

Editorial: NHF 50 years

The Nordic Association for Hydrology – NHF¹ – turned 50 years in 2020. The anniversary is celebrated by this special issue and was also marked at the Nordic Hydrological Conference (NHC) in Tallin in 2022. Since 1970, NHF has been an important hub for the hydrological community in the Nordic countries and from 1996, the three Baltic countries were included in the association. The roots of NHF can be traced back to the Baltic Sea conferences starting in 1926 and the Nordic Conferences of Hydrologists starting in 1955. In 2020, the association had more than 220 members including 13 institutional members.

According to the statutes, the purpose of NHF is to promote hydrology as a science, strive for improved understanding of hydrology, and the practical application of hydrological methods within applied science and national planning in the Nordic countries. NHF also supports international cooperation within hydrology. To fulfill this purpose, two important activities of NHF are to organize conferences and to publish scientific papers. NHF is responsible for the NHC and is one of the owners of Hydrology Research. In this editorial, we will briefly summarize the history of NHF, NHC, and Hydrology Research.

This special issue includes three review papers that have a Nordic perspective about important research topics, one opinion paper that points at important research topics within hydrology for the coming years, one paper that summarizes the history of Hydrology Research and its predecessor Nordic Hydrology, and five scientific papers that reflect on important topics for hydrological research in the Nordic and Baltic countries.

1. BRIEF HISTORY OF NHF

The NHF was founded on 28th of August 1970 in Stockholm. The origin of the association can be traced back to several initiatives for collaboration in hydrological research in the Nordic and Baltic countries. One of the oldest roots is the series of hydrological conferences of the Baltic Sea countries in the period from 1926 to 1938. These meetings were terminated due to the Second World War. Another root of NHF is the five Nordic Conferences of Hydrologists that were organized between 1955 and 1967 on a 3-year rotational basis between the five Nordic (Denmark, Finland, Iceland, Norway, Sweden) countries. The Nordic collaboration within hydrology was boosted by the International Hydrological Decade (IHD; 1965–1974) under the auspices of UNESCO. During IHD national committees were established to coordinate the boost of hydrologic science and Nordic committee for IHD cooperation (Nordisk utvalg for IHD-samarbeid – NUTSAM) was established to coordinate hydrological research across the five Nordic IHD committees. NUTSAM identified a need to organize a broad water-related forum for the exchange of hydrological research results, and professional contacts between Nordic hydrologists, i.e. an association for hydrologists in the Nordic countries was initiated. In 1970, provisional statutes were drafted and discussed at the 6th NHC in Stockholm (Sweden) and by this, the NHF was formed. The statutes were formally approved by the General Assembly at the following Conference, in Sandefjord (Norway) in 1972. Since 1972, NHF has organized the Nordic Hydrological Conferences (NHC) on a biennial basis where the hosting of NHC circulates between the member states. The three Baltic countries Estonia, Latvia, and Lithuania, became associated members in 1996 and full members from 2000. Since then, the NHC circulates between the eight member states. The general assembly for NHF is scheduled as a part of the NHC.

NHF is a part of a family of Nordic collaboration initiatives. The Nordic Hydrological Program (NHP) was the combined Nordic contributions to the International Hydrological Programme (IHP) coordinated by UNESCO, UNESCO-IHP. NHP has organized several Nordic projects and research collaborations, and several of the NHCs were associated with NHP and the proceedings from the conferences in the period 1982–2008 were published as NHP reports. NHP does no longer exist, but during the last decades, some Nordic research projects on hydrology or including hydrology have been funded through Nordforsk hosted by the Nordic Council of Ministers. The coordination committee for hydrology in the Nordic countries (Koordineringskommittén för Hydrologi i Norden – KOHYNO) and the predecessor, NUTSAM, coordinated

¹ The abbreviation NHF originate from the name of the association several of the Nordic language: Nordisk Hydrologisk Forening (N, DK) – Nordisk Hydrologisk Förening (SE).

the Nordic activities during the IHD and in particular the NHP activities. KOHYNO does no longer exist, but most Nordic countries do have national IHP-committees.

As a part of the IHP cooperation, the Northern Research Basin (NRB) Working Group was initially formed in 1975 by the IHP national committees of Canada, Denmark/Greenland, Finland, Sweden, USA and USSR (now Russia), with Iceland being added in 1992. The overall objective of the group has been to promote research in hydrological basins in cold regions using an interdisciplinary approach, with a focus on climate change in recent years. A symposium accompanied by a fieldtrip is organized every other year on a rotating basis in the partaking countries.

Furthermore, the hydrological institutes in the Nordic countries, Canada, USA, and Russia have actively participated in the Arctic-HYCOS project under the auspices of the World Meteorological Office (WMO). The main objective of the project is to collect and share hydrological data and information for the Arctic basin to estimate the freshwater flux to the Arctic Ocean as the hydrology of the Arctic plays a vital part in the present and future earth system modeling on a global scale.

On the institutional level, chiefs of the hydrological institutes in the Nordic countries (CHIN) initiated this working group in the mid-1980s, but have since been joined by the Baltic countries; hence, the name changed to CHINB in 2018. During the last four decades CHINB has led several working groups and seminars with emphasis on operational hydrology, network design and quality management of hydrological data, Geographical Information Systems (GIS), flood forecasting, and now most recently, droughts. Moreover, the Nordic and Baltic hydrological and meteorological institutes have worked closely together with energy companies, universities, and research institutions in a suite of a very successful research project focusing on climate change and its impact on renewable energy resources including hydropower initiated by KOHYNO and CHIN and funded by Nordic Energy Research and the Nordic Council of Ministers (e.g. Climate Water and Energy (CWE), Climate and Energy (CE), Climate and Energy Systems (CES)).

More information about the association can be found on our web page (NHF 2023) as well as in a conference proceeding from NHC in 1988 (Kajander 1998).

2. THE NORDIC HYDROLOGIC CONFERENCES

The earliest series of conferences in hydrology in the Nordic-Baltic region started in 1926 when Estonia, Latvia, Lithuania and Poland initiated the Hydrological Conferences of the Baltic Sea Countries. The number of countries joining the conference gradually increased. Finland, Germany, the Soviet Union and Sweden joined in 1928, Denmark and Freetown Danzig in 1930, and Norway in 1936. The conference scheduled to be held in Kaunas, Lithuania in 1941 was canceled due to the Second World War and the conference series was discontinued. In 1997 Lithuania hosted a conference in Kaunas titled 'Hydrology and Environment' in the spirit of the Baltic Sea conferences. Topically, the Baltic conferences dealt with both freshwater and sea water.

Between 1955 and 1967, five Nordic Conferences of Hydrologists were organized on a 3-year rotational basis between the five Nordic (Denmark, Finland, Iceland, Norway and Sweden) countries. The language of these meetings was one of the Scandinavian ones. This series of conferences attracted regularly some 30–50 participants, mainly from national hydrological and meteorological services, but also consulting engineers, hydrologists from hydropower companies and hydrologists from academia. These conferences had a particular focus on hydropower development, which at that time had central economic importance in the region.

The first NHC was organized in 1970, when NHF was founded. NHF immediately took responsibility for organizing future Nordic Hydrological Conferences, starting in 1972. NHC has since then been organized on a biennial basis where the hosting circulates between the member states (Denmark, Iceland, Finland, Norway and Sweden). Since 1996 the NHF has attracted many members from the three 'Baltic' states of Estonia, Latvia and Lithuania. In 2004 NHC was organized for the first time in a Baltic country, i.e. in Tallinn in Estonia. In 2020, when NHC turned 50 years, the conference was canceled for the first time due to the Covid-19 pandemics. Note that the numbering of NHC starts in 1955 with the first Nordic Conference for Hydrologists. For that reason, the most recent NHC in Tallinn in 2022 was the 31st conference. An overview of the conferences from 1955 to 2022 is provided in Table 1. The table includes the location and the main topic of each conference.

Since the beginning, NHC has focused on the applied science and scientifically based decision making. The conferences have therefore included a wide range of topics important for hydrological science and water resources management in the Nordic and Baltic countries. How to carry out hydrological measurements, i.e. hydrometry, has been discussed since the first conference. Hydrological processes including, precipitation, snow, ice, soil- and groundwater, streamflow, lakes, and

Table 1 | List of Nordic hydrological conferences since 1955

Number and year	Location	# Abst.	Title or focus
I – 1955	Stockholm, Sweden	–	–
II – 1958	Oslo, Norway	–	–
III – 1961	Viborg, Denmark	43	Hydrology
IV – 1964	Reykjavik, Iceland	28	Snow, Glaciers, river ice, observations and statistical analysis
V – 1967	Helsinki, Finland	24	Evaporation and hydrology
VI – 1970	Stockholm, Sweden	71	Effects of urbanization on water balance
VII – 1972	Sandefjord, Norway	39	<i>The role of hydrology in societal planning</i>
VIII – 1974	Aalborg, Denmark	38	Hydrogeology and its methodology
IX – 1976	Reykjavik, Iceland	44	Processing and application of hydrometeorological data and environmental aspects of hydrology
X – 1978	Helsinki, Finland	69	<i>Hydrological models and influence of man on hydrology</i>
XI – 1980	Vemdalen, Sweden	66	<i>Hydropower development and its consequences</i>
XII – 1982	Førde, Norway	75	<i>Water resources management and hydrology</i>
XIII – 1984	Nyborg, Denmark	59	<i>Hydrology and water quality</i>
IXV – 1986	Reykjavik, Iceland	72	<i>Hydrology and Water Harnessing</i>
XV – 1988	Rovaniemi, Finland	69	<i>The role of hydrology within climate and environmental changes</i>
XVI – 1990	Kalmar, Sweden	48	Hydrological processes, operational hydrology and climate conditions
XVII – 1992	Alta, Norway	79	<i>Nordic hydrology in an international context</i>
XVIII – 1994	Torshavn, Faroe Island	65	<i>Protection and Exploitation of Freshwater Resources</i>
IXX – 1996	Akureyri, Iceland	83	Surveying, hydroinformatics, cold climate hydrology, climate change, large water bodies
XX – 1998	Helsinki, Finland	98	<i>Perspectives on European Water Policy/Baltic Sea – Mare Nostrum/Human impacts on Water</i>
XXI – 2000	Uppsala, Sweden	83	<i>Towards interdisciplinary hydrology</i>
XXII – 2002	Røros, Norway	93	<i>Water and man</i>
XXIII – 2004	Tallinn, Estonia	74	<i>Fresh water resources management</i>
IXXV – 2006	Vingsted, Denmark	109	<i>Experiences and challenges in implementation of the EU water framework directive</i>
XXV – 2008	Reykjavik, Iceland	79	<i>Northern hydrology and its global role</i>
XXVI – 2010	Riga, Latvia	91	<i>From research to water management</i>
XXVII – 2012	Oulu, Finland	187	<i>Catchment restoration and water protection</i>
XXVIII – 2014	Stockholm, Sweden	89	<i>Nordic hydrology model – linking science and practice</i>
IXXV – 2016	Kaunas, Lithuania	82	<i>The role of hydrology towards water resources sustainability</i>
XXX – 2018	Bergen, Norway	115	<i>Hydrology and water resources management in a changing world</i>
XXXI – 2022	Tallinn, Estonia	80	<i>Hydrology and water-related ecosystems</i>

Title of conference given in italic. If the conference has no title, the focus of the conferences has been set based on the proceedings.

glaciers are covered in most conferences. Topics where hydrology is an important component, such as water quality and aquatic ecosystems are also well represented. Topics related to water resources management are also included, e.g. urban hydrology, hydropower development, flood and drought management, water supply, monitoring and flood forecasting and hydropower production. The importance of water policy has increased, in particular related to several European directives. Computer models in hydrology were often assigned specific sub-sessions in the first conferences whereas in the latter conferences, computer models are more integrated in all sessions. Climate change was highlighted as a sub-topic for the first time in 1988. The conferences have been thematized with both wide and narrow topics. Nevertheless, since the main purpose of

NHC is to gather the broad hydrological community together, many presentations and sub-sessions are not directly related to the main topic.

NHC is an important venue for the dissemination of project results and for the accumulation of knowledge across projects and institutions. It offers a platform for sharing experiences across the Nordic and Baltic countries, contributes to linking research and practice and is a forum where both early career and experienced hydrologists meet.

3. PUBLICATION ACTIVITIES

NHF has *Hydrology Research* as the official journal of the association, and the history of *Hydrology Research* and its predecessor, *Nordic Hydrology* is well documented in Rosbjerg (2022). *Nordic Hydrology* was initiated in 1970 under the responsibility of NUTSAM/KOHYNO as an international journal to attract manuscripts from hydrologists worldwide. The first editor was Arne Forsman from Sweden.

From 1976, NHF agreed to become the owner of the journal with Eggert Hansen from the Technical University of Denmark (DTU) as editor. DTU also hosted a journal office that employed Mona Madsen as a journal secretary. Dan Rosbjerg took over as editor in 1987. To meet international competition with an increasing number of scientific journals in hydrology, *Nordic Hydrology* was transformed to *Hydrology Research* in 2004 as a joint venture with the British Hydrological Society (BHS) and IWA Publishing (IWAP) as the publisher. The name was chosen in order not to deviate too much for the old one and at the same time being distinctly different from other journal titles. BHS appointed Ian Littlewood, UK as an editor and a broad international editorial board was established. Today also the German Hydrological Society and the Italian Hydrological Society have *Hydrology Research* as their official journal. Chong-Yu Xu at Oslo University, Norway was the Nordic editor *Hydrology Research* from 2011 to 2019 when Bjørn Kløve from University of Oulo took over. In 2020, *Hydrology Research* became a full open-access journal. This also means that all issues since 1970 can be freely downloaded from the journal website.

4. NHF 50 YEARS SPECIAL ISSUE

NHF 50 years special issue has a diverse collection of papers reflecting important topics for hydrology in the Nordic-Baltic region. The special issue consists of three review papers, one opinion paper, one paper about the history of *Hydrology Research* and five research papers. The review papers were initiated by the guest editors who approached specialists within different domains in hydrology to encourage the creation of Nordic-Baltic author teams. Dan Rosbjerg was asked to write the history of *Hydrology Research*, summarized in Rosbjerg (2022). An open call for contributions to the special issue resulted in the opinion paper and the five research papers.

Important challenges for research within hydrology in the 21st Century are discussed in Marttila *et al.* (2022). They point at the importance of hydrological knowledge to solve the upcoming challenges for the society and highlight the importance of monitoring networks and research infrastructure, sharing and accessibility of data, use of new technologies to harvest data, as well as the need for networking and cooperation within both research and education.

The quality and use of groundwater in the Baltic and Nordic countries are reviewed by Kitterød *et al.* (2022). The paper highlights the difference in groundwater resources due to differences in geology across the Nordic-Baltic region. Denmark and the Baltic countries have large and complex aquifers, whereas the aquifers in Iceland and the Fennoscandian countries are relatively small and with less complexity. The authors have compiled chemical data from all involved countries, and the data are summarized in the supplementary material of Kitterød *et al.* (2022).

The Nordic contributions to stochastic methods in hydrology during the past 50 years are summarized in Rosbjerg *et al.* (2022). The paper covers flood frequency and drought analyses, rainfall extremes, stochastic approaches to water resources management and climate change impacts. The paper highlights the development in methods from analysis of stationary and independent hydrological events to include non-stationarity, risk analysis, big data, operational research, and climate change impacts.

Larsson *et al.* (2022) analyze how the implementation of water-related European Union (EU) directives is coordinated. The evaluation is based on legal documents, management plans, as well as on the organizational structure in the five countries. The results show that the coordination between the Water Framework Directive and the Floods Directive (or flood management for Norway's case) has been successful for Estonia and Lithuania, whereas Norway, Finland, and especially Sweden need to improve more.

Both Olsson *et al.* (2022) and Hegdahl *et al.* (2023) focus on extremes. Olsson *et al.* (2022) analyze sub-daily rainfall extremes in the Nordic-Baltic region using observations from 543 meteorological stations. Gridded data sets with estimated return levels and dates of occurrence based on annual maxima data are offered as supplementary material. The paper shows that the rainfall climate across the Nordic-Baltic region is highly heterogeneous and mainly positive trends in extreme rainfall are found for the period 1980–2018. The focus of Hegdahl *et al.* (2023) is flood forecasting where the benefits of pre- and postprocessing of hydrological ensemble forecasts are evaluated for 119 Norwegian catchments. They show that postprocessing improved the forecasts only up to a lead time of 2–3 days, whereas preprocessing can improve forecasts beyond 3 days' lead time. Further on, spring floods are better forecasted than autumn floods.

Elenius & Lindström (2022) and Jekabsons *et al.* (2022) address river flow variability introduced by river regulations. In Jekabsons *et al.* (2022) the impact of small hydropower plants on fish in seven Latvian lowland rivers regulated by hydropower is studied. The authors found significant differences in habitat availability for different river types, indicating that ecological flows must be calculated separately for fast- and slow-flowing rivers. Elenius & Lindström (2022) study how hydropower regulations may increase flow variability and how this variability is attenuated downstream river regulations. This attenuation of the variability can improve the ecological status at some distance downstream of the introduced variability. The authors show that the attenuation is well represented by linear channel and linear reservoir models and in particular lakes contribute significantly to attenuation.

Weng *et al.* (2021) analyze annual and seasonal changes in streamflow in small agricultural catchments.

They find a strong coherence between discharge and precipitation, snow water equivalent, and soil water storage capacity. Mainly seasonal changes in discharge, in particular increase in autumn and winter discharge, are detected in several of the catchments.

5. FINAL REMARK

NHF is proud of its history, and NHF remains to be a forum for Nordic professionals of all ages to gather and share their experiences and visions. The Nordic Hydrological Conferences are well known for special atmosphere, arising from 'nordicness' and supporting the maintenance and generation of networks among the participants. We look forwards to the next NHC that will be held in Iceland in 2024.

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REFERENCES

- Elenius, M. T. & Lindström, G. 2022 **Introduced flow variability and its propagation downstream of hydropower stations in Sweden.** *Hydrology Research* **53** (11), 1321–1339. <https://doi.org/10.2166/nh.2022.138>.
- Hegdahl, T. J., Engeland, K., Steinsland, I. & Singleton, A. 2023 **Pre- and postprocessing flood forecasts using Bayesian model averaging.** *Hydrology Research* **54** (2), 116–135. <https://doi.org/10.2166/nh.2023.024>.
- Jekabsons, J., Abersons, K., Kolcova, T. & Tirums, M. 2022 **First steps in the ecological flow determining for Latvian rivers.** *Hydrology Research* **53** (8), 1063–1074. <https://doi.org/10.2166/nh.2022.019>.
- Kajander, J., 1998 *XX Nordic Hydrological Conference*, Vol. 1 & 2 (Kajander, J., ed.). Nordic Association for Hydrology, Helsinki, Finland, 10–13 August 1998, NHP report 44, Helsinki, Finland.
- Kitterød, N.-O., Kværner, J., Aagaard, P., Arustienė, J., Bikše, J., Dagestad, A., Gundersen, P., Hansen, B., Hjartarson, Á., Karro, E., Klavins, M., Marandi, A., Radienė, R., Retike, I., Rossi, P. M. & Thorling, L. 2022 **Hydrogeology and groundwater quality in the Nordic and Baltic countries.** *Hydrology Research* **53** (7), 958–982. <https://doi.org/10.2166/nh.2022.018>.
- Larsson, R., Belinskij, A., Kløve, B., Meilutyte-Lukauskiene, D., Lode, E., Skarbøvik, E. & Akstinas, V. 2022 **Coordination of water policies for quality and quantity: experiences from Nordic and Baltic countries.** *Hydrology Research* **53** (9), 1166–1185. <https://doi.org/10.2166/nh.2022.028>.
- Marttila, H., Laudon, H., Tallaksen, L. M., Jaramillo, F., Alfredsen, K., Ronkanen, A. K., Kronvang, B., Lotsari, E., Kämäri, M., Ala-Aho, P., Nousu, J., Silander, J., Koivusalo, H. & Kløve, B. 2022 **Nordic hydrological frontier in the 21st century.** *Hydrology Research* **53** (5), 700–715. <https://doi.org/10.2166/nh.2022.120>.
- NHF. 2023 *Association for Hydrology, its Early History*. Available from: <https://www.nhf-hydrology.org/about-4> (accessed 19 July 2023).
- Olsson, J., Dyrddal, A. V., Médus, E., Södling, J., Aniskeviča, S., Arnbjerg-Nielsen, K., Førland, E., Mačiulytė, V., Mäkelä, A., Post, P., Thorndahl, S. L. & Wern, L. 2022 **Sub-daily rainfall extremes in the Nordic–Baltic region.** *Hydrology Research* **53** (6), 807–824. <https://doi.org/10.2166/nh.2022.119>.
- Rosbjerg, D. 2022 **50 years with Nordic hydrology/Hydrology research.** *Hydrology Research* **53** (6), 908–913. <https://doi.org/10.2166/nh.2022.017>.
- Rosbjerg, D., Engeland, K., Førland, E., Haghghi, A. T., Mehr, A. D. & Olsson, J. 2022 **Nordic contributions to stochastic methods in hydrology.** *Hydrology Research* **53** (6), 840–866. <https://doi.org/10.2166/nh.2022.137>.
- Wenng, H., Croghan, D., Bechmann, M. & Marttila, H. 2021 **Hydrology under change: long-term annual and seasonal changes in small agricultural catchments in Norway.** *Hydrology Research* **52** (6), 1542–1558. <https://doi.org/10.2166/nh.2021.066>.