

What can SMOS tell us about the Arctic oceans?

The Barcelona Expert Center (BEC) produces daily maps of SMOS First Stokes (average between X and Y- pol brightness temperature) measurements at incidence angles lower than 20 degrees in the Arctic region. The brightness temperature over sea water (about 90K at nadir) is substantially lower than that over ice (around 220K at nadir for a pixel fully covered by sea ice), thus enabling differentiation.

The study focuses on the feasibility of SMOS to observe specific features and physical phenomena in the Arctic Ocean such as sea ice melt, lead opening and closing, and ice cover breakup and deformation. Two specific examples are presented.

The [Visible Infrared Imaging Radiometer Suite](#) (VIIRS) onboard [Suomi NPP](#) captured an extensive sea-ice fracturing in the Beaufort Sea off the northern coasts of Alaska and Canada. This event began in late January 2013 and ended in March 2013. During this period, a high-pressure weather system was parked over the region, producing warmer temperatures and southwesterly winds. This, in turn fuelled the [Beaufort Gyre](#), a wind-driven ocean current that flows clockwise. The gyre was the key force pulling pieces of ice westward into the Beaufort Sea. The figures below correspond to VIIRS (left) and SMOS (right) images from the same day for two different dates, showing a close visual correspondence between both images and demonstrating the capabilities of SMOS for cryospheric science.



Left images from SUOMI satellite, right images from SMOS First Stokes TB, on 26 February 2013 (top) and 28 March 2013 (bottom).

The figure composite below illustrates the potential use of SMOS imagery to address sea ice melting science. The left

panel shows anomalous melting spots in the Central Arctic on 13th June 2013, as depicted forecast by the NRL (Naval Research Laboratory) forecast. The SMOS image (right panel) also detects these melting spots, as lower brightness temperature areas.



Melting event on 13 June 2013 as depicted by NRL forecast (left) and SMOS (right).

Ice cover extension is a proxy widely used to address the current state of the sea ice in the Arctic Ocean. The figure below shows temporal variation of daily ice extension calculated from SMOS and other techniques through part of the yearly growth-melt, for the last few years, as seen by (left) SSMI/S for the period 2005-2013 period and (right) SMOS for 2011-2013. The former estimates, courtesy of Danish Meteorological Institute (DMI), are based only on pixels with more than 30% ice concentration.

Despite the overall agreement, differences due to various effects, such as sea ice edge, radio-frequency interference, sampling (SMOS does not cover the North Pole, *above* 83 degrees latitude), and ice melting, can be seen and are currently under careful evaluation.



Arctic sea ice extension evolution as estimated from SSMI/S (period 2005-2013) and SMOS (period 2011-2013) data.

New algorithms to compute ice thickness from SMOS measurements are being tuned and tested.

C. Gabarró and P. Elosegui, BEC-Team