Geophysical Research Abstracts
Vol. 16, EGU2014-5885-3, 2014
EGU General Assembly 2014

Estimation of Arctic Sea Ice Freeboard and Thickness Using CryoSat-2

Sanggyun Lee, Jungho Im, Hyeonjin yoon, Minso Shin, and Miae Kim
Ulsan National Institute of Science and Technology ,Korea, Republic Of (sglee@unist.ac.kr)

Arctic sea ice is one of the significant components of the global climate system as it plays a significant role in driving global ocean circulation, provides a continuous insulating layer at air-sea interface, and reflects a large portion of the incoming solar radiation in Polar Regions. Sea ice extent has constantly declined since 1980s. Its area was the lowest ever recorded on 16 September 2012 since the satellite record began in 1979. Arctic sea ice thickness has also been diminishing along with the decreasing sea ice extent. Because extent and thickness, two main characteristics of sea ice, are important indicators of the polar response to on-going climate change, there has been a great effort to quantify them using various approaches. Sea ice thickness has been measured with numerous field techniques such as surface drilling and deploying buoys. These techniques provide sparse and discontinuous data in spatiotemporal domain. Spaceborne radar and laser altimeters can overcome these limitations and have been used to estimate sea ice thickness. Ice Cloud and land Elevation Satellite (ICEsat), a laser altimeter from National Aeronautics and Space Administration (NASA), provided data to detect polar area elevation change between 2003 and 2009. CryoSat-2 launched with Synthetic Aperture Radar (SAR)/Interferometric Radar Altimeter (SIRAL) on April 2010 can provide data to estimate time-series of Arctic sea ice thickness.

In this study, Arctic sea ice freeboard and thickness in 2012 and 2013 were estimated using CryoSat-2 SAR mode data that has sea ice surface height relative to the reference ellipsoid WGS84. In order to estimate sea ice thickness, freeboard height, elevation difference between the top of sea ice surface and leads should be calculated. CryoSat-2 profiles such as pulse peakiness, backscatter sigma-0, number of echoes, and significant wave height were examined to distinguish leads from sea ice. Several near-real time cloud-free MODIS images as CryoSat-2 data were used to identify leads. Rule-based machine learning approaches such as random forest and See5.0 and human-derived decision trees were used to produce rules to identify leads. With the freeboard height calculated from the lead analysis, sea ice thickness was finally estimated using the Archimedes' buoyancy principle with density of sea ice and sea water and the height of freeboard. The results were compared with Arctic sea ice thickness distribution retrieved from CryoSat-2 data by Alfred-Wegener-Institute.