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Interactive comment on "Brief Communication: Does it matter exactly when the Arctic will become ice-free?" *by* J. K. Ridley et al.

Anonymous Referee #2

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Brief Communication: Does it matter exactly when the Arctic will become ice-free? By J. K. Ridley, R. A. Wood, A. B. Keen, E. Blockley, J. A. Lowe

This short communication defends the idea that existing definitions of ice-free Arctic may be insufficient to inform stakeholders and societies about impacts of climate change in the Arctic and decisions for climate change mitigation, and that more robust definitions would be welcome.

I am worried by two points. First, current definitions of "ice-free" conditions are indeed varying greatly from study to study, but I do not see that as a problem. Indeed, these definitions are meant to represent more a symbolic (and sad) milestone in the evolution of climate change than an exact threshold beyond which the system will undergo, instantaneously, drastic transformations. In the same idea, why did stakeholders

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choose to target emissions to stay below a 2°C above present? This threshold is also arbitrary: an anomaly of 2°C is equivalent to 3.6° Fahrenheit, which is not a round number. Should the UN have adopted another metric system, the target could have been slightly different (for example, 4°F to have a round number, which is 2.2°C). These types of milestones are meant to give a gross idea of limits not to exceed, not stringent limits that should be interpreted literally. That different definitions give different results is therefore not surprising.

Second, no real alternative is proposed by the authors. This note would have been very constructive if it provided new diagnostics encapsulating spatial information, information about uncertainty related to internal variability and to model error as well as to RCP scenario. This is not the case here.

In summary, I am concerned by the fact that this short notes addresses more a wording issue than a true scientific question, and by the fact that it does not resolve the question it is raising in the introduction. This makes me think that The Cryosphere might not be the best place to get this note published.

Other comments:

Line 19 - Delete blank space after ice and include one before "One".

Line 19 - "One might then speculation" –> "One might then speculate".

line 32: I don't understand the sentence: "For example the opening of navigation routes for just a few days in an individual year would be of limited value, while particular ecosystems (especially organisms with multi-year life cycles) may be robust to short term variations". What is meant by "robust to short term variations"?

Line 45 - "B. The first year when the September mean is 'ice free'.". In that definition, do the authors use the "September mean of daily sea ice extent", or the "Sea ice extent computed from the September mean of daily sea ice concentration"? The two are different since extent is a threshold definition.

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Fig. 1 is of very poor graphical quality. In addition, can the authors label the four definitions with letters A, B, C, D as in the text? Finally, I have the impression that for RCP4.5 the year of ice-free according to the definition "first day" (last row) for the yellow member occurs *later* than the year of ice-free conditions according to the definition "first month" (while it cannot be the case by construction). That is, the two yellow dots on the two last rows of the figure are not aligned as expected. Is that just an optical effect?

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