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Alpine radar conversion for LAWR

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The Local Area Weather Radar (LAWR) is a ship-born weather radar system operating in X-band developed by the DHI Group to detect precipitation in urban areas. To date more than thirty units are installed in different settings around the world. A LAWR was also deployed in the Alps, at 3883 m a.s.l. on the Kl. Matterhorn (Valais, Switzerland). This was the highest LAWR of the world and it led to the development of an Alpine LAWR system that, besides featuring important technological improvements needed to withstand the severe Alpine conditions, required the development of a new Alpine Radar COnversion Model (ARCOM), which is the main focus of this contribution.

The LAWR system is equipped with the original FURUNO fan-beam slotted antenna and the original logarithmic receiver, which limits the radar observations to the video signal (L) withour providing the reflectivity (Z). The beam is 0.95 deg wide and 20 deg high. It can detect precipitation to a max range of 60 km. In order to account for the limited availability of raw signal and information and the specific mountain set-up, the conversion model had to be developed differently from the state-of-the-art radar conversion technique used for this class of radars. In particular, the ARCOM is based on a model used to simulate a spatial dependent factor, hereafter called ACF, which is in turn function of parameters that take in account climatological conditions, also used in other conversion methods, but additionally accounting for local radar beam features and for orographic forcings such as the effective sampling power (sP), which is modelled by means of antenna pattern, geometric ground clutter and their interaction. The result is a conversion factor formulated to account for a range correction that is based on the increase of the sampling volume, partial beam blocking and local climatological conditions. The importance of the latter in this study is double with respect to the standard conversion technique for this class of radars, because it accounts for the large variability of hydrometeors reflectivity and vertical hydrometeors positioning (echo-top), which is strongly influenced by the high location of the radar. The ARCOM procedure is in addition embedded in a multistep quality control framework, which also includes the calibration on raingauge observations, and can be summarized as follow:

1) correction of both LAWR and raingauge observations for known errors (e.g. magnetron decay and heated-related water loss)

2) evaluation of the local Pearson's correlation coefficient (PCC) as estimator of the linear correlation between raingauge and LAWR observations (logarithmic receiver);

3) computation of the local ACF in the form of the local linear regression coefficient between raingauge and LAWR observations;

4) calibration of the ARCOM, i.e. definition of the parametrization able to reproduce the spatial variability of ACF as function of the local sP, being the PCCs used as weight in the calibration procedure.

The resulting calibrated ARCOM finally allows, in any ungauged mountain spot, to convert LAWR observations into precipitation rate. The temporal and the spatial transferability of the ARCOM are evaluated via split-sample and a take-one-out cross validation. The results revealed good spatial transferability and a seasonal bias within 7%, thus opening new opportunities for local range distributed measurements of precipitation in mountain regions.