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The thermodynamic differences between winter cyclones from midlatitudes and high latitudes

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Cyclones carry heat and moisture that impact local conditions along their path. Cyclones with different origins can, however, have different life cycles and cause different impacts. To quantify differences in the thermodynamic evolution of cyclones originating from different latitudes during wintertime, we separate the cyclones according to their origin (cyclogenesis location): midlatitude (ML) cyclones originating in the North Atlantic and high-latitude (HL) cyclones originating in the Nordic Seas and Barents Seas. It is found that HL cyclones generally carry lower thermodynamic energy as they originate in a cold environment. In contrast, ML cyclones have much higher thermodynamic energy throughout their lifecycle, even though they lose a large amount of heat as they travel long distances from their origin towards the Arctic. For a given region in the high latitudes (e.g., the Barents Sea), the mean vertical profiles of temperature and moisture from the HL group are colder and drier compared to the ones from the ML group, but the maximum values in the HL group can reach those of the ML group. Further analysis for the top 10% warmest profiles in the HL group suggests that these HL cyclones form in a preconditioned warm and moist environment. The precondioning is set up by the large-scale circulation with influences from the upstream North Atlantic. Under special conditions, the formation of high latitude cyclones in a preconditioned warm and moist environment can lead to extreme warming events in the deep Arctic like the one during New Year's 2015/16.