UNIVERSITY OF GOTHENBURG

Multitemporal UAV LiDAR detects seasonal heave and subsidence on palsas

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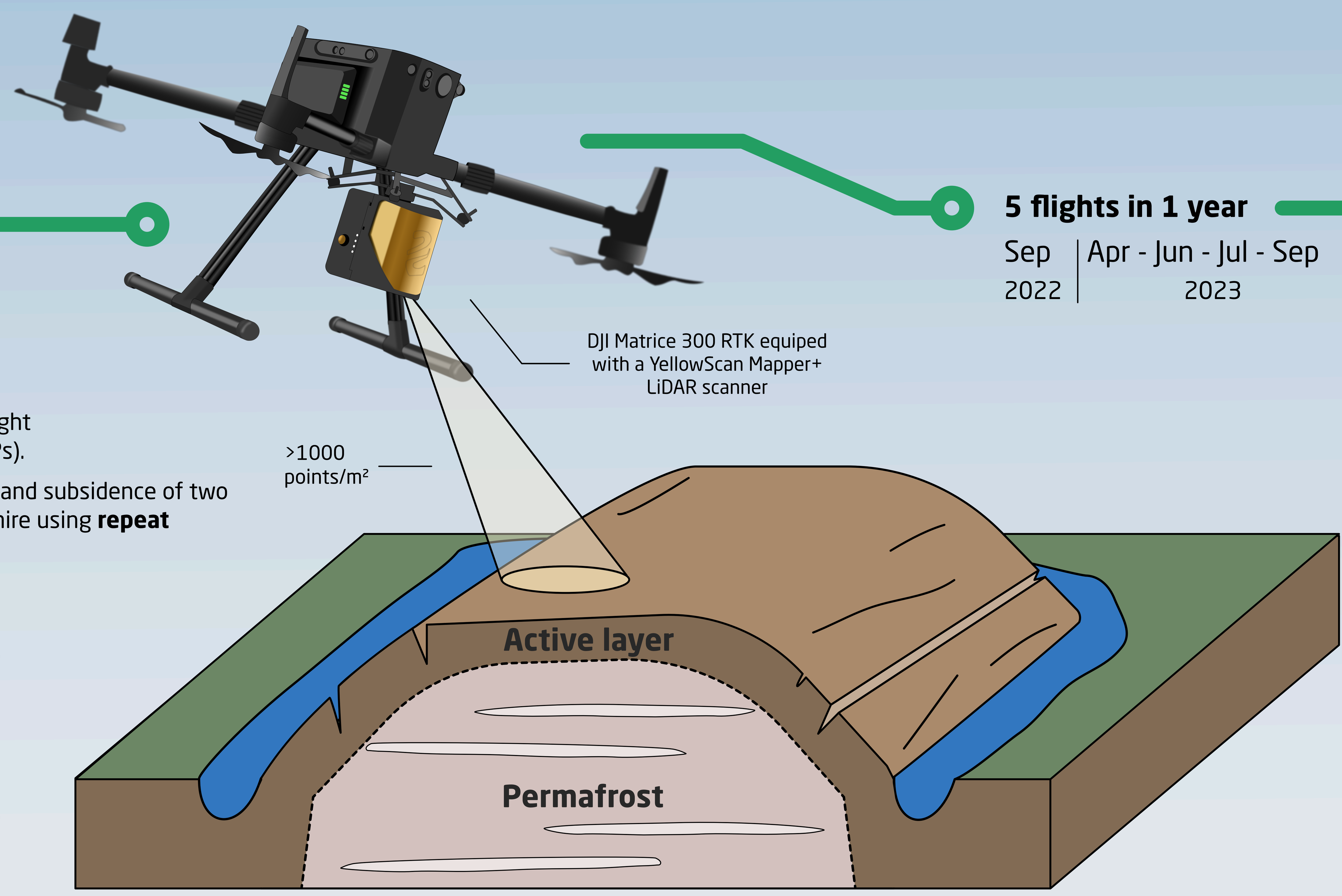
Introduction

The degradation of **palsas** - peat mounds with a permafrost core - threatens subarctic landscapes and ecosystems. While the monitoring of palsa mires has increased, there are no quantitative measurements of their **intra-annual heave and subsidence** patterns.

UAV LiDAR has advantages over photogrammetry, such as vegetation penetration, independence from light conditions and no need for ground control points (GCPs).

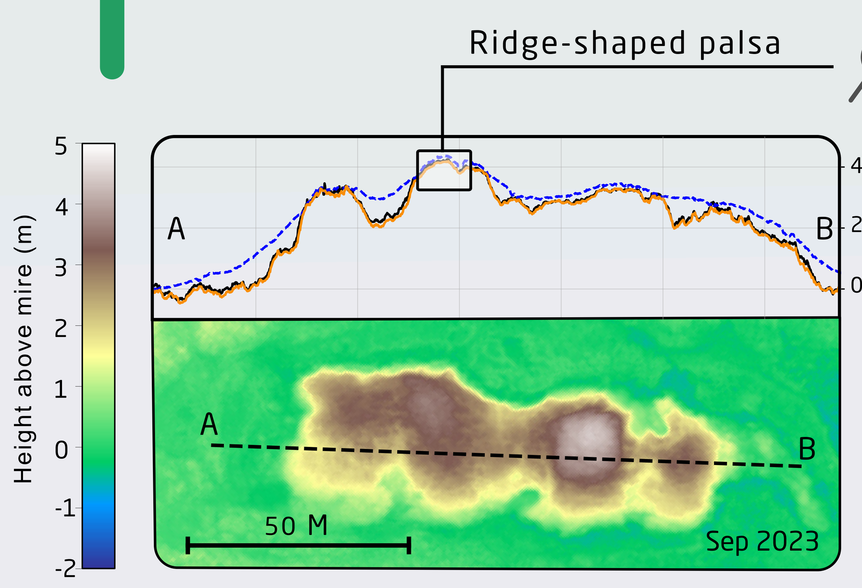
Our aim is to quantify the inter-annual vertical heave and subsidence of two 4-5 m tall palsas in Sweden's largest coherent palsa mire using **repeat measurements of UAV LiDAR** data.

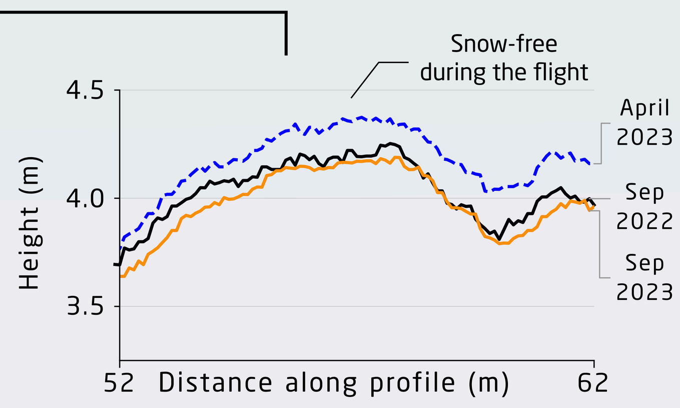


5 flights in 1 year

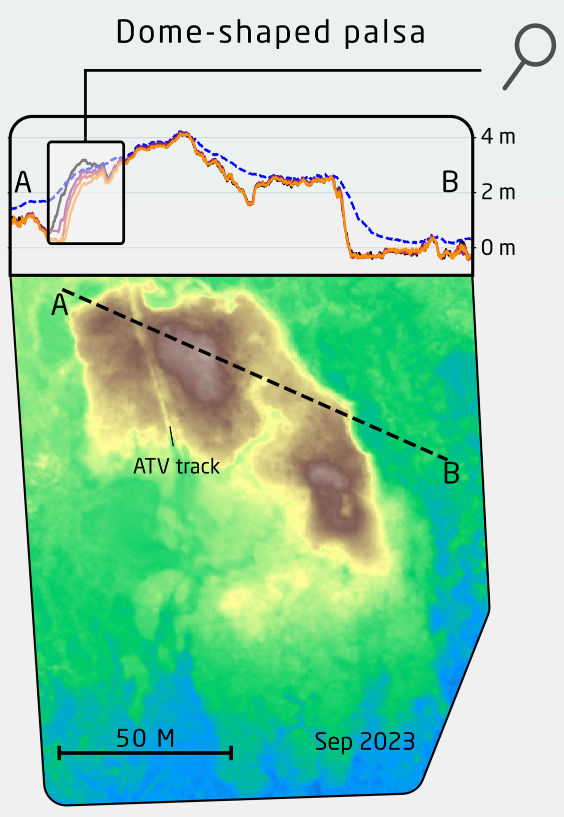
Sep 2022 | Apr - Jun - Jul - Sep 2023

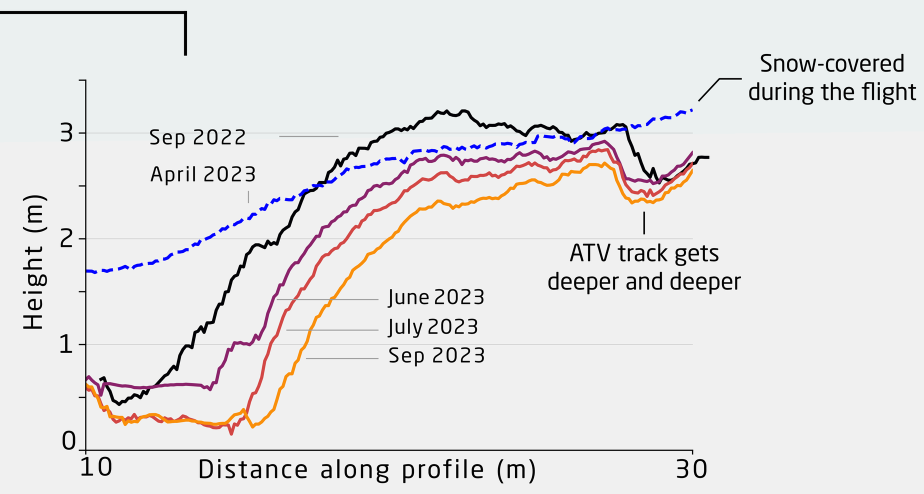
Surface Profiles





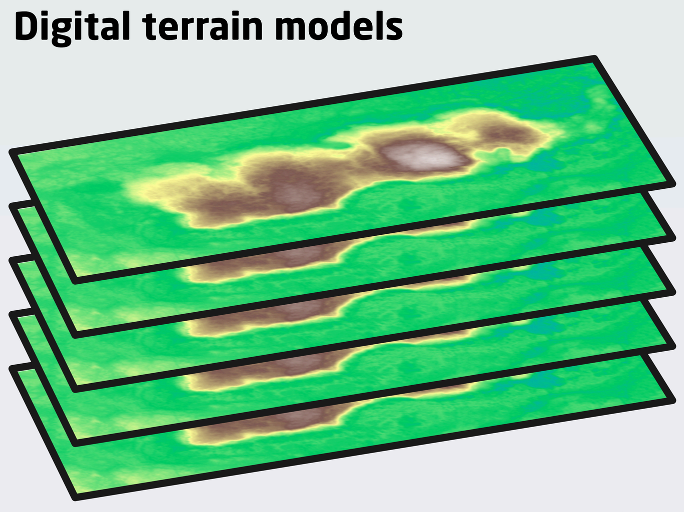
Most of the palsa was snow-free in April, so we **compare the ground surfaces** directly

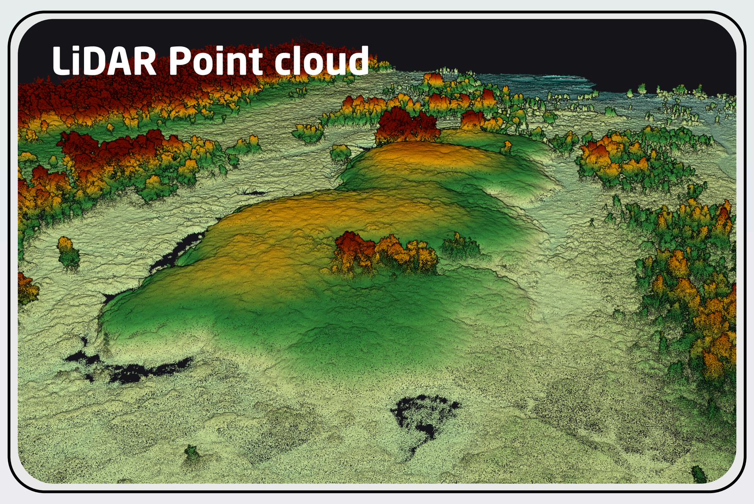




Lateral degradation: 0.5 - 2.0 m subsidence over 300 m² (see in '*Change Detection*')

Processing

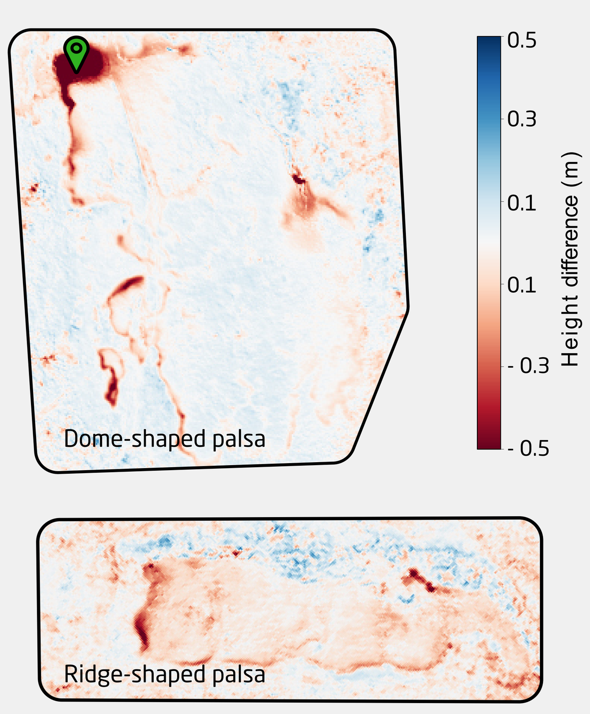


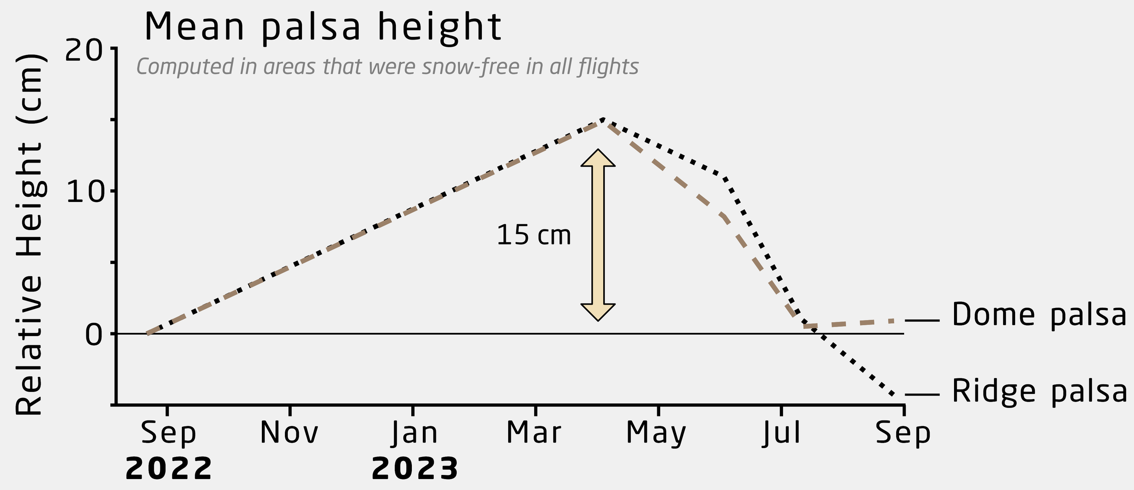


- Correct the GPS data
- Classify ground points
- Create 0.10 m DTMs

Change Detection

Between Sep 2022 and Sep 2023





15 cm frost heave. This cannot be explained by thermal expansion alone
→ Seasonal segragation ice?

Highest subsidence rate between June and July

Conclusions

- UAV LIDAR scanning can capture seasonal terrain changes on palsas.
- We observed seasonal heave and subsidence of on average of 15 cm on two large palsas in northern Sweden.
- We can follow the progression of lateral degradation on a seasonal scale, which was not limited to the summer months.

Ongoing follow-up work

- Annual UAV LiDAR flights
- Monitoring of ground temperatures and ALT
- Geophysics of the palsas' interior
- Core sampling of the entire palsa

FORMAS

Abstract

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Profile