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DEGREE:	Philosophiae Doctor
FACULTY:	Faculty of Mathematics and Natural Sciences
DEPARTMENT:	Department of Geosciences
AREA OF EXPERTISE:	Snow hydrology and avalanches
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DATE OF DISPUTATION:	

DISSERTATION TITLE: Snowpack hydrology and how it pertains to snow avalanche forecasting

Snø som har ligget lenge uten å smelte, kan oppta varme og fritt vann og det kan bli fare for våte snøskred. Avhandlingen handler om hvordan snøhydrologiske data kan forbedre prognoser for våte snøskred. Numerisk modellering og radarbaserte målemetoder er benyttet for å forbedre etablerte systemmodellers evne til å håndtere hydrologiske dataset i en snøpakke, for å gi bedre kunnskap om våte snøskred.

Wet snow avalanches can be extremely dangerous, and are more challenging to predict than their dry snow counterparts. In his PhD research D'Amboise has used snowpack hydrology to better understand the formation of the wet snow avalanche cycles. The most detailed snow pack modell (CROCUS) for understanding a snowpack was studied, and physical data from snowpack areas in Stryn, Norway was investigated.

Lack of modell input on the percolation fronts moving through the snowpack as a fine temporal resolution was identified as a problem to tackle for linking snow hydrology to the wet snow avalanche cycle in the CROCUS model. A physical water percolation routine was added to the model and a bulk water content measurement for monitoring the wetness of the snowpack was developed. The SURFEX atmosphere-surface coupling platform contains many models that simulate different surfaces, such as forest, sea and city. CROCUS is the most complicated snow mode embedded in SURFEX. The Richards routine is a physically based water percolation routine for the snowpack, based on established soil physics equations with parameterization adapted for use in snow. Developing the routine highlighted some not so well understood feedback mechanisms between the parameterizations used and the snow metamorphism routine.

The bulk water input measurement developed was able to monitor the wetness in a very wet snowpack. It uses a ground penetrating radar with antennas above and below the snowpack. The measurement system gave promising signs for recording the percolation front, evidence of lateral flow, preferential flow paths and the water fronts interaction with less permeable interfaces or barriers. The data recorded over one winter at a test site in Stryn, Norway suggests that a time resolution that is finer than 30 minutes is needed for investigating the fastest percolation fronts.

The studies of wet snow avalances are useful for other fields for avalanche prediction, like flood forecasting, hydro-power and catchment hydrology.