The Future of Sea Ice Modeling

Where Do We Go from Here?

Ed Blockley, Martin Vancoppenolle, Elizabeth Hunke, Cecilia Bitz, Daniel Feltham,
Jean-François Lemieux, Martin Losch, Eric Maisonnave, Dirk Notz, Pierre Rampal,
Steffen Tietsche, Bruno Tremblay, Adrian Turner, François Massonnet, Einar Ólason,
Andrew Roberts, Yevgeny Aksenov, Thierry Fichefet, Gilles Garric, Doroteaciro Iovino,
Gurvan Madec, Clement Rousset, David Salas y Melia, and David Schroeder

Agenda – Iceland Sea ice modelling workshop

Venue address: University of Iceland Building, Lindarbraut 4, 480 Laugarvatn, Iceland

Monday 23rd September 2019

17:00: bus transit leaves Keflavik airport to Laugarvatn (~1hr 45min)

19:00: arrival and get settled into accommodation

19:45: Informal introduction to the workshop

20.00: Dinner and reception

Tuesday 24th September 2019

07:30 - 08:15: Breakfast

08:30 - 08:50: Welcome, housekeeping, and introduction to day 1

08:50 - 12:30: Speaker presentations (15-20 min + 10 min) [Chair: Ed Blockley]

        08:50 – Danny Feltham
        09:20 – Martin Losch
        09:50 – Pierre Rampal

10:30 - 11:00: Coffee

        11:00 – Eric Maisonnave
        11:30 – Adrian Turner

12:00 - 13:00: Synthesis and initial discussion

13:00 - 14:00: Lunch

14:00 - 15:30: Free time [suggestion: walk in nearby mountains]

15:30 - 1600: Coffee

16:00 - 18:30: Discussion session for day 1
        Chair: Elizabeth Hunke
        Rapporteurs: Andrew Roberts; Sophie Morellon

19:30: Dinner

Wednesday 25th September 2019

07:30 - 08:15: *Breakfast*

08:30 - 08:50: Housekeeping, and introduction to day 2

08:50 - 12:30: Speaker presentations (15-20 min + 10 min) [Chair: Ed Blockley]

    08:50 – Dirk Notz
    09:20 – Elizabeth Hunke
    09:50 – Cecilia Bitz

10:30 - 11:00: *Coffee*

    11:00 – Jean-Francois Lemieux
    11:30 – Steffen Tietsche

12:00 – 13:00: Synthesis and initial discussion

13:00 - 14:00: *Lunch*

14:00 - 15:30: Discussion session for day 2
    Chair: Martin Vancoppenolle
    Rapporteurs: François Massonnet; Sophie Morellon

15:30 - 1600: *Coffee*

16:00 - 17:00: Wrap up and exploring next steps

17:00 - 19:00: Free time [suggestion: Fontana Geothermal bath]

19:30: Farewell dinner

Thursday 26th September 2019

05:00: Bus transit to Keflavik airport from Laugarvatn

Emergency contacts

Sophie Morellon	Ed Blockley	Martin Vancoppenolle

Workshop attendees

Name	Institution	Country
Yevgeny Aksenov	National Oceanography Centre	UK
Cecilia Bitz	University of Washington	USA
Ed Blockley	Met Office Hadley Centre	UK
Björn Erlingsson	University of Westfjords	Iceland
Danny Feltham	CPOM, University of Reading	UK
Thierry Fichefet	Catholic University of Louvain	Belgium
Gilles Garric	Mercator Océan	France
Marika Holland	NCAR	USA
Chris Horvat	Brown University	USA
Elizabeth Hunke	LANL	USA
Dorotea Iovino	CMCC	Italy
Jean-François Lemieux	ECCC	Canada
Martin Losch	AWI	Germany
Gurvan Madec	IPSL	France
Eric Maisonnave	CERFACS	France
Wieslaw Maslowski	Naval Postgraduate School	USA
François Massonnet	Catholic University of Louvain	Belgium
Carolin Mehlmann	MPI	Germany
Dirk Notz	MPI	Germany
Einar Örn Ólason	NERSC	Norway
Pierre Rampal	NERSC	Norway
Till Soya Rasmussen	DMI	Denmark
Andrew Roberts	LANL	USA
Clement Rousset	IPSL	France
David Salas y Melia	CNRM, Météo France	France
David Schroeder	CPOM, University of Reading	UK
Axel Schweiger	University of Washington	USA
Steffen Tietsche	ECMWF	UK
Bruno Tremblay	McGill University	Canada
Adrian Turner	LANL	USA
Martin Vancoppenolle	IPSL	France
Klaus Wyser	SMHI	Sweden
Sophie Morellon (IS-ENES3 project admin)	IPSL	France

Iceland workshop: motivating questions (1)

Top-level questions for the workshop:

    A1. What scientific questions or operational needs are driving current sea ice model development?

    A2. Do we think the current continuum model formulation is still the best choice for sea ice modelling?

        a. If no: what would be the best alternative?

        b. If yes: for how long will this be true? What will be the limitations?

    A3. Do we favour "evolution", "revolution", or "status quo" in relation to designing future sea ice models?

    A4. What role can the sea ice model development community play to improve progress? Are there any current practices that are inhibiting scientific advancement?

Main questions for the discussion & workshop report

    B1. Are we in a position to claim that any of the available sea ice modelling frameworks are better than any of the others? (e.g., Eulerian AIDJEX/Hibler, Lagrangian, Discrete Element, …)

        a. What are the key strengths and weaknesses of each approach?

        b. How is scientific validity of sea ice models established, in particular dynamics? Is there a consensus? What are the advantages vs caveats of the different evaluation methods? Which data products are to be used or precluded?

        c. Do we know what would be the "perfect" sea ice model physical framework (equivalent to Navier-Stokes for the ocean)?

    B2. What level of physical complexity is necessary for sea ice modelling?

        a. Are there important missing processes in contemporary sea ice models?

        b. Why are climate models with a more complex sea ice component not clearly superior to those with a very simple sea ice model?

        c. Is there a place for very simple sea ice models for climate applications?

        d. To what extent does it make sense to increase model physics given the large uncertainties in atmospheric and oceanic forcing?

Iceland workshop: motivating questions (2)

Main questions for the discussion & workshop report (contd.)

B3. What is the contribution of forcing *vs* physics to model uncertainty, in light of internal variability?

    a. Do we know enough how sea ice affects its own atmospheric and oceanic forcing?

    b. What are the trade-offs when considering coupling strategies to other Earth System Model components? How important are they?

B4. Which other constraints should be considered, in the context of current and upcoming applications and computing platforms?

    a. What is the finest resolution that can currently be used with current models? Are these limitations of physical, numerical, or computational origin? Is there a discrepancy between these limitations and the resolution required for operational applications?

    b. Should the same sea ice model be used for short-range forecasting and large-scale climate modelling?

    c. Will contemporary sea ice models (i.e., continuum+rheology) scale well enough for the next generation of exascale HPC systems?

    d. What are the most critical code design requirements for efficient use of new computational architectures?

Questions related to community practice & tools

C1. Are there current sea ice modelling practices slowing scientific progress?

C2. Should the sea ice modelling community improve modularity among different model sub-components to develop modular, interchangeable components that can be plugged into a generic framework? If so, how fine should the granularity be?

C3. Should the sea ice modelling community work toward one model or set of tools that everyone uses for many different purposes, or toward providing a diversity of model choices even for the same purpose?

C4. Should analysis, evaluation and calibration tools (including data assimilation) be included within sea ice modelling repositories? Could we benefit from international coordination or even collaboration?