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Cyclones of the Arctic: definitions, pattern and regional trends

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Through their impacts on precipitation patterns and sea ice, cyclones play a significant role in modulating the freshwater budget in the Arctic. To elucidate the mechanisms of synoptic impact on the high latitude climate we analyze cyclone activity trends and compare them with trends in major variables (temperature, precipitation, clouds) for the Lena river basin. We utilize two cyclone tracking algorithms in the Arctic region. One algorithm, developed by Mark Serreze, makes use of the sea level pressure (SLP) field, while the other, developed by Kevin Hodges, uses 850 hPa and 700 hPa vorticity fields to identify a synoptic system. We compare the results from these two algorithms and evaluate their performances in the Arctic. Overall, both algorithms reveal similar patterns. Winter is dominated by the Aleutian and Icelandic lows, while in summer these centers are accompanied by the "Arctic frontal zone" located along the coast of Siberia and propagating into the Arctic Ocean. Cyclogenesis patterns are even more similar between the two algorithms. We also perform correlation analysis for the Nordic Seas region (roughly corresponding to the Icelandic low) in winter and the Lena River basin (corresponding to the Arctic frontal zone) in summer. These two regions are prominent centers of synoptic activity in the Arctic and are expected to be the most significant in terms of cyclone activity and impact. As expected, the correlations are highest for the Nordic Seas in winter and the Lena River basin in summer, for both cyclone track counts and cyclone intensities. Cyclones identified in the reanalysis also appear to correlate with trends in the precipitation and temperature over northern Eurasia, particularly in winter. A decrease in the number of total summer cyclones since the middle of the 20th century is also consistent with the modest decline

in precipitation at stations in the Lena Basin. An apparent shift over this time from short-lived cyclones to longer-lived storms may also be consistent with the observed shift in cloud distributions from low to high clouds types.