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9.8 Spatial and Temporal Characteristics of Arctic Sea-ice Deformation and its Implication in Data Assimilation

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On interannual to decadal timescales atmospheric circulation exhibits strong modal structures, in which coherent and recursive patterns such as ones defined by NAO and AO emerge. These modes and their associated phases have Arctic manifestations as evidenced by different modes in ice motion. Given this background questions arise as to how these variations in ice motion lead to varying modes of ice deformation, how these modes in deformation modify the way in which sea ice mass is redistributed, how this is compared to possible influence on the mass balance by other oceanic and thermodynamic processes, e.g. more oceanic heat flux, higher air temperature, or more snow precipitation etc., and how this ultimately modifies the sea ice mass balance and eventually the regional freshwater balance. These questions can be more effectively answered through an optimal use of model outputs and data – data assimilation. The first and important step in this effort is to make a critical assessment on data so as to identify relevant spatial and temporal scales for assimilation analysis.

The process most directly responsible for the redistribution of sea-ice mass is uniaxial closing (contraction), e.g. a ice flow against the coast. Yet it is a rare class of events as on the average Arctic ice motion is close to being non-divergent. This requires a careful analysis on how to extract information characterizing this process. Our results based on merged ice motion data constructed from satellite and buoy observations indicate that the relevant timescale for this process likely falls in the range of month to season. Over this temporal scale the emerged spatial pattern on the frequency of uniaxial-contraction events resembles to observed and simulated patterns in ice thickness. These results suggest that within this framework roughly speaking daily to synoptic timescale is a required temporal resolution for assimilation analysis to be both valid and meaningful. They also suggest an effectiveness of a 100 km resolution.

On the basis of this assessment work is under way to construct a simple forward and adjoint ice dynamic model.