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Distinct modes of winter arctic sea ice motion

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Using monthly mean sea ice motion velocity obtained from the International Arctic Buoy Programme (IABP) for the period of 1979-1998 and the monthly mean NCEP/NCAR re-analyses dataset (1960-2002), we created a complex correlation matrix made of normalized sea ice motion velocity to investigate the leading sea ice motion mode's temporal and spatial evolutions and their association with sea level pressure (SLP) and predominant modes of surface wind field variability. The results indicate that the leading winter sea ice motion mode's spatial evolution is characterized by two alternating and distinct sea ice modes, or their linear combination. One mode (M1) shows a nearly closed cyclonic or anti-cyclonic circulation anomaly in the Arctic Basin and its marginal seas, resembling to a large extent the response of sea ice motion to the Arctic Oscillation (AO), as many previous studies have revealed. The other mode (M2) displays a coherent cyclonic or anti-cyclonic circulation anomaly with its center close to the Laptev Sea, which has not been identified in previous observational studies. In fact, M1 and M2 respectively reflect the responses of sea ice motion to two predominant modes of winter surface wind variability north of 70˚N, which well correspond to the first two modes of EOF analysis of winter monthly mean SLP north of 70˚N with slight differences. Although the AO significantly influences sea ice motion, it is not crucial for the existence of M1. The new sea ice motion mode (M2) has the largest variance and clearly differs from the response of winter month mean sea ice motion to the dipole anomaly in SLP fields revealed by Wu et al. (2006a), and corresponding SLP anomalies also show differences compared to the dipole anomaly. This study clearly indicates that in the Arctic Basin and its marginal

seas, similar SLP anomaly patterns (or slight SLP differences) result in distinct sea ice motion anomalies.