Geophysical Research Abstracts
Vol. 17, EGU2015-765, 2015
EGU General Assembly 2015

Synoptic variability of extreme snowfall in the St. Elias Mountains, Yukon, Canada

Caroline Andin (1), Christian Zdanowicz (1), and Luke Copland (2)
(1) Department of Earth Sciences, Uppsala University, Sweden, (2) Department of Geography, University of Ottawa, Canada

Glaciers in the Wrangell and St. Elias Mountains (Alaska and Yukon) are presently experiencing some of the highest regional wastage rates worldwide. While the effect of regional temperatures on glacier melt rates in this region has been investigated, comparatively little is known about how synoptic climate variations, for example in the position and strength of the Aleutian Low, modulate snow accumulation on these glaciers. Such information is needed to accurately forecast future wastage rates, glacier-water resource availability, and contributions to sea-level rise. Starting in 2000, automated weather stations (AWS) were established in the central St-Elias Mountains (Yukon) at altitudes ranging from 1190 to 5400 m asl, to collect climatological data in support of glaciological research. These data are the longest continuous year-round observations of surface climate ever obtained from this vast glaciated region. Here we present an analysis of snowfall events in the icefields of the St-Elias Mountains based on a decade-long series of AWS observations of snow accumulation. Specifically, we investigated the synoptic patterns and air mass trajectories associated with the largest snowfall events (> 25 cm/12 hours) that occurred between 2002 and 2012. Nearly 80% of these events occurred during the cold season (October-March), and in 74 % of cases the precipitating air masses originated from the North Pacific south of 50°N. Zonal air mass advection over Alaska, or from the Bering Sea or the Arctic Ocean, was comparatively rare (20%). Somewhat counter-intuitively, dominant surface winds in the St. Elias Mountains during high snowfall events were predominantly easterly, probably due to boundary-layer frictional drag and topographic funneling effects. Composite maps of sea-level pressure and 700 mb winds reveal that intense snowfall events between 2002 and 2012 were associated with synoptic situations characterized by a split, eastwardly-shifted or longitudinally-stretched Aleutian Low (AL) having an easternmost node near the Kenai Peninsula, conditions that drove a strong southwesterly upper airstream across the Gulf of Alaska towards the coast. Situations with a single-node, westerly-shifted AL were comparatively rare. The spatial configuration of the synoptic AL pressure pattern appears to play a greater role in determining snowfall amount in the central St. Elias Mountains than do pressure anomalies within the AL. The estimated snowfall gradient from coastal Alaska to the central St. Elias Mountains during intense snowfall events averaged +2.0 $\pm$ 0.7 mm/km (SWE), while the continental-side gradient from the mountains towards the Yukon plateau averaged -3.3 $\pm$ 0.9 mm/km (SWE). The findings presented here can better constrain the climatic interpretation of long proxy records of snow accumulation variations developed from glacier cores drilled in the St. Elias Mountains or nearby regions.