HiLDEN Data Collection: Summer 2018

Last updated 26, June 2018
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Background

With greater complexity being identified in tundra greening patterns and trends observed by satellites, the HiLDEN network was established to characterize landcover, conduct satellite validation and to test emerging scaling questions in landscape ecology in high latitude ecosystems.

The HiLDEN Network collected data at 10 high-latitude sites in North America, Greenland, Svalbard, Fennoscandia and Siberia in 2017. We have presented preliminary data analyses at the 2017 ArcticNet and ITEX Meetings and are in the process of drafting a manuscript to share with the group in fall of 2018.

For the summer of 2018, we hope to build on the data collection from 2017 with the following protocols and to expand the temporal and spatial coverage of our data collection.

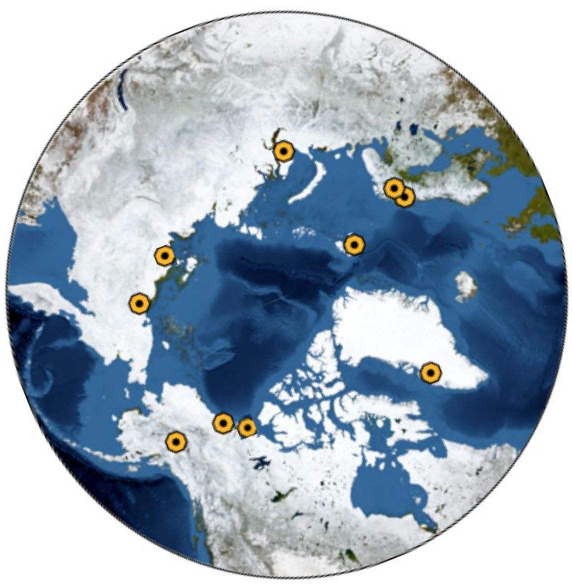


Figure 1. Sites where HiLDEN data collection occurred in 2017.

In our initial analyses, we will use the HiLDEN protocol data to test the following research questions:

1. Do tundra greenness trends vary with site topography among tundra locations?

2. Does landscape-level heterogeneity in environment (soil moisture, temperature, radiation) correspond with heterogeneity in tundra greenness (vegetation indices - NDVI, GCC, etc.)?

3. Are relationships with topography/environment and tundra greenness linear across data presented at different spatial grains? (Probably not...and we can show why!)
By collecting data over two years at some sites and adding additional site into this data collection, we will be able to more rigorously test these research questions contributing to our first manuscripts and potential funding for future activities of the network.

HiLDEN Protocols: Summer 2018

For the 2018 field season, HiLDEN data collection will be structured into three levels of opt-in involvement (Level 1, 2 and 3). Data from all levels will be incorporated into tundra syntheses as described above.

Each protocol level will require different investments of time, resources, and/or operator expertise - giving groups will all backgrounds and hardware an opportunity to contribute meaningful data while simultaneously being able to adapt HiLDEN protocols to their own project needs. All levels incorporate ground data collection to allow for ground validation of the drone data.

Level 1 - High resolution tundra surface mapping
Objective: Generate high resolution land surface maps used to characterize tundra heterogeneity across individual plants or communities at sub-satellite pixel extents.

Skill level required: beginner to moderate
Time investment: 1-2 field days for data collection.

Scientific Objectives: This level of the protocol allows for simple classifications of surface cover types, assessment of impacts of herbivory, 3D surface model creation and simple flower counts. It can be applied across many sites to ask questions about shrub cover, size, and spatial distribution in different tundra types, landcover associations with topographic features and more..

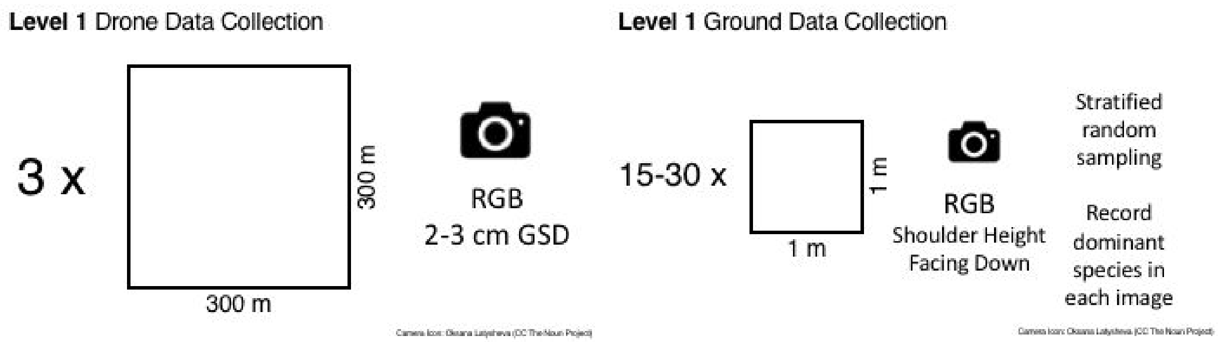


Figure 2. Imagery products: RGB only orthomosaics (300 x 300m orthomosaics, ~2-3 cm ground sampling distance). 3+ replicates during peak season. Time-series also valuable. Ideally 3+ ground control points (GCP) per ortho.

Ground data collection: 15-30 on the ground photographs of vegetation from shoulder height (of 1 x 1m quadrat frame placed on ground). Canopy height measurements at the four corners and centre of all 1 x 1m plots. Description of vegetation cover including dominant species in all 1 x 1m plots. Stratified randomly across main land cover types in the mapped areas. Notations of dominant species/communities found across images. **Critical**: take GPS records of these plot locations!

Typical hardware($): Stock Phantom 4 Advance/Pro using freely available mission planning software. Widely adaptable to most any system.

*NOTE: if this full protocol is too time intensive, or is similar to other plans you have that will gather similar data - simply do what you can in the field! Some sort of contribution is almost always valuable. We can work with a variety of orthophoto data, just keep track of your methods so when we combine datasets we can understand any issues that might arise. Detailed sampling philosophy and rationale here:
https://www.biorxiv.org/content/early/2018/05/30/334730

Level 2 - Multispectral land surface mapping
Objective: Generate spectrally calibrated multispectral land surface maps.

Skill level: Moderate to Experienced
Time investment: 3 field days (or more)

Scientific Objectives: This level of the protocol can be used to generate vegetation indices (like NDVI), validate satellite datasets, and develop linkages between biomass and local-scale remote sensing metrics. Furthermore, it enables more sophisticated classifications of surface cover types.

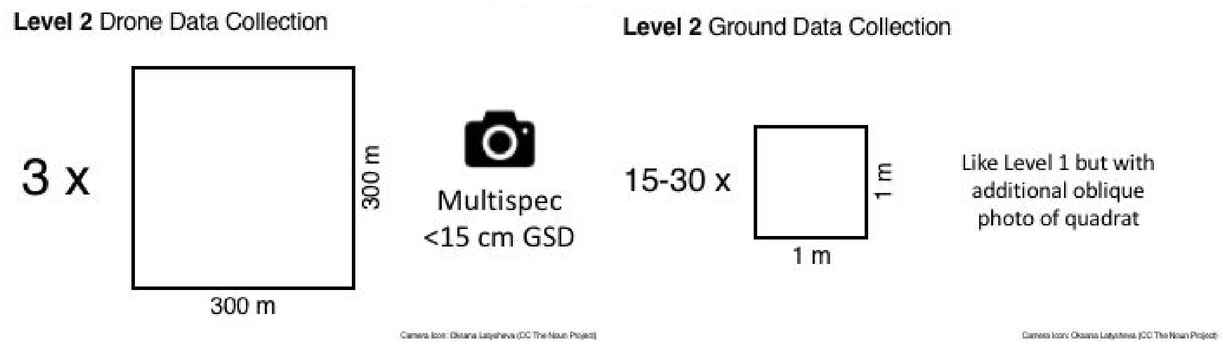


Figure 3. Imagery products: 2 - 5 band orthomosaics (ideally 300 m x 300m+, minimum 100x100m) with spectral calibration measures taken pre- and post-flight. <15cm GSD. 3+ replicates per seasonal window. Any seasonal window useful, time-series even more useful.

Ground data collection: 15-30 on the ground photographs with handheld RGB camera of vegetation from shoulder height (of 1 x 1m quadrat frame placed on ground with oblique photo showing veg height). Canopy height measurements at the four corners and centre of all 1 x 1m plots. Description of vegetation cover including dominant species in all 1 x 1m plots. Stratified randomly across main land cover types. Notations of dominant species/communities found across images. If available, a field spectrometer or handheld NDVI sensor may be used to measure reflectance / NDVI of each quadrat (protocols available if needed). If time allows destructive harvests to build relationships between biovolume and biomass would be very valuable. **Critical**: take GPS records of plot locations!

Typical hardware ($$$): Any platform (multi-rotor or fixed wing) set up to carry a multi-band camera (e.g. Parrot Sequoia, MicaSense Red Edge, other options...note: not designed for modified NIR cameras). Widely adaptable.

Level 3 - Combining intensive drone monitoring (RGB or multispectral) with landscape-scale experiments and/or long term monitoring.

Opportunities for projects to be pitched across various subgroups for more detailed research projects. Get in touch if you are interested in participating in more detailed cross-site protocols. Most of these projects are ongoing amongst our core group or with select collaborators. If you have a larger project idea to pitch - let's do it! Though it may not be able to have network wide buy in until next summer (though we can pilot test it this summer?)

Potentials projects:
<u>1. Linking drones with phenocams to capture landscape-level phenology</u> - The Qikiqtaruk Yukon Coast site has data from 2017 and will be collecting additional data in 2018 (Isla Myers-Smith,

Jeff Kerby, Jakob Assmann, Andrew Cunliffe). The drone data collection can additionally be compared with Sentinel 2 data.

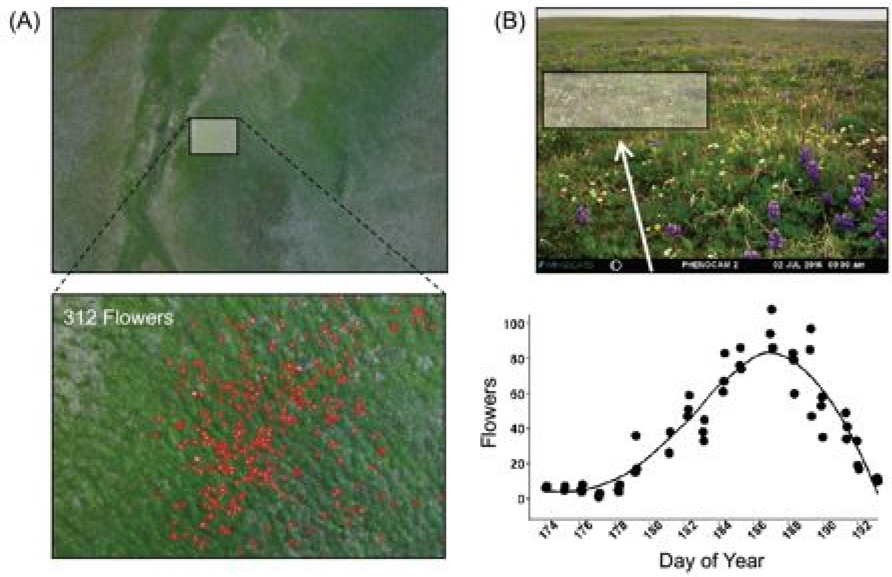


Figure 4. Phenocam and drone protocol data collection.

2. Highly accurate biovolume x multispectral measurements - The Qikiqtaruk Yukon Coast site has data from 2017 (Andrew Cunliffe, Isla Myers-Smith, Jeff Kerby) and will be collecting additional data in 2018, Trevor Lantz, Rob Fraser and Jurjen van der Sluijs collected biovolume and plot level canopy height data in 2017 with an existing protocol where multispectral data collection could be added.

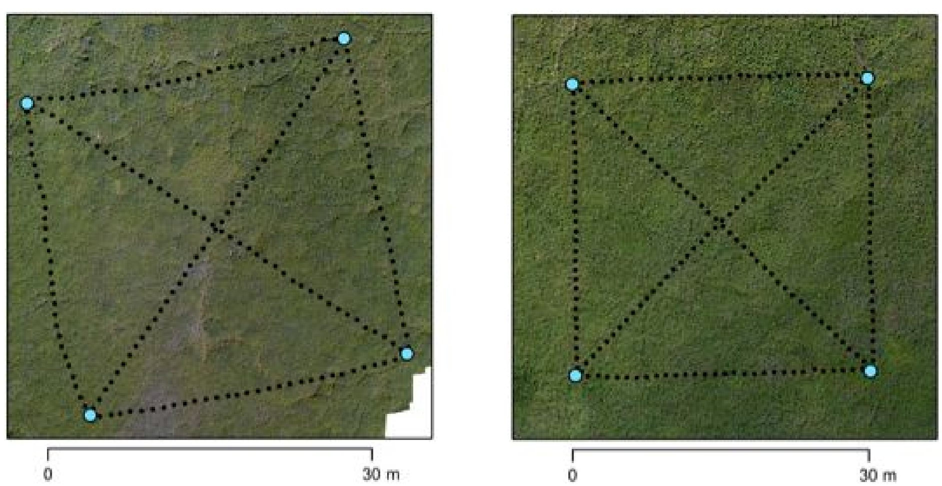
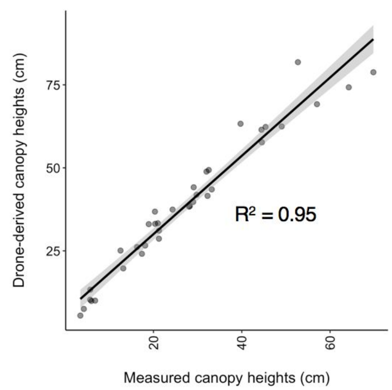


Figure 5. Canopy height and biovolume protocol.

<u>3. Biovolume before and after destructive harvests</u> - The Qikiqtaruk Yukon Coast site has data from 2016 that is being analysed by Andrew Cunliffe.



Cunliffe et al. in prep.

Figure 6. Relationships between measured canopy height and drone-derived canopy height.

<u>4.</u> Capturing the landscape context of long-term ecological monitoring - We have drone data at the long-term monitoring plots on Qikiqtaruk from 2015-2017 and will be collecting addition data using common protocols on Qikiqtaruk and at Alexandra Fjord on Ellesmere Island in 2018.

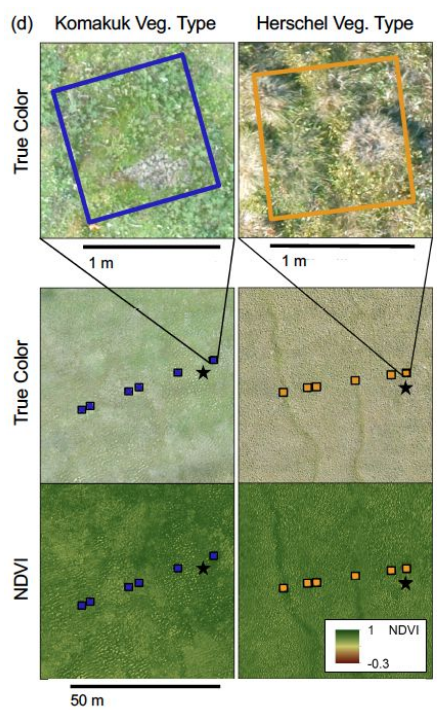


Figure 7. Capturing the landscape-context with RGB and or multispectral data collection of long-term monitoring.

Other landscape manipulations, paired vegetation monitoring with herbivore exclosure or herbivore and herbivore sign monitoring.