MMW.P07

Using the Correlation RHO_{LDR} Between the Co and Cross Channel for Target Classification of Cloud Radar Data

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Linear Depolarization Ratio (LDR) is the the key parameter for filtering Insects from cloud radar data. Unfortunately signals from Melting Layer have similar LDR values as insects.

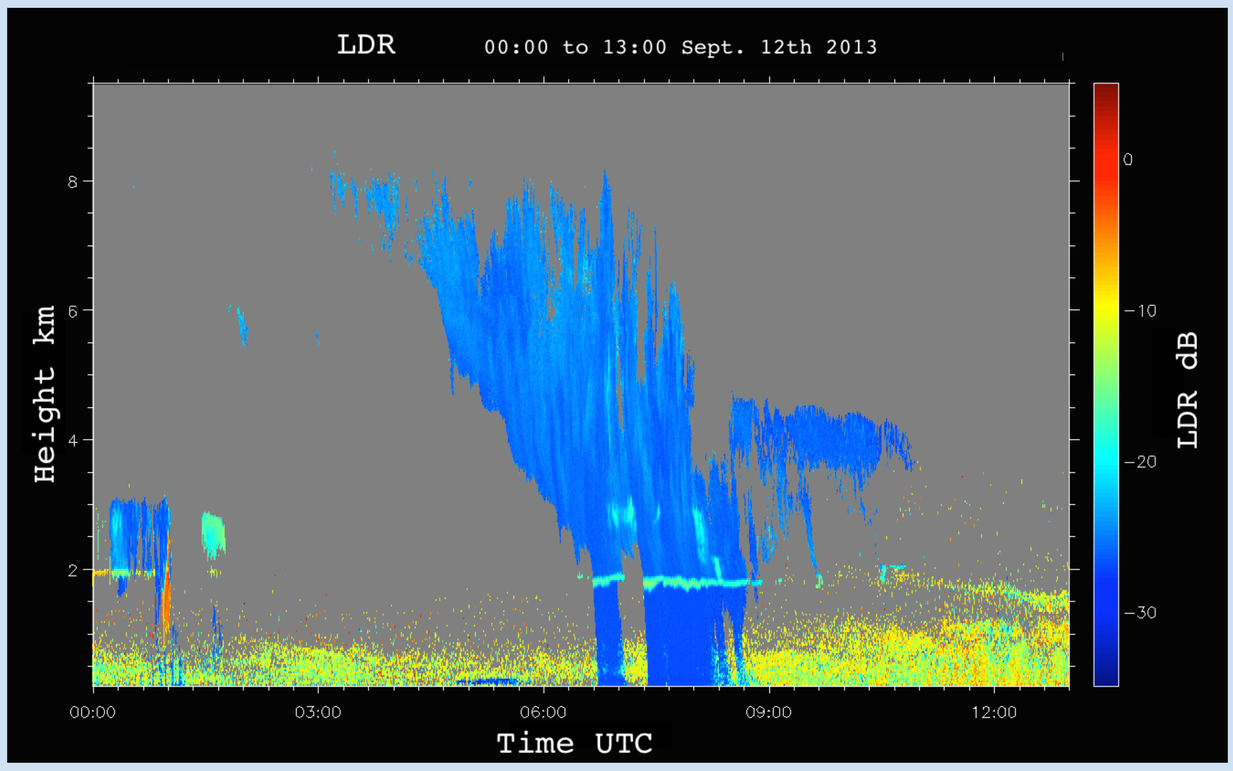
LDR is calculated by averaging the Power spectra of co and cross channel:

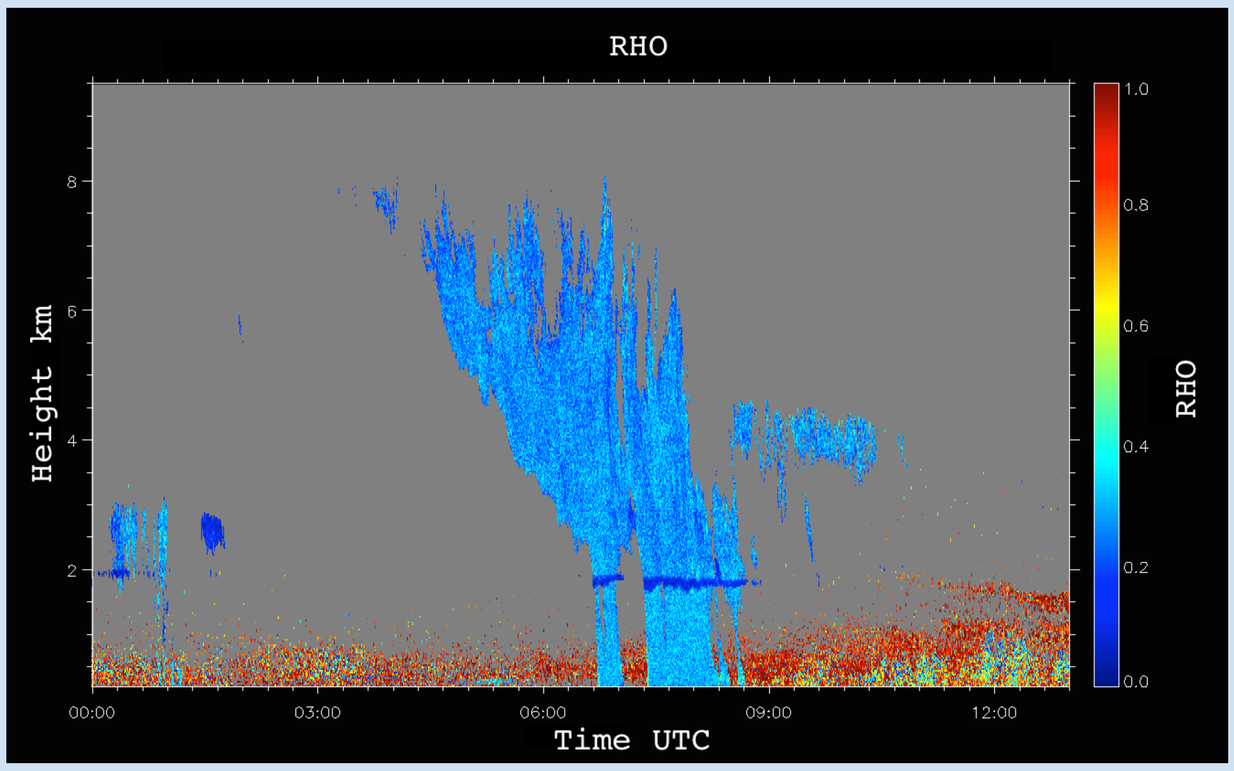
$$LDR = \frac{\langle S_{Cross} S_{Cross}^* \rangle}{\langle S_{Co} S_{Co}^* \rangle}$$

For cloud radars operating in LDR mode (transmitting with one polarization and receiving co and cross polarized signals) the correlation between the co and the cross polarized signals RHO_{LDR} has rarely been investigated.

RHO_{LDR} is calculated by averaging the complex correlation spectra:

$$RHO_{LDR} = \frac{|\langle S_{Co} S_{Cross}^* \rangle|}{\sqrt{\langle S_{Co} S_{Co}^* \rangle \langle S_{Cross} S_{Cross}^* \rangle}}$$





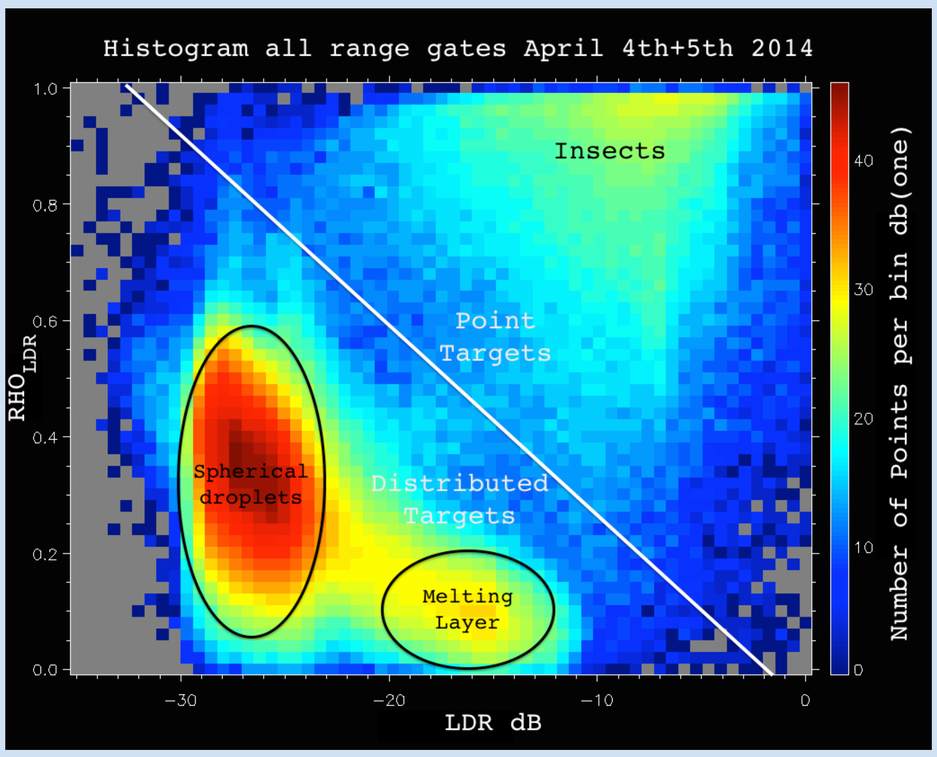
Low LDR ⇔ Spherical Targets
High LDR ⇔ Non-Spherical larger Targets

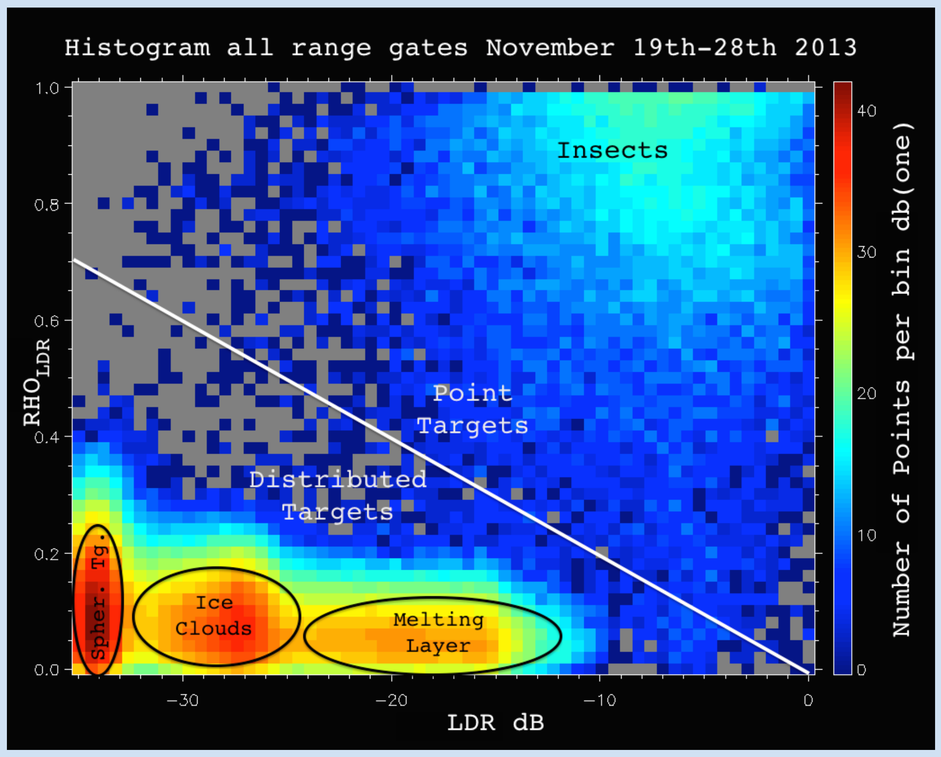
Low RHO_{LDR} ⇔ Distributes Targets
High RHO_{LDR} ⇔ Point Targets

This can be explained with help of the co-cross cannel differential phase introduced by the antenna, which undergoes large variations within the solid angles of the main beam. See "Utilization of the covariance matrix in cloud radars" Alexander Myagkov, Session 2.

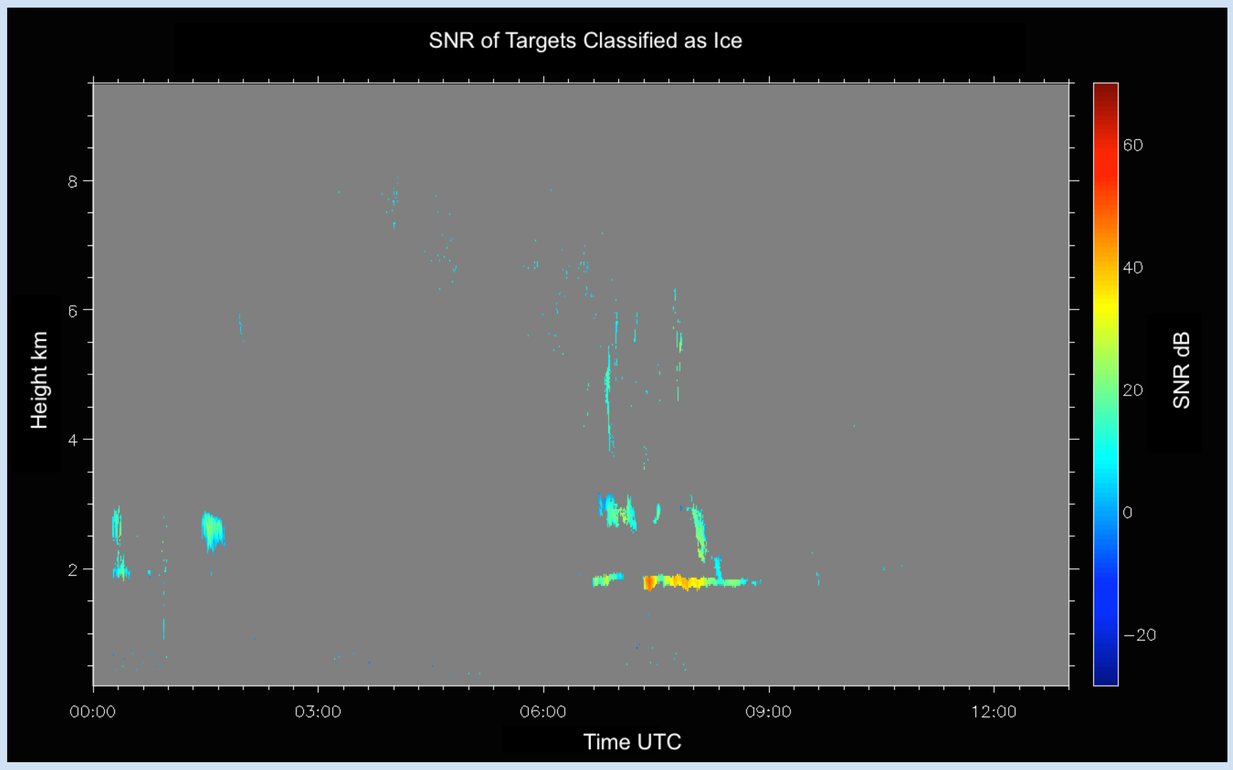
With both parameters together ice and Insects can be separated because RHO_{LDR} is high in insects and low in the melting layer:

Antenna with Moderate Polarization Decoupling





Antenna with Very Good Polarization Decoupling



By selecting regions in the LDR -- RHO_{LDR} surface (as indicated in the pictures above) we improved our target classification algorithm MMCLX (https://ams.confex.com/ams/33Radar/techprogram/paper_123456.htm)
This specially improves the separation between insects and the melting layer. The picture on the left shows regions classified as melting layer or larger ice crystals by this updated algorithm. Without using RHO_{LDR} insects and melting layer could only be separated based on external temperature information.

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Wetter und Klima aus einer Hand
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TROPOS
Leibniz-Institut für Troposphärenforschung
Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages
TeFiS
Technologie für Flugverkehrsmanagement in großen Strukturen
ITaRS
Initial Training for atmospheric Remote Sensing