

WORKING GROUP ON OCEANIC HYDROGRAPHY (WGOH; outputs from 2020 meeting)

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i Executive summary

The Working Group on Oceanic Hydrography (WGOH) closely monitors the ocean conditions in the ICES area by updating and reviewing results from standard hydrographic sections and stations.

The primary work product of the WG is its annual ICES Report on Ocean Climate (IROC), which provides expert analysis of time-series observations of ocean hydrography collected at long-standing stations throughout the North Atlantic. The report is a unique compendium of long-term hydrographic observations and analyses contributed by an international body of experts that can be found through no other source. The Ocean and Atmosphere Highlights from the IROC represent our summary of the most noteworthy oceanographic and atmospheric conditions observed in the latest year and are used in the Advisory process.

Outputs from this working group also feed into assessments for the Northwest Atlantic Fisheries Organization (NAFO) and regional and national assessments of climate variability. It is recognized that the utility of the IROC rests on its timely delivery and steps have been taken in the past 3 years to streamline the production of the report and increase accessibility.

The WGOH is continually evaluating how it might better identify and respond to stakeholder needs and has focused on distinguishing itself in the expanding world of global ocean observing systems.

ii Expert group information

Expert group name	Working Group on Oceanic Hydrography (WGOH)
Expert group cycle	Multiannual
Year cycle started	2018
Reporting year in cycle	3/3
Chair(s)	Paula Fratantoni, USA Cesar Gonzalez-Pola, Spain
Meeting venue(s) and dates	20–22 March 2018, Norwich, UK (14 participants) 19–21 March 2019, Bergen, Norway (20 participants) 26 March 2020, online meeting (21 participants)

1 Summary of WGOH activities 2018–2020

- Annual WG meetings were held in-person in 2018 and 2019 and virtually in 2020. Meetings included regional updates from participants, synthesis discussions, WGOH business, and a half day science symposium featuring presentations from local scientists.
- Delivery of IROC 2017 (ICES CRR-345¹)
- Delivery of IROC 2018 (ICES CRR-349²)
- Delivery of IROC 2019 (in press)
- Expanded access and awareness of IROC:
 - Early release of the annual highlights from the current analysis year posted on the IROC online portal, beginning in 2018
 - Archive of historical IROC reports established in online portal, 2018
 - Added database containing searchable archive of hydrographic data from IROC standard sections
- Multiple improvements to IROC production, data delivery and quality
 - Expansion of IROC editorial team, 2018
 - Implementation of stricter publication timelines
 - Transitioned production to LATEX editing tools and templates
 - Revised chapter organization
 - Standardized format of text and graphics
 - Addition of author attributes to individual sections
 - Established inventory of submitted time-series
- Engaged in purposeful outreach to GOOS community:
 - WGOH-authored manuscript and presentation at OceanObs19, discussing the unique value of the IROC and WGOH in the broader Ocean Observing Community. *The ICES Working Group on Oceanic Hydrography: A Bridge From In-situ Sampling to the Remote Autonomous Observation Era, FMS, doi:10.3389/fmars.2019.00103.*
 - Dialog initiated with JCOMMPS
- Engaged in purposeful outreach across the ICES expert community:
 - Representation at WGCHAIRS annual meetings in 2018 and 2019
 - Hosted Silvana Birchenough (EPDSG chair) at 2018 annual WGOH meeting to explore opportunities for engagement with other expert working groups
- Co-hosted special oceanography-focused session with ICES WGOOFE at 2019 ICES Annual Science Conference - “*Oceanography and ecosystems in the North Atlantic: Science and Operational Services*”

¹ <http://doi.org/10.17895/ices.pub.4625>

² <https://doi.org/10.17895/ices.pub.5461>

- *ICES/NAFO 4th Joint Symposium on Decadal Variability of the North Atlantic and its Marine Ecosystems: 2010-2019* is scheduled to take place in Bergen, Norway from April 26-28, 2022, hosted by IMR.
- Contributed content to ICES News article entitled *ICES science advice continues: Around the world, organizations are moving to a virtual working environment. And so are we.* (2 April 2020). <http://www.ices.dk/news-andevents/news-archive/news/Pages/Move-Online.aspx>
- Contributed content to ICES Annual Science Report (2018) https://issuu.com/icesdk/docs/ices_ar_2018_eng (pg 18)
- IROC highlighted in Annual Science Report (2017). https://issuu.com/icesdk/docs/ices_annual_report_2017_english_for (pg 23)

2 Report on Terms of Reference (ToRs)

ToR a) Examine the hydrographic variability of the North Atlantic and its subpolar seas. Identify events, trends and drivers in the region.

Annual meetings were convened in Norwich, UK (2018) and Bergen, Norway (2019). In each year, WGOH participants presented detailed regional reports on oceanographic and atmospheric conditions based on observations made in the preceding year and these updates were incorporated into summary highlights posted online on the IROC data portal³ immediately following the meetings. A half-day mini science symposium was hosted in both years, with invited talks presented by WGOH members and scientists from the host institute. While a majority of time is devoted to area reports and synthesis of information, the balance of time was spent condensing the regional observations into highlights for the North Atlantic, discussing IROC production, workflow and initiatives to improve the report, reviewing progress toward the planning of the decadal symposium and conducting other WG business.

Like most of the world, the working group was challenged by the onset of the COVID-19 global pandemic in 2020. The pandemic forced the last-minute cancellation of our annual in-person meeting in 2020, replacing the typical 3-day meeting with a significantly truncated 3-hour video conference. Due to the shortened format, we focused solely on regional reporting with the goal of synthesizing these regional observations into summary highlights for the North Atlantic. As in previous years, summary highlights were posted online immediately following the meeting in addition to being published later in the final IROC.

ToR b) Standard Sections and Stations summarized into the production of the IROC report and submitted to IROC data portal

The IROC was published in 2018 and 2019 and, despite delays due to the global pandemic, the 2020 publication is currently in-press. Significant improvements have been made to the IROC production during the past 3 years, with the goal of improving delivery and expanding access/awareness of the IROC. In 2018, the editorial team was expanded and we adopted the use of LATEX document typesetting tools and templates to compile and format the IROC. The tool is designed specifically for preparing technical and scientific documents and allows for maximum flexibility in the organization and content of the report. New stricter publication timelines were established for the delivery of data and descriptive text and these have helped us reach our goal of releasing the report prior to the ICES Annual Science Conference each summer. We also adopted the practice of posting summary highlights immediately following the annual meeting each spring. Other improvements include standardization of maps (still in progress), coherence of colours used in figures, reorganization of content within existing chapters and inclusion of author attributions within chapters. In addition, the WG and editorial team reviewed and revised the definition of ecosystem areas used in the report, based on input from end-user groups. Improvements have also been made to the IROC web portal, with the addition of an archive of historical IROC reports, interactive plots, improved meta-data, and an early teaser to annual highlights which are posted following the annual WG meeting.

³ <https://ocean.ices.dk/core/iroc>

While significant effort has been expended to standardize the presentation of data in the IROC, regional contributors employ a variety of different methods to process data and derive anomaly time-series presented in the report. The methods can differ based on the temporal and spatial resolution of data collection as well as the physics of the region and the WGOH has historically opted to leave these decisions to the regional experts. Plans are currently underway to develop a technical document as a supplement to the IROC which will describe the methodologies used by contributors for the derivation of regional time-series. A long term goal of the IROC editorial team is to automate the process of computing property anomaly time-series for all submitted data.

ToR (c) Report on developments within international climate monitoring, multidecadal reanalyses & prediction programmes relevant to ICES

WGOH members recognize the benefit of establishing closer relationships with the global ocean observing community and have aimed to clarify its niche in the expanding world of global ocean observing initiatives (e.g. Copernicus). Some key points that arose from discussions include:

- Time-series reported in the IROC are some of the longest in the world and become more valuable to climate science the longer they are sampled
- There will always be a need for local environmental monitoring for ecosystem management purposes; A global ocean observing system cannot fulfil that need, but these high resolution region-specific surveys can enhance a global observing system if data are made available.
- The strength of the WGOH-IROC is the science based analysis done at regional level by local specialists.

WGOH members participated in the OceanObs19 meeting in September 2019 (Hawaii), publishing a white paper discussing the unique value of the IROC and WGOH in the broader Ocean Observing Community (*The ICES Working Group on Oceanic Hydrography: A Bridge From In-situ Sampling to the Remote Autonomous Observation Era*, FMS, doi:10.3389/fmars.2019.00103). In addition, contact was established with JCOMMPS through member Penny Holliday, with the aim of establishing connections between the hydrographic monitoring programmes involved with WGOH and the GOOS community. WGOH members agree that there are strong benefits to establishing closer involvement with the GOOS community that would be of mutual benefit.

ToRs d, e, f) Support for ICES processes on hydrographic data and ocean scale marine climate variability. Including Data Centre, other EGs, and advice programmes where and when requested

WGOH was represented at annual WGCHAIRS meetings in 2018 and 2019, receiving feedback and ICES direction for the WG and strengthening ties with other ICES Working Groups (notably, WGOOFE and WGS2D). Notably, a side meeting was convened during the 2018 WGCHAIRS meeting under the topic “Integrating ocean data” that directly addressed the issue of low feedback between different EG and in particular how the work carried out by the WGOH could benefit other ICES EGs. These discussions were impetus for some of the changes to the IROC production and website discussed above and motivated further interaction with Silvana Birchenough, Chair of the Ecosystems, Processes and Dynamics Steering Group which oversees WGOH.

WGOH teamed up with WGOOFE to organize an oceanography-focused theme session for the Annual Science Conference in 2019 – Session R: “*Oceanography and ecosystems in the North Atlantic:*

Science and Operational Services". The intention was to strengthen the role of physical oceanography within ICES.

ToR g) Contribute to objectives, activities of parent science steering group EPDSG

WGOH invited EPDSG chair, Silvana Birchenough, to join the annual meeting in 2018 to discuss how we might better support the work of other expert working groups within ICES. WGOH members requested feedback from other ICES expert groups on the IROC, including who is aware of and using the product, which elements are useful, and how the product might be improved. Members expressed a desire to receive feedback on the usefulness of information and/or expert advice provided in response to requests from within ICES in order to improve WGOH service to ICES.

ToR h) Prepare a new decadal symposium in 2021

The ICES/NAFO *4th Joint Symposium on Decadal Variability of the North Atlantic and its Marine Ecosystems: 2010-2019*⁴ is scheduled to take place in Bergen, Norway, 26–28 April 2022, hosted by IMR. The conference will bring researchers together to review the variability of North Atlantic environmental conditions and marine ecosystems over the past decade. Organizing committees include representatives from WGOH, ICES Secretariat, NAFO and the community at large.

The symposium is organized around the following theme sessions:

- Ocean climate and physical environment in the North Atlantic and their linkages to changing marine ecosystem
- Decadal changes and trends in the North Atlantic/sub-Arctic plankton and their ecosystems
- Trends and drivers of decadal variability in fish and invertebrates
- Expanding horizons: assessing decadal changes and incorporating Social=Ecological Systems in the North Atlantic

Theme session convenors and keynote speakers have been confirmed and abstract submissions are currently open.

ToR i) Ongoing self-evaluation of the EGs work

The work of WGOH contributes substantively to the science priorities proposed by SCICOM. WGOH assesses the physical state of regional seas; describes changes in the predominant climatic and hydrological processes important for regional ecosystems; and contributes vital information to those seeking to understand the impacts of climate variability and change on marine ecosystems.

⁴ <https://decadal2022.imr.no/en/projects/ices-decadal-2021/ices-decadal-2022>

Conclusions

WGOH maintains working relationships with all the groups of EPDSG and has made concerted efforts in recent years to strengthen these connections through engagement in the annual WGCHAIRS meeting and in coordination with EPDSG chair. The activities of WGOH and WGOOFE (Working Group on Operational oceanographic products for fisheries and environment) are particularly complimentary. Together, WGOH and WGOOFE organized a special session at the ICES Annual Science Conference in 2019 with the intention of strengthening the role of physical oceanography within ICES. We collaborate with the ICES editorial team for the annual production of the IROC.

The work of WGOH contributes substantively to the science priorities proposed by SCICOM. WGOH assesses the physical state of regional seas; describes changes in the predominant climatic and hydrological processes important for regional ecosystems; and contributes vital information to those seeking to understand the impacts of climate variability and change on marine ecosystems.

The primary work product of the WGOH is its annual ICES Report on Ocean Climate (IROC), which provides expert analysis of time-series observations of ocean hydrography collected at long-standing stations throughout the North Atlantic. The Ocean and Atmosphere Highlights from the IROC represent our summary of oceanographic conditions in the latest year and should be used in the Advisory process together with the national reports. Outputs from this working group also feed into assessments for NAFO and regional and national assessments of climate variability.

It is recognized that the utility of the IROC rests on its timely publication. Steps have been taken to identify the users of the IROC and improve it based on feedback from a growing community of users. The WGOH is continually evaluating how it might better identify and respond to stakeholder needs and will continue to focus energy on exploring ways it can contribute to global ocean observing systems.

The information WGOH prepares is incredibly valuable to ICES and the wider community and we therefore seek to continue with this work. We aim to continue to develop the IROC website and to publish the annual ICES Report on Ocean Climate.

Annex 1: List of participants

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Annex 2: WGOH Resolution

The **Working Group on Oceanic Hydrography (WGOH)**, chaired by Paula Fratantoni, USA, and César González-Pola, Spain, will meet work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2018	20–22 March	Norwich, UK	Interim report by 1 May	
Year 2019	19–21 March	Bergern, Norway		
Year 2020	24–26 March	by corresp/webex	Final report by 15 May	physical meeting cancelled - remote work

ToR descriptors

TO R	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Examine the hydrographic variability of the North Atlantic and its subpolar seas. Identify events, trends and drivers in the region.	The contributors to the WGOH bring together a wide range of observations taken by various national programmes. Here we annually monitor developments in the environmental conditions that they sample.	1.1; 1.2; 1.9	3 years	Annual interim reports will include details of national programmes and most up to date findings.
b	Standard Sections and Stations summarized into the production of the IROC report and submitted to IROC data portal.	The Working Group recognises the need for disseminating climate information in a timely and appropriate manner. This agenda item will allow WGOH members to prepare the document during the meeting. We will review proposed new developments in IROC content.	1.1; 1.2; 1.9	3years	Annual. IROC report for CRR submission. Text and figures to ICES by June 30 th each year. Data to portal by 1 st September each year.
c	Report on developments within international climate monitoring, multi decadal reanalyses & prediction programmes relevant to ICES.	Benefit both to ICES and the international monitoring programmes to enhance internal information exchange. Additionally developments in the capacity to make climate forecasts of hydrographic parameters are being made by the international community, that may have the potential to aid future ICES work.	1.2; 1.9; 4.2	2 years	Identify the products of potential use to ICES. Report as part of 2 nd year progress.

d, e, f	Support for ICES processes on hydrographic data and ocean scale marine climate variability. Including Data Centre, other EGs, and advice programmes where and when requested	As required support for ICES Data centre on hydrographic data. Oceanic hydrography remains a fundamental component of assessing the state of marine ecosystems. WGOH documents interannual to multidecadal variability and trends in the oceanic hydrography for most ecoregions and will review the available 'Ecosystem Overviews' as they become available for each regional sea.	1.2; 1.9; 6.3	ongoing	Response to requests and reviewing input from Datacentre at WG meetings. Submit review to the annual interations of Ecosystem Overviews.
g	Contribute to objectives, activities of parent science steering group SSGEDP	A flexible ToR to allow WGOH to contribute to EPDSG requirements as they develop over the term of the current science plan.	1.1; 1.2	3 years	As and when defined by our steering group EDPSG
h	Prepare a new decadal symposium in 2021	The WGOH has been responsible for previous decadal symposia (e.g. the 2011 symposia in Santander). Such a large event requires thorough preparation and starting the preparation early acts to assure a successful event.	NA	3 years	Progress to be reported annually
i	Ongoing self evaluation of the EGs work.	WGOH is a long established EG within ICES and has ToRs that are closer to an annual workplan. The main product is the annual IROC which has been produced for 15 years, and must be continually developed - through ongoing self evaluation and review	NA	3 years	WGOH Final Report under multiannual ToRs 2020

Summary of the Work Plan

Year 1	<p>a) IROC 2018 production & recommendations for modifications to IROC format and content, including discussion on potential for reanalyses, forecast products to be included and addition of ICES Regional Ecosystem area focussed component, also potential move to purely web based product.</p> <p>b) WG Activities progress report including highlights of North Atlantic hydrographic conditions and any significant events synthesized from the national reports and IROC findings.</p> <p>c) Initial identification of climate monitoring, reanalysis and forecasting programmes.</p> <p>d) develop plans for Decadal Symposium</p>
Year 2	<p>a) IROC 2019 production including first implementation of recommended changes.</p> <p>b) WG Activities progress report including highlights of North Atlantic hydrographic conditions and any significant events synthesized from the national reports and IROC findings.</p> <p>c) Map marine climate reanalysis and forecast parameters to ICES interests.</p> <p>e) Prepare for for Decadal Symposium</p>

Year 3	<p>a) IROC 2020 production and review of content and requirement to continue IROC process.</p> <p>b) WG Final report</p> <p>c) Participation and delivery of Decadal Symposium</p>
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Supporting information

Priority	Oceanic hydrography remains a fundamental component of assessing the state of marine ecosystems. WGOH documents interannual to multidecadal variability and trends in the oceanic hydrography setting the vital context for prevailing conditions & ecosystem change. The IROC has been cited more than 110 times (http://tinyurl.com/ICES-IROC) demonstrating that it is an important resource for the marine science community within and beyond ICES.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by about 15–20 members and guests.
Secretariat facilities	Standard EG support.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There are no obvious direct linkages.
Linkages to other committees or groups	There is a very close working relationship with all the groups of EPDSG. The most direct link is to WGOOFE where the activities of the 2 groups are complementary. WGOH focusses on the larger Atlantic space and long term climate scales. Link to PUBCOM for the annual production of the IROC.
Linkages to other organizations	IOC, JCOMM, CLIVAR