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Inter-annual Variability of Snowfall and its Relationship with Land/Lake Surface Processes and Remote Oceanic Forcing in the Lower Peninsula of Michigan, USA

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Winter snowfall, including lake-effect and lake enhanced snowfall, impacts all aspects of Michigan life in the wintertime, from motorsports and tourism to impacting the day-to-day lives of residents. Understanding the inter-annual variability of snowfall will provide sound basis for local community safety management and improve weather forecasting. This study attempts to understand the trend in winter snowfall and the influencing factors of winter snowfall variability in the Lower Peninsula of Michigan (LPM) using station snowfall measurements and statistical analysis. Our study demonstrates that snowfall has significantly increased from 1932 to 2015. Correlation analysis suggests that regionally average air temperatures have a strong negative relationship with snowfall in LPM. On average, approximately 27% of inter-annual variability in snowfall can be explained by regionally average air temperatures. ENSO events are also negatively related to snowfall in LPM and can explain $\sim$ 8% of inter-annual variability. North Atlantic Oscillation (NAO) does not have strong influence on snowfall. Composite analysis demonstrates that on annual basis, more winter snowfall occurs during the years with higher maximum ice cover (MIC) than during the years with lower MIC in Lake Michigan. Higher MIC is often associated with lower air temperatures which are negatively related to winter snowfall. This study could provide insight on future snow related climate model improvement and weather forecasting.