Course syllabus and learning objectives – draft

Tentative plan

	Day 1	Day 2	Day 3	Day 4
9-10	Introduction: SAR and optical satellite data	Introduction: Mass and energy balance measurements	Introduction: Terrestrial laser scanning	Introduction: Snow pits and oxygen isotope data
10-12	Group work: Introduction to working with satellite data	Group work: Access weather station and mass balance data	Group work: Access and process laser scanner data	Group work: organize snow pit data
12-13	*Lunch*	*Lunch*	*Lunch*	*Lunch*
13-15	Group work: work on assignments	Group work: work on assignments	Group work: work on assignments	Work on assignments
15-17	Prepare report	Prepare report	Prepare report	Presentations of results

Satellite remote sensing

Learning objectives: at the end of the course, the participants should be able to:

- Understand characteristics of different glacier and snow facies and their temporal changes in radar and optical satellite imagery
- Analyse the effect of topography on projection and calibration of satellite imagery using DEMs
- Estimate and discuss the uncertainties in the characterization of glacier facies and melt processes
- Use satellite data to observe glacier retreat

Energy and mass balance: Radiation stations

Learning objectives: at the end of the course, the participants should be able to:

- Understand the various measurements required to calculate the surface energy balance
- Analyse energy balance for a certain time period using radiation stations at Vernagt Ferner
- Estimate and discuss the uncertainties in the measurements
- Compare summer and winter conditions
- Compare computed melt rates with observed melt rates

Terrestrial laser scanning (TLS)

Learning objectives: at the end of the course, the participants should be able to:

- Understand how laser scanning can be used to observe surface elevation and roughness changes
- Georeference and compare TLS measurements carried out at different scan positions
- Estimate and discuss the uncertainties in the measurements
- Compare TLS derived melt rates with in-situ observed melt rates

Snow pits

Learning objectives: at the end of the course, the participants should be able to:

- Explain how snow pit measurements are conducted
- Analyse the measurements and visualise them, specifically
    - Calculate density profiles
    - Calculate water eq.
    - Deduce surface mass balance/annual snowfall from the sites
- Estimate and discuss the uncertainties in their measurements
- Compare with past measurement of mass balance from Vernagtferner and discuss the representativeness of the data

Oxygen isotopes

Learning objectives: at the end of the course, the participants should be able to:

- Explain why oxygen isotopes are a proxy for past temperatures
- Contrast snow pit measurements with oxygen isotope measurements; differences/similarities
- Use isotope measurements to extract time profiles for Vernagtferner
- Discuss the uses of isotope measurements for the Vernagtferner and as indicators of snowfall rates.