

Response to the reviews of TC-2018-108 “The potential of sea ice leads as a predictor for seasonal Arctic sea ice extent prediction” by Yuanyuan Zhang, Xiao Cheng, Jiping Liu, and Fengming Hui

We greatly appreciate the thoughtful comments from the reviewers. According to the reviewer’s comments, we revised the original manuscript.

Responses to reviewer #2 comments

Thank you very much for your careful reviewing of our manuscript. All issues raised have been considered thoroughly and a major revision as suggested has been complete. The point-to-point response to the issues mentioned is appended below.

Question 1) There are many places where the English could be improved (also refer to the specific comments below).

Response:

We improved English of the revised manuscript.

Question 2) The key finding of this work is “to use sea ice leads as a predictor for the future sea ice extent”, it would be useful if the authors can demonstrate that by using 2003-2015 data, they predict sea ice 2013-2015 sea ice extent and verify it. This would be more convincing.

Response:

Based on the reviewer’s suggestion, we did the following three analyses. For the first column of Figure 1, all the data during 2003-2015 are used to train the linear regression model, and then the predicted Arctic sea ice extent (SIE) anomalies are calculated for 2009-2015 (2013-2015 is marked with red cross). It shows that the observed interannual variability of July sea ice extent anomalies can be reasonably reproduced by the area of sea ice leads, except that the predicted anomaly in 2013 deviates from the observations substantially. For the second column of Figure 1, only the data from the first six years (2003-2008) are used to train the linear regression model, and then the predicted SIE anomalies is calculated for 2009-2015. The result of the predicted July SIE anomalies is very similar to those of the 1st column. For the third column of Figure 1, the data from all previous years are used to train the linear regression model, and then the predicted SIE anomalies are calculated for 2009-2015, i.e., the predicted July SIE anomalies in 2009 (2015) is based on the training using the data from 2003-2008 (2003-2014). Again, the result of the predicted July SIE anomalies resembles those of the 1st and 2nd column. As shown by the 4th row of Figure 1, the prediction error by the end of April for the three analyses is much smaller than the standard deviation of the observed July SIE anomalies. Thus, the area of an-Arctic sea ice leads integrated from mid-winter to late spring has the potential to improve the prediction of July pan-Arctic SIE.

However, all three analyses show that there is still no predictive skill for August and September sea ice extent.

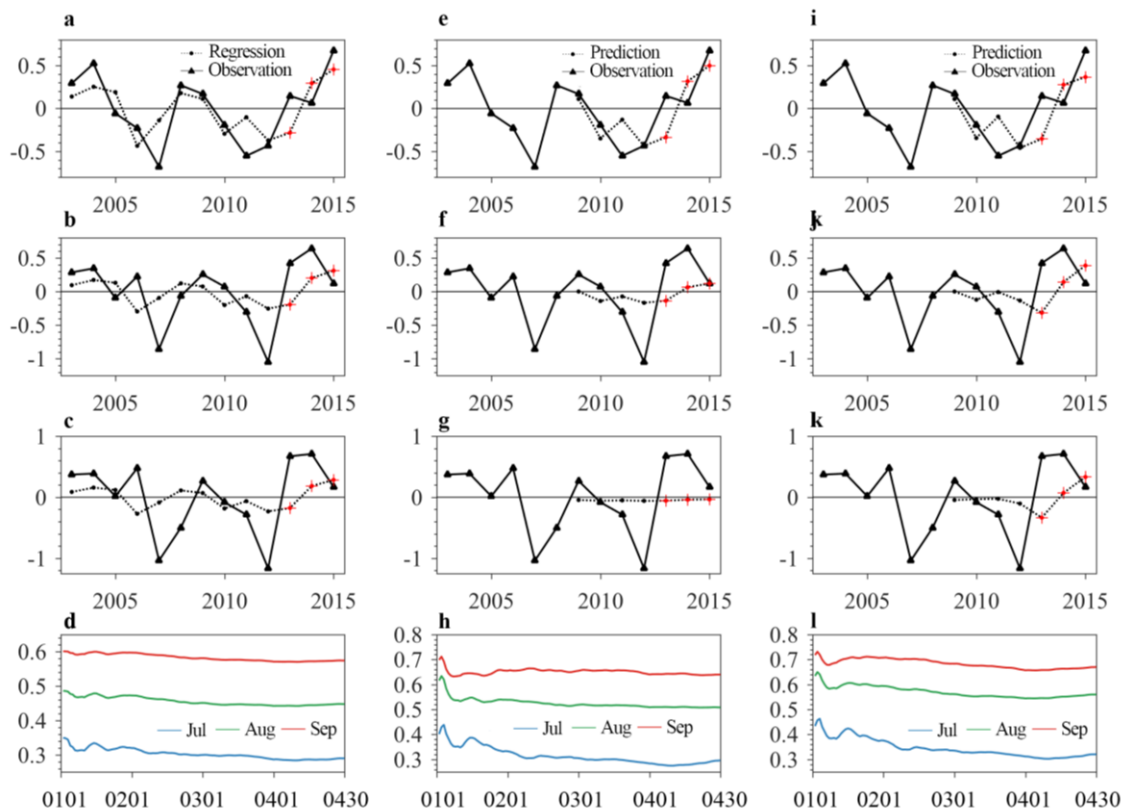


Figure 1. Predicted the total Arctic sea ice extent anomalies (million km²) in July (first row), August (second row), September (third row) during 2009-2015 based on the area of sea ice leads integrated from January 1 to April 30, 1st column: all the data during 2003-2015 are used, 2nd column: only the data from the first six years (2003-2008) are used, and 3rd column: the data of all previous years are used. The fourth row is the evolution of the prediction errors. The blue, green and red lines are July, August and September, respectively.

Question 3) Based on Figure 2, it seems that there is very large interannual variability of sea ice leads for January-April (for example, there is about 50% reduction from 2013 to 2014), it would be useful to add the sea ice extent for July, August, and September for 2003-2015 in Figure 2.

Response:

Based on the reviewer’s suggestion, we added July, August and September sea ice extent for the period of 2003-2015 in Figure 2. We also calculated the correlation coefficients between July, August, September sea ice extent and the area of sea ice leads averaged from January to April during 2003-2015, which are -0.51, -0.30 and -0.23, respectively. It appears that July sea ice extent is more closely related to the area of sea ice leads than August and September.

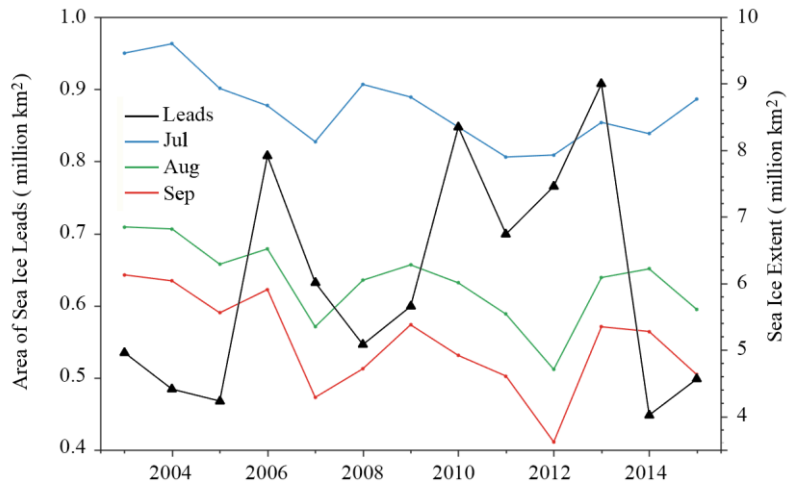


Figure 2. Time series of the area of the pan-Arctic sea ice leads averaged from January to April for the period of 2003-2015 (black line), and July, August, September sea ice extent during 2003-2015. The blue, green and red lines are July, August and September, respectively.

Specific comments:

- P1 Line 29: “north hemisphere” - change it to “northern hemisphere”.

Response:

This sentence is changed to “...increases the frequency of abnormal weather and climate in the mid-latitude of the northern hemisphere and influences the thermohaline circulation...”.

- P2 Line 10: “parameters can significantly improve” - change it to “parameters can significantly contribute to the improvement in”.

Response:

This sentence is changed to “The results show that some parameters can significantly contribute to the improvement in seasonal sea ice forecast at different lead times”.

- P2 Line 25: “depend strongly” - change it to “depends strongly”.

Response:

This sentence is changed to “Sensible heat flux over sea ice leads depends strongly on leads’ width.”.

- P2 Lines 27-28: “In additional, the albedo of sea ice leads” - change it to “In addition, the albedo of leads”

Response:

The sentence is changed to “the albedo of leads is about 0.07 under cloudy condition...”.

- *P6 Line 10: “black solid line” - there seems no black solid line in Fig. 4. Either change the word here or add the black solid line in Fig. 4.*

Response:

We have changed it to “black dot line”.

- *P14 Line 5: “2013-2015” – change it to “2003-2015”.*

Response:

We have changed it and checked throughout the manuscript.