Validation activities for the Ice, Cloud, and Land Elevation Satellite - 2 (ICESat-2) Mission

Thomas Neumann\(^1\), Kelly Brunt\(^{1,2}\), Lori Marguder\(^3\), and Nathan Kurtz\(^1\)
\(^1\)NASA Goddard Space Flight Center, Cryospheric Science Laboratory, Code 615, Greenbelt, United States of America (thomas.neumann@nasa.gov)
\(^2\)Earth System Science Interdisciplinary Center (ESSIC), University of Maryland, College Park, MD, USA
\(^3\)Applied Research Laboratories, University of Texas at Austin, Austin, TX, USA

After launching on 15 September 2018, the Ice, Cloud, and Land Elevation Satellite – 2 (ICESat-2) Mission began collecting data on 14 October 2018. The mission uses green laser light emitted by the Advanced Topographic Laser Altimetry System (ATLAS) to detect individual photons that are reflected by the Earth's surface and returned to ATLAS. These photons, when combined with information on the pointing direction, and position of the observatory in space, provide a geolocation and elevation for every measurement that spans the globe from 88 degrees north latitude to 88 degrees south. The Global Geolocated Photon data product provides a latitude, longitude, elevation, and measurement time for each photon event telemetered to Earth for each of the instrument's six beams. This product also delineates between high, medium, and low signal confidence levels and those measurements associated with background noise. The higher level, along-track products each use different strategies for photon aggregation to optimize the precision and accuracy of the surface retrievals over specific surface types. These types include land ice, sea ice, vegetation/land, ocean, and inland water. There is a separate channel dedicated to atmospheric returns to measure cloud and aerosols over a vertical window of 15 km. Calibration efforts utilized well designed on-orbit maneuvers to identify both pointing and range biases attributed to orbital variations on the satellite. Once corrected, the science-quality data products were released to the public in May 2019.

In this presentation, we will present our ongoing work to evaluate and validate the geolocation and elevation accuracy and precision of measurements provided by the ICESat-2 mission. The approaches are diverse in both location and methodology to ensure that we have a comprehensive assessment of the ATLAS performance variations throughout the orbital cycles. These strategies include comparisons with ground-based and airborne elevation measurements over the ice sheets, detailed analysis of returns from well-surveyed corner cube retro-reflectors, comparison of sea ice freeboard measured by airborne lidars, evaluation of global-scale ocean elevation through comparison with radar altimeters, and comparison of vegetation canopy height metrics measured by airborne lidar. Our work to date demonstrates that individual photon elevations are accurate to approximately 30 cm vertically, and 6 m radially. Aggregating many
photons together reduces the elevation uncertainty to less than 5 cm for relatively flat and smooth ice sheet interiors.