



Elevation and freeboard calibration/validation of IceBridge and five different CryoSat-2 retrackers for coincident sea ice observations

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The airborne IceBridge and spaceborne Cryosat-2 observe polar sea ice at different altitudes with different footprint sizes and often at different time and locations. Data products of IceBridge and Cryosat-2 use different reference ellipsoid, geoid models, tide models, and atmospheric corrections to derive surface elevation and sea ice freeboard. Furthermore, many studies using different retrackers to derive Cryosat-2 surface elevation. These make it difficult to directly compare the elevation and freeboard results of IceBridge and Cryosat-2. In this study, we compare sea ice surface elevation and freeboard using 8 coincident CryoSat-2, ATM, and LVIS observations with direct IceBridge underflights of Cryosat-2 ground tracks. We apply identical ellipsoid, geoid model, tide model, and atmospheric correction to CryoSat-2 and IceBridge data to eliminate elevation biases due to their differences. The ATM and LVIS elevation and freeboard and Snow Radar snow depth are averaged to each CryoSat-2 footprint for comparison. The five different Cryosat-2 retrackers (ESA, GSFCv1, AWI, JPL, and GSFCv2) show distinct differences in mean elevation over leads and over floes; they also show distinct differences in mean freeboards. The threshold based AWI retracker floe elevation is the closest to ATM floe elevation, which is from the air/snow boundary. The GSFCv2 and ESA floe elevations are close to the ATM floe elevation with snow depth removed, which is from the snow/ice boundary. The GSFCv2 lead elevation agrees with ATM lead elevation the best for the five studied Cryosat-2 retrackers. The AWI lead elevation is higher than ATM and the ESA lead elevation is lower than ATM. Both JPL floe and lead elevations are the lowest in the comparison. However, with snow depth measurement, the overall mean of freeboard differences between GSFCv2, ESA, AWI, JPL retrackers and ATM are all in agreement to within 0.05 meters.