Joint Initiative on Atlantic Meridional Overturning Circulation

Terms of Reference

2025 – 2027

1. Preamble

The AMOC Joint Initiative, owned and coordinated by JPI Climate and JPI Oceans, is a collaborative effort aimed at producing an authoritative scientific review report on the Atlantic Meridional Overturning Circulation (AMOC). This report will complement IPCC assessments while providing distinct insights for the Atlantic domain, with a focus on relevance for Europe and North America.

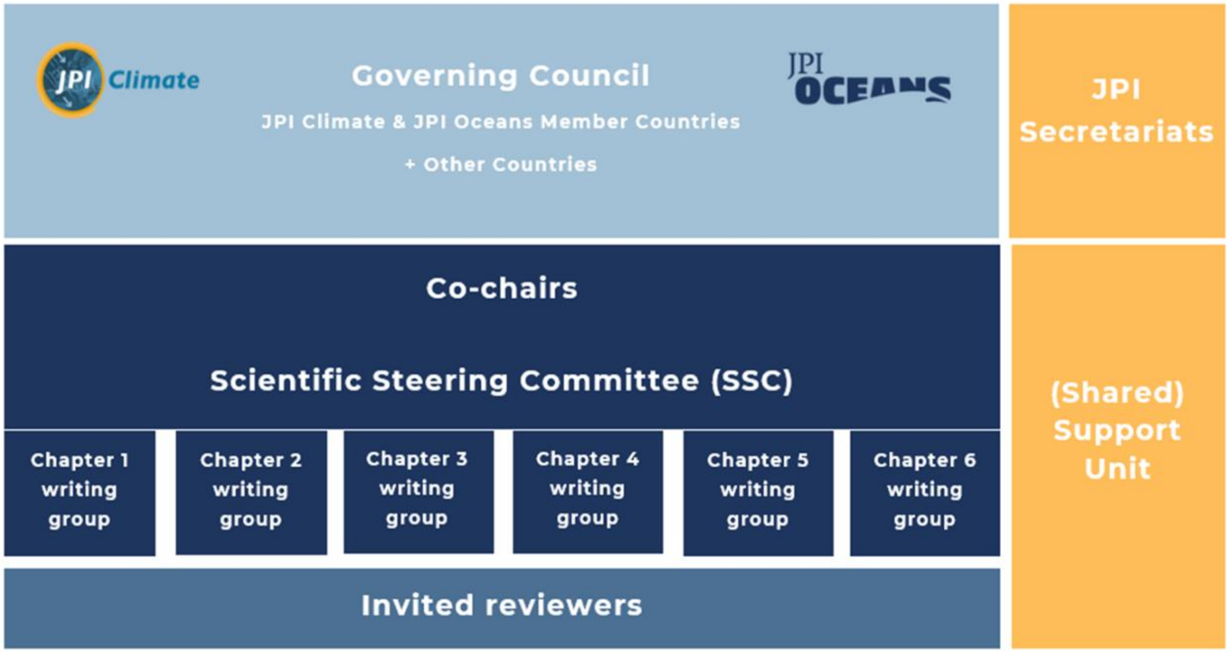
This initiative recognizes the urgency and momentum surrounding AMOC research and its potential imminent tipping points. The JPI Oceans Management Board emphasized the need to act swiftly, leveraging the strong collaboration between JPI Climate and JPI Oceans and building on the experience and lessons learned from the Assessment Report on Sea Level Rise in Europe. Given the high policy and scientific relevance, the initiative seeks to deliver timely insights into an issue of growing concern.

The initiative builds on past JPI Climate and JPI Oceans collaborations, particularly the Knowledge Hub on Sea Level Rise, as a potential foundational model.

2. Governance Structure

The AMOC Joint Initiative governance shall be considered as established when four or more formal member countries of JPI Climate and/or JPI Oceans agree, in a written communication to the JPI Climate and JPI Oceans Secretariats, to provide direct or indirect funding. In addition, countries that are not member countries of JPI Climate or JPI Oceans are also welcome to participate in the AMOC Joint Initiative if they commit funds or in-kind support through written confirmation in addition to paying an administrative annual fee following JPI Oceans' procedure for Third Country participation via signing of a Memorandum of Understanding. The Governing Structure of the AMOC Joint Initiative is outlined below.

The AMOC Joint Initiative will be coordinated by JPI Climate and JPI Oceans and governed through a multi-tiered structure to ensure effective leadership, scientific integrity, and operational support.



The governance structure consists of:

- **Governing Council (GC)** – Formed by selected National Contact Points, appointed by the JPI Boards, provides strategic oversight and decision-making.
- **Scientific Steering Committee (SSC)** – Comprises scientific leadership for the development of the report. Each SSC member will act as a co-leader for one of the chapters of the report. Two co-chairs nominated by the GC and endorsed by the JPI Boards will oversee the scientific content of the initiative, chair the SSC and guide the report-writing process, overseeing the work of six writing groups. The SSC composition is proposed by the co-chairs based on nominations by the JPI Boards and scientific expertise and finally approved by the JPI Boards.
- **Support Unit** – Provides scientific, administrative and technical assistance and directly supports the Co-Chairs.
- **Secretariat –** The JPI Climate and JPI Oceans secretariat will oversee the overall management of the Joint Initiative and act as liaison point between the Governing Council and the Scientific Steering Committee, and maintain contact with the (Shared) Support Unit to ensure timely delivery of the Joint Initiative's outputs.

2.1 Governing Council (GC)

The Governing Council (GC) will be composed of National Contact Points (NCPs) from JPI Climate and JPI Oceans member countries, as well as participating Third Countries. The JPI Climate and JPI Oceans Secretariats will provide administrative and logistical support.

The responsibilities of the GC include:

- Providing strategic oversight and approving key governance decisions.
- Nominating and approving the co-chairs of the AMOC Initiative.

- Overseeing the composition of the Scientific Steering Committee (SSC) to ensure diverse expertise and disciplinary representation.
- Approving the final AMOC Review Report before its official launch.

Decisions within the GC will be made by consensus. If consensus cannot be reached, decisions will be determined by a majority vote among Full Members. The GC will be chaired by JPI Climate and JPI Oceans, represented by elected members of their Boards or Secretariats.

2.2 Scientific Steering Committee (SSC)

The Scientific Steering Committee (SSC) will consist of scientific experts nominated by participating countries. SSC members will serve as chapter co-leads and may contribute to multiple chapters of the report. The SSC will be chaired by the Co-Chairs.

The SSC will be responsible for:

- Developing the report structure and overseeing its production.
- Ensuring the report complements IPCC AR6, while integrating the latest scientific advancements and providing added value.
- Providing expert input and fostering cross-disciplinary collaboration across the report's chapters.

The scientific process and SSC will be led by two co-chairs, nominated by member countries and approved by the Governing Council. The co-chairs will be responsible for:

- Chairing the Scientific Steering Committee.
- Supervising the six writing groups, each of which is responsible for drafting a chapter of the report.
- Leading the Summary for Policymakers (SPM) and supervising inputs to the SPM from the SSC
- Coordinating with the SSC and GC, ensuring the scientific integrity and policy relevance of the final report.
- Representing the AMOC Joint Initiative at (international) events, strengthening its visibility and engagement with key stakeholders.

2.3 Support Unit

A shared Support Unit will be established to assist the co-chairs and the SSC in scientific, administrative and technical matters. Ideally, this unit will include scientific expertise, administrative skills, communication and outreach experience including with graphics and visualisations. The Support Unit will

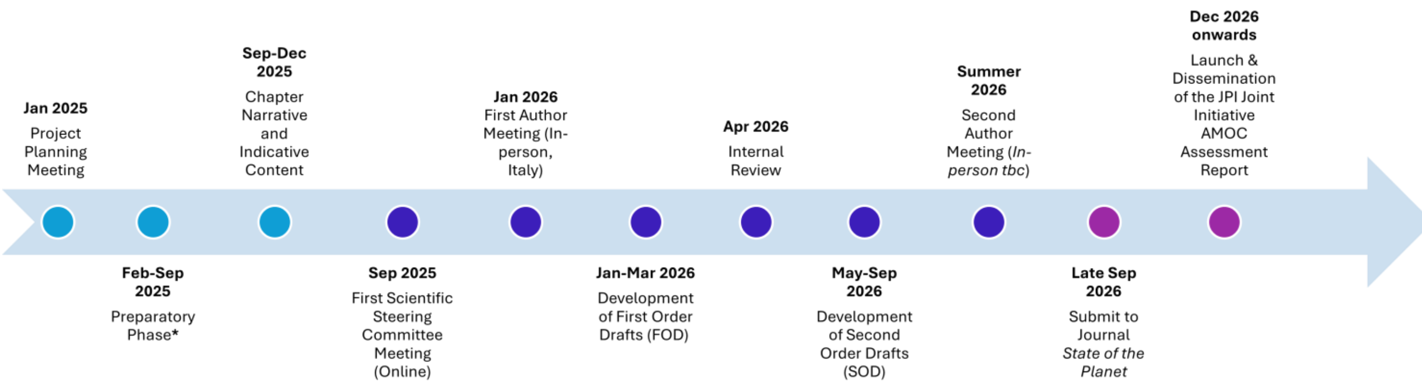
- Work directly with the Co-Chairs providing scientific, administrative and technical support to the Joint Initiative
- Assist with management of the author teams, the report development and outreach as required by co-chairs
- Cooperate with the JPI Secretariats to ensure timely delivery of the Joint Initiative's outputs and adherence to JPI guidelines.

2.4 Secretariat

The JPI Climate and JPI Oceans secretariat will oversee the overall management of the Joint Initiative and act as liaison point between the Governing Council and the Scientific Steering Committee and maintaining contact with the Shared Support Unit to ensure timely delivery of the Joint Initiative's outputs. It will also ensure coordination between JPI Climate and JPI Oceans for coordination of the joint activity and liaison with the respective Boards when necessary.

3. Project Timeline & Key Phases

The initiative will follow a structured timeline (*tentative, subject to change following developments in the initiative*):



*****Establishment of Governance units, funding base, and overall writing process.

The AMOC Joint Initiative will be structured into three phases: **Preparatory Phase, Implementation Phase,** and **Launch & Post-Launch Activities.**

3.1 Preparatory Phase (Jan-Aug 2025, 8 months)

This phase will focus on establishing the governance structure, funding commitments from participating countries, and defining the scope of the review report. Key activities include:

- Definition of the report’s scope and provisional chapter structure (development during Project Planning Meeting on January 30).
- Appointment of co-chairs and the Scientific Steering Committee (SSC).
- Establishment of the Share Support Unit and related processes and procedures
- Establishment of six writing groups following nominations from governments.
- Development of the timeline

3.2 Implementation Phase (Sept 2025-Nov 2026 ~14 months)

This phase will involve the drafting, review, and finalization of the AMOC Review Report through multiple iterations:

- **Development of Chapter and SPM narratives**: Initial outline indicating complementary text and visual narratives and provisional key messages.
- **First Order Draft (FOD)**: Draft text and visuals for each chapter and the SPM, subject to an informal (internal) expert review process.
- **Second Order Draft (SOD)**: Full content of chapters and SPM. These undergo a formal external expert review round. The individual chapters of the report will be peer-reviewed though a process to be detailed by the co-chairs working with the publisher and approved by the Governing Council.
- **Final Report**: Final revisions to Chapters and SPM. Approval by the Governing Council (GC) and submission to funding organizations for formal approval.

3.3 Launch & Post-Launch Activities (Dec 2026 onwards)

Following the completion and approval of the report, key activities will include:

- **Launch event** (*tentatively scheduled for Q4 2026*).
- **Peer-reviewed publications**: The report will be published by a professional publisher in an open access format.

4. Indicative Budget

The estimated budget for this initiative is subject to change based on evolving costs and funding availability. To ensure access to the most up-to-date budget information, please refer to the live budget document available at the following link: **LIVE BUDGET SPREADSHEET.**

This document will be kept up to date to reflect any adjustments in cost estimates, funding allocations, and expenditure planning.

5. Report Scope & Structure

- **Report Length**: To be determined with the SSC during the preparatory phase. It was initially envisaged the report could be short and concise e.g. around 50 pages.
- **Chapter Structure**: Each chapter should be sufficiently robust to qualify as standalone scientific publications and contain key messages for the Summary for Policymakers.
- **Report Title**: To be determined by the Scientific Steering Committee (SSC) during the preparatory phase.

6. Guiding Principles for Report Writing

- **Interdisciplinary Integration**: The report will adopt a multidisciplinary approach, incorporating insights from oceanography, climate science, ecological sciences, social sciences, and political science, among others, to ensure a holistic understanding of the subject.
- **Policy Relevance**: Key findings must be presented in a manner that is accessible to policymakers while maintaining scientific integrity and methodological rigor.
- **Narrative-Driven Structure**: The report will prioritize a clear and engaging narrative format over a purely technical or textbook-style presentation.
- **Balancing Uncertainty and Confidence**: Conclusions should be communicated with clarity, acknowledging scientific uncertainties while avoiding oversimplification.
- **Enhanced Visualizations**: AMOC data, related analyses and key concepts will be represented through high-quality, comprehensible figures to improve interpretability and impact.
- **Positioning with IPCC**: The report will aim to integrate new research beyond what is covered in the IPCC AR6 on the topic of AMOC. Rather than duplicating existing IPCC assessments, it will provide more granular regional insights, scientific assessment as well as indicating limits to knowledge, a holistic understanding from physical and biological sciences to societal and policy implications and seek to contribute to the current IPCC assessment cycle, i.e. IPCC AR7.

Annex 1: Chapters established in the first Project Planning Meeting (*contents subject to revisions*)

Summary for Policymakers

Chap. 1 Overview
The AMOC - a crucial element in the global ocean: concepts ("*conveyer belt*"), definitions, understanding linkages, drivers, and uncertainties for projected ocean challenges and their potential impacts, implications for decision making and implementation

Chap. 2 State of the AMOC/has the AMOC weakened?
(what it is, why it's important, has it changed)

Chap. 3 Future AMOC weakening
(i.e. what's currently considered very likely)

Chap. 4 Are we approaching a tipping point?
(i.e. what's currently worrying people)

Elements to be considered in chapters 2-4 include:

(a) learning from paleoclimate and paleo-AMOC
(b) data from observation systems physical, ecological, biogeochemical and deep-sea
(c) model analysis at a range of scales and approaches to integrate methodologies
(d) integration of evidence
(e) atmospheric consequences

Chap. 5 Impacts and Risks
Heat waves, feedback including carbon uptake and carbon cycle, ocean oxygen content, sea-level changes and storm surges: thresholds for coastal impacts
Marine, terrestrial, soil, and freshwater ecosystems (habitat and biodiversity)
Human habitat

Chap. 6 The human dimension, responses and solutions
Socio-economic impacts and consequences for adaptation and mitigation policies and goals
Policy recommendations, precautionary implementations and governance

Annex 2: AMOC Concept Note

More rapid ocean warming and weakening of ocean currents combine with faster and higher sea level rise: a rationale and outline scope for the provision of an authoritative scientific update report to the information available from the 6th assessment cycle of the IPCC (AR6).

Concept note for integrating the AMOC into a wider context, supported by EU JPI Climate and JPI Oceans (version 20250127)

H.O. Pörtner, Alfred-Wegener-Institute, Bremerhaven, Germany

Abstract:

IPCC assessment reports, especially those from WGI and WGII already indicate a shifting baseline for ocean and cryosphere systems under climate change, with high uncertainty for projected physical changes and thus their impacts. Physical changes comprise ocean warming and weakening of the ocean conveyor including the AMOC (Atlantic Meridional Overturning Circulation), combined with progressive sea level rise. Impacts not only concern human infrastructure, societies and economies but also species and ecosystems in marine, coastal and neighboring terrestrial and freshwater realms. They also concern ocean productivity, affecting oxygen import into the deep sea and the long-term capacity of marine ecosystems to absorb and store anthropogenic CO_2. Through shifts in the global carbon cycle the capacity of the ocean to support long-term climate stabilization is at risk. Uncertainty for the magnitude of these impacts results high. For sea level rise uncertainty results high, partly because the residual ice mass on earth is still large (equivalent to 65 m sea level rise) in relation to the fraction mobilized by climate change over the next decades and centuries. According to AR6 reports and their scenarios ice melt and ocean expansion may lead to between below 1 and 2 m sea level rise by 2100. However, recent findings indicate faster melting and destabilization of polar ice shelf components, bringing projections at 1.5°C global warming closer to

about 7 m higher than today's sea level of the last interglacial. In general, uncertainties about physical phenomena such as these translate to equally large uncertainties for the magnitudes and timings of impacts such as cold extremes in European climate due to potential AMOC collapse, coastal flooding overwhelming defense capacity, and faster climate change and heat wave impacts due to ocean currents progressively failing to secure heat and gas exchange between ocean basins and depths. These concerns and uncertainties call for closer monitoring of interconnected ocean challenges, a comparative approach to processes in different ocean basins for understanding the principles at work and a regular update mechanism to inform policy. They also call for a more serious consideration of those challenges in precautionary strategies to be developed by policymakers, in order to reduce the associated risks to ecosystems and their services, and to human societies and economies.

Overview

More than 90 percent of the additional heat taken up by the planet is stored in the ocean. Progressive ocean warming caused by climate change is also paralleled by extended periods of stronger marine heatwaves (https://psl.noaa.gov/marine-heatwaves/) and their impacts on ocean biology. With ongoing emissions such trends will continue and over time break one record temperature after the other. In 2023 and early 2024 ocean temperatures have indeed broken all records for months (cf. Climate Reanalyzer_sst daily). However, these recent changes are significantly higher than expected from natural phenomena and progressing climate change. For example, since the beginning of 2023 the North Atlantic has been warmer than it has ever been at any given time of year. In August 2023, the North Atlantic was about 1.4°C warmer than the average from 1982–2011, much beyond the previous warming by about 0.8°C of the so far warmest year since 1981. The temperatures of the global ocean in February 2024 reached 21.1 degrees, reflecting further warming above the previous record of August 2023 (20.98°C). (https://climate.copernicus.eu/copernicus-february-2024-was-globally-warmest-record-global-sea-surface-temperatures-record-high). Only part of this warming is explained by the El Niño phenomenon. These unusually high temperatures especially in the North Atlantic therefore require deeper understanding (Kuhlbrodt et al, 2024). Explanations discussed involve reduced circulation between the cold deep layers of the ocean and the warm surface layer and/or reduced sulphate emissions from shipping, and/or changes in the strength and position of the atmospheric jet streams in both hemispheres. More recently, the largest contribution to exceptional warming was attributed to a new phenomenon of disappearing low-lying clouds and associated reduction of the earth's albedo under recent climate change (Gössling et al., 2025). Future consideration of this process in modelled climate projections may change the outcome of such modelling towards higher degrees of global warming than previously projected. Enhanced warming has exacerbating consequences for the intensity and impacts of ocean related extreme events such as storm surges or heatwaves. The intensified heat, combined with oxygen deficiency and ocean acidification will also have stronger impacts on species and ecosystems (Pörtner, 2021, IPCC, 2022).

In this context the potential weakening of the Atlantic Meridional Overturning Circulation (AMOC) is of great concern and likely to be relevant (IPCC, 2021), while this weakening has repeatedly and recently been questioned (Terhaar et al., 2025). For a comprehensive understanding, there is a need for several scientific communities to work together.

The AMOC is part of the Ocean Conveyor Belt and considered to be a tipping element in the climate system. Studies published after the 2019 and 2021 IPCC reports point to a larger risk of the AMOC approaching its tipping point than previously thought. Van Westen and Dijkstra (2023) simulated AMOC tipping events in a state-of-the-art global climate model by slowly varying the North Atlantic freshwater forcing which weakens deep water formation and the conveyor belt. They confirm that the AMOC will collapse when this forcing is sufficiently large. Ditlevsen and Ditlevsen (2023) see the present-day AMOC on route to tipping before the end of this century. Via geostrophic balance some coastal regions will experience more than 70 cm of dynamic sea-level rise. However, the timing until such tipping will be reached is still an issue of high uncertainty. When reversing the forcing, recovery occurs and is initiated at much smaller values of the forcing than the collapse. The AMOC recovery would be about a factor six faster than the AMOC collapse and this asymmetry is caused by the effect of the North Atlantic sea-ice distribution on the AMOC recovery. The results also demonstrate that AMOC tipping does not only occur in simplified climate models, but in a large hierarchy of climate models (van Westen et al., 2024). As Rahmstorf (2024) indicates, once AMOC tipping is close it will be too late to respond by mitigation measures. Similar concerns are raised for the weakening of the Antarctic deep water formation and its contribution to the Ocean Conveyor Belt, also weakening the AMOC further (Li et al., 2023). Until now and especially for the Arctic, most climate models have not incorporated the melting of Ice Sheets (which have their own tipping points) and neglect their growing meltwater input.

It may be useful to have a table in the report with an overview of the different approaches and models used, providing access to the why of their different outcomes and projections, and then a discursive analysis of whether a more or most convincing outcome and projection can be defined. Another question is how long such an ice-melt driven disturbance of the ocean conveyor belt would last and how long term ocean conditions and gradients may secure its return.

A slowing Ocean Conveyor Belt will affect the global climate. This concerns especially the European climate, which is projected to be significantly different after the AMOC collapse, with a drop in precipitation and temperatures especially in the winter months and in the Northern parts of Europe (when the AMOC strength strongly decreases projected minimum winter temperatures plummet by 15°C in London, 35°C in Bergen, and 8°C in Vienna). Ocean life will be impacted by the declining oxygen import into the deep sea.

More specifically, one set of comments received calls for the following (with a need of considering the global conveyor background):

“The importance of balancing methods and data

There is a need for an updated assessment product that provides a balanced description of the different methods and data applied to inform the AMOC's degree of stability and projections. The report should strive for a balanced assessment and synthesis of the different studies having examined different components of the AMOC by observations with corresponding different signals (Gulf Stream, Florida Current, abyssal limb), and modelling studies having applied various methods and statistical approaches to project the AMOC's future.

Biological and ecosystem impacts of AMOC changes

The updated state of knowledge report should assess and synthesize the potential biological and ecosystem impacts of changes in the AMOC. Specifically, we need synthesized knowledge of the potential impacts on marine ecosystems caused by a disruption or slowdown of the AMOC. Examples could be implications for changes in nutrient transport, phytoplankton responses, and impacts for fisheries and other marine resources, and linking these to societal impacts and risks would also be of interest and might increase relevance for policymakers.

Changes in AMOC and CO2 uptake

The report should address the associated implications of a slowdown of the AMOC on ocean carbon uptake for Earth's climate system and its global carbon cycle. The relationship between AMOC trends, alkalinity and ocean carbon uptake to reduce uncertainty in carbon cycle feedbacks.

The semantics of "collapse", "slowdown" and "weakening"

It would be highly valuable if the updated report could provide nuanced descriptions and careful considerations of the semantics of and meaning underlying an "AMOC collapse", "AMOC shutdown" and "AMOC weakening". The report should aim to clarify what an "AMOC collapse" implies, and underline that a collapse is not to be understood as a sudden complete stop in the wind-and Coriolis driven currents itself but relates more to the overturning mechanism.

The timescale perspective

There is a need for a better understanding of the timescale perspective of a slowdown or collapse of the AMOC. How abruptly could the AMOC collapse or weaken substantially? What thresholds for weakening would induce different large-scale impacts (sea level, SSTs, regional cooling, hurricane activity, ITCZ etc)?”

Linking to sea level rise

In addition to faster and stronger changes in ocean temperatures and currents, faster and higher sea level rise may arise from faster melting of ice sheets on Greenland and Antarctica. The SROCC (IPCC, 2019) estimated that if global warming is limited to 1.5°C, future sea level rise may be stabilized below 1 m for a long period of time. If warming increases further, it could exceed 1 m by 2100 and ultimately reach several meters (IPCC, 2019, 2021). This perspective may still be too conservative. At the end of October 2023, British polar researchers published a study according to which the glaciers of the West Antarctic Ice Sheet will slide into the sea inexorably and faster than indicated by previous studies, over the next 80 years - even if the world manages to limit global warming to 1.5 °C (Naughten et al., 2023). In addition, the melting of Greenland's ice masses might be accelerated. Increasing glacier runoff into the warming ocean may thus no longer be preventable at 1.5°C warming, with a projected sea level rise of up to 3 m by 2300 projected by IPCC (2021). Taking into account the uncertainties and the most recent findings, an even higher sea level rise by up to 7 m appears possible - a rise similar to that experienced by the Earth in the last interglacial 125,000 years ago and at a comparable global mean temperature (Rohling et al., 2019). Complementary evidence comes from population genetic data collected in Antarctic octopods. These data indicate that sea level rise back then was also accompanied by the collapse of the West Antarctic Ice Sheet, which enabled gene exchange between otherwise separated populations (Lau et al., 2023). The current protection of low-lying coasts is no longer up to the challenges associated with such sea levels (Oppenheimer et al., 2019) and depending on future climate sea level will continue to rise for centuries, even beyond 7m. As sea levels rise, storm surges will become even higher and more intense (IPCC, 2019), and may penetrate far inland and into freshwater systems. With respect to AMOC, there is a need for a greater understanding of the role that the amplitude and duration of meltwater formation play in determining the degree of reduction in the AMOC. The relative roles of West Antarctic, Greenland and other ice sheets in the weakening of the ocean conveyor and AMOC require consideration.

All of these examples reflect that climate change triggers processes that can no longer be stopped or reversed in the short term, indicating loss of control by humanity. Low-lying coasts and small islands will continue to be at particular risk of flooding in the future. It is presently unclear how the AMOC and regional climate will develop under such conditions.

Ditlevsen, P., and S. Ditlevsen (2023) Warning of a forthcoming collapse of the Atlantic meridional overturning circulation. Nature 14: 4254

Goessling, H.F., T. Rackow, T. Jung (2025) Recent global temperature surge intensified by record-low planetary albedo. Science 387, 68–73.

IPCC (2019) Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, *https://doi.org/10.1017/9781009157964.001*.

IPCC (2021) Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2391 pp. doi:10.1017/9781009157896.

IPCC (2022) Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.

Kuhlbrodt T., R. Swaminathan, P. Ceppi, and T. Wilder (2024) A glimpse into the future. The 2023 ocean temperature and sea ice extremes in the context of longer-term climate change. BAMS Essay https://doi.org/10.1175/BAMS-D-23-0209.1

Lau, S.C.Y., N.G. Wilson, N.R. Golledge et al. (2023) Genomic evidence for West Antarctic Ice Sheet collapse during the Last Interglacial. Science 382, 1384–1389

Li, Q., M.H. England, A.M. Hogg, S.R. Rintoul, and A.K. Morrison (2023) Abyssal ocean overturning slowdown and warming driven by Antarctic melt-water. Nature 615(7954): 841–847.

Naughten, K. A., P. R. Holland, and J. De Rydt (2023) Unavoidable future increase in West Antarctic ice-shelf melting over the twenty-first century. Nature Climate Change 13, 1222–1228

Oppenheimer, M., B.C. Glavovic , J. Hinkel, R. van de Wal, A.K. Magnan, A. Abd-Elgawad, R. Cai, M. Cifuentes-Jara, R.M., DeConto, T. Ghosh, J. Hay, F. Isla, B. Marzeion, B. Meyssignac, and Z. Sebesvari, 2019: Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegria, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 321–445. https://doi.org/10.1017/9781009157964.006.Rohling et al., 2019

Pörtner, H.O. (2021) Climate impacts on organisms, ecosystems and human societies: integrating OCLTT into a wider context. Journal of Experimental Biology, 224, doi:10.1242/jeb.238360

Terhaar, J., L. Vogt, N.P. Foukal (2025) Atlantic overturning inferred from air-sea heat fluxes indicates no decline since the 1960s. Nat. Comm. https://doi.org/10.1038/s41467-024-55297-5

van Westen, R. M., and Dijkstra, H.A. (2023). Asymmetry of AMOC hysteresis in a state-of-the-art global climate model. Geophysical Research Letters, 50, e2023GL106088. https://doi.org/10.1029/2023GL106088

van Westen, R. M., M. Kliphuis, and H. A. Dijkstra (2024) Physics-based early warning signal shows that AMOC is on tipping course. Sci. Adv. 10, eadk1189.

Rahmstorf, S. (2024) Is the Atlantic overturning circulation approaching a tipping point? Oceanography, https://doi.org/10.5670/oceanog.2024.501.

Process and implementation

Beyond the current analysis the findings reported above support the initiation of an Ocean update mechanism for the timely assessment of critical challenges. Such update should include key authors of the SROCC (IPCC, 2019) and authors who provided updated knowledge beyond.

Tasks

IPCC assessment reports, especially those from WGI and WGII indicate a shifting baseline for ocean and cryosphere systems under climate change. Projected changes include sea level rise, shifts in ocean currents such as AMOC and their potential collapse, marine heat waves, ocean oxygen loss and acidification. In general, uncertainties concerning the magnitudes and timings of projected physical changes translate to equally large or higher uncertainties for their impacts on ecosystems and human societies. These concerns call for closer monitoring of ocean challenges and a regular update mechanism to inform policy and to develop solution options, at global and regional scales. They also call for a more serious consideration of those challenges in precautionary strategies to be developed by policymakers, in order to reduce the associated risks to ecosystems and their services, and to human societies and economies.

The report is designed to integrate contributions by multinational, predominantly European authors who are experts with respect to key ocean processes. It includes a comprehensive consideration of uncertainties concerning ongoing and projected ocean changes and impacts and concludes with a set of expert judgements that identify projected changes, as well as associated risk levels and guard rails for global changes that should not be exceeded, thereby motivating ambitious climate action. As a perspective the project may lead development and coordination of an update mechanism for relevant knowledge concerning the ocean under climate change. It may conclude with a start-up model for such mechanism. As uncertainties will prevail beyond this first version, development of an update mechanism is intended that aims to progressively reduce those uncertainties during further assessment cycles. This timely assessment is supposed to contribute to the next IPCC main report within the 7th assessment cycle. It should also contribute to shaping European and national climate policies as well as G7 and G20 discussions.

Project Coordination:

The key roles of Project Coordination include the conceptual development, coordination and overseeing of the assessment up until production. Coordination involves working with a set of 7 to 10 colleagues in a Scientific Steering Committee as well as up to 50 colleagues (Authors) during preparation of the assessment. It also involves coordination with the leadership of JPI Climate and JPI Ocean. Activities also involve supporting the development of outreach material, availability for media activities und using opportunities for public outreach.

Coordinator and Scientific Steering Committee lead the scoping process and development of the outline, and select chapter Lead Authors and Coordinating Lead Authors, as well as Reviewers. They organize the multi-step drafting and review process for each chapter and the overall assessment, and they lead the drafting of an Executive Summary of the assessment. Coordinator and SSC are the contact points of all chapter teams and authors.

Report structure and time schedule:

The report is structured in chapters, each focusing on a crucial ocean topic and each of them designed to be published as a review in the scientific literature as well as being compiled in a volume representing the Ocean Update Assessment Report. The format and mode of publishing of the overall report is to be decided. For its preparation we envision an about 19 to 21 months' timeframe with some flexibility, for example depending on the length of the start-up period. The details of the process including scoping of the report will be elaborated and discussed during the start-up meeting of the SSC and JPI office, envisioned to take place in the end of January 2025. The overall effort may equal that for 1/3rd of an IPCC

Special Report, supported by about 1/5th of a typical TSU which covers the relevant functions for the time of its preparation.

In the long run the annual Lancet planetary health report (https://www.thelancet.com/action/showPdf?pii=S2542-5196%2824%2900042-1) or the Global carbon budget report (https://globalcarbonbudget.org/, https://essd.copernicus.org/preprints/essd-2024-519/) may be role models on how to continue these efforts and may guide how to set up the process and structure during this first run, to be agreed at the scoping meeting and with the funders.