Geophysical Research Abstracts
Vol. 17, EGU2015-11332-1, 2015
EGU General Assembly 2015

A tilt correction algorithm for albedo measurements

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Surface albedo plays an important role in the surface energy budget of snow and ice surfaces, as it controls the amount of shortwave radiation that is absorbed. Reliable measurements of surface albedo are therefore crucial to assess the surface energy budget of ice and snow surfaces. In this context, automatic weather stations (AWSs) have proven very valuable sources of albedo data, but accurate detection and processing of errors and uncertainties in these data is imperative. One important source of error in these albedo measurements is the tilt of the sensor and/or surface, which can cause errors in the estimated absorbed radiation of up to 25%. Although this tilt error can be corrected based on accurate tilt information, it is often impossible as tilt information is lacking.

In this study we propose a tilt correction algorithm to retrieve the tilt information from the albedo time series before applying the tilt correction. The algorithm is based on the optimisation of the error between the observed albedo data and the theoretical diurnal cycle of albedo for a tilted sensor/surface. The output of the algorithm is surface/sensor tilt (slope/azimuth) with accompanying accuracy information.

Validation of the algorithm based on AWS data equipped with a tilt meter shows that the algorithm is capable of accurately extracting the slope and azimuth of the tilt. Correction of the albedo data based on the retrieved slope/azimuth shows moreover that the algorithm succeeds in restoring reliable diurnal albedo cycles from albedo measurements which were strongly affected by sensor tilt. The latter is important, because the interpretation of sub-daily variations in albedo was often impossible due to tilt.

Consequently, the tilt correction provides a valuable tool for the correction of any AWS albedo measurement without tilt information as it allows a more extensive interpretation of albedo data from AWSs.