ATL06 Known Issues

15 May 2019 -- Release 001

Basic filtering and data plotting

The ATLAS instrument onboard the ICESat-2 mission is a photon-counting laser altimeter, and is able to measure the heights of individual photons along the satellite track. These heights are available in the ATL03 data product. Over surfaces such as land ice, however, the number of returned photons is large, and the photons themselves are not uniformly spaced in the along-track direction. Additionally, the photon heights in ATL03 are not corrected for some of the biases inherent to the instrument. Therefore, it can be difficult to use the ATL03 product for accurate estimation of ice sheet and glacier heights and height changes.

The ATL06 land-ice along track data product (Smith et al., 2019) aggregates photons from ATL03 into 40 m segments spaced at 20 m intervals along-track for each of ICESat-2's six beams. The algorithm uses a robust least-squares fitting technique to improve precision and estimate the along track surface slope. This also allows for two additional bias corrections required for accurate estimates over land ice: the first photon bias and the transmit pulse shape correction. The bias-corrected land ice height is available in '*/gtxx/land_ice_segments/h_li*', where 'xx' can be '1l', '1r', '2l', '2r', '3l', or '3r' depending on the beam used.

In addition to the land-ice surface height, ATL06 also includes several parameters that can be used to filter spurious data. Because several parameters sometimes need to be used simultaneously for adequate filtering, we have compiled values from several parameters into the ATL06_quality_summary, indicates either that no problems with a segment have been identified (0) or that at least one problem was found (1). We recommend applying this filter for an initial look at the data product. The ATL06_quality_summary is available in '*/gtxx/land_ice_segments/atl06_quality_summary*'.

Filtering low-quality returns

Under clear-sky conditions, and even when moderately thick clouds are present, the ATL03 and ATL06 algorithms reliably identify the surface return in the data and appear to give accurate estimates of the surface height. When the surface return is sufficiently weak that the ATL03 and ATL06 algorithms do not unambiguously detect it, the ATL06 algorithm will often provide no height estimate. However, the ATL06 algorithm can also sometimes identify collections of noise photons as the surface. In these cases, the reported height will be quasi-random, and often will be as much as a few hundred meters away from the true surface height. Filtering the data based on *atl06_quality_summary* will remove most of these elevations, and filtering the segments based on height consistency between adjacent segments will also help remove low-quality returns.

When thick clouds or blowing snow are present close to the surface, scattering of photons can increase their path length between the transmitter and detector. Atmospheric flags are available

on the product that may help users identify and reject granules strongly affected by these problems, (see */gtxx/land_ice_segments/geophysical/msw_flag,* and */gtxx/land_ice_segments/bsnow_conf*).

Corrections for ocean tide and the inverse barometer effect

While most geophysical corrections applicable over grounded and floating ice (e.g., ocean load tide, pole tide, and solid earth tide) are already applied to ATL06 heights, two of the corrections (dynamic atmosphere correction and ocean tide) specific to floating ice are not. We recommend the use of an appropriate floating/grounded ice mask to determine if these corrections need to be applied.

Files with bad data

Due to both known and unknown sources, there are some files with either 1) large biases in surface height (>2 m) or 2) large biases in geolocation (>10 m). We have excluded these files in the first data release (release 001), which means that some granules that are available as lower-level (ATL03) products are not available as ATL06es.

Number of pulses per segment:

Calculations related to the surface radiometry and the background photon count depend on an estimate of the number of pulses that might have contributed to a data segment. This number (*gtxx/fit_statistics/n_seg_pulses)* is expected to be close to 57 (found from the spacecraft orbital velocity projected on the geoid, the PRF, and the length of a segment). ATL06 currently calculates this as one plus the difference between the smallest and the largest pulse number for all photons in each segment. In some circumstances early in the mission, where the ICESat-2 tracks were not parallel to the reference tracks, this results in a large calculated number of pulses per segment (up to a few hundred). Conversely, where the signal strength is poor and only a few photons are present in a segment, *n_seg_pulses* on the current version may be much less than 57, giving an improperly inflated estimate of the effective surface reflectance. In most cases, this problem should result in only minor errors in surface height retrieval, and is expected to be fixed in the next data release.

Empty files

Some files that appear in the data catalog contain no data. The ATL03 *known issues* document (the same issues exist for ATL06 files) gives this explanation: When ATLAS is taken out of science mode (for example to conduct any one of a number of internal calibrations) photon-rate data is not collected, but the ATL03 structure, ancillary data, and metadata for that time period is created. This is done to indicate than an attempt to generate the file was made, but that there was insufficient data to complete processing and data granule creation. We are attempting to filter these effectively empty files out prior to delivery to NSIDC.

Uncertainties in geolocation

Some components of the error propagation algorithms for ATL03 have not yet been implemented. To avoid providing incorrectly optimistic estimates of the horizontal geolocation uncertainty and the vertical uncertainty to which it is propagated, fixed, large (100-m) values of the geolocation uncertainty are reported on release 001. We expect that subsequent release will have more precise values reflecting the true accuracy of the measurements: Based on calibration/validation activities, uncertainties in geolocation for release 001 are typically less than 10 m.

Spurious Trends in the data

Released data are calibrated to temporal trends smaller than 1 mm/day. As calibration exercises are completed, those data will be used to produce timing-bias models that will stabilize temporal trends in the beam to be on the order of a few mm/yr.