Validation of polarimetric relations for snow estimation on radar data

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In previous work, bivariate power law polarimetric relations for snow estimation, $S(K_{DP}, Z) = \gamma K_{DP}{}^{\alpha} Z^{\beta}$, were developed utilizing 2D video disdrometer measurements in Oklahoma. Herein, these relations are generalized for the range of particle aspect ratios from 0.5 to 0.8 and the width of the canting angle distribution from 0 to 40 degrees and validated via analytical/theoretical derivations and simulations. Additionally, a novel $S(K_{DP}, Z_{dp})$ polarimetric relation which depends on the ratio between the reflectivity difference Z_{dp} and specific differential phase K_{DP} is derived. Both Z_{dp} and K_{DP} are similarly affected by the particles' aspect ratio and width of the canting angle distribution, therefore the ratio Z_{dp}/K_{DP} tends to be invariant to the changes of the two parameters. The $S(K_{DP}, Z)$ and $S(K_{DP}, Z_{dp})$ polarimetric snow relations are applied to the polarimetric S-band WSR-88D data obtained from Oklahoma, Colorado, and Virginia, and their performance is compared to the standard $S(Z)$ relations estimations and ground snow measurements. The polarimetric estimates from all three regions are in general more accurate than the ones from the $S(Z)$s, suggesting the potential for improved estimations of snow with polarimetric radar.

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