



International Baltic Earth Secretariat Publication No. 25, February 2025

Special Baltic Earth Colloquium – achievements, thanks and future challenges

Hamburg, Germany, 4 February 2025

Programme, Abstracts, Participants

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Impressum

International Baltic Earth Secretariat Publications

ISSN 2198-4247

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After a three-month transition period between 1st January and 31st March, 2025, the operation of the International Baltic Earth Secretariat will move on 1st April, 2025 from the Helmholtz-Zentrum Hereon to the Leibniz Institute for Baltic Sea Research Warnemünde (IOW) and to the Institute of Oceanology Polish Academy of Sciences (IOPAN):

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Cover image:

International Maritime Museum Hamburg, Germany (source:
<https://www.imm-hamburg.de/>)



Special Baltic Earth Colloquium – achievements, thanks and future challenges

on the occasion of the retirement of Dr. Marcus Reckermann,
Head of the International Baltic Earth Secretariat

Hamburg, Germany, 4th February, 2025

Co-organized by



Institute of Oceanology
Polish Academy of Sciences



Baltic Earth



LEIBNIZ INSTITUTE FOR
BALTIC SEA RESEARCH
WARNEMÜNDE

Preface

BALTEX was founded in 1993 after the fall of the Iron Curtain as a Regional Hydroclimate Project (RHP) within the framework of the Global Energy and Water Exchanges Project (GEWEX) of the World Climate Research Programme (WCRP). Scientists from 14 countries covering the Baltic Sea catchment established links between the research communities from East and West. As the focus was on understanding the water cycle and energy exchange between the atmosphere and the Earth's surface, data were collected from the entire catchment area, which required data exchange between all Baltic Sea countries.

In 2013, after 20 years of successful research networking, the programme was relaunched and renamed Baltic Earth, with a revised and expanded science plan. Compared to its predecessor BALTEX, Baltic Earth has a more holistic view of the Earth system, encompassing processes in the atmosphere, land, sea and anthroposphere. The aim is to understand the entire Earth system in the Baltic Sea region and to analyse the effects of all relevant influencing factors on the system. Over the years, a very active network of scientists from all Baltic Sea countries has been established with its own infrastructure, including the BALTEX/Baltic Earth Secretariat, conferences, workshops, an ambitious educational programme and publication series.

In 2025, a new phase of Baltic Earth, henceforth (in this report) called Baltic Earth 2.0, will begin. A new revised research plan with new research topics will be finalised and a new international Baltic Earth Secretariat will be established, working from two countries, Germany and Poland.

Background

On the occasion of the retirement of Dr. Marcus Reckermann, Head of the International Baltic Earth Secretariat, this colloquium will provide the framework for invited guests and for Baltic Earth scientists to highlight the achievements of the Baltic Earth network, which was made possible by the support of the secretariat.

Research results on the water cycle of the Baltic Sea region, modeling of water exchange, saltwater inflows, remote forcing of regional climate, regime shifts of the Baltic Sea system, biogeochemical functioning, climate change impact assessments, the role of regional science programmes, GEWEX and CORDEX, and the cooperation with HELCOM will be presented. Finally, future perspectives of Baltic Earth activities and the new research plan will be introduced.

For their support of BALTEX and Baltic Earth, we would like to thank the team members of the BALTEX and Baltic Earth secretariats, Dr. Marcus Reckermann, Silke Köppen and Dr. Hans-Jörg Isemer. We are also very grateful for the generous 30-year support of the Helmholtz-Zentrum Hereon, which has funded the secretariat and many of the activities in Baltic Earth. Without the secretariat, the network's successes would not have been possible.

During the colloquium, the baton will be passed from Hereon to the Leibniz Institute for Baltic Sea Research Warnemünde, Rostock, and the Institute of Oceanology of the Polish Academy of Sciences, Sopot. A memorandum of understanding will be signed between the latter two institutes, which will operate the future International Baltic Earth Secretariat and Baltic Earth.

Markus Meier

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4th February, 2025, Hamburg, Germany



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Programme

- 09:30 – 10:00 Coffee and tea
- 10:00 – 10:10 **Welcome and introduction**
(Markus Meier, BE SSG Chair, and Karol Kuliński, BE SSG Vice-Chair)
- Achievements I** **Chair: Andris Andrusaitis**
- 10:10-10:25 **Net Precipitation over the Baltic Sea - a revisit**
(Anders Omstedt, BE SAB Member)
- 10:25-10:40 **Water exchange: from box approach to sub-mesoscale**
(Jüri Elken, BE SAB Member)
- 10:40-10:55 **Changes in saltwater inflow seasonality caused warming and oxygen
depletion in the western Baltic Sea**
(Leonie Barghorn, BE Early Career Scientist)
- 10:55-11:10 **Teleconnection between the North Atlantic and Northern Europe and
the Baltic Sea Region**
(Florian Börgel, BE Working Group Co-Chair)
- 11:10-11:25 **Regime shifts in the Baltic Sea region**
(Tarmo Soomere, BE SSG member)
- 11:25-11:40 **Break**
- Achievements II** **Chair: Leonie Barghorn**
- 11:40-11:55 **Biogeochemical functioning of the Baltic Sea – latest results and
challenges**
(Karol Kuliński, BE SSG Vice-Chair)
- 11:55-12:10 **An added value provided by BALTEX / Baltic Earth**
(Hans von Storch and Anders Omstedt, BE SAB Members)

- 12:10-12:25 **Importance of regional sea-basin approach in marine research**
(Andris Andrusaitis, BE SAB Chair)
- 12:25-13:10 **Lunch**
- International collaboration** **Chair:** Anders Omstedt
- 13:10-13:40 **GEWEX and GLASS: Recent progress in the understanding of the land-atmosphere system**
(Volker Wulfmeyer, GEWEX GLASS Panel Chair)
- 13:40-14:10 **CORDEX projections of future climate in the Baltic Sea region**
(Erik Kjellström, Swedish Meteorological and Hydrological Institute)
- 14:10-14:40 **HELCOM-Baltic Earth collaboration**
(Rüdiger Stempel, HELCOM Executive Secretary)
- 14:40-14:50 **Break**
- Baltic Earth 2.0** **Chair:** Agnieszka Jędruch
- 14:50-15:00 **Future perspectives** (Markus Meier and Karol Kuliński)
- Chairs:** Markus Meier and Karol Kuliński
- 15:00-15:15 **Introduction of the new secretary at IOPAN: Underwater Pipeline Leakage Impacts on Environmental Pollution: A Case Study of Nord Stream Incidents**
(Agnieszka Jędruch, International Baltic Earth Secretariat)
- 15:15-16:00 **Speeches and Awards**
- 16:00-16:30 **Handing over the baton and signing of the memorandum of understanding**
(Laura Schwabe, Head of the Research Funding Department at Hereon; Marcus Reckermann, Head of the International Baltic Earth Secretariat; Slawomir Sagan, IOPAN Deputy Director; Oliver Zielinski, IOW Director; Markus Meier, BE SSG Chair; Karol Kuliński, BE SSG Vice-Chair)
- 16:30-16:35 **Greetings from GEWEX/GHP**
(Alireza Nazemi, Co-Chair of the GEWEX Hydroclimatology Panel, GHP)
- 16:35-17:45 **Festive finale**

The museum closes 18:00.

Abstracts

Net Precipitation over the Baltic Sea - a revisit

Anders Omstedt, Department of Marine Sciences, University of Gothenburg, Sweden

Keywords: BALTEX; Baltic Earth; Net precipitation; Water cycle

Net precipitation (precipitation–evaporation) over land and sea was one major goal to study at the start of the BALTEX program. The GEWEX approach of using the drainage basin concept was applied in the Baltic Basin, including the Baltic Sea and its drainage basin. The number of precipitation observations is generally high over land and few over sea. Direct observations of precipitation and river runoff from several land-based drainage basins were used to estimate the net precipitation over land. However, a major effort was to estimate evaporation over complex land vegetation. Here, observation, measurements, and models were used.

More problematic was to assess the net precipitation over the sea. The research, therefore, generated several studies, from developing new shipboard measurements, radar and satellite studies, high-resolution flux measurements from well-exposed coastal sites, and several different model studies. The main aim was to learn about the various contributions to the Baltic Sea water balance, and the question was whether net precipitation over the Baltic Sea was of importance, where river runoff (about 15 000 m³/s) and inflow from the Kattegat area was believed to be the main water components. The presentation will discuss estimated net precipitation rates and uncertainties.

Water exchange: from box approach to sub-mesoscale

Jüri Elken, Tallinn University of Technology, Estonia

Large-scale response of the Baltic Sea to human and climate forcing, controlled by a multitude of water exchange processes, is a continuing challenge. First successful treatments were done using the approach of connected boxes with stratification (e.g. by A. Stigebrandt, A. Omstedt, B.Gustafsson). By evolving the scientific knowledge and research capacities, variability spectrum of processes to be considered has included mesoscale eddies, and recently the large-scale water exchange studies have been refined to sub-mesoscale processes.

Changes in saltwater inflow seasonality caused warming and oxygen depletion in the western Baltic Sea

Leonie Barghorn, Leibniz Institute of Baltic Sea Research Warnemünde, Germany

Keywords: saltwater inflows, oxygen dynamics, regional ocean modeling

The salinity and oxygen dynamics of the Baltic Sea are strongly determined by inflows of highly saline water from the North Sea. Recently, we discovered a shift in the seasonality of those inflows towards more summer and autumn inflows. Since they are warmer than winter inflows, their increase led to exceptional warming trends in deep water layers of the central Baltic Sea, especially in the Bornholm Basin. This also had a negative effect on the oxygen concentrations in the affected water layers.

Teleconnection between the North Atlantic and Northern Europe and the Baltic Sea Region

Florian Börgel, Leibniz Institute of Baltic Sea Research Warnemünde, Germany

The North Atlantic serves as a key driver of atmospheric and oceanic processes shaping the climate of Northern Europe and the Baltic Sea region. In this talk, I will focus on the mechanisms underpinning these teleconnections, focusing on the interplay between the North Atlantic Oscillation and the North Atlantic Ocean. This interaction influences regional patterns of temperature, precipitation, and likely extreme events, including marine heatwaves and cold spells. By examining variability across temporal scales, from synoptic weather systems to multidecadal climate oscillations, it will be discussed how these dynamics shape the Baltic Sea's unique physical environment. The talk will also address how anthropogenic climate change may modify these teleconnections, with implications for future regional climate variability.

Regime shifts in the Baltic Sea region

Tarmo Soomere, Tallinn University of Technology, Estonia

Biogeochemical functioning of the Baltic Sea – latest results and challenges

Karol Kuliński, Institute of Oceanology of the Polish Academy of Sciences, Poland

Keywords: eutrophication, hypoxia/anoxia, ocean acidification

Location, specific topography and hydrographic setting together with climate change and strong anthropogenic pressure are the main factors shaping the biogeochemical functioning and thus also the ecological status of the Baltic Sea. This presentation summarises the current state of knowledge about the cycling of carbon, nitrogen and phosphorus in the Baltic as well as refers to the oxygen deficits in deep waters and changes occurring in the marine CO₂ system. On top of that it identifies knowledge gaps and future research needs in the field of marine biogeochemistry in the Baltic Sea.

An added value provided by BALTEX / Baltic Earth

Hans von Storch and Anders Omstedt

In 2005, when I first became acquainted with BALTEX following Erhard Raschke's retirement from GKSS, I noticed that many scientists looked to BALTEX to ensure their research topics—focused on processes and aspects of the energy and water cycle in the Baltic Sea region—were included in funding agency programs. Over time, however, I observed a shift in focus towards synthesizing diverse, loosely connected studies into a coherent body of knowledge about the region's climate, including climate change. This shift also emphasized addressing "grand challenges," topics of significant scientific and public interest. Consequently, BALTEX, and now Baltic Earth, moved away from prioritizing funding acquisition to instead concentrate on managing knowledge — assessing its robustness, completeness, and identifying gaps.

Importance of regional sea-basin approach in marine research

Andris Andrusaitis, Riga, Latvia

This contribution demonstrates on the example of the Baltic Sea the importance of a regional approach for assessing status and understanding the functioning of the earth system and marine ecosystem, thereby providing the knowledge necessary for projecting the impact of global change, protecting the environment and enabling sustainable use of marine ecosystem services. The experience of two transnational research programmes – Baltic Earth and BONUS (2004-2022) – is explored to validate the case. Reinforcing the regional effort at a sea-basin scale is particularly important in the context of the UN Decade of Ocean Science and pan-European scale research and innovation initiatives supported by the EU.

GEWEX and GLASS: Recent progress in the understanding of the land-atmosphere system

Volker Wulfmeyer, University of Hohenheim, Germany

The Global Energy and Water Exchanges (GEWEX) program is a core project of the World Climate Research Programme (WCRP). The mission of GEWEX is to observe, understand, and model the hydrological cycle and energy fluxes in the Earth's atmosphere at and below its surface. GEWEX consists of four panels, one of them is the Global Land-Atmosphere System Studies (GLASS) Panel. This panel encourages interdisciplinary studies of the Earth system over land, including observational and modeling efforts to understand processes from the sub-surface, to the surface with its land cover, to the lower troposphere. Recent results are presented focusing on the modeling of surface fluxes, particularly evapotranspiration, the effects of land heterogeneities, and the representation of entrainment.

CORDEX projections of future climate in the Baltic Sea region

Erik Kjellström, Swedish Meteorological and Hydrological Institute, Sweden

Keywords: CORDEX, regional climate change, dynamical downscaling, climate change

Climate models have been extensively applied for studies of the Baltic Sea region for past, present and future conditions. The CoOrdinated Regional climate Downscaling EXperiment (CORDEX) has produced a large amount of high-resolution regional climate simulations for Europe. The presentation will cover both evaluation of the CORDEX models and their use in projection future climate change in the Baltic Sea region.

HELCOM-Baltic Earth collaboration

Rüdiger Stempel, HELCOM Executive Secretary, Finland

Keywords: bridging the science-policy gap, science driven policy, climate change, cooperation

The long-standing cooperation between Baltic Earth and HELCOM focuses on integrating scientific research into policy to address climate change and its impact on the Baltic Sea environment. In 2018, the organizations developed a multidisciplinary, long-term approach for understanding and communicating climate change implications, which included reducing the lag in transferring quality-assured science to policy-making and fostering synergies with other regional and international organizations. This resulted in the establishment of the HELCOM-BalticEarth Expert Network on Climate Change (EN-CLIME) and the creation of the Baltic Sea Climate Change Factsheet (first published in 2021, updated in 2024).

As the triple planetary crisis intensifies, the need for science-driven decision-making grows. Baltic Earth and HELCOM play crucial roles in regional cooperation, emphasizing coordinated actions across levels of governance. Their collaboration exemplifies how science can serve as a unifying language, fostering resource mobilization, innovation, and scalable solutions to protect and preserve the Baltic Sea environment.

Future perspectives of Baltic Earth

Markus Meier, Leibniz Institute of Baltic Sea Research Warnemünde, Germany and Karol Kuliński, Institute of Oceanology of the Polish Academy of Sciences, Poland

Keywords: Baltic Earth, networking, international collaboration, assessments, stakeholder cooperation, education

Today's activities within Baltic Earth include 1) scientific networking on conferences, workshops, colloquia and working group meetings on selected scientific topics; 2) exchange with other scientific networks at the Baltic Sea (e.g. ICES), European (e.g. JPI climate and JPI ocean) and global scales (e.g. GEWEX, CORDEX, CLIVAR); 3) compilation of assessments reports on past and future climate change in the Baltic Sea region (i.e. BACC, BEAR); 4) cooperation with stakeholders such as HELCOM (e.g. EN CLIME); and 5) education of undergraduate and graduate students at summer and winter schools. In this presentation, we will discuss ideas on how these activities could be continued with the help of the new International Baltic Earth Secretariat. We will also briefly present the new science plan of Baltic Earth 2.0.

Underwater Pipeline Leakage Impacts on Environmental Pollution: A Case Study of Nord Stream Incidents

Agnieszka Jędruch, Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland

Keywords: Seabed disturbance, Munitions dumpsite, Pollution, Marine ecosystem impact

Damage to underwater pipelines poses significant risks to marine ecosystems, including the release of hazardous substances, seabed disturbance, and sediment resuspension. The Nord Stream explosions in September 2022 exacerbated these concerns, occurring near a chemical munitions dump site in the Bornholm Basin, a major contamination hotspot in the Baltic Sea. This study examines sediment samples collected from the blast area to assess concentrations of heavy metals, organic pollutants, chemical warfare agents, and explosives. The explosions mobilized approximately 500,000 tons of fine sediment, which dispersed over 50 km before redeposition. While no acute pollution was detected, the prolonged presence of the sediment plume may have had chronic impacts on marine organisms, underscoring the need for continued environmental monitoring.

Participant List

sorted alphabetically

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International Baltic Earth Secretariat Publications

ISSN 2198-4247

- No. 1 Programme, Abstracts, Participants. Baltic Earth Workshop on "Natural hazards and extreme events in the Baltic Sea region". Finnish Meteorological Institute, Dynamicum, Helsinki, 30-31 January 2014. International Baltic Earth Secretariat Publication No. 1, 33 pp, January 2014.
- No. 2 Conference Proceedings of the 2nd International Conference on Climate Change - The environmental and socio-economic response in the Southern Baltic region. Szczecin, Poland, 12-15 May 2014. International Baltic Earth Secretariat Publication No. 2, 110 pp, May 2014.
- No. 3 Workshop Proceedings of the 3rd International Lund Regional-Scale Climate Modelling Workshop "21st Century Challenges in Regional Climate Modelling". Lund, Sweden, 16-19 June 2014. International Baltic Earth Secretariat Publication No. 3, 391 pp, June 2014.
- No. 4 Programme, Abstracts, Participants. Baltic Earth - Gulf of Finland Year 2014 Modelling Workshop "Modelling as a tool to ensure sustainable development of the Gulf of Finland/Baltic Sea ecosystem". Finnish Environment Institute SYKE, Helsinki, 24-25 November 2014. International Baltic Earth Secretariat Publication No. 4, 27 pp, November 2014.
- No. 5 Programme, Abstracts, Participants. A Doctoral Students Conference Challenges for Earth system science in the Baltic Sea region: From measurements to models. University of Tartu and Vilsandi Island, Estonia, 10 - 14 August 2015. International Baltic Earth Secretariat Publication No. 5, 66 pp, August 2015.
- No. 6 Programme, Abstracts, Participants. International advanced PhD course on Impact of climate change on the marine environment with special focus on the role of changing extremes. Askö Laboratory, Trosa, Sweden, 24 - 30 August 2015 International Baltic Earth Secretariat Publication No. 6, 61 pp, August 2015.
- No. 7 Programme, Abstracts, Participants. HyMex-Baltic Earth Workshop "Joint regional climate system modelling for the European sea regions", ENEA, Rome, Italy, 5- 6 November 2015. International advanced PhD course on Impact of climate change on the marine International Baltic Earth Secretariat Publication No. 7, 103 pp, October 2015.
- No. 8 Programme, Abstracts, Participants. A PhD seminar in connection with the Gulf of Finland Scientific Forum: "Exchange process between the Gulf of Finland and other Baltic Sea basins". Tallinn, Estonia, 19 November 2015. International Baltic Earth Secretariat Publication No. 8, 27 pp, November 2015
- No. 9 Conference Proceedings. 1st Baltic Earth Conference. Multiple drivers for Earth system changes in the Baltic Sea region. Nida, Curonian Spit, Lithuania, 13 - 17 June 2016. International Baltic Earth Secretariat Publication No. 9, 222 pp, June 2016

- No. 10 Programme, Abstracts, Participants. Baltic Earth Workshop on "Coupled atmosphere-ocean modeling for the Baltic Sea and North Sea", Leibniz Institute for Baltic Sea Research Warnemünde, Germany, 7- 8 February 2017. International Baltic Earth Secretariat Publication No. 10, 24 pp, February 2017
- No. 11 Baltic Earth Science Plan 2017. International Baltic Earth Secretariat Publication No. 11, 28 pp, February 2017
- No. 12 Programme, Abstracts, Participants. MedCORDEX-Baltic Earth-COST Workshop "Regional Climate System Modelling for the European Sea Regions". Universitat de les Illes Balears, Palma de Mallorca, Spain, 14 - 16 March 2018, International Baltic Earth Secretariat Publication No. 12, 96 pp, March 2018
- No. 13 Conference Proceedings. 2nd Baltic Earth Conference. The Baltic Sea in Transition. Helsingør, Denmark, 11 - 15 June 2018. International Baltic Earth Secretariat Publication No. 13, 216 pp, June 2018
- No. 14 Programme, Abstracts, Participants. Baltic Earth Workshop "Multiple drivers for Earth system changes in the Baltic Sea region". Tallinn, Estonia, 26-27 November 2018. International Baltic Earth Secretariat Publication No. 14, 58 pp, March 2018
- No. 15 Programme, Abstracts, Participants. Baltic Earth Workshop "Hydrology of the Baltic Sea Basin: Observations, Modelling, Forecasting". St. Petersburg, Russia, 8-9 October 2019. International Baltic Earth Secretariat Publication No. 15, 44 pp, October 2019
- No. 16 Programme, Abstracts, Participants. Baltic Earth Workshop "Climate projections and uncertainties in the northern Baltic Sea Region". Helsinki, Finland, 19-20 November 2019, International Baltic Earth Secretariat Publication No. 16, 38 pp, November 2019
- No. 17 Anders Omstedt: 45 years of wandering - from processes to systems, through outer and inner seas. An interview by Hans von Storch and Marcus Reckermann with foreword by Jüri Elken, 63 pp. International Baltic Earth Secretariat Publication No. 17, 63 pp, February 2020
- No. 18 Conference Proceedings. 3rd Baltic Earth Conference. Earth system changes and Baltic Sea coasts. To be held in Jastarnia, Hel Peninsula, Poland, 1 - 5 June 2020. Held online 2-3 June 2020. International Baltic Earth Secretariat Publication No. 18, 209 pp, June 2020
- No. 19 Programme, Abstracts, Participants. ESA-Baltic Earth Workshop on Earth Observation in the Baltic Sea Region. Online, 21. September 2020. International Baltic Earth Secretariat Publication No. 19, 26 pp, September 2020
- No. 20 Programme, Abstracts, Participants. Online Conference on Marginal Seas – Past and Future. Online, 16-17 December 2020. International Baltic Earth Secretariat Publication No. 20, 56 pp, December 2020

- No. 21 Conference Proceedings. 4th Baltic Earth Conference. Assessing the Baltic Sea Earth System. Jastarnia, Hel Peninsula, Poland, 30 May - 3 June 2022. Held online 2-3 June 2020. International Baltic Earth Secretariat Publication No. 22, 201 pp, May 2022
- No. 22 Programme, Abstracts, Participants. Online Conference on River Mouth Systems and Marginal Seas - Natural drivers and human impacts. Online, 5-7 December 2022. International Baltic Earth Secretariat Publication No. 22, 74 pp, December 2022.
- No. 23 Conference Proceedings. 5th Baltic Earth Conference. New Challenges for Baltic Sea Earth System Research, Jūrmala, Latvia 13. May - 17. May 2024. International Baltic Earth Secretariat Publication No.23, 224 pp.
- No. 24 Programme, Abstracts, Participants. International Workshop "Multiple Drivers of Earth system changes in the Baltic Sea region", Helsinki, 4 - 5 December 2024 International Baltic Earth Secretariat Publication No. 24, 37 pp
- No. 25 Programme, Abstracts, Participants. Special Baltic Earth Colloquium "Achievements, thanks and future challenges", Hamburg, Germany, 4 February 2025, International Baltic Earth Secretariat Publication No. 25, 17 pp

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