

Final project report:

Snow to Rain: From phase transition of precipitation to changing local livelihoods, emotions and affects in East Greenland

ÖAW-ESS Call 2018

2019-2023

Principle Investigator: Wolfgang Schöner

Department of Geography and Regional Science Graz University, Austria

Authors:

Wolfgang Schöner^{1,2}, Jorrit van der Schot^{1,2}, Peter Schweitzer^{2,3}, Sophie Elixhauser², Anna Burdenski^{2,3}

- 1) University of Graz, Department of Geography and Regional Research, Austria
- 2) University of Vienna, Department of Social and Cultural Anthropology, Austria
- 3) Austrian Polar Research Institute



Content

1. Preliminary comment:.....	3
2. Abstract	3
3. Introduction.....	4
4. Snow2Rain research objective	4
5. Methods	5
5.1. Methods of (snow) climatology.....	5
5.2. Methods of the Snow2Rain social sciences component	6
5.3. Transdisciplinary and interdisciplinary methods.....	6
5.3.1. Preliminary comment on inter- and transdisciplinarity	6
5.3.2. Interdisciplinary methods of Snow2Rain.....	7
5.3.3. Transdisciplinary methods of Snow2Rain	8
5.3.4. Interdisciplinary and transdisciplinary aspects of fieldwork in Tasiilaq	8
6. Main results.....	10
6.1. Snow information for Greenland and related snow climatology for Sermilik region	10
6.2. The perception of climate change by people from Tasiilaq (East Greenland)	13
6.3. Local knowledge on climate change and relevant information on environmental changes for people in Tasiilaq.....	14
6.4. Main conclusions from Snow2Rain disciplinary research	15
7. Changes in the planned implementation of Snow2Rain and short justification.....	16
7.1. Shifted begin of Snow2Rain	16
7.2. Impact of Corona crisis on implementation of Snow2Rain	16
7.3. Social anthropology PhD thesis at University of Vienna	17
7.4. Adjusted work plan and implementation.....	17
8. Trans- and interdisciplinary aspects.....	17
8.1. Interdisciplinary aspects of Snow2Rain.....	17
9. Publications, contributions to conferences and thesis work	20
9.1. Publications	20
9.2. Contributions to conferences.....	22
9.3. Thesis work.....	23
9.4. Website and social media work	23

1. Preliminary comment:

Snow2Rain has been significantly affected by the Covid-19 measures. More specifically, project fieldwork had to be postponed. Also, the installation of snow measurement sensors could not be carried out to the full extent as planned in the application but was adapted accordingly and focused on the location of Tasiilaq thus achieving a stronger interface between the research disciplines involved and the local population.

2. Abstract

Snow2Rain investigated the impacts and perception of climate change in East Greenland through a holistic approach that includes natural science methods of time series analysis and statistical climatology on the one hand, and social science approaches of social anthropology on the other. In addition, this interdisciplinary approach was based in a transdisciplinary framework by involving the local people in Tasiilaq (East Greenland) and their knowledge. Based on the intention to study the effects of climate close to the everyday life of the locals, snow was chosen as one such interdisciplinary indicator of climate change. In addition, Greenland, as the study site of Snow2Rain, is a region in the Arctic and thus affected by Arctic amplification (implying a temperature increase of about three times the global average). With this in mind, Snow2Rain examined changes in snow characteristics in East Greenland and their underlying mechanisms, and placed these changes in the context of social and cultural as well as socioeconomic impacts for local people.

From the main results of Snow2Rain, it can be concluded that (i) Arctic amplification is less pronounced compared to other regions in the Arctic and therefore climate change impacts (e.g., changes in snowpack, transition from snowfall to rain) are less pronounced and co-determined by precipitation changes. The strongest signals for the transition from snow to rain were found for the summer season. In addition, the most important climate change events currently discussed by locals in Tasiilaq are the storm winds known as piteraqs and icequakes (earthquakes triggered by calving glaciers).

There is considerable interest in scientific information about meteorological and climate conditions as well as changes in the community of Tasiilaq, even though the topic of climate change is not the most pressing issue within the community. It also became clear that local knowledge holders from Tasiilaq hold relevant knowledge about past snow and environmental conditions (e.g. stories about snow conditions along dogsledding routes), but several challenges exist that make it a complex task to make this knowledge usable for climate scientists. To give a few examples of the existing knowledge, there is a lot of relevant knowledge about changes in wind direction and wind speed, and particularly a lot of memories exist in relation to extreme wind events (piteraqs and other storm winds).

Overall, the perception of climate change in Greenland is different than in Europe (the recent signing of the Paris Agreement seems to be a clear reflection of this). People from Tasiilaq region are very sensitive in observing changes of their environment including the climate. Snow is only one of those changes observed (wind/storms and earthquakes are currently widely discussed by the locals). However, they speculate much less about future changes and are cautious about the human influence on climate change.

3. Introduction

Snow, ice and water from their melting are not only physical phenomena, but also build the foundation of life, culture and sociality in the Arctic. Snow plays a central role in the cultures of indigenous Arctic people, e.g., for the reindeer herders of Eurasia who have developed a holistic snow terminology (integrating the effects on the ecology, grazing opportunities, and management of the herd). This holistic terminology clearly differs from scientific standard terms (e.g., Eira et al. 2013). The combination of Traditional Ecological Knowledge (TEK) with natural science snow observations and analysis captures a high potential of synergies and will guide strategies for a sustainable future of Arctic people in a changing climate (Riseth et al. 2011; Eira et al. 2013). TEK in general is recognized by the Arctic Council as an important source for better understanding the Arctic environment and its changes (Arctic-Council 1996). In recent years, the indigenous people's snow terminology and its relationship to natural science snow research have been subject to several studies. However, in East Greenland among the Inuit population, no such study has been conducted so far. An interdisciplinary study based on the TEK of Greenlandic Arctic people for snow and ice together with social anthropology and (natural science) climatology approaches has the potential to significantly increase our understanding of the changing Arctic environment. Such an approach appears particularly promising for East Greenlandic (Ammassalik/Tasiilaq region) where the indigenous Inuit are much more connected with traditional live (hunting, dog-sledging, fishing, ancient traditional customs) than elsewhere in Greenland as well as much of the Arctic. Due to its remote location and difficult accessibility, tourism is growing only slowly and people's daily lives and TEK are closely connected to nature and its challenges, such as weather, snow, ice and related changes over time and space. It is the general objective and novelty of Snow2Rain project to fully explore this scientific potential.

The Ammassalik/Tasiilaq region in East Greenland is characterized by a strong alpine relief, with altitudes up to 1000 m.a.s.l.. Glaciers are located mainly on the western side of ridges. The climate is low arctic, with annual precipitation amounts of more than 1000 mm, which falls mainly as snow. Very strong storms are frequent throughout the region and thus strong snow redistribution by wind is an important issue, which likely explains the glacier locations and the observed regional runoff differences (Hasholt et al., 2003). In some areas, as much as 10% of the precipitation is returned to the atmosphere by blowing-snow sublimation. On average snow water equivalent of 113 cm was obtained (not including some minor areas having snow depths as great as 4 m). Changes of the share of precipitation between liquid in solid are key for hydrological processes and partitioning models which have been commonly used are too simple (e.g., Harpold et al., 2017).

4. Snow2Rain research objective

The general objective of Snow2Rain was to better quantify past and future changes of snow properties in East Greenland as well as their underlying mechanisms and to put these changes into the context of social, cultural and subsistence as well as socio-economic implications for local people. At the same time, Snow2Rain aimed at exploring the emotional and affective relations of the inhabitants to the physical world in the field of snow and ice and its social spatial implications and that of memories.

The more specific research aims of Snow2Rain were:

- (i) To analyze existing and within the project duration newly established observational data of snow properties for the study region in order to provide a snow climatology
- (ii) To better understand spatial variability of snow changes in particular local effects in relationship to orographic effects
- (iii) To empirically downscale future snow climatology from existing regional climate model runs for Greenland for the study region
- (iv) To compliment observed changes by process understanding and description of non-observed – but relevant for the aims of this project – snow properties by a physical based modelling approach
- (v) To integrate local people`s traditional ecological knowledge (TEK) of snow, ice and water changes in the study region in a transdisciplinary and interdisciplinary manner
- (vi) To disseminate the project results to local people in order to provide relevant knowledge for managing future challenges of climate change and sustainable resilience
- (vii) Advanced learning outcome for the two PhD students in the field of interdisciplinary and transdisciplinary research methods
- (viii) New epistemological understanding of the integration of positivist scientific knowledge and the constructivist nature of anthropological and traditional ecological knowledge (TEK)

5. Methods

5.1. Methods of (snow) climatology

The snow climatology of Snow2Rain is based on observational data sets from available meteorological stations in the study region (see e.g. Cappelen, 2021). Because of the lack of long-term and spatially dense observational data for the study region (as available for e.g. the Alps) a different approach was needed for the study region. Thus, besides observational data modelling data (simulation data from regional climate model RACMO2 runs, dynamically downscaling reanalysis data of ERA40, ERA-I and ERA5 from ECMWF, van Meijgaard et al., 2008, Noël et al., 2018) were used. In addition to natural science data, the knowledge and observations of local people were integrated into the study of snowfall and snow on the ground.

Methods used in (snow) climatology include various analytical methods from statistics, such as time series analyses and corresponding considerations of the uncertainty of the derived statements.

The following meteorological data sets were used in Snow2Rain:

- Meteorological station series from Tasiilaq station operated by DMI (Cappelen, 2021)
- Meteorological station series from Sermilik station operated by University of Copenhagen

- Meteorological station series at Mittivakkat glacier operated by University of Copenhagen and GEUS (Fausto et al., 2020).
- Snow station series from all available sites outside the Greenland Ice Sheet operated by DMI and Asiaq
- RACMO2.3 (Noël et al., 2019)

Snow2Rain established also snow measurements at Tasiilaq using a Snowfox sensor from Hydroinnova (https://hydroinnova.com/snow_water.html) which offers measurements of snow water equivalent (SWE). Moreover, manual snow pits were taken at Tasiilaq over the winter 2021/22 by the Snow2Rain team also in cooperation with locals.

5.2. Methods of the Snow2Rain social sciences component

This component builds on the discipline of Social Anthropology and thus pursued qualitative, ethnographic research. It involved above all the key method of participant observation (Malinowski 1922; Eriksen 1996) realized through long-term field work in Tasiilaq (10 months in total covering the different seasons by the PhD student; 6 weeks divided into two fieldtrips by the senior researcher). The ethnographic fieldwork included semi-structured interviews (snowball and theoretical sampling approach) and informal conversations, participant observation of everyday life and social and cultural practices as well as of spatial configurations and people's activities with/within the environment (Bernard 2002; Flick 2012). The interviews and conversations comprised the method of storytelling, i.e. of listening to stories and memories told by local people (Cruikshank 2005). Another method was conducting "go-alongs" (Kusenbach 2003), which meant to accompany residents "in-situ" with their daily life practices, such as for instance boat drivers, hunters and fishermen during their activities, while engaging in conversations about their practices and the formations of the land and physical conditions. Go alongs also happened with teenagers/young people, e.g. in the frame of their activities within different youth associations, and with women of different age groups on their daily routes in town and through the landscape to understand the gendered and intersectional emotional and affective perceptions of the environment and space and related practices (cf. Ingold 2000, 2007, 2011; Massey 1994, 2005). The organization of public meetings and focus group interviews was another important method and supported the reflection and discussion of research insights with Tasiilaq residents, contributing to the data sets of both the physical and social sciences. The PhD student in anthropology unfortunately dropped out after finishing her fieldwork. While she handed over fieldwork material to the project team, the senior researcher in anthropology continued the tasks necessary to bring the project to completion. Interview transcripts and field diaries were digitally analyzed with the program Atlas.ti allowing for systemized building of categories which are the basis of qualitative, anthropological interpretation.

5.3. Transdisciplinary and interdisciplinary methods

5.3.1. Preliminary comment on inter- and transdisciplinarity

Snow2Rain project results are based on a combination of methods that incorporate climate science, social anthropology, and local knowledge. Interdisciplinary and transdisciplinary approaches have been central and we want to briefly bring forward the definitions of inter- and transdisciplinarity that we used. Throughout academic literature, several different

definitions of these terms exist. We understand **interdisciplinary science** as science integrating methods from one discipline to another. We use the following definition of **transdisciplinary science**: it is that which is at once between the disciplines, across, the different disciplines, and beyond all disciplines. Instead of having a goal within the framework of disciplinary research, its goal is the understanding of the present world, of which one of the imperatives is the unity of knowledge (Perspectives, 2014). In other words, in transdisciplinary research we address our research questions not only from the perspective of the involved disciplines (snow climatology and anthropology) but we use elements of both, and additionally include a third pillar: local Inuit knowledge. The project's methodological approach is based on close collaboration and integration of these three pillars.

In practice, it is sometimes difficult to separately describe the interdisciplinary and the transdisciplinary elements of the project. In the following sections, we mainly focus on the collaboration between the two PhD students, and additionally the senior research in anthropology, when talking about the interdisciplinary aspects. When discussing the transdisciplinary aspects, we additionally include the collaboration with Tasiilaq residents.

5.3.2. Interdisciplinary methods of Snow2Rain

As an example of interdisciplinary work, the two PhD students (in snow climatology and social anthropology) have collaborated closely during their respective PhD trajectories from the start. As earlier mentioned, this close collaboration did not yield all the potential benefits due to the discontinuation of the PhD student in social anthropology. Still, it influenced the transdisciplinary project results, which will be discussed in the following chapter. In practice, the close collaboration of the two PhD students involved, among other aspects, exchanging literature, and weekly meetings and discussion. These meetings involved sharing key ideas from the disciplines of snow climatology and anthropology that were deemed relevant to the overall project (e.g., on the meteorological methods used for measuring snowfall and on the Greenlandic concept of "Sila" [meaning weather, climate, feelings, among other things, in the Greenlandic language]). The meetings, in combination with an open attitude, helped to shape the PhD students' understanding of concepts, themes, and methods of the Snow2Rain project, which proved useful during the many fieldwork periods. During the team meetings shared by the whole project team, these learning effects were shared with the other team members. Given the different terminologies and perspectives of the three groups involved in Snow2Rain (snow climatology, anthropology, and local inhabitants of Tasiilaq), this attempt to better understand each of those groups proved helpful in the field. It improved for example the way in which results of meteorological data was shared in different workshops in Tasiilaq, but it also altered the general fieldwork approach and workshop set-up. In addition to introducing each other to the different methods of one's discipline, the PhD students also introduced each other to mindsets, habits, and research ethics of their respective disciplines. An example of this is that the two PhD students took a lot of time in their preliminary fieldwork in Tasiilaq to familiarize themselves with the local setting of Tasiilaq as well as to let local people of Tasiilaq familiarize themselves with them. This close connections with local people yielded fruitful results. Such a patient approach and attitude is not something inherently present in a snow climatologists' fieldwork and requires understanding different perspectives of time within snow climatology, anthropology, and local people's lifeways. Another example that illustrates

that the PhD students worked outside of their disciplinary boundaries is that the anthropological PhD student did snow measurements together with the snow climatology PhD student during the preliminary fieldwork. The fact that both PhD students took on this research activity together in this first month allowed the anthropological PhD student to continue the snow measurements by herself during her longer ethnographic stay. This led to a much longer time series of snow data than would otherwise have been available. During the second part of the project duration, the senior research in anthropology participated more in the research activities themselves, being part of some of the discussions and activities of the two PhD students, for instance before, during and in the aftermath of a joint field trip in Tasiilaq. After the anthropology PhD student left the team, the senior anthropologist took over the anthropological part of the inter- and transdisciplinary collaboration, conducting the final field trip of the project together with the PhD student in snow climatology.

5.3.3. Transdisciplinary methods of Snow2Rain

Our methodological approach has been significantly influenced through conversations and interactions with local people. The methodological framework has been set up in a way to provide space for local input, due to a clear existing wish to integrate scientific and local knowledge and interests in the best way possible. The foundation for this approach was laid out even before the two PhD students started their fieldwork in Tasiilaq. They used the pre-fieldwork phase of the project (during the Covid-19 pandemic) to already introduce themselves to the community of Tasiilaq and increase the already existing network. The introduction to the community in Tasiilaq was done by creating a website (<https://www.snow2rain.com/home-en>), Facebook group, Facebook page (as Facebook is a social medium that is very often used in Greenland), and by recording two videos where the PhD students introduced themselves to the local people, explained what work they were doing and how it involved the Tasiilaq community. While they noticed many challenges in reaching people before having met them personally in Tasiilaq, the two PhD students also experienced people asking when they came to Tasiilaq and found it helpful that they had laid this foundation when finally coming to Tasiilaq. In addition to introducing themselves and the project via these social media channels, they contacted many local, regional, and national stakeholders via e-mail and telephone in search for potential collaboration partners and relevant information about ongoing activities in Tasiilaq. The aim was not only to inform local, regional, and national stakeholders about the project but also to ask for input, wishes, interests, and possible collaboration.

5.3.4. Interdisciplinary and transdisciplinary aspects of fieldwork in Tasiilaq

The core element of the methodological inter- and transdisciplinary approach of the project consisted in several collaborative fieldwork periods in Tasiilaq. The fieldwork periods took place between November '21 and April '23 and included one longer ethnographic fieldwork by the anthropological PhD student (10 months), which comprised two fieldwork periods where the PhD student in snow climatology joined and one fieldwork trip by the two PhD students and the senior researcher in anthropology. The last collaborative field trip was conducted by the senior anthropologist and the snow climatology PhD student. In line with the transdisciplinary approach described we spent a long time engaging with the local community. This was done for example by having many meetings, joining daily life activities,

organizing a Kaffemik (traditional Greenlandic get-together), organizing a Snow2Rain workshop, a workshop about climate change for young people, and (during the last fieldwork) setting up an exhibition about climate and research. The PhD student in anthropology further organized a snow workshop with young people from Tiniteqilaaq, where she performed several experiments with the students. Another purpose of the fieldwork was to measure snow conditions in Tasiilaq. With this activity we received invaluable support from the local telecommunication company Tusass.

An epistemological key challenge builds the integration and conversation of qualitative data from social science and the quantitative data from physical science (cf. Moon and Blackman 2014). Community Based Participatory Research (CBPR) (cf. Holkup et al. 2004; Kassi et al. 2017; Saxinger and First Nation of Na-Cho Nyäk Dun 2018) is an increasingly used method in the Arctic and beyond to meaningfully engage the local population in knowledge production, but also in the spheres of joint development of research aims and questions and that of dissemination and making knowledge useful for the society. Furthermore, local populations might be reserved against incoming science knowledge when not considering local knowledge. Researchers today should obtain today a so called “social license to research” (Saxinger and First Nation of Na-Cho Nyäk Dun 2018) where meaningful and informed consent of the population for the realization of the project in their region is truly and substantially given. A methodological and ethical challenge in the Arctic is pronounced in particular in Canada but is valid for other regions too: that of data and knowledge ownership, control, access and possession (OCAP) (First Nations Centre 2014). This project therefore orients on this OCAP policy when local knowledge holders do not only release data but also obtain the ownership. This will be realized in this project by the dissemination of physical and social science data in a lay language publication - an attractive digital and print booklet (16-20 pages), in the standard Greenlandic language, Kalaallisut – as well as posters that are easily accessible to the population and can be displayed also in the local museum in order to contribute to the village’s cultural heritage. Furthermore, original interview transcripts will be stored in the local museum upon request and with the consent for release by the informants.

Establishing partnership with the community members in Tasiilaq were realized through several public community meetings and also that with representatives of the local and regional administration and the local museum as well as local tourism providers. Such public community meetings did not only introduced Snow2Rain in the community but also provide space for public reflection of research results and in the end for dissemination of the gained knowledge. This integrative approach, which has elements of citizen science, provides the basis for a true transdisciplinary research partnership and the practical realization of the +overall project.

Two PhD students coming from physical and social sciences worked closely together (unfortunately the social science PhD ended her contract early because of personal reasons) and learned from each other’s disciplines in an interdisciplinary manner. This was particularly possible during common field work at Tasiilaq doing snow measurements and discussing topics of climate change and related impacts with locals.

6. Main results

6.1. Snow information for Greenland and related snow climatology for Sermilik region

Although for Greenland snow is a characteristic element of the natural landscape and also has great relevance for the life of the population, there are almost no snow measurements available, in particular outside the Greenland Ice Sheet where people are living (if the number of snow measuring stations in Greenland would be transferred to the Alps, the snow conditions of the Alps would need to be described by 2 stations only). Prior to the start of the Snow2Rain research project, there were also no data available on snow conditions in Tasiilaq, the largest settlement on the east coast. The only information available concerned snow conditions on the glaciers, where several automatic weather stations were equipped with ultrasonic sensors that could measure snow throughout the year and over several years. This fact is also true for many other regions in Greenland and shows quite clearly that the interests of the climate science community have so far been significantly different from the interests of the people of Greenland. Therefore, part of our effort was to improve our understanding of the seasonal changes in snow in Tasiilaq, and thus more closely align the interests of climate science with those of the local population. With this goal in mind, we conducted manual snow depth measurements in Tasiilaq, installed a snow sensor, and made several snow water equivalent (SWE) measurements by digging snow pits and measuring snow density at different depths in the snowpack (with the assistance of local people).

Manual snow depth measurements at Tasiilaq

The motivation of the manual snow measurements at Tasiilaq was improve information about snow conditions (and thereby providing ground truth data for models). Another advantage is that such measurements can be done on multiple locations in proximity to each other. In this way they can help with providing an estimate of spatial variability on a small scale. We performed manual snow depth measurements over the '21 - '22 snow season in an area of approximately 6 x 18 meters. The results of our measurements can be seen in Figure 1. The coloured (light blue) area shows that there can be considerable variability in snow depth, even in a relatively small area.

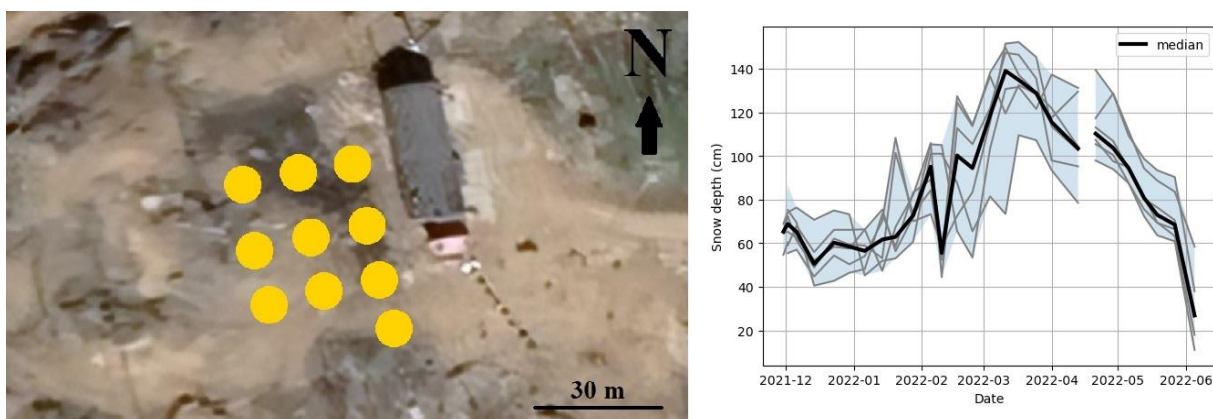


Figure 1: Left: measuring locations for the manual snow depth (SD) measurements at Tasiilaq. Right: Time series of SD during the '21-'22 winter season as derived from these manual measurements. Data from individual measuring locations is shown in grey, median is shown in black.

Snow sensor (SnowFox, automatic measurements of SWE)

In December '21, we have installed a snow sensor in Tasiilaq. The snow sensor (SnowFox, see https://hydroinnova.com/snow_water.html for details) performs automatic measurements of snow water equivalent (SWE) which is an important variable within the climate system. SnowFox has been running for two seasons ('21-'22 and '22-'23). Due to a power outage, data for the first season is only partly available. The second season is fully measured from snow build-up to snow melt.



Figure 2: Photos of our snow sensor in Tasiilaq in winter '21 (left) and summer '22 (right)

Snow pits (manual measurements of SWE)

With the main purpose of validating the measurements of the snow sensor, we performed multiple snow pit measurements in the winter season of '21-'22. Unfortunately, most of our measurements took place for a period where the snow sensor shows data gaps (due to a power outage). Still, measurements from our snow pit are highly valuable, because they nicely fill in the gaps in the time series of the SnowFox. Additionally, since the snow pits were dug in several locations, we have extensive information on the snow conditions close by the snow sensor. Lastly, an important benefit from these snow pits was that they were conducted with help from someone from the community, thereby improving the connection between people from Tasiilaq and the project.

Data from the snow sensor in Tasiilaq, as well as results from our snow pit measurements are shown in Figure 3. Note that the data from the snow sensor is based on default values for some parameters. It is part of ongoing research activities to improve the calculation of SWE-values from the snow sensor, which will likely result in a closer match between manual observations and the time series obtained from the snow sensor.

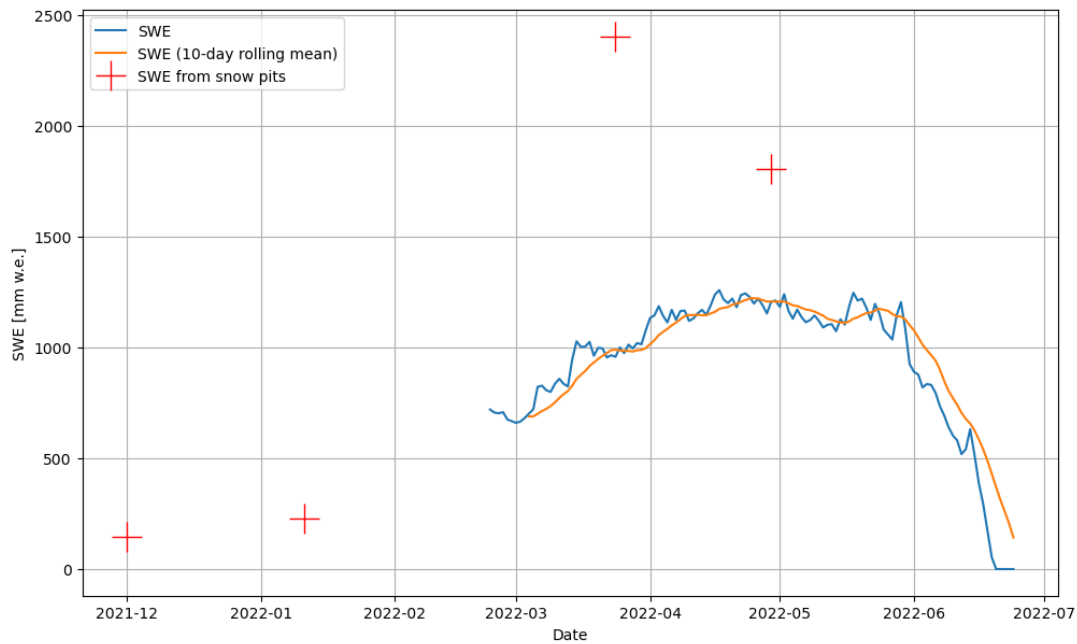


Figure 3: Time series of snow sensor data as well as results from snow pit measurements of SWE measured during the '21-'22 winter season.

- The snow data from Tasiilaq are available upon request from the University of Graz
- Snow data from sonic sensors on Mittivakkat glacier is also available. The data is owned by the University of Copenhagen and freely available upon request. Snow data from sonic sensors on Mittivakkat glacier is also available upon request from GEUS.

Changes of air temperature and precipitation and related relevance for snow climate for the Ammassalik island

- Based on a time series analysis the evolution of air temperature and precipitation for Ammassalik island was performed using available data from observations as well as reanalysis and model data (and published in *Frontiers of Earth Science* (see [van der Schot et al. 2023](#)). In this paper, the specifics of past precipitation changes (in particular focusing on the transition of precipitation from snow to rain) were analyzed. Strong summer increases in temperature, summer increases in the rainfall ratio, as well as summer increases of the snow/rain boundary altitude were found based on observations from the Danish Meteorological Institute (DMI) weather station, GEUS weather station on Mittivakkat Glacier, as well as output from the regional atmospheric climate model RACMO.

Broader context of snow information for Greenland

- In order to put the findings from van der Schot et al. (2023) into the broader context of available snow information in Greenland, a cooperation with the Greenlandic survey Asiaq was established and enabled the analyses of all available in-situ snow information (using only stations from the tundra regions of Greenland) from Greenland. Results of this analysis were presented at EGU2022 (as oral presentation) and at IUGG2023 (as poster presentation) and is currently in preparation for a journal paper (see Figure 4).

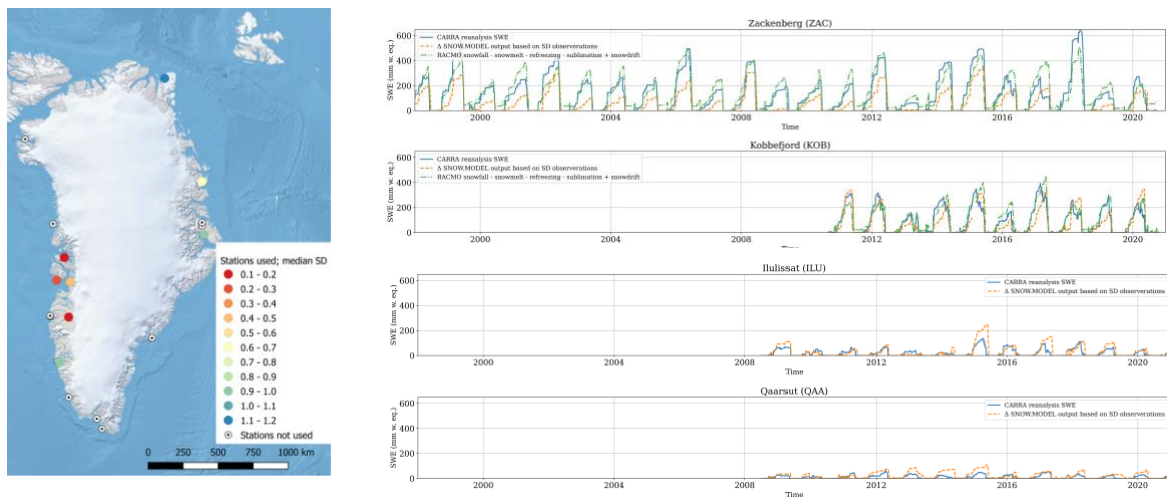


Figure 4: Available snow information in Greenland outside the Greenland Ice Sheet. Left: Location of all available stations. Right: Time series of the snow water equivalent (derived by snow model from measured snow depths) for the longest and most continuous stations (Zackenberg on the east coast, Kobbefjord, Ilulissat and Qaarsut on the west coast). Measurements are shown in comparison to the Arctic reanalysis CARRA and the regional climate model RACMO (from van der Schot et al., 2023, in preparation).

6.2. The perception of climate change by people from Tasiilaq (East Greenland)

The people in Tasiilaq experience a wide range of environmental changes that can be associated with climate change. This includes above all the rapidly retreating glaciers, both in relation to the Greenlandic ice sheet and the various smaller local glaciers in the Tasiilaq area, and less fjord and sea ice. The retreating ice influences local mobility, as once and again traditional dog sled routes (some of which cross glaciers) can no longer be used, and the season which allows for travel by dog sled and snow scooter has become much shorter (and the boating season in turn longer). This stands in relation to a decreasing number of sled dogs in the region. The inhabitants recognize various changes regarding flora and fauna, and particularly changes in animals are frequently commented upon: there are more mosquitoes nowadays, new insects and bacteria, a new fish species such as the pink salmon, and whale species rather uncommon for this region are sometimes sighted, such as the long-finned pilot whale. The region indeed features more polar bears today than 10 or 20 years ago; the polar bears come down further south from the north pole areas these days. The winter are much warmer nowadays community members frequently mention, though the particularly long and snowy winter '22 does create some doubts concerning a clear trend towards warmer winters among some of the inhabitants. Likewise, the temperatures are higher in the summer now, various residents agree upon, which also shows when considering the prolonged timetable of the big supply ship that brings all goods to the Greenlandic east coast from Denmark during the ice-free months of the year. In '22 for the first time since people remember, a community garden consisting of various raised beds was initiated in Tasiilaq (by the local youth NGO SiuTsiu) producing vegetable, herbs, flowers, etc. Though this is not directly brought together with climate change by the community members, it certainly stands in relation to the prolonged summer season nowadays. People recognise changes in the winds and storms, the strong wind called *pileraq* coming from the big inland glaciers has decreased whereas the winds coming from the sea called *neqqajaq* have been increasing. Moreover, people feel more

earthquakes today in the Tasiilaq region, some of which are of glacial origin and can clearly be brought together with climate change.

6.3. Local knowledge on climate change and relevant information on environmental changes for people in Tasiilaq

Despite these manifold environmental changes people experience and recognize some local inhabitants are not quite sure whether these changes affecting their daily lives are indeed a result of global climate change or might merely be related to “natural cycles”. In addition, and on a more general level, most community members we spoke to would not question the existence of global climate change as such, yet for many the human influence in relation to it is not quite clear. Accordingly, the responsibility for us humans to combat climate change through adapting our way of living is something which prevails only among some inhabitants that we worked with but certainly not a majority. Our findings support a recent survey about the perceptions of climate change in different regions of Greenland (Minor et al 2023), stating that in the two most remote regions of Greenland, the Qaanaaq and the Tasiilaq regions, doubts about the human influence on climate change are most widespread.



Figure 5: Photographs from Snow2Rain Workshop in June 2022 with the people from Tasiilaq discussing environmental changes in the region and the linkages with climate change

Moreover, inquiring into changes from less snow to more rain, we found that most community members participating in our project activities would support the fact that there is less snow today as compared to the past, yet the issue of more rain was hardly ever mentioned when asking about environmental changes. Hence, increasing rainfall is not something which is experienced by the community strongly in the present, yet climate scientists project an increase in rainfall in the future. While our local interlocutors showed quite some interest in scientific results and future projections about climatic changes in the region, they would rarely engage themselves in speculations about how the future will be in the light of the current environmental and climatic changes.

A result of Snow2Rain is also a literature review on the social and cultural relevance of snow in Austria and Greenland. This is available as a literature list for follow-up studies.

6.4. Main conclusions from Snow2Rain disciplinary research

Against the background of the Arctic Amplification (i.e. about 3 to 4 times the temperature increase in the Arctic compared to the global mean), it should be noted that this trend varies greatly regionally and seasonally, is less pronounced in the case of the Tasiilaq region (and thus some current climate consequences are not as obvious as for other regions in the Arctic).

Related to this, changes in snow precipitation and snow cover are also less pronounced (and co-determined by precipitation changes) but could be detected as part of Snow2Rain, such as a decrease in snow precipitation relative to rain, particularly in summer.

The perception of climate change in Greenland is different than in Europe (the recent signing of the Paris Agreement seems to be a clear reflection of this). People from Tasiilaq region are very sensitive in observing changes of their environment including the climate. Snow is only one of those changes observed (wind/storms and earthquakes are currently widely discussed by the locals). However, they speculate much less about future changes and are cautious about the human influence on climate change.

References:

- Arctic-Council. 1996. Declaration on the establishment of the Arctic Council, 1–5. Ottawa: Arctic-Council.
- Bernard, H. R. 2002. Research methods in anthropology: Qualitative and quantitative methods. Walnut Creek, California: AltaMira Press.
- Cappelen, J., Vinther, B. M., Kern-Hansen, C., Laursen, E. V., and Jørgensen, P. V. (2021). Greenland-DMI Historical Climate Data Collection 1784-2020. 105.
- Cruikshank, J. 2005. Do glaciers listen? Local knowledge, colonial encounters, and social imaginations. Vancouver: University of British Columbia Press.
- Eira, I.M.G., C. Jaedicke, O.H. Magga, N.G. Maynard, D. Vikhamar-Schuler, and S.D. Mathiesen. 2013. Traditional Sami snow terminology and physical snow classification—Two ways of knowing. *Cold Regions Science and Technology* 85: 117–130.
- Eriksen, T. H. 1996. Small places, large issues: An introduction to social and cultural anthropology. London: Pluto Press.
- Fausto, R. S. ., Abermann, J., and Ahlstrøm, A. P. (2020). Annual Surface Mass Balance Records (2009–2019) From an Automatic Weather Station on Mittivakkat Glacier, SE Greenland. *Front. Earth Sci.* 8, 1–5. doi: 10.3389/feart.2020.00251.
- First Nations Information Governance Centre. 2014. Ownership, Control, Access and Possession (OCAP™): The Path to First Nations Information Governance. Ottawa: The First Nations Information Governance Centre.
- Flick, U. 2012. Qualitative Forschung: ein Handbuch. Reinbek bei Hamburg: Rowohlt.
- Harpold, A. A., Kaplan, M. L., Klos, P. Z., Link, T., McNamara, J. P., Rajagopal, S., Schumer, R., and C.M. Steele. 2017. Rain or snow: hydrologic processes, observations, prediction, and research needs, *Hydrol. Earth Syst. Sci.*, 21, 1-22, <https://doi.org/10.5194/hess-21-1-2017>, 2017.
- Hasholt B., Liston G.E., N.T. Knudsen. 2003. Snow distribution in the Ammassalik Region, South East Greenland. *Nordic Hydrology*, 34(1/2), 1-16.
- Holkup, P., T. Tripp-Reimer, E. Matt Saloil, and C. Weinert. 2004. Community-based Participatory Research: An Approach to Intervention Research With a Native American Community. *ANS Advances in Nursing Science* 27(3): 162–175.
- Ingold, T. 2000. The perception of the environment. Essays on livelihood, dwelling and skill. London, New York: Routledge.
- Ingold, T. 2007. Lines: A brief history. London: Routledge.
- Ingold, T. 2011. Being alive: Essays on movement, knowledge and description. London: Routledge.

Kassi, N., M. Pratt, M. Van Bibber, K. Friendship, J. Butler Walker, M. Alatini, M. J. Jonson, R. Alfred, and E. Alfred, Kluane First Nation Lands, Resources & Heritage Department, Kluane First Nation Youth and Elders, and the Vuntut Gwitchin Natural Resources Department. 2017. The partnerships, the productions and the people behind the lens: Promoting youth wellness through community-based research and filmmaking. *Northern Public Affairs* 5(2): 26–32.

Kusenbach, M. 2003. Street Phenomenology: The Go-Along as Ethnographic Research Tool. *Ethnography* 4(3): 455–485.

Malinowski, B. 1922. *Argonauts of the western Pacific: An account of native enterprise and adventure in the archipelagoes of Melanesian New Guinea*. London: Routledge.

Massey, D. 1994. *Space, Place, and Gender*. Minneapolis: University of Minnesota Press.

Massey, D. B. 2005. *For Space*. London: Sage.

Minor, K., Lund Jensen, M., Hamilton, L., Bendixen, M., Dreyer Lassen, D., and Rosing, M. T. (2023). Experience Exceeds Awareness of Anthropogenic Climate Change in Greenland. doi: 10.1038/s41558-023-01701-9.

Moon, K. and D. Blackman. 2014. A Guide to Understanding Social Science Research for Natural Scientists. *Conservation Biology* 28(5): 1167-1177. DOI: 10.1111/cobi.12326.

Nicolescu, B. (2014). Multidisciplinarity, interdisciplinarity, indisciplinarity, and transdisciplinarity: Similarities and differences. *RCC perspectives*, (2), 19-26.

Noël, B., van de Berg, W. J., Lhermitte, S., and van den Broeke, M. R. (2019). Rapid ablation zone expansion amplifies north Greenland mass loss. *Sci. Adv.* 5, 2–11. doi: 10.1126/sciadv.aaw0123.

Noël, B., Van De Berg, W. J., Van Wessem, J. M., Van Meijgaard, E., Van As, D., Lenaerts, J. T. M., et al. (2018). Modelling the climate and surface mass balance of polar ice sheets using RACMO2 - Part 1: Greenland (1958-2016). *Cryosphere* 12, 811–831. doi: 10.5194/tc-12-811-2018.

Riseth, J.A., H. Tømmervik, E. Helander-Renvall, et al. 2011. Sami traditional ecological knowledge as a guide to science: Snow, ice and reindeer pasture facing climate change. *Polar Record* 47: 202–217.

Saxinger, G. and First Nation of Na-Cho Nyäk Dun. 2018. Community Based Participatory Research as a Long-Term Process: Reflections on Becoming Partners in Understanding Social Dimensions of Mining in the Yukon. *The Northern Review* 47: 187–206.

van der Schot, J. Van Der, Abermann, J., and Silva, T. (2023). Precipitation trends (1958 – 2021) on Ammassalik island , south-east. 1–12. doi: 10.3389/feart.2022.1085499.

van Meijgaard, E., van Ulf, B., van de Berg, W. J., Bosveld, F. C., van den Hurk, B., and Lenderink, G.; Pier Siebesma, A. (2008). The KNMI regional atmospheric climate model RACMO version 2.1. Tech. report; TR - 302, 43.

7. Changes in the planned implementation of Snow2Rain and short justification

7.1. Shifted begin of Snow2Rain

The reason for the shift in the beginning of the Snow2Rain project was explained in detail in a letter to ÖAW in December 2020 including a request for postponing the begin to May 2020 and adapting the workplan accordingly. The request was kindly accepted by ÖAW. The final workplan is shown below. Beside other reasons, the Corona crisis and related Covid measures were main reason for the shift and extension of Snow2Rain.

7.2. Impact of Corona crisis on implementation of Snow2Rain

The main impact from Corona on Snow2Rain was by preventing field work in Greenland for both the natural science and social science part of Snow2Rain. Additionally, because of the Covid measures the start of the transdisciplinary dialogue with the people of Tasiilaq had to be postponed as well (and was tried to be initiated via Facebook).

7.3. Social anthropology PhD thesis at University of Vienna

On the Social Anthropology side, Anna Burdenski was hired as a PhD student with the goal of a social science dissertation with close links to Jorrit van der Schot's natural science dissertation as part of Snow2Rain. However, for personal reasons, Anna Burdenski ended her dissertation prematurely and without completion. It is currently not clear whether the dissertation/dissertation project will be completed at a later time. However, it is important to mention that the work of Anna Burdenski was a very significant part of Snow2Rain for establishing the transdisciplinary work and to connect to the people in Tasiilaq including a dialogue with relevant stakeholders in town.

7.4. Adjusted work plan and implementation



Figure 6: Adjusted work plan

8. Trans- and interdisciplinary aspects

8.1. Interdisciplinary aspects of Snow2Rain

As mentioned in the methods chapter of this report, the two PhD students (snow climatology/Jorrit van der Schot; social anthropology/Anna Burdenski) worked closely together throughout the project. Since this collaboration developed within the scope of the research project, the framework of collaboration itself can also be seen as a result of the project. Several recommendations for similar research projects follow from the methodological developments within Snow2Rain.

The first recommendation has to do with the aspect of time. Close interdisciplinary collaboration, and particularly transdisciplinary collaboration, requires a significant investment of time by each involved stakeholder (in the case of Snow2Rain this means the PhD students, but also local stakeholders). This time-aspect is often mentioned in similar research activities, as it is really a crucial point that shapes the research process. PhD students in the beginning of their PhD need time to familiarize themselves with the methodologies that exist within their own discipline, and the need to build capacity for interdisciplinary collaboration often adds to this. We had the opportunity, within Snow2Rain, to take ample time for this purpose and recommended that future research projects are set-up in such a way that involved researchers can deeply engage in an interdisciplinary manner. Even more importantly, the aspect of time investment is challenging for involved local stakeholders. This

is because, in the case of Snow2Rain, local stakeholders were not involved in the project from the beginning and do (unlike the PhD students) not receive any financial compensation for their time investment into the research project. More about this point can be read in the Roadmap to decolonial Arctic research (see list of publications).

There is considerable interest in scientific information about meteorological and climate conditions as well as changes in the community of Tasiilaq, even though the topic of climate change is not the most pressing issue within the community. It also became clear that local knowledge holders from Tasiilaq hold relevant knowledge about past snow and environmental conditions, but several challenges exist that make it a complex task to make this knowledge usable for climate scientists. Here we would have liked to have more concrete results, but this has been made difficult due to the departure of the social anthropological PhD student. Still, to give a few examples of the existing knowledge, there is a lot of relevant knowledge about changes in wind direction and wind speed, and particularly a lot of memories exist in relation to extreme wind events. Furthermore, on several occasions people have told stories about snow conditions along dogsledding routes in the area.

The best example of the benefit of including local knowledge became clear to us when we received several comments about earthquakes in Tasiilaq during one of the project workshops. The topic of earthquakes falls within the scope of our project interests (climatic and environmental changes in Tasiilaq), because most earthquakes felt in Tasiilaq come from the nearby Hellheim glacier. Still, we as researchers were beforehand not aware that they were happening in Tasiilaq. Therefore, we relied on local input to increase our own understanding of this phenomena.

As mentioned before, the perception of climate change is different in East-Greenland compared to Austria, even though the background of relevant climate impacts clearly overlaps (e.g. the relevance of snow). In particular, people from Tasiilaq speculate much less about future changes which results in different views on the role of humans on climate change. The colonial history of Greenland is still an issue regarding the dialogue with the people from Greenland, even for scientists from outside our Denmark. Accordingly, time and effort is needed to create trust so that local people are willing to participate in transdisciplinary work.

Natural hazards and other environmental events from the very recent past impact the life of people from Tasiilaq and tailor their interest in the dialogue with researchers. In the case of Snow2Rain, earthquake events from nearby calving glaciers and recent windstorms (*piteraqs*) were seen as more relevant than changes of the snow cover.

The recently started reconstruction project of the Sermilik Research Station (which is in about 20-30km distance to Tasiilaq) as a joint effort from Universities of Copenhagen and Graz has a high potential to continue the dialogue with people from Tasiilaq, engage them into the research and step towards a non-colonial and participatory transdisciplinary research.



Figure 7: Research posters about Piteraqaq (left) and glacial earthquakes that were part of the of the Snow2Rain exhibition in Tasiilaq.

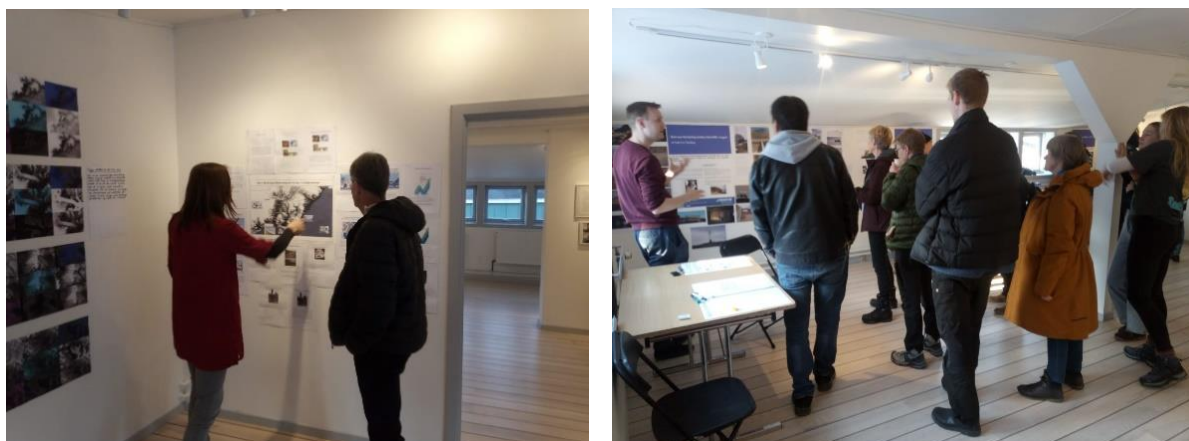


Figure 8: Pictures from the research exhibition

The final phase of the project consisted of the analysis of data and of integrating the different types of knowledge, derived from climate science, social anthropology, and local indigenous knowledge in Tasiilaq.

During a cooperation with the co-create network, Snow2Rain was able to contribute important expertise to the "Roadmap to decolonial Arctic Research", which was presented to the EU on 31 May 2023. This cooperation was based on regular online meetings, a joint workshop organized and a final writing workshop in Norway. The researchers of Snow2Rain were able to use their experience to support the process of co-creation research together with the indigenous people in the Arctic, and to use it as a basis for of the EU research in the future.

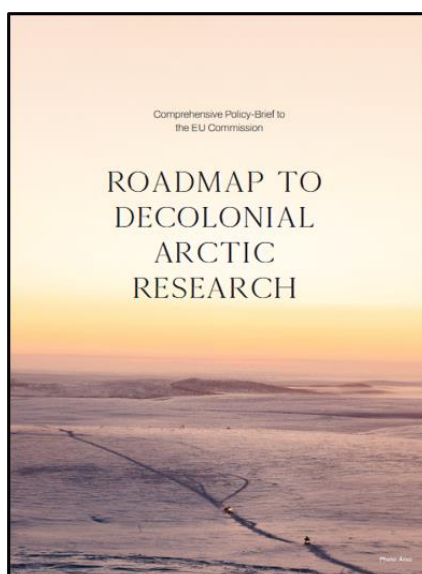


Figure 9: Title page of the Roadmap to Decolonial Arctic Research

9. Publications, contributions to conferences and thesis work

9.1. Publications

Journal articles (peer reviewed)

van der Schot, J., J. Abermann, T. Silva, C. D. Jensen, B. Noël, and **W. Schöner** (2023). Precipitation trends (1958–2021) on Ammassalik island, south-east Greenland. *Frontiers in Earth Science* 10: 1085499.

Elixhauser, S.; Boni, Z.; Gregorič Bon, N.; Kanjir, U.; Meyer, A.; Muttенzer, F.; Pampus, M.; and Sokolíčková, Z. (2023),). Interdisciplinary, but how? Anthropological perspectives from collaborative research on climate and environmental change. *Environmental Science and Policy* (submitted 17 May, 2023, accepted 21 September 2023, to be published soon). <https://doi.org/10.1016/j.envsci.2023.103586>

Elixhauser, S and **J. van der Schot** (2023, in preparation). Navigating local relevance of the research project Snow2Rain: exploring environmental changes in the Tasiilaq region, southeast Greenland. *Polar Record* (to be submitted)

van der Schot (2023, in preparation). Spatio-temporal characteristics of seasonal snow cover in coastal Greenland from in-situ observations, a climate model and reanalysis. *The Cryosphere* (to be submitted by October 2023)

Journal/magazine and blog articles, contributions to newspapers (non peer-reviewed)

Hermann, T.M., Brunner Alfani, F., Chahine, A., Doering, N., Dudeck, S., Elster, J., Fjellheim, E., Henriksen, J.E., Hermansen, N., Holmberg, A., Kramvig, B., Keskitalo, A.M.N.,

Omma, E.M., Saxinger, G., Scheepstra, A., **van der Schot, J.** (2023). Comprehensive Policy-Brief to the EU Commission: Roadmap to Decolonial Arctic Research. University of Oulu, Helmholtz-Centre for Environmental Research-UFZ, The Indigenous Voices (IVO) research group – Álgoálbmogii jienat, Arctic University of Norway UiT, Saami Council. Áltá – Káráš-johka – Leipzig – Oulu. <https://doi.org/10.25365/phaidra.400> URL: <https://phaidra.univie.ac.at/o:1653557>

van der Schot, J. & **S. Elixhauser** (2023). From snow to rain in Tasiilaq, East Greenland: reflections on collaboration and local relevance of a transdisciplinary research project. *GeoGraz* (2023) Issue 73. <https://unipub.uni-graz.at/geograz> (available in October 2023)

Elixhauser, S. (2022, Nov 25): The challenges and chances of interdisciplinary collaborations on climate/environmental change. *Kontrapunkte*, <https://kontrapunkte.hypotheses.org/5116>

Kristensen K. (& **Burdenski A.**) (2022, May 17) Forsker undersøger klimaændringers påvirkning af befolkningen i Tasiilaq. *Sermitsiaq AG*. <https://sermitsiaq.ag/node/237272>

Ravn-Højgaard, S. (& **Burdenski, A.**) (2022). Anna's mission is to make weather research useful for the people of East Greenland, Arctic Hub, Nuuk, Greenland <https://arctichub.gl/annas-mission-is-to-make-weather-research-useful-in-east-greenland>

Burdenski, A. & **van der Schot, J.** (2022, March 2) Into the Snowy Realm: Snow2Rain project: fieldwork report from Tasiilaq, East Greenland, Part I, *Austrian Polar Research Institute (APRI)* <https://www.polarresearch.at/into-the-snowy-realm/>

Burdenski, A. & **van der Schot, J.** (2022, March 9) Exploring changes in snow: Snow2Rain fieldwork report from Tasiilaq, East Greenland, Part II, *Austrian Polar Research Institute (APRI)* <https://www.polarresearch.at/exploring-changes-in-snow/>

Burdenski, A. & **van der Schot, J.** (2022, March 16) Immersing into the snow: Snow2Rain fieldwork report from Tasiilaq, East Greenland, Part III, *Austrian Polar Research Institute (APRI)* <https://www.polarresearch.at/immersing-into-the-snow/>

Burdenski, A. (2021): #CoronaAlltag: Polarforschung auf Eis gelegt. Gastkommentar in der Rubrik "Corona - Geschichten aus dem Krisen-Alltag" auf *Austria Presse Agentur-Science*, <https://science.apa.at/power-search/16894540995830678407>, 3 May 2021

9.2. Contributions to conferences

Presentations and posters

van der Schot, J. (2023). Evaluating state-of-the-art climate models' ability to simulate spatio-temporal patterns of seasonal snow cover in coastal Greenland. Poster presented at *IUGG General Assembly*, Berlin, 11-20 June 2023

van der Schot, J. (2023). Tension of time scales in Tasiilaq - Local youth involvement in the Snow2Rain project. Presentation at the workshop "Tensions of time scales: local youth involvement in interdisciplinary Arctic climate change research" at *Arctic Science Summit Week (ASSW)*, Vienna, 17-24 February 2023

Elixhauser, S. (2023). Experiencing and learning about climate change in East Greenland: The importance of situated and relational learning and land-based educational methods. Presentation at the workshop "Tensions of time scales: local youth involvement in interdisciplinary Arctic climate change research" at *Arctic Science Summit Week (ASSW)*, Vienna, 17-24 February 2023 (due to illness presented internally)

Elixhauser, S. (2023). Interdisciplinarity and the project frame: Some thoughts about time, collaboration and co-creation. Presentation at the workshop "The aspect of time as a resource in co-creative work", at the *Relations and beyond: conference of the Finnish Anthropological Society*, Rovaniemi, 21-23 March 2023

Burdenski, A. (2022) Contribution to: Greenland and the Climate Change Challenge, presentation at *Nuuk Arctic Circle Greenland Forum 2022* by University of Vienna / Snow2Rain project, AAU Arctic, FACE-IT

van der Schot, J. (2022). The Snow2Rain project. Presentation at annual meeting of *Austrian Polar Research Institute (APRI)*, Innsbruck, 25 November 2022

van der Schot, J., Schöner, W., Abermann, J., and Ferreira Da Silva, T. M. (2022) Linking past precipitation changes with changing snow conditions on Ammassalik Island, Southeast Greenland, EGU General Assembly 2022, Vienna, Austria, 23–27 May 2022, EGU22-1726, <https://doi.org/10.5194/egusphere-egu22-1726>, 2022.

Burdenski, A. & van der Schot, J. (2021). Introducing Snow2Rain. Presentation at *Greenland Science Summit Week*, Nuuk, 2021, 18 October

Burdenski, A. & van der Schot, J. (2021). Initiating a polar project during a global health crisis:

A perspective of unexpected challenges & accomplishments along the process of

Snow2Rain. Presentation at 7th annual APECS International Online Conference Polar Science: Success Stories from the Field and from Home, 2021, 12 May

van der Schot, J. (2021) Past trends in precipitation and in the ratio of snow to rain in East Greenland, EGU General Assembly 2021, online, 19–30 Apr 2021, EGU21-11632, <https://doi.org/10.5194/egusphere-egu21-11632>

Workshops organized

van der Schot, J. (2023). Organisation of workshop “Tensions of time scales: local youth involvement in interdisciplinary Arctic climate change research” at *Arctic Science Summit Week (ASSW)*, Vienna, 17-24 February 2023

Elixhauser, S. (2023). Organisation of workshop “The aspect of time as a resource in co-creative work”, at the *Relations and beyond: conference of the Finnish Anthropological Society*, Rovaniemi, 21-23 March 2023 (with T. Hermann, S. Dudeck and CO-CREATE Arctic Research Group)

Elixhauser, S. (2022). Organisation of workshop “Researching climate/environmental change from a more-than-anthropology perspective: The challenges and opportunities of interdisciplinary and multi-epistemic knowledge production”, at *Vienna Anthropology Days (VANDA)*, Vienna, 26-29 September 2022 (with Z. Sokolíčková, A. Meyer, & E. Ramirez Hincapié)

9.3. Thesis work

Burdenski, A. PhD research proposal “From snow to rain: environmental change and the future of East Greenlanders”, Department of Social and Cultural Anthropology, University of Vienna, October 2021

van der Schot, J. : Snow Climatology in the Ammassalik region – PhD thesis, University of Graz, ongoing

9.4. Website and social media work

<https://www.snow2rain.com/> (in English, Danish and Greenlandic)

Facebook:

<https://www.facebook.com/people/Snow2Rain/100064114900574/>