Geophysical Research Abstracts
Vol. 18, EGU2016-10574, 2016
EGU General Assembly 2016
© Author(s) 2016. CC Attribution 3.0 License.

Mapping sea ice using reflected GNSS signals in a bistatic radar system

Clara Chew, Cinzia Zuffada, Rashmi Shah, and Anthony Mannucci
Jet Propulsion Laboratory, California Institute of Technology, Pasadena, United States

Global Navigation Satellite System (GNSS) signals can be used as a kind of bistatic radar, with receivers opportunistically recording ground-reflected signals transmitted by the GNSS satellites themselves. This technique, GNSS-Reflectometry (GNSS-R), has primarily been explored using receivers flown on aircraft or balloons, or in modeling studies. Last year's launch of the TechDemoSat-1 (TDS-1) satellite represents an enormous opportunity to investigate the potential of using spaceborne GNSS receivers to sense changes in the land and ocean surface.

Here, we examine the ability of reflected GNSS signals to estimate sea ice extent and sea ice age, as well as comment on the possibility of using GNSS-R to detect leads and polynyas within the ice. In particular, we quantify how the peak power of Delay Doppler Maps (DDMs) generated within the GNSS receiver responds as the satellite flies over the Polar Regions. To compute the effective peak power of each DDM, we first normalize the peak power of the DDM by the noise floor. We also correct for antenna gain, range, and incidence angle. Once these corrections are made, the effective peak power across DDMs may be used as a proxy for changes in surface permittivity and surface roughness.

We compare our calculations of reflected power to existing sea ice remote sensing products such as data from the SSMI/S as well as Landsat imagery. Our analysis shows that GNSS reflections are extremely sensitive to the sea ice edge, with increases in reflected power of more than 10 dB relative to reflected power over the open ocean. As the sea ice ages, it thickens and roughens, and reflected power decreases, though it does not decrease below the power over the open ocean. Given the observed sensitivity of GNSS reflections to small features over land and the sensitivity to the sea ice edge, we hypothesize that reflection data could help map the temporal evolution of leads and polynyas.