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Growing season boundary layer climate and surface exchanges in a subarctic lichen woodland

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Abstract

Between June and August 1990, observations were made at two surface micrometeorological towers near Schefferville Quebec (54°52'N, 66° 40.5'W), one in a fen and one in the subarctic lichen woodland, and at four surface climatological stations. Data from these surface stations were supplemented by regular radiosonde launches. Supporting measurements of radiative components and soil temperatures allowed heat and moisture balances to be obtained at two sites. The overall surface meteorological experiment design and results of micrometeorological observations made on a 30-m tower in the lichen woodland are presented here. Seasonal variation in the heat and water vapor transport characteristics illustrate the marked effect of the late summer climatological shift in air mass type. During the first half of the summer, average valley sidewalls only 100 m high are sufficient to channel winds along the valley in the entire convective boundary layer. Channeling effects at the surface, known for some time at the long-term climate station in Schefferville, are observed both at ridge top and in the valley, possibly the response of the flow to the NW-SE orientation of valleys in the region. Diurnal surface temperature amplitude at ridge top (~ 10 °C) was found to be half that observed in the valley.

Relatively large differences in precipitation among these stations and the climatological station at Schefferville airport were observed and attributed to the local topography. Eddy correlation observations of the heat, moisture, and momentum transports were obtained from a 30-m tower above a sparse (~ 616 stems/ha) black spruce lichen woodland. Properties of the turbulent surface boundary layer agree well with previous wind tunnel studies over idealized rough surfaces. Daytime Bowen ratios of 2.5–3 are larger than those reported in previous studies. Surface layer flux data quality was assessed by looking at the surface layer heat balance. Diurnal and seasonal scale heat budget imbalances were found. We suggest that unmeasured surface heat storage may be responsible for some of the observed imbalance. The presence of the unexplained residual in this and other studies of energy balance over forests casts a note of caution on the interpretation of energy

balance components obtained using heat residual methods.

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