Liquid Water in Snow – Workshop 2014

From 2-4 April 2014 about 50 researchers attended the workshop „Liquid water in snow – measurements techniques and modeling approaches“ that took place at the Institute for Snow and Avalanche Research (SLF) in Davos, Switzerland – the first one since 1982 in Innsbruck, Austria.

The workshop intended to bring together researchers dealing with avalanche formation, remote sensing issues as well as other cryospheric objectives related to the snow water equivalent of snowpacks. As it was more than 30 years since the last workshop - aims and scope were to assemble the state of knowledge across disciplines to compare different measurement techniques and their accuracy, discuss current assumptions to model liquid water transport and storage in snow, and gather ideas on how to best obtain good validation and verification data.

The first day was dedicated to measuring techniques whereas the second focused on modeling approaches. The third day was organized as a field day at the Weissfluhjoch field test site to operate different measurement techniques at the same time and compare results and interpretation.

The workshop participants produced a synoptic overview on measuring and modeling water in snow. The talks and discussions revealed that our physical understanding of liquid water distribution within the snowpack still requires improvements, on the microscale as well as on emerging properties, which are considered in measurements and models. Especially the distribution and lateral movement of liquid water, the related differential flow and temporal changes urgently require treatment.

On the measurement side, a “golden standard” or compilation of methods, parameters and physical properties against which to gauge all measurement techniques is urgently needed for an objective evaluation. A long-term issue remains the application of dielectric mixing models, their homogenization and recommendations to use. The optimal combination of classical concepts (e.g. dilution, calorimetry and permittivity devices) as well as modern approaches like upward-looking radar, TDR, impedance analyzer, micro-CT, application of elastic waves and full-waveform inversion was found necessary.

Regarding models, bridging the different spatial scales, from micro-scales to hydrological catchments remains one of the largest challenges. On larger scales more simple modeling approaches still seem appropriate. However, on the scales below the snow cover thickness the application of the Richards’ equation is necessary for an adequate description.

For the future, establishing model calibration and validation requires treatment on multiple spatio-temporal scales. Higher spatial coverage with several data points in an individual catchment and more experimental sites are one recommendation. Standard experiments and suitable data sets have to be developed to achieve improvements towards data assimilation. Overall, the available techniques are partially appropriate, but insufficient for detailed considerations.

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