Earth Syst. Dynam. Discuss.,
https://doi.org/10.5194/esd-2018-59-RC1, 2018

Earth System Dynamics
Discussions

Interactive comment on "The role of moisture transport for precipitation on the interannual and inter-daily fluctuations of the arctic sea ice extension" *by* Luis Gimeno-Sotelo et al.

Anonymous Referee #1

Received and published: 13 October 2018

Summary statement This paper explores the very timely topic of moisture transport into the Arctic and the consequences for sea ice extent. Previous work has identified key moisture sources for the Arctic and variations in moisture transport into the Arctic. This study focuses on the interannual variations around the declining trend in sea ice. We know from the Sea Ice Outlook (https://www.arcus.org/sipn/sea-ice-outlook) synthesis research that sea ice forecasts are able to forecast the September minima well if it is close to the trend rather than if it deviates far from the trend (Hamilton and Stroeve 2016). So, understanding the causes of variations around the trend is really important for improving sea ice forecasts.

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Discussion paper

This study finds that monthly negative ice extent anomalies (from the trend) are associated with increased moisture transport in summer, fall and winter and decreased moisture transport in spring. Extremes in humidity transport have a slightly different relationship with sea ice extent. The results are publication-worthy and the topic timely but before being publishable the manuscript needs revisions to refine the interpretation and to make the material more easily understandable.

Major comments 1) All of the relationships that are explored are contemporaneous on a monthly time scale between moisture transport and sea ice. I am not sure if moisture transport into the Arctic can have an impact on sea ice extent within a month of falling. It is not obvious to me that the moisture is causing the changes in sea ice extent. This is my biggest sticking point for the presentation of the results of this paper. Maybe this causality is clear in the authors minds but it has not been explained clearly enough in the paper. I feel that there is a gap in this part of the story. It could be that more extreme precipitation in winter and increased sea ice are both the results of some other factor. It is an interesting result but I think the explanation/interpretation needs to be refined. Large changes to sea ice in the winter occur in the marginal ice zone. Perhaps if there is lots of moisture transported then the wind forcing of sea ice leads to a northward movement of the ice edge. The changes at the southern perimeter of the ice have the biggest impact on the hemispheric sea ice extent (larger proportion of total area). So I think there could be other mechanisms that favor both more moisture and less ice. These ideas need more attention in this paper.

2) I found the paper hard to read in places because it is not self-contained. There are multiple places in the text where I am referred to the supplement or previous work to understand the concept. I think referencing published works for details is fine, but a conceptual description of the method or result is needed to make this paper more self-contained. For example, the following text does not help me understand what the CTC method uses without having to dig out this paper. It does not require a lot of input a concise description would make the paper flow better. Below is just one example but

this happens throughout the paper. line 170-171 The circulation types (CTCs) used in this study are the same as those described in Gimeno-Sotelo et al (2018), based on a approach developed by Fettweis et al. (2011) and shown in Supplementary Figure S3.

3) This is something between a major and a minor comment... lines 158-169, Would this fit better in the introduction? This is published work that is relevant for this study.

Minor comments 1) line 43-45, increased moisture in the summer typically is associated with cooling and slower sea ice melt, so the statement as it stands pertains to the cool season (sept-april).

2) line 81, I am more used to seeing the phrase 'vertically integrated moisture transport'

3) line 90, change 'rewides' with 'resides'

4) line 107-110, This sentence seems repetitive. The amounts of moisture provided by each of the four sources is listed twice.

5) line 115-116, 'The Pacific source dominates in the Barents.' I think the authors mean Bering not Barents.

6) Figure 3 caption, needs some more descriptive text. List the chosen high and low years in the caption and identify them with a star on the time series.

7) Line 124, the definition given here for the smoothing would be an 11-year running mean.

8) lines 126-128, the discussion of the standard deviation lines would fit better in the caption of Figure 3. Lines 128-136, The general discussion of how the extreme years are chosen can be tightened to use this space elsewhere.

9) line 140, 'for years' is repeated

10) The phrase 'annual march' is used throughout. It is confusing on one of the figures which are labeled 'Annual March'. I suggest 'seasonal cycle' instead in order to avoid

any confusion with the month of March when the Arctic sea ice maximum occurs.

References Hamilton, L. C. and Stroeve, J. “400 Predictions: the SEARCH Sea Ice Outlook 2008–2015” (2016): 1–15. doi:10.1080/1088937X.2016.1234518

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