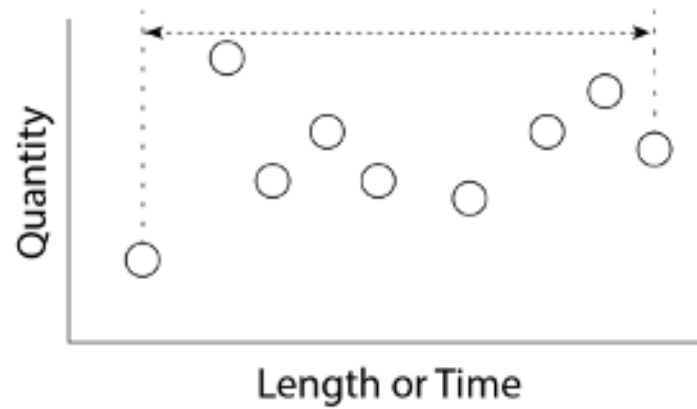
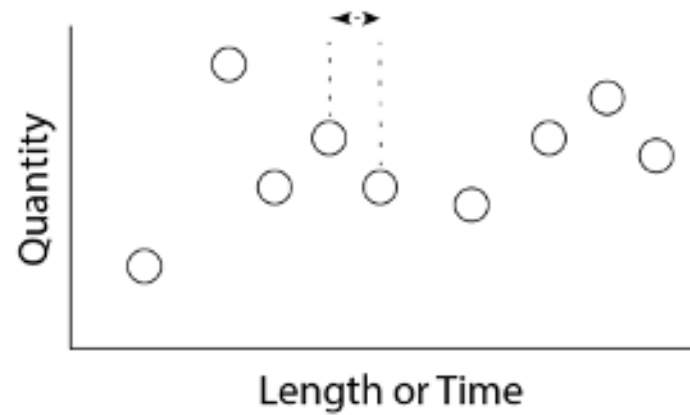




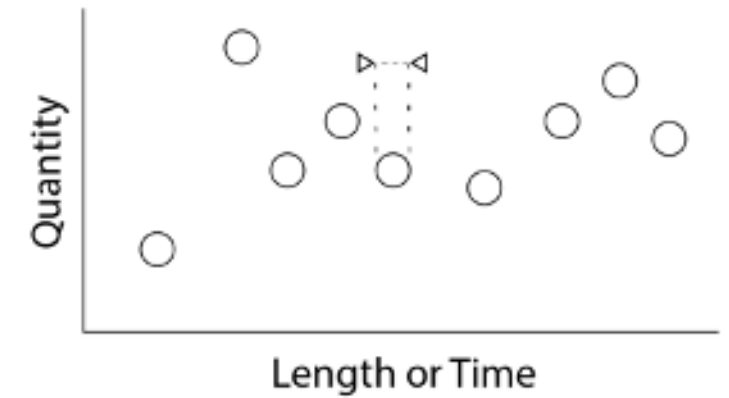
Extent



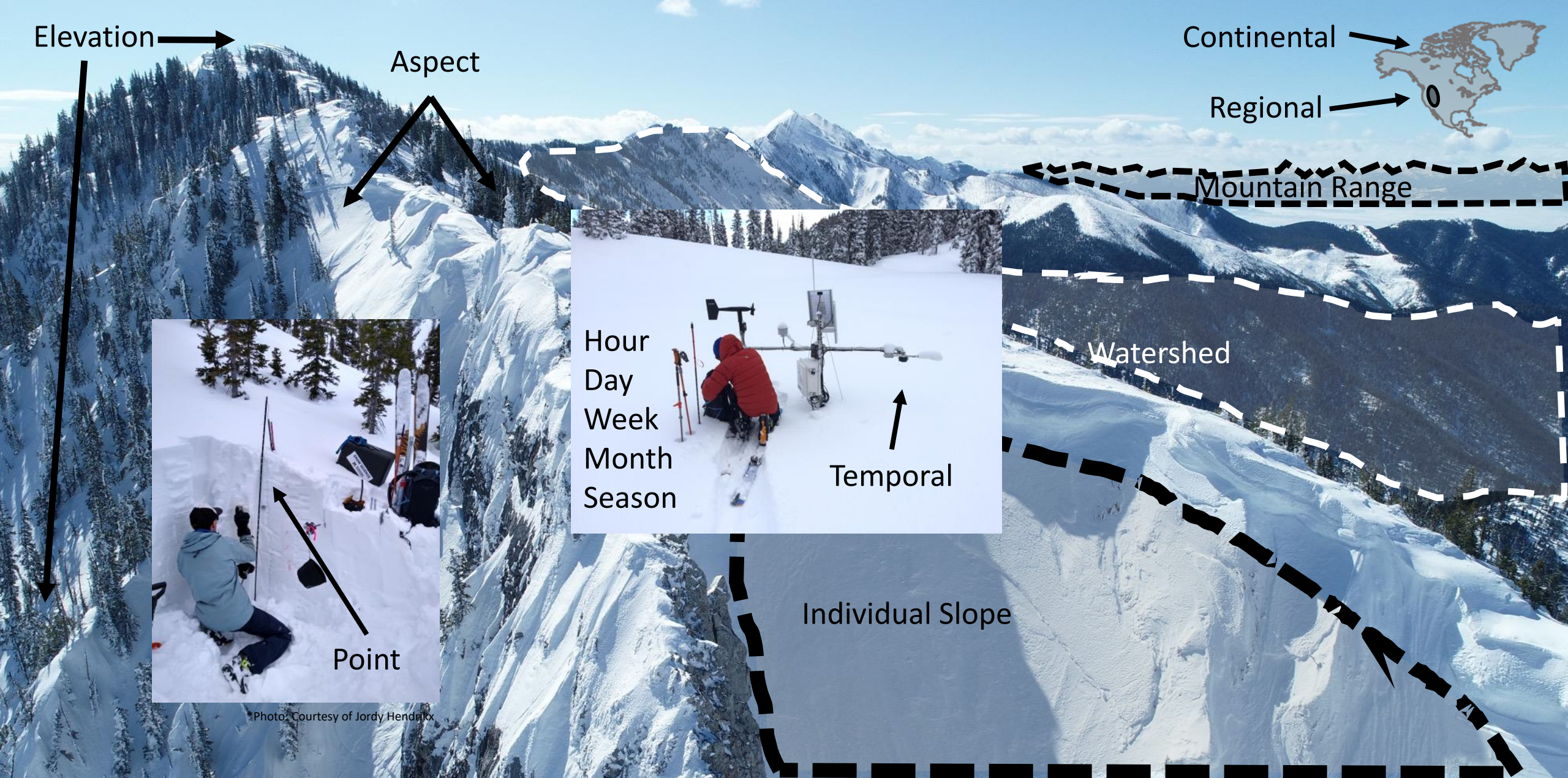
Resolution



Integration



adapted from Blöschl and Sivapalan

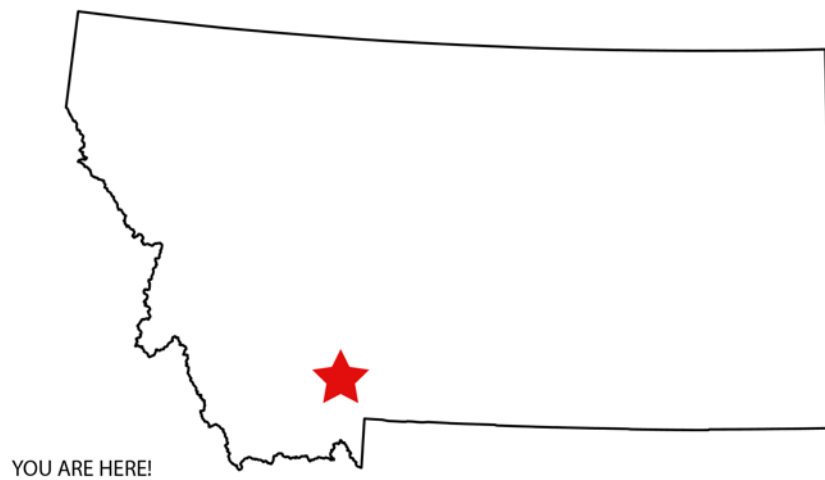


Slide adapted from Zach Miller

IN-SCALING SNOW MEASUREMENTS IN MOUNTAINOUS TERRAIN

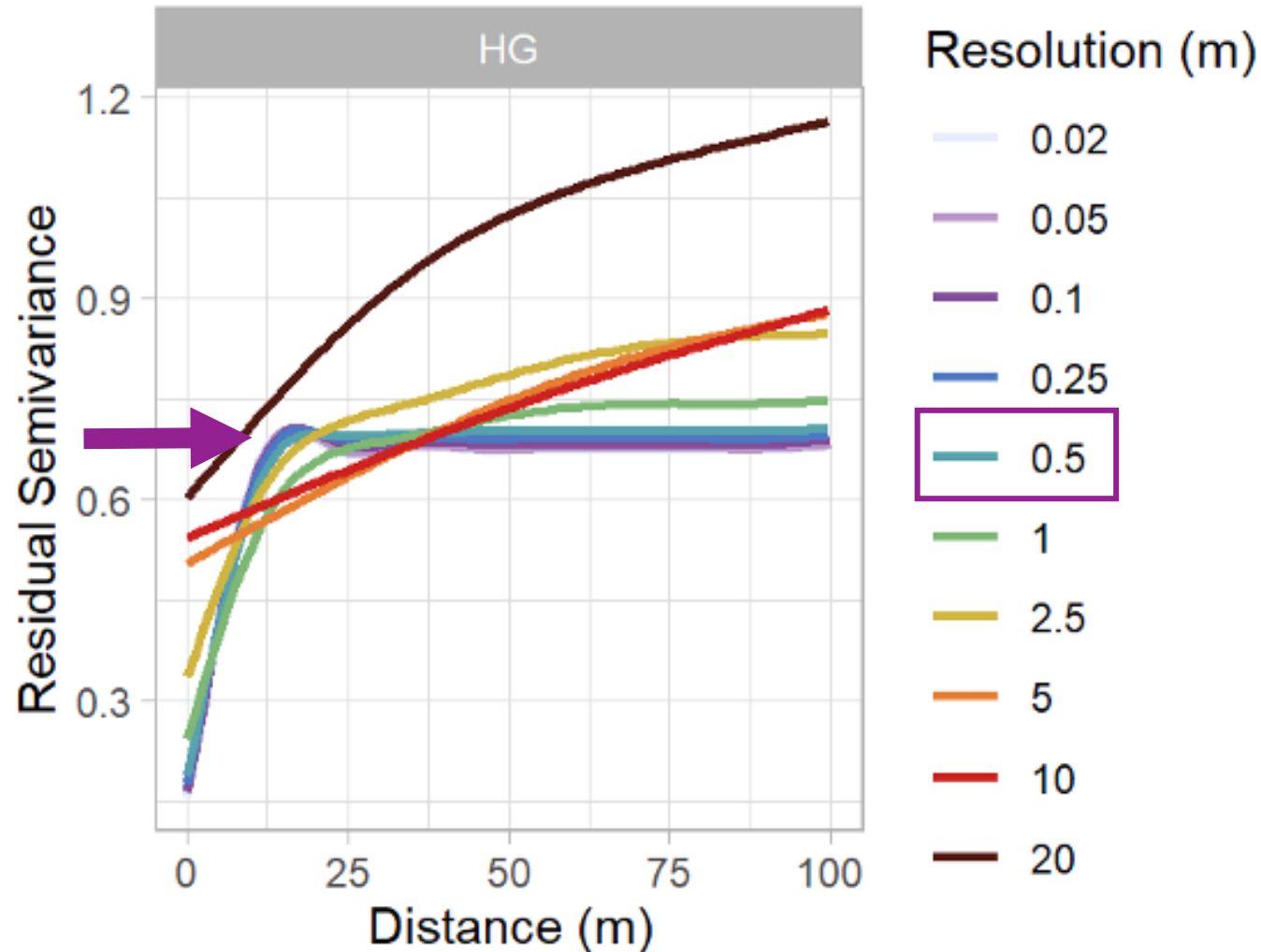
Eric Sproles
Dept of Earth Sciences





Zach Miller - USGS

What is the correct spatial resolution to measure snow depth in steep terrain?



The Cryosphere, 16, 4907–4930, 2022
<https://doi.org/10.5194/tc-16-4907-2022>
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The Cryosphere
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Assessing the seasonal evolution of snow depth spatial variability and scaling in complex mountain terrain

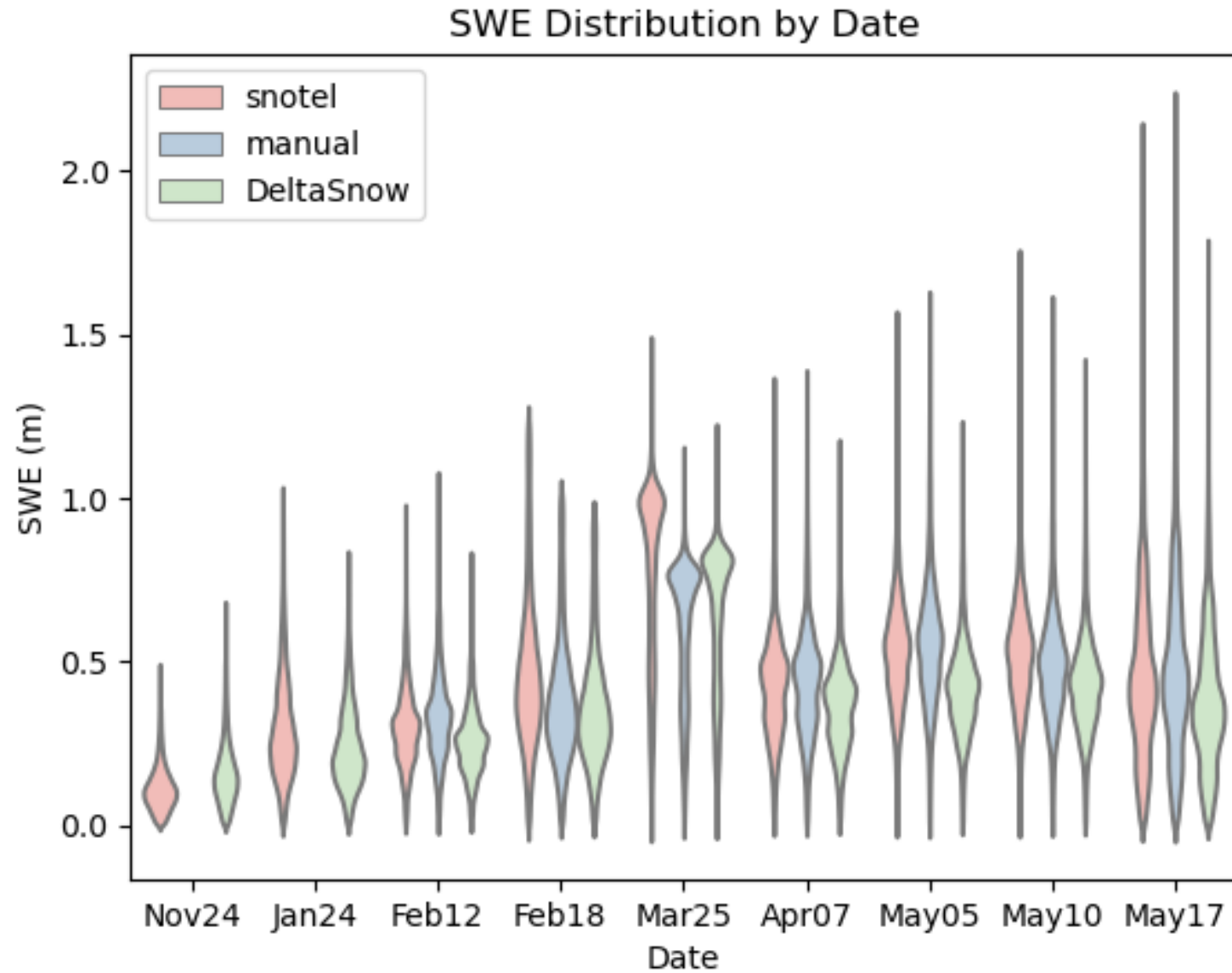
Zachary S. Miller¹, Erich H. Peitzsch¹, Eric A. Sproles², Karl W. Birkeland³, and Ross T. Palomaki²

¹U.S. Geological Survey Northern Rocky Mountain Science Center, West Glacier, MT 59936, USA

²Geospatial Snow, Water, and Ice Resources Lab, Department of Earth Sciences, Montana State University, Bozeman, MT 59717, USA

³USDA Forest Service National Avalanche Center, Bozeman, MT 59771, USA

How much water is held this snowpack?



Maddie Beck

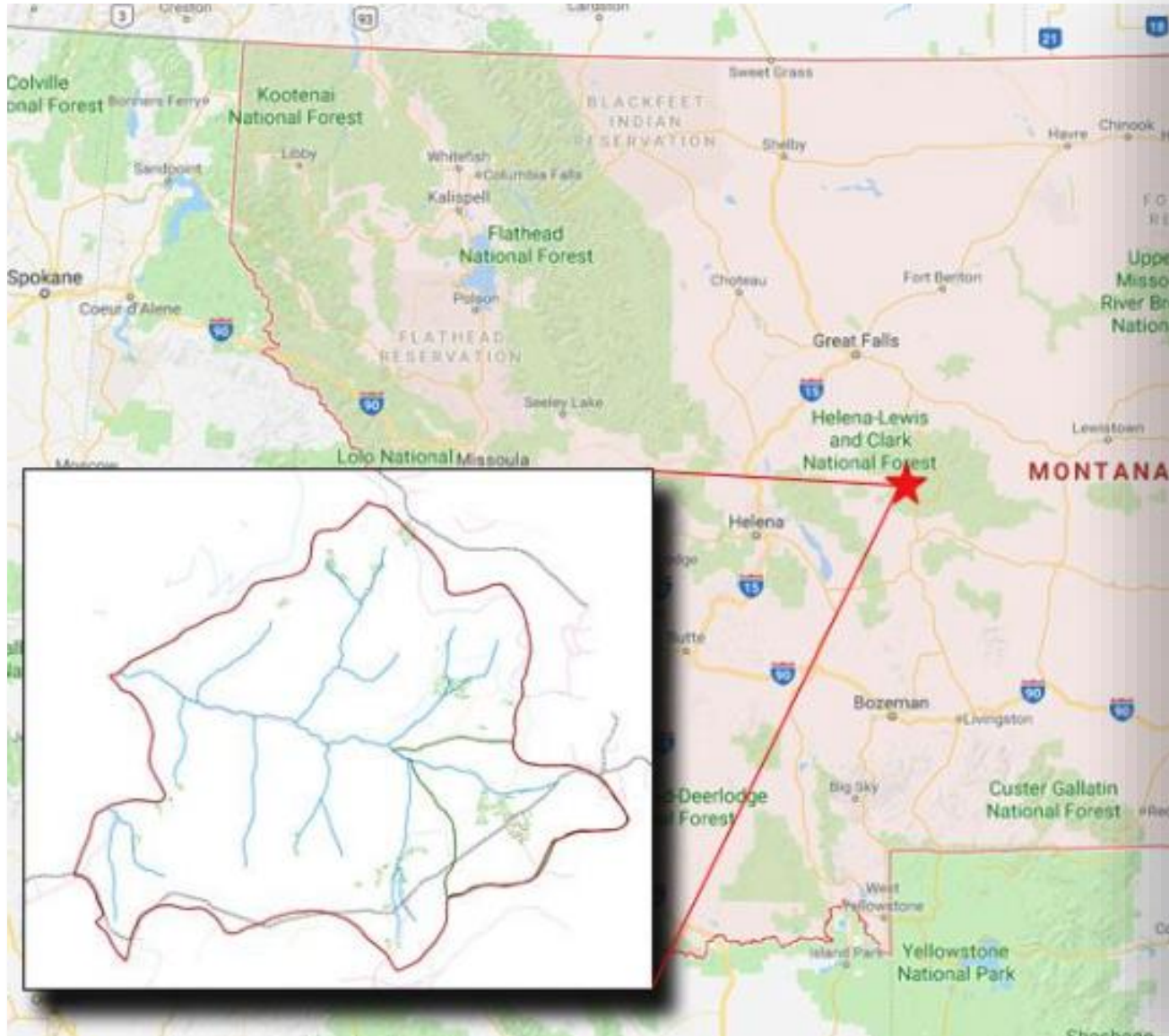
UAV Gamma ray and LiDAR



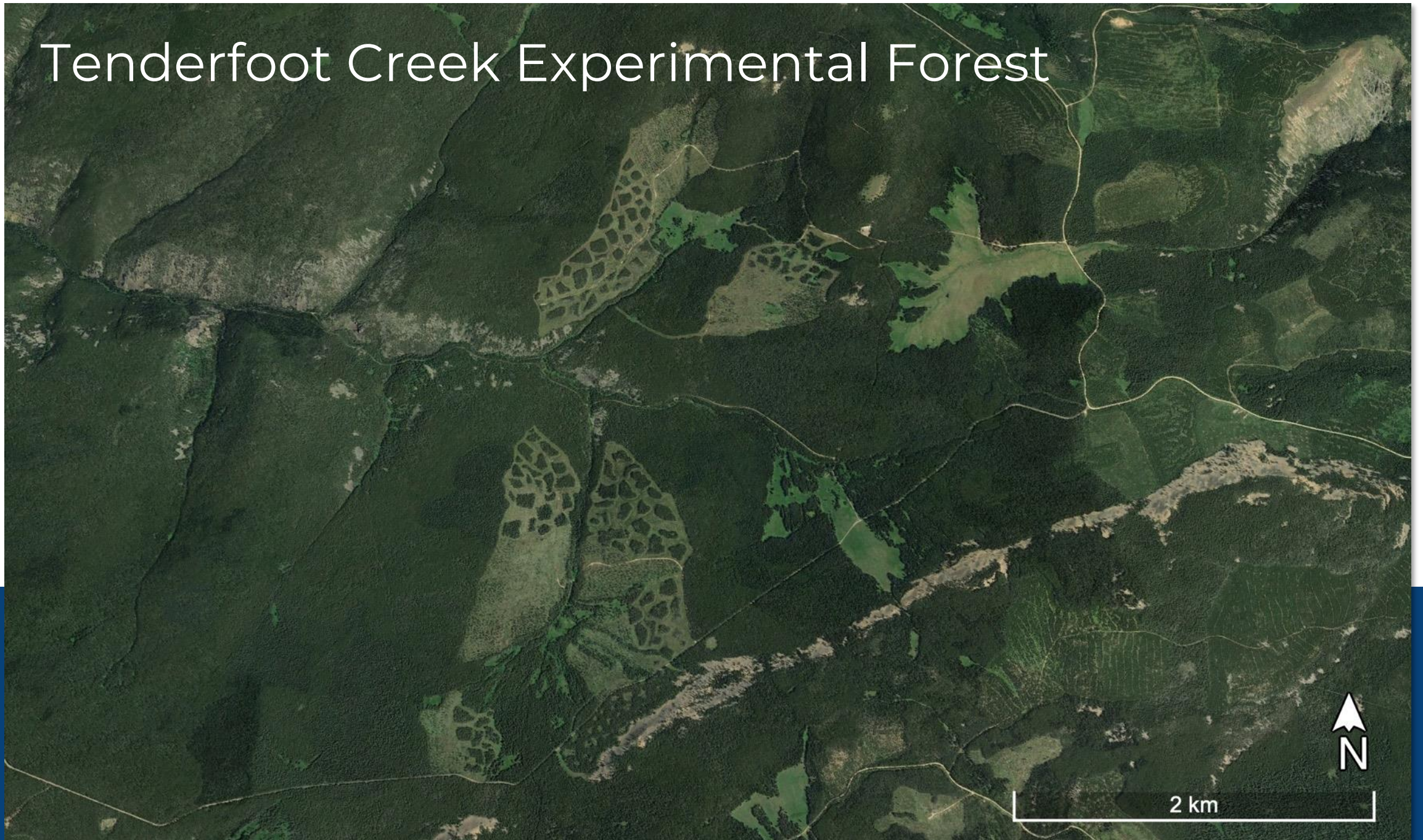
— BUREAU OF —
RECLAMATION

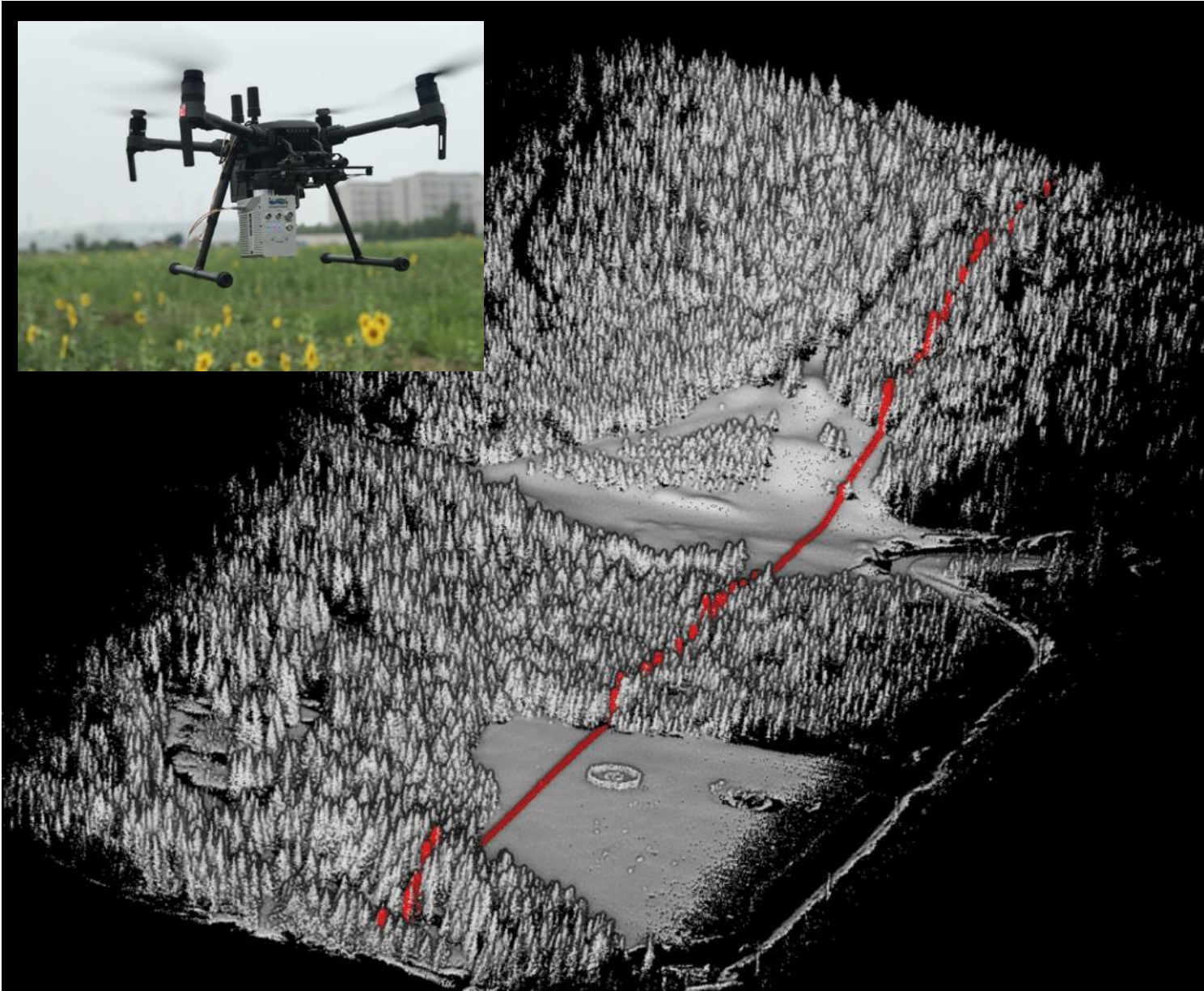
Sam Tuttle – Syracuse University
Eunsang Cho – Texas State University

Tim Covino - Montana State University
Siwei He – Montana State University



Tenderfoot Creek Experimental Forest





High Spatial Resolution

Snow depth across landcovers



High Spatial Resolution

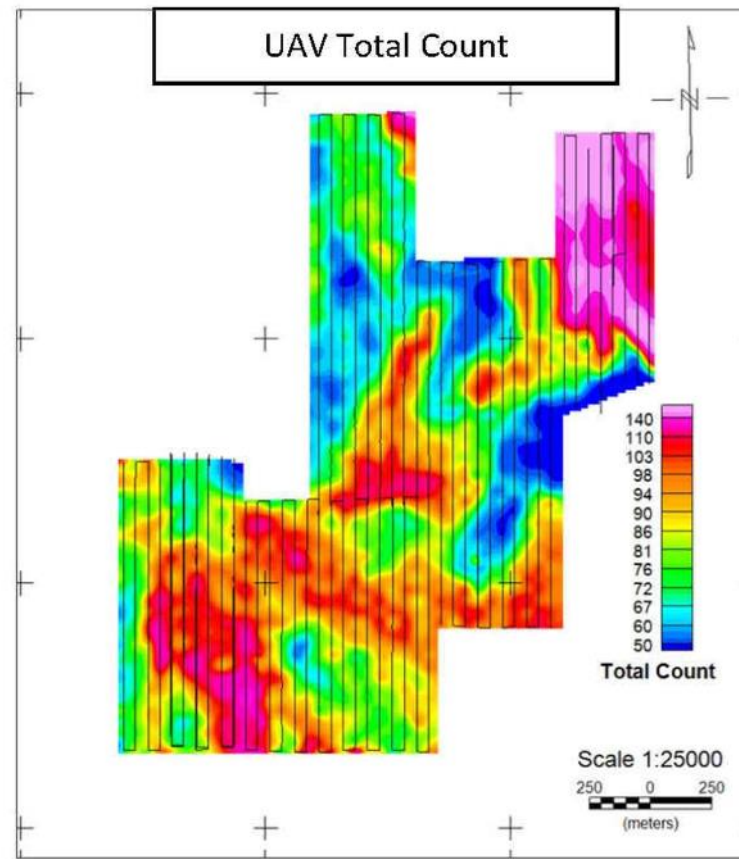
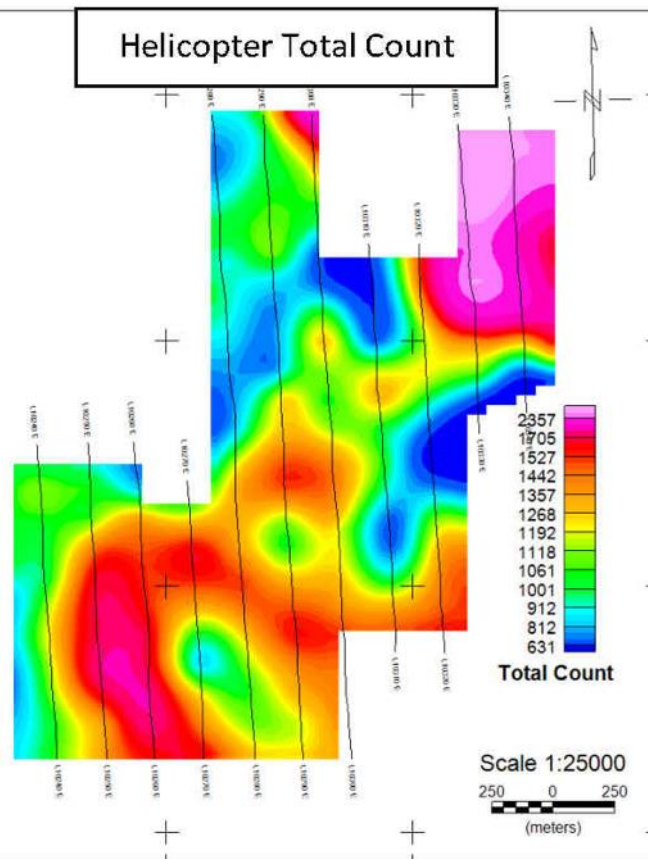
Snow water across landcovers



mwhgeo.com



kromek.com





High Temporal Resolution

Two Co-located Cosmic Ray

Neutron Sensors



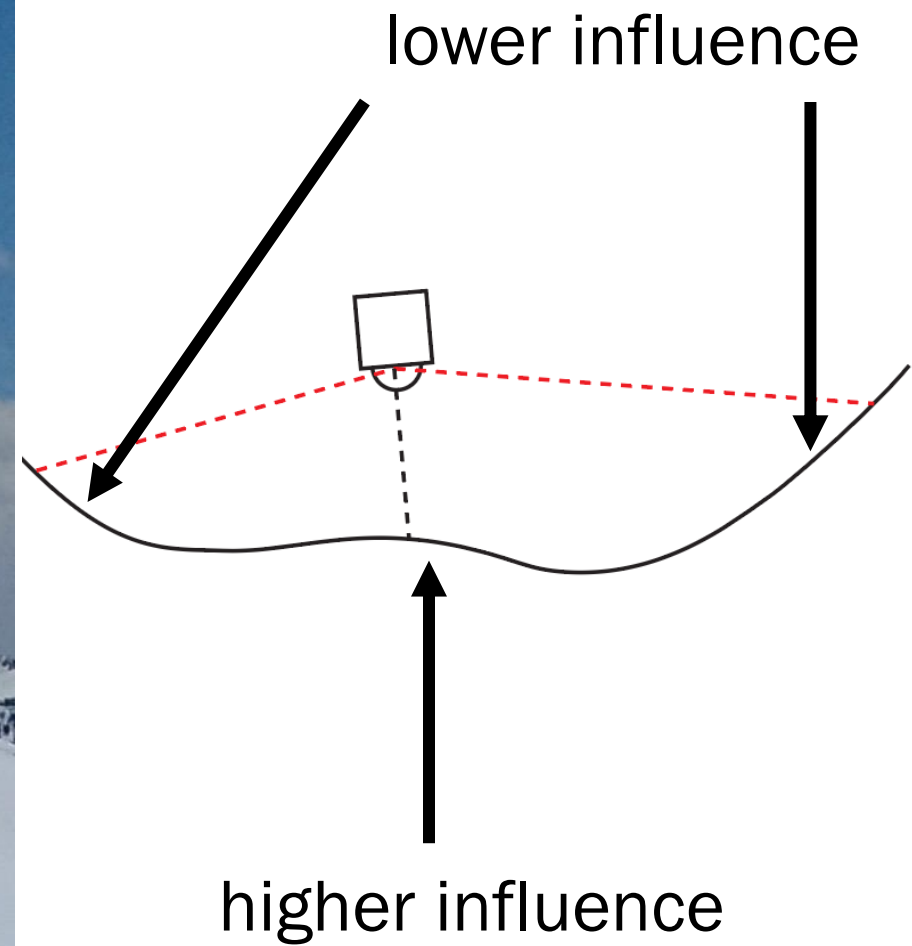
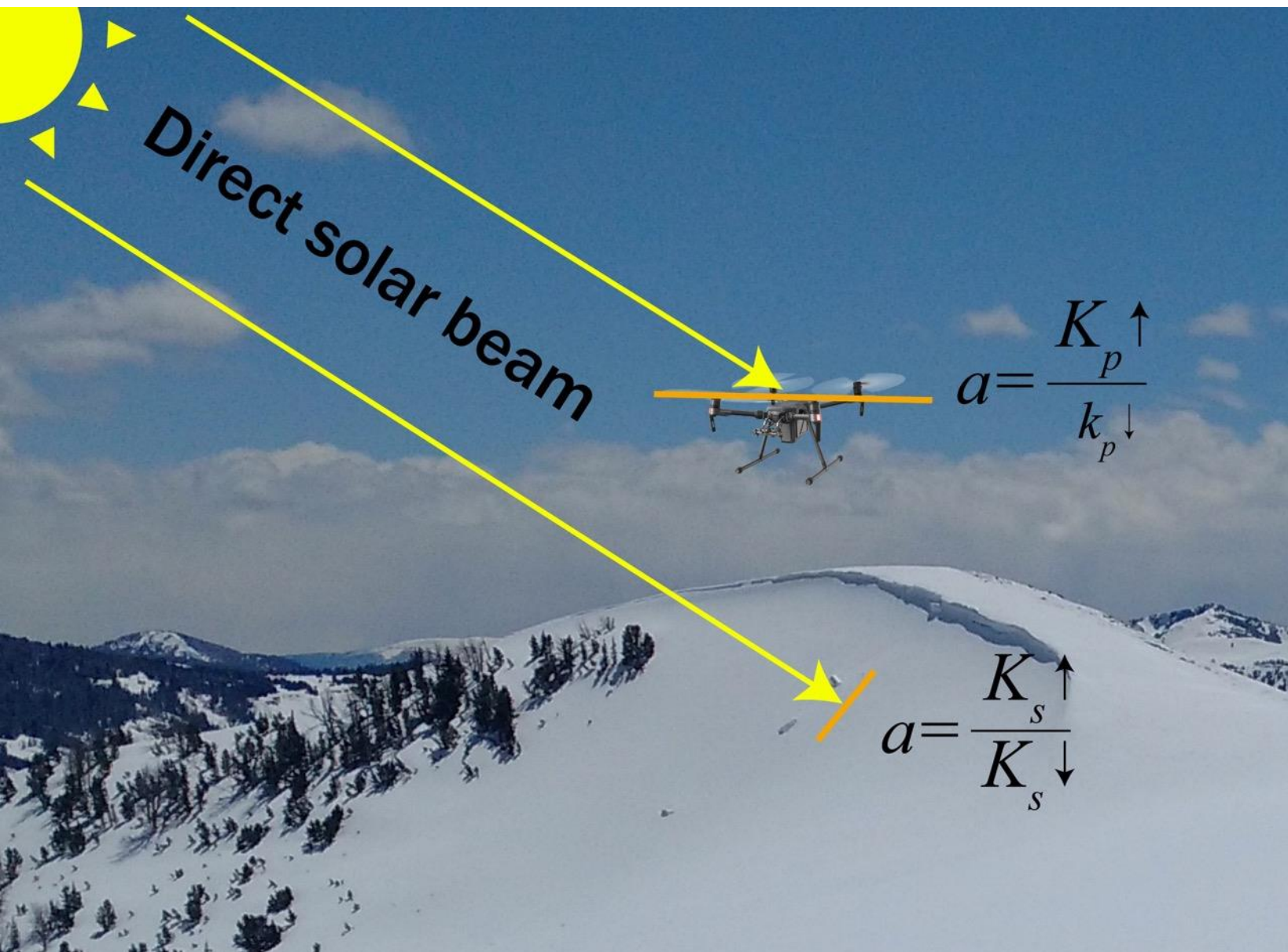
HydroInnova

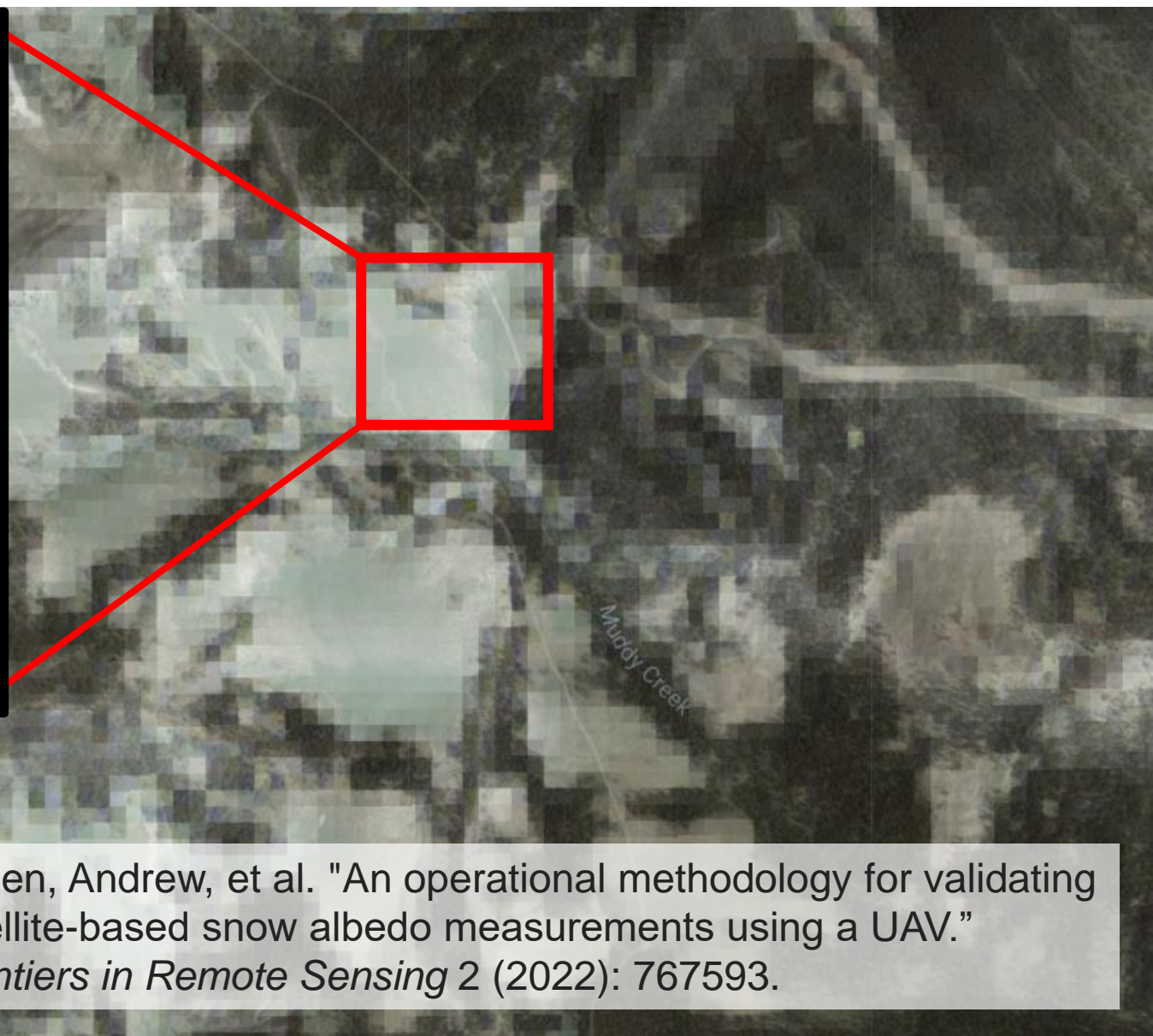
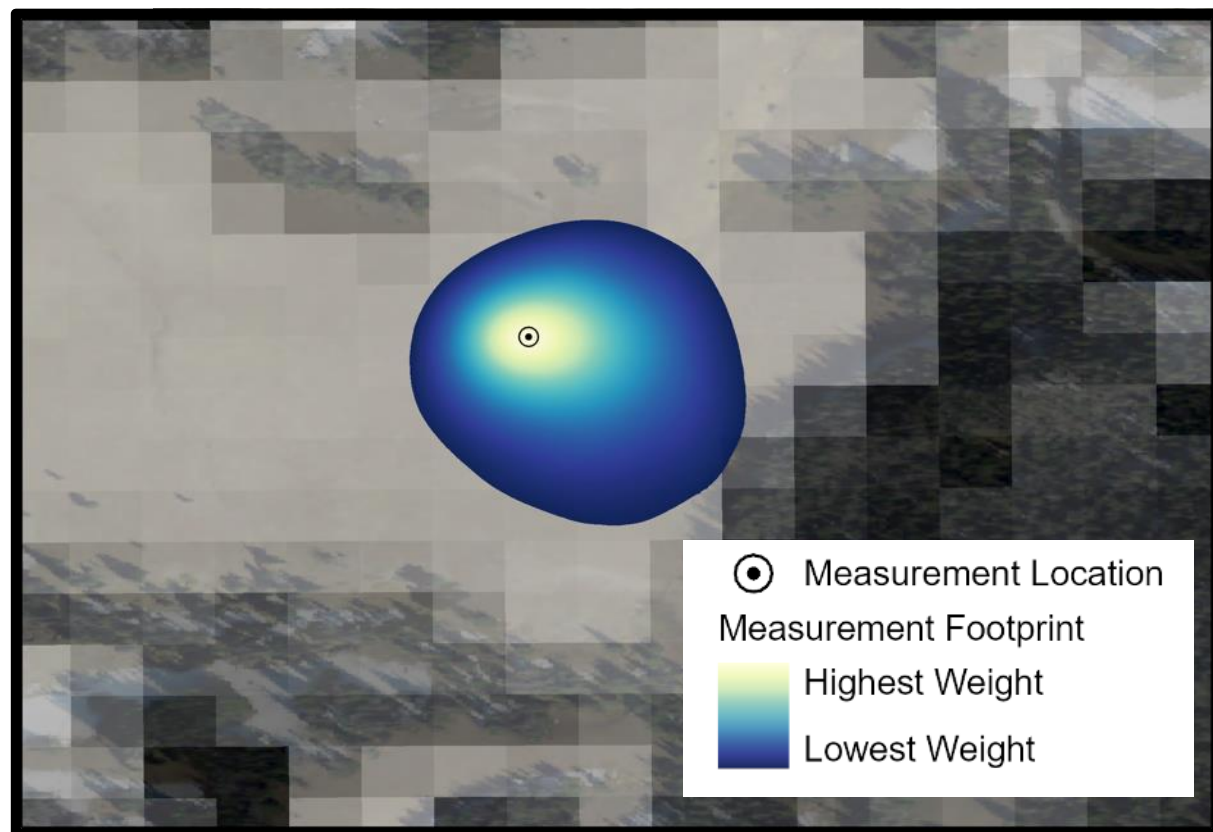
SNOW ALBEDO



Andrew Mullen
Woodwell Climate Research Center

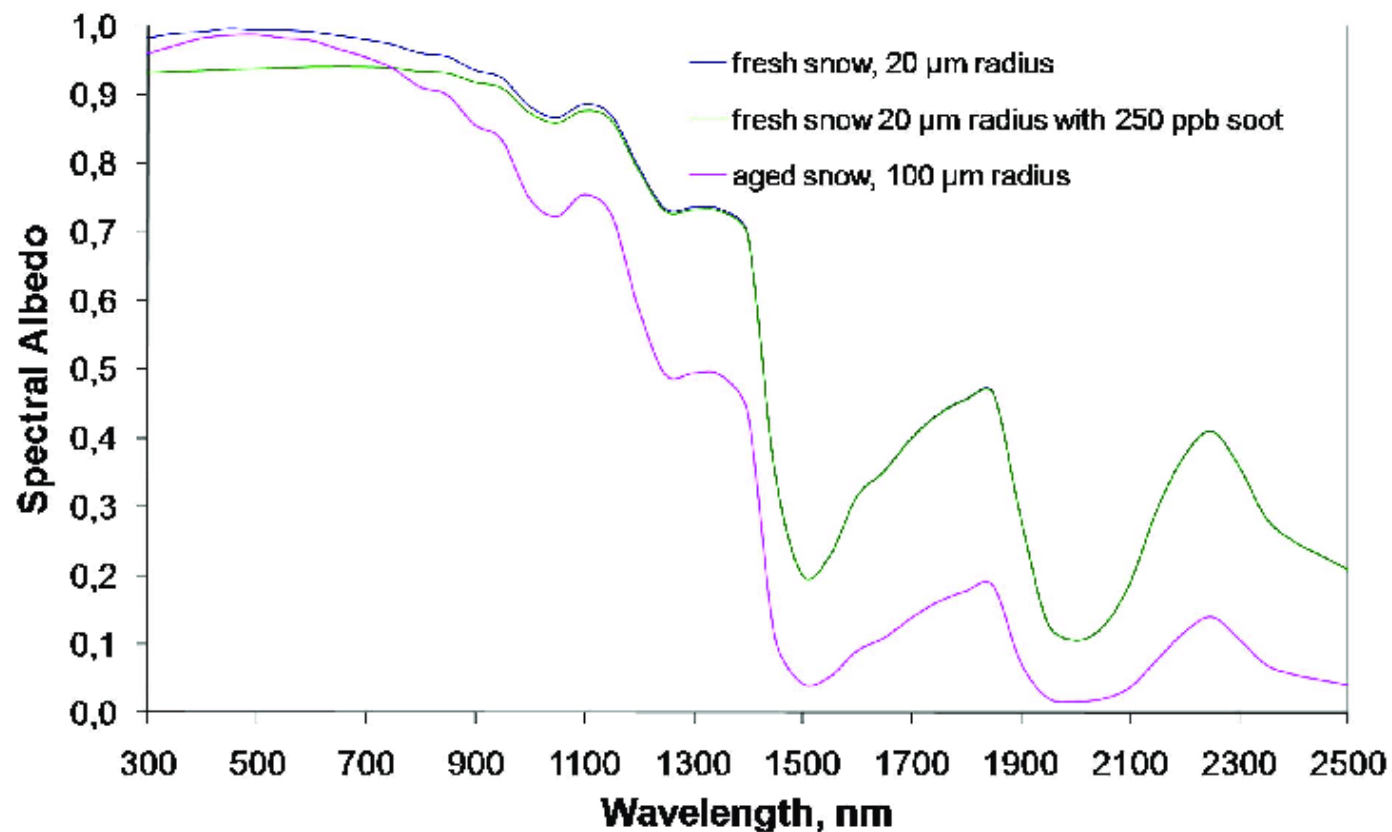




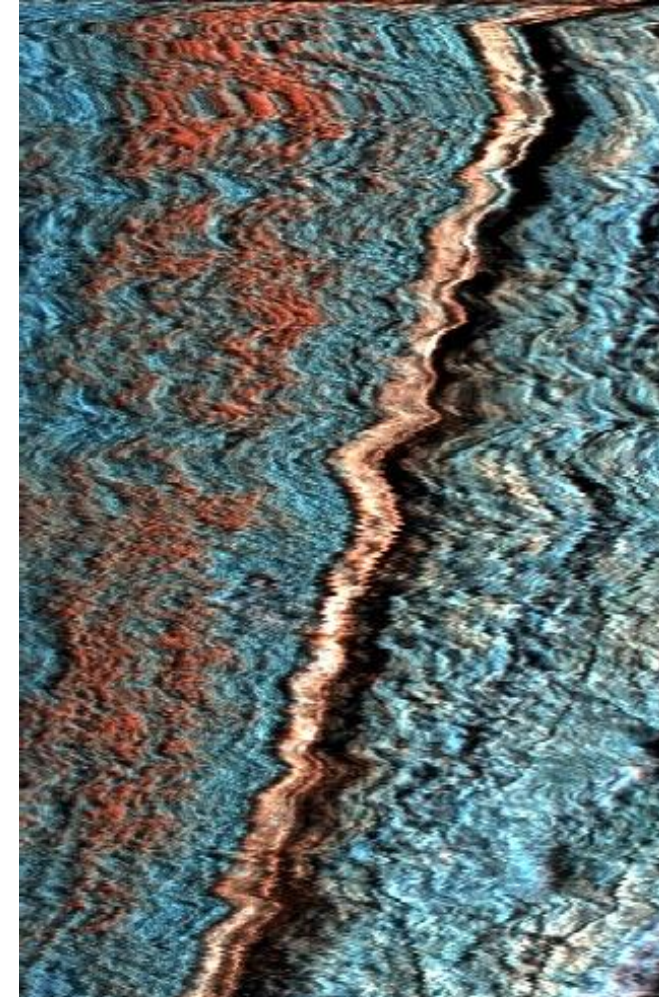


Mullen, Andrew, et al. "An operational methodology for validating satellite-based snow albedo measurements using a UAV." *Frontiers in Remote Sensing* 2 (2022): 767593.

HYERSPECTRAL IMAGING



Venice Bayard | Dr. Joe Shaw
Dr. Anna Schweiger
Shannon Hamp
Duilio Fonseca



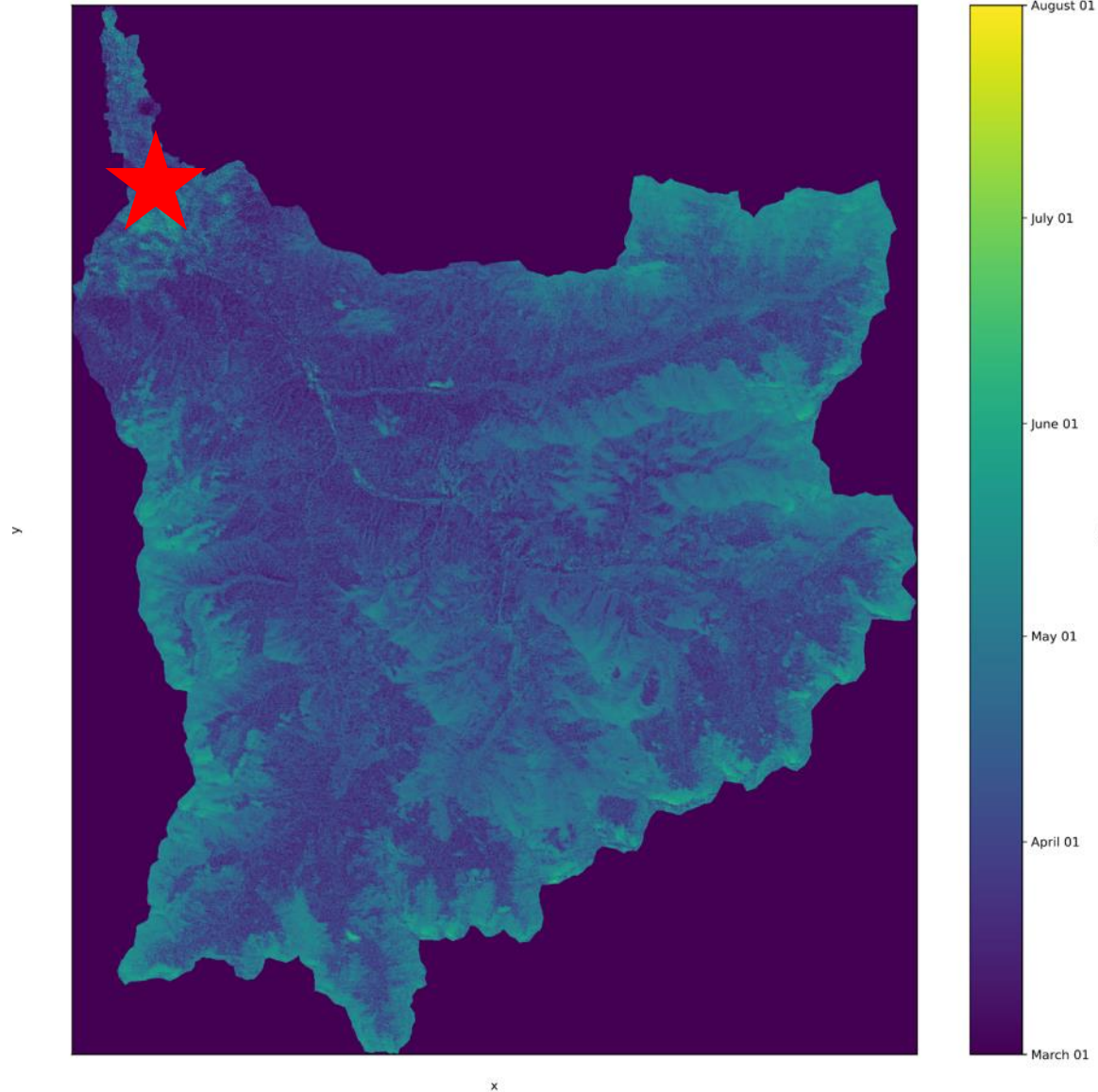
INTEGRATING SCALES

Sentinel 1 and Stable Isotopes

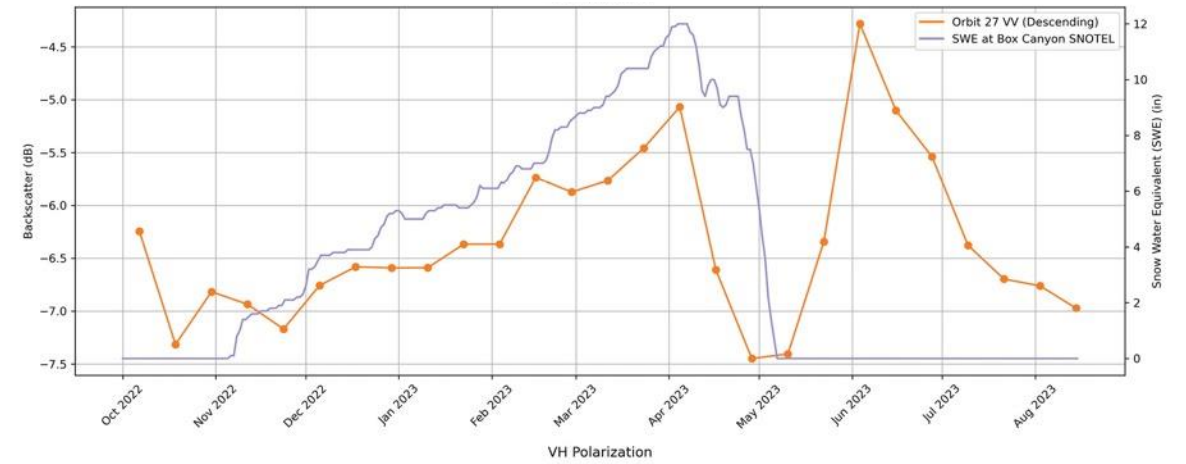


Eliza
Rickenbaugh

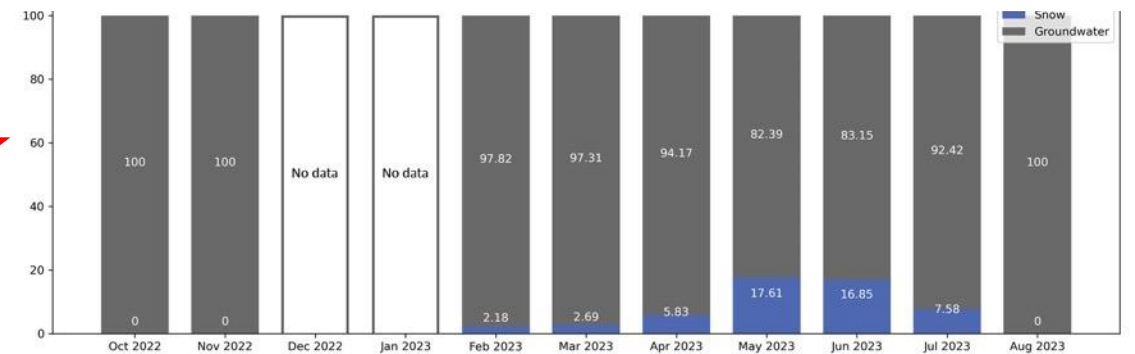
Median DOY Runoff Onset (2015 – 2022)



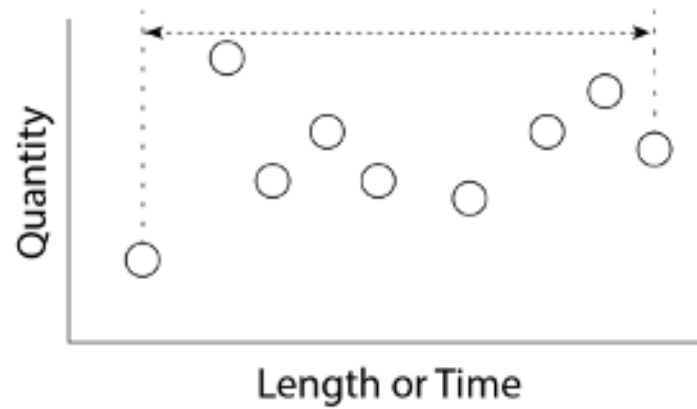
Sentinel 1 and SWE (2022)



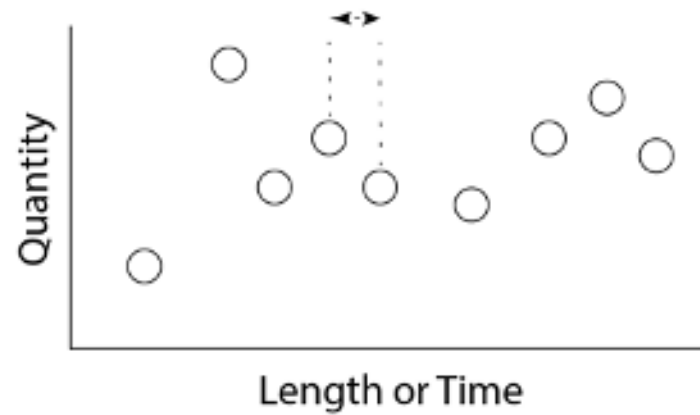
Fraction of Streamwater composition



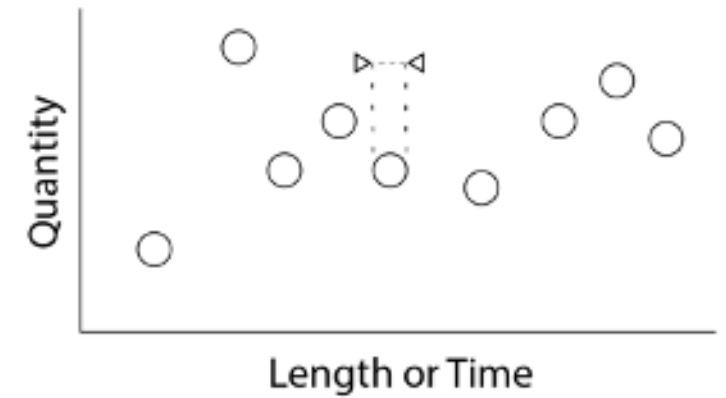
Extent



Resolution



Integration



adapted from Blöschl and Sivapalan



MONTANA
STATE UNIVERSITY

GEOSWIRL

Geospatial Snow, Water, & Ice Resources Lab