We thank the anonymous reviewers for their careful reading of our manuscript and their insightful comments and suggestions. Following the suggestions, we included several improvements in the manuscript resulting in a stronger and clearer manuscript. Below, we will give a detailed replay to the comments.

Anonymous Referee #1:

``*This paper presents a data-driven methodology for detecting early-warning signs of critical transitions on ice sheets. The approach is based on a spectral partitioning of image data acquired by remote sensing, using a directed graph equipped with an asymmetric affinity matrix constructed from lagged sequences of images. The method is applied to ice surface velocity data for the Antarctic, and is found to successfully detect the formation of the A68 iceberg in the Larsen C ice shelf that took place in 2017.*
Overall, my assessment is that this is an interesting paper, worthy of publication at NPG. I recommend revisions to clarify some aspects of the analysis and improve presentation, as detailed below.''

We want to thank the referee for his careful read, positive feedback, and constructive comments.

1. *The introduction, as well as the conclusions, read overly critical of interferometric approaches as a tool for analysis and prediction of sea ice cracks. I wonder, however, if the issue here is not with interferometry itself but rather with how the data is processed in order to extract information pertinent to crack formation. After all, as stated in lines 169– 175, the velocity data utilized in this study are at least partly based on interferometry, so whatever information the proposed methodology extracts was at least partially present in interferometric data.*

We agree with the reviewer that ``*the issue here is not with interferometry itself but rather with how the data is processed in order to extract information pertinent to crack formation*''. We changed several sentences to reflect this tone, and we updated the manuscript to reflect more clarifications about the comparison. See the revised manuscript, line 206-222. We clarified that using the ice velocity data, our method revealed interesting details. Still, it could not predict the critical change and branching of the crack that happened in May 2017. On the other hand, using only the satellite images, our method was able to detect this critical branching by November 2016, and it was able to predict more accurate boundaries to the overall calved iceberg.

2. *Section 2 describes the graph affinity matrix as being constructed from color data, but the text in lines 169–175 suggests that ice surface was used. Please clarify and explicitly state the data sources employed in the analysis.*

We thank the reviewer for the comment on this important point. In lines 116-121, added a discussion to clarify that our method is not limited to a specific measured quantity, and we state that: "*It is crucial to keep in mind that we chose the color as the evolving quantity for a designated spatial location for clarity and consistency with our primary application and approach introduced in this paper. However, we can select the evolving quantity to be the magnitude of the pixels obtained from spectral imaging or experimental measures obtained from the field, such as pressure, density, or velocity. The results section introduces examples where we used the ice surface velocity instead of the color to show how results may vary based on the selected measure***".**

In the results section, we ensured that the data source is cited clearly in each figure caption.

3. *Although I believe that this is the case, it is not fully clear whether the results in figures 4, 7, and elsewhere in the paper are predictive in nature. That is, if the directed partitioning method detects significant changes in July 2016, is this based solely on data up to that point in time? It would be helpful to explicitly state this.*

We updated the document, and we emphasized this point in the discussion on the caption of Figure 5, and we clarified that the results were based solely on data up to that point in time.

4. *What is the sensitivity of the results on τ, α, and σ parameters in the graph affinity function? In general, there is little information about how these parameters are chosen. Similarly, other than a high-level reference to k-means clustering, there is little information about how the eigenvectors of the graph Laplacian are employed to pro- duce the final image segmentation. These issues considerably affect the reproducibility of the results, and it is important that the implementation of the technique is adequately explained in the revised manuscript.*

In lines 110-114 and lines 126-131, we added a discussion on the parameters' sensitivity and selection. In lines 167-171, we added a paragraph that clarifies the main principle in applying the K-means clustering on the graph Laplacian's eigenvectors and how we obtain our labeled image.

5. *Consider rewording the sentence in lines 189-191 (describing the partitions Aj) as it appears to be grammatically incorrect. Similarly the text in lines 194-200 could be improved in terms of English/clarity.*

We revised the sentence in lines 189-191 and reworded it for more clarity. You can see the revised paragraph in lines 196-202. Also, we carried an extensive review throughout the manuscript, for clarity, English, and grammatical errors.

Anonymous Referee #2:

``*Please note, I am a geophysist who considered the glaciology and mechanics in this paper. I do not comment on the mathematical method. In that context I would like to say it is exciting to see new mathematical methods to extract discontinuities in velocity field in glacial ice. It is interesting that one can estimate the onset of the crack formation, and perhaps with subsequent images the crack propagation. I did not assess if the method is able to show the velocity discontinuity within measurement error, but if it is a real result the method should be of interest to the cryospheric community.*''

We want to thank the referee for his positive feedback and constructive comments.

Specific points:

1. *line 22: "Still, this contribution starts to change in the 21st century because of the ice shelves cracks". This sentence is rather clunky. Ice shelf retreat? Or increased iceberg calving? There are other places with clunky English. For example line 35 "attribute in Greenland" is not grammatically correct. r line 55 "most massive known iceberg" is not formal language. I would suggest having someone proof read for professional English who is in the field.*

We thank the reviewer for his careful read and helpful comments. We revised the mentioned sentences and marked them in blue in our revised manuscript. And we carried an extensive review all over the manuscript, for clarity, English, and grammatical mistakes.

2. paragraph 37-42: Not sure if this is needed. It is a little out of context. There are other examples of information that is interesting but is out of context of the immediate point of interest, ice shelf cracking.e.g. "Interestingly, two and a half years later, it remains mostly intact and has drifted from the near Antarctica seas into the more turbulent open Arctic

Ocean where it is expected to break apart more quickly." .... I would suggest a proof read focused on direct narrative in the paper. In general the introduction could be more focused to ice shelf processes that involve it's growth and ice loss through iceberg generation.

We thank the reviewer for his careful read and helpful comments. We agree with the reviewer, and we removed the mentioned sentences, with several other sentences all through the manuscript to focus on our main objectives and subject.

3. *There are spelling mistakes in the manuscript*

We carried an extensive review all over the manuscript for spelling and grammatical mistakes.