

Interactive comment on “An Early Warning Sign of Critical Transition in The Antarctic Ice Sheet – A New Data Driven Tool for Spatiotemporal Tipping Point” by Abd AlRahman AlMomani and Erik Boltt

Anonymous Referee #1

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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 pre-

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sentation, as detailed below.

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.

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.

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.

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 produce 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.

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

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