1-year evaluation of non-meteorological echo removal for two C-band radars using dual-pol fuzzy logic

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Since January 2017, the Royal Netherlands Meteorological Institute (KNMI) operates two new dual-polarization C-band weather radars in Simultaneous Transmission And Reception (STAR; i.e., horizontally and vertically polarized pulses are transmitted simultaneously) mode. Data from these radars are composited to obtain operational 2-D rainfall products for the Netherlands. These products are extensively used for e.g. nowcasting, water management, and climatological purposes.

Despite the application of Doppler filtering, remaining ground echoes due to anomalous propagation still pose a problem. Moreover, remaining sea echoes can be abundant. This calls for additional filtering algorithms.

The polarimetric radars offer new opportunities for ground clutter removal. Here we explore the effectiveness of the open-source wradlib fuzzy logic classification, extended with the depolarization ratio and the clutter phase alignment. Static clutter map and radial velocity were not taken into account. Note that already Doppler filtering has been applied, making it less logical to use radial velocity in the fuzzy logic, which also aims to remove non-stationary targets. Optimal weights and threshold are determined employing a 4-h calibration dataset from one radar near the coast. These are applied to a full year of volumetric data from the two radars in this temperate climate.

The verification focuses on the presence of remaining ground echoes by mapping the number of exceedances of radar reflectivity factors for given thresholds. Moreover, accumulated rainfall maps are obtained to detect radar pixels with unrealistically large rainfall depths. The results are contrasted to those for which no further filtering has been applied. Verification against rain gauge data reveals that only little precipitation is removed. Despite the fuzzy logic algorithm removing many non-meteorological echoes, compositing data from both radars in logarithmic space (as opposed to linearly averaging reflectivities) remains necessary to reduce non-meteorological echoes to an acceptable level.

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