The Snow ALbedo eVOlution (SALVO) Campaign 2022
Metadata Document Date: April 23, 2023
Datastream: Orthomosaic Images & Digital Elevation Models

Contact Information
Jennifer Delamere (jsdelamere@alaska.edu)
2156 Koyukuk Dr.
Fairbanks, AK 99775
Anika Pinzner (apinzner@alaska.edu)
Matthew Sturm (msturm1@alaska.edu)
Author: Anika Pinzner

In the field
Between April 16th and June 21th 2022, measurements were taken at each site about every two to three days using a DJI RTK Phantom drone for photo-surveys (fig. 1) to create both orthomosaic images and digital elevation models (DEMs).

The photo-surveys are based on the acquisition of highly overlapping image sequences from a diversity of views taken above a ~200 x 450 m swath, each from a different location or a different orientation at an altitude of between 200-400ft.

Instruments & Software
We used a DJI RTK Phantom drone flying along a pre-set path for each site. Both data products, the orthomosaic images and the digital elevation models, were produced using structure-from-motion (SfM) techniques (Nolan et al., 2015; Over et al. 2021). Agisoft Metashape Pro Version 1.7.2 was used to process the imagery. The resulting images and DEMs vary slightly in extent and area covered but were cut to the same dimensions for further analyses such as calculating snow area and subsequently depletion curves. The main steps of the SfM processing are summarized below.
All data products uploaded have been cut to size to cover mainly the area of the 200x20 m swath.

Ground Control Points
Along each 200-m strip, ground control points (GCP) were established by drilling into the frozen tundra or sea ice and freezing a 15 mm diameter rod in the hole. At the top of the rod a horizontal metal plate 120 X 120 mm wide, was screwed on in a 90-degree angle. These plates were painted various colors so they could be identified in the merged photo products.

Figure 1: Photo-survey of the ICE site in progress. The 200-m line location is marked by white pvc pipe.

Metashape Workflow:

1. Pre-Process Photos
    a. Removal of redundant/ accidental photos
    b. Adjusting oblique photos to correct orientation
2. Adding photos to Metashape
    a. Add all photos from one survey
    b. Mask people/ objects out
    c. Save as (yyyy/mm/dd_location)
3. Camera Calibration *for Hero7Black
    - Type: Fisheye
    - Rolling shutter comp
    - Type: Precalibrated
4. Lens Calibration (using camera calibration file)

5. Aligning Photos for point cloud creation
    i. Checking: Generic Preselection
    ii. Checking: Reference Preselection
    iii. Checking: Adaptive Camera
6. Creating of Bounding Box around area of interest
7. Placing known markers in each photo
8. Model > Gradual Selection
    - Checking all selections but the Image count selection
    - Deleting uncertain points, Clear points above and below study area
9. Tools > Optimize Camera Alignment
10. Building dense cloud
    i. Quality: medium
    ii. Advanced
        1. Depth Filtering metering: medium
        2. Calculating point colors
    iii. Keep all other selected
11. Building Mesh
    i. Source Data: dense cloud
    ii. Surface type: 2.5 D
    iii. Face count: medium
12. Building orthomosaic
    i. Surface: mesh
    ii. Pixel size: Resolution in meters: 0.01
13. Building DEM
14. File > Export orthomosaic
    a. Export as Tiff/jpg
    b. Pixel in meters= 0.01
    c. Save as yyyymmdd _location_pixel size _ORTHO.tiff
15. File > Export DEM
    a. Set pixel size to 0.1m
    b. Setup boundaries around the area of interest.
    c. Save as yyyy/mm/dd _location_pixel size _DEM.tiff

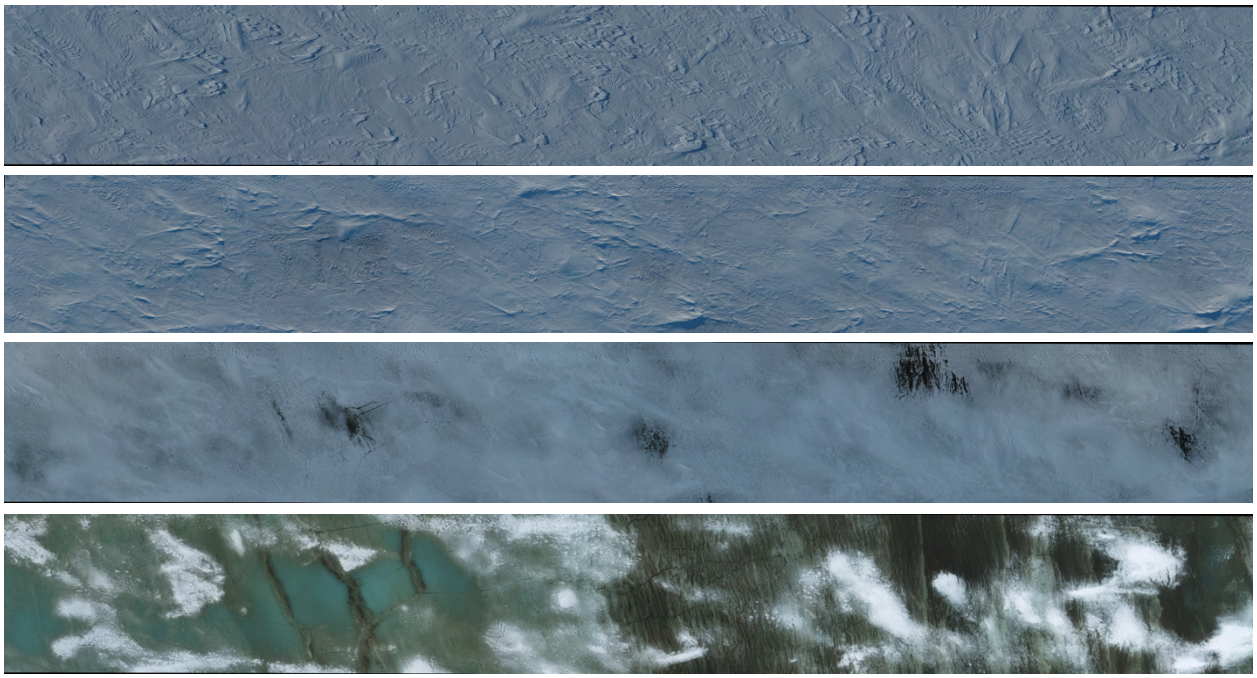

Figure 2: Four example orthomosaic images from the ICE site. Top: ice_orthomosaic_WGS84.c1.20220416.tif; second: ice_orthomosaic_WGS84.c1.20220531evening.tif; third: ice_orthomosaic_WGS84.c1.20220618.tif; bottom: ice_orthomosaic_WGS84.c1.20220619.tif.

References

Nolan, Matt, Chris Larsen, and Matthew Sturm. "Mapping snow depth from manned aircraft on landscape scales at centimeter resolution using structure-from-motion photogrammetry." *The Cryosphere* 9, no. 4 (2015): 1445-1463.

Over, J. S. R. et al. (2021). *Processing coastal imagery with Agisoft Metashape Professional Edition, version 1.6—Structure from motion workflow documentation* (No. 2021-1039). US Geological Survey.