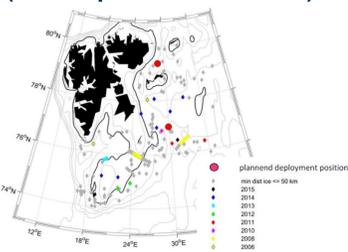


Fig. 4: Spatial distribution of ice/near-ice hydrographic profiles in the northern Barents Sea. The color code indicates the observation year.

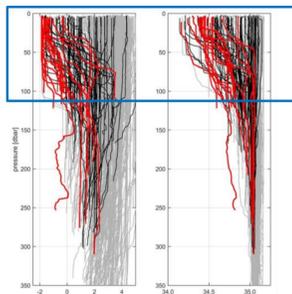


Fig. 5: Vertical profiles of temperature (left) and salinity (right) the UDASH data set for the northern Barents Sea for month 1-4. Near ice profiles (<50 km) in black, in-ice profiles in red and all profiles in grey.

