



## **Accuracy of winter precipitation measurements in alpine areas: snow pillow versus heated tipping bucket rain gauge versus accumulative rain gauge**

Georg Leitinger (1,2), Nikolaus Obojes (1), Ulrike Tappeiner (1,2)

(1) University of Innsbruck, Institute of Ecology, Innsbruck, Austria, (2) European Academy Bolzano (EURAC), Institute for Alpine Environment, Bolzano, Italy

Accurate and continuous measurement of winter precipitation is a basic prerequisite to develop and validate snow melt schemes in hydrological models. Hence, representative measurements in mountain ecosystems need multiple replicates to cover varying topographic characteristics. Besides limitations in installation in steep terrain, continuous and accurate measurement techniques are very cost intensive and numerous samples hardly affordable. In a study on an alpine meadow (1800m a.s.l.) in the Eastern Alps, Stubai Valley, Austria, we compared precipitation measurements of a snow pillow (size 3x3m), a heated and non-heated tipping bucket rain gauge meeting the specifications of the World Meteorological Organization (WMO), and an accumulative rain gauge provided by the hydrographical service of Tyrol, Austria. Snow height was continuously recorded by an ultrasonic sensor and regularly manually validated with on-site measurements and a snow yardstick. Boundary conditions like wind-speed, air temperature and air humidity were assessed by a nearby meteorological station.

Our results provide new insights in necessary power supply for heating rain gauges in mountainous environment with limitations in power supply as well as comparability of the used measurement techniques. Additional validation data was provided from a meadow in the valley bottom (900m a.s.l.) and weather stations maintained by the hydrographical service. In order to meet practical aims, we evaluate the results according to cost effectiveness, installation effort, and applicability in mountainous terrain.