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Fourth ESF SEDIFLUX Science Meeting & First Workshop of I.A.G./A.I.G. SEDIBUD

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REPORT

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Title:
Fourth ESF SEDIFLUX Science Meeting & First Workshop of I.A.G./A.I.G. SEDIBUD

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Summary:

This **Fourth ESF SEDIFLUX Science Meeting and First I.A.G./A.I.G. SEDIBUD Workshop** builds on three previous ESF SEDIFLUX Science Meetings held in Saudarkrokur (Iceland) in June 2004, Clermont-Ferrand (France) in January 2005 and Durham (UK) in December 2005. The theme of the Meeting is "Source-to-Sink-Fluxes and Sediment Budgets in Cold Environments". The Meeting is split between scientific presentations and workshop discussions focussed on the principle working groups of ESF SEDIFLUX. The key aims of SEDIFLUX are to provide a framework for integrated, multidisciplinary research on sediment fluxes, sediment transfers, sediment budgets and climate change and to foster research collaboration between researchers in Europe and globally.

This Meeting will address the key aim of ESF SEDIFLUX and I.A.G./A.I.G SEDIBUD to discuss Sedimentary Source-to-Sink-Fluxes and Sediment Budgets in Cold Environments. Major emphasis will be given to consequences of climate change, scaling issues, source-to-sink correlations, exogenous-endogenous interactions, and to the bridging among different geo-scientific fields as well as among geo-, bio- and social sciences.

Central issues will be the discussion and further development of the ESF SEDIFLUX Handbook, the development of further ideas to continue and to extend the scientific activities, which have been started within ESF SEDIFLUX within the I.A.G./A.I.G. Working Group SEDIBUD (selection of new key test sites, etc.), and the development of contacts and collaborations between earth scientists in Europe and North America.

Keywords:	Source-to-Sink Fluxes / Correlations	Sediment Transfers
Sediment Budgets	Scaling Issues	Multidisciplinary
Climate Change	Cold Environments	ESF Network / I.A.G. Working Group

Fourth ESF SEDIFLUX Science Meeting

&

First Workshop of I.A.G./A.I.G. SEDIBUD

Source-to-Sink–Fluxes and Sediment Budgets in Cold Environments

Trondheim, Norway,

October 29th – November 02nd, 2006

Extended Abstracts of Science Meeting Contributions

Editor: A.A. Beylich

October 2006

ESF SEDIFLUX Science Meeting & I.A.G./A.I.G. SEDIBUD Workshop

ESF Network SEDIFLUX & I.A.G. Working Group SEDIBUD
http://www.ngu.no/sediflux, http://www.esf.org/sediflux
http://www.geomorph.org/wg/wgsb.html

Fourth ESF SEDIFLUX Science Meeting & First Workshop of I.A.G./A.I.G. SEDIBUD

Source-to-Sink–Fluxes and Sediment Budgets in Cold Environments

October 29th – November 02nd, 2006

Location

Geological Survey of Norway (NGU)
Leiv Eirikssons vei 39
N-7491 Trondheim
NORWAY
http://www.ngu.no

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Fourth ESF SEDIFLUX Science Meeting & First Workshop of I.A.G./A.I.G. SEDIBUD:

Source-to-Sink–Fluxes and Sediment Budgets in Cold Environments

Trondheim, Norway, October 29th – November 02nd, 2006

- **Introduction**
- **Science Meeting Programme and Schedule**
- **Extended Abstracts of Science Meeting Contributions**
- **Short Description of Field Trips**
- **List of Registered Participants of the Science Meeting**

Introduction

This Fourth ESF SEDIFLUX Science Meeting and First I.A.G./A.I.G. SEDIBUD Workshop builds on three previous ESF SEDIFLUX Science Meetings held in Sauðárkrókur (Iceland) in June 2004, Clermont-Ferrand (France) in January 2005 and Durham (UK) in December 2005. The theme of this Meeting is "Source-to-Sink-Fluxes and Sediment Budgets in Cold Environments". The Meeting is split between scientific presentations and workshop discussions focussed on the principle working groups of SEDIFLUX. The key aims of SEDIFLUX are to provide a framework for integrated, multidisciplinary research on sediment fluxes, sediment transfers, sediment budgets and climate change and to foster research collaboration between researchers in Europe and globally.

This Meeting will address the key aim of SEDIFLUX and SEDIBUD to discuss Sedimentary Source-to-Sink-Fluxes and Sediment Budgets in Cold Environments. Major emphasis will be given to consequences of climate change, scale issues, source-to-sink correlations, exogenous-endogenous interactions, and to the bridging among different geo-scientific fields as well as among geo- bio- and social sciences.

Central issues will be the discussion and further development of the SEDIFLUX Handbook, the development of further ideas to continue and to extend the scientific activities, which have been started within SEDIFLUX within the I.A.G./A.I.G. Working Group SEDIBUD (further definition of key test sites, etc.), and the development of contacts and collaborations between earth scientists in Europe and North America.

Changes in climate have a major impact on Earth`s surface systems, especially in high-latitude and high-altitude cold environments. Such changes have a major impact on sediment transfer processes. However, until now quantitative analysis of sediment transfers have largely been confined to other climatic zones, therefore a properly integrated study of source-to-sink sediment fluxes and sediment budgets in cold environments is long overdue. There is a wide range of high-latitude and high-altitude cold environments that need to be studied, from high arctic/Antarctic to subarctic/subantarctic, alpine and upland sites. This provides a great opportunity to investigate relationships between climate, vegetation cover and sedimentary transfer processes across a diverse range of cold environments, with the ability to model the effects of climate change and related vegetation cover adjustments through space-for-time substitution. There is now broad agreement among climatologists that global warming is occurring, the subject of the Science Meeting is therefore of vital interest for the whole world.

Climate change affects Earth surface systems all over the world but with arguable the greatest impact in high-latitude and high-altitude cold environments. In these areas climate change shapes earth surface processes not just by altering vegetation and human activities but also through its impact on frost penetration and duration within the ground surface layers. Climate change also exerts a strong control on cryospheric systems, influencing the nature and extent of glaciers and ice sheets, and the extent and severity of glacial and paraglacial processes. Changes within the cryosphere have major knock-on effects on glaciofluvial, aeolian and marine sediment transfer systems. All of these factors influence patterns of erosion, transport and deposition of sediments. However it is a major challenge to develop a better understanding of how these factors combine to affect sedimentary transfer processes and sediment budgets in cold environments. As a starting point our baseline knowledge of the sedimentary transfer processes operating within our current climate and under given vegetation cover, as a basis for predicting the consequences of future climate changes and related vegetation cover changes needs to be extended. Only when we have these reliable models will we have fuller understanding. It is therefore necessary to collect and compare data from different cold environments, and use this to assess a range of models and approaches for researching the relationships between climate change, vegetation cover and sediment fluxes.

The primary aim is to provide an integrated quantitative analysis of sediment transfers, nutrient fluxes and sediment budgets across a range of key cold environments. Such an analysis has so far been lacking. The major focus is on the impact on sediment transfer processes in response to a variety of climate change scenarios at a scale, which incorporates sediment flux processes from source to sink. In order to perform a fully integrated study of source to sink sediment fluxes and sediment budgets in cold environments, the Science Meeting analyses the key components of weathering, chemical denudation, erosion, aeolian processes, mass movements, fluvial transfers/transport, glacial sediment transfers, and sedimentation in lakes and coastal areas. Bringing these different weathering, erosion, transfer and sedimentation processes into one integrated study requires collaboration between a variety of specialists working on the respective subjects. The Science Meeting is bringing together both leading and young scientists in these fields, and creating a unified approach that will take the research forward within the specific focus of climate change impact on the Earth surface. One of the great strengths is the wide variety of scientific fields being harnessed, including physical geography, Quaternary geology, geology, oceanography, limnology, civil engineering, ecology, biodiversity research, social sciences. The Meeting is also considering the impact of human activity on the environmental sites being studied and how this might relate to climate change.

Trondheim, October 2006

Achim A. Beylich

Science Meeting Programme & Schedule

Sunday, October 29th, 2006

13:30 – 17:00
ESF SEDIFLUX Steering Committee Meeting (NGU Møterom 1)

17:00 – 19:00
Registration of Workshop participants (Registration desk at NGU Foyer)

18:00
Reception for Workshop participants (with pizza, beer and softdrinks) (NGU Foyer)

Monday, October 30th, 2006

08:00 – 09:00
Registration of Workshop participants (morning coffee will be served) (Registration desk at NGU Foyer)

09:00 – 09:15
Opening of Fourth ESF SEDIFLUX and First I.A.G./A.I.G. SEDIBUD Workshop and Welcome to Trondheim (**Achim A. Beylich**) (NGU Møterom 2)

09:15 – 09:40
Overview of SEDIFLUX and SEDIBUD objectives,
Report from ESF Steering Committee Meeting and
Aims for this Workshop (**Achim A. Beylich**) (NGU Møterom 2)

Paper Presentations (NGU Møterom 2)

09:40 – 10:20
Invited Keynote Lecture:
Olav Slaymaker (Vancouver): Source-to-Sink and Sediment Budget Studies in Cold Environments under the influence of Global Change

10:20 – 10:50
Review of the SEDIFLUX Process (2004 – 2006) by **Olav Slaymaker**

10:50 – 11:15
Coffee (Outside Møterom 2)

Paper Session 1

Chairs: Jukka Käyhkö & Karl-Heinz Schmidt

11:15 – 11:30
Thomas Geist (Innsbruck): Monitoring surface elevation and volume changes in glacial and periglacial environments with laser scanning technology

11:30 – 11:45
Niels Nygaard (Uppsala) & Else Kolstrup (Uppsala): Detailed geomorphological mapping: a potential with sediflux assessment

11:45 – 12:00
Vladimir R. Belyaev (Moscow): Impact of long-range pipeline construction and exploitation on geomorphic processes in cold environments

12:00 – 12:15
Andreas Kellerer-Pirklbauer (Graz), Gerhard Karl Lieb (Graz) & Michael Avian (Graz): Supraglacial debris entrainment by the Pasterze Glacier, Austria

12:15 – 12:30
Bernd Etzelmüller (Oslo): Mountain permafrost and its impact on sediment transport in the northern hemisphere - with examples from the northern hemisphere

12:30 – 12:45
Samuel Etienne (Clermont-Ferrand), Denis Mercier (Paris) & Olivier Voldoire (Clermont-Ferrand): Paraglacial evolution of Conway glacier complex foreland, Northwestern Spitsbergen, Svalbard

12:45 – 13:00
Emil M. Gachev (Bulgarian Academy of Sciences): Starting a Programme for the analysis and monitoring of sediment transfer processes in the periglacial zone of Bulgaria (Bulgarian Periglacial Programme)

13:00 – 13:50
Lunch (NGU Kantine)

13:50 – 14:30
Invited Keynote Lecture:
Ulf Molau (Göteborg): On the interface between ecology and geomorphology

14:30 – 15:00
Experiences with ITEX and Comments on the SEDIFLUX Handbook by **Ulf Molau**

15:00 – 15:30
Coffee (Outside Møterom 2)

15:30 – 17:45
Working Group Session 1 (Møterom 1, 2, 3)

19:00
Dinner (in central Trondheim)

Tuesday, October 31st, 2006

08:30 – 09:10
Invited Keynote Lecture:
Scott Lamoureux (Kingston): Watershed sediment and related fluxes: a perspective from the Canadian Arctic

09:10 – 09:45
Discussion on the development of contacts and collaborations between Earth scientists in Europe and North America

Paper Session 2:

Chairs: Fiona S. Tweed & Jeff Warburton

09:45 – 10:00
Ilona Bärlund (Helsinki), J. Koskiaho (Helsinki), Sirkka Tattari (Helsinki), A. Lepistö (Helsinki) & T. Huttula (Helsinki): Utilising spatially distributed monitoring data in model based sediment transport studies – a case study from south-west Finland

10:00 – 10:15
Willibald Kerschbaumsteiner (Vienna), W. Gattermayr (Innsbruck) & H. Habersack (Vienna): Temporal and spatial variability of suspended and bedload transport and their relevance for monitoring in an highly glaciated alpine catchment in Tyrol, Austria

10:15 – 10:30
Geir Vatne (Trondheim), Øyvind Takøy Naas (Trondheim), Achim A. Beylich (Trondheim) & Ivar Berthling (Trondheim): Bed load transport in a steep mountain stream, Vinstradalen, Norway

10:30 – 11:00
Coffee (Outside Møterom 2)

11:00 – 11:15
Lena Rubensdotter (Trondheim) & Gunhild Rosqvist (Stockholm): The significance of geomorphological setting and fluvial redeposition on sediment accumulation and composition in pro-glacial lakes

11:15 – 11:30
Richard M. Johnson (Lancashire), Jeff Warburton (Durham) & Alona Armstrong (Leeds): Spatial and short-term sediment budget dynamics of a mountain torrent

11:30 – 11:45
Ivar Berthling (Trondheim), Espen Fadnes (Trondheim), Reidun Onsøien (Elverum), Achim A. Beylich (Trondheim) & Geir Vatne (Trondheim): Sediment fluxes from debris flows, Vinstradalen, Oppdal, Norway

11:45 – 12:00
Ola Magne Sæther (Trondheim), Tor Erik Finne (Trondheim), Belinda Flem (Trondheim), Eiliv Steinness (Trondheim) & Gøran Åberg (Kjeller): Estimation of anthropogenic and geogenic lead in podzolic soils using isotopes of lead

12:00 – 12:15
Marc-Henri Derron (Trondheim) & Achim A. Beylich (Trondheim): Chemical denudation in Erdalen (Nordfjord, Norway), first estimations and numerical modelling

12:15 – 12:30
John C. Dixon (Arkansas), Colin E. Thorn (Illinois), Robert G. Darmody (Illinois) & Charles E. Allen (Santa Cruz): Spatial scale and chemical weathering in Kärkevagge, Swedish Lapland: Influences on landscape evolution

12:30 – 13:15
Lunch (NGU Kantine)

13:15 – 14:00

Poster Session (Outside Møterom 2)

Chairs: Achim A. Beylich, Hughes Lantuit & Þorsteinn Sæmundsson

Achim A. Beylich (Trondheim): Sediment transfers and sediment budgets in five small catchments situated in different cold environments in Iceland, Swedish Lapland, Finnish Lapland and Norway

Achim A. Beylich (Trondheim), Samuel Etienne (Clermont-Ferrand), Bernd Etzelmüller (Oslo), Vyacheslav V. Gordeev (Moscow), Jukka Käyhkö (Turku), Hugues Lantuit (Potsdam), Andrew J. Russell (Newcastle), Þorsteinn Sæmundsson (Sauðárkrókur), Karl-Heinz Schmidt (Halle/S.), Fiona S. Tweed (Stoke-on-Trend) & Jeff Warburton (Durham): The European Science Foundation (ESF) Network – Sedimentary Source-to-Sink-Fluxes in Cold Environments – (SEDIFLUX, 2004-2006)

Achim A. Beylich (Trondheim) & the SEDIBUD Team: The I.A.G./A.I.G. Working Group SEDIBUD – Sediment Budgets in Cold Environments: Introduction and Overview

Achim A. Beylich (Trondheim), Ulf Molau (Göteborg) & Carina Keskitalo (Umeå): Dynamics and Landscape Formation in Cold Environments

Robert G. Björk (Göteborg), Mats P. Björkma (Göteborg), Mats X. Andersson (Frederiksberg C) & Leif Klemedtsson (Göteborg): Temporal pattern of CO_2, CH_4 and N_2O fluxes and soil microbial structure from snow-covered Alpine plant communities

Marie Chenet (Paris): The slope development in South-East of Iceland: comparison between two recently deglaciated slope around the Skaftafellsjökull Glacier

Armelle Decaulne (Clermont-Ferrand) & Þorsteinn Sæmundsson (Sauðárkrókur): Reconstructing spatio-temporal patterns of snow-avalanche activity, and related debris transfer, using dendrogeomorphological analysis – preliminary results from northern Iceland

Regula Frauenfelder (Oslo): Debris transport by rockglaciers – a quantitative estimate for a small Alpine study site

Kari Grøsfjeld (Trondheim) & Jochen Knies (Trondheim): Modern dinocysts reflecting the influence of the Gulf Stream System in the Barents Sea, offshore Spitsbergen

Louise Hansen (Trondheim), Valentin Burki (Trondheim), Knut Stalsberg (Trondheim), Marc-Henri Derron (Trondheim), Raymond Eilertsen (Trondheim), Ola Fredin (Trondheim), Eiliv Larsen (Trondheim), Astrid Lyså (Trondheim), Atle Nesje (Bergen) & Jan Fredrik Tønnesen (Trondheim): Towards a quantification of long-term valley-fill accumulation of a deglaciated fjord-valley system, Nordfjord, Norway

Helgi Páll Jónsson (Turku): Annually laminated sediments studies from lake Pohjajärvi, Eastern Finland

Andrzej Kostrzewski (Poznan), Andrzej Mizgajski (Poznan) & Zbigniew Zwolinski (Poznan): Typology of Cross-Boundary Fluxes of Mineral Matter Between Geoecosystems of Ebbadalen, Central Spitsbergen

Hugues Lantuit (Potsdam), N. Couture (Montréal) & Paul Overduin (Potsdam): ACD II – Arctic Coastal Dynamics II – New project, new ambitions and possible connections with SEDIFLUX.

Malgorzata Mazurek (Poznan), Renata Paluszkiewicz (Poznan) & Zbigniew Zwolinski (Poznan): The geoecosystem of small tundra lakes on terrace levels of the Petunia Bay coast (Billefjorden, Central Spitsbergen)

Hanna Ridefelt (Uppsala): Spatial variability in solifluction processes in the Abisko region, northern Sweden

Erwan Roussel (Clermont-Ferrand): Post Little Ice Age changes in the proglacial fluvial pattern of the Morsarjökull (South of Iceland, Vatnajökull).

Inger-Lise Solberg (Trondheim), Louise Hansen (Trondheim) & Marc-Henri Derron (Trondheim): Long-term erosion of a Norwegian fjord-valley dominated by marine deposits

Witold Szczucinski (Poznan), Georg Schettler (Potsdam) & Marek Zajaczkowski (Sopot): Sediment accumulation rates, geochemistry and provenance in a complex high Arctic fjord, Hornesund, Svalbard

Ola Magne Sæther (Trondheim) & Gøran Åberg (Kjeller): Strontium isotope systematics in the Oppstryn drainage basin, western Norway

Susan Wache (Halle/S) & Achim A. Beylich (Trondheim): Investigations on the Dynamics and Sediment Budget of a Braided River System in Erdalen, Nordfjord, Western Norway

Paper Session 3

Chairs: Samuel Etienne & Bernd Etzelmüller

14:00 – 14:15
Etienne Cossart (Paris) & Monique Fort (Paris): Consequences of landslide dams on alpine river valleys: examples and typology from the French Southern Alps

14:15 – 14:30
Monique Fort (Paris): How does the scale of landslide dams affect the sediment budgets? A perspective from the Himalayas

14:30 – 14:45
Valentin Burki (Trondheim) & Eiliv Larsen (Trondheim): Glacially reworked sediments in Bødalen, western Norway

14:45 – 15:00
Witold Szczucinski (Poznan), Jan Scholten (Monaco) & Marek Zajaczkowski (Sopot): Impact of glaciers retreat on sediment accumulation rates in fjords – changes following "Little Ice Age" in Billefjorden, Svalbard

15:00 – 15:15
Jukka Käyhkö (Turku), Petteri Alho (Turku), Elina Haapala (Turku) & Eini Puoskari (Turku): Reconstruction of the largest Holocene jökulhlaup within Jökulsá á Fjöllum, NE Iceland, based on hydraulic modelling and sedimentary field evidence

15:15 – 15:30
Dag Ottesen (Trondheim) and Leif Rise (Trondheim): Volume calculations for glacial erosion in MidNorway during the last 3 million years and large-scale depositional pattern of the corresponding shelf

15:30 – 15:45
Coffee (Outside Møterom 2)

15:45 – 17:15
Working Group Session 2

17:15 – 18:15
Conclusions and discussion from the Fourth ESF SEDIFLUX and First I.A.G./A.I.G. SEDIBUD Workshop:
Comments and recommendations by Invited Guests, Experts and Keynote Speakers

18:15 – 18:30
Closure of Workshop by Steering Committee Chair (Achim A. Beylich)

20:00
Conference Dinner (in central Trondheim)

Wednesday, November 01st, 2006

09:00 – 16:00
Excursion (including Lunch at 12:00 in Tyholt Tower): Trondheim and Surrounding Areas

Field Guides:
Lars Olsen (Excursion Organiser) (NGU)
Harald Sveian (NGU)
Geir Vatne (NTNU, Department of Geography)

Science Meeting Presentations

Accepted Extended Abstracts

Utilising spatially distributed monitoring data in model based sediment transport studies – a case study from south-west Finland

Ilona Bärlund, Koskiaho, J., Tattari, S., Lepistö, A. & Huttula, T.

Finnish Environment Institute, PB 140, FI-00251 Helsinki, Finland

One aim of the CatchLake project (2006–2007, funded by the Finnish Funding Agency for Technology and Innovation) is to improve the use of catchment scale sediment and nutrient transport models utilising automated intensive measurements and long-term, spatially distributed monitoring data as well as remote sensing data. The case study area, the catchment of Lake Pyhäjärvi, situated in south-west Finland is surrounding a highly valuable lake in terms of professional fishery and recreational use. In this study, special emphasis is laid on the catchment of River Yläneenjoki (A = 234 km^2) draining into Lake Pyhäjärvi and contributing, according to previous assessments, over 50% of the total external total phosphorus load to the lake. Thus, one of the modelled variables is suspended sediment concentration since soil particles carry phosphorus from the catchment to the lake. Nutrient and suspended sediment concentrations have been monitored in River Yläneenjoki by taking and analysing, in general bi-weekly, water samples and measuring the daily water flow at one point. Furthermore, water quality has been monitored on a monthly basis in three additional points in the main channel in the 1990's and in 12 open ditches running into the River Yläneenjoki since the 1990's until present.

Mathematical models can be utilised to support decision-making. Models help to understand processes and mechanisms of ecosystems, and they can be used for testing scientific hypotheses, as well as for evaluation of scenarios concerning e.g. measures to reduce environmental loading. The exploitability of models, however, not only depends on the validity of the incorporated processes, but also on the available input data. The SWAT model, Soil Water Assessment Tool, was tested in a previous project (EU funded Benchmark Models for the Water Framework Directive, BMW) in this same Yläneenjoki catchment. It was found that calibration to one point is not sufficient to prove reliable functionality of a complex model like SWAT. Results from three additional points in the mainstream and 12 additional points at sub-catchment outlets indicated sediment transport dynamics within the catchment that were not correctly captured by this first SWAT calibration utilising data from one point only. The measured average suspended sediment concentrations for the years 1991-1995 indicate a rise in mainstream concentrations from the river mouth to the agriculturally intensive upper parts of the catchment – the simulation results show just the opposite. Further, the average suspended sediment concentrations measured at sub-catchment outlets indicate a good linear correlation between the average concentrations and the share of agricultural land in the sub-catchment (min. ~20 mg l^{-1} with 6% agricultural land and max. ~100 mg l^{-1} with 50% agricultural land, R^2 = 0.73). The first SWAT set-up could not reproduce this relationship but rather resulted in a constant average concentration of 20 mg l^{-1} with no change due to the share of agricultural land in the sub-catchment – indicating that the suspended sediment concentration in this first SWAT set-up is governed by in-stream processes in the sub-catchment rivulets of similar size rather than by eroded soil material transported from agricultural land.

Thus, one objective of the CatchLake project is to improve calibration with respect to data from these additional monitoring points. Secondly, continuous measurements on turbidity from the intensive flow period connected to snow melt (17.3.-3.5.2006) is utilised to quantify sediment transport at two different scales (sub-catchment outlet and downstream mainstream). The aim of this presentation is to give an overview of the CatchLake project and present first results on data analysis and improved model calibration.

Impact of long-range pipeline construction and exploitation on geomorphic processes in cold environments

Vladimir R. Belyaev

The Laboratory of Soil Erosion and Fluvial processes, Faculty of Geography, Moscow State University, 119992, Moscow, Russia

Cold northern regions of Russia contain large amounts of natural hydrocarbon recourses. Transport of crude oil and gas from recovery fields is normally carried out by means of high-capacity long-range pipelines. Those usually represent artificial structures in order of a few thousand kilometers long and up to few hundred meters wide. Construction of high-capacity long-range pipelines is associated with substantial impact on natural environment. First of all, natural vegetation and soil cover become completely destroyed along the entire route of a pipeline system corridor, as well as at sites of auxiliary constructions. Secondly, serious modification of local topography also often occurs, involving grading of steep slopes, leveling of uneven surfaces, possible profound changes of morphology of small and medium stream channels. Thus, it can be concluded that such pipelines should be considered as large-scale anthropogenic features of the landscape. However, as it is being increasingly understood at present, very little attention has been paid so far to their impact on natural set of geomorphic processes and landscape functioning. It seems to be especially important for cold environments such as northern taiga and tundra. Those are extremely vulnerable to human impact because of weak, brittle and slowly-recovering soil and vegetation cover in combination with dynamic surface processes related to presence of a permafrost.

This paper presents some results of the ongoing investigations of modern geomorphic processes and their recent acceleration along routes of existing and currently constructed long-range pipelines. The work has been carried out over the last few years in northern taiga and tundra environments. It has concentrated along the "SRTO-Torzhok" long-range gas pipeline connecting the Yamal peninsula gas fields with redistribution stations within the central part of European Russia. There have been a few separated research projects funded by contracts with one of the "Gazprom" branches directly responsible for the construction of the both new gas pipelines. Main attention has been paid to pipeline crossings with river valleys of various sizes. Those are sites where the most intensive geomorphic processes are expected to occur, both under natural conditions and in environments severely disturbed by human activities associated with a pipeline construction.

Continuous monitoring of geomorphic processes at a number of selected pipeline crossings with river valleys has now been carried out for 2-3 years. It involved repeated surveys of the key sites 2 or 3 times per year with measurements of selected quantitative parameters indicating intensity of various geomorphic processes. Main conclusion drawn from the data collected by now is that pipeline crossings with medium-size rivers represent the relatively largest risk in terms of possible acceleration of geomorphic processes, especially channel bank and bed erosion as well as sheet, rill and gully erosion on valley slopes. This can be explained by the fact that at pipeline crossings with large rivers all applicable constructional regulations and project decisions are carefully followed, whereas at crossings with small rivers in the studied landscapes natural rates of geomorphic processes is too low to produce risks of serious acceleration. Case study examples of various degree of mutual effects of pipeline construction activities and accelerated geomorphic processes on each other will be presented and discussed. Brief examples will also be given of possible approaches to minimize the environmental impact of pipeline constructions and, adversely, detrimental effects of accelerated geomorphic processes on a pipeline system functioning.

Sediment fluxes from debris flows, Vinstradalen, Oppdal, Norway

Ivar Berthling [1], Espen Fadnes[1], Reidun Onsøien[2], Achim A. Beylich[1, 3] & Geir Vatne [1]

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Vinstradalen is a steep tributary catchment to Drivdalen, entering the main valley about 10 km south of Oppdal. The catchment comprises two distinct sub-catchments with quite differing properties. The northern part is a semicircular basin and the river is incised in ravine-like channels. The southern sub-catchment follows a fault line towards the Dovrefjell plateau. This sub-catchment has a pronounced relief and steep debris-mantled slopes, enabling the coupling of slope and channel systems during low frequency-high magnitude events. Historical documentation and recent events show that this catchment is prone to react violently to extreme meteorological events. In August 2003, a number of debris slides and flows were triggered within the catchment, causing very high fluvial sediment transport down-channel that eventually destroyed or damaged the bridges were the E6 and the Oslo-Trondheim railroad line cross the river. Investigations in Vinstradalen were started by the Department of Geography, NTNU, in 2004. These studies cover both the slope and the channel systems.

The morphometric characteristics of about 50 debris flows triggered during the 2003-event were measured in the field, and form the basis for calculating the mass transport along the slopes and partly down into the river due to this specific event. The slide scarps and channels from the 2003 event also made sections available for investigations. A few datings of organic horizons buried by colluvium were obtained in 2005. From the amount of colluvium above theses layers, estimates of average sediment accumulation from specific slope areas can be obtained.

Sediment transfers and sediment budgets in five small catchments situated in different cold environments in Iceland, Swedish Lapland, Finnish Lapland and Norway

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Quantitative and longer-term process geomorphological studies on sediment transfers and sediment budgets have been carried out and will be continued in five selected small catchments (<30 km^2) situated in cold environments in Iceland, Swedish Lapland, Finnish Lapland and Norway. Investigations in East Iceland (Austdalur and Hrafndalur), northernmost Swedish Lapland (Latnjavagge) and northern Finnish Lapland (Kidisjoki) have been conducted for over five years whereas studies in western Norway (Erdalen) have just been started two years ago. The five catchments are seen as clearly defined landscape units where detailed quantitative process geomorphological studies on sediment transfers and sediment budgets are possible. The application of unified techniques and approaches (including both the longer-term monitoring of relevant present-day denudative processes as well as the quantitative analysis of storage elements like lake sediments, talus cones, valley fillings, etc.) creates comparable data sets on present-day fluxes and budgets as well as Holocene sediment budgets from the different cold environments. The five catchments are considered to be representative for the selected target areas in East Iceland, northernmost Swedish Lapland, northern Finnish Lapland and western Norway.

The research programme (NGU Source-to-Sink Fluxes in Cold Environments) is carried out in collaboration with partners at geo- and bio-scientific institutions in Iceland, Sweden, Finland, Germany and Norway. The main focus is on analysing the role of the factors morphoclimate, vegetation cover, ground frost, ice cover, human impact, relief and lithology for present-day sediment fluxes, denudation rates, sediment budgets and trends of relief development in the five different study areas. Direct comparison of the data collected in the different cold environment target areas provides information on variations in the absolute and relative quantitative importance of different relevant denudative processes and contributes to getting more understanding of the spatial differentiation of cold environments and its dependency on environmental factors and human impact.

The two selected catchments in sub-Arctic oceanic East Iceland are characterized by very steep alpine relief and a partly destroyed vegetation cover (as caused by direct human impact). Mechanical denudation dominates over chemical denudation. Austdalur (basalt) is showing lower mechanical denudation rates than Hrafndalur (less resistant Rhyolites). The slightly less steep Latnjavagge in Arctic-oceanic Swedish Lapland (mica schist) is characterized by clearly lower mechanical denudation rates, which is mainly due to a very stable and closed vegetation cover and stable step-pool systems developed in the creeks. In this valley chemical denudation appears to be slightly higher than mechanical denudation. Kidisjoki in sub-Arctic Finnish Lapland (gneisses) is situated in the low-relief area of the Baltic Shield and shows very low chemical and mechanical denudation rates. Chemical denudation dominates slightly over mechanical denudation.

All four catchments are characterized by altogether low denudation rates. Chemical denudation ranges from 2.6 t $km^{-2}yr^{-1}$ in Kidisjoki to ca 8 t $km^{-2}yr^{-1}$ in East Iceland. All four valleys are characterized by restricted sediment availability. More than 90 % of the annual fluvial sediment transport occurs within a few days during snowmelt and/or rainfall generated peak-runoff. Only in the very steep catchments with partly destroyed vegetation cover in East Iceland mechanical denudation dominates significantly over chemical denudation. The very steep Erdalen in the Nordfjord area in western Norway, which is connected to the Jostedalsbreen glacier and in its uppermost areas partly glaciated (Erdalsbreen), shows low chemical denudation but significantly higher mechanical denudation than the other four valleys, which are not glaciated and less steep than Erdalen.

The European Science Foundation (ESF) Network -Sedimentary Source-to-Sink-Fluxes in Cold Environments- (SEDIFLUX, 2004 - 2006)

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Climate change will cause major changes in the Earth surface systems and the most dramatic changes are expected to occur in the cold climate environments of the Earth. Cold climate landscapes are some of the last wilderness areas containing specialized and diverse plants and animals as well as large stores of soil carbon. Geomorphologic processes, operating at the Earths` surface, transferring sediments and changing landforms are dependent on climate, vegetation cover and human impacts and will be significantly affected by climate change.

In this context it is a major challenge to develop a better understanding of the complex ecosystems and the mechanisms and climatic controls of sedimentary transfer processes in cold environments. More reliable modelling of sediment transfer processes operating under present-day climatic settings is needed to determine the consequences of predicted climate change. It is necessary to collect and to compare data and knowledge from a wide range of different high latitude and high altitude environments and to develop more standardised methods and approaches for future research on sediment fluxes and relationships between climate and sedimentary transfer processes. In Europe the wide range of high-latitude and high-altitude cold environments provides great potential to investigate climate-process relationships and to model the effects of climate change by using space-for-time substitution.

The highly relevant questions to be addressed need a multidisciplinary approach and the joining of forces and expertise from different scientific fields. Especially a closer cooperation between geoscientists and biologists / ecologists is needed. The ESF Network "Sedimentary Source-to-Sink-Fluxes in Cold Environments" (SEDIFLUX, 2004 – 2006), is bringing together leading scientists, young scientists and research teams from different fields. The large number of projects run by the ESF Network participants demonstrates the high level of research activity of scientists working on sediment fluxes in different cold environments. The Network forms a framework for an integrated and multidisciplinary investigation of the research topic and serves as a catalyst for strengthening and extending contacts and exchange.

The Steering Committee of SEDIFLUX consists of scientists from seven countries: Achim A. Beylich (Co-ordinator of SEDIFLUX), Trondheim, Norway; Samuel Etienne, Clermont-Ferrand, France; Bernd Etzelmüller, Oslo, Norway; Vyacheslav V. Gordeev, Moscow, Russia; Jukka Käyhkö, Turku, Finland; Hugues Lantuit, Potsdam, Germany; Andrew J. Russell, Newcastle, UK; Karl-Heinz Schmidt, Halle/S., Germany; Þorsteinn Sæmundsson, Sauðárkrókur, Iceland; Fiona S. Tweed, Staffordshire, UK; Jeff Warburton, Durham, UK.
SEDIFLUX is organized in different Working Groups: 1. Selection of critical test catchments, 2. Analysis of geographical and geological settings of test catchments, 3. Analysis of present-day sediment fluxes, 4. Integration and data management.

Network activities include four SEDIFLUX Science Meetings in Sauðárkrókur, Iceland (June 2004), Clermont-Ferrand, France (January 2005), Durham, UK (December 15th- 19th, 2005) and Trondheim, Norway, October 29th – November 02nd, 2006, Steering Committee Meetings attached to these Science Meetings, a Session on *Hydrology and sediment fluxes in permafrost regions* co-organized by ESF SEDIFLUX at the 2nd European Permafrost Conference in Potsdam, Germany (June 12th-16th, 2005), Journal Publications (Special Issues), Publication of Abstract Volumes, Publication of a SEDIFLUX Handbook (including guidelines for longer-term monitoring programmes in selected cold climate catchments), development of a SEDIFLUX Database, and the diffusion and dissemination of Network activities and outputs by using electronic media (Web pages, Newsletters, Forum, etc.).

A strong monitoring and operational data collection and more standardized methods will provide a baseline for the development of reliable models and for future research in the changing cold environments. ESF SEDIFLUX (2004 – 2006) continues in form of the new I.A.G./A.I.G. Working Group *Sediment Budgets in Cold Environments* (SEDIBUD) (2006 – 2009) (http://www.geomorph.org/wg/wgsb.html).

Apart from further collaborations and collaborative research activities several project and programme proposals both at national and at international level (IPY, ESF, EC) have been initiated. For further information see http://www.ngu.no/sediflux, http://www.esf.org/sediflux and http://www.geomorph.org/ wg/wgsb.html.

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The I.A.G./A.I.G. Working Group SEDIBUD – Sediment Budgets in Cold Environments: Introduction and Overview

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The new I.A.G./A.I.G. Working Group SEDIBUD (Sediment Budgets in Cold Environments) builds up on activities which were started within the European Science Foundation (ESF) Network SEDIFLUX (Sedimentary Source-to-Sink Fluxes in Cold Environments, 2004 - 2006) (see: http://www.ngu.no/sediflux, http://www.esf.org/sediflux). I.A.G./A.I.G. SEDIBUD shall run for at least four years from 2006 – 2009.

Changes in climate have a major impact on Earth`s surface systems, especially in high-latitude and high-altitude cold environments. Such changes have a major impact on sediment transfer processes. However, until now quantitative analysis of sediment transfers have largely been confined to other climatic zones, therefore a properly integrated study of source-to-sink sediment fluxes and sediment budgets in cold environments is long overdue. There is a wide range of high-latitude and high-altitude cold environments that need to be studied, from high Arctic / Antarctic to sub-Arctic / sub-Antarctic, alpine and upland sites. This provides a great opportunity to investigate relationships between climate, vegetation cover and sedimentary transfer processes across a diverse range of cold environments, with the ability to model the effects of climate change and related vegetation cover adjustments through space-for-time substitution. There is now broad agreement among climatologists that global warming is occurring, the subject of SEDIBUD is therefore of vital interest for the whole world.

Climate change affects Earth surface systems all over the world but with arguable the greatest impact in high-latitude and high-altitude cold environments. In these areas climate change shapes earth surface processes not just by altering vegetation and human activities but also through its impact on frost penetration and duration within the ground surface layers. Climate change also exerts a strong control on cryospheric systems, influencing the nature and extent of glaciers and ice sheets, and the extent and severity of glacial and paraglacial processes. Changes within the cryosphere have major knock-on effects on glacifluvial, aeolian and marine sediment transfer systems. All of these factors influence patterns of erosion, transport and deposition of sediments. However it is a major challenge to develop a better understanding of how these factors combine to affect sedimentary transfer processes and sediment budgets in cold environments. As a starting point our baseline knowledge of the sedimentary transfer processes operating within our current climate and under given vegetation cover, as a basis for predicting the consequences of future climate changes and related vegetation cover changes needs to be extended. Only when we have these reliable models will we have fuller understanding. It is therefore necessary to collect and compare data from different cold environments, and use this to assess a range of models and approaches for researching the relationships between climate change, vegetation cover and sediment fluxes.

The primary aim of I.A.G./A.I.G. SEDIBUD is to provide an integrated quantitative analysis of sediment transfers, nutrient fluxes and sediment budgets across a range of key cold environments. Such an analysis has so far been lacking. The major focus is on the impact on sediment transfer processes in response to a variety of climate change scenarios at a scale, which incorporates sediment flux processes from source to sink. In order to perform a fully integrated study of source to sink sediment fluxes and sediment budgets in cold environments, SEDIBUD analyses the key components of weathering, chemical denudation, erosion, aeolian processes, mass movements, fluvial transfers/transport, glacial sediment transfers, and sedimentation in lakes and coastal areas. Bringing these different weathering, erosion, transfer and sedimentation processes into one integrated study requires collaboration between a variety of specialists working on the respective subjects. SEDIBUD is bringing together both leading and young scientists in these fields, and creating a unified approach that will take the research forward within the specific focus of climate change impact on the Earth surface. One of the great strengths is the wide variety of scientific fields being harnessed, including physical geography, Quaternary geology, geology, oceanography, limnology, climatology, civil engineering, paleobiology, ecology, biodiversity research, social sciences. SEDIBUD is considering the impact of human activity on the environmental sites being studied and how this might relate to climate change. SEDIBUD is able to build on existing and earlier work carried out in the selected test areas, especially in the fields of geomorphology, quaternary geology, ecology, biodiversity research and social sciences. Indeed the large number of current related research projects highlights the great interest that already exists in this field.

More information on I.A.G./A.I.G. SEDIBUD can be found at: http://www.geomorph.org/wg/wgsb.html.

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Dynamics and Landscape Formation in Cold Environments

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Within Europe there is a wide array of high-latitude and high-altitude landscapes, covering a significant proportion of the total land area. These cold climate landscapes represent a variety of stages of deglaciation history. We can find landscapes at different levels of postglacial stabilization providing the unique possibility to study the interactions between geo-, bio- and social systems at the land surface.

The proposed Programme DYNACOLD (Dynamics and Landscape Formation in Cold Environments) shall bridge among geo-, bio- and social sciences in order to investigate the complex dynamics of stabilization, succession and landscape formation during and after ice retreat and under human impact. The proposed Programme shall provide an interdisciplinary forum where research groups – representing a wide range of geo-scientific, ecological, genetic and social sciences fields – can come together, a cross-disciplinary integration that has hitherto rarely been brought about. DYNACOLD shall create a new level of interactions between fields with traditional communication problems.

DYNACOLD includes a number of European cold environment target areas, including also areas in Finland, Sweden, Norway, Greenland and Iceland. The outcomes are expected to be relevant for a wide array of end users, including risk assessment, sustainable land use, land management and conservation. Also questions of utmost importance with regard to Global Change are addressed (hazards, permafrost degradation, loss of biodiversity in all of its aspects, etc.).

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Temporal pattern of CO_2, CH_4 and N_2O fluxes and soil microbial structure from snow-covered Alpine plant communities

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Global warming is expected to have large effects on carbon exchange between the biosphere and the atmosphere in the Arctic. Arctic ecosystems, which can be a net sink in the summer, are often a net source of CO_2 to the atmosphere on an annual basis. Few studies on winter CO_2 and CH_4 efflux have been conducted in the subarctic part of Sweden. So far, no integrated estimates of winter fluxes of CO_2, CH_4 or N_2O has been reported from the alpine areas in the Scandinavian mountains. As much as 44 to 53% of the northern hemispheres landmass may be snow covered for parts of the year. The depth and spatial spread of snow cover is a result of moisture availability, duration of temperatures bellow 0ºC, storm frequency and the more local factors such as wind redistribution and compaction. In future climate scenarios, predictions of warmer climate and increased precipitations are often mentioned, but to which extent is more uncertain. However, the major changes in precipitation will occur over the North Pacific, North Atlantic and Scandinavia.

The controlling factor for microbial activity in the organic layer during winter in alpine areas is the development of a consistent snow cover, which effectively decouples the soil from the atmospheric temperature. The air and soil temperature the days before snow cover development is important, as it sets the temperature conditions for the whole winter period. Soil microbial activity is markedly reduced below temperatures of 0 to -5°C, when the soil starts to freeze and free water becomes limited. Nitrogen mineralisation, nitrification and denitrification can, however, be maintained down to -4°C, and N_2O production (from denitrification) in frozen soils has potential to affect annual dynamics and budgets of N (although the soil pore water content prior to freezing is an important regulating factor for winter N_2O production). Snowbed communities are rarely, if ever, subjected to temperatures as low as -5°C, which implies that they may be favourable for microbial activity during the winter. Furthermore, tundra soil microbial biomass reaches its annual peak under snow, and fungi account for most of the biomass. However, how the microbial community changes during winter and snowmelt are poorly know and, in particular, in relation to trace gas fluxes.

Flux of CO_2, CH_4 and N_2O through a seasonal snowpack, using Fick's law, from four plant communities with different snow regime and how it changes during snowmelt in the subarctic-alpine part of Sweden will be presented. We will also try to relate the trace gas fluxes to the soil microbial community composition using phospholipid fatty acid analysis.

Glacially reworked sediments in Bødalen, western Norway

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Our investigation of terminal moraines in the Bødalen valley indicates a multiple source of glacially reworked sediments. The valley is host to the Bødalsbreen glacier, a westerly outlet from Jostedalsbreen ice cap. A set of terminal moraine ridges was formed distally to a proglacial lake by a renewed Jostedalsbreen ice cap after the Holocene climatic optimum. After reaching its maximum Little Ice Age position (a.d. ~1755), the glacier retreat was punctuated by several minor re-advances forming eight main moraine ridges. The end-moraines are up to 9 m high, with steep distal- and gentle proximal slopes, whereas the lateral moraines are only 2-3 m high. The end-moraines contain fine-grained, matrix-supported sediment, while the lateral moraines are composed almost exclusively of boulders, lacking fine sediment. The high proportion of fines in the end-moraines is attributed to minor readvances recycling proglacial lake sediments. Roundness measurements of boulders and pebbles in the moraine ridges result in different sediment sources. Angular boulders are especially found on the distal side of the lateral moraines. They derived either from rock fall on to the ice or directly on the lateral moraine. The high proportion of rounded boulders in the lateral moraines is remarkable and we regard the transport distance to be too short to explain the rounding. We hypothesize that these boulders instead have experienced several cycles of transport – deposition, and that their source was in a subglacial position further upstream on the glacier

The slope development in South-East of Iceland: comparison between two recently deglaciated slope around the Skaftafells-jökull Glacier

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The Global Warming, which affects Iceland since the end of the Little Ice Age, has caused an important retreat of the glacier fronts. On recently deglaciated slopes, news dynamics occur.
Thus, in the South-East of Iceland, the Skaftafellsjökull Glacier, an outlet of the Vatnajökull ice cap (8400 km²), moved back ca. 2 km since the end of the 19th century. The basaltic slopes, which have been deglaciated, show different facies on both sides of the glacier. The western slope is characterised by destruction of glacial polishes, which leads to the formation of talus and block falls, whereas the eastern slope shows series of cones linked to the triggering of debris flows (doc. 1).
A reconstitution of the glacier retreat (use of aerial photographs and dating of the moraines by lichenometry) and a field study lead to show different models of slope development according to the position of the trimline on the slope.
Indeed, the western slope has been almost totally glaciated (doc. 1a). The retreat of the glacier involve a post-glacial distress, which generate rock-slope failures. The disturbance of the slope, compound with frost action, causes processes of rockslides and rockfalls.
The eastern slope has been only partially glaciated (doc. 1b). Immediately after the departure of the glacier, the slope undergoes processes of rockslide and rockfall, but their marks are quickly erased by the contribution of debris flows which trigger at the top of the slope. Thus, the dynamics of the non-englaciated slope mask the effect of glaciation of the Little Ice Age.
This example shows the importance of the position of the trimline in the slope paraglacial development.

a)

b)

Doc. 1.
(a) The western slope of the Skaftafellsjökull Glacier and the LIA-trimline. The slope is characterised by rockslide and rockfall processes.
(b) The eastern slope of the Skaftafellsjökull Glacier and the LIA-trimline. The slope shows series of cones, linked to the release of debris flows.

Consequences of landslide dams on alpine river valleys: examples and typology from the French Southern Alps

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Landslide dams are common features in mountain environments, and they may develop at all spatial and temporal scales (Costa and Schuster, 1988). At local scale, they control the longitudinal profile of rivers and the spatial pattern of sedimentary storage units, whereas at the catchment scale, they influence sediment fluxes, transfers and storages. Such controls are quite prominent in tectonically active mountains such as the Himalayas, where the magnitude and duration of landslide dams depends mainly on both uplift and river incision rates, and subsequently on the possibilities of landslide mass removal (Hewitt, 2002; Fort 2006). In most of the mountains however, landslide dams are spatially restricted and their impact may greatly vary according to the nature of the material and stability of the dam, the bedrock topography, the rate of water inflow and, more generally, to the modalities of hillslope-channel interactions.

We present here a few examples selected in the French Southern Alps, in order to assess the durability of landslide dams, hence their overall influence on sedimentary fluxes in a moderately, tectonically active orogen. From a preliminary inventory, three sites were selected according to their position in the Alpine range and to the slope-failure mechanism at the origin of the dam. (1) The early Holocene Pré de Madame Carle rock-avalanche site, located in the external Alpine crystalline zone, corresponds to a very rugged terrain, where relief, post-glacial debuttressing forces, together with seismic activity and a dense faults network, determine a high rate of slope instability. (2) The early Holocene Chenaillet earth-flow site typifies the internal Alpine "schistes lustrés" zone, lithologically very prone to slope instabilities, in a context of moderately rugged terrain, low debuttressing forces, yet high seismic activity. (3) The historical Claps rock-fall site, documented by G. Brocard (2004), characterizes the Pre-Alpine zone, an area marginally glaciated, where alternating, thick marls and limestones folded series favour local slope instabilities.

Our approach was as follows. i) From geomorphologic survey and mapping, we reconstructed the extent of landslide deposits, identified and tried to date various generations of landslide runouts, if any; we established the cross section of the landslide mass in its valley and characterized the dam material (texture). ii) The geometry of the reservoir created upstream the dam and the volume of trapped sediments were assessed with the use of a DEM within a GIS. iii) Eventually, the geometry of post-depositional erosional features (gullying, superficial landsliding, river incision) was assessed to calculate the volume of the eroded landslide mass.

From the calculated volumes of sediment filling and dam erosion, it appears that the degree of river incision across the dam mainly varies as a function of local parameters: longitudinal slope and drainage pattern; type, size and permeability of the dam; current rate of sediment supply from upstream and adjacent slopes, etc. It also appears that landslide dams are persistent features, controlling the sediment fluxes long after their occurrence. Eventually, the limited extent of river incision may also indirectly reflect a geodynamic context characterized by moderate uplift rates.

References

Brocard G., 2004. Le grand lac du Claps de Luc-en-Diois (Drôme) : évaluation, à la lumière d'une analyse morphologique, du volume d'un lac comblé. *Bulletin de la Société Géologique de France*; 175 (3), 303-312

Costa J.E. and Schuster R.L., 1988. The formation and failure of natural dams. Geological Society of America Bulletin, 100, 1054-1068.

Fort M., 2006. Ephemeral natural dams in the Nepal Himalaya: types, geomorphic impacts and induced risks. European Geosciences Union Conference, Vienne (Austria) [http://www.cosis.net/abstracts/EGU06-A-06904.pdf]

Hewitt K., 2002. Postglacial landforms and sediments associations in a landslide-fragmented river system : the Transhimalayan Indus stream, Central Asia. In : Hewitt K. (ed.), Landscapes of transition, 63-91.

Reconstructing spatiotemporal patterns of snow-avalanche activity and related debris transfer using dendrogeomorphological analysis - Preliminary results from northern Iceland

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Slope processes are geomorphologic efficient in cold climate landscapes, and the international literature states that recurrent snow avalanches are responsible for significant sediment transfers, creating specific landforms. The geomorphologic impact of snow avalanches has recently been highlighted in Iceland. In the Fnjóskadalur valley, North Iceland, geomorphic evidences of different processes acting on slopes are preserved, while such proofs are removed in the surroundings of most of the coastal communities threatened by snow avalanches, especially those field evidences, which are connected to the maximal run-out distances of snow-avalanches. Therefore, the Fnjóskadalur valley is of special interest for hazard assessments and connected investigations on possible effects of Climate Change. Moreover, the Fnjóskadalur slopes are covered with birch (bushes and trees of *Betula pubescens*), which is offering a rare opportunity for dendro-geomorphologic investigations in Iceland.

By considering (1) the size of the trunks, (2) the growth disturbances of trees, (3) the vertical distribution of boulder impacts on stem surfaces, (4) the radial distribution of scars, (5) increment cores, the propagation of the snow-avalanche on the cone surface is highlighted, as well as its frequency. Furthermore, geomorphologic methods underline the furthest reach of snow-avalanche transported boulders. Such findings have major implications not only from a geomorphic point of view, but also for risk assessment and land management. They help illustrating the potential damages inflected by snow avalanches and boulders transported by snow-avalanches in inhabited areas, even at a longer distance from the slope.

References

Decaulne A. & Sæmundsson Þ., 2004. Present-day geomorphic efficiency of slope processes in the Icelandic Westfjords. Some considerations on snow avalanches and debris-flow impact. In A.A. Beylich, Th. Saemundsson, A. Decaulne & O. Sandberg [Eds.]: First Science Meeting of the European Science Foundation-Network SEDIFLUX, Extended Abstracts of Science Meeting Contributions, Náttúrustofa Norðurlands Vestra, NNV-2004-003, 32-33.

Decaulne A. & Sæmundsson Þ., 2006. Geomorphic evidence for contemporaneous snow-avalanche and debris-flow impact in the Icelandic Westfjords. *Geomorphology* (in press).

Sæmundsson Þ. & Decaulne A., 2005. Morphological impact of ground snow avalanches in Iceland. In S. Etienne [Ed.]: Second SEDIFLUX Science Meeting, Shifting Lands, new insights into periglacial geormophology, Mélanie Seteun, Clermont-Ferrand, pp. 98-99.

Sæmundsson Þ., 2000. Sedimentary transport with snow-avalanches. Does it occur? In A. Russell, M. Edge, O. Knudsen, J. Harðardóttir, C.J. Caseldine & F.S. Tweed [Eds.]: Iceland 2000, Modern processes and Past Environments, Keele, pp 101.

Sæmundsson Þ. & Decaulne A., 2005. Morphological impact of ground snow avalanches in Iceland. In S. Etienne [Ed.]: Second SEDIFLUX Science Meeting, Shifting Lands, new insights into periglacial geormophology, Coll. Géoenvironnement vol. 2, éditions Mélanie Seteun, Clermont-Ferrand, pp. 98-99.

Chemical denudation in Erdalen (Nordfjord, Norway), first estimations and numerical modelling

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Within the project SEDITRANS (processes and quantification of valley-to-fjord sediment transport), several approaches have been used to estimate the contribution of minerals dissolution to the overall flux of material. The catchment formed by the upper part of the valley of Erdalen, on an orthogneissic bedrock, and with elevation ranging from 460 to 1890 m a.s.l., has been selected for this purpose.

Chemical denudation is estimated by measuring the amount of minerals dissolved during a period of time with respect to a surface of reference. Two methods, at different time and space scales, have been applied:
1) Geochemical depletion of a moraine: The amount of matter dissolved since the deposition of a moraine is quantified by the method of Brimhall & Dietrich (1987) adapted to soil profiles (White 1995). The podzosoils developed on two 10000 years old moraines provide chemical denudation rates of 2 and 4 mm/ka. This method takes into consideration a small area (some m^2) during a relatively long period of time (10 ka).
2) Dissolved load in river water: A catchment sediment budget study for both solid and dissolved loads in Erdalen is in progress (c.f. A.A. Beylich). A preliminary estimation has been done by analysing some samples from creeks and springs waters. The amount of each mineral dissolved in one liter of water is estimated by thermodynamic modelling (a forward kinetic model). With an average annual precipitation of 1250 mm/a, a chemical denudation rate of about 4 mm/ka has been obtained. This estimation takes into consideration the entire surface of the catchment but is based on a very short period of time (only one year so far).

In addition, a numerical modelling of the chemical dissolution in the catchment is in progress. The aim is to provide maps of chemical denudation (or quantities of minerals dissolved in $g/m^2/a$), taking into consideration the topography, the spatial distribution of temperature, precipitation and bedrock mineralogy, and the thermodynamic properties of the minerals. It consists in coupling a thermodynamic calculator and a flow path model within a GIS.

Even if the suspended and bed-load budgets are not yet thoroughly investigated and quantified, it can be preliminarily estimated that the present-day chemical denudation rate in Erdalen is around one to three orders of magnitude inferior to the present mechanical denudation which was roughly estimated by Bogen (1989) to be in the scale of ~700 mm/ka.

Further longer-term investigations, including longer-term monitoring of denudative surface processes, are in progress (see Beylich, this volume) to get better quantitative estimations of the sediment fluxes and their spatio-temporal variability in the upper Erdalen catchment.

Spatial scale and chemical weathering in Kärkevagge, Swedish Lapland: Influences on landscape evolution

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Chemical weathering processes have now been firmly established as significant processes in effecting both strong erosion and denudation in the Arctic alpine valley of Kärkevagge, Swedish Lapland. Quantities of material removed as chemical load and the amount of landscape lowering have been established as being as important in this valley in Swedish Lapland as in other more temperate environments.

Controls on chemical weathering are observed to operate across several orders of magnitude. The dominant weathering controls fall into four fundamental categories: geological, hydrological, biological and climatic: the influence of each of these controls also changes with spatial scale.
Mineral grain scale geological controls are mineral grain size, chemistry and crystal structure. Hydrological controls primarily involve micro pore water movement. Biological controls involve the presence or absence of micro-organisms, or perhaps simply organic acids. Climate controls are related principally to moisture and temperature at the grain surface.

Millimeter scale geologic controls also include mineral grain arrangement as well as grain size, and mineral geochemistry. Hydrologic controls continue to be primarily micro pore water movement, but also includes surface water films. Biological controls include the presence of colonies of micro-organisms as well as individual organisms. Climate factors continue to be predominantly temperature and moisture, but also include other boundary layer effects such as boundary layer air movement and the presence/absence of ice .and aerosols.

Centimeter scale geological controls include geologic structures such as bedding and foliation as well as grain size and arrangement and geochemistry. Hydrologic factors include surface and pore water in both macro and micro pores, biological factors include the presence of bacterial mats and other biofilms as well as lichens and mosses. Climate controls are principally boundary layer climate parameters.

Meter scale, geologic controls are predominantly stratigraphy, structure, and tectonics, hydrologic controls include surface and subsurface channeled flows, biological controls include both micro and macro biological ecosystems, boundary layer climate parameters dominate.

Kilometer scale geological controls include stratigraphy, structure, and tectonics, hydrologic controls are those of the drainage basin, biologic controls are dominated by biomes present, and the climate control is regional climate.

Our observations of chemical weathering processes and related forms clearly indicate that there is strong spatial variability in the controls on weathering and hence sediment budgets in an Arctic environment.

Paraglacial evolution of Conway glacier complex foreland, Northwestern Spitsbergen, Svalbard

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This study aims to provide information concerning paraglacial evolution of landforms and sediments in a proglacial area in the Kongsfjorden area. Several subjects are emphasized:
1- chronology of deglaciation
2 - morphology of landforms
3 - sedimentology of deposits
4 –disintegration of the moraine complex by contemporary processes

1 – Study area
Conwaybreen catchment is located in the Kongsfjorden area on the western coast of Spitsbergen (79°N, 12°45'E). In 1980, this glacier was 16,6 km length and its area was estimated to 56,60 km², with an equilibrium line estimated to be *circa* 460 m a.s.l. During the Little Ice Age, Conwaybreen was in contact, on its right side, with a small glacier (about 3 km²) named Baronbreen, and at its front, Conwaybreen was in contact with the Feiringbreen (7,6 km²) (fig. 1). Culmination of the Little Ice Age occurred at the beginning of the XXth century in this part of Arctic, and many glaciers had their maximum Holocene extent at that time. The study area corresponds to the proglacial area of this glacial complex and is located just above contemporary sea level. Glaciers retreat had released huge volumes of melt water which have created several typical landforms and enhanced sediment fluxes. Both will be examined here.

2 – Landforms
The Conwaybreen foreplain consists on a patchwork of glacial and fluvioglacial deposits that are reworked or built by paraglacial processes. Morainic deposits, alluvial fans, lacustrines deposits or kame terrace have been identified. Their stratigraphic and sedimentologic characteristics help to reconstruct the evolution of the proglacial area during the heterochronic retreat of the three glacial tongues acting in the study area.

3 – Sediment analysis
Sediment analyses of a proglacial alluvial fan lying between the 2 glacial tongues reveal a succession of geomorphic events where high energy sedimentation alternates with low energy rythmic sedimentation (fig. 2). A glaciolacustrine sequence and a kame terrace suggest the temporary storage of Baronbreen meltwater behind an ice-dam built by the Conwaybreen front.

4 – Interpretation: Geomorphic sequence of ice retreat
A glacier retreat timetable will be proposed in a palaeogeographical reconstruction sequence based upon aerial photographs interpretation, and proglacial landforms analysis. Four stades can be identified:
1 – At the end of the LIA, Conwaybreen, Baronbreen and Feiringbreen show their maximum extent. Glacial dynamics built huge front and lateral moraines.
2 – The paraglacial sequence starts in the first years of the twentieth, with a glacial retreat clearly visible on 1936 aerial photographs. But the Baronbreen retreat is faster than the Feiringbreen and Conwaybreen, because it is a very small glacier which responds quickly to climate change. This differential retreat allows the Conwaybreen to dam meltwater and solid fluxes coming from the Baronbreen. So, a kame terrace and lacustrine deposits appear beside the glacial dam.
3 – The third stade is a paraglacial crisis inside the post-LIA paraglacial sequence: breakage of the mediane moraine between Baronbreen and Conwaybreen leads to the brutal release of the lake water (jökulhalup) which reworks sediments on the deglaciated foreplain of the Conwaybreen.
4 – The last and contemporary sequence corresponds to the destruction of the moraines (dead ice melting) and the paraglacial adjustement of slope deposits. Mud-flows and debris flows appear now as the most dynamic processes acting on these landforms. Alluvial fans and cones stand downstream. This dead-ice melting

dynamics is still and brutal at the same time and corresponds to different tresholds.

Conclusion

Palaeogeographic reconstructions, sedimentological results, analysis of accumulation forms, all contribute to show the strong energy of paraglacial dynamics in a geomorphological sequence of fast glacial withdrawal, under the impact of current climatic changes. The identification of the paraglacial deposits represents a considerable projection for the palaeo-environmental reconstructions. This sharp interpretation (the Conwaybreen glacier always records in 2006 a noticeable retreat) is new and makes it possible to understand the older deposits associated with former deglaciations in Spitsbergen and in the other fields having been englaciated in the world.

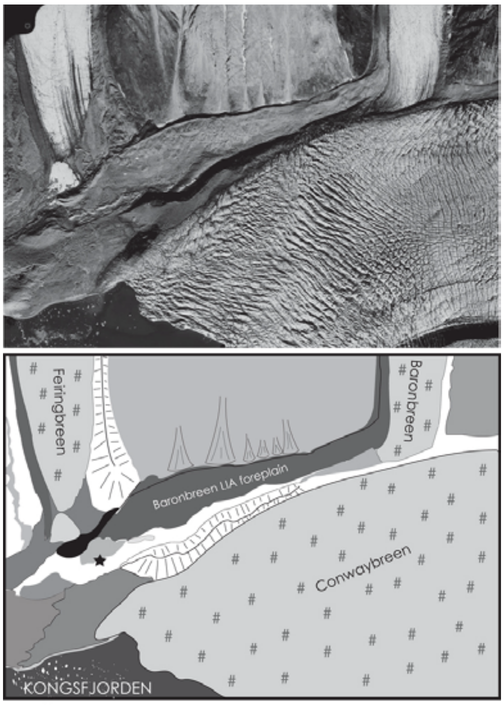

Figure 1. Aerial view of the Baronbreen glacial foreplain

★ sediment log

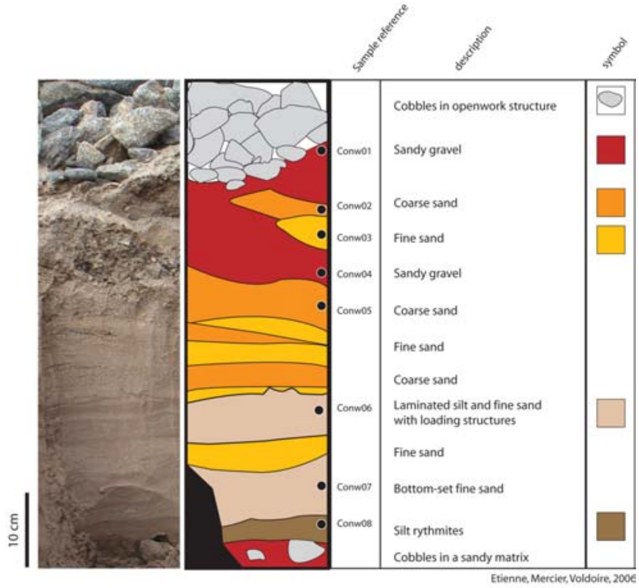

Figure 2 - Lithofacies of the Baronbreen fan, Spitsbergen

Permafrost as a governing factor for sediment availability and transport in mountainous regions – a conceptional frame work

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High mountains in Europe and North America were glaciated in varying extend during the Pleistocene and Holocene in contrast to more continental areas in northern Yukon, Alaska and parts of Siberia, which were never or only very marginally glaciated. Thus, in these formerly or presently glaciated mountains most of the sediment availability and mass flux can be described within the concept of paraglacial adjustment. The exhaustion rate of sediments within this framework is depending on different factors, such as bedrock geology, topography and climate. A consequence of certain climate factors is the evolution or prevalence of permafrost after early Holocene glacier retreat in core areas of many mountain chains. This presentation discusses conceptionally the influence of permafrost on paraglacial processes in the light of Ballantyne's (2002) paraglacial process modelling and land system evolution concepts.

Reference:

Ballantyne CK. 2002: Paraglacial geomorphology. Quaternary Science Reviews 21: 1935-2017.

How does the scale of landslide dams affect the sediment budgets? A perspective from the Himalayas

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Landslide dams are common features in tectonically active mountain ranges. They may occur at different spatial and temporal scale, and the conditions of their formation and failure are manifold (Costa and Schuster, 1988). Their impact on mountain stream, thus on sediment transfer, was recently revisited (Hewitt, 1998, 2002; Korup, 2002). Both temporary and permanent stream blockages influence sediment input into the stream channel at all stages of the dam evolution, from sediment trapping (incipient stage) to catastrophic debris flushing (dam failure). From examples selected in both the monsoonal and arid slopes of the Himalayas, we illustrate the various modalities of hillslope-channel coupling and dam stability as directly influencing the response of the fluvial system. We discuss the notion of scaling threshold. Whereas short-term dams (less than one year) directly supply the volume and control the longitudinal transfer of sediments along the river system, long-term dams (hundred- to thousand-years) spatially fragment and temporarily offset the sedimentary pathways at the catchment scale. Yet, it appears that these contrasts of scale are only apparent. We find that both the channel gradient and the nature (alluvial, lacustrine) of forced aggradation upstream the dams are prominent factors controlling the stream behaviour, the sedimentary fluxes and the fluvial system adjustment. Thus, the efficiency of high-magnitude low frequency processes *vs* low-magnitude high frequency processes is again questioned in this high energy environment.

References

Costa J.E. and Schuster R.L., 1988. The formation and failure of natural dams. Geological Society of America Bulletin, 100, 1054-1068.

Hewitt K., 1998. Himalayan Indus streams in the Holocene: glacier-, and landslide-“interrupted” fluvial systems. In Stellrecht I., Karakoram-Hindukush-Himalaya: Dynamics of change. 4, 1, Rüdgers Köppe Verlag, Köln, 3-28.

Hewitt K., 2002. Postglacial landforms and sediment associations in a landslide-fragmented river system: the Transhimalayan Indus stream, Central Asia. In Hewitt K. (ed), Landscapes of transition, 63-91.

Korup O., 2002. Recent research on landslide dams – a literature review with special attention to New Zealand. Progress in Physical Geography, 26, 2, 206-235.

Debris transport by rockglaciers – a quantitative estimate for a small Alpine study site

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Active rockglaciers are part of the mass movement system in mountainous areas. They creep downslope with velocities in the order of cm to dm per year, and despite this comparably slow movement, they can be seen as efficient debris transport agents. Jäckli (1957) estimated the mass turnover by active rockglaciers in the catchment area of the Rhine river to be in the order of 18*106 m3a-1, or in horizontally shifted mass: $8.5*10^9$ $mkga^{-1}$. Barsch (1977) estimated the horizontal mass transport by active rockglaciers for the entire Swiss Alps to be in the order of 400 to $650*10^9$ $mkga^{-1}$.

In the present study, we investigate the mass accumulation and relocation by rockglaciers in a small study site in the Eastern Swiss Alps by way of numerical modelling and inclusion of empirical data. The study site is 6 x 6 km large and comprises 29 rockglaciers and protalus rampart, 12 of which are active, 13 inactive and 4 relict. The applied model is based on the cellular automata approach by Von Neumann (1966). Cellular automata are dynamical systems in which space and time are discrete. The model allows the numerical simulation of the spatial and temporal evolution of rockglacier occurrence. The time scale considered encompasses the Holocene.

After a model run over 10'000 years, the total amount of rockglacier material in the study area adds up to $4.9*10^5$ m in 22044 cells of 25 m size. This equals $3.08*10^8$ m^3 of material, or a mean thickness of 20 m of the rockglacier material per cell. Taking an average density of the rockglacier material of 1.5 gcm^{-3} – as reported, for example, by Barsch *et al.* (1979), Wagner (1992), Vonder Mühll (1993), and Arenson (2002) – gives a total relocated mass of 4.6 10^8 t for the entire Holocene period, or in annual values, of $4.6*10^4$ ta^{-1}. Taking into account typical values for ice content by volume of active rockglaciers of up to 50 to 90% (cf. Arenson, 2002; Haeberli *et al.*, 1998; Vonder Mühll *et al.*, 2001) yields a total accumulation of debris (without ice) in the study area of $2.3*10^4$ ta^{-1} to $4.6*10^3$ ta^{-1}. Based on these values and estimating mean rockglacier lengths in the study area, horizontal transport rates will be calculated in the near future.

The amount of debris supplied to the rockglacier starting cells during the model run corresponds to roughly 3–4 mma^{-1} vertical accumulation. These values are in the same order as rock wall retreat rates estimated by Barsch (1977), but considerably higher than those found, for example, by Hofmann & Schrott (2002). Two reasons might explain the comparably high values attained during the modelling: (a) rockfall is often highest along faults and fault zones, and most talus cones are developed at the foot of such zones. In addition, rockfall is often channelled in gullies and along natural topographic breaklines. Altogether, this leads to concentrated debris accumulation on the talus slopes. (b) As mentioned above, ice content by volume in active talus-derived rockglaciers averages between 50 and 90%. Setting these values against the modelled numbers, gives modelled debris supply rates of 0.3–2 mm a^{-1}.

References

Arenson, L.U., 2002. Unstable alpine permafrost: a potentially important natural hazard. Variations of Geotechnical behaviour with time and temperature. PhD Thesis, ETH Zurich, 271 pp.

Barsch, D., 1977. Eine Abschätzung von Schuttproduktion und Schutttransport im Bereich aktiver Blockgletscher der Schweizer Alpen. Zeitschrift für Geomorphologie 28, 148–160.

Barsch, D., Fierz, H. and Haeberli, W., 1979. Shallow core drilling and borehole measurements in permafrost of an active rock glacier near the Grubengletscher, Wallis, Swiss Alps. Arctic and Alpine Research 11(2), 215–228.

Haeberli, W., Hoelzle, M., Kääb, A., Keller, F., Vonder Mühll, D., Wagner, S., 1998. Ten years after drilling through the permafrost of the active rock glacier Murtèl, Eastern Swiss Alps: answered questions and new perspectives. In: A.G. Lewkowicz and M. Allard (Eds.), 7th International Conference on Permafrost. Proceedings. Collection Nordicana. Centre d'Etudes Nordiques, Université Laval, Yellowknife, Canada, pp. 403–410.

Hoffmann, T. and Schrott, L., 2002. Modelling sediment thickness and rockwall retreat in an Alpine valley using 2D-seismic refraction (Reintal, Bavarian Alps). Zeitschrift für Geomorphologie 127, 153–173.

Jäckli, H. 1957. Gegenwartsgeologie des bündnerischen Rheingebietes: ein Beitrag zur exogenen Dynamik alpiner Gebirgslandschaften. Beiträge zur Geologie der Schweiz. Geotechnische Serie; Lfg. 36. Kümmerly & Frey, Bern: 136 pp. + 6 p. + 5 maps.

Vonder Mühll, D., 1993. Geophysikalische Untersuchungen im Permafrost des Oberengadins. PhD Thesis, ETH Zurich, 222 pp.

Vonder Mühll, D., Arenson, L. and Springman, S., 2001. Two new boreholes through the Murtèl-Corvatsch rock glacier, Upper Engadin, Switzerland. In: B. Rea (Ed.), 1st European Permafrost Conference, Rome, pp. 83.

Von Neumann, J., 1966. Theory of self-reproducing automata. Urbana, University of Illinois Press, 388 pp.

Wagner, S., 1992. Creep of Alpine permafrost, investigated on the Murtèl-rock glacier. Permafrost and Periglacial Processes 3(2), 157–162.

Starting a Programme for the analysis and monitoring of sediment transfer processes in the periglacial zone of Bulgaria (Bulgarian Periglacial Programme)

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The Programme introduced here is organized by the Institute of Geography of the Bulgarian Academy of Sciences. It aims at investigating and observing the dynamics of contemporary sediment transfer processes that occur in the Bulgarian periglacial zone in order to create a set of landscape models, which shall be used for predicting environmental reactions on global change and for qualitative and trustworthy risk assessment of environmental hazards. Realization of the Programme is considered to be of sufficient importance for the Institute and for Bulgarian science as a whole, because such kind of studies are lacking in the Bulgarian periglacial environment.

The realization of the Programme is supported by the following circumstances:
1. Existence of European and global networks for monitoring and research in cold environments (European Network SEDIFLUX funded by the European Science Foundation (ESF) and I.A.G./A.I.G. Working Group SEDIBUD, which coordinates activities of geomorphologists from many countries in Europe and throughout the world).
2. The presence of BEO "Musala" – a Basic Environmental Observatory that is situated on the highest peak of Bulgaria and the Balkan peninsula – Musala (2925 m a.s.l.). This station for complex environmental monitoring is a member of the European Network of High Mountain Observatories (HMO).
The Bulgarian periglacial zone includes parts of the two highest mountains in the country – Rila (2925 m a.s.l.) and Pirin (2914 m a.s.l.). Here - at altitudes above 2200 – 2300 m a.s.l. - some of the southernmost periglacial landscapes in Europe, formed in a relict Pleistocenic glacial landform complex, can be found. At present these landscapes exist in a transitional climate between temperate semi-continental and Mediterranean (mountain modification). Periglacial geomorphic processes are strongly influenced by surface lithology, and the two mountains, Rila and Pirin, provide two contrast types of periglacial environments, determined by bedrock differences: Silicate rocks (Rila) and carbonate rocks (parts of Pirin).

The Programme Team is convinced that the best way of integrating this research programme into the global science community is to include a selected part of the Bulgarian periglacial zone into the global network of I.A.G./A.I.G. SEDIBUD Test Sites. The most appropriate Bulgarian test site for this is the area around Musala Peak in Rila Mountain where a variety of processes in a homogeneous geology can be observed and where a scientific logistic base allows frequent visits and stays throughout the year.
At present, the Bulgarian Periglacial Programme consists of two modules – Rila module and Pirin module, which perform research with the use of one and same methods, which are applied in two not very large model sites – Musala cirque in Rila (area about 5 km^2) in granite rocks and the cirques Kazanite and Banski Suhodol in Pirin (area 10 km^2) in marbles. The following activities are projected in the programme concept:
1. Creation of a database (including GIS modelling); 2. Fieldwork referring to three main aspects: Landform mapping; Measurement of environmental parameters (weather and climate, water, soils and sediments);

Observation and analysis of contemporary processes (weathering, mass movement and accumulation, sediment budget, anthropogenically stimulated processes); 3. Analysis and modelling referring to three aspects: Analysis of Holocene evolution of the landscapes and of the tendencies of their future development; predictions of environmental reactions on Global Change scenarios; risk assessment of natural disasters; 4. Promotion, contacts, and public relations

The Programme should be performed in close collaboration with the European and Global scientific community, and with application of up-to-date methodologies, including a high level of standardization, which allows the comparison of results with results generated in other parts of the world. By essence, the Bulgarian Periglacial Programme is not a project; it is more intended to form a strategic line, which shall generate a series of project proposals that will ensure the fulfillment of all the planned tasks. The main goal of the Programme for now is to assure an international partnership on a broad basis.

Monitoring surface elevation and volume changes in glacial and periglacial environments with laser scanning technology

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Climate Change will affect geomorphologic processes in high-latitude and high-altitude cold environments significantly. Different conditions in the cryosphere will have major knock-on effects on sediment transfer systems. More reliable modelling of sediment transfer processes is needed to determine the consequences of climate change. Therefore, it is necessary to collect relevant data and knowledge.

Laser scanning is an up-to-date technology, which enables for an area-wide acquisition of topographical information with high resolution (1 data point / m^2 for airborne laser scanning) and high accuracy (better 1 m horizontal and better 0.2 m vertical for airborne laser scanning). Therefore, laser scanning can provide important fundamental information for many investigations. The most common products of the measurements are raster-type digital elevation models, but the use of the point cloud itself will have a high potential for future applications.

Since 2001 the Institute of Geography has carried out a total of 14 airborne laser scanning campaigns in glacial and periglacial environments, twelve at Hintereisferner (Ötztal Alps, Austria – ca. 40 km^2) and four at Engabreen (Svartisen ice cap, Norway – ca. 60 km^2), yielding multi-temporal topographic data sets of high significance for high mountain areas.

In this presentation the technology and the data acquisition in remote high-mountain terrain will be described and the potential of the data will be highlighted and discussed with results from the ongoing analysis of the multi-temporal data sets, e.g.:

Data quality assessment
Description and mapping of geomorphological processes
Quantification and interpretation of surface elevation and volume changes

Ongoing research is outlined, e.g. the analysis of the laser intensity signal in order to classify different surface types (e.g. snow, firn or ice areas on the glacier surface), the derivation of flow velocity fields, the automatic detection of crevasses and glacier outlines, the data visualisation, e.g. for educational purposes, and the use of terrestrial laser scanners.

Laser scanning has potential for further collaborative research activities within the SEDIFLUX community. The information derived can be used for the integrated and multi-disciplinary investigation and analysis of present day mass fluxes.

Modern dinocysts reflecting the influence of the Gulf Stream System in the Barents Sea, offshore Spitsbergen

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Geological Survey of Norway

Dinocysts in numerous surface samples, both inshore and offshore Spitsbergen in the Barents Sea, have been analysed. This is the first comprehensive dinocyst investigation of surface samples from this region. The results show that dinoflagellate cyst analysis is a useful tool for separating regions that have been influenced by the Gulf Stream System from areas that have no or restricted influence of such currents. The results illustrate the importance of dinocysts as a proxy to indicate past environmental conditions and climates and provide us with a tool to provide a detailed picture of past environmental conditions. Areas that are influenced by warm waters of the Gulf Stream System, are dominated by *Operculodinium centrocarpum* and contain a significant percentage of *Nematosphaeropsis labyrinthus*. Regions with restricted influence of this current are dominated by *Islandinium minutum*. In addition, the comparatively low cyst concentration inshore Spitsbergen compared to areas offshore reflects high sedimentation rates in the inshore areas.

Towards a quantification of long-term valley-fill accumulation of a deglaciated fjord-valley system, Nordfjord, Norway

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The west coast of Norway is dissected by numerous deep fjord-valleys that were occupied by valley glaciers during the last Ice Ages. These bedrock-confined valleys were generally cleared of unconsolidated sediments during the Weichselian glaciations. It follows that the present day valley fill accumulated primarily during and after the last major deglaciation of western Norway. Qualitative as well as quantitative studies of entire valley-fill systems are relatively few. The SEDITRANS project focuses on these topics to establish new valley-fill models, to compare these with existing models, and to increase the understanding of such systems in time and space.

In this case study we focus on a valley-fjord transect reaching from the lower end of Lake Strynevatnet to a present day out-let glacier of the Jostedalsbreen ice cap, the Erdalen glacier. The sediment fill in lake Strynevatnet has been investigated by extensive seismic profiling. The upstream valley, Erdalen, has been investigated with a combination of georadar and seismic refraction surveys. Together the geophysical surveys enable us to determine depth to bedrock beneath the lake and valley fill deposits, as well as outlining the main valley fill components.

Here we give a first approximation of the total volume of sediments that accumulated in lake Strynevatnet and in Erdalen following the last deglaciation. Local, ice-marginal accumulations help to establish a chronological framework for the valley-fill deposits, aiding assessment of the average accumulation rate for the deposits.

Spatial and short-term sediment budget dynamics of a mountain torrent

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Detailed quantification of sediment transport in mountain stream catchments is rare. Where measurements have been made these are generally related to a few high-magnitude events or have been averaged over longer periods of time. Here we describe a high-resolution record of coarse sediment supply, storage, and flux from a mountain torrent (Iron Crag) in the English Lake District. This is a small, steep catchment (area 2.4 ha, mean slope of 0.273 m m^{-1}) with a morphology consisting of multiple hillslope sediment sources, a main bedrock step-pool channel with gorge sections, and a basal fan. The sediment budget period runs between April 2002 and April 2003, and focuses on the catchment gully head. The site was visited approximately every two weeks, to collect data on sediment dynamics (hillslope traps, channel cross sections, and channel weir trap) and hydrometerological conditions (rainfall, temperature, evaporation, runoff, and channel discharge).

The sediment budget shows supply-limited and transport-limited sediment flux behaviour. It demonstrates coarse yield from the channel (6.1t), is dominated by episodic pulses separated by periods of relative inactivity. A thunderstorm in July 2002 accounts for 55% (3.4t) of measured output. Corresponding upstream observations and measurements of channel change highlight significant scour of the channel down to bedrock. Hillslope sediment supply is less sensitive, with the July 2002 event accounting for 8.6% of annual hillslope transfer (4.95t) to the channel zone. Conditions of transport-limited sediment delivery occur in response to local hydro-meteorological events. Significant factors include the intensity-duration of rainfall, seasonal variations in runoff response, and whether channel discharge is complicated by freezing and snowmelt conditions. Channel sediment supply and exhaustion are especially important to understanding catchment sediment yield. Furthermore, as annual hillslope supply, and channel yield are of similar quantity, it appears there is a near balanced evacuation of sediment from the gully head.

Annually laminated sediments studies from lake Pohjajärvi, Eastern Finland

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Lake Pohjajärvi (62.812°N, 28.039°E, 82.9 m asl) is located 20 km southeast of the town of Kuopio in eastern Finland. Its shape is elongated with a maximum length of 1.5 km. Its surface area is about 0.36 km^2 and the maximum water depth is 20 m. The regional bedrock is composed of quartz diorite and granite underlying Quaternary till. Two rivers, Juoperojoki and Joutenjoki, flow into the the lake on its western side, and the lake itself drains into the Saimaa complex (81.7 m a.s.l.) on the eastern side.

A previous study of the lake (Saarinen 1997) revealed clastic-organic varve structure with a clear seasonal succession: the light minerogenic layer forms when meltwater flows to the lake, chiefly in springtime, and the darker and more organic layer forms in summer and autumn, in relation with the biological activity in the lake and its catchment area. A couplet of light and a dark layer has been interpreted as a varve. By counting from fresh sediment surface, a varve chronology of 3200 years has been established. The study showed that deposition in the lake has been nearly linear during the last 3200 years, with a mean deposition rate of 1 mm/year.

As a complement, the objective of the present study is to establish a reliable chronology for a new core from lake Pohjajärvi, so other parameters can be studied in details (i.e. magnetic sucsceptibility and varve thickness) for further analysis of the sediment influx to the lake, and to locate erosional events in the catchment area together with their temporal distribution. The results will be compared with previous sediment studies in the lake.

The present study focuses on 2.6 m long sediment core from lake Pohjajärvi extracted from the lake in springtime 2006. The core was measured for magnetic susceptibility using split-core logging and MS2E spot reading sensor (Nowaczyk 2002). Samples from the core were prepared for digital image analysis by following the water-acetone-epoxy exchange method (Lamoureux 1994; Tiljander *et al.* 2002). Also, thin sections have been prepared from which x-radiographs have been made. The radiographs were scanned at high resolution and converted into digital images for further analysis.

The use of the WinGeol Lamination Tool (Mayer *et al.* 2006) is examined for the digital image analysis. The new software has been successfully tested on various annually banded samples from various environments. Here it will be applied to digital images of samples composed of clastic-organic varves and its performance will be evaluated.

References:

Lamoureux, S. F. 1994. Embedding unfrozen lake sediments for thin section preparation. *Journal of Paleolimnology 10, 141-146.*

Mayer, M.C., Faber R., Spötl, C. 2006. The WinGeol Lamination Tool: new software for rapid, semi automated analysis of laminated climate archives. *The Holocene 16, 5, 753-761.*

Nowaczyk N. R., 2001. Logging of magnetic susceptibility. *In Last & Smol (eds) Tracking Environmental Change Using Lake Sediments: Volume 1:Basin analysis, Coring and Chronological Techniques, Kluwer Academic Publishers, Dordrecht, The Neatherlands. 155-170.*

Saarinen T. 1997. High-resolution palaeosecular variation in northern Europe during the last 3200 years. *Physics of the Earth and Planetary Interiors 106, 299-309.*

Tiljander M., Ojala A., Saarinen T., Snowball I. 2002. Documentation of the physical properties of annually laminated (varved) sediments at a sub-annual to decedal resolution for environmental interpretation. *Quaternary International 88, 5-12.*

Reconstruction of the largest Holocene jökulhlaup within Jokulsá á Fjöllum, NE Iceland, based on hydraulic modelling and sedimentary field evidence

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Glacial outburst floods (jökulhlaups) have a significant role for landscape evolution in NE Iceland. A number of jökulhlaups have routed from the northern margin of Vatnajökull during the Holocene. In this study, we present a reconstruction of the largest Holocene jökulhlaup in Möðrudalur along Jökulsá á Fjöllum, and evaluate the accuracy of the reconstruction based on field evidence of fine sediments deposited by backwater ponding onto areas where flow velocity was near to zero. The hydraulic modelling was undertaken using the HEC-RAS model and HEC-GeoRAS flood mapping techniques with a Digital Elevation Model (DEM) derived from ERS-InSAR data and field-based wash limit evidence. Based on the hydraulic model, the largest jökulhlaup produced extensive erosional and depositional landforms across an inundated area of ~1390 km^2 and is calculated to have had a peak discharge of 0.9 x 10^6 m^3s^{-1}. The distribution of fine backwater sediments indicates the actual minimum extent of flood water, whereas the stratigraphic position of the sediment beds can be utilised in dating of the flood events. The analysis results of the sedimentary field evidence are under construction and will be discussed in the presentation.

Supraglacial debris entrainment by the Pasterze Glacier, Austria

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Supra-glacial debris covers are common at valley glaciers with substantial adjacent supra-glacial slopes and with lithologies prone to weathering accompanied by frequent gravitational-driven slope processes. In view of ongoing climate warming, glacier shrinkage causes an increase of such valley walls and slopes overlooking ice surfaces. Consequently, this enhances the rate of debris input on the glacier surface below. Furthermore, a reduction in glacier volume decelerates glacier velocity. Thus, the efficiency of sediment transport from glacier ice to melt water is reduced: a 'clean' glacier may transform into a debris-covered glacier and finally - if permafrost conditions are present - into a moraine-derived/glacial rock glacier or ice-cored moraine.

This project investigates present and past supra glacial debris transport accomplished by the Pasterze Glacier, the largest glacier in Austria (*c.*18 km², 47°05'N, 12°44'E). The ablation area of Pasterze forms a glacier tongue covering some 3.8 km² and is separated from the main accumulation area by a distinct icefall. In particular the right part of the glacier tongue is extensively covered by a debris mantle with a current spatial extend of some 1.2 km².

Different methods have been applied to assess this supraglacial debris occurrence, transport and its changes over time: (i) field measurements (thickness measurements at 500 locations) and (ii) GIS-aided calculations focusing on the characteristics of the present (2005) supraglacial debris layer, (iii) geodetic measurements of ice motion along profiles (1970-2005) focusing on movement pattern and temporal velocity changes, and (iv) multi-temporal analysis of remotely sensed data (1984-2003) focusing on temporal changes of the spatial extend of the debris cover and supraglacial slopes. Results are presented and discussed in a wider spatio-temporal context.

Temporal and spatial variability of suspended and bedload transport and their relevance for monitoring in an highly glaciated alpine catchment in Tyrol, Austria

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High quality suspended and bed load data are becoming more and more important for addressing issues like good water and ecological quality, the design and management of reservoirs, damage prevention in floodprone areas, channel clogging, alteration of aquatic habitats and impacts on flora and fauna. Also the Water Framework Directive as well as the Austrian water law requires an appropriate monitoring of the relevant parameters.
However, up to now there is no standardized method to proceed.

In order to provide baseline data for sediment transport in glaciated catchments in Austria the Hydrological Survey of Tyrol decided to implement a combination of direct and indirect monitoring methods and installed a number of different sensors at the gauging station Vent/Rofenache. The catchment is located in the central eastern Alps. It drains an area of 98 km², with 40% of the area being covered by glaciers.
A U-shaped concrete canal serves as measuring site. The water level and the surface velocity are monitored with radar sensors. An optical backscatter sensor is monitoring the turbidity. 13 hydrophones were mounted at the bottom of a certain cross-section in order to record the impulses due to bed load transport.

The turbidity as well as hydrophone data serve as surrogates for suspended sediment concentrations and bed load transport with a high temporal resolution. Optically sensed turbidity recordings provide insight into suspended sediment transport at a fixed single point within the cross-section. The 13 hydrophones with a spacing of 0,5 m provide information on the spatial distribution of bed load transport in the considered profile. Although the turbidity values are strongly biased by the grain size distribution and the conversion of the acoustic signals of the bed load provides difficulties, the recordings give valuable information on the initiation of motion and its correlation to discharge. Nevertheless it is attempted, by means of frequent bottle and bed load sampling, to convert the gathered data into meaningful suspended sediment concentrations and bed load transport rates.

A preliminary analysis of the collected data over a five year period revealed, not surprisingly, a strong seasonal and distinctive diurnal pattern of suspended and bed load transport. The data show a strong correlation between the turbidity recordings and the discharge (R^2 = 0,9) while bed load transport seems to be much less linked to discharge or stage (R^2 = 0,7).
The gained knowledge of the ongoing transport processes is of great assistance in designing and optimising bottle, pump or bed load sampling procedures in order monitor these highly unsteady processes properly. This is especially important for sediment budgeting in hydrologic years with substantial floods. Floods and high flow seasons play a dominant role sediment transport.

It is proposed that the turbidity measurements as well as the hydrophone recordings are utilized for governing sampling in order to concentrate sampling in periods with intensive suspended sediment and bedload transport, while in periods, which do not contribute much to the annual sediment yield, the frequency of the sampling can be substantially reduced.

Turbidity measurements and hydrophone recordings in combination with an appropriate sampling strategy are promising tools for successful long term sediment budgeting.

Typology of Cross-Boundary Fluxes of Mineral Matter Between Geoecosystems of Ebbadalen, Central Spitsbergen

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Central Spitsbergen is characterized by spatial patterns of geoecosystems different from other parts of the island in the Svalbard Archipelago. A distinctive characteristic of the northern tip of Billefjorden is aridness of climate which, combined with a rapid recession of glaciers caused by climate warming, is reflected in the nature of geomorphological processes and forms. Consequently, a peculiar pattern of morphogenetic domains is developed. Detailed field mapping and the analysis of topographic maps, aerial photographs and satellite images made it possible to distinguish four major types of geoecosystems considered along the longitudinal and transverse axes of the Ebbaelva valley: glacial, fluvial, littoral and slope. Within each type, it was possible to distinguish from two to six subtypes. Altogether seventeen geoecosystems were distinguished: glacial (of glacial tongue, of marginal zone), fluvial (proglacial [of outwash plain, braided channels], meander [of floodplain, river gap], estuarial [of meander band, estuary]), littoral (of beach, tidal plain, bay {fjord}), slope (of rock towers, regolith, talus cones, alluvial fans, washed-out moraines, raised marine terraces with tundra ponds). Field work allowed to define typical chains of mineral matter flux giving the sequence of individual geoecosystems and cross-boundary matter fluxes from one geoecosystem to another. The poster shows the most characteristic spatial patterns of geoecosystems for the Ebba valley. It was accepted as a property that some geoecosystem patterns repeat themselves or have a very similar course in the migration of matter across the valley. Two sample patterns are the following: geoecosystems of a glacial tongue, marginal zone, braided channels, floodplain, river gap, meander band, estuary, tidal plain and bay as well as the geoecosystems of a tower rock, talus cones, alluvial fans and continuing further beginning with the geoecosystems of a braided chanels or floodplain or river gap all the way to a bay. While discussing the manners in which mineral matter migrates from one geoecosystem to another, it was noted that individual cross-boundary matter fluxes could have one of the following characters: point, gate, linear or areal. The manner in which boundaries are crossed by mineral matter determines the rate and magnitude of matter transported between geoecosystems, consequently, it determines the manner in which the feeding system is degrading and the fed system is aggrading. The chains of mineral matter flux in the Ebba valley can be taken to be common for the valleys of Central Spitsbergen and representative for similar natural systems in the polar zone.

Watershed sediment and related fluxes: a perspective from the Canadian Arctic

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The goal of the research program at Cape Bounty, Melville Island, Nunavut (74°55' N, 109°35' W) is to investigate the effects of climate variability on the short term (intra- and inter-seasonal variations in sediment, carbon and nutrient fluxes from two similar, small high arctic watersheds. Through this intensive, integrated research, we hope to identify the controls over these fluxes by weather, snow accumulation, different vegetative communities, and permafrost disruption in order to identify key processes in response to projected climate changes. We also plan to reconstruct sediment and organic carbon delivery to the two lakes through the use of annually-laminated (varved) sediments in order to quantify long term (500-2000+ years) climate, hydro-climate and ecological change in the Canadian Arctic in order to understand the climate mechanisms that produce these changes. Through the linked system of climate, hydrology, and aquatic ecology, the research seeks to accurately define primary terrestrial sources and sinks and their probable response to projected climate changes.

The research constitutes a number of interrelated studies to quantify the linkages between meteorology, hydrology, geomorphology, biogeochemistry and aquatic ecology. A key dimension of this work is the development of parallel data sets from two watersheds that contain similar physiographic conditions and are subject to comparable weather conditions during study. We have carried out spring snow surveys and operated a network of weather and river stations (discharge, suspended sediment concentration and temperature) during the melt season (early June- late September) for four years (2003-6). In 2005, the biochemical sampling regime was intensified to a wider range of catchment environments to explore the sources and pathways for aquatic carbon and nitrogen fluxes. We also significantly expanded sediment sampling to include continuous hourly sample collection for particle size characterization and water velocity measurements to link stream power to sediment transport and to assess sediment transport hysteresis. The two lakes were monitored using a combination of sediment traps and sensors to identify the temporal linkages between sedimentation (quantity and particle size distributions) at the lake bottom and catchment processes. Additionally, separate traps have been used to collect samples of diatom deposition in both lakes through the growth season to examine the linkages between diatom assemblages and external environmental conditions. Littoral and stream environments were systematically sampled at the same intervals to investigate the relative contributions of diatoms from these habitats to the lake sedimentary record. Finally, laboratory analysis is underway to investigate the annually-laminated (varved) sedimentary records from both lakes. Advanced image analysis of the sedimentary record will add a number of innovative sedimentary measures to the emerging multi-proxy records from the Cape Bounty lakes.

Future work will include experimental manipulation of small sub-catchments at the site to document the role of changing snow cover on hydrological and ecological fluxes and characterization of nutrient and carbon delivery from the catchments. Additionally, plans are underway to carry out atmospheric carbon flux measurements to develop a carbon balance model. Finally, an integrated landscape-ecosystem hydrological model will be developed as a means to evaluate the response to projected climate variability and will be validated using reconstructed conditions from the sedimentary records.

ACD II – Arctic Coastal Dynamics II – New project, new ambitions and possible connections with SEDIFLUX

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Arctic Coastal Dynamics (ACD) is a joint project of the International Arctic Science Committee (IASC) and the International Permafrost Association (IPA). Its overall objective is to improve our understanding of circum-arctic coastal dynamics as a function of environmental forcing, cryology, coastal geology and morphodynamic behaviour. The five-year science plan which guided the first phase of the ACD project expired at the end of 2005. We present results from the first phase of the ACD project, including the circum-arctic coastal classification, the ACD WebGIS server, the metadata collection on coastal key sites and the circum-arctic coastal photo collection.
In addition, we present the key science questions for the second phase of ACD and the plan developed for implementing the science agenda. Candidate science questions have been suggested in the Coastal Working Group report from the Second International Conference on Arctic Research Planning (ICARP II) and will be developed within the context of International Polar Year (IPY) activities in the coastal margins cluster (IPY Full Proposal #90). Additional goals are the development of a template for monitoring activities within an international network of Arctic coastal observatories, and the integration of ACD activities with other organizations.

As recommended at the last ACD workshop and at ICARP II, the interactions between people and the coastal environment will be a central cross-cutting theme in ACD II. Additional suggested themes include 1) the transition between onshore and offshore permafrost, 2) modelling of land-ocean interactions, 3) biogeochemical fluxes, 4) remote sensing and geophysical tools, and 5) the coastal observatory network. We believe that the plans of ACD II can be linked to those of SEDIBUD and DYNAFLUX to provide a coordinated approach to sediment fluxes in cold regions and therefore explore possible connections on this poster.

The geoecosystem of small tundra lakes on terrace levels of the Petunia Bay coast (Billefjorden, Central Spitsbergen)

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On the eastern coast of the Petunia Bay (Billefjorden, Central Spitsbergen), along the mouth section of the Ebbaelva and on the slopes of mountain massifs surrounding it, there is a system of raised marine terraces. The lowest erosion-accumulation terraces from the Middle and Younger Holocene are uplifted to between 5 and 16 m a.s.l. They are built of marine sediments of gravel and stones high in calcium carbonate and malacofauna remains. The surface of the marine terraces is covered by tundra vegetation on different kriosoils.

The specific polar continental climate of the Petunia Bay features a short period of polar summer, usually of 2-3 months' duration, higher temperatures during the ablation period, and very low rainfall figures throughout the year. The thickness of the active permafrost layer in the area exceeds 1.2 m during the polar summer. During the Arctic summer, there develop ponds and marshes of various sizes on the terrace levels which accumulate water from the melting snow and summer degradation of permafrost. Since 1987 a decrease in the number and area of those basins have been recorded. Fluctuations of the water level in the lakes ranged up to 20 cm. Periodic changes in the lakes' water level are also due to precipitation as well as fluctuations of the temperature and evaporation. On the basis of preliminary analyses of sediment cores, it was found that the lake bottoms were filled predominantly with structureless dark and light grey as well as black silt (gytia). The silt layer in the lakes analysed averages from 10 to 50 cm. Within the silt sediments intercalations of gravel 2-3 cm in thickness were observed at places. The bottom of lake sediments is made up of a stone layer - sediments of the marine terrace.

During several expeditions, researchers have conducted studies of the spatial and temporal variability of the chemical composition of selected water bodies. The tundra lakes under examination differ in the degree of mineralisation and ionic composition of their waters. The water reaction varied between 7.62 and 8.69. Water mineralisation figures as expressed by specific electrical conductance (SEC) ranged from 244 to 559 μScm^{-1}. The lowest weekly SEC figures were recorded in the largest and deepest lake. The mineralisation level tended to increase slightly during the polar summer. The highest SEC figures caused by cryochemical processes were observed to accompany a drop in the air temperature and the appearance of the ice cover. By the hydrochemical type, the tundra lake water was classified into three types: a bicarbonate-calcium one, a bicarbonate-calcium-sodium-potassium one, and a bicarbonate-sulphate-calcium-magnesium one. Predominant in water samples were bicarbonate ions, which made up 59-76% of anion totals, while calcium ions constituted 53-72% of cation totals. The nourishment of the tundra lakes and changes in their chemical composition depend on the pattern of water migration and the leaching of the defrosted layer of rock and tundra soil, which processes are controlled by weather conditions, especially variations in air temperature. The chemical composition of the tundra lake water with the dominance of calcium and bicarbonate ions confirms a significant contribution of the active layer as a source supplying these compounds in non-glaciated areas. Owing to the relatively low air humidity, low rainfall in the summer, and low mineralisation of precipitation water on the Petunia Bay coast, rainfall can be assumed to play a negligible role in the formation of the water chemistry of the tundra lakes. However, on the coast, precipitation and sea aerosol are still an important source of chloride and sodium ions, which can be regarded to be of atmospheric origin in the surface waters under study.

Differences in the mineralisation and chemical composition of water in the tundra area, which are recorded in non-glaciated catchments during the polar summer, are largely the effect of changes in the inflow of meltwater and water released as a result of the summer degradation of permafrost (to a lesser extent of rainwater), the nature of substratum sediments (including the occurrence of organic deposits), and the intensity of biogeochemical processes occurring in areas where the water bodies are situated.

On the interface between ecology and geomorphology

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There is a growing awareness of the importance of the interface between ecology and physical geography, particularly geomorphology, hydrology, and climatology. An increasing collaboration across the formerly relatively isolated disciplines has mutual benefits, in theory as well as practice. Ecology and geomorphology are both very broad and multifaceted fields, but there is a large overlap that merits further exploration. In this brief review, I approach the promising zone of amalgamation as an ecologist with experiences from collaborative efforts with scientists representing physical geography.

Ecology can be anything from rather descriptive to utterly theoretic, which is also reflected in the statistical methods in use, ranging from descriptive statistics and multivariate analysis to mathematic modeling. Perhaps the essence of modern ecology is best summarized by "the three Ms", i.e., Monitoring, Manipulation, and Modeling. Manipulation, the testing of hypotheses generated from monitoring of natural systems in field and/or laboratory experiments, is the cornerstone of contemporary ecology, generating input algorithms to be combined with empiric data in various kinds of modeling efforts. Ecological field experiments in biomes characterized by adverse climatic conditions, particularly arctic and alpine environments, often suffer from being conducted over too short time periods to generate significant results. A three-year project funding, which is the normal slot provided by most national scientific research funding bodies, does not allow an in-depth experimental design including pilot surveys in slow reacting ecosystems established near the climatologic limits for life. The sound principle for experimental design in ecology, BACI (Before-After-Control-Impact) is hard to implement as the "Before" monitoring of a natural system often has to be sacrificed. Instead, ecologists turn to massive replication of experiments and controls, including space-for-time substitution.

The ecosystem is normally the basic study unit in ecology. The biotic and abiotic environment comprising the prerequisites for a certain assembly of organism communities is known as the "habitat". Wherever habitat conditions are similar in a region sharing a common species pool, a local stand of the typical ecosystem will ultimately become established. At present, however, there is an ongoing shift towards a focus on the landscape level in ecology, in terms of pattern as well as process. Landscape units are most often delimited watersheds (drainage basins, catchments) but may also be islands or isolated mountains. The landscape approach makes use of modern geodetic techniques such as GIS, and this is an area where ecology and geomorphology has a common interest. The landscape has always been the basic study level in hydrology and geomorphology, and here ecologists have much to learn and gain from collaboration. At the same token, geomorphologists may acquire data on biotic patterns and processes, and move from the normal descriptive view to a more hypothesis-based approach.

A good example of the mutualistic nature of bio-geo interaction in science is provided by the long-term studies of the Latnjajaure watershed in northern Swedish Lapland. Here ecologists study climate change impacts on tundra ecosystems whereas slope processes, hydrology, and sediment fluxes is the main focus in physical geography. The overlap where collaboration and data sharing takes place is extensive, including climatology, snow distribution, weathering, hydrology, and GIS. Cross-disciplinary network building among scientists is fostered in such environments.

Detailed geomorphological mapping: a potential with sediflux assessment

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The landscape in Uppland, Sweden, is characterised by a combination of landforms: The basement is an old peneplane with rift valleys where locally occurrences of metarhyolithite, granodioritite, granite, iron ore, limestone and marble are exposed. The area is highly affected by past glaciations and isostatic rebound and in most parts of Uppland the surface is covered by moraines and sedimentary plains, so that glacial, marine and glaciofluvial sediments dominate in the area. Ongoing processes today are anthropogenic accumulation and denudation, fluvial erosion in cooperation with continuously ongoing glacio-isostatic rebound, slope processes such as soil creep and frost creep, earth flow and mechanical-, chemical- and biological weathering. Of these the anthropogenic activities are the most active land forming processes today while amongst the natural processes fluvial erosion is the most active. The ongoing glacio-isostatic rebound, which is more than half-a-cm/year at the present, causes continued fluvial incision and erosion of the sediments. In areas with clayey and silty sediments the fluvial erosion results in development of ravines along channels where also mass movement takes place.

A geomorphologic map of the Vattholma area, Uppland, Sweden, shows a transect across a characteristic gentle Uppland landscape. The detailed map follows a new legend by Gustavsson, Kolstrup and Seijmonsbergen (2006) and shows hydrography, morphometry/morphography, processes/genesis, specific features, unconsolidated and consolidated lithology, age and structure and thus demonstrates how the landscapes appears today and has developed through time. The information in the map provides a strong basis for an inventarisation of the sediments, their sediflux history both in the past and at the present, and further gives a basis for predictions of the development with regard to how the natural processes may change the sediments and landforms in the Vattholma area in the future.

Ongoing and future changes of geomorphological units within the mapped area depend on the configuration of the landforms, their composition and the processes that prevail within defined subareas at a given time. It follows that the geomorphologic map can provide a basis for assessment of sedimentological and morphological changes at different time levels from daily changes to several thousand years.

In the populated field area anthropogenic processes will continue to reshape the landscape considerably in the shorter time perspective but such effects are difficult to predict more than a few years in advance. The slower process of future fluvial erosion combined with isostatic rebound is more easily predicted whereas a possible future ice age probably would change the landscape at a large scale.

Volume calculations for glacial erosion in MidNorway during the last 3 million years and large-scale depositional pattern of the corresponding shelf

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During the last c. 3 million years, large quantities of glacially derived material (the Naust Formation) were transported westwards from the Norwegian mainland and inner shelf areas and deposited mainly as prograding sediment wedges into a basin of intermediate depth offshore Mid Norway. The deposits are more than 1000 m thick over an extensive area, and the shelf edge migrated up to 150 km westwards. About 100,000 km^3 of sediments were deposited in the area of the present Mid-Norwegian shelf between 64°N and 68°N (160,000 km^2) during this period. This is equivalent to an average erosion of c. 500 m of the corresponding denudation area (c. 160,000 km^2) which comprised the inner shelf areas and the land areas of Norway eastwards to the main water divide.

Spatial variability in solifluction processes in the Abisko region, northern Sweden

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Solifluction is a widespread process in northern Sweden and has been monitored in the the Abisko region through point specific measurements, mainly in the valley of Kärkevagge. Using data from one well-developed landform to explain solifluction mechanisms is relevant, but may not be representative for solifluction occurrences and variation on a larger scale. This study focuses on modelling the spatial variations in a region with a well-documented moisture gradient, which provides different environmental conditions affecting the occurrence of solifluction. The spatial distribution of soliflcution can be explained on a regional scale, with help from GIS and remote sensing. A DEM with a 50 m resolution has been combined with digital data on slope gradient, soil and vegetation in overlay operations are used to test for the spatial occurrence of solifluction. The results show a digital model that is broadly consistent with field and aerial-photo based mapping.

At the micro scale the spatial variability of solifluction may be caused by different factors than those explaining the large scale variations. For this purpose, a total station has been used to build up detailed terrain models over selected sites with grids covering areas up to 50*50 m. Within these grids wooden dowels are placed out every 1-2 meters in lines separated by 5-10 meters to measure movement and heave rates. Detailed soil moisture mapping with a TDR-probe is also done in proximity to every wooden dowel. The terrain model will be used to relate terrain forms and movement rates to the distribution of soil moisture, soil particle size distribution, vegetation and soil thickness and some of these results will be presented. Regional trends of ground temperatures and soil moisture distribution will also be presented, as year-round monitoring is carried out at selected sites covering different aspects of the region.

Post Little Ice Age changes in the proglacial fluvial pattern of the Morsarjökull (South of Iceland, Vatnajökull)

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The Global Warming which occurs since the end of the Little Ice Age (about 1870 in Iceland), leads to the retreat of the glacier fronts. Thus, the terminus of the Morsarjökull Glacier (South-East of Iceland), an outlet of the Vatnajökull ice cap, has receded around 1 to 1,5 km since the LIA. This retreat induces new dynamics in the glacier foreland, especially related to run-off and glacial meltwater.

The aim of this study is to evaluate the way the proglacial fluvial pattern has changed during the last retreating period of the Morsarjökull glacier. Indeed, the glacier retreat induces major changes in two main controlling factors of the hydrological system. On the one hand, the glacial meltwater causes an increase in the liquid flow inside the channels (Q increase) and on the other hand the retreat of the glacial front implies the release of a massive stock of glacigenic sediments potentially reworkable by the rivers (Q_s increase).

We intend to evaluate the post-LIA changes of the proglacial fluvial pattern through various spatial scales:

- The evolution of the plan fluvial pattern is done based on the analysis of aerial photographs (from 1945 to 2006).
- The evolution of the channels morphology is carried out from several channel cross sections collected on the active sandar and the palaeosandar (dated with lichenometry).
- The glacial retreat chronology is reconstructed jointly starting from the lichenometric dating of the moraines and from the mapping of the glacier front on the different aerial photographs.

These three types of data provide an opportunity to reconstruct palaeoflows, and to improve our understanding of the evolution of proglacial hydrology by diachronic mapping.

The significance of geomorphological setting and fluvial redeposition on sediment accumulation and composition in pro-glacial lakes

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Lake sediments are often used in paleoclimate reconstructions as continuous archives of physical and biological proxies. The relation between autochthonous and allochthonous sedimentation forms however a complex system that may cause problems when interpreting both physical and biological parameters. Results from previous studies of non-glacial lakes in Sweden have demonstrated that non-glacial processes may produce minerogenic lake sediment sequences with similar physical characteristics as sediments in pro-glacial lakes.

In this study of two consecutive pro-glacial lakes we show that fluvial redeposition of alluvial fan deposits may significantly affect pro-glacial lake sedimentation. This demonstrates that a non-glacial fluvial signal may, depending on the geomorphological setting, actually overprint any present glaciofluvial signal. In this case this results in sediment stratigraphies with minerogenic laminations of alternating (or combined) glacial and non-glacial origin, which are impossible to separate using the most common lithological sediment parameters. This in turn emphasizes the complexity of sediment transport system in proglacial (paraglacial) settings where redeposition of older glacial sediment is of major importance. The results also highlight the continued need of a thorough understanding of the geomorphological setting in lake sediment studies.

Both lakes in this study contain both episodic (turbidites) and more continuously deposited sediments. The effect of episodic sedimentation on age-depth models is demonstrated by removing turbidite sediment layers from the stratigraphy before age model construction, which results in a potential dating error of sediments below the turbidites of up to several hundred years. This study also illustrates the effect of fluvial hierarchy on deposition of sediment in consecutive lakes. We find that normal sedimentation rates are up to five times higher in the first of the two lakes. The fluvial hierarchy also affects grain-size distribution patterns, with especially the silt fraction displaying a fining from coarse to medium silt between the lakes.

Source-to-Sink and Sediment Budget Studies in Cold Environments under the influence of Global Change

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Tracking sediment inputs, throughputs and outputs through landscapes subjected to varying degrees of environmental change is challenging. The problem we are attempting to tackle depends as much on the definition of spatial units (whether zones, basins, slopes or sites) as it does on the time frame of interest. The landscape scale is an important scale but one that lacks the quantitative research associated with process geomorphology; the decadal to century time scale is also important, but levels of uncertainty in predictive models are profound. Scenarios based on a series of most probable outcomes are at best semi-quantitative.

Ice caps, with and without ice streams and surging glaciers (e.g. Bogen and Bonsnes, 2003); glacierized mountain zones (e.g.Jäckli, 1957); non-glacierized mountains (e.g. Rapp, 1960); and low relief tundra zones (Bobrovitskaya et al., 2003) present four strikingly different source-to-sink and sediment budget environments. Hallet et al. (1996) have discussed the critical factors that differentiate glacierized and non-glacierized basin sediment yields. Factors other than percent ice cover, ice thermal regime and available relief that influence the absolute rate of sediment production include size of basin, thickness and availability of sediment cover, presence of lakes and reservoirs and land cover change. The mapping of preferred runoff and sediment sources and pathways is desirable, but this is frequently unavailable for medium to large-scale units. Many of these factors were clearly understood as early as Jäckli`s (1957) seminal study of the upper Rhine basin. The following considerations were included in Jäckli`s study but they continue to be overlooked in many studies today: value of lake sediments in estimating sources and pathways; identification of local sinks and storage areas; mapping of process domains; assessment of magnitude and frequency of operation of anthropogenic and geomorphic processes; determining rates of operation of individual processes; rates of operation of multiple processes acting together (positive and negative feed back); and non-stationarity of climatic, hydrologic and sediment transport data, especially under rapid global environmental change.

Specific illustrations are drawn from the glacierized mountain zone of the Canadian Cordillera.

Long-term erosion of a Norwegian fjord-valley dominated by marine deposits

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Several hundred meters thick glacio-marine and marine deposits accumulated in Norwegian fjords during and after the last major deglaciation. Some of these deposits were later exposed on land due to glacio-isostatical uplift during the Holocene period. Buvika, as an example, is a small fjord-valley in Mid Norway surrounded by 300 to 400 m high bedrock hills, today characterized by undulating terrain with numerous ravines and slide scars. In Buvika the highest sea level (marine limit) following the last glaciation was about 175 m above present sea level. This is reflected by high occurrences of glaciomarine and marine deposits, which dominate the valley fill. Some coarser-grained deposits like glaciofluvial sediments are also present. During early uplift, sediment input from glaciers decreased, and the fjord-valley was increasingly subjected to erosional processes.

This study describes various erosion processes like river erosion, groundwater-seepage erosion, and sliding activity that have taken place within Buvika, as part of an attempt better to understand the long-term erosional pattern and landscape development of areas with thick marine deposits. Calculations are made on the volume of sediments that have been removed by erosion from the valley following isolation from an upstream lake shortly after deglaciation. Part of the present landscape in Buvika is interpreted as a remnant of the old seabed. This interpretation is the basis for reconstruction of the entire seabed as illustrated by a number of profiles in different sections across the valley. Another source of information for the seabed reconstruction is the local sea level curve. The total amount of eroded sediment is calculated by summarizing the volumes of each valley section. Methods used will be presented, including a discussion of their uncertainties.

Sediment accumulation rates, geochemistry and provenance in complex High Arctic fjord, Hornsund, Svalbard

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Hornsund fjord, southern Spitsbergen, represents a complex fjord system with a catchment area of about 1200 km^2. The catchment is glaciated in 73 %, which ranks it among the most glaciated fjord basins in Svalbard. It is supplied with sediments mainly from several tidewater glaciers, which retreated up to 16 km in the recent decades (Pälli et al. 2003). To determine fjord sediments accumulation rates and provenance a set of radiochemical and geochemical methods were applied for four short cores and fifty five surface sediment samples.

Sediment accumulation rates in axial part of the fjord determined with ^{210}Pb and ^{137}Cs are in range of 0.5 to 0.7 cm yr^{-1} with slightly decreasing trend from the fjord head to the entrance. They are the highest modern sediment accumulation rates among those observed in central parts of the major Spitsbergen fjords (Sexton et al. 1992; Elverhøi et al. 1995; Hald et al. 2001; Svendsen et al. 2002; Szczuciński 2004).

Fjord surface sediments were analyzed for their grain size composition, carbonate content, TC, TOC and thirty nine elements including REE. The sediments are composed of mud with common drop stones and are characterized by generally similar chemical composition. Only samples collected from shallow locations near sediment sources (river mouth or tidewater glacier front) draining basins of specific geology (e.g. limestone and marbles) differ remarkably. As revealed by statistical analysis (cluster analysis) the inner and central basin of the fjord may be clustered together in one group and the outer basin and shelf sediments in another. The results suggest that the sediments were deposited very close to the sources and there is little sediment flux from the inner basins, which are supplied by glaciers draining mainly clastic sedimentary rocks to the outer basin supplied from metamorphic rock dominated catchments. The geochemistry of the bottom sediments shows that they are transported in direction following the Coriolis force (to the east along the southern shoreline and to the west along the northern). No significant changes in geochemistry of the dated cores were detected. It proves that the provenance of those sediments was stable during the last decades.

References

Elverhøi, A., Svendsen, J.I., Solheim, A., Andersen, E.S., Milliman, J., Mangerud J. & Hooke, R.LeB., 1995: Late Quaternary Sediment Yield from the High Arctic Svalbard Area. *Journal of Geology* 103: 1-17.

Hald, M., Dahlgren, T., Olsen, T.E. & Lebesbye, E., 2001: Late Holocene palaeoceanography in Van Mijenfjorden, Svalbard. *Polar Research* 20: 23-35.

Pälli, A., Moore, J.C., Jania, J. & Głowacki, P. 2003. Glacier changes in southern Spitsbergen, Svalbard 1901-2000. *Annals of Glaciology* 37: 219-225.

Sexton, D.J., Dowdeswell, J.A., Solheim, A. & Elverhøi, A., 1992: Seismic architecture and sedimentation in northwest Spitsbergen fjords. *Marine Geology* 103: 53-68.

Svendsen, H., Beszczynska-Møller, A., Hagen, J.O., Lefauconnier, B., Tverberg, V., Gerland, S., Ørbæk, J.B., Bischof, K., Papucci, C., Zajaczkowski, M., Azzolini, R., Bruland, O., Wiencke, C., Winther, J.-G. & Dallmann, W., 2002: The physical environment of Kongsfjorden-Krossfjorden, an Arctic fjord system in Svalbard. *Polar Research* 21: 133-166.

Szczuciński, W., 2004. *Late Holocene Sedimentation and Environmental Change Record in Billefjorden, Svalbard.* PhD Thesis, A. Mickiewicz University, Poznań, 139 pp.

Impact of glaciers retreat on sediment accumulation rates in fjords – changes following "Little Ice Age" in Billefjorden, Svalbard

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Sediment accumulation rates (SAR) and their fluctuations were studied in Billefjorden - a fjord in central Spitsbergen which catchment area is to a large extent glaciated (in 44 %). Most of the glaciers around the fjord retreated several km after the "Little Ice Age". The ^{210}Pb, ^{137}Cs and AMS ^{14}C techniques were employed to determine short and long term SAR in eight short sediment cores taken along the axial part of the fjord.

In the studied cores the modern SAR decreases from the fjord head supplied by the only tidewater glacier, where a maximum SAR of 0.5 cm yr^{-1} was documented, to the fjord entrance where almost no modern sedimentation occur (AMS ^{14}C dates revealed both modern (60 yr BP) and fossil (460 yr BP) ages for shells in surface sediments). In the longest core collected in the central basin of the fjord the modern SAR is 0.12 cm yr^{-1}, however, average for last 500 years based on ^{14}C dating revealed for the period 1460 – 1952 (the first ^{137}Cs in sediments) fourth fold lower rate: 0.03 cm yr^{-1}. The latter result is in agreement with previous investigations by Elverhøi et al. (1995) .

The recent increase in SAR was demonstrated by Elverhøi et al. (1995) and Hald et al. (2001) for other fjords in Spitsbergen: Isfjorden and van Mijenfjorden, respectively. They attributed rapid increase in SAR over the last decades to high rates of sediment supply associated with recent surges of several glaciers (governed by non climatic factors). Similar explanation is not likely for Billefjorden since they are no surges recorded in the last decades (Hagen et al. 1993).

Significant change in SARs after "Little Ice Age" maximum is probably associated in Billefjorden with increase in temperature and negative glacier mass balance, which along with increased precipitation (Førland & Hanssen-Bauer 2003) resulted in larger freshwater discharge offering larger eroding and transporting potential. Retreating glaciers left also large amounts of sediments in front of them which can be easily mobilized.

References

Elverhøi, A., Svendsen, J.I., Solheim, A., Andersen, E.S., Milliman, J., Mangerud J., Hooke, R.LeB., 1995. Late Quaternary Sediment Yield from the High Arctic Svalbard Area. *Journal of Geology* 103, 1-17.

Førland, E.J. & Hanssen-Bauer, I., 2003: Past and future climate variations in the Norwegian Arctic: overview and novel analyses, *Polar Research*, 22: 113-124.

Hagen, J.O., Liestøl, O., Roland, E., Jørgensen, T., 1993: Glacier atlas of Svalbard and Jan Mayen, *Norsk Polarinstitutt Meddelelser*, 129: 1-141.

Hald, M., Dahlgren, T., Olsen, T.E. & Lebesbye, E., 2001: Late Holocene palaeoceanography in Van Mijenfjorden, Svalbard. *Polar Research* 20: 23-35.

Estimation of anthropogenic and geogenic lead in podzolic soils using isotopes of lead

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Lead (Pb) is one of the most heavily utilized metals in human history having been exploited by man over thousands of years for a variety of metallurgical, medicinal, and industrial purposes. The cumulative output of Pb from mining is estimated to be 260 million metric tonnes, and 85% of this has occurred over the last two centuries (Nriagu 1998). Global annual production of Pb from mining is about 3 million tonnes (Sangster et al. 2000).

Terrestrial ecosystems all over Norway have been contaminated moderately to strongly by lead and other trace elements from atmospheric deposition as a result of long-range atmospheric transport from other parts of Europe. Especially the southernmost part of Norway has been strongly affected (Amundsen 1992, Steinnes et al. 1992, 1994, 2005).

With the aim of developing a method for mapping the accumulated content of anthropogenic Pb and how deep in the soil profile atmospherically deposited lead has penetrated, the concentration of Pb and the ratio between the isotopes ^{206}Pb and ^{207}Pb has been studied in podzolic soils at four locations with different geology, i.e. age and type of bedrock, in the Oslo area, Norway.

Soil profiles were sampled by digging pits down to 50-70 cm depth at four places with different bedrock located 20-30 km from downtown Oslo. Samples of humus were collected from a minimum of five sub-sites around each soil pit for analysis of anthropogenic lead isotope signal as reference.

The ratio $^{206}Pb/^{207}Pb$ is c. 1.12-1.15 in samples of humus and c. 1.17-1.21 in the uppermost centimetres of the soil profile. The ratio $^{206}Pb/^{207}Pb$ increases towards depth and converges towards geogenic background values that are characteristic for the lithology at each site.

Knowledge of the regional geochemical background levels and the isotopic composition of lead in soils and sediments can thus be used successfully in distinguishing particulate material contributed by anthropogenic activity from chemical stratification of lead as function of soil weathering processes.

Strontium isotope systematics in the Oppstryn drainage basin, western Norway

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The strontium (Sr) isotope composition of runoff and particulate material can be used in catchments to determine the proportion of weathering products originating in areas with different bedrock as a supplement to major ion geochemistry. The Sr budget of a catchment is determined by the relative contributions of erosion and weathering of carbonate rocks versus silicate rocks, but also the preferential weathering of carbonate minerals versus silicate minerals and the contributions from different silicate minerals within the same rock unit. As an example it has been suggested that the importance of carbonate relative to plagioclase weathering could be exaggerated in cases where only the plagioclase-to-kaolinite dissolution reaction is considered (Pretti & Stewart 2002).

Samples of filtered river water and suspended particulate material collected on the filters are collected to estimate the particulate and dissolved loads of runoff from the northwest end of the Jostedalen glacier, western Norway. Strontium isotopic fingerprinting will be carried out by analysing the same samples for Sr-87 and Sr-86 isotopes in an attempt to delineate the relative contribution the two to three different major types of bedrock in the area under and adjacent to the glacier. In addition we will analyse for isotopes of lead (Pb) to be able to distinguish sub-glacial runoff from direct runoff from surface of the glacier.

Strontium isotope systematics could enhance the precision of the more general mass balance, which is performed with respect to major in geochemistry in the Oppstryn drainage basin and contribute to understanding the contribution of different types of minerals, rock types and sub-catchments when estimating the overall erosion and weathering in this part of Europe.

Bed load transport in a steep mountain stream, Vinstradalen, Norway

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The hillslope-system constitutes the most significant sediment source for mountain fluvial systems. Massive slope destabilisation may occur in response to extreme climatic events, causing hillslope-stream channel coupling. The fluvial system responds to such events by increasing the sediment load, and by adjusting the stream channel morphology.

Vinstradalen, Central Norway, experienced an extreme precipitation event in August 2003, that initiated a large number of slope failures, and numerous debris flow fed sediment into the steam channel. Massive sediment transport was observed in the lover parts of the stream Vinstra during this event.

This study aims to investigate the temporal aspect of the fluvial system response to extreme sediment input, and how particle path length during transport reflects the morphological scale of steps and pools. The downstream displacement of bed particles in a given period of time is fundamental to understand bed load transport processes and the development of channel morphology. In this paper we use data from a tracers and shock sensors to characterize temporal bed load transport patterns and rates in a steep step-pool channel reach.

The results corroborate with those from earlier work in that there is a relatively narrow range of high discharges at which the major bed load transport occurs. More than 95% of the total movement occurred during a relatively short period of peak discharge during the spring flood event. The transport rates for the selected tracers sizes (< d25) were high and individual tracers were observed to move in excess of 500 m during the spring flood event. Tracer recovery rates were low due to heavy paint abrasion, long transport distances, and burial of tracers. The shock sensors indicate high transport rates of fine-grained bed load during high discharges. No significant change in bed geometry was observed, as the stream power during the spring flood was not sufficient to mobilise the large step forming boulders. Most tracers showed displacements in excess of the scale of step-pool morphology, and there is no significant correlation between path length and step-pool dimensions.

Investigations on the Dynamics and Sediment Budget of a Braided River System in Erdalen, Nordfjord, Western Norway

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Bedload transport plays a significant role for the sediment budget of the very steep and glacier-fed Erdalen catchment in Nordfjord, Western Norway.

The investigations presented here are carried out within the NGU Project *Source-to-sink-fluxes in cold environments*, which has the focus on the quantification of mass transfers and sediment budgets in selected cold climate catchments.

The selected braided river system in Erdalen is characterized by a high variability of discharge, with high runoff during spring snowmelt, summer glacier melt and heavy rainfall events. Fluvial bedload supply from up-valley, throughput and output of material are high. Avalanches, slush flows and debris flows transport material from the surrounding slope systems into the braided system.

The studies include (i) detailed geomorphologic and vegetation mapping of the braided system and the surrounding slope systems, (ii) morphometric analysis of channel stretches, pavement and bedload components using different quantitative methods, (iii) tracer experiments.

The functional relationships between channel morphometry, channel pavement and bedload characteristics as well as bedload dynamics are investigated at seven selected channel stretches within the braided river system.

The results from the process geomorphic studies described here are integrated with data on the long-term valley-fill accumulation and internal structure of the valley-fill collected with a combination of georadar and seismic refraction surveys within the NFR *SEDITRANS* Project (Hansen et al., this issue).

The investigations provide first information on (i) the Holocene development of the braided system, (ii) the intensity of slope-channel coupling, (iii) the pattern of zones of stability, erosion, accumulation within the braided system and (iv) the current scale of input, throughput and output rates of sediments and the current sediment budget of the entire braided system as well as of different parts of the braided system.

Day Field Excursion

in the Trondheim region

The excursion is planned to include several topics from the late- and postglacial period. Thematically, the excursion will be separated in four parts, i.e. (1) deglaciation history, (2) glacial rebound, (3) clay slide history and (4) recent fluvial environment.

The transportation during the excursion will be carried out by bus. The selection of sites will be done when more is known about the expected weather conditions during the excursion.

Deglaciation history (1) and glacial rebound (2)

Ice marginal deposits from several lateglacial readvances are recorded in the Trondheim region. Some of these, both from the main Younger Dryas (YD) ice advance (10600 – 10900 ^{14}C-yr BP) as well as younger YD ice advances will be visited during the excursion.

The glacial isostatic conditions lead to a high relative late-/postglacial sea level in the Trondheim region, and a mean altitude of c. 175 m asl is recorded for the lateglacial marine limit in this area. The glacial rebound slowed down during the considerable ice growth in the initial part of YD, and this lead to formation of distinct YD shore lines, both in unconsolidated sediments and in bedrock. The rebound gradient is supposed to be as high as 1.4 m/km since mid YD. Examples of shore lines and deltaic terraces corresponding to high relative sea levels will be given.

Clay slide history (3)

Numerous scars form clay slides are recorded in this region, and some of the historic slides are well described in the literature. The huge clay slide in Verdalen (90 km to the northeast of Trondheim) in 1893 is perhaps the best known such slide, and was a catastrophy that lead to more than 100 human casualties.

Examples of old clay slide scars, both small and km-wide scars will be demonstrated during the excursion.

Fluvial environment (4)

The excursion will examine the river Nidelva, draining through central Trondheim, which has caused many of the historical quick clay slides in Trondheim. During the last years several deep scour hollows, extending well below sea level, has been discovered in the river bed, that may cause slope instabilities and has the potential to initiate quick clay slides. Department of Geography at NTNU has initiated a research project to study selected scour hollows. The excursion will visit the selected field sites in Nidelva, and field methods and preliminary results of the study will be presented and discussed.

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