# MEETING

## Assessing Approaches for Determination of Liquid Water in Snow

***Liquid Water in Snow— Measurement Techniques and Modeling Approaches; Davos, Switzerland, 2–4 April 2014***

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Scientists with expertise in avalanche formation, remote sensing issues, and other cryospheric matters gathered in Davos, Switzerland, in early April for a workshop on liquid water in snow—the first such meeting since 1982. The focus of this year's workshop, held at the Institute for Snow and Avalanche Research, was to compare different measurement techniques and their accuracy, to discuss current assumptions for modeling liquid water transport and storage in snow, and to gather ideas on how to best obtain good validation and verification data.

The first day was dedicated to measuring techniques; 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 scientists' physical understanding of liquid water distribution within the snowpack still requires improvements, on the microscale and to emerging properties, which are considered in measurements and models. The distribution and lateral movement of liquid water and the related differential flow and temporal changes urgently require treatment.

On the measurement side, a "gold 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 for use. The optimal combination of classical concepts (e.g., dilution, calorimetry, and permittivity devices) and modern approaches such as upward-looking radar, time domain reflectometry, impedance analysis, micro-computer tomography, application of elastic waves, and full-waveform inversion was found to be necessary.

Regarding models, bridging the different spatial scales, from microscales to hydrological catchments, remains one of the largest challenges. On larger scales, more simple modeling approaches still seem to be 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 will require treatment on multiple spatiotemporal 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 toward data assimilation. Overall, the available techniques are partially appropriate but insufficient for detailed considerations.

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