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Radar rainfall estimation for flash floods and debris flows analysis: application of the mountain reference technique at C-band frequency

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This work is dedicated to radar rainfall estimation for the post-event analysis of two storm events occurred on 16-17 July 2009 and on 30 July 2009 on the Upper Adige river system, in the Central Italian Alps. The high rainfall amounts triggered flash floods, landslides and debris flows causing damages to properties and to the road system. The storm events were observed by means of a C-band weather radar system and a rain gauge network enabling the validation of radar rainfall amount estimates with fine time resolution. Results obtained by applying a number of corrections to radar reflectivity measures are described. Particular attention is paid on application of the mountain reference technique on signal attenuation, screening and vertical profile of radar reflectivity. Signal attenuation is corrected for by using the Mountain Reference Technique.

The worth of using the Mountain Reference Technique is demonstrated to quantify rain attenuation effects that affect C-band radar measurements in heavy rain. Maximum path-integrated attenuation of about 5.5 dB were measured thanks to mountain returns for path-averaged rain rates up to 90 mm h-1 over a 50 km path. Screening effects were quantified based on a numerical model of the radar beam propagation and using a digital terrain model of the monitored region. Ground clutter and beam blockages were used to check the correct geo-referencing of the radar rainfall estimates.

The worth and the uncertainties of using radar rainfall estimates for the analysis of very localised events as flash floods, debris flows and landslides is discussed.