Water Vapor Transport Associated with Lake-Effect Snowfall over Southern Ontario

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ABSTRACT

The water vapor transport associated with lake-effect snowfall over Southern Ontario is examined for the years 1992-1999 using a variety of observational and model datasets. We show that the synoptic situation that gives rise to heavy lake-effect snowfall (snowfall>20cm/day) is very different from that associated with light to moderate lake-effect snowfall (snowfall<20cm/day). In particular, heavy lake-effect snowfall is associated with a warm and saturated layer in the middle troposphere that is absent for light to moderate lake-effect snowfall. All lake-effect snowfall in the region occurs in the northwesterly flow established after the passage of a synoptic-scale low. This flow results in the evaporation of water from the lakes that leads to a moistening and deepening of the atmospheric boundary layer. The presence of a warm and saturated layer in the middle troposphere allows for the possibility of an interaction with the boundary layer moisture that can give rise to intensification in the snowfall. Through analysis on isobaric and isentropic surfaces, we show that the source of moisture in the middle troposphere is the Gulf Stream region that is advected into the Great Lakes region by the parent low. Only slowly moving systems that propagate towards the east are able to support such a transport. As we will show, such synoptic situations are relatively rare.

Keywords: Lake-effect, snowfall, Southern Ontario

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