Cyclone Forcing of Coupled Dynamic and Thermodynamic Processes In Arctic Sea Ice, and Across the Ocean-Sea Ice-Atmosphere Interface

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The declining summer Arctic sea ice is impacting cyclone forcing of dynamic and thermodynamic processes in Arctic sea at different spatial and temporal scales throughout the annual cycle. A seasonally ice-free Arctic Ocean may become a reality sooner than originally thought, and this possibility therefore emphasizes the need for better understanding of storm interactions with Arctic sea ice and ocean. Synoptic-scale atmospheric circulation patterns drive wind forcing of dynamic and thermodynamic processes in Arctic sea ice. Synoptic typing and compositing is a common technique used to identify a limited number of prevailing weather classifications that govern a region's climate. A catalogue of daily synoptic weather types is generated for the southern Beaufort Sea, covering the period 1979 to 2011 using NCEP/NCAR reanalysis mean sea level pressure data, principle components and k-means cluster analyses. Synoptic type statistics are used to assess changes in atmospheric circulation characteristics, sea ice vorticity, and lead formation. Significant ($p < 0.05$) seasonal synoptic type frequency anomalies are revealed between 1979–1998 and 1999–2011, and indicate a stronger Beaufort high, and increased easterly wind forcing in autumn and winter. High rates of young ice production in November and December 2007 were linked to strong easterly wind forcing. The corresponding atmospheric variables within the troposphere (surface – 250 hPa) are also examined, and reveal increasingly meridional atmospheric circulation concomitant with a deepening Aleutian Low and strengthening of pressure gradients over the southern Beaufort Sea and Chukchi Sea. Coastal-based wind observations show a shift towards increased easterly wind forcing. Increased easterly wind forcing during autumn and winter may force areas of relatively thin sea ice to fracture, forming open water features known as sea ice leads. Winter sea ice leads typically rapidly refreeze, releasing heat and water vapour to the atmosphere in the process. Subsequent refreezing and deformation of thin ice within these leads may promote dynamic ice growth (ridging of ice).

Summer storm forcing of the declining sea ice cover and emerging expanses of open water are of great intrigue.Firrci e4-gg–150 m diameter) floes. This process