Atmos. Chem. Phys. Discuss., 11, C6380–C6384, 2011
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol concentration and size distribution measured below, in, and above cloud from the DOE G-1 during VOCALS-REx" *by* L. I. Kleinman et al.

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Response to Interactive Comment by S. Lance

I thank Dr. Lance for calling to our attention problems with CDP and CAS probes, specifically the high incidence of coincidence errors at cloud droplet number concentrations (CDNC) as low as 200 cm-3. Evidence for the coincidence problem is contained in an article "Water droplet calibration of the Cloud Droplet Probe (CDP) and in-flight performance in liquid, water, and mixed-phase clouds during ARCPAC", Atmos. Meas. Tech., 3, 1683-1707, 2010, by Lance et al. This article is about the CDP probe but notes similarities between the CDP and CAS probes. Further work in progress by Dr.

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Lance, as described in the Comment, shows that the CAS probe has a similar problem. Undercounting of droplets at CDNC > 200 cm-3 could account for the sublinear response of CDNC to pre-cloud aerosol (Fig. 10 of Kleinman et al, 2011, ACPD) which is usually interpreted in terms of a lower fraction of aerosols activated at higher aerosol concentration, due to competition between particles for water vapor.

The results of Lance et al (2010 and work in progress) must be taken seriously because of the high quality of their analysis and the importance to understanding the indirect effects of aerosol on radiative forcing.

In the Comment and in Lance et al (2010) it is noted that a CAS probe used for a field campaign in 2002 did not have a coincidence – undercounting problems (Conant et al, JGR, 2004), suggesting that DMT has since made changes to the probe. That there have been changes to the probe, albeit unrelated to the problem under discussion, was confirmed by Dr. Haf Jonnson of the Naval Postgraduate School (private communication). This does not preclude other changes related to coincidence – undercounting.

Figures 1 and 2 contain measurements from VOCALS that provide evidence that the G-1 CAS probe was not undercounting droplets at CDNC > 200 cm-3. The VOCALS data set was split into 3 subsets, according to CDNC as measured by the CAS probe on the G-1. Subsets contain either 20 – 200, 200 – 400, or greater than 400 droplets per cm3. The Gerber probe was not operating on one flight (23 Oct.) and the 01 Nov. flight was eliminated because of a divergence between the hot wire and Gerber probe on part of the flight. Graphs of liquid water from the CAS have been plotted vs. either the CAPS Hot wire liquid water or the Gerber liquid water, for each CDNC subset. Except as noted, all data from the VOCALS campaign (16 flights) is included. Data points are one second averages. Each graph includes a least squares fit forced through the origin. Slope and correlation coefficient are shown on the graphs. A large underestimate in CDNC above 200 cm-3, as shown in Fig. 13 of Lance et al. (2010) would correspond to a large decrease in slope at higher CDNC. For the hot wire, the slope increases 6% with CDNC; for the Gerber probe there is an 11% decrease supporting our view that the CAS probe used on the G-1 during VOCALS did not significantly underestimate the droplet concentration due to coincidence errors

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 17289, 2011.

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Interactive Comment

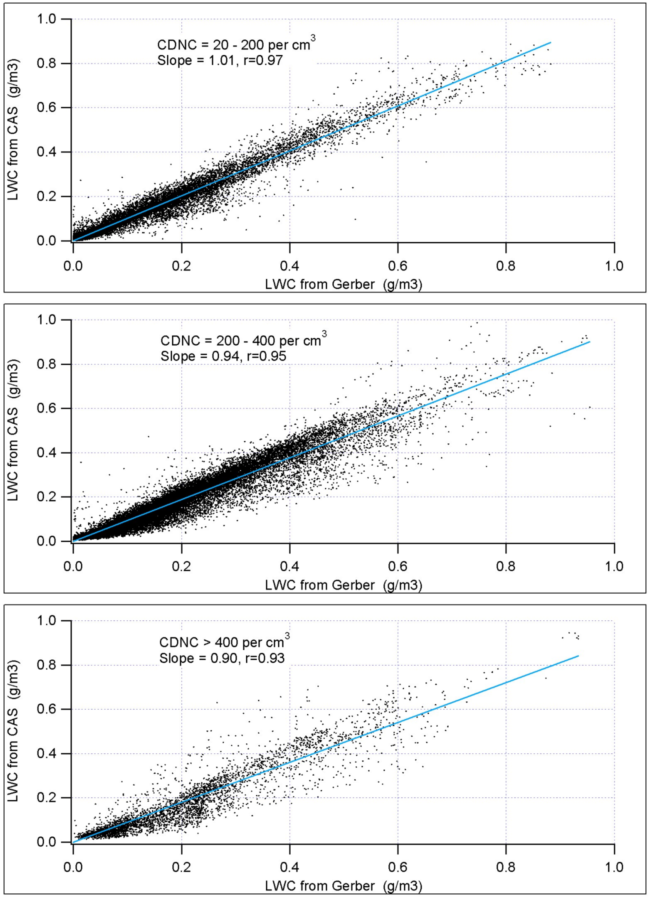

Fig. 1. CAS Gerber LWC comparison for 3 CDNC ranges

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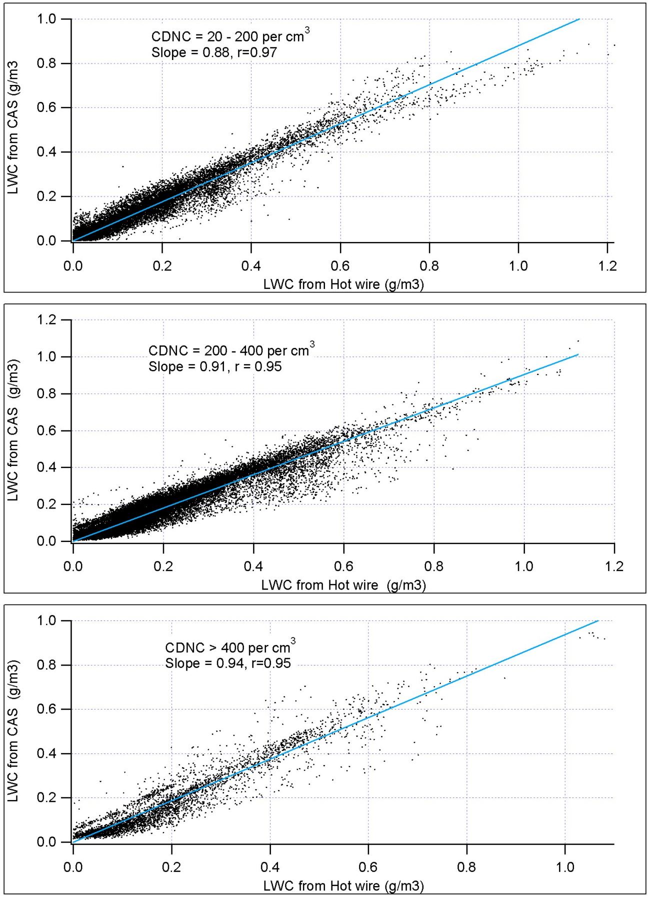

Fig. 2. CAS Hot wire LWC comparison for 3 CDNC ranges

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