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Satellite surface salinity maps to determine fresh water fluxes in the Arctic Ocean

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Salinity and temperature gradients drive the thermohaline circulation of the oceans, and play a key role in the ocean-atmosphere coupling. The strong and direct interactions between the ocean and the cryosphere (primarily through sea ice and ice shelves) are also a key ingredient of the thermohaline circulation. Recent observational studies have documented changes in upper Arctic Ocean hydrography [1, 2].

The ESA's Soil Moisture and Ocean Salinity (SMOS) mission, launched in 2009, have the objective to measure soil moisture over the continents and sea surface salinity over the oceans [3]. However, SMOS is also making inroads in Cryospheric science, as the measurements of thin ice thickness and sea ice concentration. SMOS carries an innovative L-band (1.4 GHz, or 21-cm wavelength), passive interferometric radiometer (the so-called MIRAS) that measures the electromagnetic radiation emitted by the Earth's surface, at about 50 km spatial resolution wide swath (1200-km), and with a 3-day revisit time at the equator, but more frequently at the poles.

Although the SMOS radiometer operating frequency offers almost the maximum sensitivity of the brightness temperature (TB) to sea surface salinity (SSS) variations, such sensitivity is rather low, even lower at cold waters [4]: 90% of ocean SSS values span a range of brightness temperatures of just 5K. This implies that the SMOS SSS retrieval requires a high performance of the MIRAS interferometric radiometer [5].

New algorithms, recently developed at the Barcelona Expert Center (BEC) to improve the quality of SMOS measurements [6], allow for the first time to derive cold-water SSS maps from SMOS data, and to observe the variability of the SSS in the higher north Atlantic and the Arctic Ocean.

In this work, we will provide an assessment of the quality of these new SSS Arctic maps, and we will illustrate their potential to monitor the impact on ocean state of the discharges from the main rivers to the Arctic Ocean. Moreover, results make you think that assimilating SMOS Arctic SSS data could be beneficial for the TOPAZ Arctic Ocean Prediction system.

Therefore, SMOS shows great potential to routinely monitor the extension of the surface freshwater fluxes also in the Arctic Ocean. The new SMOS Arctic products can therefore substantially contribute to increase our knowledge of the critical processes that are taking place in the Arctic.

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