

The Cryosphere Discuss., author comment AC1  
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## Reply on RC1

Alexei V. Kouraev et al.

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Author comment on "Giant ice rings in southern Baikal: multi-satellite data help to study ice cover dynamics and eddies under ice" by Alexei V. Kouraev et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-146-AC1>, 2021

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First of all we would like to thank you for the time and attention dedicated to the manuscript and for many constructive remarks.

Our item-by-item answers below are marked ">>". We have already prepared a new version of the manuscript to address your suggestions and comments.

On behalf of all co-authors, sincerely

Alexei Kouraev, Toulouse, 27 July 2021

RC1: 'Comment on tc-2021-146', Anonymous Referee #1, 14 Jun 2021  
GENERAL COMMENTS

Using a wealth of different types of remote sensing imagery and meteorological data, Kouraev and colleagues provide a fascinating description of the development and disappearance of an ice ring in southern L. Baikal in early spring, 2020. In addition, the authors cleverly estimate the rotational velocity of the eddy current that created the ice ring by determining the rotational speed of ice floes moved by this current. The authors also describe changes in the visual features of the ice cover's surface as weather conditions shift suddenly. With this paper, Kouraev and his colleagues not only extend and strengthen their previous work on the origin of ice rings in lakes, but they also provide excellent examples of how ice clarity and reflectance can change suddenly. Perhaps most importantly, however, their work demonstrates how the visible features of the ice surface on lakes are determined both by meteorological events occurring above the ice and water movements and heat flux occurring from below. This work will be useful not only to cryospheric scientists, but also to hydrodynamicists studying under-ice movement of eddies (or meddies) and to limnologists interested in measuring and predicting primary production under lake ice. The article is well illustrated and written in such a way that it is accessible to scientists from multiple sub-fields. This is no small feat given the highly technical nature of the fields of remote sensing and hydrodynamics.

>> We highly appreciate your positive evaluation of our work, thank you very much!

My main suggestion is to clarify figure and table captions by providing additional

information (see below).

## SPECIFIC COMMENTS

--A more precise title might be: "Giant ice rings in southern Lake Baikal: multi-satellite data facilitate an analysis of ice cover dynamics and eddies under the ice"

In the alternative title, the word 'evolution' is replaced with 'dynamics', and I encourage the authors to use alternative words such as 'dynamics' or 'development' instead of 'evolution' throughout the entire paper. For many scientists, the word, evolution, implies genetically-based inheritance, so replacing it with more appropriate terminology would increase clarity.

>> Good point. We have made changes to the manuscript (title and elsewhere).

Figure and table captions would benefit from the inclusion of additional information such that all figures and tables are interpretable without reading the main text of the paper. (See specific suggestions below).

>>Done

Fig. 1 – Describe in caption where zero (on x-axis) is located relative to the structure of the ice ring. Also, mention that water temperature data was collected under the ice because the ice is not easily seen in this figure.

>> Done

Fig. 2 – Briefly explain in caption why the ice ring disappears on 20 April and why that image is so dark. Without a brief explanation, the reader may assume problems occurred with the reproduction of the image.

>> Done

Fig. 3 – Excellent figure showing locations of ice rings in five different years in Kultuk Bay.--Place compass rose or a vertical line indicating the direction of north on the figure so the reader can distinguish easily the north from the south coast.--Consider indicating in the figure the position of Tunka Valley.--Explain significance of red dashed line (Jason-3 track No 79). Unclear why this dashed line is in the figure.

>> Tunka valley and compass rose - done. Jason track is referred to Fig 3 in Section 1.3; we also added there that "Radar altimetry do not provide images, but point measurements along the satellite track". We also indicate in this figure location of the Nizhneye Izgolovye Cape (see your later comment).

Table 1 – Date format in footnote should read (DD/MM); not the reverse.Caption – Consider beginning caption with "Inventory of all ice rings...." because I believe this table includes all ice rings observed to date for Kultuk Bay.

>>Done; caption changed.

Figure 4 – Define or explain 'cycle number' in caption. In text of paper and/or this figure caption, you may want to explain that the backscatter coefficient is not synonymous with albedo. Also consider explaining in the caption what these backscatter values are measuring or signify.

>> X axis values modified, now it is just time with dates. Caption modified. We have now provided in the beginning of Section 3 a description of various ice types, and how different surface types are seen on satellite images.

Figures 5 & 7 – Consider combining them into a single figure.

>>We would prefer to keep them separate, as Figure 5 shows the initial state, before ice break-up started in the eddy/ice ring region. Additional issue is that combining them will

reduce their size and thus readability. Please also note that now we show Jason-3 data overlaid on satellite image on Figure 5a.

--Indicate in each of the figure captions for Figs. 5,7,9, & 11 that these are satellite images to distinguish these images from Fig. 8 which is a photo shot while standing on the ice and looking down at it. Also, consider marking where the direction north is in these figures so that the compass directions mentioned in the text are more readily interpreted in these images.

>>Done. We put "satellite images" on caption for Figure 5 (Figures 7,9, and 11 have captions "same as Fig. XX" so it should be self-explanatory) and "Photo shots" for Fig. 8 caption.

--Fig. 5 – Explain in caption what the white streaks are. Ice cracks? They are especially visible on 20 April.

>>Done. We now also provide new text in the beginning of section 3 on how different surface types are seen on satellite images.

--Fig. 6 – Very good display of meteorological data, but why doesn't this graph begin April 8th when the ice ring was first detected? I believe this figure begins on April 15 to demonstrate how the ice ring changed markedly in response to weather fluctuations. If that is true, consider stating this in the caption.

>>We added to the figure caption: "Period is selected to represent meteorological conditions for satellite imagery presented in the paper"

--Fig. 7 – Are black areas open water in this figure, Fig. 9, and Fig. 11? Explain in caption.

>>Done .

--Fig. 8 – Indicate in caption that that these photos were taken while standing on the ice as opposed to having been taken from a satellite.--In caption, does the word 'limits' refer to edges? If so, replace 'limits' with 'edges' or 'boundaries'.--Last sentence of caption is redundant with information presented earlier in this caption.

>>Done

Fig. 10 – Great depiction of ice floe movement!

>>Thank you!

Table 2 – State in the caption the year (2020) that these data represent. Also, "Total:219" in the column titled 'Angle of ice floe' is confusing. This is not a sum, because the numbers in that column do not total to 219. Instead, "Total:219" appears to be a restatement of the angle of ice flow on 27 April. Consider removing "Total:219".

>>Done

Fig. 11 – Do the black areas in this photo, indicate open water?

>>Please see answer to your comment on Fig 5.

Fig. 12 – State in caption that this image is for an ice ring in the middle basin of L. Baikal. This is necessary because many readers will not be familiar with the location of Cape Nizhneye Izgolovye.-

>>Done, we also point to Figure 3 when now we show the location of Cape Nizhneye Izgolovye)

-Also state in caption that this image depicts ice surface temperatures.

>>Done, "Ice and land surface temperatures" (we also have the Cape in the image, so it is not only ice).

TECHNICAL CORRECTIONS (typing errors).

-- The manuscript would benefit from redactory editing by a native English speaker. The use of articles (i.e., the, a, of) and verb tense need attention. Authors of scientific articles typically write about their study in the past tense but about the findings of others in the present tense.  
>>Done

--line 52 – insert the word “Lake” or “L.” in front of all lake names throughout the paper.  
>>Done

--lines 36 & 37 – A citation or website seems appropriate at the end of these two sentences.  
>>Done

--line 60 – Please place ‘(clockwise)’ after the word ‘anticyclonic’.  
>>Done

--line 68 – Define ‘Meddies’ as Mediterranean eddies.  
>>Done

--line 70 – Remove ‘(anticyclonic)’ because it is now explained in line 60.  
>>Done

--line 117 – replace ‘gap in time’ with wording that is more precise such as ‘the lack of daily images’ or ‘days between useable images’  
>>Done

--line 121 – Lines 121-125 present a useful road map or outline to the paper. But, the first section of the paper (i.e., data used) is not mentioned. Insert after the word ‘first’, ‘identify the types of satellite imagery analysed and describe the geographical location of the study’.  
>>Done

--line 128 – replace ‘ the large scale’ with ‘a large spatial scale’  
>>Done

--line 156 – acclimatisation of whom or what? The astronauts?  
>>Yes, added "their acclimatisation".

--line 158 – replace ‘brought’ with ‘obtained’  
>>Done

--line 196 – replace ‘earliest observation’ with ‘first observation of an ice ring’  
>>Done

--line 198 – Was this undocumented ice ring in Kultuk Bay or elsewhere? You present ice ring data for Kultuk Bay in 2019 in Table 1 so please clarify if this undocumented ring also occurred in Kultuk Bay.  
>>Yes, it was in Kultuk Bay, text changed.

--line 210 – Replace ‘head’ with ‘western end’  
>>Changed to "extremities", as, for example, for the Cape Nizhneye Izgolovye it is a north-oriented end with narrow slopes, a kind of underwater canyon.

--line 270 – Consider replacing ‘changes’ with ‘increases’  
>>Done

--lines 308-309 – Great analogy!  
>>Thank you!

--lines 323-324 – Replace 'brought a possibility....' with 'presented an opportunity to assess the speed of the eddy current by analyzing ice flow movement.'  
>>Done, thank you!

--line 326-7 – replace 'looking at ice floes A...' with 'looking at the changing position of ice floes A...'  
>>Done

--line 376 – Cite Figure 2 at end of this sentence?  
>>Done (citing figure 7)

--line 392 – Replace 'is transporting and rotating' with 'transported and rotated'. Also replace 'such' with 'this'.  
>>Done

--line 394 – replace 'to west-east' with 'west to east'  
>>Done

--line 416 – what is fast ice?  
>>Changed to "consolidated"