Prospective Methods for Retrieving Cloud Parameters Using Radar Measurements

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NOAA Environmental Technology Laboratory (ETL) was among the pioneering organizations which about a decade ago began extensive quantitative studies of non-precipitating clouds using ground-based millimeter wavelength radar. In addition to radar, a suite of ground-based radiometers (IR and microwave) and lidars are used now for ETL cloud research. A number of the remote sensing methods has been developed for retrieving radiatively important cloud parameters such as characteristic particle size, liquid/ice (depending on cloud phase) water content and cloud particle number concentration. The simpler methods that use limited observational input provide layer-average values of these parameters while more sophisticated ones allow the retrievals of vertical profiles. Figure 1 shows a example of layer average ice cloud median size and ice water path (squares) of a cirrus cloud retrieved using the method described by Matrosov et al. (1992). The results of this retrieval are compared with a later technique (Mace et al. 1998) which is based on the same principals but uses interferometer instead of IR radiometer measurements. Figure 2 shows an example of the retrievals of liquid water content profiles in a marine stratocumulus cloud using the technique described by Frisch et al. (1995). The method for retrieving vertical profiles of ice cloud microphysical parameters uses measurements of radar reflectivity, Doppler velocity and IR and microwave brightness temperatures (Matrosov 1997). Figure 3 depicts an example of the time-height cross sections of cloud parameters obtained using this method for the observational case which was used for the layer averages estimates in Figure 1. The results of these retrievals were verified by in situ measurements from aircraft passing over the ground-based instruments. The agreements for cloud particle median size and ice water content retrievals were about 30% and 50%, respectively. Such agreements should be considered good given very high natural variability of these cloud parameters (over several orders of magnitude).

References

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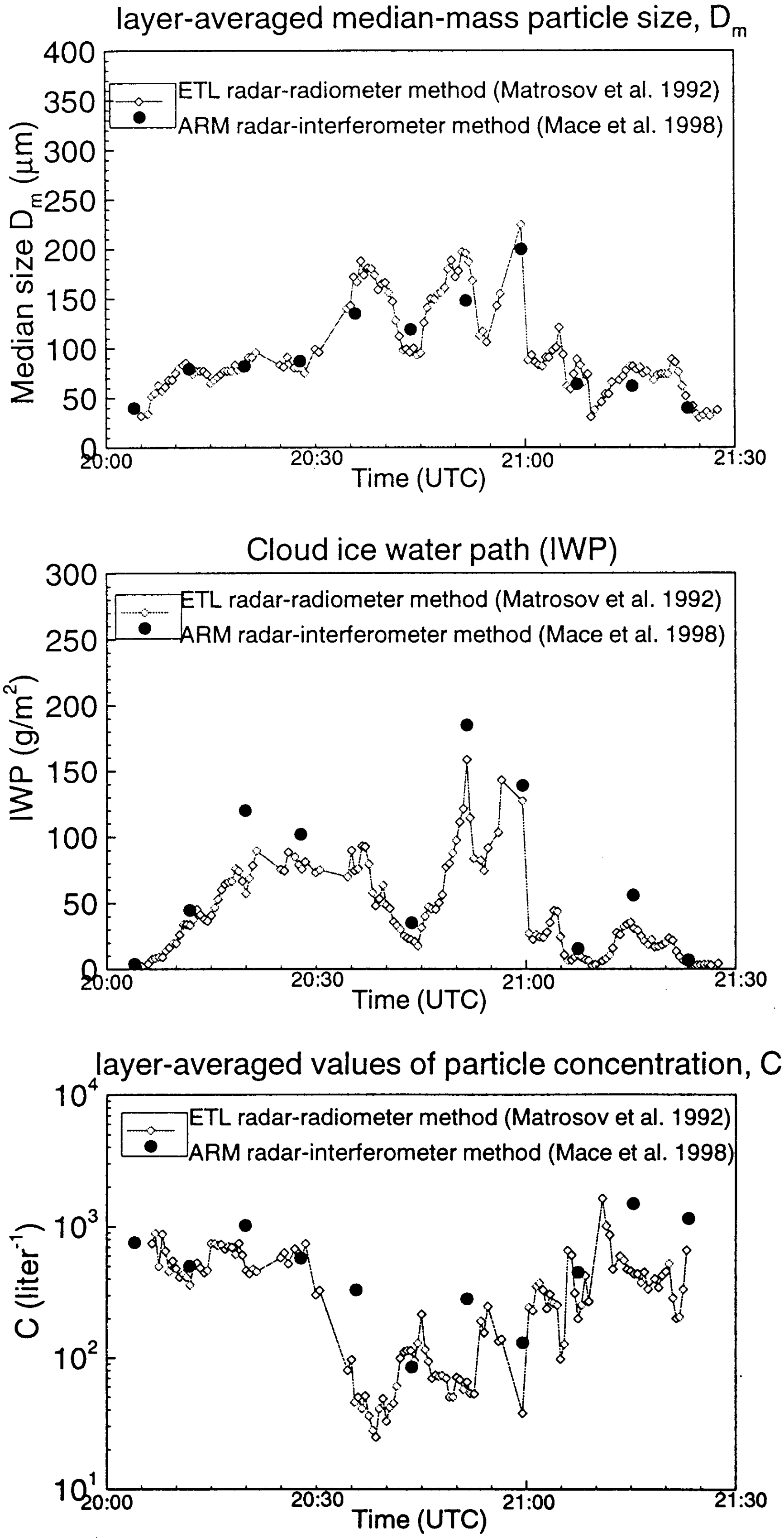

Figure 1. Comparisons of the ice cloud layer average parameter retrievals

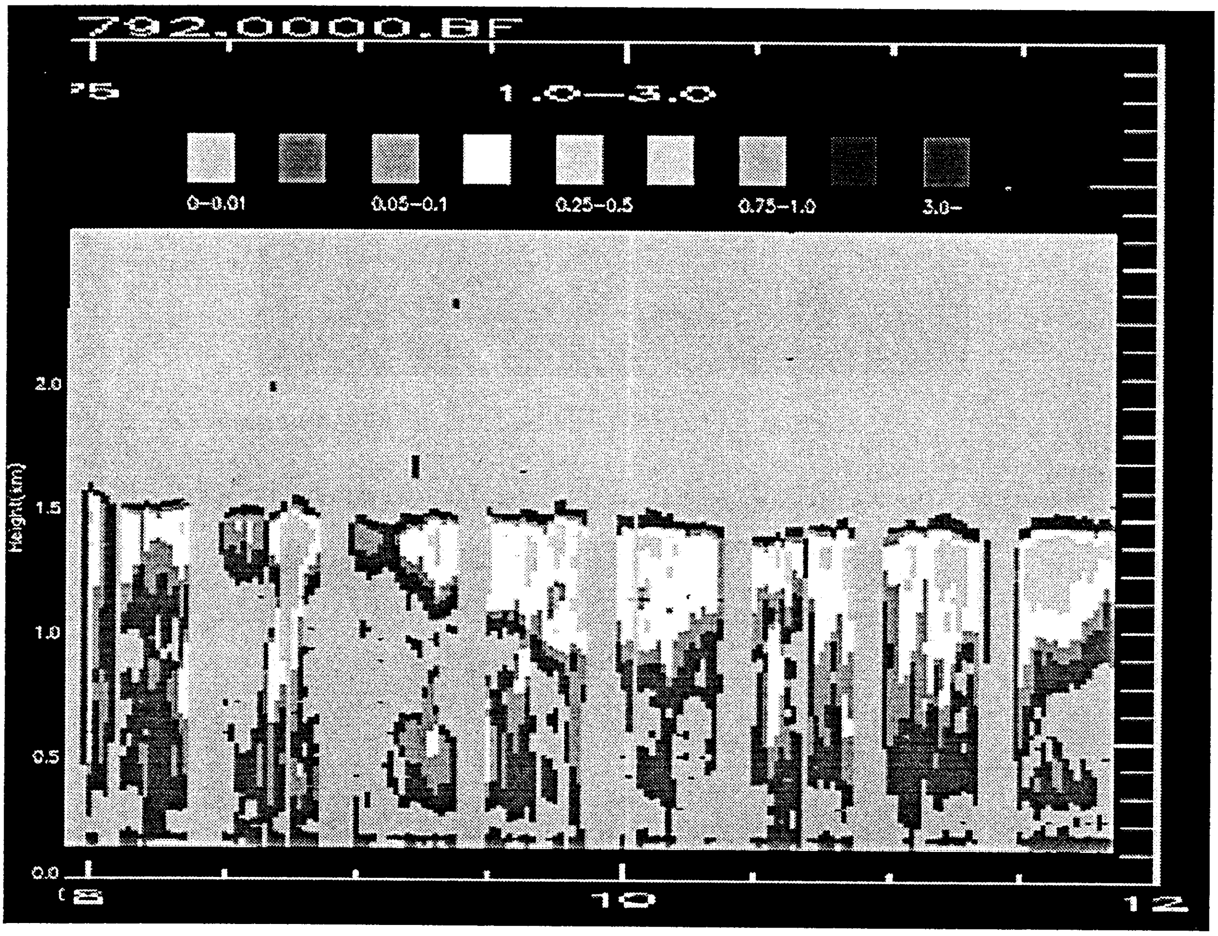

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Figure 2. Time-height cross-section of liquid water content (in g/m^3) retrieval

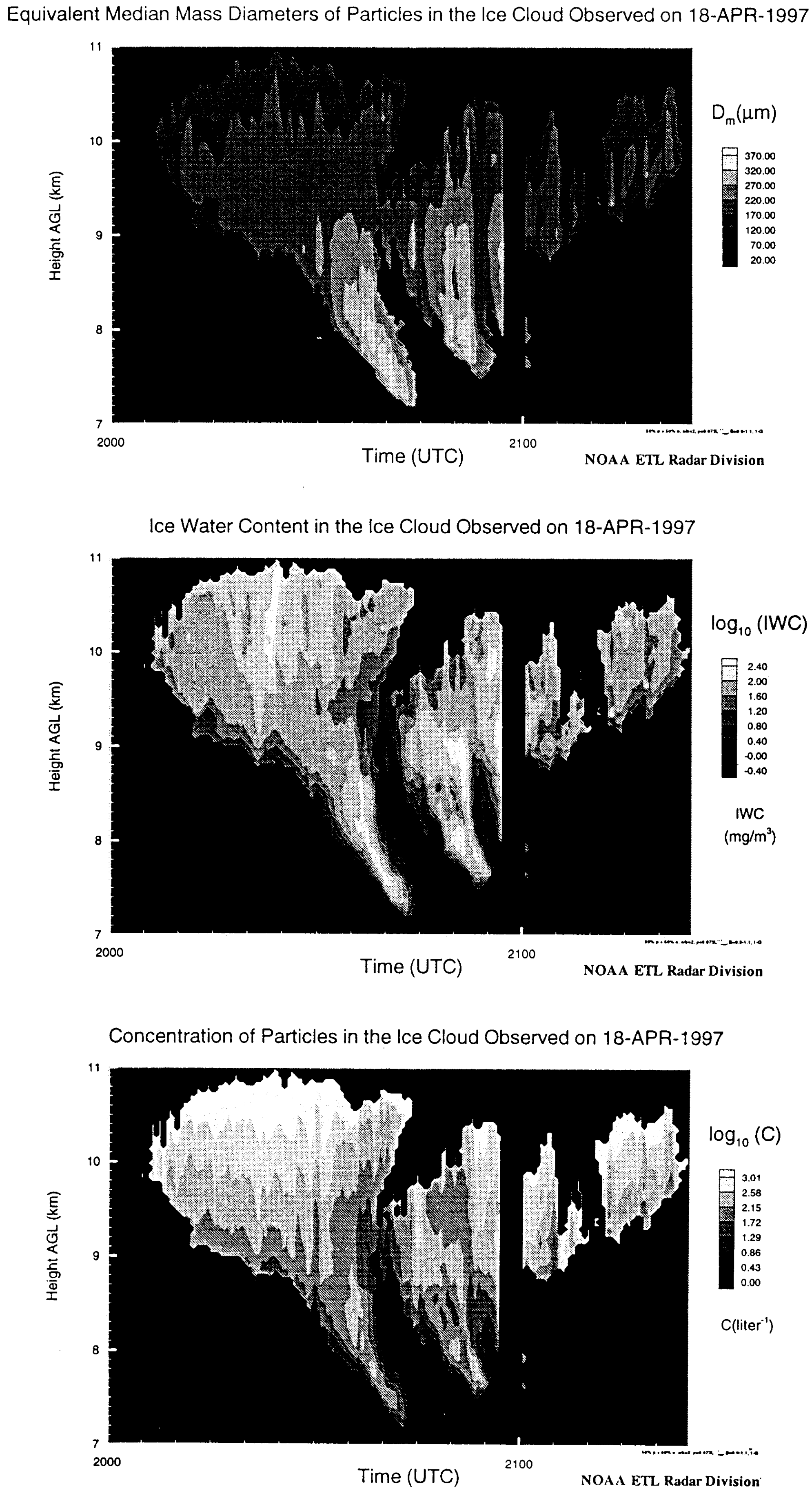

Figure 3. Time-height cross-sections of ice cloud parameter retrievals