

Response to the editor's comments by Yavor Kostov and co-authors.

Dear Dr Kostov and co-authors,

Thank you very much for your considered editing of the manuscript in response to the reviewers' comments. The revised manuscript will be suitable for publication in the Cryosphere. However, I would ask you to please consider implementing the below minor changes to help with readability. Once these are addressed, I would be happy to recommend for publication.

Best regards,

Felicity McCormack

Dear Dr McCormack,

We thank you for patiently reviewing our manuscript and for recommending the Minor Revisions with detailed suggestions. We have implemented everything that you outline, and we respond to each of your comments below.

Best regards,

Yavor Kostov and co-authors

---

- L29: perhaps expand this sentence to describe what is the problem with representing the icebergs as point particles

Thank you for this suggestion. We have expanded the sentence in Line 29 with the text "particularly challenging, especially when they are represented as point particles because this ignores the impact of spatial variability in the ocean properties along the horizontal and vertical extent of the keels, as well as the interaction with bottom topography."

- L29-L32: slight editing of language to improve clarity would be good here

Thank you for this comment. In Lines 30-34, we now say, "The modelling approach of Stern et al. (2017) does capture the effect of the ocean and the atmosphere over the entire breadth and depth of large icebergs. Similarly, Martin and Adcroft (2010), as well as Merino et al. (2016), partially mitigate the issue of representing icebergs in NEMO as point particles by imposing that the latter respond to spatially averaged ambient properties, and that iceberg keels are aware of bottom topography."

- L74-81: Here, it would be helpful to add a sentence or two at the end of this paragraph describing what is the problem with current approaches to modelling icebergs. I.e. what aspects of the previous attempts are lacking? What don't we represent well, particularly w.r.t. Iceberg grounding / ungrounding? That then motivates the following paragraph that talks to what the approach of this paper is; i.e. how it addresses the knowledge gap.

We are grateful for this helpful comment. We have described the knowledge gap, as you suggest. In Lines 83-88, we now say, "Since the developments of Merino et al. (2016), the keels of simulated icebergs interact with shallow bottom topography as an obstacle. However, icebergs in NEMO are unable to ground realistically and cannot remain trapped in the sediment. They stop and bounce off topographic obstacles instead. In turn, this has prevented the further development of algorithms simulating the blocking of sea-ice by grounded icebergs. The present work, which updates iceberg grounding in the model, is therefore a stepping-stone towards a future improvement of the interaction between icebergs and sea-ice in NEMO." We think that this highlights what has been lacking and motivates the following paragraph, as you suggest.

- Signposting around section 2. R2 raised the idea to separate this manuscript into 2 papers: one on grounding and one on drift dynamics. I agree with the authors that it's better to keep these aspects together, but I would recommend some more signposting that helps the reader to understand why certain ideas are introduced and how they relate to the aims of the paper. Section 2 in particular should include some more signposting, as per my below comments:

Thank you for your detailed suggestions. We have added the signposting that you request, and we address each of your comments below.

-- L103: Here, it would be helpful to motivate why you include section 2 with a couple of sentences. I.e. section 2 provides an overview of the dynamics related to iceberg grounding (from observations) that are essential to understand if we are to model them correctly (as per section 3).

Thank you! In lines 111-112, we now say, "Section 2 thus provides an overview of the relevant real-world conditions, which are essential to understand and model iceberg grounding as per Section 3."

-- Sections 2.1-2.3. Can you start these sections with a couple of sentences that describe why we need to understand these processes, and how neglect of these processes in previous attempts to model icebergs impacts the accuracy / reliability of the modelling?

We appreciate this suggestion. We have added introductory sentences to the beginnings of these sections (Lines 118-124 and 179-181) to explain why we need an understanding of these properties and how that impacts the model's ability to simulate grounded icebergs and their residence times.

-- L125:128: the sentences "Here, we manually map more than 60 scours from existing... calibrate the modelled scouring in Section 4." could be moved to the start of the section after a sentence on why iceberg scours are important to map. E.g. "Iceberg scours are a ubiquitous

feature of the Amundsen Sea sector, providing insight into the dynamics and history of iceberg grounding in the past. In this section, we manually map more than 60 scours..." Then proceed to describe where iceberg scours are found, what they tell us about the dynamics, and their morphology.

Thank you! We have indeed made these changes and the rearrangement that you propose. Lines 118-124 now read, "Iceberg scours (also called ploughmarks) are widespread in two Amundsen Sea regions and imply that thick icebergs can remain embedded in the bottom sediment for extended periods of time, a feature absent from previous versions of NEMO. Sediment scours also provide indirect evidence for the shape and size of the iceberg keels that interact with bottom topography, and this information is needed for the proper simulation of grounding in models. Here, we manually map more than 60 scours from existing multibeam-bathymetric data on the eastern flank and central part of Bear Ridge as a representative population of modern scours. We describe their morphology qualitatively with the aim of characterising modern iceberg grounding events, and then we provide metrics on their dimensions to calibrate the modelled scouring in Section 4."

-- L168-172: As for section 2.1, modifying the first couple of sentences of section 2.2 to be clear on why sediment density and strength is important and the aim of this section would be good.

Following your helpful suggestion, we have indeed added new sentences and modified existing ones in the beginning of Section 2.2 (Lines 179-185) to highlight the aim of the section and the importance of these sediment properties, "In order to simulate the residence time of icebergs embedded in the bottom sediment, a model needs realistic values for the saturated density and shear strength, properties which determine resistance forces acting on grounded icebergs. In this section we present observations of saturated density and shear strength characteristic of the Amundsen Sea. Data from sediment cores recovered from the basin (Figure 3; Smith et al., 2011; Clark et al., 2024) provide a range of values for both the saturated density and shear strength."

- L180-181: remove second "to" → "...at or close to (<25 km) to the ice sheet..."

Done (Line 194).

- L380-382: recommend to add clarification that the new rolling criteria detailed in Olivé Abelló et al. (2025) is not also employed in this manuscript

Thank you for pointing this out. We have added a clarification in lines 396-400: "Our work and the Olivé Abelló et al. (2025) companion study test each of the new updates to the NEMO iceberg algorithms separately. Our study introduces the new representation of grounding but relies on the old rolling criterion. In comparison, Olivé Abelló et al. (2025) use the new rolling criterion combined with the old grounding algorithms. These coordinated efforts will contribute to the improved representation of icebergs in future versions of NEMO."

**Editor decision: Publish subject to minor revisions (review by editor)** by [Felicity McCormack](#)

**Public justification (visible to the public if the article is accepted and published):**

Dear Dr Kostov and co-authors,

Apologies for the delay in my response.

Based on the reviewers' comments and recommendations, I agree that this manuscript is suitable for publication pending minor revisions. Please ensure that all reviewer feedback, as well as the points raised in my earlier response, are fully addressed when you upload your revised manuscript.

Best regards,

Felicity McCormack

Dear Dr McCormack,

We once again thank you for your time and effort. We appreciate all suggestions and have fully implemented them, as indicated in our line-by-line response above.

Kind regards,

Yavor Kostov and co-authors