Utilization of the covariance matrix in cloud radars

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The literature review shows the high efficiency use of the covariance matrix and its derivatives, such as cross-channel correlation and mean differential phase shift, in weather radars for the classification of precipitations and their intensity estimations. Nevertheless at the moment polarimetric methods are still not widely used in cloud radars. Therefore we have started theoretical investigations as well as experimental studies based on the 35 GHz cloud radar MIRA35 for evaluation of the polarimetric methods. In this presentation we will show the preliminary results obtained in collaboration of Leibniz Institute for Tropospheric Research (TROPOS, Leipzig, Germany) and the cloud radar manufacturer METEK (Elmshorn, Germany) within the Initial Training Network ITARS. It will be shown that the combined analysis of the covariance matrix and complex antenna patterns of the cloud radars gives additional possibilities for atmospheric remote sensing. First, it makes it possible to distinguish between point and distributed targets. Second, it is known that polarimetric measurements can be influenced by polarization leakage. This problem is especially important for the cloud radars operating in polarization diverse mode. The covariance matrix decomposition provides a way to define the source of leakage (waveguides with OMT or antenna) and to correct both coherent and non-coherent polarization leakages that are produced in the radar antenna system. Third, it will be shown that for specific antennas the cross-channel correlation and differential phase shift can be used for shape estimation in scanning regime. The main feature of these parameters is their sensitivity to slightly non-spherical particles.