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## ***Interactive comment on “neXtSIM: a new Lagrangian sea ice model” by P. Rampal et al.***

### **Anonymous Referee #2**

Received and published: 15 April 2016

This paper describes a new sea ice model based on a novel rheology and Lagrangian mesh. The paper is well written, describing the pertinent points of the model and validating it against a range of observations. I recommend the paper for publication subject to the following minor revisions:

#### General comments:

The authors do a good job of describing previous sea-ice modeling efforts but they should spend more time criticizing these efforts and describe in more detail how their model corrects the deficiencies of previous models. Also they should compare their new rheology to the EAP and Elastic-Decohesive rheologies. How is the rheology described here superior to these other attempt to correct previous model deficiencies?

Clarify whether this model has an ice thickness distribution and if it does how this is varied with time

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[Interactive Discussion](#)

[Discussion Paper](#)



I may have missed it but model resolution does not seem to be mentioned in this study. While its hard to describe the resolution given the mesh moves some scale metric of the mesh should be given.  $\sqrt{\text{mean cell area}}$  maybe?

The conclusions talk about this model being useful as a general sea ice model. This model cannot realistically be included into aGCM without it being parallelized and having good performance. Its unclear if this model is parallelized at all or how the performance compare to other models. If those remarks are going to be made in the conclusion the authors should state whether the model is parallelized, if it will be and what its performance is. I imagine the changing grid could prove problematic for parallelization.

Specific comments:

pg: 5888, line 7: Since the authors list a series of vertical thermodynamic models, they should list the two most state of the art ones: Vancoppenolle and Turner.

Equation 5: The authors should explain the physical meaning behind this equation rather than just introduce without explanation.

Equation 7: Again some explanation of the origin/meaning of this equation is needed.

Equation 9: Some explanation of the origin/meaning of this equation is needed.

pg: 5896, line 1: "i.e. increase ice conc." Wouldn't new ice formation lead to thicker ice as well or is this referring only to frazil ice formed in open water - clarify.

pg: 5896, line 9-11: What is the justification for relaxation time proportional to  $\Delta T$ ? What other options are there?

pg: 5897, line 12: Explain why it is not possible to derive an equation for A from first principles.

pg: 5898, line 2: Is the thermal conductivity and specific heat capacity the same as Semtner 1976?

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pg: 5899, line 5: What salinity is assumed for the ice? Does it vary? What vertical profile?

pg: 5899, line 16: Explain more fully what this means. I didn't understand this point.

pg: 5899, line 25: Surely a discrete element sea ice model would be Lagrangian and not require an unstructured mesh?

pg: 5901, line 1-2: Explain more fully what the affect on the simulated results is of this assumption.

pg: 5903, line: 4: "Progressively" - progressive in what way?

pg: 5905, line 20-22: The plots seem to suggest that the an infinite healing time is not significantly better than the chosen one. This seems to imply that healing isn't really needed for good model results. Please comment much more fully on this important point!

pg: 5908, line: 10-11: "the internal stress should also be correct". Its unclear what this means or why it should be true

pg: 5908, line: 16: not sure what "point-to-point" means in this context

pg: 5908: line 19-21: Explain this point more fully.

pg: 5909: line: 12: Explain more fully why the snapshots were discarded.

Technical comments:

pg: 5889, line: 28-29: "days or weeks" -> "days to weeks"; "seconds or hours" -> "seconds to hours"

pg: 5894, line 1: "is represented by" -> "represents"

pg: 5896, line 9: "supposed" -> "assumed"

pg: 5900, line: 1: "It also allows" -> "They also allow"

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pg: 5900, line: 18: "every hour" -> "every model hour"

pg: 5901, line 4: "mesher": This is not a real word

pg: 5901, line 11: ",...)" Not sure what this is meant to represent. Remove?

pg: 5907, line: 11: "X over Y" -> "ratio of X to Y"

pg: 5907, line: 25: "much likely the mark of" -> "is likely to be caused by"

pg 5910: line 3: "vertices" -> "vertex"

pg 5910: line 19-21: explain this point more fully.

pg 5912: line 12: "forwards" -> "forward"

pg 5913: line: 11: "therefore" -> ", therefore, "

pg 5914, line 1-3: However is being used to link two sentences. Break into two sentences.

pg 5914, line 5: "it is reassuring ...in the extent". This sentence is not correct english.

Figure 10: Make the y axis start at 0.

Figure 14: Describe the grey boxes in the caption

Figure 16: "Ice thickness per unit area": What is that?

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Interactive comment on The Cryosphere Discuss., 9, 5885, 2015.

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