MODELLING FLOW ROUTING PATTERNS IN PERMAFROST LANDSCAPES WITH TOPOGRAPHICAL WETNESS INDEX AN EVALUATION AGAINST SITE SPECIFIC WETNESS MEASUREMENTS

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Abstract

In northern peatlands the thawing of permafrost by increasing the active layer depth and in turn changes in the hydrology may lead to feedbacks in the climate system through changes in the biogeochemistry of carbon. However, it is extremely difficult to determine the temporal-spatial dynamics of the permafrost-hydrological dynamics through empirical studies. We are examining this association on the Stordalen peatland complex in subarctic Sweden by analyzing a digital elevation model (DEM) derived from high resolution LIDAR-data and the calculation of a topographical wetness index (TWI).

The DEM is tested with a spatial resolution of 1 m and the derived TWI is evaluated against one season of continuous water level measurements from 30 sites distributed over the peatland. The TWI is calculated with a form based flow routing algorithm which produce a natural flow routing pattern. In permafrost wetlands the topography is the major driver and is very important even though its magnitude is low. Site specific wetness measurements from the 30 sites were compared for the three different peatland types that occur in study area, i.e. fen, internal fen and palsa. The results showed a strong correlation between the TWI and the palsa. The TWI was better at describing general patterns than site specific hydrology. The evaluation of spatial patterns against site specific wetness reveal the resolution required to develop the technique to be useful for climate change studies.

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