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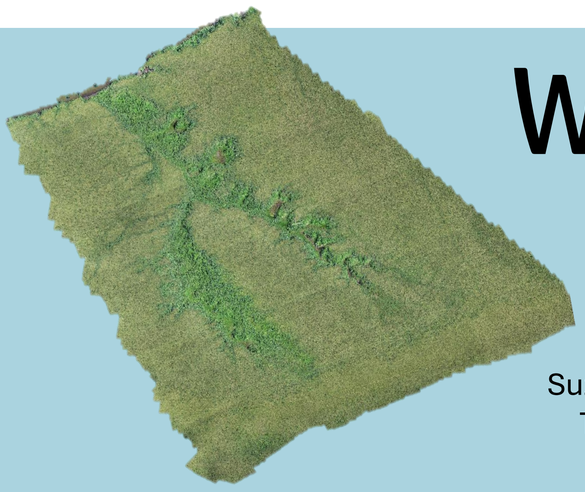


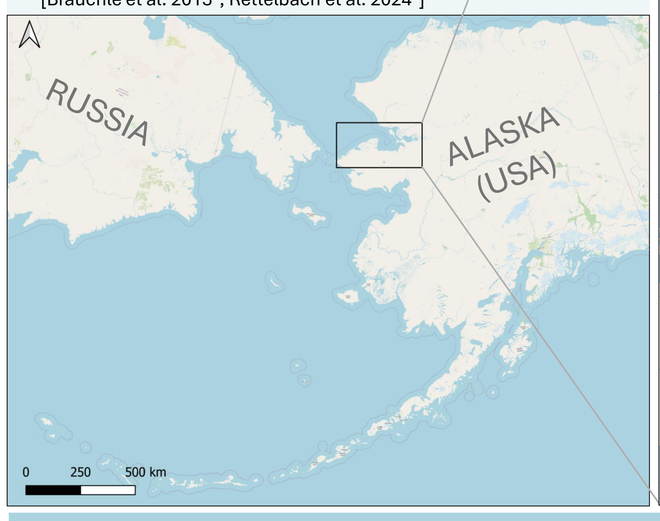
Water down the gully

Using multi-source derived DSMs to monitor thermo-erosional gully evolution

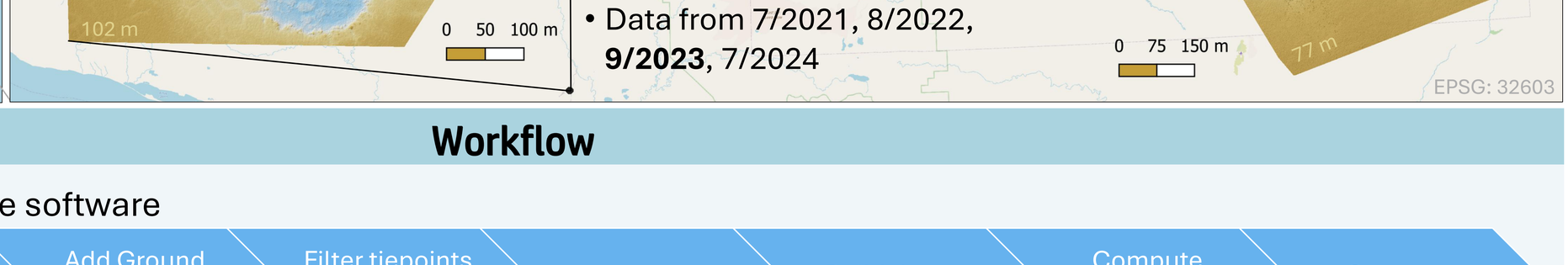
Suzann Ohl[1,2], Cornelia Inauen[1,2], Sophia Barth[1], Mackenzie Baysinger[1], Caitlynn Hanna[3], Benjamin M. Jones[4], Tillmann Lübker[1], Anne Morgenstern[1], Ingmar Nitze[1], Tabea Rettelbach[5], Alexandra Runge[6], Carl Stadie[1,7], Aleksandra Veremeeva[1], Guido Grosse[1,2]

Background

- Rapidly warming Arctic
  → thermo-erosional gullies develop more often and expand, influencing local hydrology and releasing greenhouse gases
  [Chartrand et al. 2023[1], Rowland 2023[2]]
- Multiple expeditions to Northwest Alaska, data collection with UAV- and airplane-based surveys
  [Brauchle et al. 2015[3], Rettelbach et al. 2024[4]]



Study Area – Northwest Alaska



Workflow

1. Processing in Agisoft metashape software

Add photos (incl. GPS RTK base data) → Align photos → Add Ground Control Points (GCPs) → Filter tiepoints [Mohren & Schulze 2024[6]] → GCP fitting → Build dense cloud → Compute Digital Surface Model (DSM) → Compute Orthomosaic

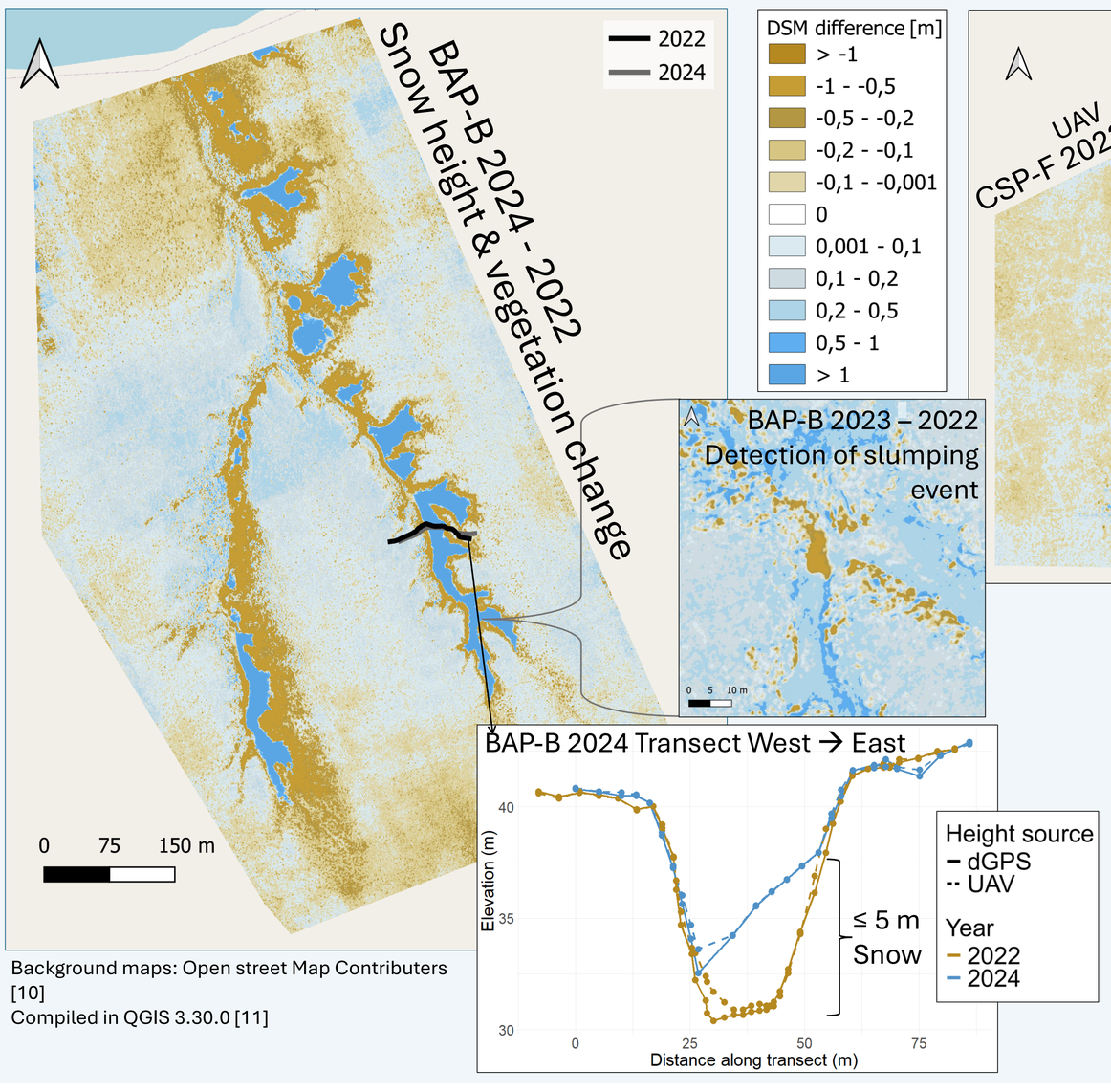
2. Processing with Python script

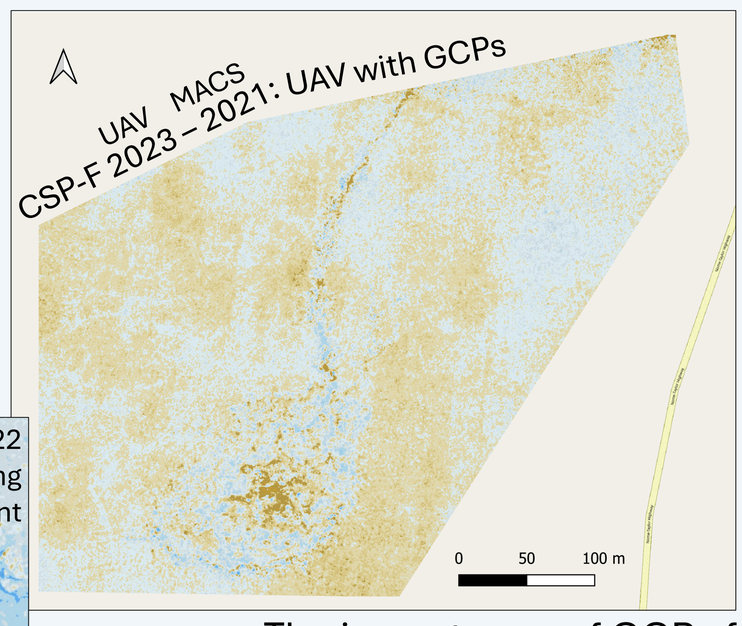
Preprocessing → AROSICS → xDEM (ICP, Vertical, NuthKaab)

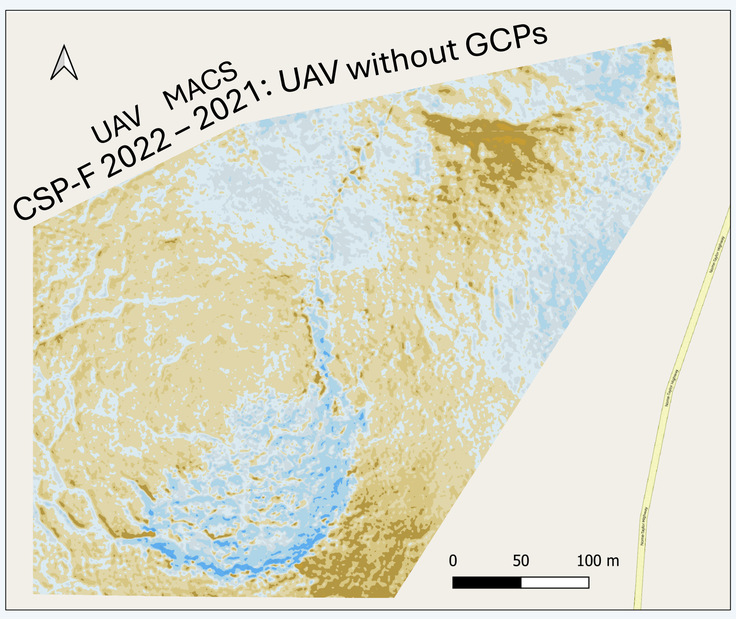
AROSICS: detection and correction of sub-pixel misalignments [Scheffler et al. 2017[7]], used for horizontal co-registration based on optical UAV data

xDEM: Python package for the analysis of elevation data [Besl & McKay 1992[8], xDEM contributors 2024[9]], used for 3D co-registration based on elevation data

Results – DSM differences







The importance of GCPs for successful co-registration: residuals of dome effect in 2022 UAV data without GCPs

Background maps: Open street Map Contributers [10]
Compiled in QGIS 3.30.0 [11]

Take home messages

- UAV-derived DSMs provide reliable elevation data even in difficult tundra settings
- To detect small-scale events (i.e. subsidence) longer time series are needed, as vegetation and snow can blur signal
- Good mission planning, a large number of ground control points and careful co-registration are vital

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Abstract, References and further Results: