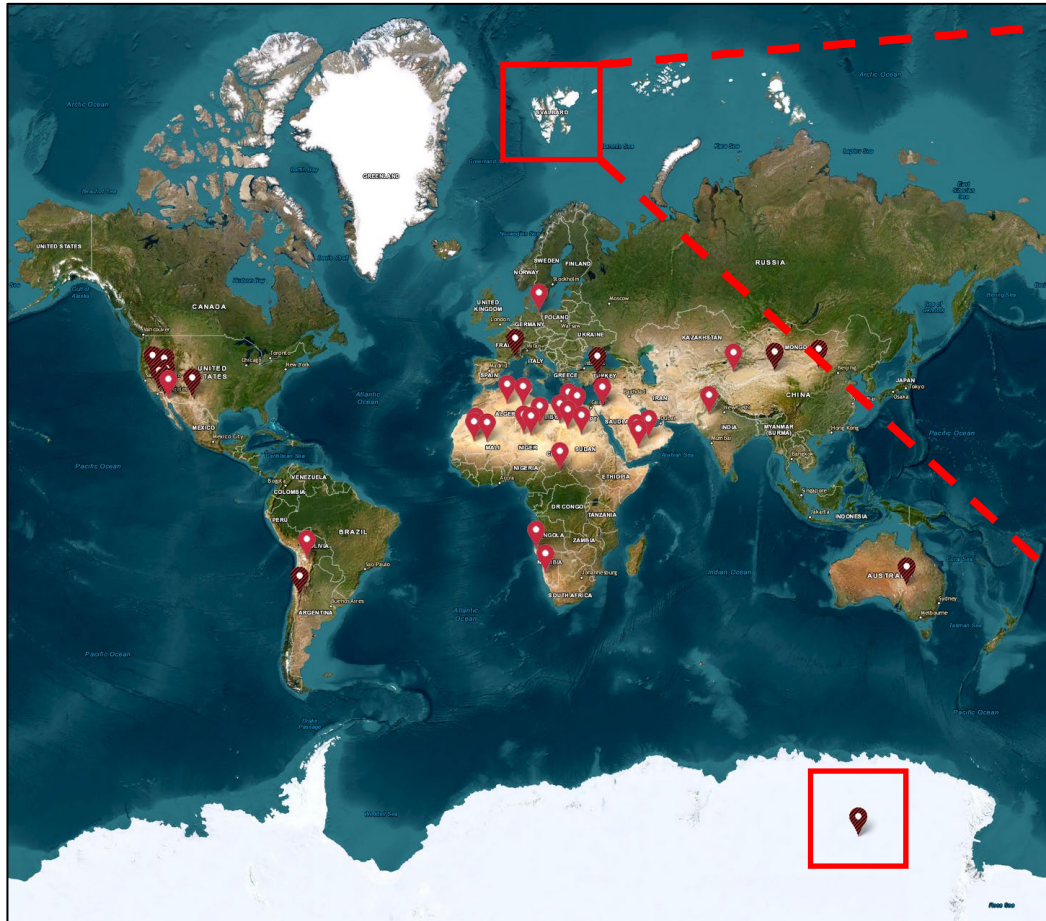




The Integrated Description of the Snow Cover in Polar Areas: a Multi-scale and Multi-platform Solution

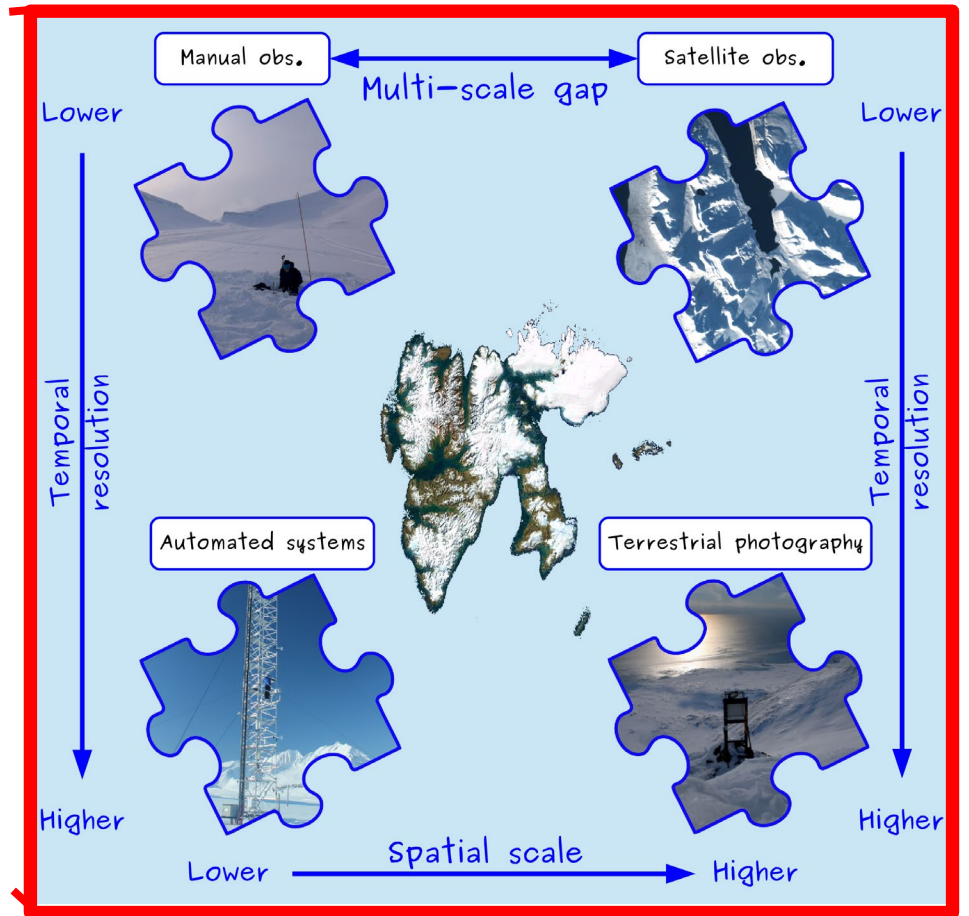
Roberto Salzano, Giulio Esposito & Rosamaria Salvatori

roberto.salzano@cnr.it



<https://www.usgs.gov/tools/test-sites-catalog>

CEOS catalog of prime candidate worldwide test sites for the post-launch characterization and calibration of space-based optical imaging sensors.



Salzano et al. (2021) <https://doi.org/10.5281/zenodo.4294092>

Remote sensing of the snow cover

The description of the snow cover can be approached with different spatial and time scales. This large variability is not a weakness; rather, it represents a relevant opportunity to fill the multi-scale gap that affects the snow cover monitoring.

The availability of long time series is the key to observing long-term climate changes and to support Cal/Val activities on active and future satellite missions.

Ground-based

Manual



(e.g., Fieldspec, ASD inc.)

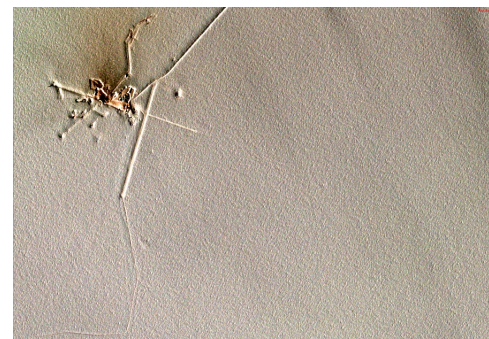
Automated



(e.g., CReM)

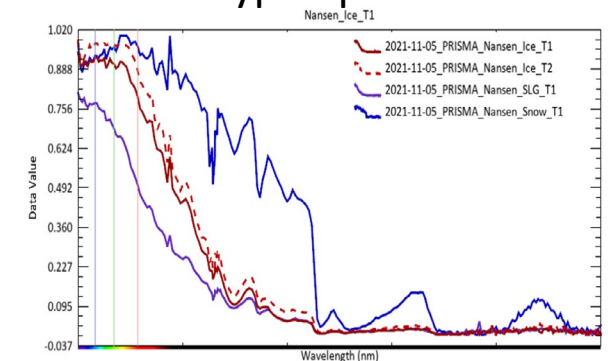
Satellite

Multi-band



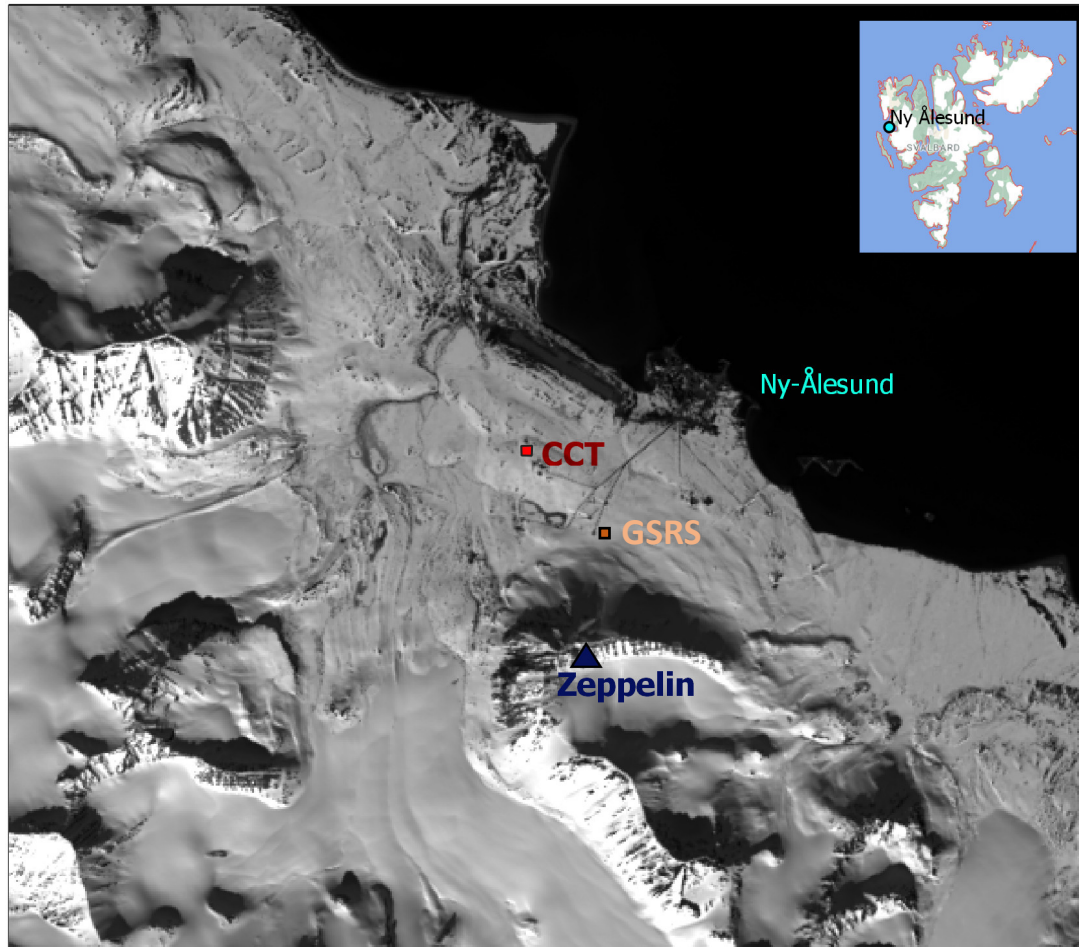
(e.g., Sentinel-2)

Hyperspectral



(e.g., PRISMA)

The study site



Sentinel-2 imagery



0 1 2 km

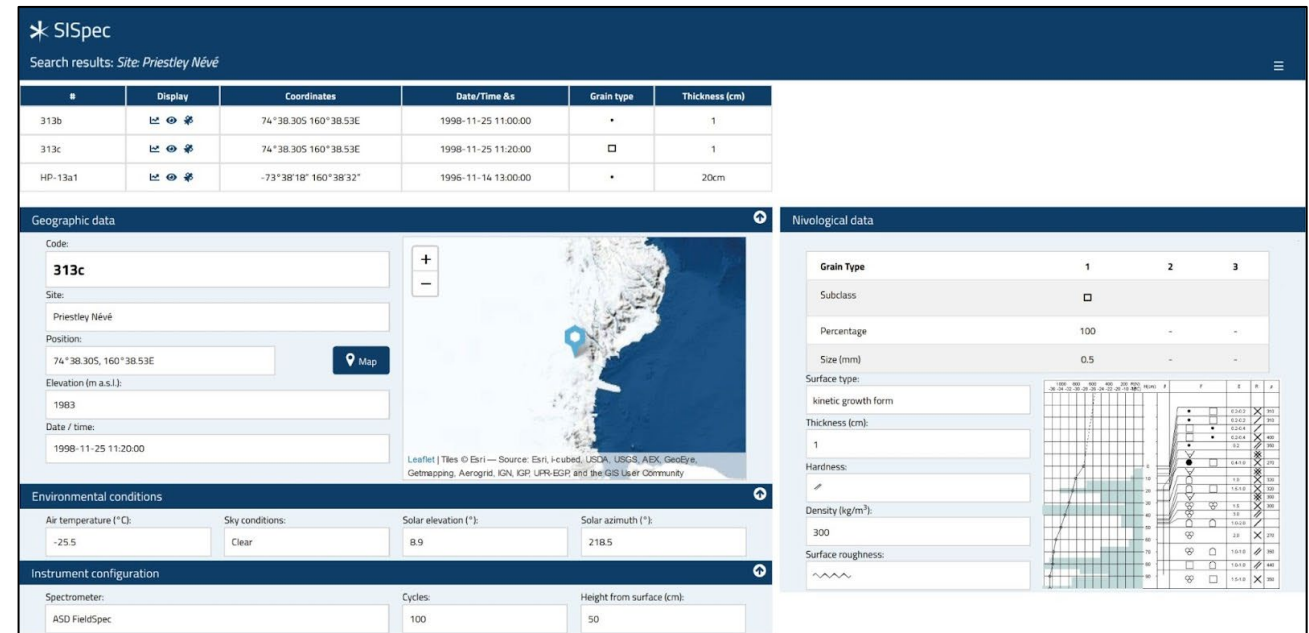


Involved facilities:

- ***Amundsen-Nobile Climate Change Tower (CCT)***
Research infrastructure operated by CNR in the Kolhaugen site.
- ***Gruvebadet Snow Research Site (GSRS)***
Field site maintained by CNR all-round year close to the Gruvebadet Laboratory.
- ***Zeppelin observatory***
Facility operated by NPI on the top of the Zeppelifjellet (500 m a.s.l.)



The SISpec web portal collects and supports queries on hyperspectral measurements and specific metadata, obtained during different field campaigns carried out in the last 20 years in Svalbard and Antarctica.

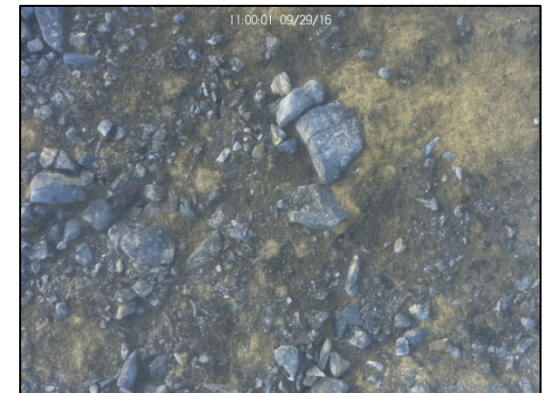
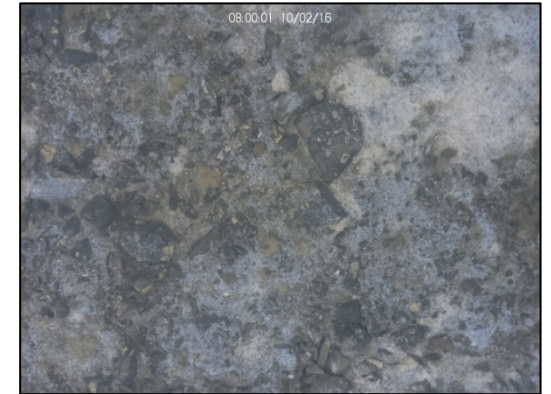
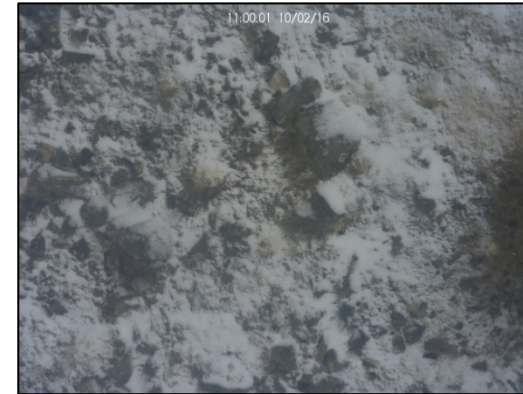


<https://niveos.cnr.it/SISpec/>

Salvatori et al. (2022) <https://doi.org/10.3390/rs14092213>

The CReM device

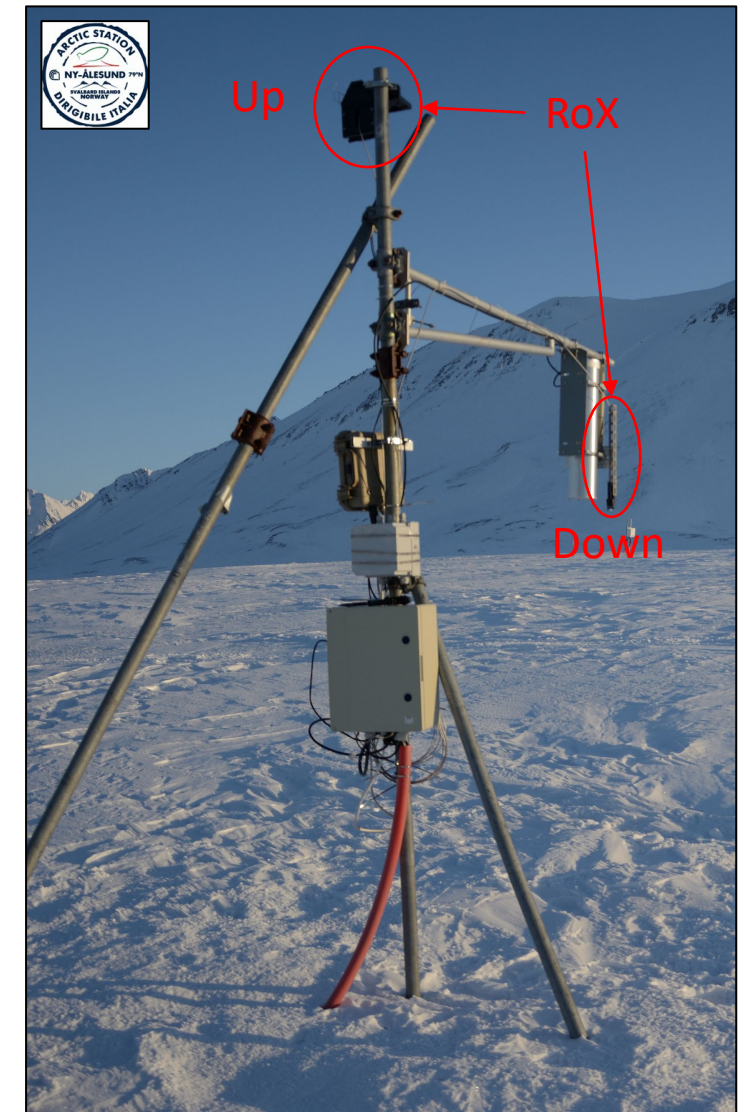
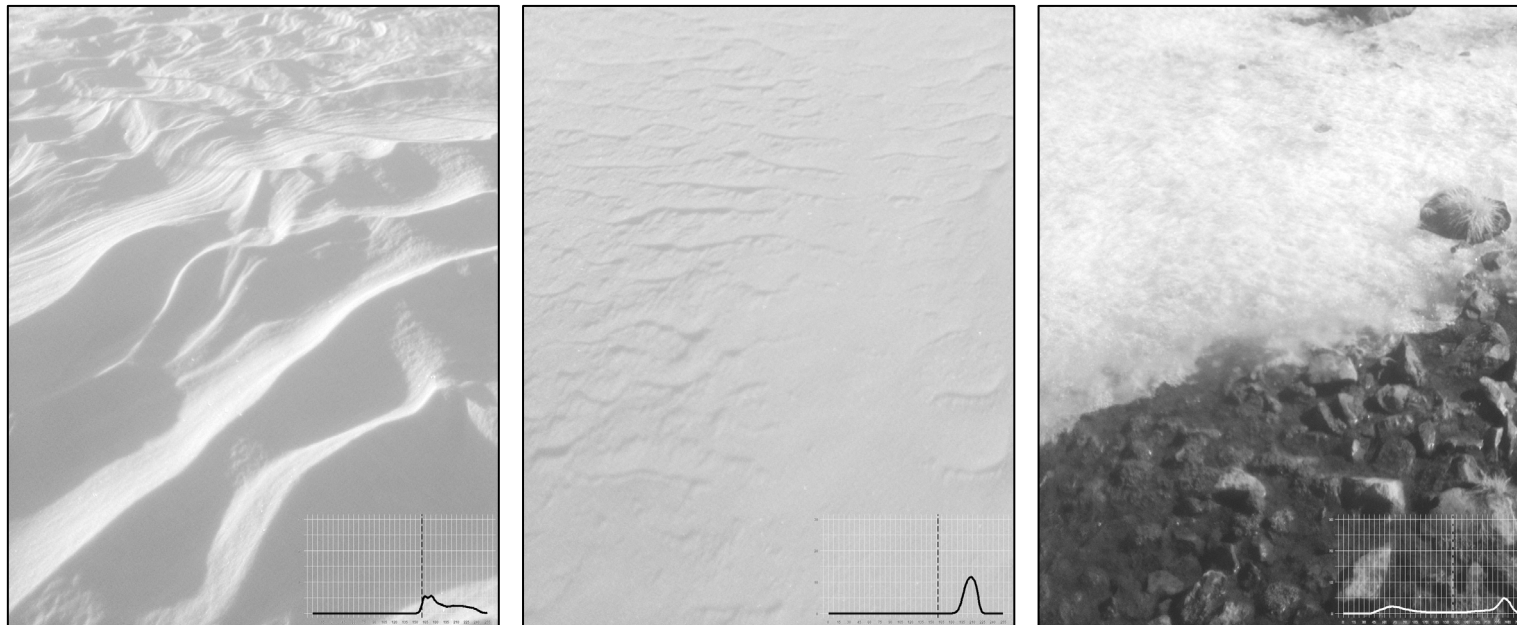
The snow spectral behavior is obtained at Ny-Ålesund using automated systems such as a narrow-band spectral device (CReM). The proposed system supports the quality check of the acquired data with sky and ground images useful in assessing the different illumination and surface conditions. It was possible to estimate spectral indexes and SWIR reflectance and we have found interesting links between both features and air/ground temperatures, wind-speed, and precipitations.



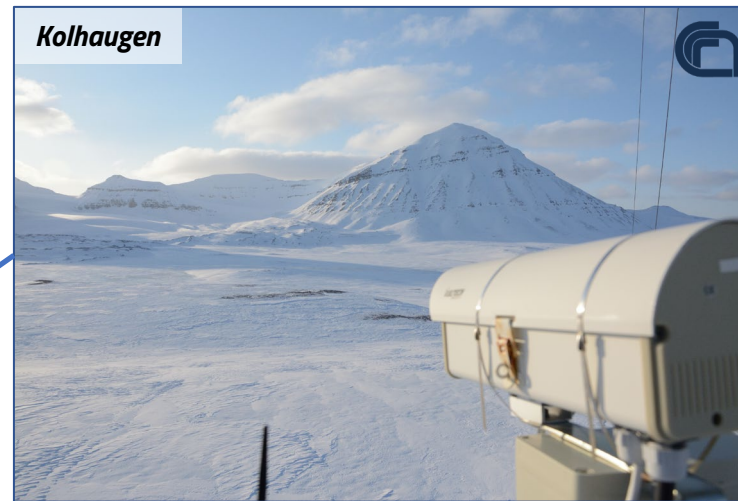
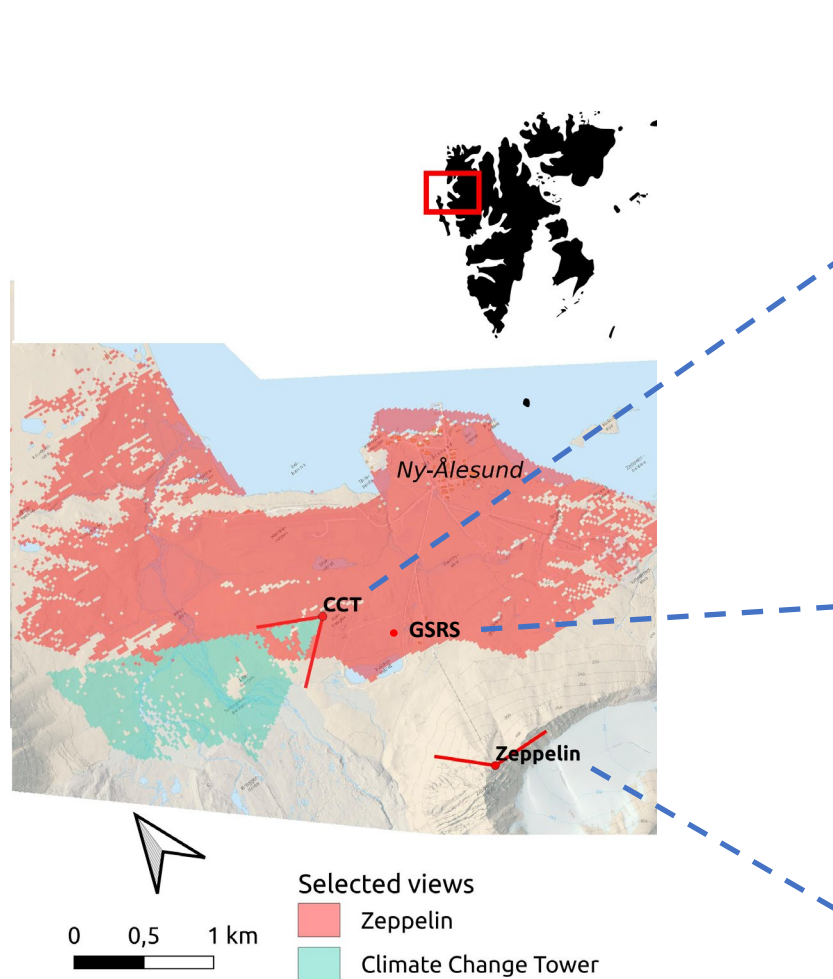
Salzano et al., 2021 - <https://doi.org/10.3390/geosciences11030112>

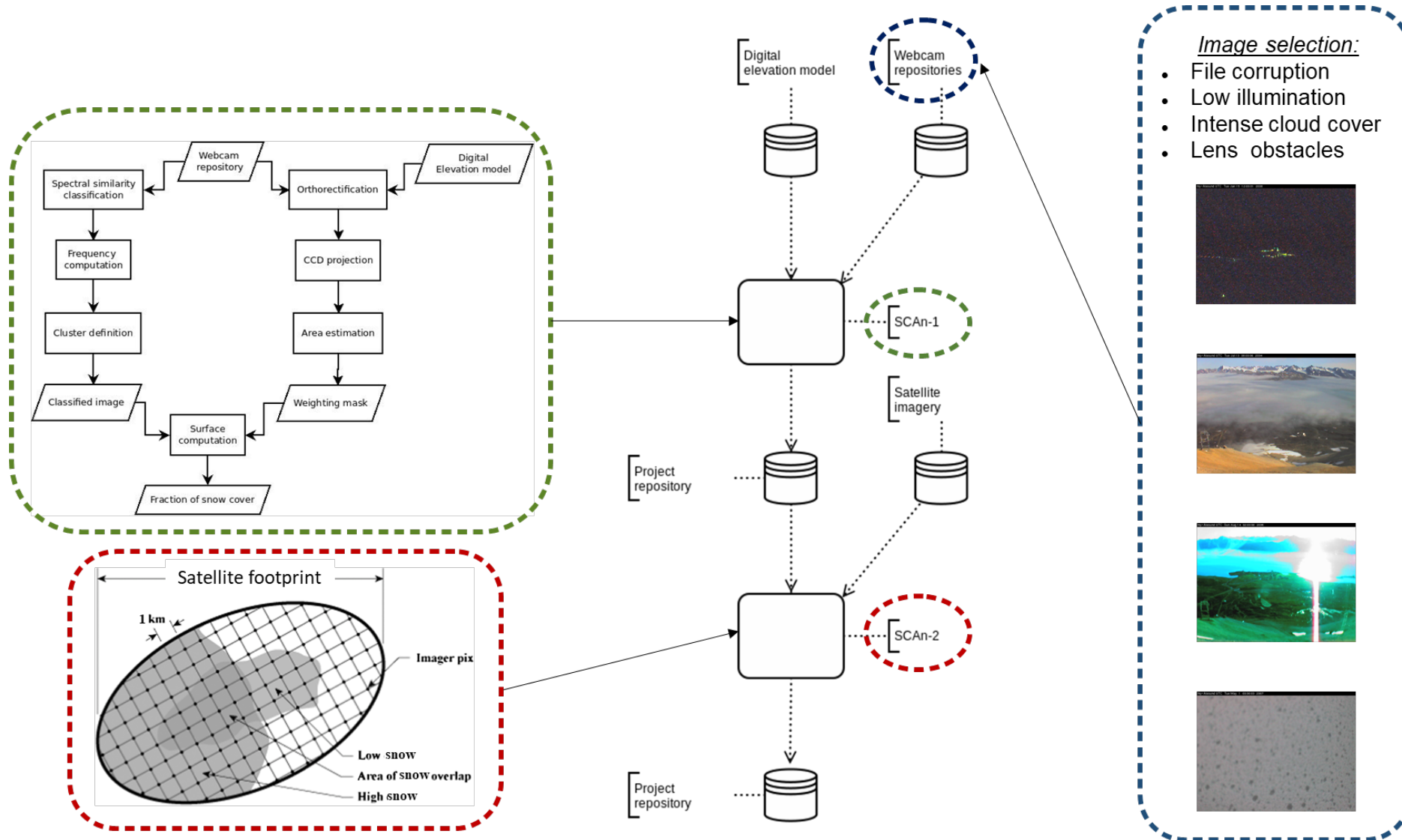
The RoX instrument

The snow spectral behavior is obtained at Ny-Ålesund using automated systems such as a narrow-band spectral device (CReM) and the RoX instruments (JB Hyperspectral Devices GmbH). The proposed system supports the quality check of the acquired data with sky and ground images useful in assessing the different illumination and surface conditions. The detected ranges are in the Visible, the Near-infrared and the Short-wave infrared wavelength domains.



Time-lapse photography





Time-lapse photography



Metadata base

- Metadata
- Citation
- Extent
- Lineage
- Reference system
- Data quality (ISO 19157)
- Feature catalogue (ISO 19110)
- General feature (ISO 19109)
- Geometry (ISO 19107)
- Polylinguistic text (ISO/TS 19103)
- Spatial coordinates (ISO 19111)
- Temporal (ISO 19108)

from ISO 19115-3 XML implementation
from ISO 19115-1:2014 Metadata fundamentals

Acquisition information

- Environmental conditions
- Instrument
- Objective
- Operation
- Plan
- Platform
- Requirement

from ISO 19115-3 XML implementation
from ISO 19115-2:2019 Metadata – part 2

Extension*

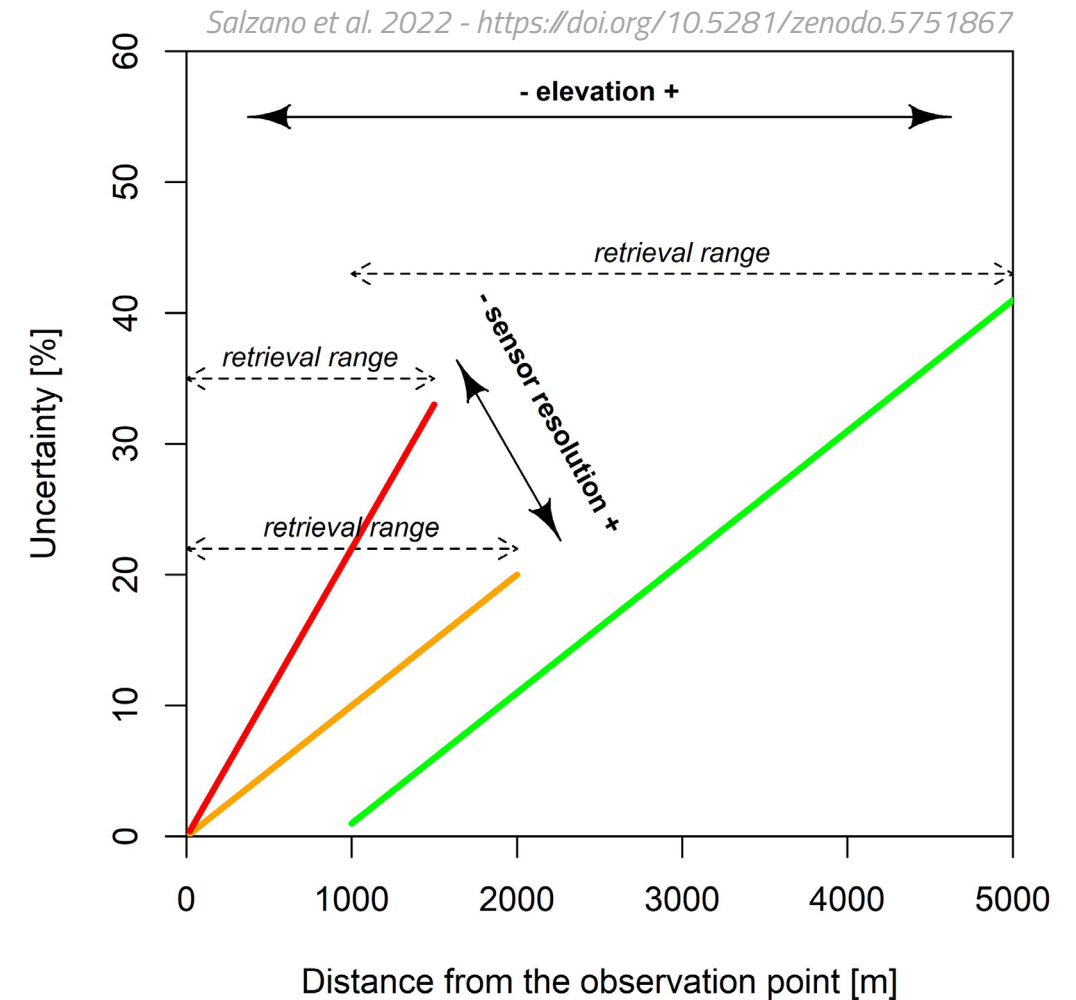
Image processing

- FSC estimation
- Distortion calibration
- Perspective calibration
- Ground control points
- Differential GPS
- Classification algorithm

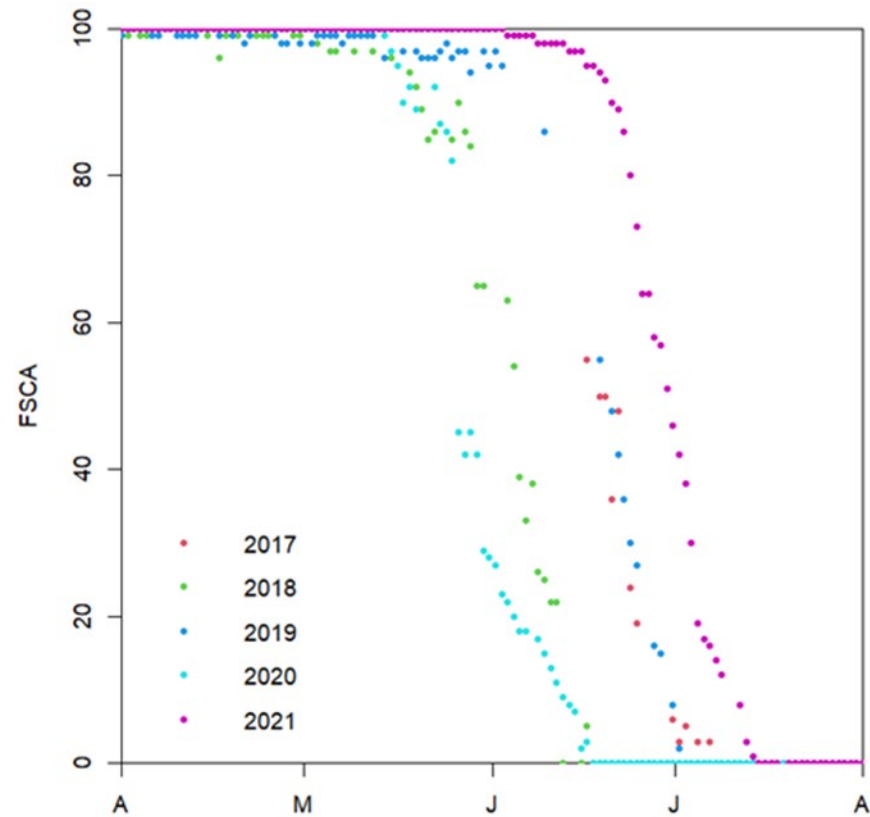
Camera setup

- Setup type
- Inclination
- Orientation
- Field of view
- Seasonality

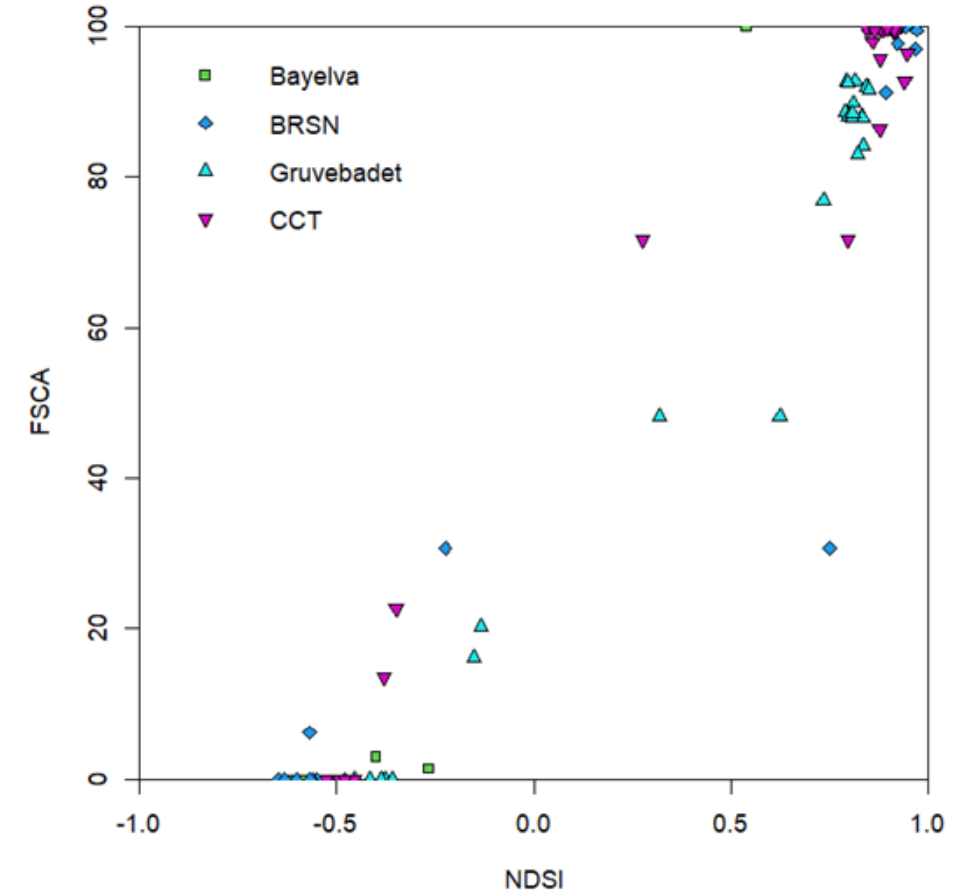
* specific for terrestrial photography applications



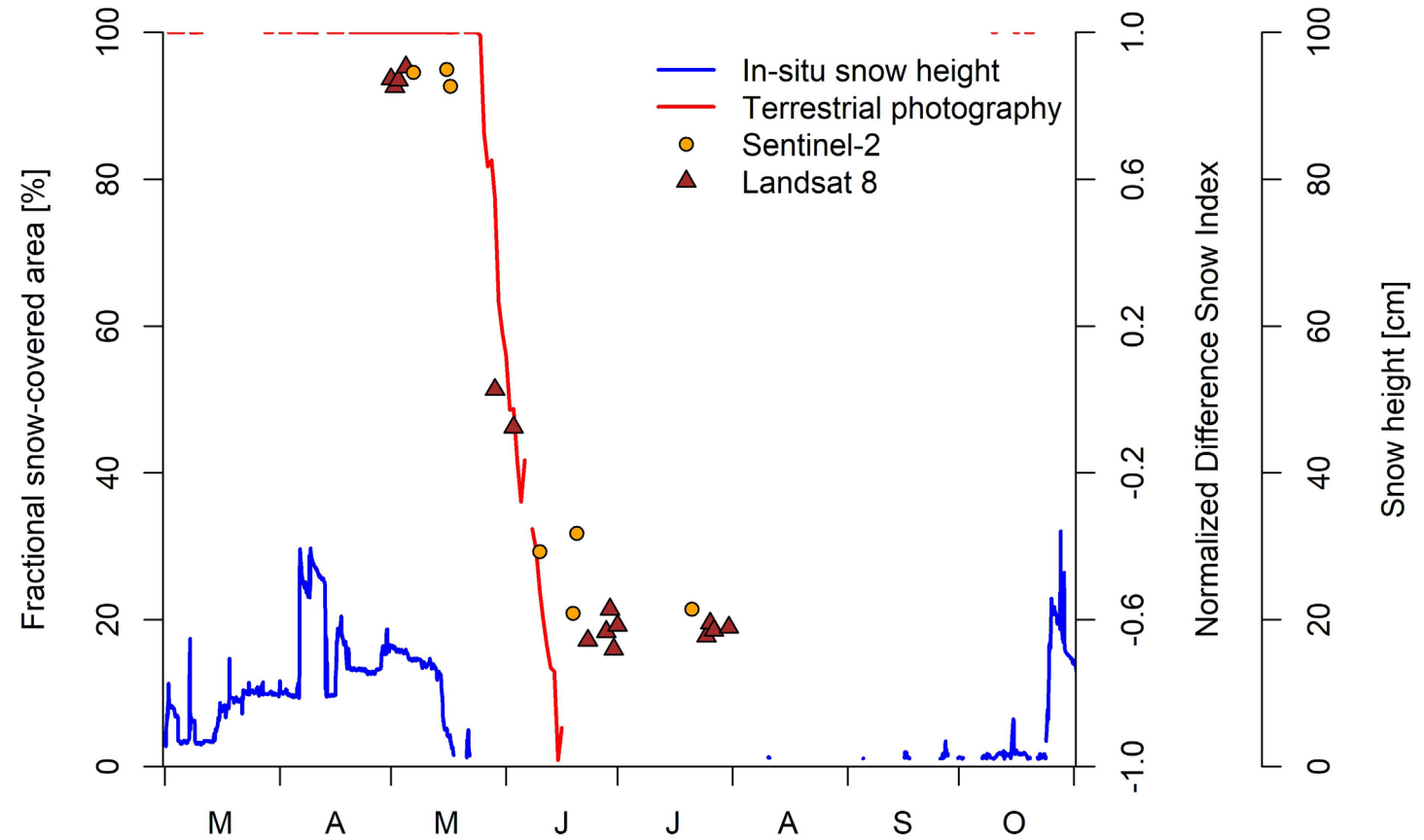
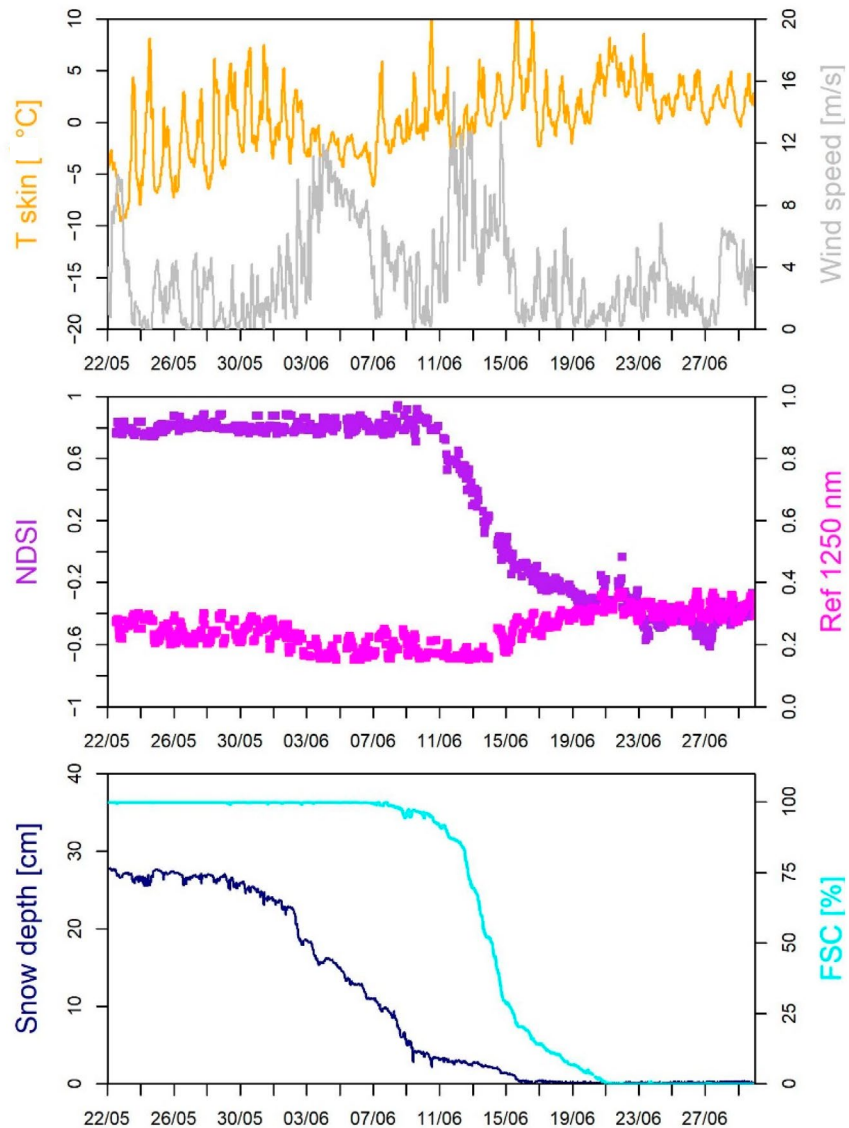
FSCA vs spectral behaviour



Seasonal evolution of the FSCA in the Ny-Ålesund area from 2017 to 2021 from April to July.

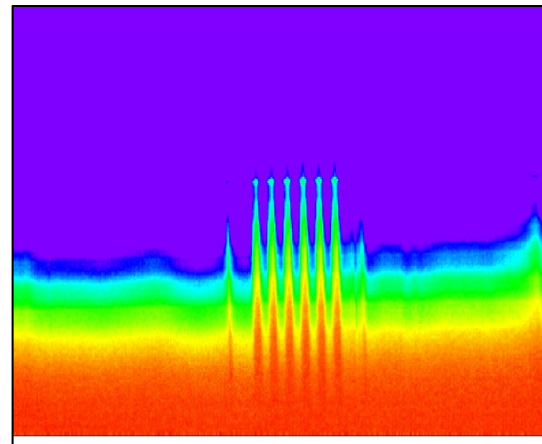


Relation between FSCA (terrestrial photography) and NDSI (Sentinel-2) in different sites located in the Ny-Ålesund area. This example refers to 2019 and different facilities have been considered with a 50m buffer.



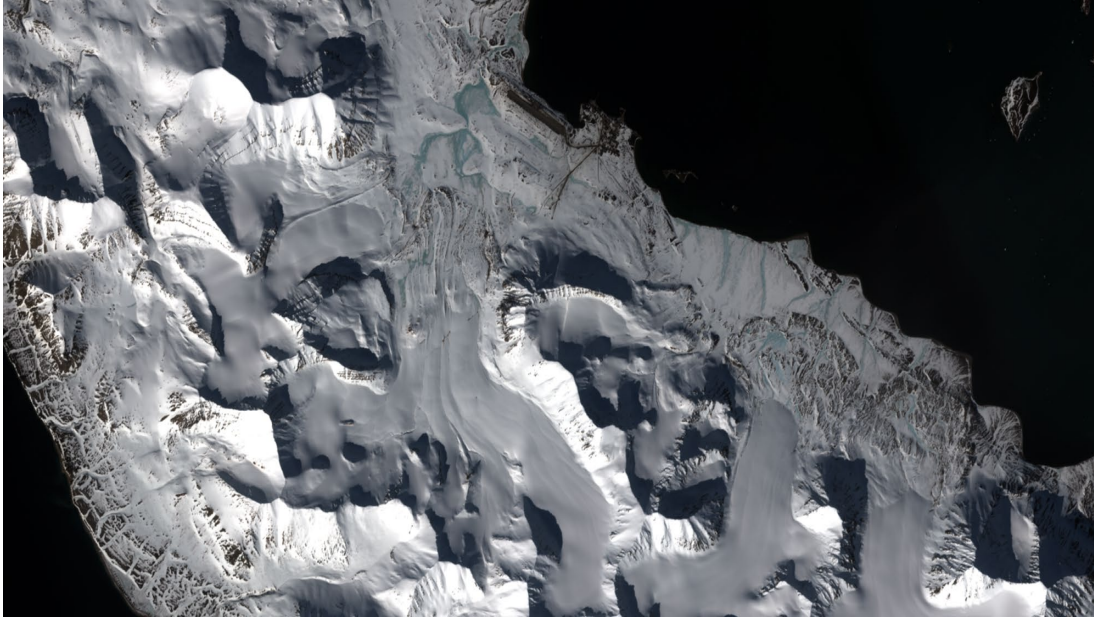
Salzano et al. 2022 - <https://doi.org/10.5281/zenodo.5751867>

The step forward at the Concordia station consists in developing an hyperspectral system aimed at defining the spatial heterogeneity of spectral reflectance



The considered wavelengths include the visible-NIR spectral domain as well as some selected narrow bands in the SWIR range.





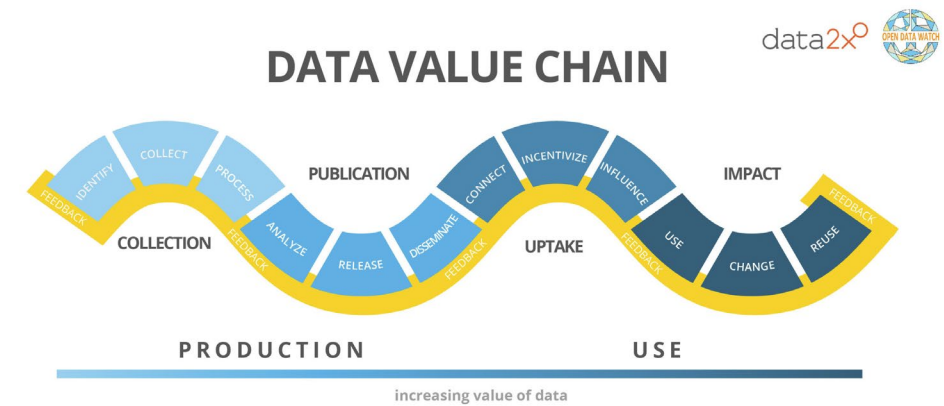
The impact of the observed information can be maximized increasing:

- The harmonization of data chains
- The FAIRness of ground-based datasets

The optical snow properties are a key information useful for calibrating and validating satellite data products at high latitudes.

Major snow information are:

- Fractional snow-covered area (aka FSCA, FSC, SCF)
- Snow spectral albedo
- Snow water equivalent





remote sensing

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Special Issue: New Insights in Remote Sensing of Snow and Glaciers

Dr. Roberto Salzano

Institute for Atmospheric Pollution Research, National Research Council of Italy (CNR)

Dr. Rosamaria Salvatori

Institute of Polar Sciences, National Research Council of Italy (CNR)

Prof. Dr. Angelika Humbert

Helmholtz Centre for Polar and Marine Research, Alfred Wegener Institute

Submission Deadline: 20 May 2023

Submission link:

https://www.mdpi.com/journal/remotesensing/special_issues/X2P3E0B8S1



www.mdpi.com

The scope of this Special Issue is to collect research articles focused on, but not limited to, applications of remote-sensing data/techniques combined with other approaches to better monitor and/or understand processes occurring on snow-covered and glaciated areas, in different environmental frameworks.

Manuscripts using novel approaches based on data integration and on multimission products are particularly welcome.

Special Issue