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Verification of re-analyses model output data in an Arctic glacier environment

Florian Karner (1), Friedrich Obleitner (1), and Jack Kohler (2)

(1) Institute for Meteorology and Geophysics, Innsbruck University, Department of Earth Sciences, Innsbruck, Austria (friedrich.obleitner@uibk.ac.at), (2) Norwegian Polar Institute, Polar Environmental Centre, Tromsø, Norway

Glacier mass balance modeling essentially relies on proper meteorological input. Conventional approaches employ in-situ measurements or upscaling techniques which e.g. suffer from diverse measurement problems or large distances to the nearest climate station, respectively. This is essentially true in the remote Arctic regions. Meanwhile, model re-analyses data are considered as promising alternatives and associated downscaling methods have successfully been applied over the large ice sheets.

We study the use of different re-analyses data sets for energy balance modeling in a Svalbard glacier environment (Kongsvegen glacier, 78.78° N. 13.16° E). Air temperature, humidity, wind, precipitation as well as radiation and energy balance components are tested. Two independent data sets serve for verification: 1) measurements at climate stations near to the glacier (Ny Ålesund, Longyearbyen) and 2) homogenized in-situ data at about the equilibrium line of the glacier (543m a.s.l). The investigations also include data from radio soundings and a mountain station and cover a full decade (2000 until 2010). The main study is based on monthly or daily data and particular emphasis is put on the parameters that are critical for mass balance modeling on a longer time scale (temperature, precipitation, albedo). Secondary studies aim at investigations on shorter time scales and consideration of more and differently combined data sets.

Different methods were used considering monthly biases, variable lapse rate approaches, seasonally variable pseudo-vertical gradients and regression analyses. Preliminary results indicate that model data can well reproduce measured temperature, humidity and down welling radiation components. Major deficiencies were noted with respect to precipitation, wind and surface radiation components. These shortcomings are mainly related to limited grid resolution, improper land masks and deficiencies of surface parameterizations in the models. This is also supported by the finding that the skills generally improve with elevation of the considered reference station.