# Application of the self-consistency among the polarimetric variables to improve the precipitation estimation

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The self-consistency among the radar horizontal reflectivity (Zh), differential reflectivity (Zdr) and specific differential phase (KDP) has been revealed from many in-situ raindrop spectral observations. It depends on radar wavelength but it is insensitive to the variability of the drop size distribution. In this study, two radar calibration methods proposed by Ryzhkov et al. (2005) and Gourley et al. (2009) using the self-consistency theory have been used to detect Zh biases on the French operational weather radars working at S, C and X bands. The results have been compared to those obtained from the monitoring of ground clutter echoes. The Ryzhkov’ s method working at radar gates can determine the Zh bias with a large sample size. However, its incertitude is very sensitive to the quality of KDP estimation. The high (or low) KDP values obtained from the self-consistency relationship tends to be always larger (or smaller) than the KDP estimated from Phidp. As a result, the determined Zh bias is unstable, varying vastly from light rain cases to intense rain situations. The Gourley’ s method working on entire radar rays is independent from the KDP estimator. However, the sample size of radar rays selected in the calibration is often too small. Sensitivity tests of the thresholds used in this method are carried out for S, C and X bands radars, respectively. With the new thresholds, daily Zh calibration is achieved with error less than 1 dB.

If the Zh and Zdr measurements are known to be well calibrated, the Ryzhkov’ s method can be used to improve the KDP estimation. In current study, a well calibrated radar is selected to investigate the difference between the estimated and consistent KDP as function of Phidp smoothing/regression window length and radar reflectivity. A small (large) difference can indicate a good (bad) KDP estimation. This schema allows an optimization of the smoothing/regression window length in the KDP estimation for each reflectivity value. We have tested this adapted KDP estimator in our radar processing chain with a new rain-gauge adjustment system and shown improvements on quantitative precipitation estimation.

Keywords: Precipitation estimation, Dual polarization radar, Self consistency