Proposal for a new UArctic Thematic Network on Nordic Snow Network

Research and security in the Arctic region require comprehensive snow observations and modelling. Analysing and forecasting the temporal and spatial variability of snow is important for weather prediction as well as for climatic and hydrological purposes. Understanding the changes in snow conditions are particularly important for rapidly warming Arctic regions. Snow is very sensitive to changes in temperature; reductions in snow extent and amount have been widely documented, and are predicted to continue at an alarming rate. Moreover, modern society can be directly affected by many practical problems directly related to snow, e.g.: slipperiness, snowpack or drifting snow may cause problems for all modes of transport, while snow contributes to natural hazards such as floods and avalanches. Snow provides a vital water source for agriculture, as large populations in both high-altitude and Arctic regions rely on water derived from melting snowpacks. Snow cover is an essential climate variable directly affecting the Earth energy balance, and is the primary building block of glaciers and ice sheets. Proper description and assimilation of snow cover information into hydrological, land surface, ecosystem, meteorological and climate models are critical to address the impact of snow on various phenomena, to predict local snow water resources and to warn about snow related natural hazards. Snow package is a natural collector of pollutants deposited from the atmosphere (e.g. black carbon and microplastic), enabling relatively cheap methods to quantify the spread of these constituents and thus, to understand better their atmospheric-terrestrial cycle.

The Nordic Snow Network (NordSnowNet) (https://nordsnownet.fmi.fi/) is established to address these issues with 5 national meteorological institutes (NMI (Norway), DMI (Denmark), FMI (Finland), SMHI (Sweden) and IMO (Iceland)), universities (Agricultural University of Iceland, Reykjavik University-Iceland and University of Tartu-Estonia) and Asiaq – Greenland Survey from Greenland. The point of view of the network is focused on snow in Nordic and related Arctic areas. The FMI, a member of the UArctic, is coordinating the NordSnowNet. The NordSnowNet is funded by the Nordic Council of Ministers for the time-period from 1.9.2019 to 1.9.2022. The network activities are extended till 31.8.2024 due to the break from COVID-19. The members of the NordSnowNet are strongly motivated to become a UArctic thematic network as a continuation of its mission and activities. Working under the umbrella of UArctic as a new thematic network would help consolidate the NordSnowNet and promote further coordination efforts on in-situ snow observations towards to harmonization and its applications in research and education, focused on students, indigenous people, and stakeholder involvement in the Arctic with collaboration of other thematic networks.

Thematic focus area of the network

Snow cover is an essential climate variable directly affecting the Earth energy balance. Proper description and assimilation of snow cover information into hydrological, land surface, meteorological and climate models is critical to address the impact of snow on various phenomena, to predict local snow water resources and to warn about snow-related natural hazards. This induces a challenging problem of bridging information from micro-structural scales of the snowpack up to the grid resolution in regional and global models.

The network will be focus on snow in Nordic and related Arctic areas: making existing Nordic-Arctic research and snow data from observations and models (forecasts and assimilated observations by weather and hydrology models, projections by the climate models) visible for the researcher, data user and education communities. It would support snow-related research and development of applications by exchange of information and data, arranging workshops, training and supporting also informal Nordic researcher contacts and meetings.

The presence of snow affects society and business activities over a large part of the year in Nordic countries. At the meteorological and hydrological services, we have long experience in observing and predicting of snow conditions Nonetheless , we also see a big potential for improvements, not only in our traditional activities (weather prediction and flood forecasting) but also for adopting new snow measurement technologies, disseminating details about snow conditions and making use of this information in other sectors of society. Some of these details we have not yet been able to disseminate. We also see a lack in awareness of the potential that enhanced snow information can provide to society and business, such as trafficability in forestry, revenues from hydropower, and water security for agriculture. With the proposed network we continue to tackle both the lack in detailed descriptions of snow conditions and the lack in dissemination of such information. Moreover, we want to improve the assimilation of snow data in hydro- and meteorological models. This includes understanding and forecasting the temporal and spatial evolution of snow cover in the changing conditions of the Arctic and making that information widely available. A large part of the snow research is done within a multitude of temporally limited projects. Results of past research projects are commonly lost in the ocean of reports and journal papers read only by a small community of experts. Networks cease to exist after their funding periods have ended. Snow is often a small aspect in a larger activity , e.g. the reanalysis or weather forecast. The amount of open data, also on the snow cover, is increasing in the Nordic countries. However, its availability in practice is limited and the data is scattered around institutions and multiple sources. We lack a permanent framework for connecting the Nordic-Arctic snow researchers and making their results and data visible. There is plenty of information about the Arctic and Nordic snow already available, and at the same time there is a strong need to regularly observe snow variables that are presently measured only in field campaigns. There is a well-established ground-based network that observes only a couple of snow variables, used by the weather prediction and hydrological models for forecasting since last century. Due to the increased resolution and sophistication of the snow schemes in models, the ongoing research aims to develop measurement techniques and tools that enable the regular acquisition of new essential snow parameters (related for instance to snow presence, snow microstructure and interaction of snow and electromagnetic radiation).

What are the goals and planned activities of the network?

The main objective is to create a sustainable network for connecting the Nordic-Arctic snow researchers and making their results and data visible. The other goals may be listed as follows:

- Continue existing collaboration and start new collaboration within Nordic countries and beyond about snow related research topics.
- Snow information in Arctic is distributed and used by stakeholders to a greater extent than today.
- Information of existing snow-related research and application projects and networks as well as observation and forecast data and resources on snow cover are shared. The existing Web-based framework (https://nordsnownet.fmi.fi/) for open and continuous information exchange is further developed.
- Exploitation of the snow observational network in terms of (1) snow in-situ observations ((a) enhancing harmonization of the measurement practices, (b) enhancing standardization of data and metadata formats to facilitate the usability and interoperability of snow data) (2) remote sensing (development of snow retrieval algorithms from satellite-based sensors) and (3) data assimilation (coordinating the development of observational operators to assimilate radiances, in association with the modelling of snow processes) for the benefit of atmospheric and hydrological modelling from hourly to seasonal time scales.

The planned activities of NordSnowNet are:

- Thematic workshops
- Snow field campaigns
- Training schools
- Extending the presently Nordic-based network to wider UArctic partner coverage
- Sessions in international and UArctic conferences
- Mobility on scientific missions
- Creating scientific benchmarks studies among members that their outcomes can be resulted in scientific publications / reports / white papers.
- Preparing scientific proposals within the network, to ensure funding and continuation of the activities.

How indigenous issues are included in TN's network's operation?

People and stakeholders residing in the Arctic will be involved via workshops, field campaigns, training schools, website, and social media. Questionnaires on how changes in snow conditions directly impact people´s life in remote Arctic areas to be distributed around the planned workshops in such areas. Reindeer husbandry's local and traditional snow knowledge is readily engaged with snow-related research projects from members of the thematic network, such as H2020 Charter project charter-arctic.org. Try to find and involve future snow measurement volunteers in such remote areas, trainee including SYNOP coding where this is practically possible and realistic. This all under supervision of local project´s representatives. In-situ snow data is essential for validating satellite derived snow products and services and better forecast for models which will be very important for local and regional demand. Utilizing and promoting existing citizen science initiatives, such as talviseuranta.fi in Finland and https://wwwi.ymparisto.fi/citobs/html_wintermon_iceinsnow_service_code_202203171301502_CURRENT.html.

Holding a workshop incorporating indigenous issues will help to ensure that local demands are met by putting local arctic conditions, challenges and needs into focus. By being locally present, the opportunity arises to present and discuss the project aims and receive input from additional local, arctic stakeholders.

Quality control at the network

How TN defines the quality on its own terms

Open and responsible operational culture is the basis for quality research. Quality control also includes development and innovation activities. Peer review process is an important part of quality control. Quality research is visible as high-level publications, receiving competitive funding and societal impact.

How UArctic member organizations and institutions will benefit from the new TN, what is the added value in establishing such a network?

Artic snow is a vital theme to many socio-economical activities (tourism, reindeer husbandry, infrastructure), hazard management (floods, droughts, avalanches), and northern ecology and biogeochemistry. All the institutions and organizations in snow-influenced regions will benefit from a thematic network bringing together snow-related information, data and expertise.

What kind of quality control has been already done in TN partner institutions' educational programs, courses etc (i.e. in accepting new program/course, student feedback and tutoring)

Quality work of the University of Lapland includes the basic functions of the university, i.e. education, research, artistic activities and the social interaction and effectiveness based on them, as well as services supporting basic functions. Quality work arises from joint goal-oriented activities, commitment to achieving goals and continuous improvement of operations. Through quality management, the university maintains and develops the quality of its operations and services. Feedback is collected from the students after courses.

Has the network already been awarded some funding? If so, for what activities?

The NordSnowNet is funded by the Nordic Council of Ministers for the time-period from 1.9.2019 to 1.9.2022. The network activities are extended till 31.8.2024 due to the break from COVID-19. The funding was given for similar activities as provided in this proposal. The activities are funded as follow

Activity 1 –Establish webpage and continuous update.

Activity 2 –Collection of snow related activities by a survey.

Activity 3- Assessing existing Arctic snow observations and a compilation of a snow data user list (list of ongoing research projects and operational services using snow observations).

Activity 4- Workshop 1 on "Snow data management".

Activity 5- Workshop 2 on "Exploitation of snow measurements".

Activity 6- Workshop 3 on "Arctic Snow" in Greenland with a special focus on Arctic snow conditions as current HARMONIE-AROME snow-models are largely based on snow in the Alps and need to be improved for Arctic conditions.

Activity 7 –Snow measurement field campaigns.

Activity 8- Harmonization of the measurement practices and standardization of data and metadata formats to facilitate the usability and interoperability of snow observations.

Activity 9- Establishment of a framework for mobility and training of snow researchers in the Nordic and neighboring countries, continuous within and beyond years of the suggested project.

List the names of members and their home organizations and email address, name and contact information of the host organization and leader.

The Nordic Snow Network has more than 50 scientists representing institutes from Finland, Sweden, Norway, Iceland, Denmark, Greenland and Estonia. Some of their profile can be seen in https://nordsnownet.fmi.fi/expert-pool/ . Selected core group members will be responsible for establishment of the Nordic Snow Network as a UArctic thematic network:

1. Ali Nadir Arslan (leader), Finnish Meteorological Institute (host institution). Department of Space and Earth Observation, Helsinki, Finland. Email: ali.nadir.arslan@fmi.fi
2. Leena Leppänen, University of Lapland. Arctic Centre, Rovaniemi, Finland. Email: leena.leppanen@ulapland.fi
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Helsinki 21 March 2024

Letter of Support: Proposal for a new UArctic Thematic Network on Nordic Snow Network

Dear Vice-President Kirsi Latola,

I would like to confirm the support of Finnish Meteorological Institute, UArctic member, to establish a new UArctic Thematic Network on Nordic Snow Network (NordSnowNet). Dr. Ali Nadir Arslan, proposed leader of the Thematic Network on the NordSnowNet, has dedicated his work to establish and lead the Association to become internationally recognized research network.

The FMI as a host organization is committed to the work as a leader of the Thematic Network with providing the support for travels, activities related to maintaining the NordSnowNet and allocation of work hours for the leader of the Thematic Network.

Yours sincerely,

Heilimo Jyri 91214734S

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