The inertial sensors dedicated for the Argo floats capable of operating in the Arctic seas

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Description of the new technology and its importance for science and applications: Locating of the Argo floats is based on the surface position – GPS signal or telemetry. Lack of this possibility is especially important in case of the Arctic floats positioning, where the float should operate longer under the ice without hazardous surfacing. Small inertial measurements units (IMU) may be installed in the Argo floats and used in the Arctic. However, the general conclusion is that at present this system cannot be successfully used for the float navigation. The position error raises very quickly in the function of time. Yet, after some experiments conducted under water with the IMU device, it is pretty clear that it may be at least appropriate as an additional sensor, especially for the physical oceanography purposes (turbulence, microstructure, surface waves, internal waves, oceanic fronts).

Results: In 2014 the IOPAN continued activities aimed at preparing and deployment Arctic floats. Two floats equipped with Iridium telemetry and Ice Detection Algorithm were ordered. In the second float the IMU sensor and processor were implemented. Three various IMU devices were tested by IOPAN. Various modes of IMU work were analysed. The OPTIMARE GmbH as the float producer and the FORKOS Ltd. (SME) as the IMU module (IMU sensor, processor, software and data storage module) provider worked together on the implementation. Due to the high power consumption (mostly by the data processor) it was decided to switch off the sensor two months after deployment to save batteries for the usual float functions. Both floats were launched in July 2014 from the IOPAN research vessel 'Oceania' (Fig. 1). The technical problems have been encountered with the first float. The first data package was sent 59 days after deployment, however data were incomplete. Finally, the float sent 10 incomplete sets of data and stopped to transmit on 9th October. All in all, the float did 33 profiles (part of them has not been sent). Deployment of the second, IMU float was successful. By the date of 18th January 2015 the full set of hydrographic data has been transmitted (Fig. 2). The IMU data were transmitted as planned for the first 17 days (16 profiles with IMU data were received). Two way communications via Iridium was tested and changes in the float working mode were successful (IMU sensor was stopped). So far, the float did 51 profiles and it is still working. Obtained profiles have been sent to the Coriolis database.

Conclusion: As the result of this experience the idea, hardware and software for the IMU data processing, storage and transmission were developed.The accuracy of the available IMU devices is still low, but development of this technology is very fast. Even now there are IMU devices (based on the laser technology) with accuracy, needed for application in floats, but they are still too big, too expensive and consume too much power. In the future IOPAN, in cooperation with other interested institutions, is going to continue development of the Arctic float with IMU sensor as an alternative way of the under ice navigation.

Figures:

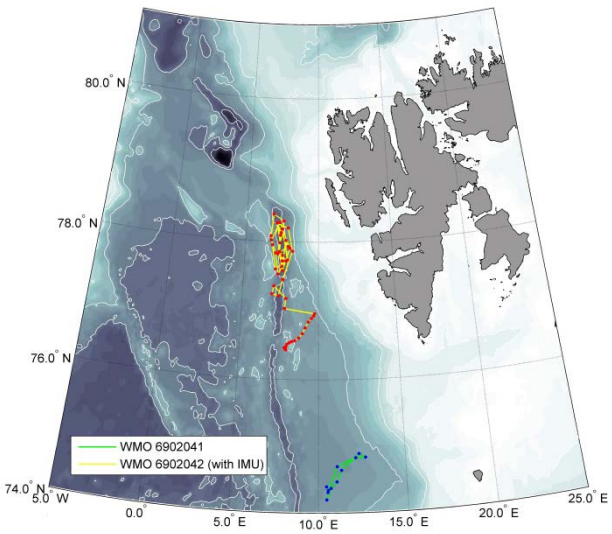

Fig. 1. Surfacing position of two Argo floats deployed south and west of Spitsbergen in July 2014: WMO# 6902041 and WMO# 6902042.

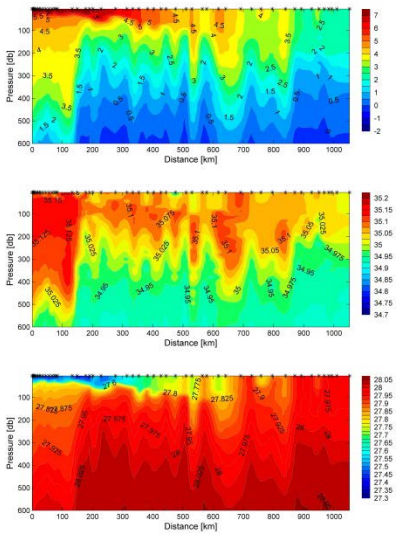

Fig. 2. Distribution of temperature, salinity and density in the upper 600 dbar layer based on profiles collected by the second float (WMO 6902042) west of Spitsbergen.