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Atmospheric Measurement Techniques Discussions

Interactive comment on "Combining cloud radar and radar wind profiler for a value added estimate of vertical air motion and particle terminal velocity within clouds" *by* Martin Radenz et al.

Anonymous Referee #1

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This manuscript describes how to estimate vertical air motion using two vertically pointing radars operating at different frequencies positioned next to each other. The longer wavelength radar (frequency of 482 MHz) can detect both Bragg scattering from turbulence refractive gradients and Rayleigh scattering from hydrometeors. The shorter wavelength radar (frequency of 35 GHz) is sensitive to Rayleigh and non-Rayleigh scattering from hydrometeors. By examining the Doppler velocity spectra from both radars, the Bragg scattering signal can be isolated in the 482 MHz radar spectra and used to estimate the vertical air motion during precipitation events.

General Comments

The analysis presented in this manuscript is appropriate for Atmospheric Measurement Techniques. After a couple suggested changes, this manuscript should be ready for publication.

Specific Comments

1. Equations (1), (5), (6), and (7). The term dˆ3 is not needed in these equations and is not defined in the text. I expect that "d" is raindrop diameter, but "D" is defined as the raindrop diameter in the text. Also, the variable eta(r) denoting the volume reflectivity includes the influence of raindrop diameter. Thus, raindrop diameter does not need to be explicitly stated in the equations.

2. Page 3, line 10. For completeness, the backscattered cross section sigma(D) should be a function of radar operating frequency (or wavelength). Since the backscattering cross section at 35 GHz includes both Rayleigh scattering for small drops and non-Rayleigh scattering from larger drops, this should be reflected in the variable of sigma(D).

3. Page 3, line 10, equation (1) and also page 9, lines 1-14. Since the calibration is using small raindrops that are in the Rayleigh regime, it would make sense to include after equation (1) the Rayleigh and non-Rayleigh dependence in the 35 GHz backscattering cross-section (see comment #2 above). While this is discussed in the Discussion section (page 21, line 1), Rayelgih and non-Rayleigh scattering should be mentioned near the text developing equation (1).

4. Page 9, lines 1-14. Is there any attenuation correction performed while implementing the calibration procedure? Even if there is not an attenuation correction performed, please include in the manuscript the need to account for attenuation at 35 GHz while performing the reflectivity estimation. Also, is this calibration procedure only performed at low altitudes, when the attenuation will be smaller than at further ranges?

5. Page 4, lines 1-12, and Fig. 2. The diagram shown in Fig. 2 reminds me of a figure

from Ralph (J. Atmos. Oceanic Technol. 257-267, 1995) showing the sensitivities of Bragg and Rayleigh scattering. But, the Ralph figure only goes up to a frequency of 10 GHz.

6. Page 8, line 1. Please clarify the expression, “is calculated by subtracting the RWP retrieved air velocity from the cloud radar derived Doppler velocity”. This “subtraction” could mean the subtraction of power within Doppler velocity spectrum, or could mean the subtraction of velocity moments between different radars. Also, the “subtraction” could mean the shift in Doppler velocity spectrum before estimating the moments.

I thought the rest of the manuscript read very well with good descriptions of the algorithm and the applications.

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