

Small scale spatial variability of bare-ice albedo at Jamtalferner, Austria

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AS2.10 Atmosphere-Cryosphere interaction with focus on transport, deposition and effects of dust, black carbon, and other aerosols.

Q: What are we doing?

A: Measuring spectral reflectance of the ice surface in the ablation area of Jamtalferner, in Austria. The glacier is receding rapidly:



Q: Why are we measuring spectral albedo of the ice surface?

A: Jamtalferner has become almost completely snow free in summer in recent years, like many other Alpine glaciers. Albedo is a key factor in predicting the further evolution of these glaciers on local, regional, and global scales.

As the bare-ice areas of many glaciers increase, it is increasingly important to:

- Understand the possible **range and variability of spectral albedo** of the exposed ice surfaces
- Understand the **processes governing these factors** in order to predict them and incorporate them appropriately into energy balance models

Collecting in situ data and improving the (currently relatively limited) data basis is a first step towards these aims.

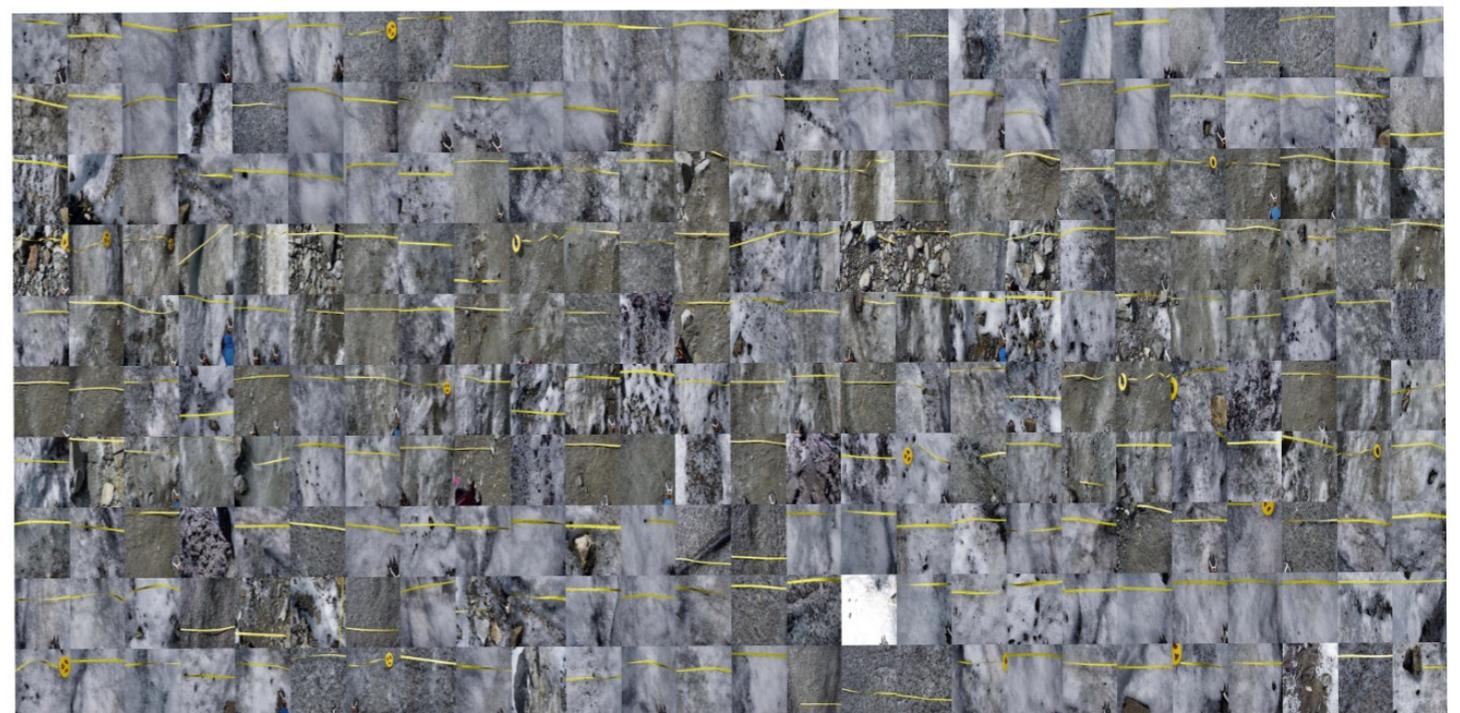
Q: How did we measure the spectral albedo of the ice surface?

A: We used a handheld ASD field spectrometer to gather 246 spectra along multiple profile lines.



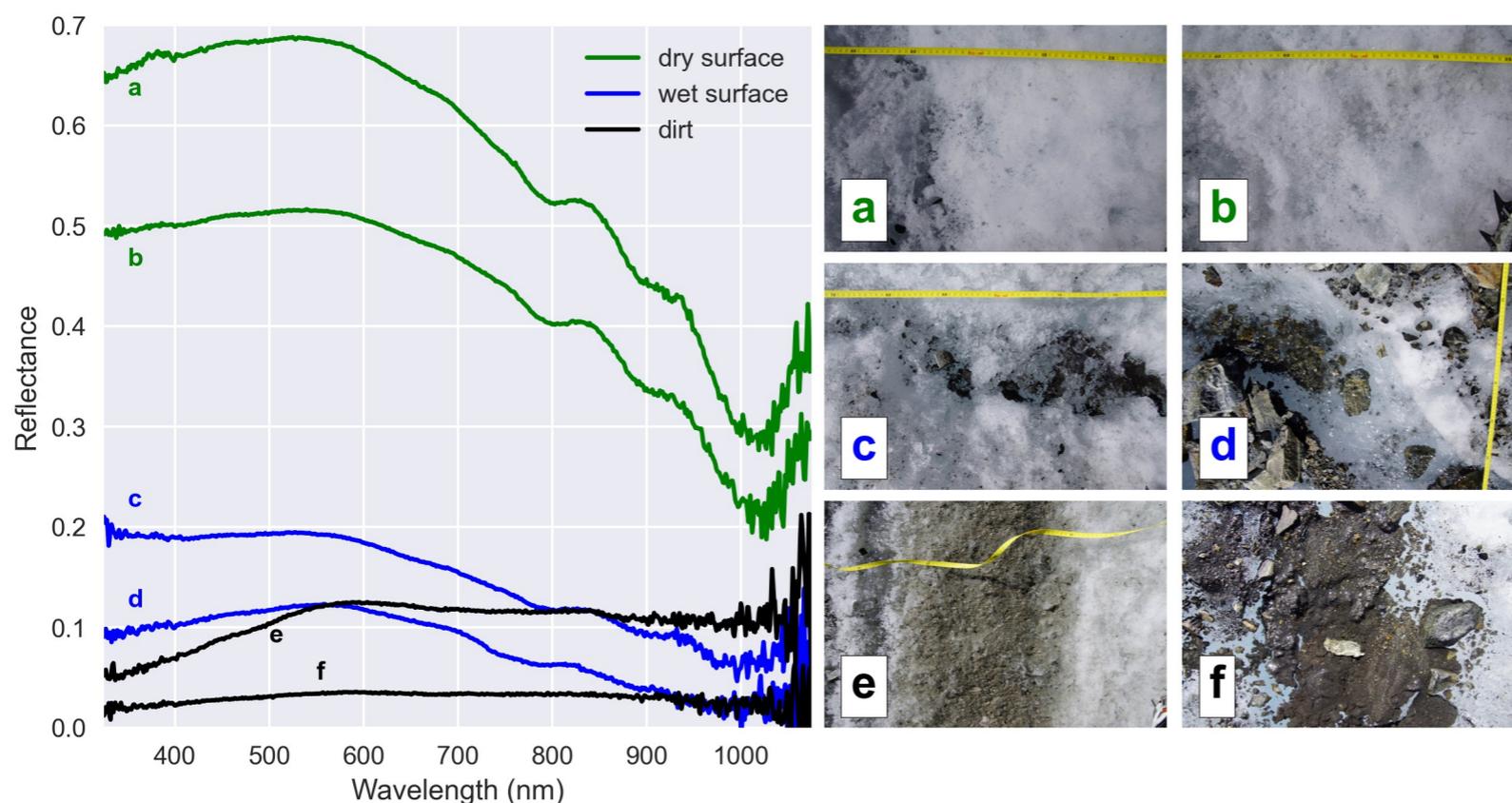
← Locations of profile lines on the glacier

Photos of the ice surface at each measurement point



Q: What did we find out about the albedo of the ice?

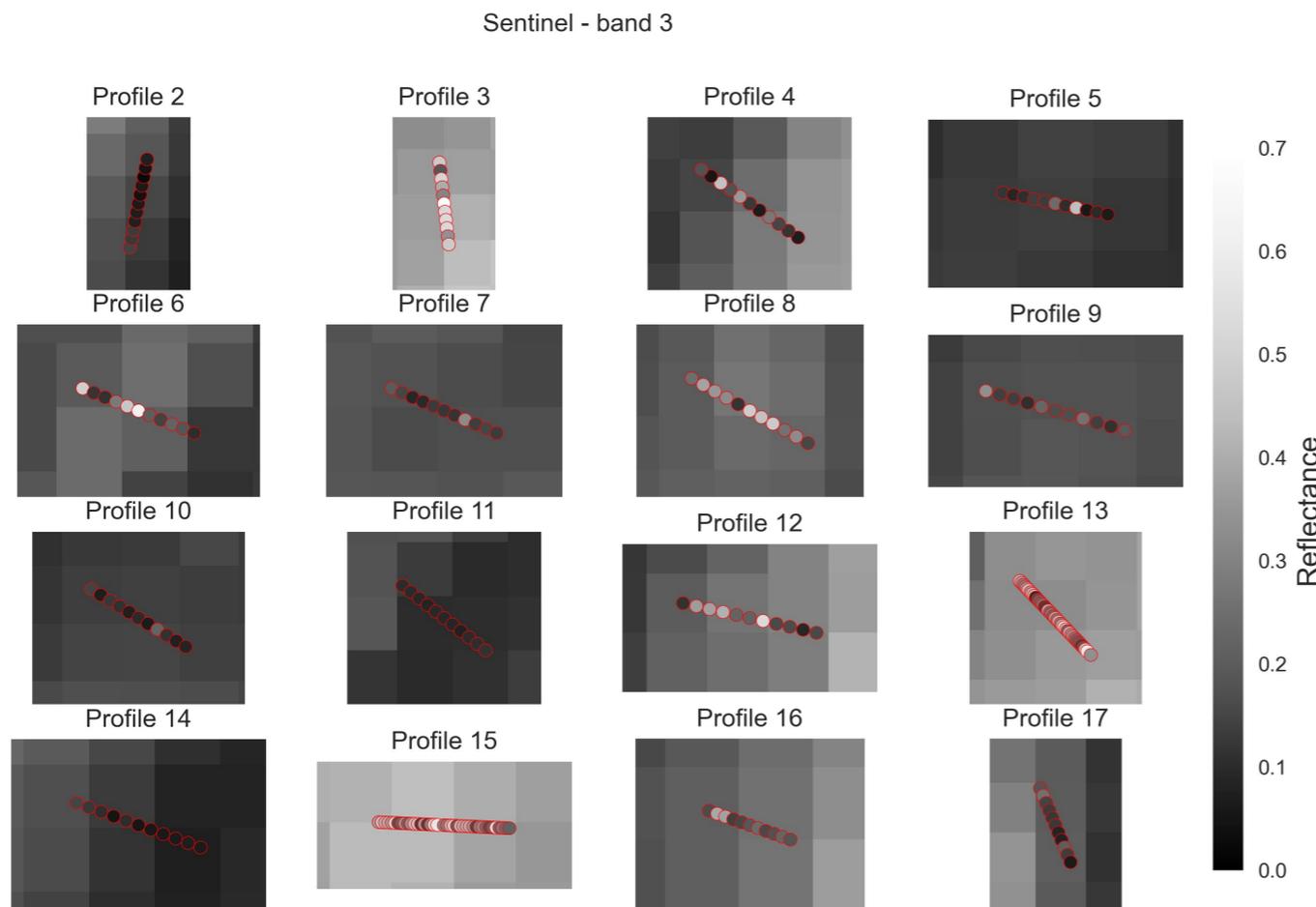
A: 1) It varies a lot between profiles and even within the 20m long profile lines. The presence of liquid water and/or “dirt” (fine mineral dust, coarser debris, organic materials, etc.) are the defining factors.



← Example spectra of different surface types

Q: What did we find out about the albedo of the ice?

A: 2) Sentinel and Landsat reflectance products derived from scenes taken within 1 day of our measurements do not capture the full range of albedo values, nor the variability. How well the satellite data correlates with ground values varies between satellites and wavelength bands.



Example visualization:
Reflectance in Sentinel band 3 pixels (L2A surface reflectance product) compared to mean of in situ reflectance in the band 3 wavelength range at each profile point. The color bar is the same for the background raster and the filled circles representing the profile points.

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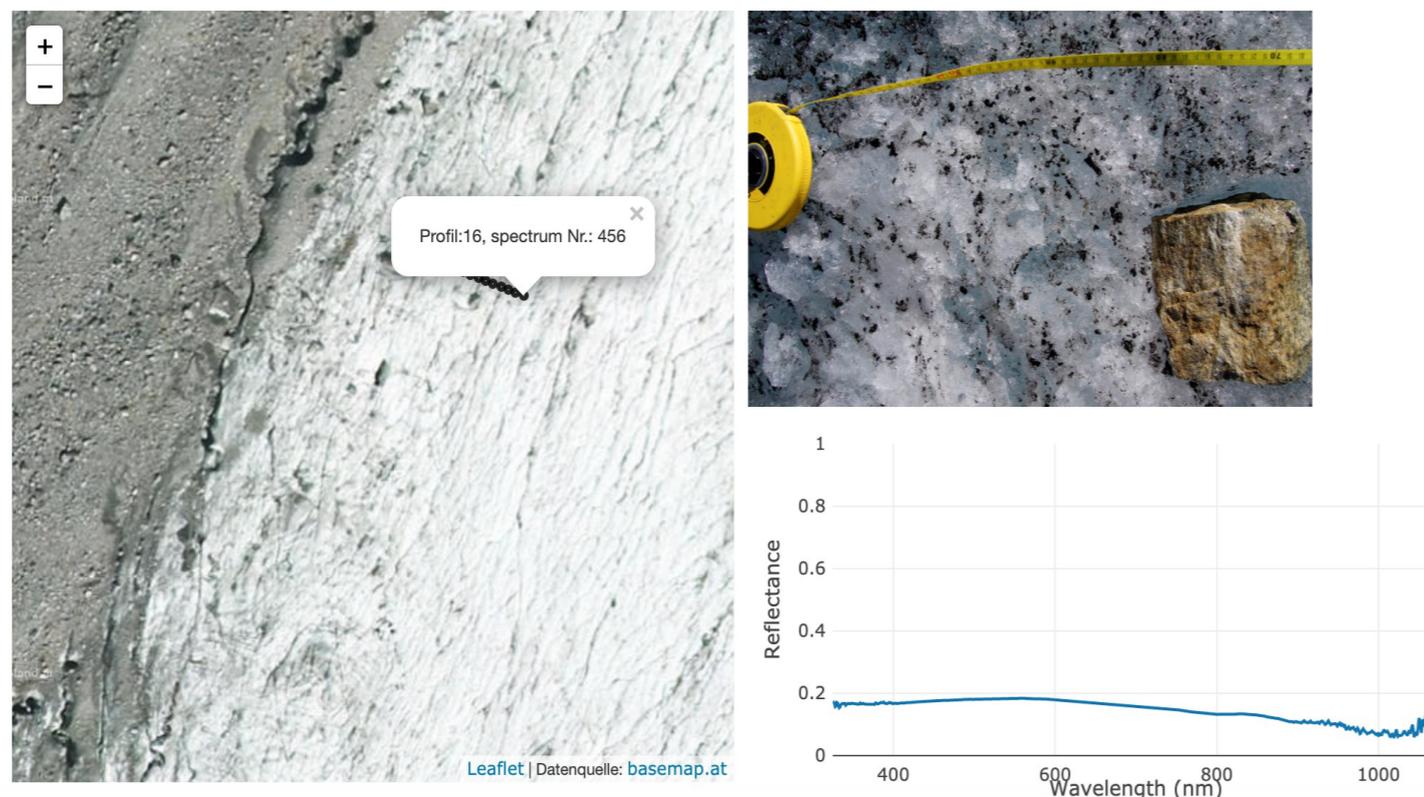
A: 3) More details and discussion can be viewed in a preprint manuscript currently under review at The Cryosphere:

DOI: <https://doi.org/10.5194/tc-2020-92>

The reflectance spectra and corresponding surface photos can be viewed interactively here: <http://spectralalbedo.mountainresearch.at/> (website is a work in progress)

Jamtal: Spectral reflectance

Zoom and click on the markers in the map to see details.



← Example screenshot of web app at:
spectralalbedo.mountainresearch.at/

Q: What else would we like to know about the spectral albedo of ablation area glacier ice?

A: Everything!

Specifically:

- What are the most important processes driving albedo variations at the scale of a specific glacier and on a regional scale?
- Are these processes the same across spatial scales or unique to each site?
- How does spectral albedo vary over time (hourly, daily, seasonal), and why?
- Are albedo driving processes occurring on temporal and spatial scales below the resolution of satellite data?
- How can we quantify resulting uncertainties in satellite data and eventually reduce them?

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Further study needed!!!

Q: Why are we in this session?

A: We want to learn from you!

Aerosol transport and deposition are sources of albedo variability in the cryosphere.

We would like to know more about which transport/deposition processes are likely to have strong (short- or long term) effects on the albedo of snow-free glacier ice.

Based on the above, we would like to develop strategies to efficiently monitor the effects of these processes in the field. Our experience suggests that albedo-defining processes happen across a variety of spatial and temporal scales, which makes them challenging to capture.

Questions? Comments? Working on something similar and interested in collaborations? Any feedback is welcome!

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Thank you!