Geophysical Research Abstracts
Vol. 13, EGU2011-7647, 2011
EGU General Assembly 2011

Precipitation measurements in the Alpine environment by a cost-effective X-band weather radar

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The ability of capturing the variability of precipitation in space and time in mountainous regions is particularly important in relation to the correct prediction of storm triggered natural hazard. In the context of the project APUNCH (Advanced Process UNderstanding and prediction of hydrological extremes and Complex Hazards, www.apunch.ethz.ch), we are currently conducting several intensive experiments of precipitation observation in the inner Alpine region of the Klein Matterhorn (Canton Wallis, Switzerland). These aim at studying the influence of the Alps on precipitation formation (orographic forcing of moist air flow, condensation, convective activity, etc.), but also focus on the negative effects of the Alps on the measuring techniques (e.g. radar beam shielding and ground clutter, ground-wind influence, harsh conditions, etc.), in order to assess how these affect the reliability of measurements.

This paper describes the set-up of the installation and the first achievements obtained by the analysis of a few months of observations in both winter and summer periods. These were carried out by means of a dense network of raingauges complementing rainfall maps from an X-Band Local Area Weather Radar (LAWR) located on the top of the Klein Matterhorn (45º.95N, 7º.72E, 3883 m a.s.l., Wallis).

The work examines first the issue of the congruence of data, both among the sensors (e.g. radar vs rain-gauge) and with respect to some specific features of the physical processes to be observed (e.g. continuity in space of the precipitation). Known issues of different measurements due to different raingauge types are analysed in view of their use for radar operation and calibration. The latter are then discussed extensively, to consider a broad range of factors specific to the mountain environment that affect the quality of the radar estimates, from hardware requirements to withstand the extremely harsh conditions, to software improvements and calibration procedures aiming at overcoming problems related to beam blocking correction and anomalous propagation. A preliminary analysis of the events collection shows that the X-band rain estimates favourably compare to those obtined from composite maps derived from raingauges.