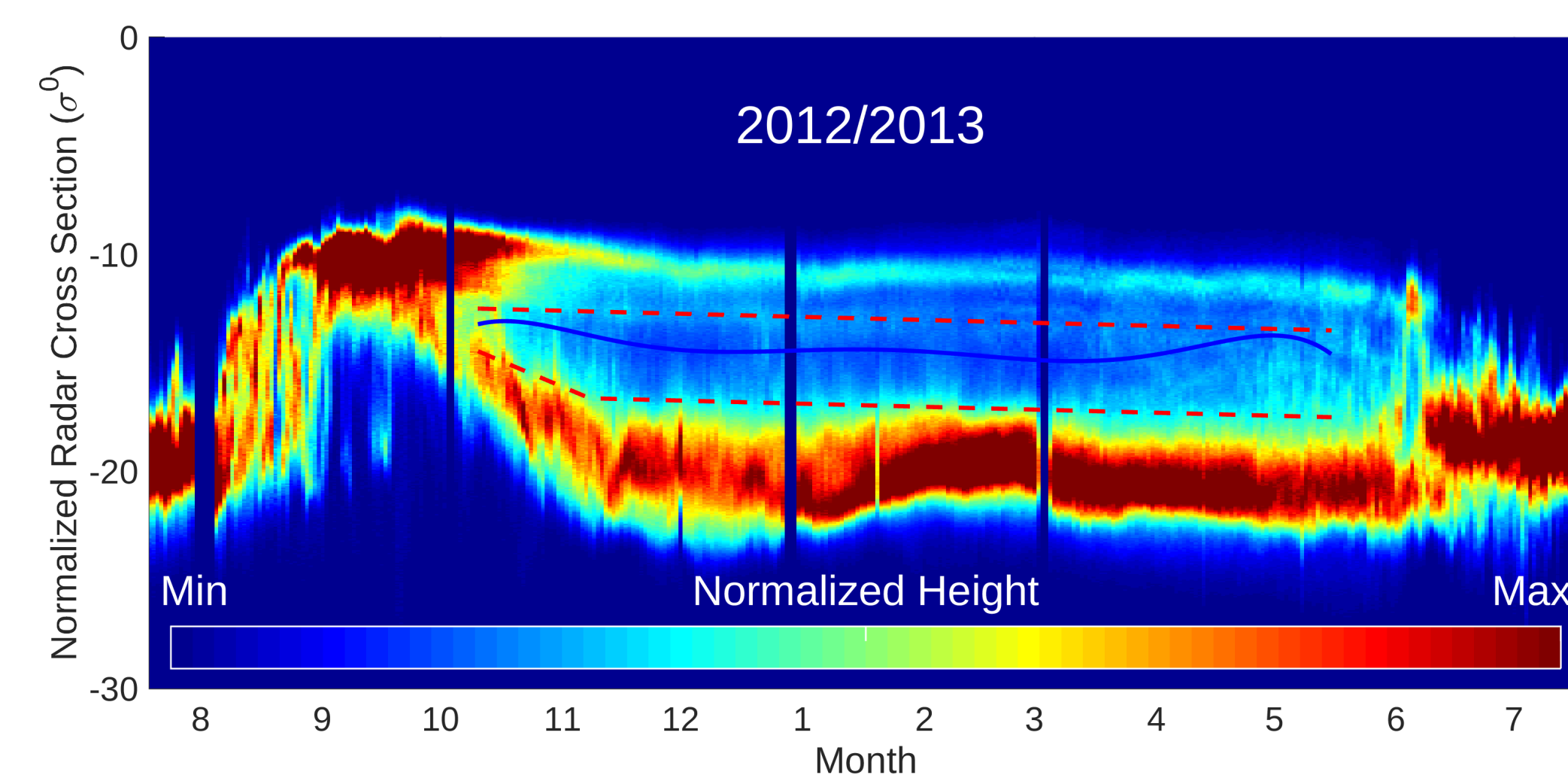


## Overview

Though originally designed for ocean wind observations, scatterometer data has proven remarkably useful for sea ice studies where its frequent coverage and all-weather sensitivity can map sea ice extent as well as classify sea ice as first-year (FY) or multi-year (MY). In a series of studies we have extended the QuikSCAT Ku-band sea ice record for ice extent and ice age using OSCAT data to yield a 15 year-long dataset. This is compared to sea ice extents and ice age maps derived from passive microwave data. We find comparable performance but with higher resolution for the scatterometer maps. We have also developed an algorithm for sea ice age classification for use with C-band ASCAT data. We find that Ku-band is much more effective for ice age classification than C-band due to greater  $\sigma^0$  contrast between FY and MY at Ku-band than at C-band.

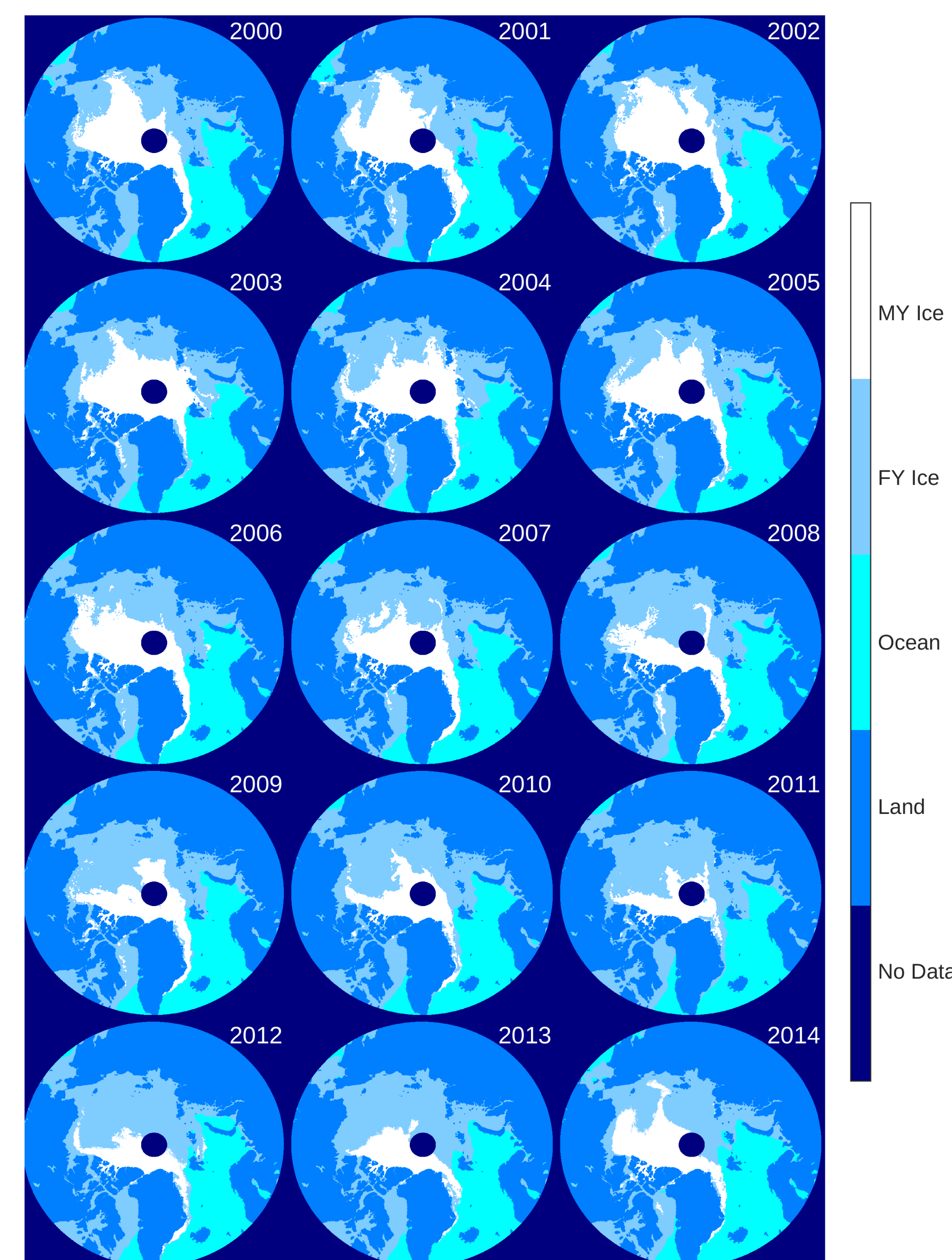
## OSCAT Ice Age

Arctic sea ice can be classified as first-year (FY) or multiyear (MY). The Oceansat-2 Ku-band scatterometer (OSCAT) is used to classify ice as FY or MY from 2009 to 2014. This is completed by applying a temporally adjusted threshold on backscatter values. A NASA Team ice concentration product derived from passive microwave brightness temperatures is also used to restrict the classification area to within the sea ice extent [2].



Yearly time series of daily  $\sigma^0$  histograms for OSCAT 2012-2013. The blue line shows the division between FY and MY ice used as the classification threshold.

## Classification Results



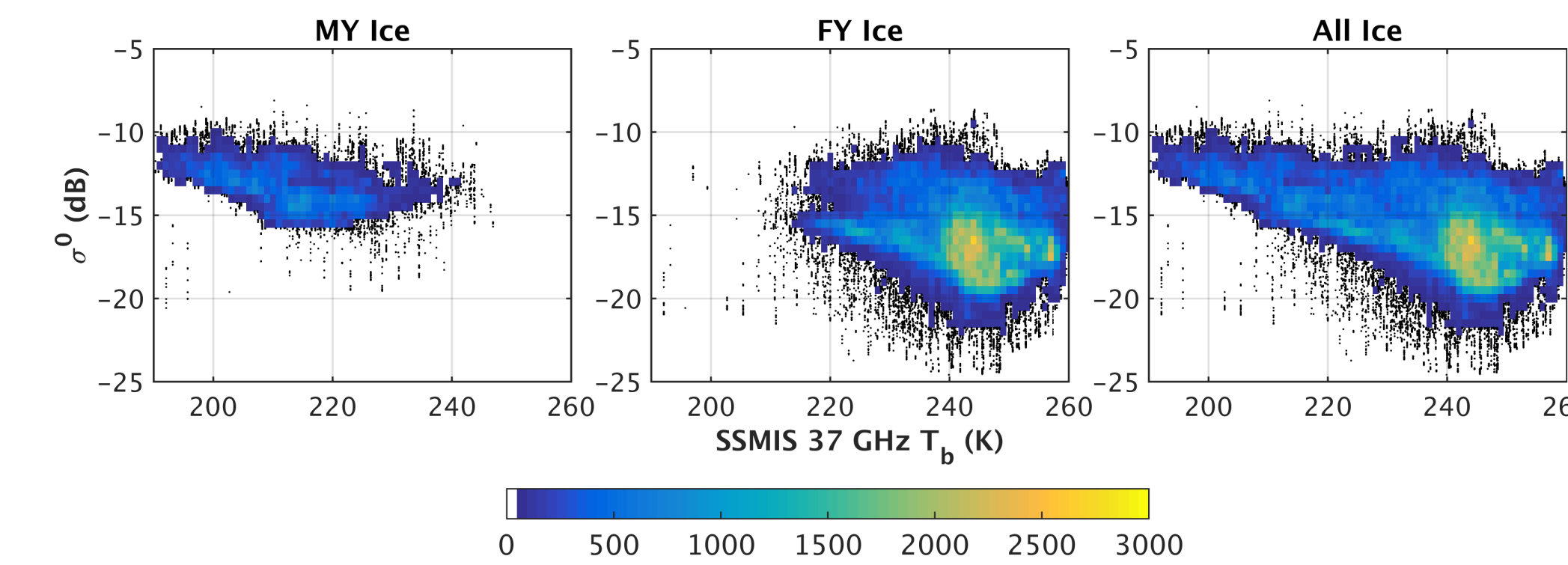
Maps of FY and MY ice, land, and ocean for DOY 45 from 2000 to 2014.

## References

- [1] D. B. Lindell and D. G. Long, "Multiyear Arctic Sea Ice Classification Using OSCAT and QuikSCAT," *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 54, No. 1, pp. 167-175, doi:10.1109/TGRS.2015.2452215, 2016.
- [2] D. B. Lindell and D. G. Long, "Multiyear Arctic Ice Classification using ASCAT and SSMIS," *Remote Sensing*, Vol. 8, art. 204, doi:10.3390/rs8040294, 2016.
- [3] J. C. Hill and D. G. Long, "Extension of the QuikSCAT sea ice extent dataset with OSCAT data," *IEEE Transactions on Geoscience and Remote Sensing*, in preparation.

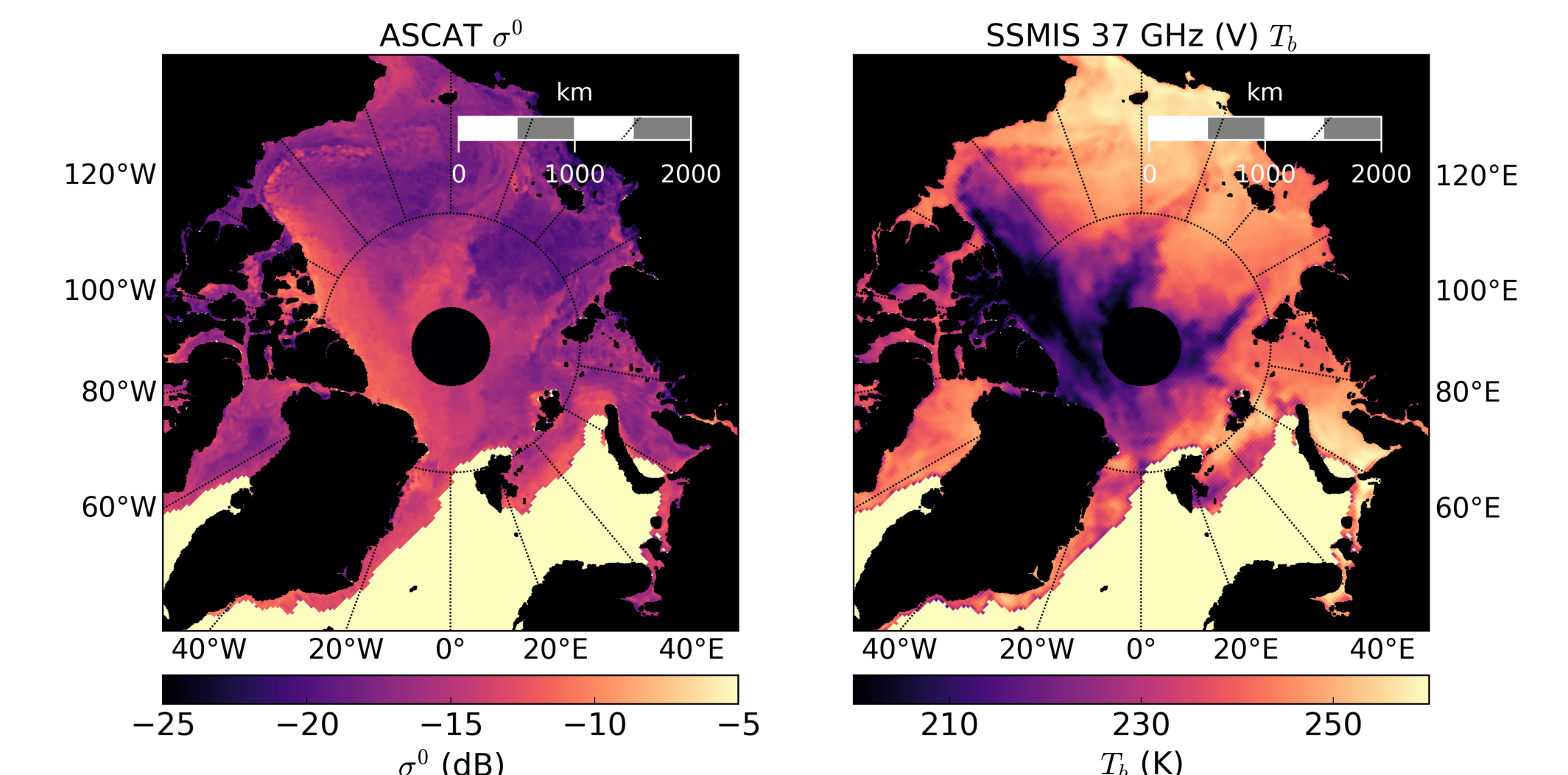
## ASCAT Ice Age

An algorithm is developed for the C-band Advanced Scatterometer (ASCAT) backscatter measurements to continue the sea ice classification dataset following the failure of OSCAT in 2014. The classification method uses  $\sigma_0$  measurements from ASCAT and 37 GHz brightness temperature measurements from Special Sensor Microwave Imager Sounder (SSMIS) to derive a probabilistic model based on a multivariate Gaussian distribution [1].

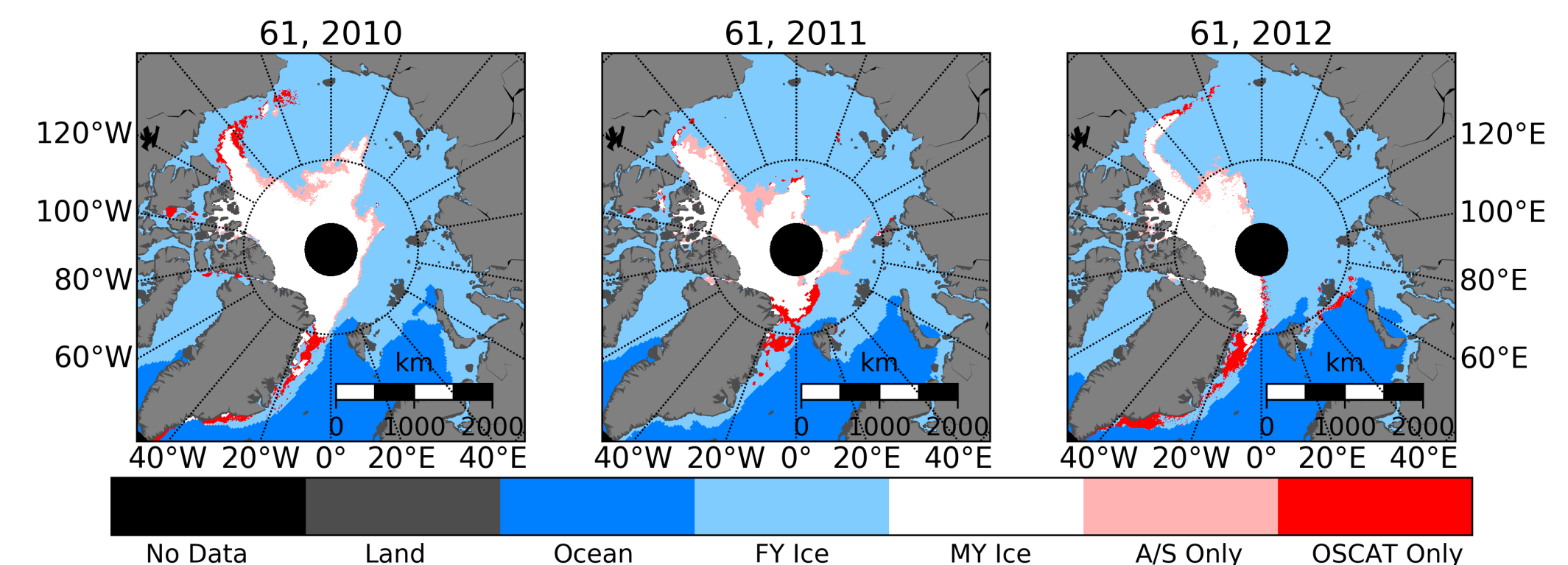


Scatterplot/histograms of ASCAT  $\sigma_0$  values and SSMIS reported brightness temperatures ( $T_b$ ) for day of year 61, 2011.

## Dataset Comparison



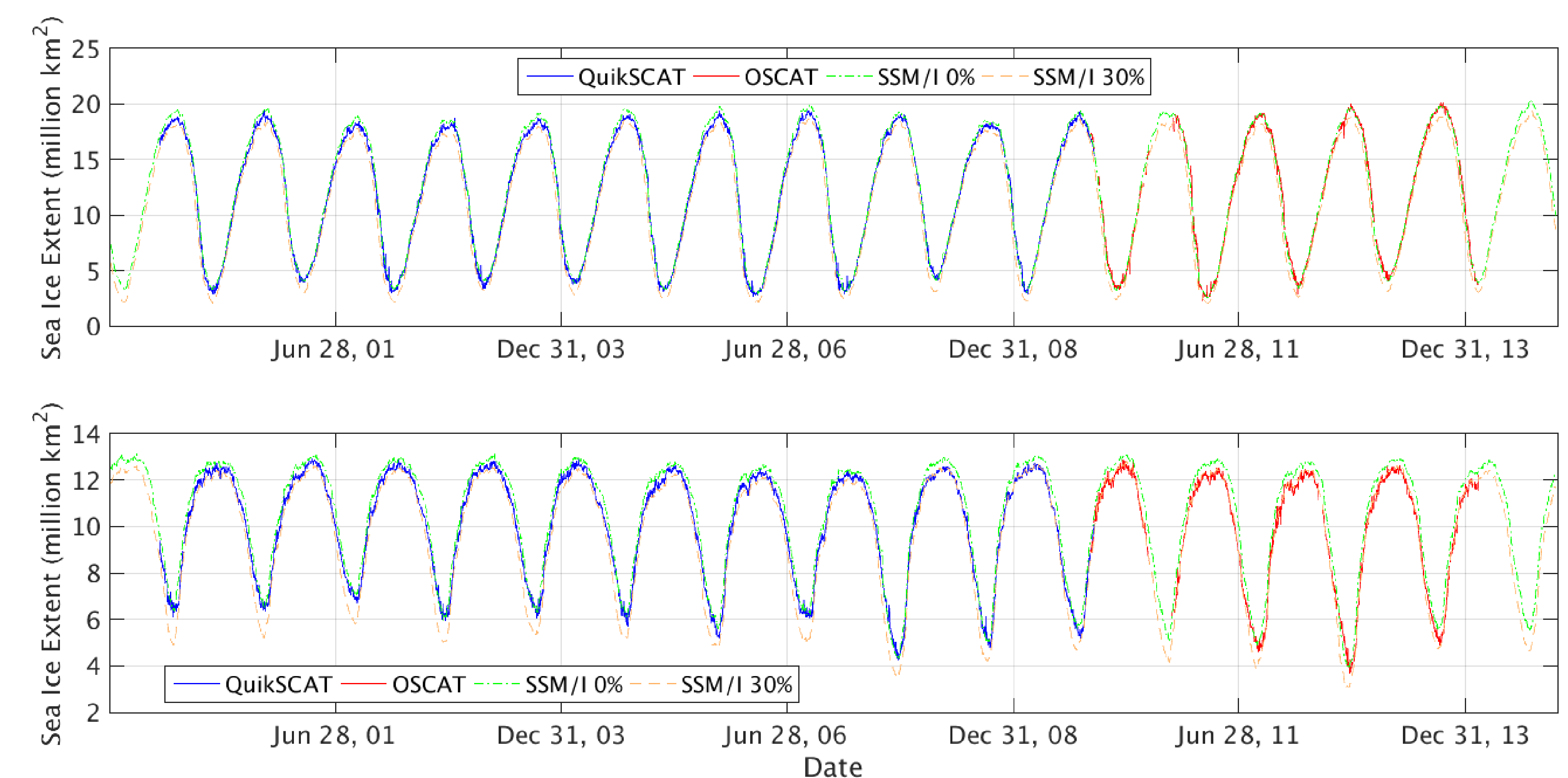
Example images of ASCAT  $\sigma_0$  values and brightness temperatures for day of year 61, 2011 from the 37 GHz (V) channel of SSMIS over the Arctic.



Example ice classification images from day of year 3 for years 2010, 2011, and 2012.

## OSCAT Ice Extent

In the polar regions, sea ice is classified from water to measure the total sea ice extent. The algorithm, developed for QuikSCAT, uses an iterative maximum likelihood classification technique to determine what is ice, land, and ocean based on the radar backscatter. Adjustments are made for OSCAT due to the variability of OSCAT data. The OSCAT sea ice extent data is validated with QuikSCAT and Special Sensor Microwave/Imager (SSM/I) sea ice extent data. The QuikSCAT data set and the OSCAT data set are combined to provide a continuous sea ice extent data set from 1999 to 2014 [3].



Antarctic daily total sea ice area over the OSCAT operation mission.