Geophysical Research Abstracts
Vol. 17, EGU2015-10099-3, 2015
EGU General Assembly 2015

The ability of CryoSat-2 to measure Antarctic sea ice freeboard

Daniel Price (1), Wolfgang Rack (1), Justin Beckers (2), Robert Ricker (3), Nathan Kurtz (4), Christian Haas (5), Veit Helm (3), Stefan Hendricks (3), Greg Leonard (6), and Pat Langhorne (7)

(1) Gateway Antarctica, University of Canterbury, Christchurch, New Zealand, (2) Department of Earth & Atmospheric Sciences, University of Alberta, Canada, (3) Alfred Wegner Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany, (4) Cryospheric Sciences Laboratory, NASA Goddard Space Flight Center, MD, USA, (5) Department of Earth, Space Science and Engineering, York University, Toronto, Canada, (6) School of Surveying, University of Otago, Dunedin, New Zealand, (7) Department of Physics, University of Otago, Dunedin, New Zealand

Antarctic sea ice cover has been routinely monitored since 1979 but sea ice thickness remains one of the least understood physical components of the global cryosphere. Quantification of thickness is of crucial importance, since when combined with areal data it allows the computation of sea ice volume providing insight into the heat budget of the Antarctic sea ice system and quantification of freshwater and saltwater fluxes in the Southern Ocean.

The use of satellite altimetry for sea ice thickness estimation relies on the measurement of freeboard. Thickness can then be estimated based on the assumptions of hydrostatic equilibrium given densities of snow, ice, water, and snow thickness are known.

Using in situ data for 2011 and 2013 we evaluate the ability of CryoSat-2 (CS-2) to retrieve sea ice freeboard over fast-ice in McMurdo Sound. European Space Agency Level 2 data (ESAL2) is compared with results of a Waveform Fitting procedure (WfF) and a Threshold-First-Maximum-Retracker-Algorithm employed at 40% (TFMRA40). A supervised freeboard retrieval procedure is used to reduce errors associated with sea surface height identification and radar velocity in snow.

We find ESAL2 freeboards located between the ice and snow freeboard rather than the frequently assumed snow-ice interface. WfF is within 0.04 m of the ice freeboard but is influenced by variable snow conditions causing increased radar backscatter from the air/snow interface; in such conditions a positive bias of 0.14 m away from the ice freeboard is observed. TFMRA40 freeboards are within 0.03 m of the snow freeboard. The difference in freeboard estimates is primarily driven by different retracker assumptions, although waveform alteration by variations in snow properties and surface roughness is evident. Techniques were amended where necessary and automatic freeboard retrieval procedures for ESAL2, WfF and TFMRA40 were developed.

CS-2 detects annual fast-ice freeboard trends in McMurdo Sound using all three automatic procedures that are in line with known sea ice growth rates in the region. We present a systematic validation of CS-2 in the coastal Antarctic and provide insight into the assumptions currently used to process CS-2 data.