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Seven years of SMOS Sea Surface Salinity in the Arctic Ocean

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In the recent years, the Arctic Ocean has been under significant transformation as shown by numerous in situ and remote sensing measurements. The temperature of the upper layer of the Arctic Ocean has been increasing and more solar heat has been absorbed by the increasing ice-free areas. Latest observational and modeling studies have documented changes in the upper Arctic Ocean hydrography. In particular, an increase of liquid freshwater content over both the Canadian Basin and the central Arctic Ocean has been observed.

An increased Bering Strait freshwater import to the Arctic Ocean, a decreased Davis Strait export, and the enhanced net sea ice melt could have played an important role in the observed freshwater trend. Besides, rivers are important sources of freshwater and heat to the Arctic Ocean and changes in the river runoff or temperature could have a strong impact on the Arctic system.

Unfortunately, the number of surface salinity measurements is very scarce at high latitudes, and specially inside the Arctic Ocean. In such context, the Soil Moisture and Ocean Salinity (SMOS) mission can provide an unprecedented source of salinity information over the Arctic Ocean. In this work we have generated 7 years of SMOS sea surface salinity (SSS) in ice-free areas of the Arctic Ocean using a recently developed retrieval methodology [1]. This methodology consists in computing debiased SSS anomaly fields and adding an annual SSS reference.

An assessment of the 7 years of SMOS SSS maps have been performed by using different in situ data. Two different results raise: (i) at moderated high latitudes (out from the Arctic ocean) SMOS SSS provides an RMSE of 0.5 practical salinity units (psu), and it is in general in better agreement with independent Thermosalinograph (TSG) data than other source of SSS data in this region (models and reanalysis); (ii) however, in some regions of the Arctic ocean differences with in situ become larger. Those regions coincide with the regions where different annual SSS references (used in this study) have the largest differences. Despite of the observed degradation, over those regions, we show that SMOS is capable of showing spatial and temporal salinity variability which is consistent with the Arctic SSS dynamics in general, and in particular, with the runoff of the main Arctic rivers.

Finally we have analysed the trend of the SMOS SSS anomaly fields during these 7 years in different Arctic basin.