Geophysical Research Abstracts
Vol. 16, EGU2014-9259, 2014
EGU General Assembly 2014

Comparison of surface fluxes and boundary-layer measurements at Arctic terrestrial sites

Andrey Grachev (1,2), Taneil Uttal (2), Ola Persson (1,2), Robert Stone (1,2), Sara Crepinsek (1,2), Robert Albee (2,3), Alexander Makshtas (4), Vasily Kustov (4), Irina Repina (5), and Arseniy Artamonov (5)

(1) University of Colorado CIRES, Boulder, CO United States (Andrey.Grachev@noaa.gov), (2) NOAA Earth System Research Laboratory, Boulder CO, United States, (3) Science and Technology Corporation, Boulder CO, (4) Arctic and Antarctic Research Institute, St. Petersburg, Russia, (5) A.M. Obukhov Institute of Atmospheric Physics, Russian Academy Sciences, Moscow, Russia

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. This study analyzes and discusses variability of surface fluxes and basic meteorological parameters based on measurements made at several long-term research observatories near the coast of the Arctic Ocean located in USA (Barrow), Canada (Eureka), and Russia (Tiksi). 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 fluxes of the momentum, sensible heat, water vapor, and carbon dioxide are supported by additional atmospheric and surface/snow/permafrost measurements (mean wind speed, air temperature and humidity, upwelling and downwelling short-wave and long-wave atmospheric and surface radiation, snow depth, surface albedo, soil heat flux, active layer temperature profiles etc.) In this study we compare annual cycles of surface fluxes including solar radiation and other ancillary data to describe four seasons in the Arctic including spring onset of melt and fall onset of snow accumulation. Particular interest is a transition through freezing point, i.e. during transition from winter to spring and from summer to fall, when the carbon dioxide and/or water vapor turbulent fluxes change their direction. According to our data, in a summer period observed temporal variability of the carbon dioxide flux was generally in anti-phase with water vapor flux (downward CO_2 flux and upward H_2O flux). On average the turbulent flux of carbon dioxide was mostly negative (uptake by the surface) in summer indicating that the Arctic terrestrial sites are generally net sinks for atmospheric CO_2 during the growing season when surface is extensively covered with vegetation. This study also shows that the sensible heat flux, water vapor, and carbon dioxide fluxes as well as air temperature exhibit clear diurnal cycles during the Arctic summer. During the Polar winter and cold seasons, the sensible heat flux, water vapor and carbon dioxide fluxes were small and mostly irregular when the ground is covered with snow and air temperatures are sufficiently below freezing. The work is supported by the U.S. National Science Foundation (NSF) with award ARC 11-07428 and by the U.S. Civilian Research & Development Foundation (CRDF) with award RUG1-2976-ST-10.