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Annual and latitudinal variations of surface fluxes and meteorological variables at Arctic terrestrial sites

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This study analyzes and discusses seasonal and latitudinal variations of surface fluxes (turbulent, radiative, and soil ground heat) and other ancillary surface/snow/permafrost data based on in-situ measurements made at two long-term research observatories near the coast of the Arctic Ocean located in Canada and Russia. The hourly averaged data collected at Eureka (Canadian territory of Nunavut) and Tiksi (East Siberia) located at two quite different latitudes (80.0 N and 71.6 N respectively) are analyzed in details to describe the seasons in the Arctic. Although Eureka and Tiksi are located at the different continents and at the different latitudes, the annual course of the surface meteorology and the surface fluxes are qualitatively very similar. The air and soil temperatures display the familiar strong seasonal trend with maximum of measured temperatures in mid-summer and minimum during winter. According to our data, variation in incoming short-wave solar radiation led the seasonal pattern of the air and soil temperatures, and the turbulent fluxes. During the dark Polar nights, air and ground temperatures are strongly controlled by long-wave radiation associated generally with cloud cover. Due to the fact that in average the higher latitudes receive less solar radiation than lower latitudes, a length of the convective atmospheric boundary layer (warm season) is shorter and middle-summer amplitude of the turbulent fluxes is generally less in Eureka than in Tiksi. However, since solar elevation angle at local midnight in the middle of Arctic summer is higher for Eureka as compared to Tiksi, stable stratification and upward turbulent flux for carbon dioxide is generally did not observed at Eureka site during summer seasons. It was found a high correlation between the turbulent fluxes of sensible and latent heat, carbon dioxide and the net solar radiation. A comprehensive evaluation of energy balance closure problem is performed based on the multi-year data sets collected at the Arctic terrestrial sites. The work is supported by the NOAA Climate Program Office, 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.