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Arctic sea-ice freeboard and thickness from NASA's LVIS observations

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The sea-ice freeboard and thickness are derived from the six sea-ice flights of NASA's IceBridge Land, Vegetation, and Ice Sensor (LVIS) over the Arctic from 2009 to 2013.
The LVIS is an airborne scanning laser altimeter. It can operate at an altitude up to 10 km above the ground and produce a data swath up to 2 km wide with 20-m wide footprints. The laser output wavelength is 1064 nm and pulse repetition rate is 1000 Hz. The LVIS L2 geolocated surface elevation product and Level-1b waveform product (http://nsidc.org/data/ilvis2.html and http://nsidc.org/data/ilvis1b.html) at National Snow and Ice Data Center, USA (NSIDC) are used in this study. The elevations are referenced to a geoid with tides and dynamic atmospheric corrections applied. The LVIS waveforms were fitted with Gaussian curves to calculate pulse width, peak location, pulse amplitude, and signal baseline. For each waveform, the centroid, skewness, kurtosis, and pulse area were also calculated. The waveform parameters were calibrated based on laser off pointing angle and laser channels. Calibrated LVIS waveform parameters show a coherent response to variations in surface features along their ground tracks. These parameters, combined with elevation, can be used to identify leads, enabling the derivation of sea-ice freeboard and thickness without relying upon visual images. Preliminary results show that the elevations in some of the LVIS campaigns may vary with laser incident angle, this can introduce a cross-track elevation bias if not corrected. We will further analyze the LVIS data and develop an algorithm to remove this bias. The sea-ice freeboard and thickness results from LVIS are compared with NASA's Airborne Topographic Mapper (ATM) for an April 20, 2010 flight, when both LVIS and ATM sensors were on the same aircraft and made coincidental measurements along repeat ground tracks.