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An improved method for detecting solid precipitation from snow depth and solar radiative flux measurements

R. Finkelnburg (1), M. Möller (2), M. Braun (3), D. Scherer (1), and C. Schneider (2)

(1) Department of Ecology, Technische Universität Berlin, Germany, (2) Department of Geography, RWTH Aachen University, Germany, (3) Center for Remote Sensing on Land Surface (ZFL), University of Bonn, Germany

Data on amount and spatio-temporal distribution of snowfall are essential to study energy and mass balance of glaciers and ice sheets. Since precipitation measurement with conventional techniques like gauges are strongly biased for solid precipitation, snow depth measurements are used as a substitute for direct precipitation measurements. Due to the fact that snowdrift can also change snow depth a false estimation of precipitation solely from snow depth measurements is possible.

At sites where snow depth is measured shortwave radiative fluxes are frequently recorded at automatic weather stations. During periods of sufficient solar radiation these records can be used to filter the snow depth data to get a better estimation of solid precipitation. The subject of this presentation is a new method for retrieving precipitation data from combined measurements of snow depth and solar radiative fluxes. The method is tested for selected sites on Vestfonna, an arctic ice cap located on Nordaustlandet, Svalbard.

A method is described to detect clear sky conditions from solar radiation and to use the obtained information to mask periods where precipitation is not possible. In a second step albedo is calculated for the remaining periods, i.e. during cloudy conditions where diffuse radiation is dominant, and results are compared with snow depth data. The relation of snowfall, changes in albedo and snow depth is used to determine periods where precipitation events did occur. Finally, an estimation of the precipitated water equivalent during these events deduced from snow depth change and concurrent alteration of the optical properties is carried out.

The constraints, uncertainties and errors of the described method will be discussed and compared with conventional approaches.