New methodology to estimate Arctic sea ice concentration from SMOS combining brightness temperature differences in a maximum-likelihood estimator

Monitoring sea ice concentration is required for operational and climate studies in the Arctic Sea. Technologies used so far for estimating sea ice concentration have some limitations, for instance the impact of the atmosphere, the physical temperature of ice, and the presence of snow and melting. In the last years, L-band radiometry has been successfully used to study some properties of sea ice, remarkably sea ice thickness. However, the potential of satellite L-band observations for obtaining sea ice concentration had not yet been explored.

In this paper, we present preliminary evidence showing that data from the Soil Moisture Ocean Salinity (SMOS) mission can be used to estimate sea ice concentration. Our method, based on a maximum-likelihood estimator (MLE), exploits the marked difference in the radiative properties of sea ice and seawater. In addition, the brightness temperatures of 100 % sea ice and 100 % seawater, as well as their combined values (polarization and angular difference), have been shown to be very stable during winter and spring, so they are robust to variations in physical temperature and other geophysical parameters. Therefore, we can use just two sets of tie points, one for summer and another for winter, for calculating sea ice concentration, leading to a more robust estimate.

After analysing the full year 2014 in the entire Arctic, we have found that the sea ice concentration obtained with our method is well determined as compared to the Ocean and Sea Ice Satellite Application Facility (OSI SAF) dataset. However, when thin sea ice is present (ice thickness $\lesssim$ 0.6 m), the method underestimates the actual sea ice concentration.

Our results open the way for a systematic exploitation of SMOS data for monitoring sea ice concentration, at least for specific seasons. Additionally, SMOS data can be synergistically combined with data from other sensors to monitor pan-Arctic sea ice conditions. https://www.the-cryosphere.net/11/1987/2017/

The Cryosphere, 11, 1987-2002, 2017
https://doi.org/10.5194/tc-11-1987-2017