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Classification of Non-Meteorological Echoes from Finnish and Turkish Dual-Polarization Weather Radar Data

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At present the usual approach in weather radar measurements is to reject a major part of non-precipitating echoes as "clutter". Such solutions can destroy valuable meteorological and ecological multi-purpose information [Leijnse et al. 2016]. Efficient utilization of non-meteorological information in various applications requires that objective classification tools are available. Preferably, they should be probabilistic, that is, the classification scheme should provide the probability of each measurement bin belonging to a given target class.

This work proposes a naive Bayesian classifier utilizing labeled training data selected by an experienced radar meteorologist who is also familiar with biological phenomena. The primary application is identification of birds and insects. The naive Bayesian classifier is used for two main reasons: it provides a computationally simple stand-alone classification tool and it can be used as a baseline for verification of more advanced methods [e.g. Mäkinen et al. 2016].

The features used as input for the classification include reflectivity (Z), differential reflectivity (ZDR), co-polar correlation coefficient (RHOhv), radial doppler velocity (V) and (normalized) standard deviation of Z and ZDR. The classes used include aircraft, ships, birds, insects, buildings, ground clutter & anomalous propagation, chaff, drizzle, external emitter, noise, rain or dry snow, attenuated rain, reflection, sea clutter and wet snow. Nonparametric techniques are used for estimating the class densities. The advantage of this approach is that no prior assumptions on the shapes of the distributions are required. Incorporating auxiliary information (e.g. melting layer height from NWP) in the classification via prior probabilities is also demonstrated.

One objective of the study is to find out whether the classification algorithms developed for the Finnish radar data is applicable elsewhere. Dual-polarization radar data from both Finland and Hatay, Turkey are employed for this purpose. The data from Finland is from three radars in 2012 and 2013, and the Hatay data is from 2016 on days when no precipitation was recorded. Between the two radars, statistical variations in the dual polarization moments, especially the RHOhv attained from insects, were observed.