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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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I am concerned about your conclusions resulting from CDNC data derived from CDP and CAS probes. The observation in Figure 10 show a sublinear relationship between CDNC and aerosol with dp > 100 um. You can interpret this as resulting from meteorological processes. However, large coincidence errors will have the same effect (undercounting bias of droplets as actual droplet concentrations increase).

I found with the CDP that coincidence errors were much larger than expected. The instrument manual states that coincidence errors are not significant (< 1%) for the CDP at droplet concentrations < 1000 cm-3. However, a type of coincidence resulting from

the large viewing area of the sizing detector makes the coincidence error significant at much lower droplet concentrations. We showed this in our paper in AMT (See Figure 13). http://www.atmos-meas-tech.net/3/1683/2010/amt-3-1683-2010.pdf

This conclusion was based on careful laboratory calibrations of the CDP with single water droplets, Monte Carlo simulations, and in-flight intercomparison with LWC measurements.

We are currently finalizing a paper for submission to JOAT which will put the nail in the coffin on this conclusion. We modified a CDP, so that the sizing detector viewing area was substantially reduced, to see how this affected measured droplet concentrations. We flew both the modified and a standard CDP side-by-side, and saw clearly the relationship that we expected based on our understanding of coincidence; The modified CDP reported higher droplet concentrations than the standard CDP, and this discrepancy depended on droplet concentrations.

Furthermore, we were able to fly a CAS alongside the modified and standard CDPs, and we found that it suffered from coincidence errors as much as the standard CDP. This was surprising given that a CAS was used (successfully) in cloud droplet closure experiments at very high droplet concentrations, with minimal correction for coincidence (Conant et al, JGR, 2004). For a number of reasons, we believe that the CAS design has changed since that study in 2002, and that current versions of the CAS now suffer from large coincidence errors. Of the three DMT forward scattering cloud probes that we have tested (2 CDPs and 1 CAS), all three have shown the same problem.

The divergence between measured and actual droplet concentrations (from the CAS and the modified CDP, respectively) started at around 200 cm-3, which could explain what you see in your Figure 10.

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