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Analysis of Surface Fluxes at Eureka Climate Observatory in Arctic

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The Arctic region is experiencing unprecedented changes associated with increasing average temperatures (faster than the pace of the globally-averaged increase) and significant decreases in both the areal extent and thickness of the Arctic pack ice. These changes are early warning signs of shifts in the global climate system that justifies increased scientific focus on this region. The increase in atmospheric carbon dioxide has raised concerns worldwide about future climate change. Recent studies suggest that huge stores of carbon dioxide (and other climate relevant compounds) locked up in Arctic soils could be unexpectedly released due to global warming. Observational evidence suggests that atmospheric energy fluxes are a major contributor to the decrease of the Arctic pack ice, seasonal land snow cover and the warming of the surrounding land areas and permafrost layers. To better understand the atmosphere-surface exchange mechanisms, improve models, and to diagnose climate variability in the Arctic, accurate measurements are required of all components of the net surface energy budget and the carbon dioxide cycle over representative areas and over multiple years. In this study we analyze variability of turbulent fluxes including water vapor and carbon dioxide transfer based on long-term measurements made at Eureka observatory (80.0 N, 85.9 W) located near the coast of the Arctic Ocean (Canadian territory of Nunavut). Turbulent fluxes and mean meteorological data are continuously measured and reported hourly at various levels on a 10-m flux tower. Sonic anemometers are located at 3 and 8 m heights while high-speed Licor 7500 infrared gas analyzer (water moisture and carbon dioxide measurements) at 7.5 m height. According to our data, that the sensible heat flux, carbon dioxide and water vapor fluxes exhibited clear diurnal cycles in Arctic summer. This behavior is similar to the diurnal variation of the fluxes in mid-latitudes during the plants growing season, with carbon dioxide uptake from the atmosphere during the day due to photosynthesis, and carbon dioxide loss to the atmosphere due to vegetation respiration during the night. However, at Eureka vegetation was a source of carbon dioxide during sunlit periods. Thus the sign of carbon dioxide flux was controlled by air temperature even during Arctic summer.