

### **IICWG Mission, Vision, and Strategic Goals**

28 September 2018

### Mission

The International Ice Charting Working Group (IICWG), formed in 1999, promotes cooperation among the world's ice services and acts in an advisory capacity on matters concerning sea-ice and icebergs.

## Vision

The IICWG supports the provision of robust products and services for maritime communities to operate safely and efficiently in and around ice-encumbered waters. We achieve this by harnessing the knowledge, skill and experience of the national ice services and international experts and incorporating advancements in data collection, science, and technology.

### **Strategic Goals**

- 1. Improve maritime safety through collaboration across the international ice services, maritime users and associated groups.
- 2. Develop our human and technical resources to leverage advances in data acquisition and management, modelling, remote sensing, machine-learning, and artificial intelligence to create efficiencies in data services, analysis and forecasting.
- 3. Facilitate the transition of applied science into ice services, while ensuring operational needs are considered.
- 4. Advise and influence relevant international organizations.
- 5. Advance and support contributions to ice information and climate services.

## Implementation

During the annual meeting, the IICWG will discuss priorities and coordinate tasks to achieve these goals, which will be evaluated on a regular basis.



## **APPENDIX B**

## Locations of IICWG Meetings

IICWG-I	October 1999	Copenhagen, Denmark	Danish Meteorological Institute	Erik Boedtker (Denmark); David Grimes (Canada); Helen Wood (USA)
IICWG-II	October 2000	Reykjavik, Iceland	Iceland Meteorological Office	Trausti Jónsson (Iceland); David Grimes (Canada); Zdenka Willis (USA)
IICWG-III	November 2001	Tromsö, Norway	Met.no	Helge Tangen (Norway); David Grimes (Canada); Zdenka Willis (USA)
IICWG-IV	April 2003	St. Petersburg, Russia	Arctic and Antarctic Research Institute	Ivan Frolov (Russia); David Grimes (Canada)
IICWG-V	April 2004	Hamburg, Germany	Federal Maritime and Hydrographic Agency	Klaus Strübing (BSH); David Grimes (Canada)
IICWG-VI	October 2005	Ottawa, Canada	Canadian Ice Service	David Grimes (Canada); Richard Barazotto (USA)
IICWG- VII	September 2006	Helsinki, Finland	Finnish Ice Service	Ari Seina (Finland); Doug Bancroft (Canada); Gary Petti (USA)
IICWG- VIII	October 2007	Frascati, Italy	European Space Agency	Gary Petti (USA); Jens Sunde (Norway)
				New ToR adopted re: co-chair terms
IICWG-IX	October 2008	Luleå, Sweden	Swedish Ice Service	Kathy Kelly (USA); Jens Sunde (Norway)
IICWG-X	October 2009	Geneva, Switzerland	World Meteorological Organization	Kathy Kelly (USA); Jens Sunde (Norway)



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IICWG-XI	October 2010	Washington, USA	National Ice Center	Kathy Kelly (USA); Jens Sunde (Norway)
IICWG- XII	October 2011	Cambridge, U.K.	British Antarctic Survey	Diane Campbell (Canada); Juhani Damski (Finland)
IICWG- XIII	October 2012	Tromsø, Norway	Norwegian Meteorological Institute	Diane Campbell (Canada); Juhani Damski (Finland)
IICWG- XIV	October 2013	Reykjavik, Iceland	University of Iceland / Icelandic Meteorological Office	Diane Campbell (Canada); Juhani Damski (Finland)
IICWG- XV	October 2014	Punta Arenas, Chile	Chilean Navy Meteorological Service	Vanessa Griffin (USA); Peter Rasch (Denmark)
IICWG- XVI	October 2015	Rostock/Neustrelitz, Germany	Federal Maritime and Hydrographic Agency	Vanessa Griffin (USA); Peter Rasch (Denmark)
IICWG- XVII	October 2016	Ottawa, Canada	Canadian Ice Service	Vanessa Griffin (USA); Marianne Thyrring (DMI)
IICWG- XVIII	September 2017	Hobart, Australia	Antarctic Climate & Ecosystem Collaborative Research Centre	Marianne Thyrring (DMI); Diane Campbell (Canada)
IICWG- XIX	2018	Helsinki, Finland	Finnish Meteorological Institute	Marianne Thyrring (DMI); Tom Cuff (USA)
IICWG- XX	2019	Copenhagen, Denmark	Danish Meteorological Institute	Marianne Thyrring (DMI); Tom Cuff (USA)
IICWG- XXI	2020	Videoconference		Marianne Thyrring (DMI); Russel White (Canada)
IICWG- XXII	2021	Videoconference		Marianne Thyrring (DMI); Russel White (Canada)
IICWG- XXIII	2022	Buenos Aires, Argentina	Argentine Naval Hydrographic Service	Marianne Thyrring (DMI); Russel White (Canada)



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IICWG- XXIV	2023	Cambridge, U.K.	British Antarctic Survey	Russel White (Canada); Marianne Thyrring (DMI)
IICWG- XXV	2024	Monterrey, U.S.A	U.S. National Ice Center	Russel White (Canada); Marianne Thyrring (DMI)

## **Appendix C**



#### CHARTER OF THE INTERNATIONAL ICE CHARTING WORKING GROUP

Recognizing the ongoing interest of the nations influenced by ice covered waters in the use and protection of those waters; and further recognizing the value and economics of cooperative activities in operational ice services supporting maritime navigation; the ice charting services of the world formed the International Ice Charting Working Group (IICWG).

The IICWG provides a forum for coordination of ice matters, including icebergs, and offers nonbinding recommendations to senior management as appropriate.

After reviewing the Terms of Reference for the IICWG, Attachment One, the signers of this Charter intend to participate in the activities of the IICWG to the best of their abilities. It is understood that membership in the IICWG is not binding and does not imply any legal or financial obligation on their part.

Any signatory may end its relationship with the IICWG at anytime by giving 60 day written notice to the IICWG Co-Chairs.

Finland

Person/Title: Ari Seina, Head of Finnish Ice Service For: Finnish Institute of Marine Research

Sweden

Person/Title: Anette Jönsson, Head of Swedish Ice Service For: Swedish Meteorological and Hydrological Institute

Norway

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Person/Title: Helge Tangen, Regional Director For: Norwegian Meteorological Institute

Denmark

Erih Buch

Person/Title: Erik Buch, Director, Centre for Ocean and Ice For: Danish Meteorological Institute

Date: 23. 10. 2007

Date: 23/10/2007

Date: 23 10.2007

Date: 23.10.2007

United States

Date: 10

Person/Title: Commander/Scott Rogerson, Co-Director North American Ice Service, Commander International Ice Patrol, United States Coast Guard For: North American Ice Service (International Ice Patrol)

United States

Canada

Russia

Date: 23 00+07

Person/Title: Commander Raymond Chartier Jr., Co-Director North American Ice Service, Director National Ice Center, United States of America For: North American Ice Service (National Ice Center)

23 00507

Person/Title: Douglas Bancroft, Co-Director North American Ice Service, Director Marine and Ice-Services, Environment Canada For: North American Ice Service (Canadian Ice Service)

Date: 23.10.07

Date:

Person/Title: Ivan Frolov, Director For: Russian Federation Arctic and Antarctic Research Institute of Roshydromet

Hallart

Germany

Person/Title: Jürgen Holfor, Head, German Ice Service For: Federal Maritime and Hydrographic Agency of Germany

Iceland

Date: 3/ 10.200

Date: 23. 11. 2007

Magnús Jónsson, Director General Person/Title Icelandic Meteorological Office For:

BAS

Person/Title: Professor Nicholas Owens, Director For: British Antarctic Survey

Date: 18 october 2011.

Bal

10/03/2012 Date:

Poland

Person/Title: Tomasz Balcerzak, Director For: Institute of Meteorology and Water Management National Research Institute, Maritime Branch in Gdynia

Argentina

Date: 28/10/2015 Person/Title: Rear Admiral (R) Andrés Roque Di Vincenzo, Director For: Argentine Naval Hydrographic Service

11/z016-Date: 17

Chile

Person/Title: Rear Admiral LT Mario Montejo Orellana, Director For: Directorate of Maritine Safety, Security and Operations

Australia

Date: 15/9/2023 Person/Title. Dr Andrew Johnson CEO and Director of Meteorology

Person/Title: For:

For: Bureau of Meteorology

Date:

Person/Title: For:

Person/Title: For:

Date:

Date:

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# **IICWG** TASK TEAMS

The following listing of task teams is intended as illustration of the breadth of work undertaken by the IICWG. For complete descriptions of the tasks, please refer to the IICWG secretariat.

Task Team	Name	Objective	Status	Lead
1	ROSE-L	C-, L-Band SAR Comparison	Completed 2022	W. Dierking
2	Iceberg Model Modernization	Re-code iceberg model in modern maintainable code	Completed 2020	M. Hicks
3	e-Navigation	Facilitate presentation of ice chart information in ECDIS	Completed 2020	J. Holfort
4	Uncertainty	Quantify the uncertainty in ice charts	Completed 2020	S. Helfrich
5	Ice Analyst / Forecaster Competencies	Develop set of competencies that could be adopted by all ice services	Completed 2020	C. Tita / S. Weese
6	Regional Climate Centre Contributions	Contribute to the establishment of Arctic Regional Climate Centre	Completed 2020	S. Weese / J. Lieser
7	Arctic Council Interactions	Follow the development of the Finnish Presidency of the Arctic Council	Cancelled 2019	M. Thyrring
8	Marine Training Centre Engagement	Engage with training centres offering mariner training for ice navigation	Completed 2020	K. Qvistgaard
9	Value Chain Management	Describe a best practice for managing the full value chain for an ice service	Completed 2020	S. Olufson / N. Hughes / C. Panowicz
10	Sea Ice Modelling and Data Assimilation Group Interaction	Reconnect the IICWG with this sub-group to help bring scientific developments in to operation more easily	Completed 2023	L-A. Breivik / D. Flett
11	Ice Analyst Workshop	Organize an ice analyst workshop	Completed 2023	P. Eriksson
12	Uncertainty-2	Conduct an uncertainty evaluation of sea ice concentration and edge	Completed 2023	N. Hughes
13	Iceberg Model Case Studies	Identify situations where the iceberg model does not work in both hemispheres.	Completed 2022	M. Hicks
14	SOLOKI	Develop a product depicting the Southern Ocean Limit of Known Ice	Active – 20% complete	A. Scardilli / P. Wagner
15	Iceberg Risk- Based Product	Develop an operational iceberg hazard product that can be standardized across ice services	Complete 2022	M. Hicks



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16	Sea Ice Risk- Based Product	Evaluate experimental ice	Complete 2022	S. Weese / K. Berberich
2021-1	Operational Multi-SAR Intercomparison	Investigate the advantages of combining multi-frequency synthetic aperture radar (SAR)	Active – 30% complete	A. Scardilli / W. Dierking
2021-2	Enhanced Ice Information for Mariners	Explore how ships in different ice regimes use, and would like to use, enhanced ice-metocean information	Complete 2022	K. Qvistgaard
2021-3	Ice Edge Uncertainty Measures	Implement and evaluate metrics on ice edges from different services	Active – 20% complete	N. Hughes
2021-4	Iceberg Density Risk-Based Product	Standardize and publish iceberg density definitions	Active – 20% complete	A. Hamel
2021-5	Sea Ice Pressure Risk Product	Evaluate sea ice pressure events and forecasts to recommend ice pressure depiction standards	Active – 95% complete	K. Berberich / S. Weese
2022-1	Roadmap towards a Consolidated NAIS Iceberg Drift Model	Finalize NAIS iceberg model documentation and define future stewardship of the model	Active – 75% complete	P. Lamontagne
2022-2	Practical Use of Polaris for Risk Assessment in Polar Waters	Investigate how Polaris is, and could be, used by mariners for risk assessment	Complete 2023	K. Qvistgaard
2022-3	White Paper on Needs and Gaps in Operational Capability	Prepare a paper on gaps and needs in the operational ice services	Complete 2023	D. Flett
2022-4	Ice Climatology Terminology	Investigate the various uses of terminology and make recommendations for future improvements	Complete 2023	A. Tivy / C. Geiger
2023-1	S-411 Product Specifications	Update the S-411 product specification for ice information in ECDIS	Active – 15% complete	J. Holfort / S. Weese
2023-2	Ice Forecaster Competencies	Implement the ice analyst and forecaster competency framework	Active – 22% complete	V. Pinard / K. Qvistgaard
2023-3	Historical Data Modernization Plan	Develop an implementation plan to modernize historical records from all ice services	Active – 30% complete	C. Geiger
2023-4	Ice Climate Harmonization and Standardization	Draft a guidance document for the harmonization and standardized of sea ice climate products.	Active – 5% complete	A. Tivy
2023-5	Technical Readiness Levels Methodology	Provide an organized view of new developments in Machine Learning /Artificial Intelligence for sea ice and icebergs	Active – 33% complete	B. Deschamps



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2023-6	Science to Service	recommend ways to improve engagement between IICWG and the international sea ice and icebergs research community	Active – 10% complete	A. Denton / N. Hughes
2023-7	Updating IICWG Governance Documents	Produce a renewed Vision and Strategy document and a Terms of Reference document for the IICWG	Active – 80% complete	J. Parker

## **APPENDIX E**



## **IICWG MEETING PRESENTATIONS**

The annual meetings of the IICWG have been the focal point for the collaboration and sharing of information and ideas within the ice community. In the 25 years that have passed, over 500 presentations were given at meetings. As a part of this current work, a categorized index of these presentations was developed. The categories are:

- Ice Charting Operations
  - o 79 presentations on ice chart production processes and techniques
- Ice Monitoring
  - o 105 presentations on activities, methods, and missions to monitor ice conditions
- Ice Modeling and Forecasting
  - 65 presentations on ice and iceberg models and forecasting techniques
- Ice Climatology
  - 37 presentations on large scale changes in the ice environment
- User Engagement
  - $\circ$  113 presentations on the activities and needs of ice information users

Not included in the index, are annual updates by the ice services on their activities, regular presentations by space agencies on the status of earth observation missions and future plans, and status updates on action items and projects.

The index is too large for inclusion here. It can be accessed on the IICWG website at <u>https://nsidc.org/noaa/iicwg</u>. Several sections of the index follow for illustration.

#### **Ice Charting Operations**

Year	Title	Presenter	Affiliation
2023	Using Technical Readiness Levels (TRLs) to assess AI/ML systems for sea ice	B. Deschamps	Canadian Ice & Marine Service
	applications		
2023	AI in Routine Production of Regional Sea Ice Charts	K. Qvistgaard	Danish Meteorological Institute
2022	Automated Ship Removal in automated Iceberg Products	J. Buus-Hinkler	Danish Meteorological Institute
2022	Automated Drawing of Ice Maps: The Missing Link	N. Hughes	Norwegian Meteorological Institute
2022	Assessment of Using C- and L-band SAR imagery for Operations Ice and Iceberg	N. Hughes	Norwegian Meteorological Institute
	Charting		
2022	Sea ice detection and forecasting using convolutional neural networks	M. Rogers	British Antarctic Survey
2021	Survey on the Use of Automated Products in Operations - Summary Report	J. Falkingham	International Ice Charting Working Group
2021	Automated Classification of Sea Ice using C+L Bands	J. Lohse	The Arctic University of Norway
2021	Use of Automated Products in Ice Service Operations	J. Parker	Canadian Ice & Marine Service
2021	Multi-SAR Band Intercomparison - Operational Uses	C. Salvó	Argentine Naval Hydrographic Service
2021	EisKlass2 – Artificial Intelligence for Ice Classification	S. Singha	German Aerospace Centre
2020	Impacts Assessment of the Addition of L-Band to US NIC Products	S. Helfrich	U.S. National Ice Center
2019	Accuracy and Inter-Analyst Agreement of Visually Estimated Ice Concentration in	A. Cheng	Canadian Ice & Marine Service
	Canadian Ice Service Ice Charts		
2019	New Strategies for Automated Sea Ice Classification at CIRFA	J. Lohse	The Arctic University of Norway
2018	Cloud-based handling and operational use of big data – opportunities   risks	A. Cziferszky	British Antarctic Survey
	necessity		

#### **Ice Climatology**

Year	Title	Presenter	Affiliation
2023	What Do Ice Charts Add to the Historical Record of Sea Ice for Long-Term Monitoring and to Service the Research Community	F. Fetterer	National Snow and Ice Data Center
2023	Recent rapid declines in Antarctic sea ice: Current understanding and future implications	C. Holmes	British Antarctic Survey
2023	Sea ice variables and climatology in Polar RCCs seasonal reviews: presence of information, ice charting blending and shortcomings (with updates up to Sep 2023)	V. Smolyanitsky	Arctic and Antarctic Research Institute
2022	Southern Ocean Ice Conditions and Recent Trends	J. Lieser	Australian Bureau of Meteorology



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#### Ice Modeling and Forecasting

Year	Title	Presenter	Affiliation
2023	Developing a Deep Learning forecasting system for short-term and high-resolution prediction of sea ice concentration	A. Karvonen	Norwegian Meteorological Institute
2022	The new version of the SHN sea ice model: first experiments	S. Barreira	Argentine Naval Hydrographic Service
2022	Iceberg Model - Community Edition	P. Lamontagne	National Research Council of Canada
2020	Daily and Monthly Antarctic Sea Ice Forecast, Development and Validation	S. Barreira	Argentine Naval Hydrographic Service
2020	Current Status of the Implementation of the NAIS 2.0 Iceberg Drift and Deterioration in the South Atlantic Ocean and Antarctic Waters	G. Díaz	Argentine Naval Hydrographic Service
2020	NAIS Iceberg Model Developments for the North Atlantic	M. Hicks	International Ice Patrol
2019	Bringing Together Ice Service Initiatives to Improve Extended Range Ice Forecasting	S. Weese	Canadian Ice & Marine Service
2018	Retrieval of sea ice drift and deformation and assimilation into a Lagrangian sea ice model	A. Korosov	NERSC
2017	Short-Term Ice Forecasting - Current Practices and Future Directions	S. Graham	Canadian Ice & Marine Service
2017	Perspective on Using Models and Data	N. Hughes	Norwegian Meteorological Service
2017	Modeling Sea-Ice Extent Trends Around Antarctica (and 2016 Sea Ice Minimum	K. Kusahara	University of Tasmania
2017	Sea Ice Processes and Challenges - An Antarctic Navigational Perspective	R. Massom	Australian Antarctic Division

#### **Ice Monitoring**

Year	Title	Presenter	Affiliation
2023	Copernicus Marine Service Contribution to Polar Regions Monitoring=g	A. Reppucci	Mercator Oceans International
2023	Additional observations of the ice from Signals of Opportunity	J. Cartwright	Spire - Earth Intelligence
2023	AutoICE Challenge Results	M. Kreiner	Danish Meteorological Institute and others
2023	Ice Monitoring Activities at the Canadian Space Agency	P. Vézina	Canadian Space Agency
2023	Remote Ice Information Systems used Onboard the SDA	R. Stevens	British Antarctic Survey
2022	Using Active Learning to Characterize Ice Types	A. Darden	U.S. National Ice Center
2022	Compact Polarimetry on the RADARSAT Constellation Mission	B. Deschamps	Canadian Ice & Marine Service
2022	Experience with SAOCOM L-Band SAR Experience with SAOCOM L-Band SAR	C. Salvó	Argentine Naval Hydrographic Service
2022	Towards combining C- and L-band SAR imagery for automated sea ice classification	J. Lohse	Artic Institute of Norway
2022	Assessment of Using C- and L-band SAR Imagery for Operational Ice and Iceberg	K. Qvistgaard	Danish Meteorological Institute
	Charing		
2022	Alignment of L- and C-band SAR images for enhanced observations of sea ice:	L. Eriksson	Chalmers University of Technology
	current status		
2022	SAOCOM 1 Constellation Contributions to Ice Environment Monitoring and Ocean	M. Camuyrano	Comisión Nacional de Actividades
	Studies		Espaciales
2022	Canada's Icebreaking Program - Remotely Piloted Drones	T. Hodgson	Canadian Coast Guard
2022	Sea ice detection from SAR using a convolutional neural network (CNN) with	X. Chen	University of Waterloo
2022	Seemless PADAPSAT Constellation Mission Mosaics for CIS Operations and Public	V Luo	Canadian Ica & Marine Service
2022	New Global Lee Observations from SDIRE GNSS Reflectometry	I. Cartwritcht	Spire Forth Intelligence
2021	Arotia In gitu Observations and Citizen Saianea	J. Cartwinght	Dritich Antaratio Survey
2021	Alconment of L and C hand Images	J. WIIKIIISOII	Chalmana University of Technology
2021	Alignment of L- and C-band images	L. Erisksson	Chaimers University of Technology
2021	Iceberg Detections at C- and L-band	L. Færch	Arctic University of Norway

#### **User Engagement**

Year	Title	Presenter	Affiliation
2023	Working with Clients and Partners	A. Ogilvie	Fednav Ice Service
2023	Polar Shipping: Environmental Protection / Safety / Economic Development / Security	J. Bond	American Bureau of Shipping
2023	International Cooperative Engagement Program for Polar Research	J. Woods	Office of Naval Research-Global
2023	ICE SEA - A Digital Ice Information Service	L. Rabbenstein	Drift+Noise Polar Services
2023	Roles and Responsibilities in Ice Risk Management	R. Hall	Equinor Energy ASA
2023	Ice and Environmental Services	S. Green	PAL Aerospace
2022	Risk-Based Iceberg Products	A. Hamel	International Ice Patrol
2022	Search and Rescue in Polar Waters	C. Recio	Argentine Navy
2022	Automatic Sea ice Mapping for Navigation in Polar Areas with Satellite SAR Images	D. Murashkin	University of Bremen
2022	Autonomous Passage Planning for a Polar Vessel	J. Smith	British Antarctic Survey
2022	Vessel Patterns / Trends during a typical Antarctic Season	L. Kelley	ΙΑΑΤΟ
2022	The Role of SAR Satellite Imagery to Support Risk Assessment and Maritime	P. Wagner	Norwegian Meteorological Institute
	Situational in the Arctic	_	
2022	Towards Harmonization of Future Sea-ice Pressure Products	S. Weese	Canadian Ice & Marine Service
2021	ARNACOSKY - Arctic Navigation with Cosmo-SkyMED	D. Giampaulo	e-geos