

Annual Report 2021

Malin Stenberg de Serves (ED)



Lake in Jämtland with a view of Sylarna, northern Sweden. Photo: Stefano Manzoni.

Department of
Physical Geography

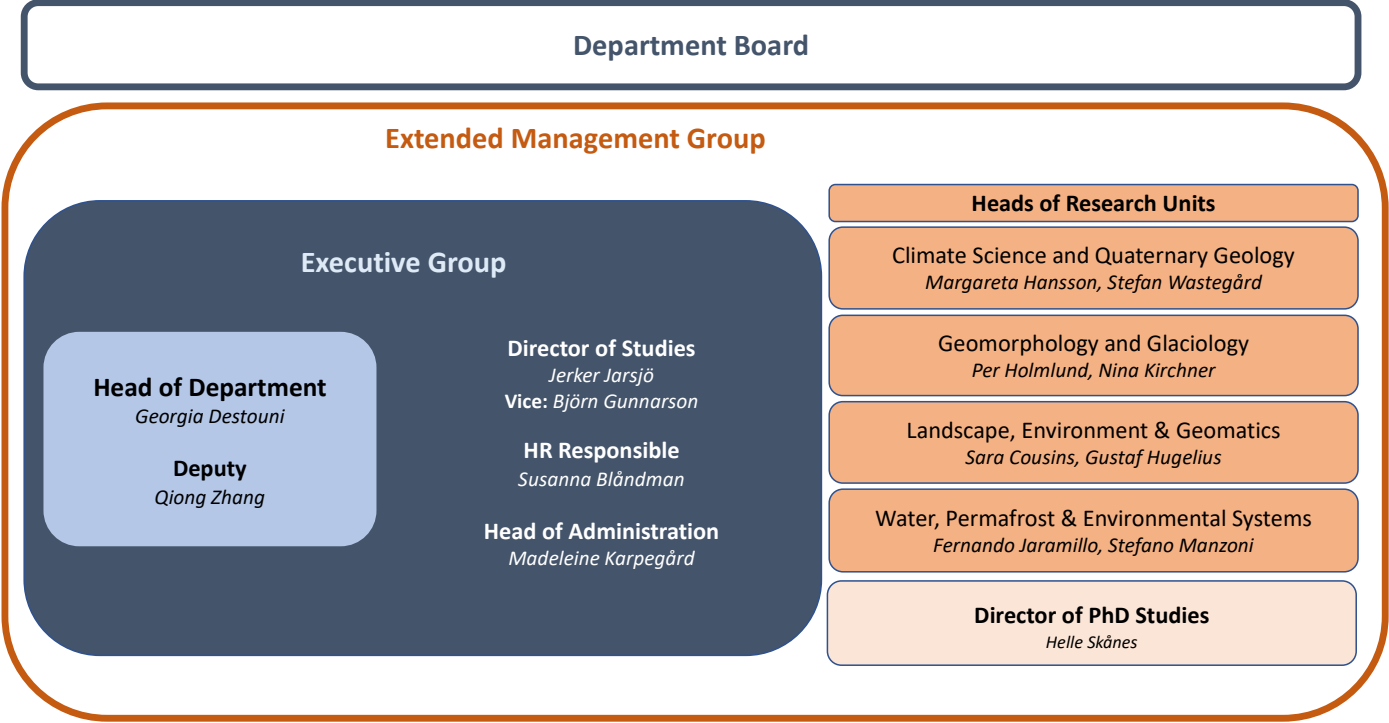


Stockholm
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Contents

Department Structure	2
Words from the Head of Department	3
Research Grants and Contracts 2021	4-5
Publications 2021	5
Climate Science and Quaternary Geology	6-7
Geomorphology and Glaciology	8-9
Landscape, Environment & Geomatics	10-11
Water, Permafrost & Environmental Systems	12-13
Tarfala Research Station (TRS)	14
Navarino Environmental Observatory (NEO)	15
The Bolin Centre for Climate Research	16
Infrastructure	17
Education	18
PhD Education	19
Collaboration	20-21
Staff 2021	22-23
The Geoscience Building	24

Department Structure



Words from the Head of Department

The year 2021 was the last full year I served as head of the department. After nearly six years at the post, it will soon be time for me to rotate off when my term of office expires after the summer of 2022. It has been a great honor and fantastic fun to serve on this post with the support from many excellent coworkers. Through fruitful cooperation and thanks to your commitment, we have successfully developed the department during these years.

We have turned a previous period of cost excess and decreasing faculty positions to positive and growing department finances, allowing for new faculty recruitments. Our scientific publications have been steadily increasing while continuing to appear in top international journals, and we have achieved on average 6.7 PhD dissertations per year since 2016. In the last years, our educational volume has also increased and been successful in meeting and exceeding our educational commitment. And these achievements have been reached all while the Covid-19 pandemic has been raging over the last two years.

The 2021 indicator report for research quality from the Natural Science Faculty of Stockholm University (SU) confirms the success of our department, stating that "SU's research within the research subject group Geoscience and Environmental Science is conducted primarily within the Department of Physical Geography", and that our department is "SU's largest research actor" in the subjects Physical Geography as well as Climate Research, Oceanography, Hydrology and Water Resources, and Ecology".

Our attraction of major international research funding in the recent years is another department success example. A third example is our collaboration with many societal actors and organizations outside of academia in joint projects with research co-creation processes and numerous scientific publications with co-authors from the partner organizations.

Many contributors have met and many contributions have merged in driving this successful evolution, and together we have been able to form an impactful voice in science and society for our department. Such cooperation with high level of competence and great commitment is a source of joy. It has been a privilege to work with you. I want to thank you all for great efforts and friendship given in the many teams we have worked in to further develop the department's activities and operations during these years.

New times are coming. Thank you from me and I wish everyone at the department all the best for the future.

Professor Georgia Destouni



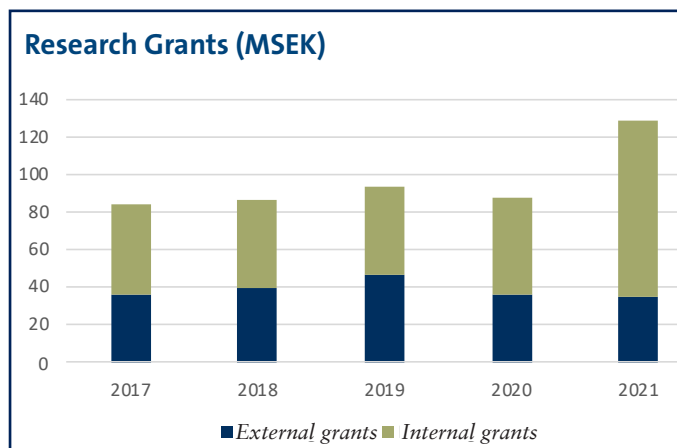
Photo: Annika Hallman / Stockholm University.

Research Grants Awarded 2021

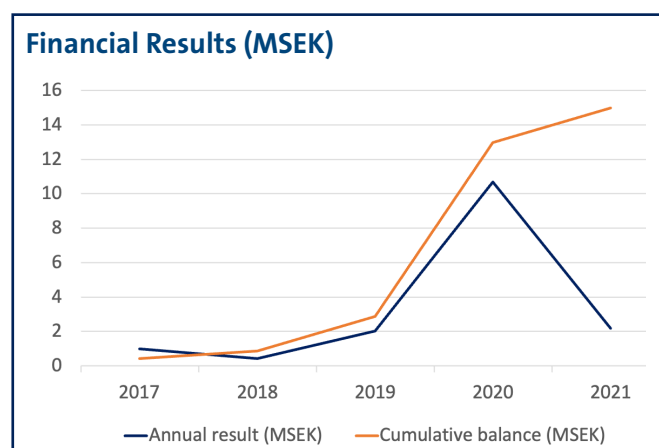
Grant Receiver	Funding Organisation	Project Name	Total Grant (TSEK)
<i>Chandler Benjamin</i>	<i>Formas</i>	<i>Fördjupad förståelse av platåsars respons på klimatförändringar genom en ny kombination av upprepade drönar- och radarundersökningar</i>	4 718
<i>Cousins Sara</i>	<i>Vetenskapsrådet</i>	<i>Förlust av växtdiversitet och ekologiska funktioner: Hur mycket, hur snart?</i>	3 600
<i>Destouni, Georgia</i>	<i>Formas</i>	<i>Innovation och partnerskap för effektiva åtgärdsprogram för god vattenkvalitet och ekologisk status – med pilotstudie för Askrikefjärden</i>	1 495
<i>Destouni, Georgia</i>	<i>Universitets- & Högskolerådet</i>	<i>Training new generations on geomorphology, geohazards and geoheritage through Virtual Reality Technologies</i>	2 865
<i>Greiser, Caroline</i>	<i>Formas</i>	<i>Skogens förmåga att buffra klimatextremer - samverkan mellan krontäckning och markvatten</i>	4 959
<i>Hugelius, Gustaf</i>	<i>Trafikverket</i>	<i>Våtmarkers ekosystemtjänster: påverkan från nya projekt och möjligheter till klimatkompensation</i>	1 770
<i>Jaramillo Fernando</i>	<i>Vetenskapsrådet</i>	<i>Under the trees: Quantifying invisible changes in wetland water availability.</i>	4 000
<i>Jaramillo Fernando</i>	<i>Kungl. Tekniska Högskolan</i>	<i>Postdoktorprojekt inom centrumet Digital Futures, SFO IT och mobil kommunikation</i>	2 000
<i>Jarsjö, Jerker</i>	<i>Statens Geotekniska Inst.</i>	<i>Development and test of nano zero-valent iron for in-situ treatment of anoxic arsenic contaminated gw</i>	846
<i>Kalantari, Zabra</i>	<i>Formas</i>	<i>AI-baserad kunskapsintegration för omställning av städer och samhällen till klimatneutralitet</i>	3 988
<i>Kalantari, Zabra</i>	<i>Vetenskapsrådet</i>	<i>Vetenskap för ett säkert samhälle: Hydroklimatrisker, krisberedskap och krishantering i Sverige</i>	6 784
<i>Kirchner, Nina</i>	<i>Privatpersoner</i>	<i>Donationer till TRS</i>	101
<i>Kirchner, Nina</i>	<i>Carl Tryggers Stiftelse</i>	<i>LoTUS v2.0 – Monitoring how much the ocean is melting North Greenland glaciers Kirchner, Jakobsson & Kutteneuler</i>	427
<i>Manzoni, Stefano</i>	<i>EU H2020</i>	<i>Holistic management practices, modelling and monitoring for European forest soils (Holisolis)</i>	3 879
<i>Ramage Justine</i>	<i>Formas</i>	<i>Förändringar i Ekosystemtjänster inom den Arktiska permafrostregionen</i>	4 469
<i>Skånes, Helle</i>	<i>Formas</i>	<i>Markorganismer i odlingslandskapet – är gamla gräsmarker en underjordisk mångfaldsskatt?</i>	488
<i>Skånes, Helle</i>	<i>Naturvårdsverket</i>	<i>BIOTOP Stockholm</i>	1 040
<i>Stoessel, Marianne</i>	<i>Göran Gustafssons Stiftelse</i>	<i>Kumulativa effekter av markanvändning och klimat på renbete och fjällmiljö: en retrospektiv analys av vegetationen i renbetesmark</i>	49
Sum			47 477

Research Contracts Awarded 2021

Grant Receiver	Funding Organisation	Project Name	Total Grant (TSEK)
Frampton, Andrew	SKB	Flow and tracer transport in crystalline fractured media	1 000
Jarsjö, Jerker	SWECO	Development and test of nano zero-valent iron for in-situ treatment of anoxic arsenic contaminated gw	450
Stroeven, Peter Arjen	SKB	Cosmogenic nuclides, modelled glacial erosion rates, and the Forsmark shoreline displacement curve	434
Sum			1 884

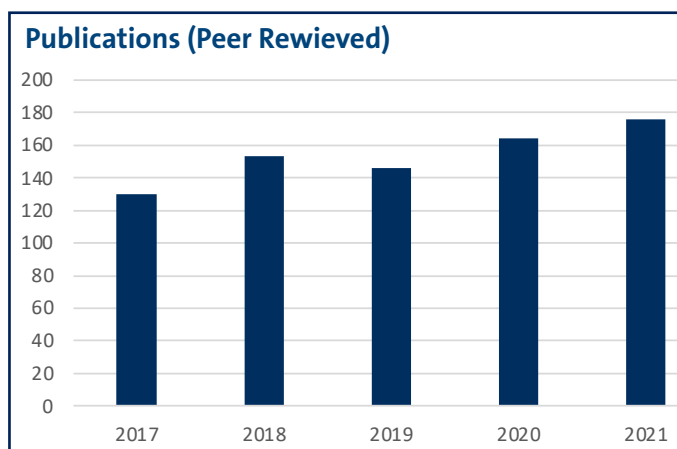


Research grants received 2017-2021.



Department annual financial result and cumulative balance 2017-2021.

Publications 2021



Number of peer reviewed publications 2017-2021. A total of 176 papers were published in peer reviewed journals 2021. Statistics for 2021 reported in DiVA as of 2022-02-28.

QR Code to All NG Publications in 2021



Climate Science and Quaternary Geology

Heads of Research Unit: Margareta Hansson and Stefan Wastegård

We study climate and environmental changes, under present conditions and back in time during the glacial cycles of the Quaternary period. Modern instrumental observational data are used together with information from natural archives such as lake sediments, peat bogs, ice cores, cave deposits, tree rings, glacial sediments, and archaeological material, to study changes in climate and the environment. Our research material come from the entire world and we have ongoing projects in the Nordic countries, Europe, Africa, the Himalayas, the Arctic, Antarctica and Greenland. We also perform simulations with climate models on large computers to study the functional behaviour of the climate system under conditions different from those of today. That helps us to better interpret the information stored in the different natural archives.

Also the year 2021 was a different year, marked by the COVID-19 pandemic. This affected many activities that we do in a normal year, and many of us had to cancel fieldwork and excursions. Most teaching during the spring and summer was performed online, and we replaced some of the field-based teaching and laboratory practicals with films and video clips that were greatly appreciated by the students.

We had one PhD dissertation in 2022 when Eva Rocha successfully defended her PhD thesis on Trees and the Environment in June.

The EU-supported deep ice core drilling project in Antarctica, Beyond EPICA, could start with the first field campaign in 2021/22. Margareta Hansson is one of the WP leaders in the project responsible for International and Cross-disciplinary Exchange and she was co-convener of a virtual session at EGU in April and participated in a project meeting in Paris in October. However, the field campaign within the ongoing international East Greenland Ice-core Project (EGRIP) in Greenland had to be cancelled for the second year in a row. Virtual steering committee meetings have been held during the year and a field season is planned for summer 2022. Margareta also served as faculty opponent for Emily Doyle's PhD thesis at University of Cambridge, UK in November and participated in an assessment panel for the PhD education in Geosciences, Uppsala University. Anders Moberg continued to work as coordinator of the Bolin Centre Database. A major achievement this year was the release of the Oden data repository, <https://bolin.su.se/data/oden-data-repository>, which is a collection of data acquired at the Swedish icebreaker Oden during 19 expeditions held between 2007 and 2021.

Steffen Holzkämper gave a presentation on his experiences from teaching online during the Corona pandemic at "SYV-dagen" in October. The presentation was directed to student counsellors at primary and secondary schools.

Within the Research School for teachers of Natural Science and Geography, focusing on Climate and the Environment, licentiate

student Marit Hichens-Bergström has been tutoring students from upper secondary school for their exam work.

Gunhild Ninis Rosqvist and Carl Österlin visited their research collaborators in Laevas, Sirges and Vilhelmina norra reindeer herding communities during the spring to discuss how to develop methods to assess effects from climate warming, especially snow conditions on reindeer land use. The research on multiple pressures from climate and land use on reindeer herding, which is partly funded by the Bolin Center has been portrayed by Sveriges Television a serie about 'Kebnekaise eight season' and also by international media e.g. AFP. Results from the study were presented at the Arctic Science Summit Week in April. Ninis was also invited to be a host of Sommar in P1, SR (<https://sverigesradio.se/avsnitt/gunhild-ninis-rosqvist-sommarprat-2021>). She shared her insights from palaeoclimatic research in polar and high alpine environments and her ongoing collaboration with Sámi reindeer herders focusing on impacts of warming on snow conditions

Qiong Zhang attended EC-Earth meeting in February and presented the finding of a pronounced centennial oscillation in the newly performed long EC-Earth3 model simulations, the presentation raised great interest in the EC-Earth community. A further follow-up work was presented in the EC-Earth meeting in November and proposed the interpretation. The climate modelling group has attended a 30 hour online marathon conference across time zones on 2-3 December, to celebrate the PMIP 30th anniversary.

In December, Stefan Wastegård gave an online guest lecture at University of Southampton, UK about the Late Quaternary Tephrochronology of the Azores Islands. Stefan also served as faculty opponent for Sunniva Rutledal's PhD thesis at University of Bergen, Norway in April.

Josefine Axelsson had her half-time seminar and gave a talk during the Bolin Days. She also presented her on-going work at KROnline Seminar series and during a workshop organized by the PAGES working group CVAS.

Josefine Axelsson, Simon Larsson and Hannah Watts participated at the EGU online conference in April. Hannah also gave a talk called 'Meet a glacier scientist' for high school students at the Bolin Days, where she spoke about what it's like to do a PhD studying glacial environments. Ellen Berntell was awarded with second prize for her poster at the Bolin Days.

In October, Martina Håttestrand, who is the Department environment representative, organised the workshop "Flying less: How can we go from words to action and reduce our flying at SU?". The workshop was organised in collaboration with the Department of Geological Sciences and the Department of Environmental Science. About 50 persons from SU participated.



Upper secondary school student Mandreja Söderberg from Brinellskolan, Fagersta performing peat research in one of our laboratories.
Photo: Marit Hichens-Bergström.



Ninis Rosqvist was invited to be a host of Sommar in P1, SR. Photo: Mattias Ahlm, Sveriges radio.



Eva Rocha with her PhD hat after successfully defending her PhD thesis.
Photo: Stefan Wastegård



Simon Larsson explaining the difference between silt and sand during a filming session in Dalarna aimed at the distance learning course Tellus III. Josefine Axelsson and Hannah Watts also appear in the photo. Photo: Stefan Wastegård.

Geomorphology and Glaciology

Head of Research Unit: Per Holmlund and Nina Kirchner

Research and teaching by members of the Geomorphology and Glaciology research unit focus on Earth surface processes and their effects on landforms, landscapes, environment, and society in a wide range of settings; from the north and south polar regions to the the subtropical climate zones. Interesting MSc and BSc theses were presented within the research unit during 2021. These theses focused on glacial dynamics, landscapes, and processes in Greenland, Svalbard, and Sweden. Below we present short excerpts from these studies.

Kangerlussuaq Glacier, one of the major fjord-terminating outlets of the Greenland Ice Sheet along the east Greenland coast, was investigated by Jamie Barnett who conducted numerical experiments. Those aimed to shed light on relative importance of various drivers of glacier retreat until the year 2065, such as surface mass balance, submarine melt, and ice mélange buttressing force. Model results showed that when an ice mélange fails to form during consecutive years, Kangerlussuaq glacier retreats by more than 30 km into the large overdeepenings in Kangerlussuaq Fjord, necessitating to anticipate excessive mass loss from Kangerlussuaq Glacier in the future.

At fjord-terminating Ryder Glacier in northern Greenland, the spatio-temporal dynamics of supraglacial lake evolution and its impact on glacier flow dynamics were investigated by Jacqueline Otto. Using satellite imagery, the drainage behaviour of supraglacial lakes was analysed for the time period 1985 – 2020. Results showed not only that supraglacial lakes expand inland and to higher elevation, but also that drainage patterns change markedly. In 2002, a simultaneous rapid drainage of several lakes was observed for the first time, and then observed every year since 2010. This may have yet unknown impacts on glacier speed up, including potential surges.

The marginal moraine complex of Nansenbreen, a tidewater glacier in Svalbard, was studied by Amandine Missana, in collaboration with UNIS, Svalbard. Based on aerial imagery, historical images, digital elevation models, and radiocarbon ages, a sedimentological and landform map was produced, allowing for the identification of several Late Holocene advances.

Two push-moraines were distinguished, the most distal one being interpreted as the oldest moraine. A maximum constraining age of 750 ± 50 years BP was determined, placing the associated maximum glacial advance in the Medieval Warm Period. Based on those results, the implications for glaciotectonic processes and paleo-climatic and paleo-oceanographic conditions were discussed.

The mass balance of Rabots glacier in close proximity to Tarfala Research Station was reanalyzed by Travis Dickinson. Just like neighboring Storglaciären, Rabots glacier is one of the four glaciers for which mass balance is reported annually to the World Glacier Monitoring Service. Both Storglaciären and Rabots glacier are so-called reference glaciers in the WGMS database, because more than 30 years of continuous measurements are available for them. Results from the reanalysis indicated that Rabots glacier had a slightly more positive mass balance during 1982 - 2020 compared to results derived previously, and provides interesting angles to further studies.

Sálajiegna Glacier in the Sulitelma massif at the Swedish Norwegian border is one of the few glaciers in Sweden that has an active calving front. Using hydrophones, Martin Schulthess collected data capturing the acoustic signature of calving at Sálajiegna, and used the data to develop an acoustic detector using signal processing methodology. Comparison with time synchronous footage of calving events indicate that the detector can correctly identify calving events from the underwater soundscape. This opens promising avenues to be further explored in long term, continuous and low-maintenance observations of calving in harsh polar environments.

Using satellite imagery and cloud-based image processing and methodology developed by the research unit's former Post Doc James Lea, Markus Zaring reconstructed the frontal variation of Sálajiegna glacier during 1984-2021, not only annually, but also at seasonal scale. This provides opportunity to replace labor and cost-intensive observations presently carried out sporadically by easy to acquire quasi-continuous ones that do not need physical presence in the future.



Ryder glacier in northern Greenland. Photo: Felicity Holmes.



Sálajiegna Glacier in the Sulitelma massif at the Swedish Norwegian border is one of the few glaciers in Sweden that has an active calving front. Photo: Per Holmlund.



Rabots glacier is one of the four glaciers for which mass balance is reported annually to the World Glacier Monitoring Service. Photo: Nina Kirchner.

Landscape Environment and Geomatics

Heads of Research Unit: Sara Cousins and Gustaf Hugelius

In 2021 our research unit grew with several new members. To better reflect the scope of research interests we changed the name of the unit to Landscape, Environment and Geomatics (LEG). We are a diverse group of researchers that study landscapes, natural ecosystem processes, social-ecological systems and how they shift in space and time. We use ecological and societal data, geo-data, modelling and historical information. Our research focuses on understanding historical, present and future interactions of humans, plants and animals with landscapes and the environment, both in water and on land. We study landscapes and resource management, biodiversity, conservation and ecosystem services as well as feedbacks to climate.

We work at multiple scales, from local to global, from genes to biome, from individual to society. A range of different approaches and methods are needed to work across scales and disciplines and many of our researcher use geomatics. Geomatics is the acquisition, management and analysis of geospatial data. It includes geographical information science (GIS), Earth Observation (EO), surveying and geodesy. Our research develops these methods to better use the capabilities of geodata for a range of applications in Earth and environmental sciences.

Our unit is responsible for two Master's programs-Landscape Ecology and Geomatics with Remote Sensing and GIS- and we are engaged in all three of the department's Bachelor level programs.

In 2021 we had three research area leaders in the Bolin Climate Research Centre; Gustaf Hugelius - Biogeochemical Cycles and Climate (RA4), Regina Lindborg - Landscape processes and Climate (RA7), and Sara Cousins - Biodiversity and Climate (RA8). Many of the unit members are also part of the Bolin Centre.

Continuing from 2020, much field work and meetings were postponed, cancelled or disrupted because of the Covid-19 pandemic. While work on Swedish field sites could be continued, 2021 also offered some opportunities to visit field sites on other countries.

Dr. Anna Treydte joined the department, and the LEG-unit, as Senior Lecturer in Nature and Environmental Management. She joins us from the Nelson Mandela African Institution of Science and Technology in northern Tanzania where she still supervises several students.

Deogratias Mulokozi successfully defended his thesis "Integrated Aquaculture systems for diversified food production in Tanzania".

After a two-year break due to the Covid-19 pandemic, Nina Roth and Sara Cousins were finally able to return to their winter warming experiment in Teesdale (England) in September 2021 to take measurements and check that everything is working properly.

In Tovetorp Field Station in Södermanland, the drought and carbon amendment experiment went into its third year, where Daniela Guasconi and Nina Roth keep following the treatments' above- and belowground effects.

Julia Wagner organized a field sampling campaign of permafrost peatland complexes in the remote Tavvavuoma area in Norrbotten county.

Rozália Kapás carried out fieldwork in several different areas, including inventory of seedlings in grasslands and re-surveying of 275 plots in former forests converted to grazing.

During December and January the Swedish Antarctic Expedition DML21/22 carried out research into radar scattering and penetration on the East Antarctic icesheet. The research was led by Ian Brown; the data will be used by Mikael Hovemyr to model radar-snow interactions.

At the COP-26 climate negotiation meeting in Glasgow, UK, Gustaf Hugelius represented the Bolin Centre for Climate Research and gave several scientific presentations in the Cryosphere Pavilion.

Heather Wood worked with citizen scientists in the Batmapper project (batmapper.org) where valuable data was collected from bat roosts and surrounding landscapes across Sweden from Skåne to Norrbotten.

Regina Lindborg was re-elected as a panel member of the Scientific board for biodiversity and ecosystem services (Swedish Environmental Protection Agency) and is co-author of the book *Biologisk mångfald, naturnyttor och ekosystemtjänster. Svenska perspektiv på livsviktiga framtidsfrågor*. <https://www.slu.se/antologi-bm>.

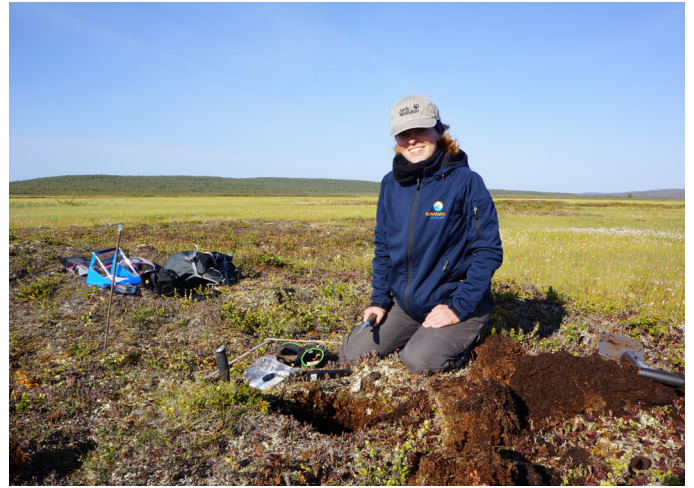
Sara Cousins is part of the management team to give practical advice on the landscape restoration around Stensjö Village (owned by Vitterhetsakademin) where she is monitoring the plant biodiversity and investigate functional connectivity with Rozália Kapás.

In June, we were able to arrange LEG-day with a full-day excursion to field sites around Södermanland. This included visits to Uppså kulle, Ämtvik (photo below), Tovetorp and Torp and we wrapped up with a barbecue outside Geohuset.





Sara Cousins talked about the results on green infrastructure and grassland habitats from two research projects (LiM and FUNgreen) in a short Youtube film produced by the Swedish Natural Protection Agency.



Julia Wagner sampling permafrost peatland during fieldwork in Tjavvavuoma, Northern Sweden.



Anna Treydte meeting with her students in the Nelson Mandela African Institution of Science and Technology in northern Tanzania.



Harvesting from an integrated agriculture-aquaculture system in Tanzania.



Heather Wood puts up an audio-recorder in one of the target habitats with citizen scientists in the Batmapper project, collecting data from bat roosts and surrounding landscapes, from Skåne to Norrbotten.



Sampling during the Swedish Antarctic Expedition DML21/22.

Water, Permafrost and Environmental systems

Heads of Research Unit: Fernando Jaramillo and Stefano Manzoni

We investigate hydrological processes in water and land environments, the anthropogenic effects on these processes and their variability and change, both in time and space, to contribute to the knowledge and capacity advancement needed for sustainable development. We also develop methods and tools for decision support in urban development and planning, watershed/urban modelling integration, and water resources management by combining sub-disciplines such as hydro climatology, remote sensing, geodesy and ecology. Our research focuses on water quantity and quality, how liquid and frozen, subsurface and surface water compartments interact, and how water flows and carries other substances through the landscape – in plants, locally, regionally and globally, and from past, through the present and into the future. We study the possible fate of permafrost under global warming and the total amount, landscape distribution and vertical partitioning of soil organic carbon stocks in these regions. We also inform decision-makers and planners on managing current and mitigating future hydrologic impacts of weather extremes.

This year we had two new PhD students: Erik Schwarz, Xiankun Li, and two new postdocs: Daniel Althoff, Feifei Cao. We also received visiting PhD and master students from Iran, China, and Spain. The year was also very productive, with four proud researchers defending their doctoral studies; Romain Goldenberg, Guillaume Vigouroux, Arjun Chakrawal and John Livsey.

Our researchers received the following research grants and funds:

Salim Belyazid: Co-applicant FORMAS research grant “Sustainable solutions within shifting societal paradigms and a changing climate – Informed decisions based on science and stakeholder priorities”.

Caroline Greiser: Formas mobility grant, “Securing the capacity of forests to buffer climate extremes - the interplay between canopy and soil water”.

Gia Destouni and colleagues: 1) EU ERASMUS+ project for Cooperation partnerships in higher education “Training new generations on geomorphology, geohazards and geoheritage through Virtual Reality Technologies”, with Carla Ferreira, Zahra Kalantari, Giorgos Maneas, and Samaneh Seifollahi, 2) Formas grant for Blue Innovation program, “Innovation and partnerships for effective programs of measures for good water quality and ecological status – with pilot study for Askrikefjärden”, with Carla Ferreira, Zahra Kalantari, and Samaneh Seifollahi, and Lidingö stad.

Zahra Kalantari and colleagues: 1) VR project grant entitled “Science for a secure society: Hydro-climatic hazard, risk, and crisis management in Sweden”, with Navid Ghajarnia, Samaneh Seifollahi, and Gia Destouni. 2) Formas project “AI-powered Knowledge Integration to Carbon-Neutral Cities” with Gia Destouni and Samaneh Seifollahi.

3) C3.ai Digital Transformation Institute-funded “Optimization of Agricultural Management for Soil Carbon Sequestration Using Deep Reinforcement Learning and Large-Scale Simulations” with Carla Ferreira and Gia Destouni.

Fernando Jaramillo: 1) VR Starting Grant, “Under the trees: Quantifying invisible changes in wetland water availability worldwide”. 2) Postdoc fellow scholarship for Francisco Pena from Digital Futures, 3) Co-applicant. SIDA cross-national project “Sustainable management and governance of water and soil in Bolivia”.

Stefano Manzoni: 1) Co-applicant, Horizon 2020, “Holistic management practices, modelling and monitoring for European forest soils”. 2) Co-applicant, Formas special call, “Continuous-cover forestry in Sweden - carbon sink, economic returns and soil biodiversity.”

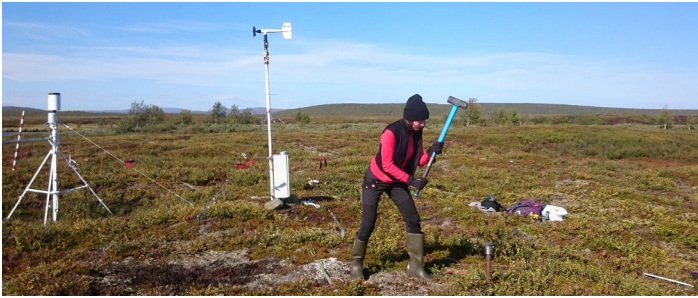
Stefano Manzoni was ranked among the Highly Cited Researchers in the category Cross Field. It is worth mentioning the outreach activities of postdoc Anna Scaini on the environmental issues of the Tagliamento Rive, Italy, including five interviews and six workshops or presentations. Furthermore, the EU-COASTAL project held its second multi-actor workshop (November 2021-online) with local and regional stakeholders for the Swedish Northern Baltic Proper coast, sharing the land-sea system dynamics model and its results and discussing potential business roadmaps and policy options for inland and coastal water quality improvement.

Significant publications

Important publications include: 1) “Hydro-climatic changes of wetlandscapes across the world” led by Imenne Åhlen and published in Scientific Reports, 2) the “Scientists’ warning to humanity on the freshwater biodiversity crisis”, published in Ambio and with Gia Destouni as co-author, 3) “Common irrigation drivers of freshwater salinisation in river basins worldwide” published in Nature Communications and lead by Josefin Thorslund, 4) study co-authored by Arjun Chakrawal and Stefano Manzoni on “Energetic scaling in microbial growth” published in Proceedings of the National Academy of Sciences of the United States of America, and 5) Britta Sannel’s co-authored paper “Expert assessment of future vulnerability of the global peatland carbon sink” published in Nature.



Our research focuses on water quantity and quality.



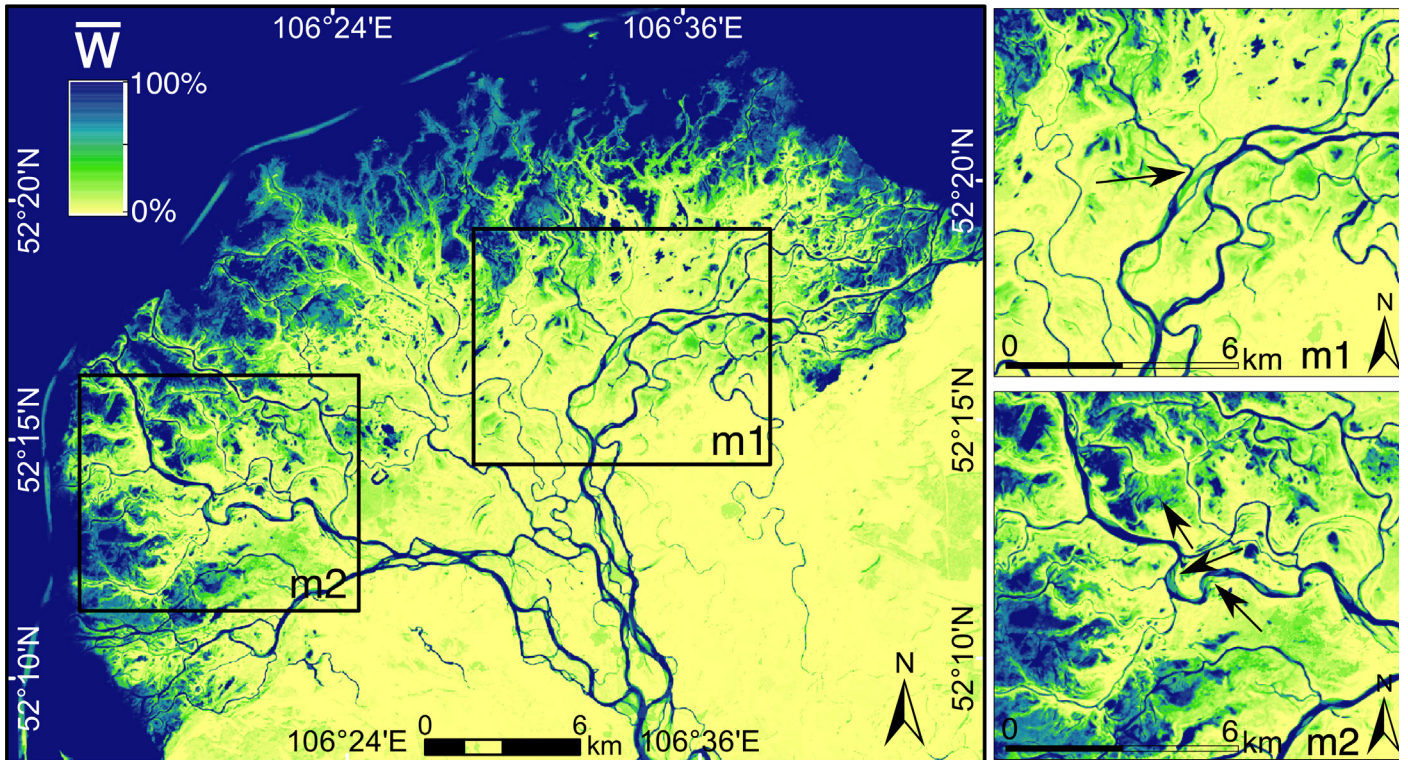
MSc student Ida Rehn making a hole for a thermistor cable in the permafrost Tuvavuoma. Photo: Britta Sammel.



Erik Schwarz and Stefano Manzoni sampling soils in rice paddies, Piemonte, Italy. Photo: Anna Scaini.



Installation of a new thermistor cable in Tuvavuoma together with MSc student Fabian Seemann. Photo: Ida Rehn.



Water occurrence in the Selenga River Delta based on space observations (Aminjafari et al., 2021).

Tarfala Research Station (TRS)

Director: Nina Kirchner

Vice- director: Per Holmlund

Tarfala Research Station (TRS) is located at 1130 m asl in the Kebnekaise Mountains, in northern Sweden, and is hosted by the Department of Physical Geography at Stockholm University. Inaugurated in 1961, TRS has supported research in the fields of glaciology and geomorphology since. Mass balance investigations on Storglaciären started in 1946 and continues today, rendering the World's longest continuous glacier mass balance record. More recently, activities at TRS are complemented by ecosystem research in cooperation with Swedish Infrastructure for Ecosystem Science, SITES. TRS is open during two field seasons (spring and summer), and welcomes scientist from all disciplines to conduct research in a unique arctic-alpine environment.

A change in organisation and leadership of TRS became effective as of January 2021 with new by-laws, a new Board, and a new director. The president of Stockholm University appointed Nina Kirchner as director, and Per Holmlund as vice-director. Martin Jakobsson chairs the TRS Board. The new TRS team is complemented by Annika Granebeck as acting station manager, and by Jamie Barnett as research engineer. An international external advisory group has started to form and includes experts from physical and human sciences.

A very reduced TRS staff conducted a short, intensive and successful spring field season during three weeks in April 2021 when they dedicated their focus on glaciological work. The summer season at TRS started in early July 2021, with duties ranging from glacier safety and first aid exercises, and practising emergency routines, to station and equipment inspection and maintenance, and general logistics. Field assistants and a kitchen staff complemented the permanent staff from mid-July onwards, and supported a wide range of TRS projects and data collection programs at and around the station, as well as in the wider Tarfala area. Field work on glaciers, their forefields, in the valleys, and at lakes and streams could mostly be conducted as planned, but was occasionally delayed by harsh weather, not least when the Swedish Meteorological and Hydrological Institute's weather station at TRS recorded a record high July wind speed of 40 m/s on July 16: smhi.se/bloggar/vaderleken-2-3336/vindbyar-pa-40-1-m-s-i-tarfala-svenskt-julirekord-1.174052. Even the days before that storm were eventful: complete ice-off at Lake Tarfala was recorded on July 12. The rapid ice loss destroyed a mooring comprising of a chain of temperature sensors in the central part of Lake Tarfala, which was installed in 2016 to continuously monitor changes in the lake water temperature. A new mooring, equipped with a larger variety of sensors than the lost one, could however be installed in September.

Measurements of the elevation of Sweden's (formerly) highest peak, Kebnekaise Southtop, were conducted on August 14, 2021, and confirmed what was anticipated: the Southtop elevation was 2094.6 m above sea level, which is more than 2 m less than the elevation of the Northtop (2096.8 m). Both national and international media reported and commented.

A dry calving event at Isfallsglaciären started on August 23, 2021 which could be observed from TRS, where a Time Lapse Camera was immediately installed to monitor further activities. After the dry calving activities ceased, a large portion of bedrock was exposed, along which meltwater continues to fall down in streams.

Due to the pandemic, TRS welcomed a smaller number of guest researcher groups than usually. Guests were from Stockholm university, KTH, Uppsala University, and Lund University. Our guests from Lund inspired TRS staff to deepen the newly established collaboration between the Bolin Centre Climate Research School at Stockholm University, and the ClimBEco research school at Lund University (bolin.su.se/research-school), through collaborative projects at TRS. Through the INTERACT program, students affiliated with Afry also visited the station, and one remote access project was carried for colleagues at the British Antarctic Survey in Cambridge/UK.

Internationally, we would like to express our congratulations to Profs. Julie Bryce and Ruth Varner from the University of New Hampshire, USA, for receiving NSF funding for the project "ICE TALKS - International Collaborative Experiences to Track Arctic LaKe Systems". ICE TALKS supports US graduate and undergraduate students to carry out field work at TRS, but also at Finnish research stations Kilpisjärvi and Värrio, to which Tarfala is connected through Arctic Avenue, a spearhead research project between Helsinki University and Stockholm University. We are looking forward to welcoming students and staff of Stockholm University as well as guest researcher from other Swedish and international universities, to TRS in 2022!



Tarfala Research Station in August 2021. Photo: Per Holmlund.

Navarino Environmental Observatory (NEO)

Director: Zahra Kalantari

Station Manager: Giorgos Maneas

The Navarino Environmental Observatory (NEO) is a Mediterranean hub for research and education where science, business, society and policy makers join in a cooperation to create a more sustainable future under a changing climate. NEO is a collaboration between Stockholm University, the Biomedical Research Foundation of the Academy of Athens (BRFAA) and the Tourism Enterprises of Messinia S.A. (TEMES), in an international partnership between the academia and the private sector.

NEO has 9 associated members, research institutions from Greece, Sweden, Germany and the USA. NEO itself is a member of the European Research Infrastructure for the observation of Aerosol, Clouds and Trace Gases ([ACTRIS](#)), PANhellenic infrastructure for Atmospheric Composition and climate change ([PANACEA](#)), Global Wetland Ecohydrology Network ([GWEN](#)), and The Greek Long-term Ecosystem Research Network ([LTER-Greece](#)).

The NEO field station is located at Costa Navarino, Messina, Greece and is open to researchers and students from collaborating institutions and other universities from Greece and abroad, as well as to other societal stakeholders who are willing to share their environmental challenges and contribute to the development of sustainable solutions. NEO turns research on climate change and associated societal and environmental challenges into actions, by organizing several events to promote research outcomes among scientists, corporates, decision makers and even society members on local, regional and global scales.

During 2021, the COVID-19 pandemic created implications for many NEO activities, especially those regarding students' field courses. The class from the NaSa-programme at Värmdö Gymnasium (Stockholm) was the only educational visit that took place in 2021, while other planned visits were cancelled. NEO has organized a virtual fieldtrip to Navarino Bay as an online course with more than 80 international students on 21st April 2021. The course was part of a series of online virtual field trips on Geomorphology and Quaternary Geology, and was developed under the CIVIS framework, a collaboration between the National and Kapodistrian University of Athens, Aix Marseille University, Stockholm University - Navarino Environmental Observatory (NEO) and Universidad Autónoma de Madrid. During summer 2021, NEO hosted six interns from the American College of Greece (ACG), and one intern from Stockholm University (SU).

NEO researchers have been active in publishing new research articles in international journals (24), (virtual) conferences (15), and book chapters (6). In terms of EU research projects in 2021, NEO continued the work under the [COASTAL](#) project focusing on the development of quantitative System Dynamics models for business and policy analysis. The models and their outcomes were shared and discussed with stakeholders and relevant business roadmaps and policy options were developed for the two cases of SW Messinia and Norrström/Baltic Sea.

Under the [GIALOVA](#) project, coordinated by NEO, in 2021 the team updated the network of water stations inside the wetland, installed new sensors to monitor groundwater resources at the surrounding area, and collected water and sediment samples for analysis. The monitoring efforts were supplemented with fish sampling and regular observations of waterbirds during the breeding/nesting period (April –June). The data, along with suggestions for restoration actions, were reported and discussed with societal and policy stakeholders, following an iterative process which started in 2020 and is planned to continue at the same pace in 2022 and 2023.

In 2022, NEO will participate in two new EU projects, one funded by PRIMA foundation focusing on research and innovation (SALAM_MED: Sustainable Approaches to Land and water Management in Mediterranean Drylands), and the other funded by ERASMUS+ focusing on education through Virtual Reality Technologies (GeoVT).

Based on the NEO Communication Platform, which was developed in 2020, the management team structured a dissemination strategy on which various new materials were prepared for communication and dissemination purposes. More specifically, the team updated the [NEO website](#), created new [dissemination material](#) (leaflet, NEO fact sheet) and produced a new introductory [video](#) about NEO. All of our activities are now available also to our social media [Facebook](#) and [Twitter](#).

With the hope that the COVID-19 situation will improve in near future, we are looking forward to see you all in-person at NEO in 2022!

NEO management

NEO associated members:

<https://www.navarinoneo.se/associated-members>

For more information please visit: www.navarinoneo.se



Värmdö Gymnasium students on fieldwork. Photo: Paul Strehlenert.

The Bolin Centre for Climate Research

Co-directors: Nina Kirchner and Alasdair Skelton

The Bolin Centre is a consortium of more than 350 scientists in Sweden who conduct research and graduate education related to the climate of the earth. The Bolin Centre is a collaboration between SU's departments ACES, DEEP, IGV, MISU, NG and Zoology, together with FLOW at the Royal Institute of Technology (KTH) and the Rossby Centre at the Swedish Meteorological and Hydrological Institute (SMHI).

The Bolin Centre focuses on extending and disseminating knowledge about the Earth's natural climate system, climate impacting processes, climate modelling, human impact on the climate and climate impacts on ecosystems, biodiversity and humanity as well as how society can minimise the negative impacts of climate change. It contributes to the knowledge base for climate mitigation and adaption policies nationally and internationally.

Even during 2021, the COVID-19 pandemic was everpresent, and kept its hard grip on virtually all parts of life. Work-life continued digitally, from home offices, and with occasional in person meetings. In Glasgow, the COP26 meeting could be held during the first two weeks of November, and those wanting to follow remotely could meet members of the Bolin Centre, and the International Cryosphere and Climate Initiative at Kulturhuset in Stockholm to watch and discuss live streamed events from Glasgow.

At the end of 2021, the Bolin Centre leadership was handed over to a new director, Prof. Ilona Riipinen from ACES, a new vice-director, Assoc. Prof. Gustaf Hugelius from NG, and two new co-Chairs of the Board, Prof. Johan Nilsson from MISU and Prof. Martin Jakobsson from IGV. We feel proud to be able to pass on leadership of a flourishing centre, whose members continue to create the fundamental knowledge on which a sustainable transformation must be based, and wish Ilona and Gustaf all the best.

Our eight multidisciplinary cross-departmental research areas:

- Oceans-atmosphere dynamics and climate
- Clouds, aerosols, turbulence and climate
- Hydrosphere, cryosphere and climate
- Biogeochemical cycles and climate
- Historical to millennial climate variability
- Deep time climate variability
- Landscape processes and climate
- Biodiversity and climate



Alasdair Skelton opens the Bolin Days. Photo: Magnus Atterfors.



The new director, Prof. Ilona Riipinen from ACES and vice-director, Assoc. Prof. Gustaf Hugelius from Department of Physical Geography. Photo: Magnus Atterfors.



Poster session during the Bolin Days. Photo: Magnus Atterfors.

Infrastructure

Field stations:

Tarfala Research Station (TRS)

Navarino Environmental Observatory (NEO)

Other facilities:

Stockholm Tree Ring Laboratory

Chemical Laboratory

Microscope facilities

Optically Stimulated Luminescence

Laboratory (OSL)

Sediment Laboratory

GIS and remote sensing cluster

Ice Laboratory

Geomorphology Laboratory



Teaching in one of our GIS and remote sensing laboratory.



Björn Gunnarson in the Stockholm Tree Ring Laboratory shows a series of annual rings from a sample found at Hanvedsmossen in Botkyrka, Sweden. The sample is 3600 years old and the thinner rings show a climate event probably due to a volcanic eruption in the Greek archipelago. Photo: Lena Katarina Johansson, Stockholm University.



Core with glacial clay varves, from Lundinsmossen, Sörmland. This bog has been used for several courses on both Bachelor and Master's level. We analyse cores in the Sediment Laboratory. Photo: Stefan Wastegård.

Education

Director of Studies: Jerker Jarsjö
Vice Director of Studies: Björn Gunnarson

The Department's goal is to offer high quality education, reflecting its research profile, and meeting society's needs for theoretical and practical expertise and skills.

The Department offers education at undergraduate (Bachelor's) level in Geography, Earth Sciences, Integrated Biology-Earth Science, and Environmental Studies. In addition, a wide spectrum of graduate (Master's level) programmes and courses are given, reflecting the research profile of the Department.

Every year about 1200 students attend our undergraduate and graduate courses.

Bachelor Programmes (180 credits) in:
Biology-Earth Sciences
Geography
Earth Sciences

Master's Programmes (120 credits) in:
Environmental Management and Physical Planning
Geomatics with Remote Sensing and GIS
Hydrology, Hydrogeology and Water Resources
Landscape Ecology
Polar Landscapes and Quaternary Climate

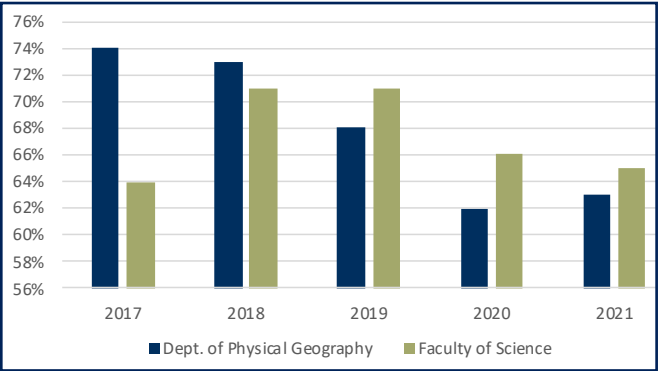


Students on the Bachelor's Programme in Biology-Earth Sciences 2020/23 in central Sweden in Sala silver mine.
Photo: Stefan Wastegård.

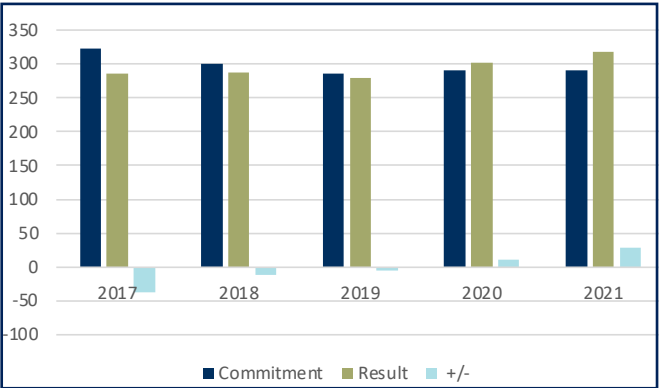


Students on the Bachelor's Programme in Biology-Earth Sciences 2020/23 on excursion in central Sweden visiting Säterdalen.
Photo: Stefan Wastegård.

Student Completion Rate in % (Genomströmning)



Annual Performance Equivalent/HÅP



PhD Education

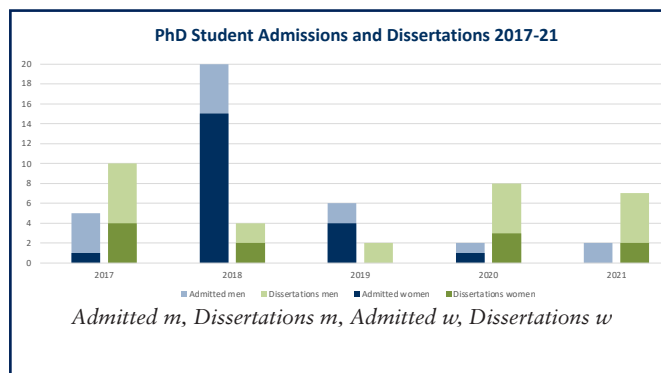
Subject representative: Stefan Wastegård
Director of PhD Studies: Helle Skånes

The year 2021 was, just like the year before a very different year, marked by the COVID-19 pandemic. Although, we have learnt to deal with the situation, the pandemic still affected the PhD education in many ways. Everyone kept on working hard to mitigate the situation having most activities in Zoom. During the year we had seven dissertations (see list). All of them were held completely or partly in Zoom. Introductions to new PhD students, halfway seminars, nailing ceremonies, and follow-ups of individual study plans were all held in Zoom or in hybrid form. Other recurrent activities were individual supervisor meetings in the spring. In December, an evaluation of our PhD education was initiated by NG providing a detailed self-evaluation report to the Faculty. The report was written by Helle Skånes, Stefan Wastegård, Susanna Blåndman, and Josefin Axelsson. The outcome of the evaluation will be communicated during late spring 2022.

The PhD students did a great effort keeping their projects afloat and to mitigate the negative effects of the COVID-19 pandemic. Also this year, they organized a survey to assess the wellbeing of department's PhD students. The annual department PhD day was organised by the PhD students in April. The PhD council was successful in applying funding for a well attended one-day workshop on Visual Communication, with the founder of the course VisualizeYourScience. At Halloween, when temporarily restrictions were not so severe, there was a masquerade party at the department in the Geoscience building lifting everyone's spirits remarkably (see picture below). At the end of 2021, they also got funding for a writing retreat for one week in Askö research station next Spring.

Abhay Prakash won 3rd prize for oral presentation at the Bolin Centre Climate Research School PhD day, with his talk on Numerical modelling of ice-ocean interactions at Petermann glacier, Northwest Greenland. Alexandra Hamm won first prize for her poster Impact of lateral groundwater flow on hydrothermal conditions of the active layer in a high arctic hillslope setting at the Regional Conference on Permafrost 2021, and Ellen Berntell won second prize for her poster Vegetation feedbacks enhance the West African Monsoon during the Mid-Holocene at the Bolin days.

PhD Student Admissions and Dissertations 2017-21



Doctoral Theses 2021

Deogratias Mulokozi, *Integrated Agriculture and Aquaculture Systems (IAA) for Enhanced Food Production and Income Diversification in Tanzania*

Eduard Nedelciu, *Global phosphorus supply chain dynamics: Sustainability implications for the 21st century*

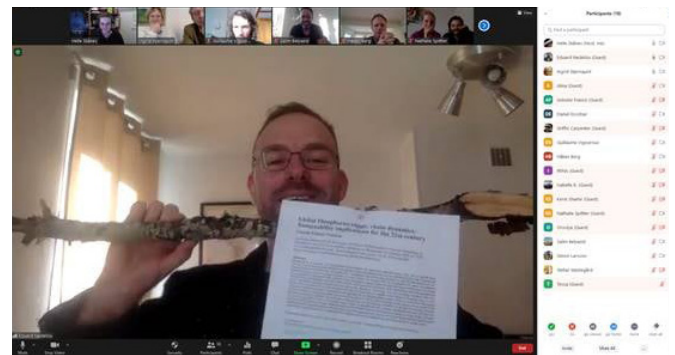
Romain Goldenberg, *Nature in urban regions: understanding linkages and benefits to human populations*

Maartje Oostdijk, *Fisheries Management under Individual Transferable Quota. Outcomes for Ecology and Equity*

Eva Rocha, *Trees and the environment - Possibilities and challenges in tree-ring research across spatial and temporal scales based on case studies in Sweden*

John Livsey, *Sustainable agriculture - From global challenges to local land management*

Guillaume Vigouroux, *Managing coastal eutrophication: Land-sea and hydroclimatic linkages with focus on the Baltic coast*



Digital nailing with Eduard Nedelciu.



PhD students celebrate Halloween in the coffee room.

Collaboration

International Exchange Education

International coordinator: Maria Damberg

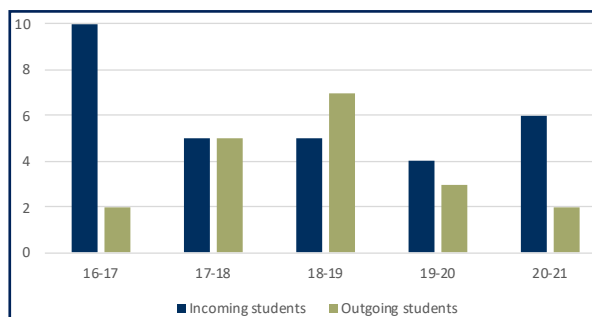
Partner Universities until spring semester 2022

Aachen, Germany
Brussels, Belgium
Copenhagen, Denmark
Freiburg, Germany
Gent, Belgium
Grenoble, France
Innsbruck, Austria
Kiel, Germany
Leuven, Belgium
Liège, Belgien
NTU, Singapore
Turku, Finland



Go international, study abroad!
Öresundsbron. Photo: Maria Damberg.

Erasmus Exchange Students 2017-21



The number of students in the graph only show exchange students from our own exchange agreements. In addition we also receive as well as send out exchange students via central (university-wide) agreements, North2North, Nordlys and CIVIS, agreements handled by the International Office at Stockholm University.

Alumni Network

We wish to stay in touch with former students and researchers. Our alumni are part of the valuable network that supports us in a range of different ways: by being important ambassadors and by engaging in the development of reserach and education.



A digital Carrier Day 1 December 2021 was arranged by the Faculty of Science. About 270 registered students and 25 exhibitors participated.

Some Awards and Prizes



Ellen Bertell won second prize in the Bolin Day PhD poster competition, November 2021. Photo above: Josefine Axelsson.

Gia Destouni is the only researcher from Stockholm University and among only nine from Sweden (all other men) on the recent Reuters Hot List of the world's top-1000 climate scientists.

Stefano Manzoni is one of six researchers at Stockholm University who are on the company Clarivate's list 2021 of the world's most cited researchers.

Johan Kuylenstierna was appointed Sweden's third most "Miljömäktigaste" in 2021.

Abhay Prakash won 3rd prize for oral presentation at the Bolin Centre Climate Research School PhD day

Alexandra Hamm won first prize for her poster at the Regional Conference on Permafrost 2021.

Outreach

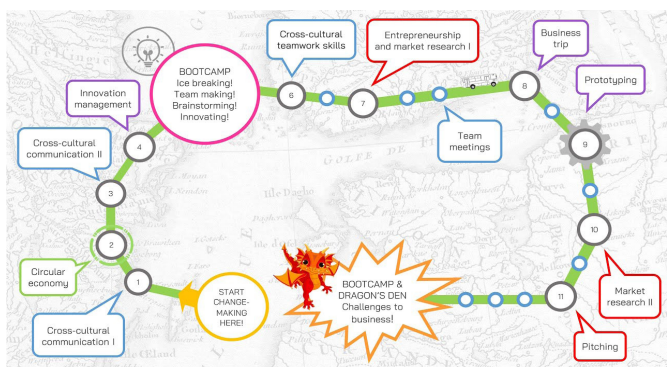
We interact with the public and schools at annual events like; the Researchers Night, the Geology Day, the Bolin Centre Climate Festival, the Sustainability Forum and the World Water Day. This year most of the activities were in digital form.



Digital Sustainability Forum 2021. A historical perspective on major societal crises by Fredrik Charpentier Ljungqvist, associate professor in both history and physical geography and a member of the Bolin Center for Climate Research. Photo: Jens Olof Lasthein.



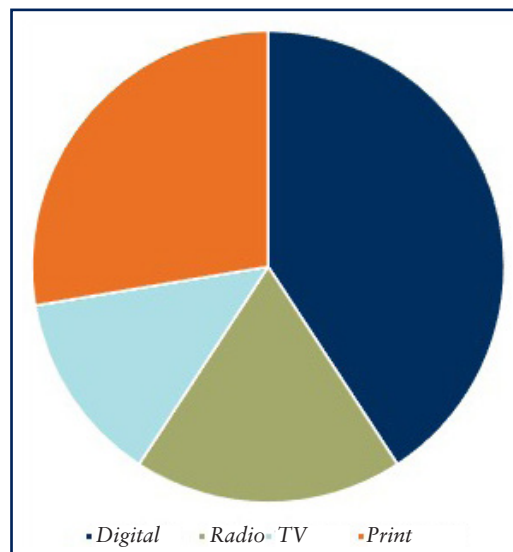
Gustaf Hugelius presenting on the climate impacts of Arctic wetlands in a side event at the COP-26 climate negotiation meeting in Glasgow.



Navid Ghajarnia, Samaneh Seifollahi, Zabra Kalantari and Hanna Kreplin work with the ChangeMakers project, start-ups for sustainable environment created by youngsters. One of the tools is the Central Baltic Negotiation Game (picture above) developed at Stockholm University.

Our Department in the Media

Advances in research are not just for us but for society in general. Through the media, we can contribute to the dissemination of knowledge and debate. With communication we can increase understanding and interest and broaden the views for the future. Almost every week our researchers and teachers appear in the media. The diagram below shows the distribution of appearances in different kinds of media in 2021.



Gunhild Rosqvist was one of the "Sommarpratarna i P1" in the summer of 2021. She talked 30 July about how our lifestyle affects melting in the Arctic. Photo: Mattias Ahlm, Sveriges Radio.

PhD students

PhD Students with Department Employment

Aminjafari, Saeid
Axelsson, Josefine
Berntell, Ellen
Cantoni, Jacopo
Chakrawal, Arjun
Escobar Carbonari, Daniel
Fischer, Sandra
Goldenberg, Romain
Guasconi, Daniela
Hamm, Alexandra
Holmes, Felicity
Hovemyr, Mikael
Kåresdotter, Elisie
Kapás, Rozalia
Larsson, Simon
Li, Xiankun
Livsey, John
Ma, Yan
Mas E Braga, Martim
Newall, Jennifer
Page, Jessica
Pike, Felicity
Prakash, Abhay
Rocha, Eva
Roth, Nina
Stoessel, Marianne
Schwarz, Erik
Vigouroux, Guillaume
Wagner, Julia
Watts, Hannah
Wood, Heather
Åhlen, Imenne

Other PhD and Licentiate Students

Aggemyr, Elsa
Alavaisha, Edmond
Fröjd, Christina
Gisladottir, Johanna
Hichens-Bergström, Marit
Högberg, Charlotta
Joandi, Linnéa
Maneas, Giorgos
Mulokozi, Deogratias
Nedelciu, Eduard
Nyangoko, Baraka
Oostdijk, Maartje
Senkondo, William
Sigfridsson, Sabine

Administrative Staff

Bländman, Susanna
Damberg, Maria
Hansson, Erik
Holmlund, Moa
Hörnby, Kerstin
Jacobson, Rolf
Jacobsson, Runa
Karpegård, Carola
Karpegård, Madeleine
Karlin, Torbjörn
Paldanius, Marcus
Persson, Karin
Plog, Rickard
Schaffer, Christina
Stenberg de Servas Malin
Stolarska, Monika
Sturesson, Elisabeth
Trygger Bergman, Sophie
Åkerblom, Lena

Human Resources Officer
Study and Career Counsellor
Educational Administrator
Educational Administrator
Educational Administrator
Web Editor
Financial Officer
Financial Officer
Head of Administration
Administrator
Financial Officer
Educational Administrator
Archivist
Educational Administrator
Communicator
Administrator
Educational Administrator
Educational Administrator
Educational Administrator

Technical Staff

Barnett, James
Burger, Mikael
Eriksson, Pia
Hättstrand, Martina
Kreplin, Hanna
Maneas, Giorgos

Prieto, Carmen
Rimondini, Lukas
Skantz, Johan
Spångberg, Martin
Stock, Brandon
Wennbom, Marika

Research Engineer
Systems Engineer
Research Engineer Tarfala
Laboratory Officer
Research assistant
Superintendent Navarino Environmental Observatory
Research Engineer
Research assistant
Facilities Technician
Systems Engineer
Research assistant
Research Engineer

Professors Emeriti

Christiansson, Carl
Ihse, Margareta
Lidmar-Bergström, Karna
Lundén, Bengt
Lundqvist, Jan
Ringberg, Bertil
Wastenson, Leif

Professors Emeriti

In Memoriam - Wibjörn Karlén



Wibjörn Karlén passed away in 2021 84 years old. He came to Tarfala Research station in 1959 as a field assistant and he became designated to mountain areas and science. His thesis concerned paleoclimate and his studies covered glaciers, lichens, tree line and lake sediments and he took part in a number of polar expeditions. In 1985 he became professor in Physical Geography and director of Tarfala Research station and a member of the Royal Academy of Sciences in 1992. He was a warm person and a source of knowledge that we now miss a lot. Photo: Per Holmlund.



The Natural Sciences faculty club (NF) arranges many different activities during the year. This is the kick-in for new students with soap football outside the Geoscience building in the fall 2021. Photo: Jens Olof Lasthein, Stockholm University.

Contact

Visiting address: The Geoscience building (Geovetenskapens hus), Svante Arrhenius väg 8, Stockholm - Frescati

Postal Address: Stockholm University, Department of Physical Geography, SE-106 91 Stockholm



Stockholm University in Frescati. Photo: UltraCam Eagle, LMV.

Department of Physical Geography

Telephone: +46 8-16 20 00 natgeo.su.se



**Stockholm
University**