Influence of upper-air conditions on glaciers in Scandinavia

L. A. Rasmussen, H. Conway
Department of Earth and Space Sciences, University of Washington
Seattle, Washington, U.S.A.

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ABSTRACT. A simple model using once-daily NCEP-NCAR Reanalysis upper-air values estimates winter balance, summer balance, and net balance at ten glaciers in Norway and two in Sweden with $0.37 \leq r^2 \leq 0.90$. The October-May Arctic Oscillation (AO), an index of sea level pressure (SLP) in the northern hemisphere, correlates with winter balance and net balance with $0.09 \leq r^2 \leq 0.82$, lower than the model in all but three of the 24 cases. The October-May North Atlantic Oscillation (NAO), an SLP gradient in the North Atlantic, has lower correlations than the AO for all but five of the 24 cases. At all ten glaciers with records beginning before 1987, net balance became more positive after 1988, owing mainly to increased winter balance, with summer balance changing little. Although winter temperatures increased, they were still well below freezing, so the rain-snow division of the precipitation was only slightly affected. Increase in winter balance was due to increased precipitation caused by a change in atmospheric circulation, resulting in more frequent westerly flow concurrent with the warming. At 850 hPa, westerly flow is $\approx 2.5\,^{\circ}$C warmer than easterly; westerly flow warmed by $\approx 0.3\,^{\circ}$C, easterly by $\approx 0.7\,^{\circ}$C. Both the AO and NAO, with which winter balance is positively correlated at all 12 glaciers, were more positive after 1988.