Geophysical Research Abstracts
Vol. 21, EGU2019-4314, 2019
EGU General Assembly 2019

A robust eddy-covariance method for monitoring turbulent surface fluxes in polar regions.

Maurice Van Tiggelen, Paul Smeets, Carleen Tijm-Reijmer, and Michiel van den Broeke
Utrecht University, Institute for Marine and Atmospheric Research, Netherlands (m.vantiggelen@uu.nl)

During extreme Greenland ice sheet (GrIS) melt events, the turbulent exchange of heat between the surface and the atmosphere, or sensible heat flux, becomes the largest source of energy for melt in the surface energy balance. Measuring turbulent heat exchange in harsh and remote polar environments is particularly challenging, but is necessary to improve their representation in large-scale weather and climate models. This research aims to develop, test and apply energy-efficient methods for measuring the turbulent fluctuations close to the surface. Instead of using a conventional sonic eddy-covariance (EC) system, propeller sensors and thermocouples sampling at a higher-than-usual rate are used in order to improve both robustness and energy efficiency, at the expense of increased stochastic uncertainty. This method for estimating the surface fluxes is tested against EC instruments at the Cabauw Experimental Site for Atmospheric Research (CESAR) in the Netherlands, and is applied to existing automatic weather stations on the GrIS. We show that this method produces an unbiased estimation of the turbulent surface fluxes at the CESAR site. Furthermore, we show this simple single-level measurement approach gives more insight on turbulent exchange processes than the widely-used bulk method on the GrIS. In particular, we show that the surface roughness in the ablation area of the GrIS changes over the course of a season due to snow redistribution and melt effects. These new results are eventually used to develop new parametrizations for surface roughness and turbulent exchange processes over melting glaciers, ice caps/sheets and sea-ice worldwide, for use in weather and climate models. We conclude that this robust EC method offers unprecedented possibilities in monitoring the surface-atmosphere exchange processes in polar regions.