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1 Detection of liquid droplet using ground-based polarization and dual-wavelength radar and radiometer

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The development of remote sensing methods to detect, measure, and map cloud liquid water content (LWC) is in its infancy, but has enormous potential benefits for basic cloud physics research and detection of supercooled liquid droplets. One of the methods uses dual-wavelength radar and relies on the fact that the shorter of the two wavelengths is more strongly attenuated by liquid water than the longer wavelength. For Rayleigh scattering conditions (hydrometeors much smaller than the radar wavelengths), the range derivative of the observed wavelength reflectivity difference is linearly related to the LWC of the cloud in that location. Studies such as those by Gosset and Sauvegeot (1992), Martner et al. (1993) and Vivekanandan et al. (1999, 2001) have demonstrated the feasibility of such a system for estimating range resolved liquid water content along the beam path. The retrieval of liquid water content is confounded by the presence of larger hydrometeors, either ice or liquid, in the Mie-scattering size range (where the particle diameter is no longer much smaller than the radar wavelength).

Matched-beam dual wavelength radar with appropriate sensitivity is capable of detecting liquid droplets when Rayleigh scattering dominant. However, in the case of mixed phase (liquid and ice) and in Mie scattering, detection of liquid water content is possible only when absorption and scattering components are separated using a combination of radar (Gaussiat, and Savvageot, 2003) and radiometer measurements. Recently, a dual-wavelength S and K_a-band radar system with matched resolution volume and sensitivity was built to remotely detect supercooled liquid droplets. The radar system was deployed during the Winter Icing Storms Project 2004 (WISP04) near Boulder, Colorado to detect and estimate liquid water content. Also, a dual-wavelength microwave radiometer was collocated with radar for estimating liquid water path along slant path along radar scan coverage. Observations were collected in both non-precipitating and lightly precipitating clouds. A brief description of dual-polarization and dual-wavelength radar and dual-wavelength ground-based microwave radiometer observations that relate to detection of liquid droplet will be discussed.

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