



Boundary-layer measurements and surface fluxes in Arctic at the Eureka (Canada) and Tiksi (Russia) climate observatories

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This study focuses on variability of turbulent surface fluxes based on measurements made at two different sites located near the coast of the Arctic Ocean at Eureka (Canadian territory of Nunavut) and Tiksi (East Siberia). Turbulent fluxes and mean meteorological data are measured continuously and reported hourly at various levels on 10-m (Eureka) and 20-m (Tiksi) flux towers. Tower-based eddy covariance and solar radiation measurements provide a long-term near continuous temporal record of hourly average mass and energy fluxes respectively. The turbulent data are supported by additional atmospheric and surface/snow/permafrost measurements. The data show that sensible heat flux, water vapor and carbon dioxide fluxes were small and mostly irregular in the cold seasons when the ground is covered with snow. However the turbulent fluxes increase rapidly when air temperatures rise above freezing during spring melt and eventually reach a summer maximum. According to our data, strong upward sensible and latent heat fluxes are observed throughout the summer months indicating unstable (convective) conditions on average. This study also shows that the sensible heat flux, water vapor, and carbon dioxide fluxes exhibit clear diurnal cycles during the Arctic summer. This behavior of the sensible heat flux is similar to the diurnal variations in mid-latitudes in summer. On average the turbulent flux of carbon dioxide was mostly negative (uptake by the surface) in summer indicating that the Eureka and Tiksi Arctic sites are net sinks for atmospheric CO₂ during the growing season. This result is not unexpected as both Eureka and Tiksi have a summer surface that is extensively covered with vegetation. It is also found that in a summer period observed temporal variability of the carbon dioxide flux was generally in anti-phase with water vapor flux (downward CO₂ flux and upward H₂O flux). During late summer and early autumn all turbulent fluxes rapidly decreases in magnitude when the air temperature decreases and falls below freezing. Although the Tiksi and Eureka sites have general similarities in annual surface fluxes, some more detailed differences in net characteristics are investigated resulting from such phenomena as the on-shore flow from the Laptev Sea in Tiksi which is absent at the more land-locked Eureka site.