Preliminary results of the oceanographic features of the bottom density-driven currents on the Storfjorden continental slope (Svalbard)

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Introduction

The offshore SW Svalbard Archipelago (Fig. 1) is a region where Atlantic waters, considerably warmer than the locally formed dense waters, flow northwards embedded in the so-called West Spitsbergen Current (WSC) through the eastern side of the Fram Strait. They keep this region nearly ice-free even during winter season and their variability in terms of temperature is able to modify the local climatic conditions. Cold Arctic waters (East Greenland Current), instead, descend southward on the western side of the Fram Strait contributing to the maintenance of the Greenland ice cap. Additionally, there is a certain contribution of dense waters formed during winter through freezing and salt release in the polynyas of the Barents Sea and particularly in the Storfjorden. After their generation phase, they flow northwards in geostrophic balance following the isobaths of the shelf slope. All these ocean processes have strong implications on the climate. Such shelf dense water plumes are also responsible for the formation of contourites (sedimentary structures affected by along slope bottom currents), probably formed during the Early Pleistocene glacial expansion. Contourites are also important because their study can provide valuable information on the history of ocean circulation and climate. In particular, two contourites were recently discovered in the area: the Isfjorden and Bellsund contourite drifts (Rebesco et al., 2013). The main objective of the research project DEFROST (DEep Flow Regime Off SpiTsbergen), is to investigate the temporal and spatial variability of the deep flow in the area of the above mentioned contourites, with emphasis on the near-bottom currents and their associated physical and biogeochemical properties. In-situ measurements are conducted mainly by means of deep moorings, deployed in the layer between 1000m and 1500m depth. They are equipped with current meters, temperature, salinity, dissolved oxygen sensors, and sediment traps. Deep moorings are important because the most energetic processes, which are able to reshape the seabed and form contourites, occur in late winter and early spring. Due to the harsh meteorological conditions in these seasons, surveys by means of research vessels are hardly feasible. DEFROST follows up previous international initiatives, such as the Eurofleets 2 - PREPARED (Present and past flow regime on contourite drifts west of Spitsbergen) cruise carried out in June 2014 (R/V G.O. Sars, Norway), and two following cruises carried out in the same region in June and September 2015 on board the R/V Helmer Hansen (UiT, Norway, HH cruise) and R/V OGS Explora (EDIPO project, OGS, Italy). DEFROST is a project funded by the Italian Ministry of Education, University and Research (MIUR) within the PNRA programme (Italian Antarctic Research Program). The German Alfred Wegener Institute for Polar and Marine Research (AWI), one of the supporting partners of DEFROST, offered ship time during the PS99.1 cruise. This opportunity was essential for the project to be funded.

Results

The CTD vertical profiles and water samples were collected during the 2016 DEFROST cruise (study area in **Figure 1**), the 2015 cruise (EDIPO cruise) and 2014 PREPARED cruise. The time

series of temperature, salinity (S), currents, turbidity, and downward particle fluxes at the mooring sites (S1 and I2) span a 2-yrs period (2014-2016). The dataset collected aims at describing the interannual and seasonal variability of deep currents northwest of the Storfjorden. Here we show the preliminary results of the data collection: **Figure 2** schematizes the moorings configuration at the S1 and I2 sites. **Figure 3** shows detailed distribution of the thermohaline properties along the two offshore sections in correspondence to the moorings S1 and I2 in June 2016 (PS99.1 cruise). **Figure 4** shows the vertical section south of Storfjorden in June 2014 before moorings deployment, and the time series at mooring S1 during 2014-2016.

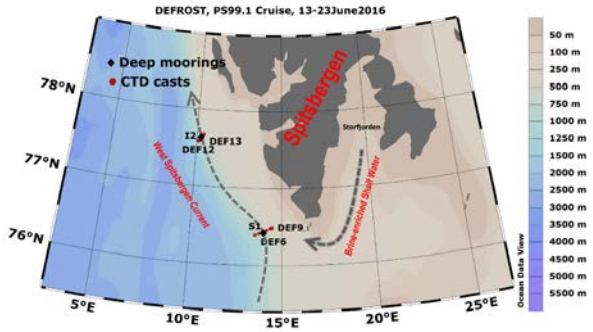

Figure 1: *DEFROST study area. Red dots and black diamonds indicate CTD casts and moorings S1 and I2 (PS99.1 cruise).*

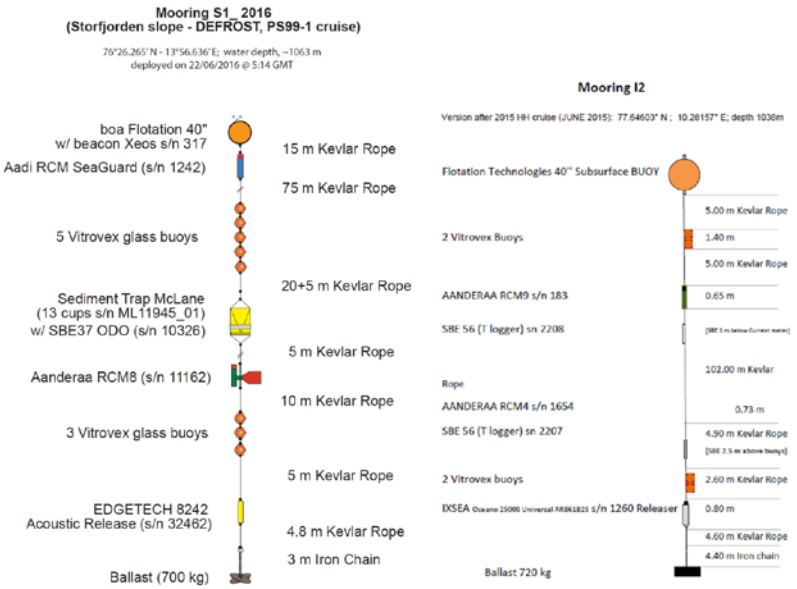

Figure 2: *Schemes of the DEFROST moorings, S1 (2016 version after PS99.1 cruise) and I2 (2015 version after HH cruise).*

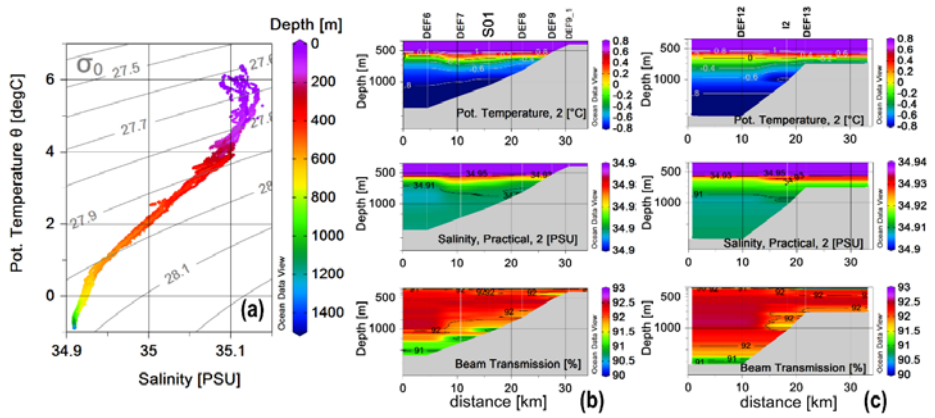

Figure 3: *θ-S diagram from the CTD down-casts during the DEFROST cruise, June 2016 (a). Vertical distribution of pot. temperature θ (°C), S, and beam transmission (%) along two sections in the moorings S1 (b) and I2 (c) areas.*

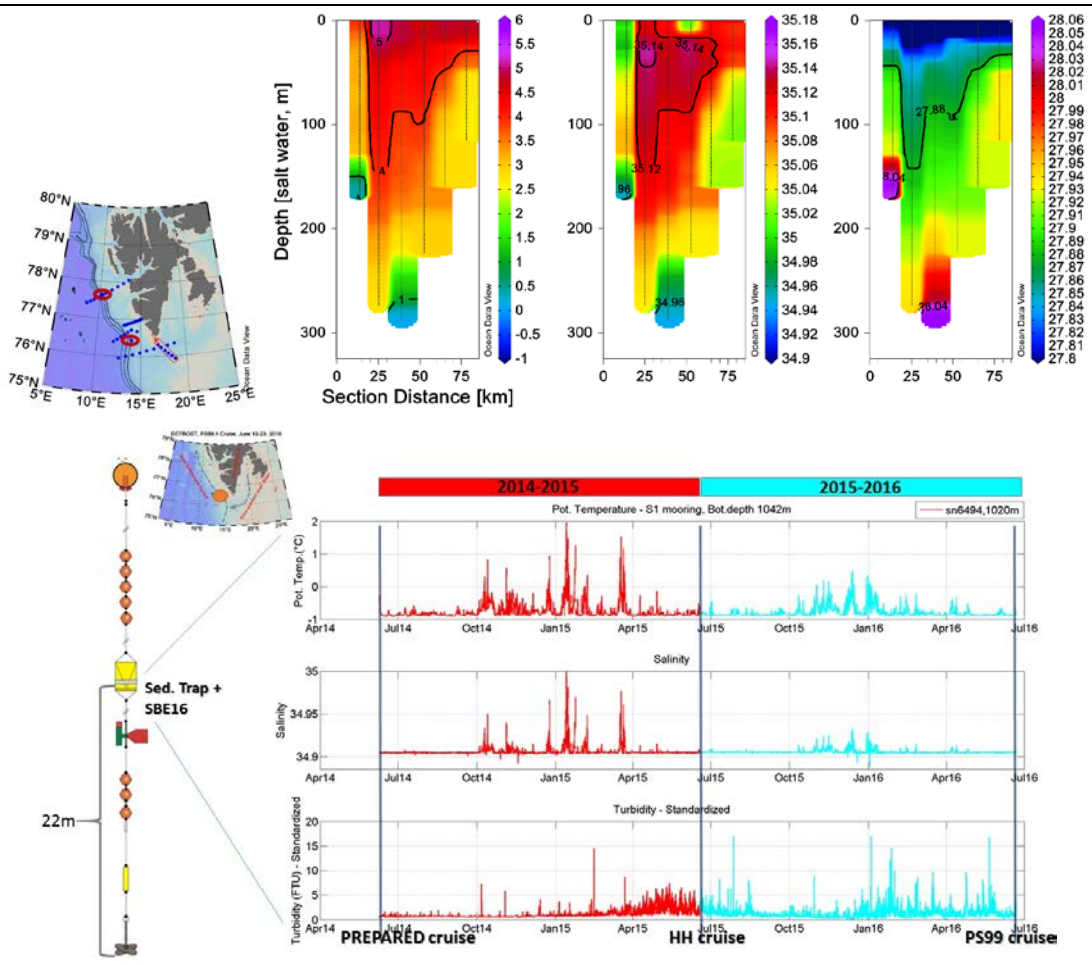

Figure 4: *Offshore section south of Storfjorden in June 2014 (upper panels), before moorings deployment: snapshots of thermohaline properties (from the left to the right:* ***pot. temperature θ (°C), S, and pot. density (kg m^{-3})****. Depth (m) is shown on the y-axis. The lower panel shows instead the* ***θ (°C), S, and turbidity (FTU)*** *time series at mooring S1 from June 2014 to June 2016. They highlight the enhanced variability during the winter period.*

References

Rebesco, M., et al. (2013), Quaternary contourite drifts of the Western Spitsbergen margin, Deep Sea Research Part I: Oceanographic Research Papers, 79, 156168, doi:10.1016/j.dsr.2013.05.013.