

# Remote Sensing of Lava Lake Activity at Mount Erebus

## Using SWOT Altimetry Data, Ground Based Thermal Data and ICESat-2 Altimetry Data

Michael Richmond

University College London (UCL), Faculty of Social and Historical Sciences

Supervisor: Dr Rosemary Willatt, Faculty of Mathematical and Physical Sciences



### Introduction

In this project, the limits of two satellites, NASA's SWOT satellite, designed to measure water surfaces, and ICESat-2, designed to measure ice sheets and sea ice, were tested on a lava lake. They were used to try to understand the activity of Mount Erebus in Antarctica, the world's southernmost active volcano and one of the few with a permanent lava lake.

The data the satellites picked up from the crater and lava lake of Mount Erebus was then paired with thermal data recording the heat from the lava lake. By combining space-based height measurements with heat signals, the project explored whether satellites originally built for oceans and ice can reveal useful information about volcanoes. This approach could provide a safe and practical way to study Mount Erebus and other remote, hazardous volcanoes around the world.

### Methodology

- Used Python to process and visualise satellite data.
- Downloaded SWOT and ICESat-2 data from NASA/NSIDC online websites. This data was filtered so only data files containing satellite passes over the crater were downloaded.
- Paired with thermal data ((**Figure 2**)MODVOLC) to compare with satellite measurements.
- Created plots of SWOT passes (**Figure 1**) and ICESat-2 (**Figure 3**) alongside surface height (SSH) data files to record how the satellites interpreted the steep and varied terrain as well as the crater and lava lake.
- Focused on identifying measurements that fell directly within the lava lake area.
- Combined and compared datasets to look for links between ssh and lava heat.

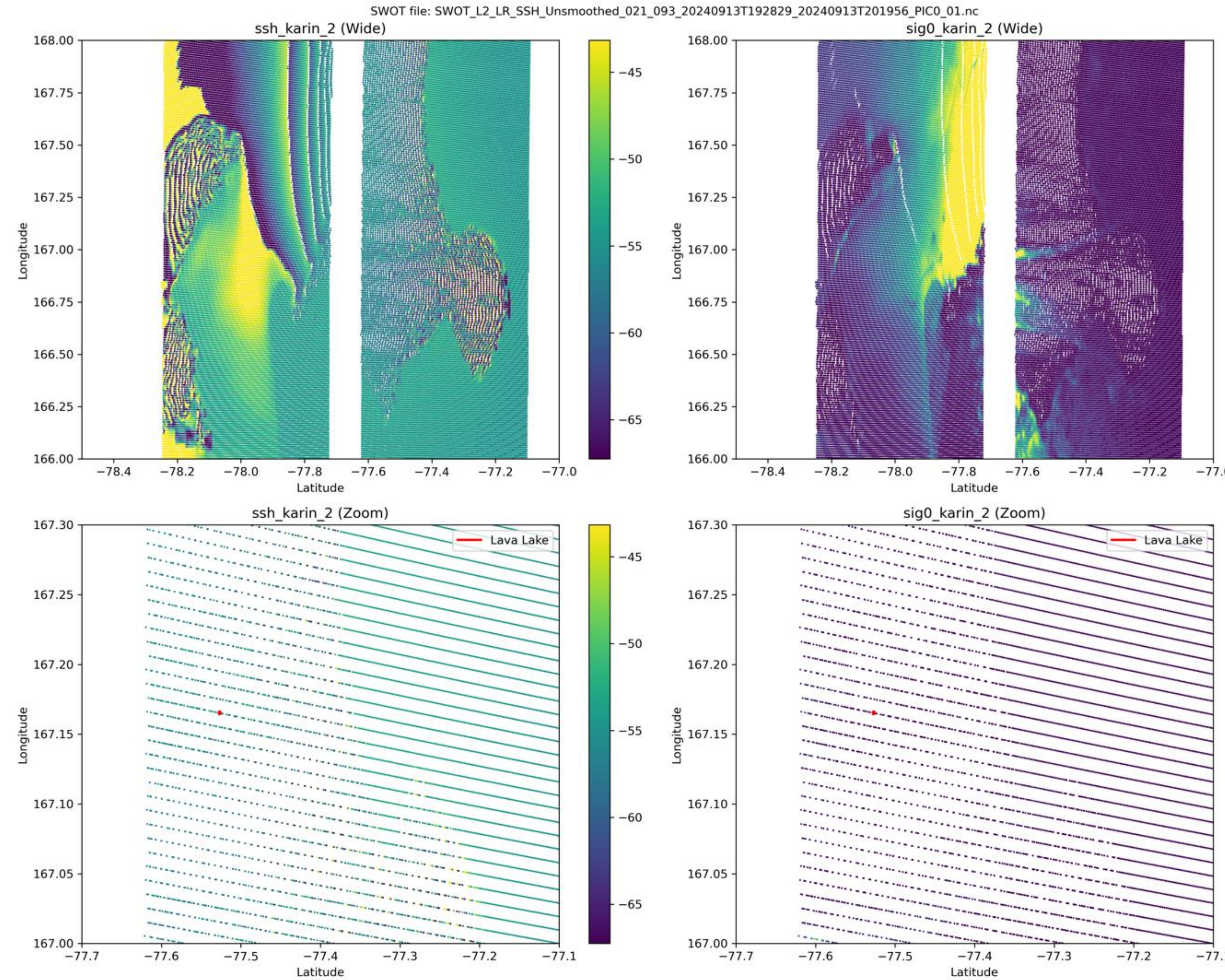


Figure 1: SWOT pass over Ross Island, Antarctica

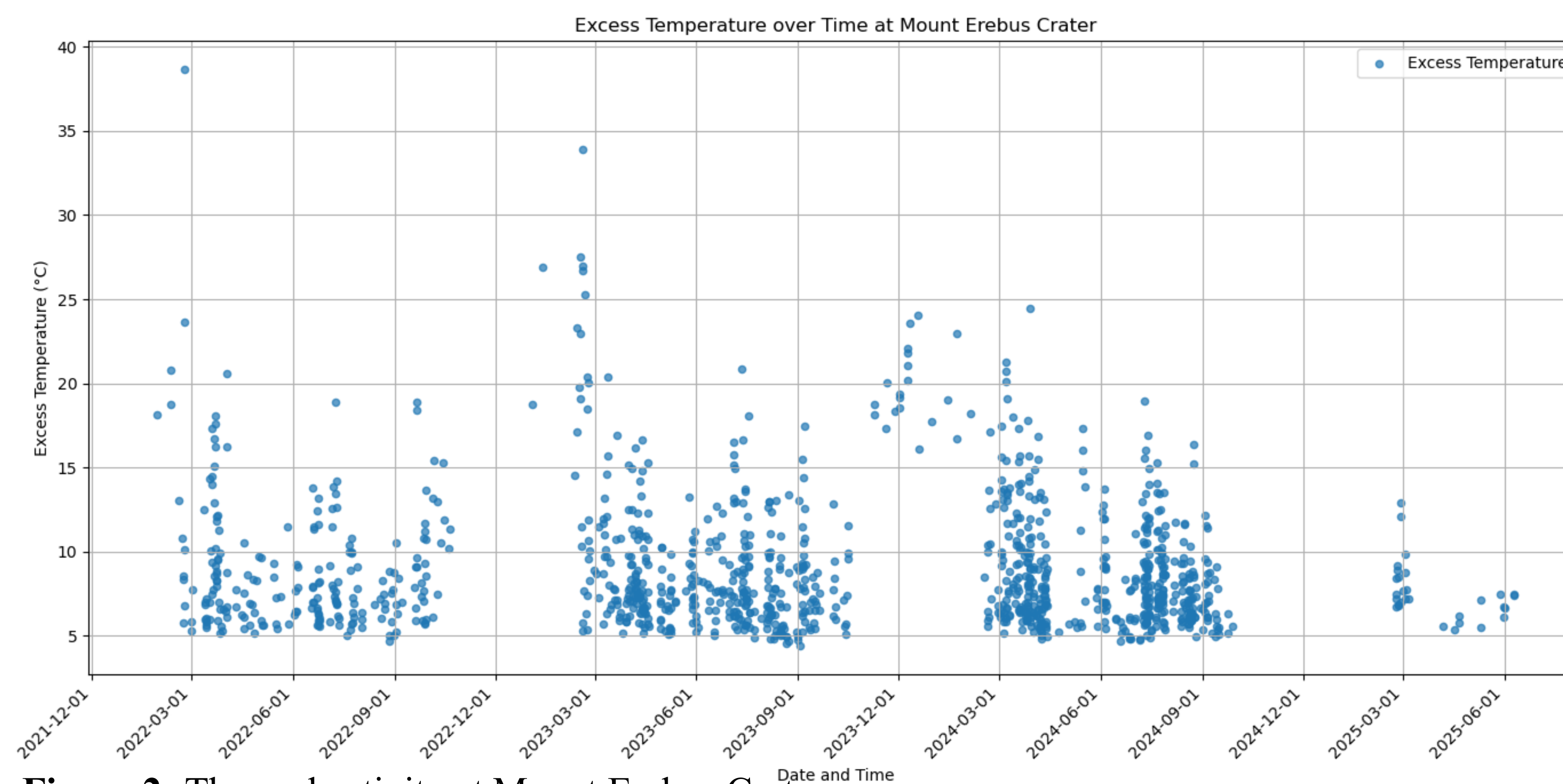


Figure 2: Thermal activity at Mount Erebus Crater

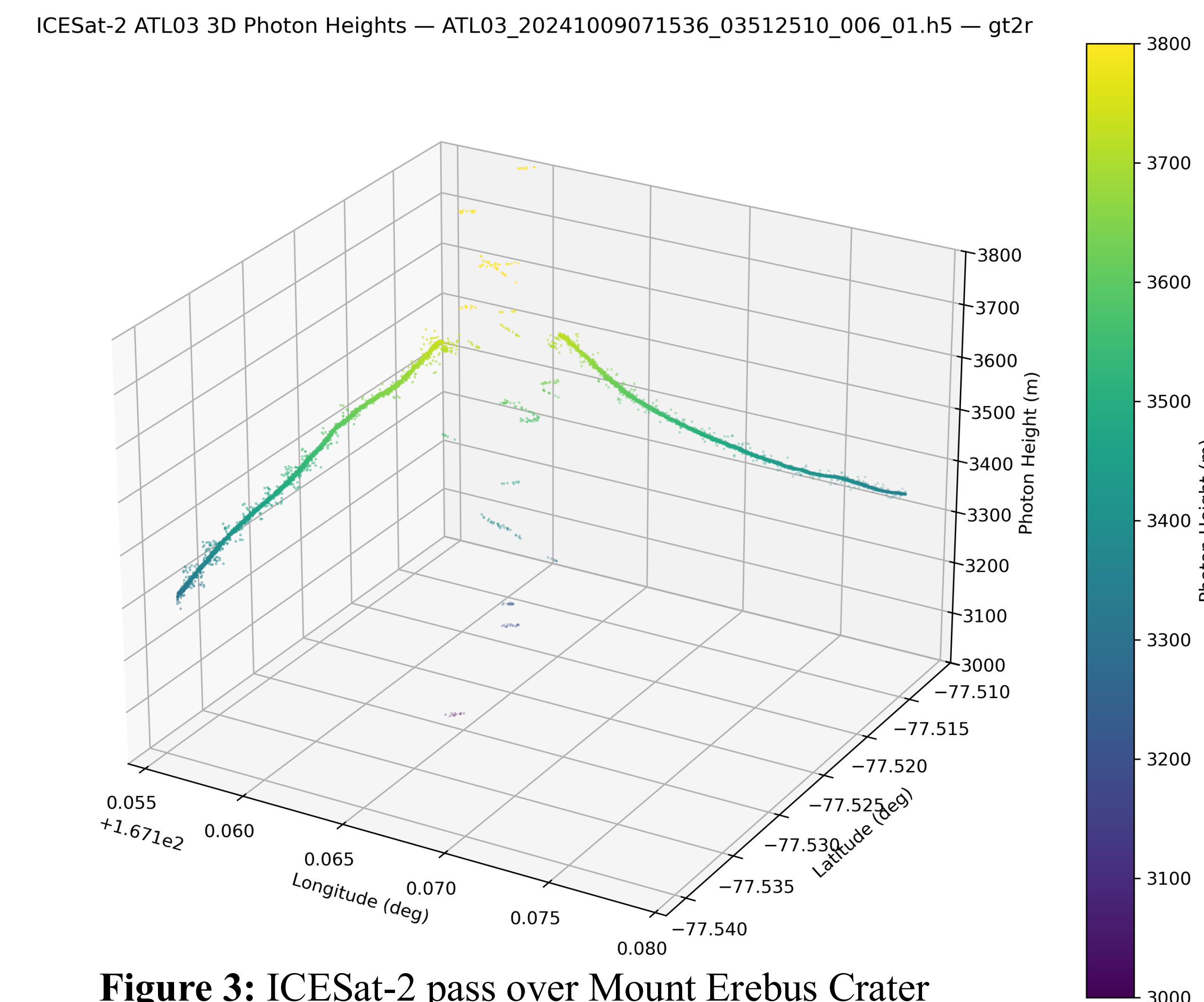


Figure 3: ICESat-2 pass over Mount Erebus Crater

### Conclusions

- SWOT comfortably detected Erebus's crater but gave inconsistent results over the lava lake due to the steep crater walls. Only three SWOT passes directly measured the lava lake, too few for strong statistical conclusions.
- ICESat-2 was much stronger when it came to understanding the terrain, but coverage was limited.
- Combining satellites shows promise for tracking volcanic changes but there are limitations to the satellites in either/and software and hardware. Moreover, data is needed over a greater timescale. (these satellites are only a few years old)