SMAP Salinity Retrievals near the Sea-Ice Edge Using Multi-Channel AMSR2 Brightness Temperatures

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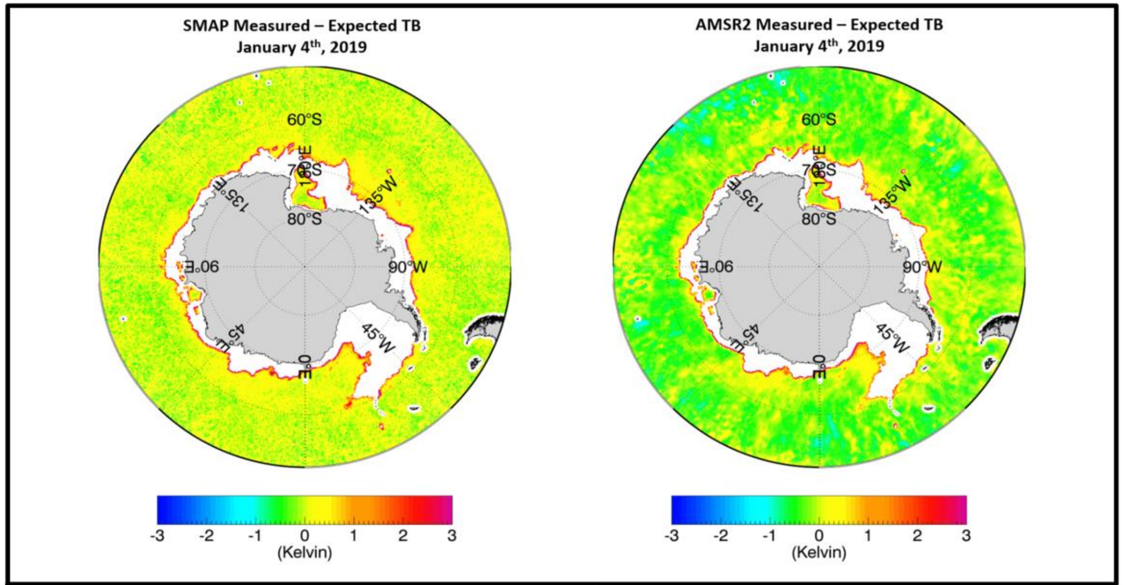

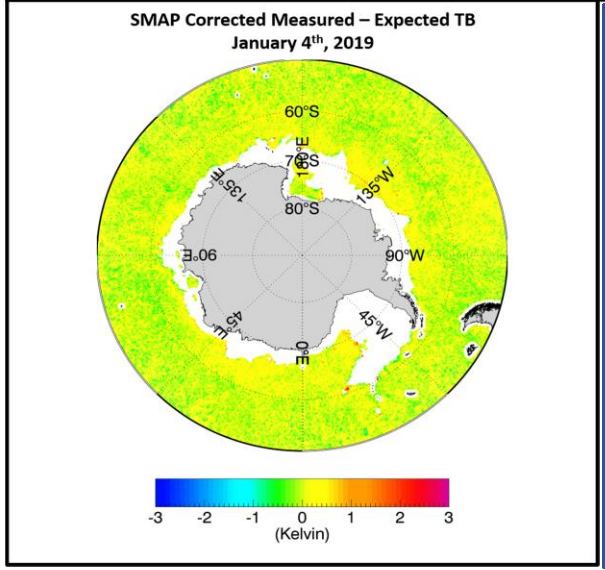

ABOVE: Figures depicting the 8-day averaged measured minus expected (i.e., calculated from a radiative transfer model) brightness temperatures from SMAP (left) and AMSR-2 (right) centered on January 4th, 2019 around Antarctica.
LEFT: SMAP measured minus expected brightness temperatures once the new RSS sea-ice correction has been applied. The 'red ring' around Antarctica, which indicates sea-ice contamination, is now almost non-existent.

PROBLEM: It is very challenging to retrieve sea-surface salinity (SSS) near the sea-ice edge with L-band (1.4 GHz) radiometers (SMOS, Aquarius, SMAP). The main reasons are:

1. Low sensitivity in cold water.
2. Lack of accurate sea-ice concentration data near the sea-ice edge.
3. Small ice contamination in the antenna field of view leads to large errors in the salinity retrieval. An undetected ice fraction of only 1% results in a salinity error of 5 psu.

Large drifting icebergs off the Antarctic ice sheet are particularly problematic. These icebergs go undetected in all available external ancillary sea-ice products and make the L-band salinity measurements in those areas unusable. It is important to detect and correct for sea-ice interference in the polar oceans near the sea-ice edge in order to retrieve SSS in these areas more accurately and reliably.

DATA AND RESULTS: In this work, we have developed new sea-ice detection and correction algorithms for the SMAP microwave radiometer using 8-day averaged brightness temperatures from the AMSR2 microwave radiometer, which are highly correlated at the sea-ice edge. There are two main reasons for using AMSR2 data for this purpose:

1. AMSR2 has approximately the same footprint size/resolution as SMAP i.e., the two sensors 'see' roughly the same Earth scene.
2. AMSR2 is sensitive to changes in sea ice while also relatively insensitive to SSS. This means that AMSR2 will not incorrectly flag areas of freshwater runoff (e.g., at the mouths of rivers at high latitudes) as sea ice.

In our work, we have found that these new sea-ice detection and correction algorithms allow us not only to flag areas of sea ice and large drifting icebergs more accurately, but to retrieve SSS closer to the sea-ice edge as well.

SIGNIFICANCE: Accurate SSS retrievals at high latitudes are paramount for the study of our world's oceans and how they are both changing presently and possibly will change in the future. Retrieving accurate SSS in polar regions closer to the sea-ice edge will help scientists garner more insight into phenomena such as river discharge or ice melt in these areas, both of which can be potentially linked to changes in Earth's climate.