Absolute dual-polarization radar calibration: temperature dependence and stability with focus on antenna-mounted receivers and Noise Source-generated reference signal

Dennis Vollbracht
Research and Development Department, Selex ES GmbH, Germany
Sartori, Maurizio (Collaboratore scientifico Divisione Radar, Satellite e Nowcasting, MeteoSvizzera, Locarno-Monti, Svizzera)
Gabella, Marco (Collaboratore scientifico Divisione Radar, Satellite e Nowcasting, MeteoSvizzera, Locarno-Monti, Svizzera)

E-mail: d.vollbracht@gematronik.com

In 2011 MeteoSwiss started renewing and extending its operational C-band weather radar network. The three existing radars have been replaced by state-of-the-art polarimetric Doppler radars with antenna-mounted receivers (AMR); two additional systems at high altitude are foreseen (one of them will be soon operational).

After two years of operational atmospheric monitoring, MeteoSwiss is satisfied of the AMR system concept choice, also in view of the necessary constrains related to maintenance and temperature control inside the radome.

Main advantages of AMR systems are the reduced receive path losses and the innovative waveguide path, in which the single-channel azimuth and elevation rotary joints do not introduce differential phase and amplitude biases during transmit and receive.

The key aspect in the Swiss receiver design is the use of a noise source as absolute reference for calibrating the radar system. Most important benefits of this calibration solution are the high temperature stability, online monitoring of TR Limiter losses, online noise figure measurements, Hi-Low Calibration for the Dynrex solution (dynamic range extension) and the online absolute calibration of the high sensitivity channel, since most of the metrological echoes are between -114 dBm and -50 dBm. The term “online” describes a calibration performed twice during the 5min volume scan by injecting the noise signal in defined range gates.

This presentation describes the AMR concept and the inherent radar calibration concept by focusing on the temperature-dependence on the horizontal and vertical receiver chain and the calibration noise source. The receiver temperature dependencies for reasonable day/night cycles derived by field measurement on all Swiss radar sites are verified with lab measurements in an oven. The bias depending on temperature for differential polarimetric measurements (ZDR) is analyzed and discussed.

Finally a recommendation about temporal calibration cycles for AMR systems is given to assure accurate absolute radar calibration.