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A season of heat, water vapor, total hydrocarbon, and ozone fluxes at a subarctic fen

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Abstract

High-latitude environments are thought to play several critical roles in the global balance of radiatively active trace gases. Adequate documentation of the source and sink strengths for trace gases requires long time series of detailed measurements, including heat and moisture budgets. A fen near Schefferville, Quebec, was instrumented during the summer of 1990 for the measurement of the surface energy, radiation, and moisture balances as well as for eddy correlation estimates of ozone and methane flux. Despite the limited fetch at this site, analysis of the tower flux ‘‘footprint’’ indicates that at least 80% of the flux observed originates from sources within the fen. Sensible heat fluxes averaged 25% of the daytime net radiation at the site, while the latent heat flux, determined from the energy balance, was 63%; the Bown ratio varied from 0.2 to 0.8 from day to day, without a seasonal trend to the variation. The competing effects of rooted macrophyte development (with concomitant effects on roughness and transpiration) and the normal shift in synoptic pattern around day 200 to warm, dry conditions results in a lack of net seasonal effect on the energy partitioning. Over the period from days 170 to 230, the evaporation (167 mm) was double the rainfall, while the decline in water level was 107 mm, leaving a net runoff of 0.44 mm/d. The total hydrocarbon was 75–120 mg m^{-2} d^{-1}, following a diumal pattern similar to heat or moisture flux, while the daytime ozone flux was about -1.11×10^{11} molecules cm^{-2} s^{-1}. A period near the end of the experiment, during week 30, produced the strongest total hydrocarbon flux, associated with warmer deep (1 m) soil temperatures, lower fen water levels, and the late summer shift in wind direction at that time. An early summer ‘‘flush’’ of total hydrocarbon was not observed.

Index Terms: 0315 Atmospheric Composition and Structure: Biosphere/atmosphere interactions; 1818 Hydrology: Evapotranspiration; 3379 Meteorology and Atmospheric Dynamics: Turbulence.

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