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Stochastic transfer function modelling of snow depth at Polish Polar Station in Hornsund, Spitsbergen

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There is great interest in modelling snow cover at high latitudes. Unfortunately only basic long-term meteorological observations are available, making the use of distributed snowpack models impossible. This paper presents an application of a statistically efficient lumped parameter time series approach to modelling the dynamics of snow cover accumulation at the Hornsund Polish Polar Station (PPS), SW Spitsbergen. A Dynamic Stochastic Transfer Function (STF) model is developed that follows the Data Based Mechanistic (DBM) approach, where a stochastic data-based identification of model structure and an estimation of its parameters are followed by a physical interpretation. Apart from snow accumulation estimates, the model provides also the uncertainty limits. We applied this methodology to daily meteorological time-series (1983 - 2008) consisting of: average temperature, precipitation and snow height. Due to the difficult weather conditions, many observations are missing, which makes utilisation of the data even more difficult. To overcome this problem the observations were checked for consistency and data gaps filled using the Dynamic Harmonic Regression (DHR) method. An analysis of the variation in parameter estimates over the whole measurement period provides an insight into the possible influence of recent climate change on snow accumulation in Hornsund. To help explain the physical meaning of the model parameters, we classified the data into accumulation and ablation periods. The models were run for each of the periods separately. The first-order model structure was found to be the most suitable, probably due to the small variability of the snow-cover depth. We investigate the correlation of model parameters with external forcing factors, such as wind speed and wind direction and the NAO index.