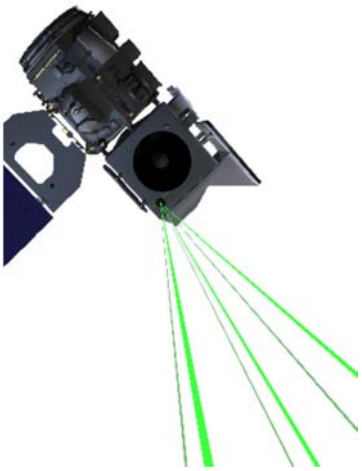
Current topic for a Master's Thesis

Monitoring Inland Water Levels Using Photons: The Capabilities of the ICESat-2/ATLAS LiDAR Sensor



The Advanced Topographic Laser Altimeter System (ATLAS) is the space LiDAR (Light Detection and Ranging) instrument onboard ICEsat-2. it was originally designed to determine ice sheet elevations. But this sensor can also be used to measure the water levels of ocean and inland waters. Pre-processed water elevation heights as well as raw photon data are available for this purpose. Especially for inland applications, ATLAS could significantly improve the accuracy due to its small footprint (i.e. the area illuminated by the photons on the ground) compared to the large footprints of classical radar altimeters (e.g. Jason-3, whose echoes are often seriously distorted due to topography, multiple reflections and noise). Furthermore, ATLAS has the potential to obtain bathymetric information.

The goal of this thesis is to investigate the potential of ICESat-2 for the monitoring of water levels of inland waters. It shall be studied, how the application of pre-processed along-track water elevation heights performs in comparison with photon data, and which improvement can be reached with respect to classical radar altimeters (e.g. Jason-3). The analysis shall be carried out for different types of inland water bodies (larger and smaller lakes, rivers of different widths). Results shall be validated by a comparing the water levels with in-situ gauge data. It would also be possible to investigate the bathymetric capabilities of ATLAS.

Main tasks:

- Understanding the measurement principle of ICESat-2/ATLAS (vs. classical radar altimeters)
- Comparison of the spatial distribution of the along-track water surface heights and photon data
- Development and implementation of a processing tool to estimate water level time series from ICESat-2/ATLAS observations
- Computation of water level time series for different lakes and rivers
- Validation: Analysis of the precision of water level time series with respect to gauge data
- Comparison of results with water levels from DGFI-TUM's inland altimetry data base DAHITI (https://dahiti.dgfi.tum.de)

References:

Neumann, T., et al. (2020): ICE, CLOUD, and Land Elevation Satellite-2 (ICESat-2) Project: Algorithm Theoretical Basis Document (ATBD) for Global Geolocated Photons: ATL03. NASA, Goddard Space Flight Center.

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Parrish, C., Magruder, L., Neuenschwander, A., Forfinski-Sarkozi, N., Alonzo, M., Jasinski, M. (2019): Validation of ICESat-2 ATLAS Bathymetry and Analysis of ATLAS's Bathymetric Mapping Performance. Remote Sensing, https://doi.org/10.3390/rs11141634.

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