Meltwater on the Greenland Ice Sheet during a Record Melt Season

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Purpose: Improve NASA's ability to monitor changes in the location and depth of melt ponds and lakes throughout the cryosphere

Study Objective: Quantity the extent and impact of meltwater on the surface of Greenland ice sheet during the 2019 melt season

Imagery: SkySat (Planet), IceSat-2, Landsat

Findings: Results indicate significant potential for employing a variety of satellites (e.g., ICESat-2 ATL03) for detecting melt ponds and calculating melt pond volume at sub-weekly timescales. The data provided an unprecedented account of the effects of a record Greenland melt season. The techniques employed can potentially be used to constrain atmosphere/ice sheet models. Parts of the tasking effort were designed to coincide with the NASA Operation IceBridge flights which occurred at the beginning and end of the melt season. The imagery provided additional validation as well as a stacked dataset useful for advancing cryosphere research. Issues associated with sensor calibration, parallax, and radiometry may hinder similar analyses in other polar (or snow-covered) regions, and separate assessments would be required to understand the impact. This is especially true where topography is steep and ice sheet surfaces are complex.
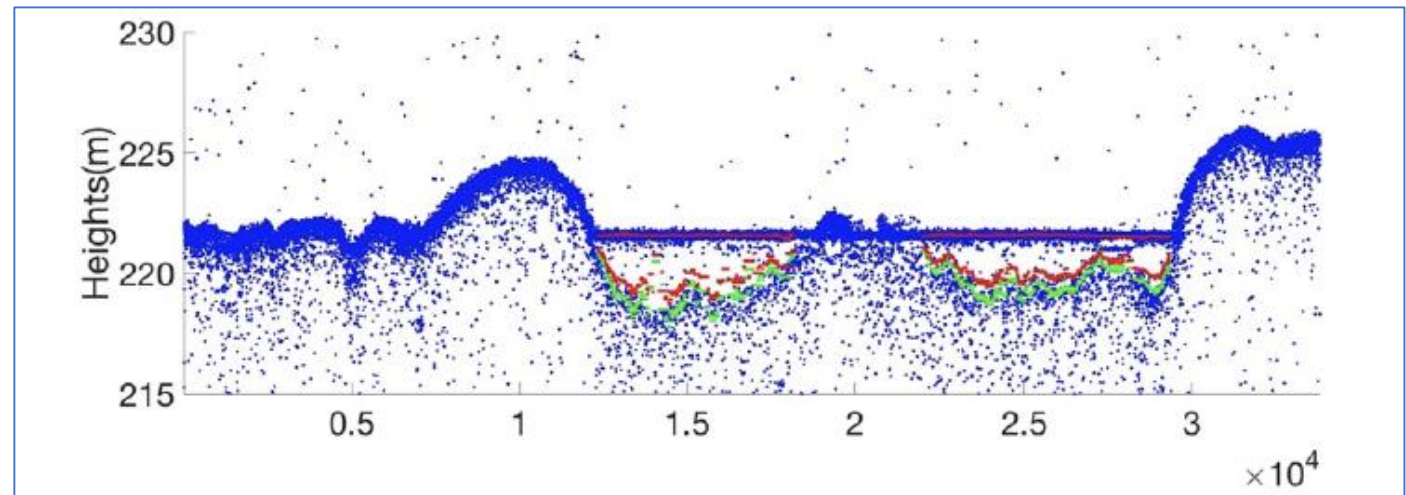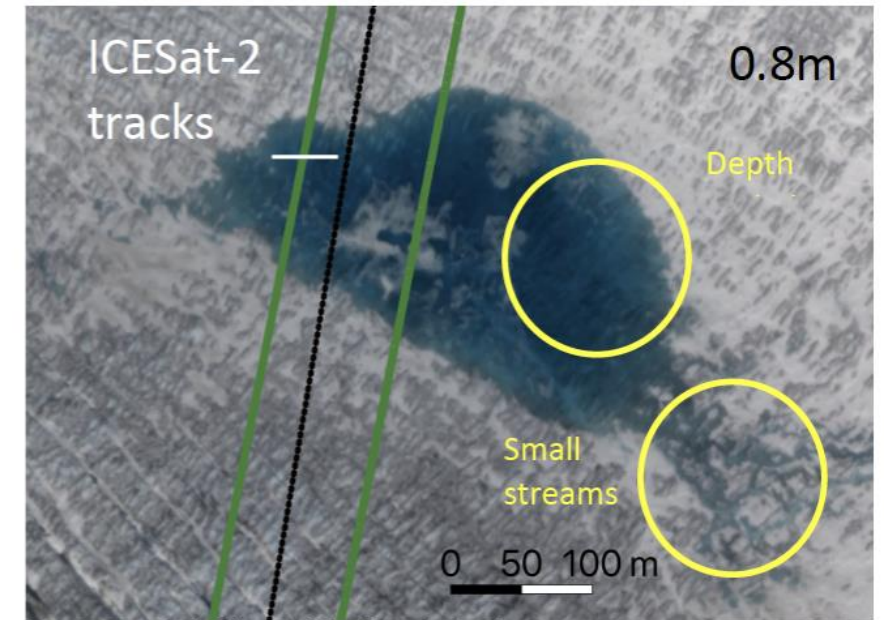

ICESat-2 ATL03 photon cloud -based depth calculation on the Amery ice shelf. Photon heights (blue), depth calculation (green), refraction- corrected values shown in red.
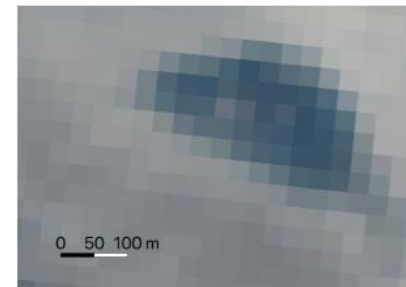
(a) Landsat (30m)

(b) PlanetScope (3m)

(c) Planet SkySat (<1m)

Melt pond shown from imagery collected within 3 days from LandSat (a), Planet Scope (b) and Planet SkySat (c). ICESat-2 tracks shown in green with Operation IceBridge flight line shown in black over Greenland.