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Interactive comment on "Spaceborne infrared imagery for early detection and cause of Weddell Polynya openings" *by* Céline Heuzé and Adriano Lemos

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Summary:

This paper develops an early opening detection method for the Weddell Polynya using the spaceborne infrared imagery, AVHRR. Causes of the openings are investigated using atmospheric reanalysis, hydrographic mooring and Sentinel-1 SAR data. The results indicate that the method performs well on detecting the events without finding false positives. Both oceanic upwelling and wind-induced divergence contributes to the opening of Weddell Polynya.

General comments:

1. The summary of satellite observations for sea ice monitoring needs improvement. A

more thorough reading of the relevant references is needed.

2. The method is not clearly described in the manuscript. A flowchart of the "early warning system" could be helpful. For example, how the polynya-prone area is determined and how it varies with years? In Section 3.1, when determining the polynya dates, is the minimum SIC area-wise (the polynya-prone area)? If yes, is the polynya-prone area fixed? How large? How many pixels are we talking about? Such questions pop when we start to read section 3.1, however only find it till the end (in the caption of Figure 3). In section 3.2, why plotting the data on the 15-day minimum and maximum axes? It is not clear that, what are the final criteria for the early detection until I read the manuscript a couple times.

3. It is a bit difficult to follow the flow of the manuscript, especially for the method. Section 3.1 and 3.2 are part of the method however presented in the "Results and Discussion" section. It could be easier to read if restructuring the "Method" and "Results and Discussion" sections, with "the warning system" (and identifying criteria) in "Method" and "cause of the opening" in "Results and Discussion".

Specific comments:

P1L1: "a crucial information" to "crucial"

P2L45-46: "sea ice concentration from passive radiometers or spectrometers (Spreen et al., 2008), mostly in the microwave region . . ." I don't recall any spectrometers used for sea ice concentration retrieval. The most commonly used data to derive sea ice concentration is microwave radiometer data, because the sensor (i.e. microwave radiometer) can work independence of light and penetrate clouds. There is no need to mention spectrometers. It can be rewritten to sth like ". . . sea ice concentration from microwave radiometers (Spreen et al., 2008)."

P2L46-52: The authors give a list of references to present the low and high resolution applications. It is true that SAR has much higher spatial resolution than microwave

radiometer, BUT both are microwave sensors. It is not appropriate to use “microwave products” to refer to the radiometer/scatterometer-based products. On the other hand, it is common to use microwave radiometers for sea ice drift tracking, sea ice classification and thickness retrieval (e.g., SMOS/SMAP). In Korosov et al., 2018, the microwave radiometers were firstly used to derive sea ice drift information, on the basis of which sea ice age was tracked. These sentences should be rephrased. Please also check the use of “microwave” (when referring to microwave radiometer), in the whole manuscript.

P2L52-53: Microwave radiometers have been used to monitor sea ice since late 1970s, they are not recent sensors compared to infrared sensors.

P3L59: “determine the mechanisms” to “understand the mechanisms”

P3L69: “reanalysis”

P3L72-74: since these two datasets have different resolution, please specify the resolution respectively.

P6L128-129: “using the traditional criterion sea ice minimum . . .”, do you mean sea ice concentration minimum? It is not clear here how the “sea ice minimum” is determined? If this is the minimum concentration of the polynya-prone area, a description of how the polynya area is determined and how large is the area is needed.

P7L140: “yield” to “yields”

P7L143: “then a third opens . . . the largest one splits into two”. It is confusing here, which one is the largest one?

P7L147-148: “thirty” to “30”; “”

P7L166: 3443 days? For how many years? In the next paragraph, the number of days is replaced with the number of events? Why?

P7L160-171: These two paragraphs basically explains that threshold for single band does not work well for early detection but the three bands together do. A summary of

the final criteria and the reason is needed. P12L220: which three events do you mean? Do you mean the average temperature in the 15 days, or when the opening starts? In Figure A5, there are more cases with 2 m air temperature of -10 degree by the time of opening.

P13L235: I don’t find temperature and salinity at 480 m depth oscillate with a near 12 hour frequency, at least not from -30 days to -13 days. Only smaller oscillations are found during 30-20 days before the event.

P13L250: Again, I don’t find increase of temperature at depth. It is too small to notice. The brightness temperature increases following the dip of T45 however only for one day.

P7L257-258: I would suggest delete the two question mark and words in parentheses.

P15L265: “rejected”

P17L300: “Sentinel” to “Sentinel-1”, the revisit time for the twin Sentinel-1 satellites is 6 days not 4 days.

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