3.1 A RENDEZVOUS OF RESEARCH AND OPERATIONS THE NEW SWISS RADAR GENERATION

U. GERMANN[1], M. GABELLA[1], H. BARRAS[12], Y. BARTON[12], N. BESIC[13], M. BOSCACCI[1], L. CLEMENTI[1], J. FIGUERAS[1], L. FORESTI[1], J. GRAZIOLI[1], U. HAMANN[1], A. HERING[1], D. NERINI[14], L. NISI[1], L. PANZIERA[1], M. SARTORI[1], I. SIDERIS[1], S. TREFALT[12], F. VAN DEN HEUVEL[13], B. CALPINI[1]

[1] MeteoSwiss, Locarno-Monti, Switzerland
[2] University of Bern, Mobiliar Lab for Natural Risks, Switzerland
[3] Environmental Remote Sensing Lab, EPFL, Lausanne, Switzerland
[4] Institute for Atmospheric and Climate Science, ETH, Zurich, Switzerland
urs.germann@meteoswiss.ch

The renewal and extension of the operational Swiss radar network is completed. The design was driven by the needs of air traffic control, civil protection and hydrology requiring high stability, availability and accuracy. The complex terrain in the Swiss Alps and the demands for new and customized products also require adapted data processing and flexibility for continuous improvements. Furthermore, two new radar stations are located on mountain tops close to 3000 meters above sea level, a challenge for installation, operation and data processing. The system combines fully-digital dual-polarization Doppler receiver-over-elevation technology and has triggered an avalanche of innovation and research. The paper presents the design and performance of the network and discusses recent achievements and ongoing research.

More than 350 system parameters are monitored and submitted from each radar to the central server after completion of every single sweep, that is 20 times in five minutes. The parameters are crucial for the surveillance of unmanned stations on remote mountain tops and are automatically checked for anomalies and archived for diagnostic analyses.

Dual-polarisation capability has proved its practical usefulness in short time. The incorporation of polarimetric moments in the clutter suppression substantially improved the distinction between mountain returns and weather, especially in regions with Doppler velocity close to zero. A semi-supervised polarimetric hydrometeor classification was developed and implemented. The usage of dual-polarisation for attenuation correction and QPE is under investigation. The QPE processing chain is currently being re-designed with the aim to incorporate dual-polarization and hydrometeor-specific processing and to replace the VPR correction operational since 2001 with a novel approach for vertical extrapolation.

The operational space-time kriging-with-external-drift technique for real-time integration of radar and rain-gauge data has recently been upgraded to 5-minute resolution. This was possible thanks to the development of new algorithms for automatic identification of outliers and proper treatment of representativeness errors of gauge data in convective rain.

For seamless blending of QPE, Lagrangian nowcasts and NWP forecasts we are currently testing flow-dependent methods using local anisotropic correlated noise and a Kalman-ensemble filter. Furthermore, we are exploring the added value of

machine learning techniques trained on 10+ years of radar imagery to predict flow-dependent growth and decay as precipitation moves over the orography. The QPE archive has also been used to derive a radar-based study of extreme rainfall over Switzerland.

For the nowcasting of convective storms radar cell tracking is integrated with satellite and lightning data and the operational nowcasting systems TRT and COALITION are continuously being improved. In addition to the existing single-polarization hail algorithms hail is identified operationally in 3D using dual-polarization moments. In order to verify and re-calibrate radar hail algorithms hail information from three independent sources is combined: crowd sourced reports from users of the MeteoSwiss weather app, insurance damage claims, and kinetic energy and diameter of hail stones observed by a new network of 80 automatic hail sensors currently under construction. The combination builds the basis for automatic hail nowcasts and a new hail climatology over Switzerland.