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icepyx: querying, obtaining, analyzing, and manipulating ICESat-2 datasets

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Software

- Review
- Repository
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Summary

icepyx is both a software library and a community composed of ICESat-2 (NASA satellite) data users, developers, maintainers, and the scientific community. We are working together to develop a shared library of resources - including existing resources, new code, tutorials, and use-cases/examples - that simplify the process of querying, obtaining, analyzing, and manipulating ICESat-2 datasets to enable scientific discovery.

Statement of need

icepyx aims to provide a clearinghouse for code, functionality to improve interoperability, documentation, examples, and educational resources that tackle disciplinary research questions while minimizing the amount of repeated effort across groups utilizing similar datasets. icepyx also hopes to foster collaboration, open-science practices, and reproducible workflows by integrating and sharing resources.

The Ice, Cloud, and Land Elevation Satellite-2 (ICESat-2) (Markus et al., 2017) was launched by NASA in September 2018. The laser altimeter on board the satellite emits green light to the Earth's surface and measures the time until each pulse is returned to the satellite's sensors. This information is used to determine the surface height of the land, ice, snow, trees, water, clouds, etc. that the satellite is passing over. The instrument provides close to 500 GB of data per day, allowing scientists to investigate the surface height of earth's features in unprecedented detail.

icepyx began during the cryosphere-themed ICESat-2 Hackweek at the University of Washington in June 2019. At the event, there was a clear need for a collaborative, shared community space that combined and generalized the tools and materials written by past, present, and future Hackweek participants, ICESat-2 Science Team members, and the data user community. A unified framework of code and documentated examples for downloading, reading, and visualizing ICESat-2 data that is well tested makes it more accessible for everyone to use. The library and community continue to grow and evolve, adding new features and building scientific literacy in open-science, cloud computing, and collaborative development best practices.

icepyx is now a foundational tool for accessing and working with ICESat-2 data, responsible for nearly a quarter of all NASA data center granule downloads in 2022. The library is

complemented by a series of other specialized tools for interacting with and obtaining ICESat-2 data. These include OpenAltimetry (Khalsa et al., 2020), a browser based web tool to visualize and download selected ICESat and ICESat-2 surface heights, SlideRule (Swinski et al., 2023), a server-side framework to create cloud-based, on-demand customized data processing for ICESat-2 data, and multiple product-focused tools for scientific data analysis (e.g. PhoREAL, PhotonLabeler). These tools are described in more detail in the icepyx documentation's ICESat-2 Resource Guide.

icepyx is also featured in multiple scientific publications (Bisson & Cael, 2021; Fernando, 2021; Li et al., 2020), presentations (J. Scheick et al., 2019, 2020; Jessica Scheick et al., 2022), and educational events/Hackweeks (Arendt et al., 2020; J. Scheick et al., 2022).

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