Field-course GEO 4410/9411

The field course will visit two major sites: Storbreen/Juvvass and Tronfjell. We will define 4 to 5 groups, and each group works with a little project in both sites. The groups will switch themes between the sites. Each group prepares a short presentation at the end of the field course.

The following tasks are defined:

Finse area

Weichselian and Holocene glacier dynamics by mapping glacial striae and glacial landforms. We will have one and a half day for identifying and mapping glacier features from recent and former glaciations.

Relevant literature:

Storbreen

Group 1. Glaciology – mass balance

Mass balance methods

- Traditional stake measurements. Use stakes installed by NVE for daily ablation measurements
- Use AWS-data from running NVE station
- Measure by GPS stake positions
- We will try one survey of all stakes on the glacier – both in ablation and accumulation area
- We will consider the possibilities for the hydrology/runoff measurements

Necessary to bring good mountain boots. Glacier equipment will be provided (harness, crampons, rope). You do **not** need any climbing/glacier experience (or very limited).

Research questions:

- How correlates the mass balance variation with climate parameters?
- How varies ablation on the glacier with elevation?
- What is the impact of future climate scenarios on the fate of the glacier (literature etc)
- How varies run-off from the glacier, annually and decadal?

Group 2. Geomorphology – deglaciation history

- Describe the deglaciation since LIA

- Map the moraine systems in front of Storbreen since LIA, use GPS for positioning.
- Use Lichenometry and/or Schmidthammer for dating of moraines
- Map the current front position by GPS
- Describe a cross section in one moraine ridge, e.g. fabric analysis.
- If possible look at the current or recent past formation of moraine ridges at the current front position.

Research questions:

- What was the deglaciation history of Storbreen between 1750 and today?
- How influences glacier thermal regime in the front of the glacier geomorphological processes?
- What type of glacial and glacio-fluvial landforms are found in front of Storbreen, and how are they formed?
- Are there any periglacial processes acting in recently deglaciated terrain, and what forms will develop?

Relevant literature:

1) Liss M. Andreassen (PhD-thesis): Glacier variations in Norway - Measurements and modeling (I will bring outprint)

2) NVE-report series: Glaciological investigations in Norway in 19xx.
I will bring some reports. They can also be downloaded from NVE.

3) Liestøl, O. Storbreen glacier in Jotunheimen, Norway. Norsk Polarinst. Skrifter, 141, 63 p.

4) Matthews, J. A. 'Little Ice Age' glacier variations in Jotunheimen, southern Norwvay: a study in regionally controlled lichenometric dating of recessional moraines with implications for climate and lichen growth rates. The Holocene 15,1 (2005) pp. 1-19

Juvvass

Group 3. DC resistivity sounding and permafrost characteristics

The project will measure 2D DC resistivity profiles (over areas with ground temperature information along a transect down from Juvvasshøe. Will investigate relation between apparent resistivity and ground temperature, soil type, soil water content and topography.

Research questions:

- How does multi-temporal resistivity monitoring represent the development of the activie layer
- Can we use the monitoring approach to estimate variations in ice and water content in the ground?
- Is there any relation between apparent resistivities and ground temperatures?

Relevant literature:

Hauck, C., K. Isaksen, et al. (2004). "Geophysical surveys designed to delineate the altitudinal limit of mountain permafrost: an example from Jotunheimen, Norway." Permafrost and Periglacial Processes 15(3): 191-205.

Heggem, E. S. F., H. Juliussen, et al. (2005). "The permafrost distribution in central-eastern Norway." Norsk Geografisk Tidskrift 59(2): 94-108.

Isaksen, K., C. Hauck, et al. (2002). "Mountain permafrost distribution on Dovrefjell and Jotunheimen, southern Norway, based on BTS and DC resistivity tomography data." Norsk Geografisk Tidsskrift 56(2): 122-136.

Group 4. Bore hole temperatures – analysis and modeling/MAT/GST relation considering snow cover

Analysis of air-, ground surface and ground temperatures along a transect in Jotunheimen. Description of sites incl. topography, soil types etc. Estimation of n-factors, TTOP, thermal characteristics (diffusivity etc). Modeling of ground temperatures based on air temperature series. Normalisation of temperatures, climate change assessment

Research questions:

- How are nF and nT factors varying along the transect?
- How is air and ground surface temperature varying along the transect, with special emphasize on winter inversions.
- Can we estimate snow cover evolution based on temperature monitoring?
- Are there any difference in ground thermal regime in blocky, sediment and bedrock sites?
- How does blocky surfaces influence ground temperature?
- What are the lapse rates (temperature-elevation change) in air and ground surface?

- Have the sites warmed up during the last decades, and how much?
- How are the ground temperatures varying with depth, and can we use simple heat flow modeling to address this variation?
- In which elevation are the boundaries for permafrost in the area?
- How will the thermal conditions along the transect react on future warming trends?

Relevant literature:

Etzelmüller, B., I. Berthling, et al. (2003). "Aspects and Concepts on the Geomorphological Significance of Holocene Permafrost in Southern Norway." Geomorphology 52(1-2): 87-104.

Isaksen, K., C. Hauck, et al. (2002). "Mountain permafrost distribution on Dovrefjell and Jotunheimen, southern Norway, based on BTS and DC resistivity tomography data." Norsk Geografisk Tidsskrift 56(2): 122-136.

Isaksen, K., P. Holmlund, et al. (2001). "Three deep alpine permafrost boreholes in Svalbard and Scandinavia." Permafrost and Periglacial Processes 12(1): 13-26

Juliussen, H. and O. Humlum (2007). "Towards a TTOP ground temperature model for mountainous terrain in central-eastern Norway." Permafrost and Periglacial Processes 18(2): 161-184.

Riseborough, D., N. Shiklomanov, et al. (2008). "Recent advances in permafrost modelling." Permafrost and Periglacial Processes 19(2): 137-156

Smith, M. W. and D. W. Riseborough (1996). "Permafrost monitoring and detection of climate change." Permafrost and Periglacial Processes 7(4): 301-309.

Williams, P. J. and M. W. Smith (1989). The Frozen Earth: Fundamentals of geocryology. Cambridge, Cambridge University press.

Group 5: Distribution pattern and morphometry of patterned ground in the Juvvass area

10 m DEM, analyses of distribution of different types of patterned ground and topographic parameters. Morphometric analyses of patterned ground (size, form, slope, activity etc).

Research questions:

- Which type of periglacial landforms are abundant at the sites?
- Is there any relation between surficial material, topography and type of periglacial landforms?
- Is there any relation between topography and activity of the landforms?
- Is there any relation between landform morphometry and topography/sediment type?
- Are there climatic boundaries

Relevant literature:

French, H. (2008). Periglacial geomorpholgy and permafrost.

Tron mountain

Group 1: Distribution pattern and morphometry of patterned ground in the Tron area

10 m DEM, analyses of distribution of different types of patterned ground and topographic parameters. Morphometric analyses of patterned ground (size, form, slope, activity etc).

(see above)

Group 2. Bore hole temperatures – analysis and modeling/MAT/GST relation considering snow cover

(see above)

Group 3: Deglaciation, block field, striation and other glacigenic landforms on Tron mountain

Traditional mapping of glacial landforms on Tron mountain, incl. striae. Use of air photos and field surveillance. Documentation of landforms, and interpretation in relation to the general glaciations/de-glaciation pattern in the area.

Research questions:

Relevant literature:

Juliussen, H. and O. Humlum (2008). "Thermal Regime of Openwork Block Fields on the Mountains Elgåhogna and Sølen, Central-eastern Norway." Permafrost and Periglacial Processes 19(1): 1-18.

Juliussen, H. and O. Humlum (2007). "Preservation of block fields beneath Pleistocene ice sheets on Sølen og Elgåhogna, south-eastern Norway." Zeitschrift für Geomorphologie, Suppl. Bd. 51(2): 113-138.

Group 4. DC resistivity sounding and permafrost characteristics

(see above)