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Ocean Science
Discussions

Interactive comment on "Variability of scaling time series in the sea ice drift dynamics in the Arctic Ocean" *by* A. Chmel et al.

Anonymous Referee #4

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General comment

The manuscript presents observations of the sea ice floe velocity during the drift of the North Pole 35 camp. The manuscript addresses the statistical structure of the sea ice drift in the Arctic Ocean, which is the topic relevant to the scope of Ocean Science. The measurements have a certain degree of novelty, and by themselves might be of an interest for an enthusiastic reader. However, despite the interesting observations and conceivable ideas, the manuscript fails short to address in depth the mechanisms which generate the observed signatures in the sea ice floe velocity time series. The hypotheses presented in the manuscript are not supported by the analysis. The reviewer feels that the manuscript needs including more thorough analysis to be convincing.

The more detailed comments are:

1.Being not familiar with the GPS, the reviewer nevertheless found difficult to believe that with the GPS accuracy of 180 m one could obtain anything but noise from the measurements with the sampling period shorter than 7.5 min., given ice velocity is less than 0.4 [m/sec] (i.e. 180 [m]/0.4[m/sec]=450 [sec]). The recording sampling period was 1 min., but was it the same for the analysis? Has any low-pass filtering been applied? This needs to be clarified.

2.The statement that the 12-hour periodic variations in the velocity on 11-16 March are caused by tides is not supported. As the matter of fact, the oceanic inertial oscillations in the Arctic have the same period of ca. 12 hours. It is also unclear what mechanism the authors have in mind regarding the impact of tides on the sea ice drift. Is it the divergence of the ice cover and, therefore the reduction of the ice compactness causing the consequent floe acceleration due to free-drift? Is it something else? Correlating the high velocity during this period with tidal phase might help to establish the cause of the ice acceleration and a possible mechanism. Did the authors calculate spectrum for these events? From the time series it is not clear whether it is 2 cycles per day or slightly less than 2 cycles per day.

3.The reviewer failed to see the increase of ice cover fragmentation between 29 February and 10 March in the AVHRR images depicted in the Fig 4. Overall, in the reviewers' view AVHHR resolution (1.09 km) is not sufficient to detect ice fragmentation, i.e. break-up of floes. The only thing which AVHRR can detect, is the appearance of the large leads. This process results in the change of sea ice compactness. This is different to ice fragmentation which changes the floe size distribution with more-or-less the same compactness. Any aerial sea ice surveys are available for this period? They might be of some help; otherwise it is the unsupported claim.

4.Decomposing the whole time series into periods of "stationary wind-driven drift", "wind-driven drift", "highly excited movement", "ice cover fragmentation" and "tidal-

driven drift" is subjective and highly debatable. Firstly, in the reviewers' opinion, the whole time series look highly correlated with the wind. Secondly, the period 16-20 February demonstrates the change in the ice floe speed, from almost zero to 28 cm/sec, thus it is not a stationary drift. Thirdly, judging from the Figure 3, both periods 21-23 ("excited movement") and 24-6 (wind drift) show the same features: (i) high correlation with the wind speed and (ii) presence of "spikes" related to the ice floe acceleration/deceleration. Are the latter due to floe-to-floe collisions or stick-slip events? Unfortunately no one can tell it from the analysis presented in the manuscript. Concerning the "ice cover fragmentation period" on 7-10, the reviewer have already expressed his doubts. Finally, about the "tidal-driven drift". During this period ice is not tidal driven: one can see that the ice velocity closely follows the increase in the wind speed. Moreover, the residual tidal ocean velocity is quiet small in the central Arctic and cannot advect sea ice with velocities up to 15 cm/s. What one can see in the time series, is the modulation of the sea ice drift, possibly by tides, but it is unproven, please see the comment above.

Technical corrections

1.Is "gamma" in the Figure 3 equivalent to "beta" in the equation 2? 2.There is no Figure 3a. Typos? Should it be Figure 5a? 3.Following the Figure 5, the time-window B exhibits a single-exponent power law, whereas the double exponent is a character of the time-window C, the manuscript states differently. Typos? 4.Page 1600, line 24. Typos: logarithmic, not "doubly logarithmic" coordinates.

Interactive comment on Ocean Sci. Discuss., 6, 1595, 2009.