



## INTERNATIONAL ICE CHARTING WORKING GROUP (IICWG)

---

Task Team 12

### Uncertainty-2

Most Recent Update: 6 May 2021

**Task Team Leaders:** Sean Helfrich (sean.helfrich@noaa.gov) / Nick Hughes (nick.hughes@met.no)

**Team Members:**

- Colleen Wilmington - [colleen.wilmington@noaa.gov](mailto:colleen.wilmington@noaa.gov)
- Angela Cheng - [angela.cheng@canada.ca](mailto:angela.cheng@canada.ca)
- Ekaterina Kim - [ekaterina.kim@ntnu.no](mailto:ekaterina.kim@ntnu.no)
- Falon Essary - [falon.essary@noaa.gov](mailto:falon.essary@noaa.gov)
- 
- 

**Task Objectives:**

- Conduct an uncertainty evaluation of sea ice concentrations and edge; document the process and the results.
- Establish a high-resolution (<30m resolution) ice concentrations dataset for ice services to use for their own uncertainty evaluations.
- Work with modelers to evaluate the utility of the ice charts RMSD mentioned in item 1) and report the findings.
- Compare ice charts from different services against one another and against automatic products using a variety of metrics including:
  - Aggregate statistics (e.g. RMSD)
  - Geospatial relationships (e.g. ice edge through RMSD, MHD and IIEE)
- Build up a picture of how the uncertainty changes through the seasonal cycle.

**Status:**

- Have not been able to meet yet but have a good group identified
- Have a large dataset of Landsat images and want to add Sentinel-2 to it
- Would like to get US Naval Research Lab involved in the project
- Clarified that this task will look at developing uncertainty measures and communicating them with modelers but not with end users – that falls into Task Teams 15 and 16
- Monthly telecons:
  - Telecom 1, 2020-12-14
  - Telecom 2, 2021-01-12
  - Telecom 3, 2021-02-16
  - Telecom 4, 2021-03-16

**Next Steps:**

- SH: Set up example with high-res optical SIC as comparison.
- NH: Continue generating statistics from metrics.



## INTERNATIONAL ICE CHARTING WORKING GROUP (IICWG)

---

- AC: Develop new distance metric. Continue looking at analyst variations, and comparison with MAGIC.
- EK: AARI-METNO comparison.
- Next telecom (4) 16 March.

**Estimated Percent Complete:** 10%

### **Interaction with Other Task Teams:**

- Uncertainty measures will be useful to Task Team 14 (SOLOKI)
- Communication of uncertainty to mariners is the responsibility of Task Teams 15 (Iceberg Hazard Product) and 16 (Sea Ice Hazard Product)

**What is working well?**

**Are there barriers hindering progress?**



### Minutes of Meetings

#### Telecom 2020-12-14 20:00-21:00 CET

Attendees: NH, SH, AC

Apologies: HB

#### *1. Introductions and current activities.*

Discussion on the different work being done to evaluate uncertainty:

NH looking at ice edge, and how that compares against the ice chart. Norwegian ice chart ice edge viewed as accurate, and metrics from data June 2019 to present can be used to develop a fingerprint of the characteristics of the product being compared. Being used to understand difference against ice charts (NIC, AARI), and automatic products (PMW SIC from various sources, various experimental SAR classifications). Aims to expand to forecast results.

HB provided David Poulter paper of previous (2016-17) PMW and ice charts (MET and DMI) intercomparison commissioned within the OSISAF project (SIMPE). This found that PMW products underrepresented sea ice cover. Intercomparison was meant to go into a performance dashboard, but appears not to have been taken up by the project.

SH looking at RMSD from high resolution optical and whether SIC from ice chart is consistent. Trying to build up an idea of whether analyst assessment is accurate and robust.

AC evaluating difference between analysts for same area of ice within a satellite image.

#### *2. Define what is meant by "high-resolution" for 2nd task objective.*

The group felt that for practical purposes, the resolution of Landsat and Sentinel-2 should be their level of "high-resolution". However it was agreed that datasets at higher resolution (e.g. aerial footage from drones or airborne) or medium resolution satellite sensors would provide a different measure of error, with the range of this error maybe varying (some kind of fractal scaling). SH referred to recent paper with Walt Meier.

#### *3. Determine work plan for:*

- a) RMSD sea ice concentration work including which products are to be evaluated.*
- b) Determine work plan for ice edge evaluation and metrics to be used.*

Because of the different approaches being taken within the group, decided that the best course of action was to use this to develop a framework of rules and best practises for determining uncertainty that could be used by the ice services to evaluate their products, and automatic or forecast products being proposed for operational use.

Further discussion, and presentation of results to promote discussion, seen as necessary and planned for next meeting. Focus areas are:



## INTERNATIONAL ICE CHARTING WORKING GROUP (IICWG)

---

NH - Ice edge, automatic products, ice edge

SH - Ice concentration

AC - ice concentration, analysts

*4. Decide on how we are bringing in Landsat and Sentinel-2 data.*

Used to compile a standard dataset that can be used to evaluate other products and methodologies.

*5. Involvement of Naval Research Lab. Who, how and what is their role?*

Provide GOFS and can be used to assess the effect of integration of ice chart data into model forecasts.

This led to some further discussion as to whether forecast models are included in the uncertainty evaluation. For this GOFS, and various Copernicus products (TOPAZ, neXtSIM), are readily available. Could this extend the work to sea ice thickness and ice drift?

*6. Determine a telecom schedule, probably with meetings beginning February, end of April and beginning of August 2021.*

Monthly meetings, next meeting first half of January. NH to set up. At this meeting, present some results of evaluations for further discussion.

*7. Any other business.*

None

### **Telecom 2021-01-12 16:00-17:00 CET**

Attendees: NH, SH, AC, CW, EK

Comparison with different types of products:

- Ice charts versus high-res ground truth as data source.
- Optical - thresholding issue, time of year and new ice

High variation in high concentrations doesn't matter. In low concentrations, more critical. Need to have accurate ice edge is clearer. For SIC, what source of data is regarding as the truth.

Can uncertainty be predicted?

- Take into account seasonality.

How much no ice is acceptable? And how much of limited ice along the edge is acceptable?

- Depends on whether it is a compact or diffuse ice edge.



## INTERNATIONAL ICE CHARTING WORKING GROUP (IICWG)

---

High-resolution data to calculate SIC comes with its own caveats. Typically, use optical with thresholds (Dorothy Hall, then Grenfell and Perovich).

CNN approaches do not take account of extreme conditions.

SH - How can I work with the NIC to develop uncertainty?

AC - Comparing new distance-based method versus metrics RMSD, MHD, IIEE, etc. What datasets to use?

SH - Landsat SIC. Coastline areas. Comparison with ice charts, works better with high-resolution ice charts. Aims to look at hundreds of samples.

Building signature of variation.

How to define the ice edge?

NRL - CW has letter of support from Wieslaw Maslowski.

TT should contact modellers to get their ideas of uncertainty metrics.

AC - How confident can we be in SIC in the ice chart? What to do with comparing exact SIC from products with ice chart SIC ranges?

Also, how to take into account the lag between satellite data and ice chart.

Plan for next meeting:

- Me - show some results
- SH - show one ice chart/Landsat comparison.
- EK - Norway/Russia comparison
- AC - Canadian comparison

Next telecom - 16 February 16:00 CET

### **Telecom 2021-02-16 16:00-17:20 CET**

Attendees: NH, EK, FE, AC, SH

Agenda:

- Me - show some results
- SH - show one ice chart/Landsat comparison.
- EK - Norway/Russia comparison
- AC - Canadian comparison



## INTERNATIONAL ICE CHARTING WORKING GROUP (IICWG)

---

SH - Still working with Rich Dworak in finding the right datasets and converting Landsat. DAT files, processed in Matlab. Canadian archipelago would be the best location for evaluation. Will present examples at the next telecom.

NH - Examples of different products, and metrics. Ice edge RMSD. MHD, IIEE and SPSLEN, 2021-02-09 example.

EK - East part, Kara Sea. METNO vs AARI ice charts. July 2017, 2018 and 2019. Some years, big differences. 2018, was someone different drawing the chart at METNO in 2018? AARI more conservative. However MET giving higher high SIC. Tried gridded vs vector. Big difference with bias.

[NH 2021-02-17: *Answer to the METNO 2018 question is yes. In 2018 20 out of 22 charts were produced by less experienced analysts*]

AC - Developing a metric for distance, rather than area. MHD sensitive to bias, different depending on chart -> model, vs model -> chart. New metric symmetric in forward vs backward path. Test case examples. Mimicking what analyst does with the ice edge.

SIC comparison - analysts vs MAGIC. Effect on climatology. Skill score. Analysts agree with each other, but less so with the computer algorithm.

SH - Try to set up CIS comparison with NIC.

NH - Need to provide analysts with context (e.g. meteorology and other satellite channels) when assessing how they evaluate SIC.

Background on existing studies:

Pedersen, O. M., & Kim, E. (2020). Evaluating Human and Machine Performance on the Classification of Sea Ice Images. In PROCEEDINGS OF THE 25th INTERNATIONAL SYMPOSIUM ON ICE. IAHR International Symposium on Ice.  
<https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2726623>

Cheng, A., Casati, B., Tivy, A., Zagon, T., Lemieux, J. F., & Tremblay, L. B. (2020). Accuracy and inter-analyst agreement of visually estimated sea ice concentrations in Canadian Ice Service ice charts using single-polarization RADARSAT-2. The Cryosphere, 14(4), 1289-1310. <https://tc.copernicus.org/articles/14/1289/2020/>

Next telecom - 16 March 20:00 CET



## INTERNATIONAL ICE CHARTING WORKING GROUP (IICWG)

---

### Telecom 2021-03-16 20:00-20:20 CET

Attendees: NH, CW, EK, AC

Agenda:

- Show some results?
- E-mails with Florence Fetterer
  - 10 km gridded NetCDF product
  - Try to form a standard with CMEMS DMI product?
- 

NH - Working on data.

Follow up with Florence Fetterer on NetCDF data formats. Set up NetCDF common standard from gridded, e.g. with what Copernicus CMEMS are doing?

EK - Set up analysis for Kara Sea, investigating possibility of a student to work on the topic for 2 months in summer.

AC - Study with CIS in parallel with NIC. Set up with Sean and Florence (NSIDC). Best practises for how to apply RMS comparison with high-res optical products.

Next meeting 21 April 16:00 CEST

### Telecom 2021-04-21 16:00-17:00 CEST

Attendees: NH, CW, EK, AC

Agenda:

NH - Compare 2020 with 2021 IIEE and MHD. Follow-up on NetCDF.

EK - Student starting next week. Working with MET Norway and AARI 2017, 2018 and 2019 dataset. Will also look at NIC charts for Kara Sea.

Uncertainty, important to modellers, but how it works in practise. Conservative ice charts, less strict rules (if with icebreakers).

AC - 1990-2020 climatology.

Actions (NH):

- E-mail Sean and get an update.
- Prepare a report for IICWG co-chairs telecom (6 May).
- Revisit and present Florence Q's for next co-chairs report (see below).



## INTERNATIONAL ICE CHARTING WORKING GROUP (IICWG)

---

- 
- 

Next meeting 25 May 16:00 CEST

Questions received from Florence Fetterer (23 February 2021):

It would be fantastic if you planned a study that would allow me to make some general statements about accuracy. Any answers to these questions, even ballpark figures, would be great:

- What is the accuracy of total sea ice concentration estimates in the weekly USNIC hemispheric charts? Or in any service's charts.
- Does it vary by region? For example, I'd expect accuracy not to be so high in the central arctic, because larger polygons are used there, and it is not of such critical operational interest.
- Does accuracy vary by season? Is it easier for analysts to get good results in summer, when vis band can be used, or in winter, when SAR is more reliably interpreted? (I'm just guessing at all that!)
- How accurate are partial concentrations? And these could be grouped as we do in G10033, user guide Table 8, to get accuracy estimates for concentrations of multiyear, first year, and thin ice.

Adding the results of a study of chart accuracy to the operational chart product documentation would go a long way toward having the data be accepted by the research community!