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Interactive comment on "Sea Ice Drift and Arch Formation in the Robeson Channel Using Daily Coverage of Sentinel-1 SAR Data During the 2016–2017 Freezing Season" *by* Mohammed E. Shokr et al.

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The study visually identifies individual ice floes in a daily record of Sentinel-1 images from 26 September 2016 to end of April 2017, tracks their motion in relation to the 3-hour reanalysis wind from ERA5, and reports about the combined affects of wind, ice concentration and to some extent current on the floe motion. This approach makes use of the fine-resolution daily Sentinel-1 images to track the motion of individual ice floes.

We do not know of a similar approach published in open literature. Its advantage is to generate motion tracking of individual floes in such a narrow channel. Gridded ice trackers with their coarse resolution fails to provide the information in narrow channels. Non-gridded trackers based on Maximum Cross Correlation technique also used a nested correlation approach to reduce the computation time, hence do not make use of the fine-resolution of SAR. In addition, they perform correlation between ice "features" not necessarily ice floes.

The daily SAR coverages also allow us to monitor the evolution of the ice arch from its inception until it stabilized after 10 days, highlighting the effect of the wind. Once again, as far as we know, this is the first time the impact of the wind on the arch development is revealed. Previous studies on ice arch in this area and in neighboring areas such as NOW and Lancaster Sound focus on the existence of the arch, its causes, impacts and interannual record of formation. The present study does not address these points but it focuses on the development of the arch's shape, which is a new subject.

The reviewer raised the point that while the paper draws conclusions on "the transport of ice with respect to wind, ice congestion and current, it is unable to separate the contributions of wind and current". This is admittedly true but the separation can only be performed through a modeling approach. This is mentioned in the manuscript and a reference of such work, though in a different geographic area, is given.

In this study we have data of ice floes motion, wind field (speed and direction) and current. Wind is the prime factor that affects the ice motion. When we find that the wind does not explain the observed motion we resort to the current for explanation. One of the reported conclusions is that upstream of the channel, where ice congestion is observed, the motion does not seem to be driven by wind or current unless the ice concentration is low enough (we provided examples). So, the internal forces within the ice cover becomes the prime factor here. On the other hand, the motion within the RC (open drift ice regime) mostly follows the north-south extension of the channel, triggered by the combination of wind and current. Here the current is used to explain situations when the floe motion does not match the wind direction.

The reviewer also raised the point that the effect of the tide on floe motion was not considered. We did not consider this effect because we use daily data while tide occurs twice per day. In addition to be difficult to quantify, tidal effect on motion along the channel is minor compared to wind effect.

Please keep in mind that the subject of the study is not about the relative weight of each factor that contributes to the ice floe motion. The focus is on the effect of the wind, which we have detailed data on. Effects of current and ice concentration were brought in when we do not find match between ice motion and wind. We listed all the factors in the fourth paragraph in the Introduction, though not all of them are actually used numerically in the study. We will add the tide to this list and will search for tidal information in the RC and try to include its impact but, once again, when wind does not explain the observed motion.

Regrading the point raised by the reviewer in "Specific Comments" about the ice tracker algorithm using AVHRR, we will look at this but the individual ice floe motion in the narrow RC cannot be obtained from coarse-resolution AVHRR tracker.

The point about putting the ice arch in historical context was not done because for one thing this is not the subject of the manuscript, moreover we do not have the data to do so.

Most of the questions/concerns raised by the reviewer in the "Specific Comments" will be addressed in a revised version. But here we would like to refer to some of those points and try to answer.

The revisit time of RCM depends on the geographic area but more importantly it is specified in the user's request of the data. One purpose of this manuscript is to show the possibility of identifying gross features of ice floe motion tracking in narrow passages that would be of interest to the marine operational community. Ice floe gates

within the Northwest Passage is an example. With results from this study we might be able to make a case for daily acquisition of RCM over one or more of these gates to study the dynamics of hazardous multi-year ice drift in different periods.

The effect of the SSH will be defined more thoroughly and references will be used. The question about "why are floes moving northwest under light wind from south? Tide?" will be addressed based on the times of image acquisition and tide. We will give brief historical information about the arch in the RC in Section 4.2 "Formation of ice arch" and remove the well-known information about the polynya formation. We will reduce the number of parenthesis.

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