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Atmospheric Measurement Techniques Discussions

Interactive comment on "Fast time response measurements of particle size distributions in the 3–60 nm size range with the Nucleation Mode Aerosol Size Spectrometer" *by* Christina Williamson et al.

Anonymous Referee #3

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Overall comments: This is a very well-written paper that provides a detailed description of the Nucleation-Mode Aerosol Size Spectrometer (NMASS) instruments that were developed in the late 1990s and have subsequently been used successfully to measure high-temporal-resolution aerosol size distributions aboard a variety of research aircraft including the NASA ER-2 and DC-8. The authors do a very good and thorough job of describing the NMASS design, performance characteristics and calibration procedures and of carefully determining the precision and possible errors in their derived size distributions. I think the study and paper are excellent and should be published after a few

minor revisions.

Specific Comments: Figures 1 and 2: I don't understand how flow velocity is maintained constant in each of the CPCs. I had assumed that critical flow orifices (CFOs) were installed on the exhaust of each unit (as is done in standard TSI3010 or TSI3772 counters) and that system pressure was controlled by varying flow through a bypass line. However, although it shows a solenoid control valve dangling in space above the column of counters, Figure 1 seems to indicate that system pressure is controlled using the valve located just upstream of pump; varying flow through this valve would result in varying the flow velocity through the entire bank of counters. Can you please clarify? If the flow through each CPC isn't controlled by a CFO or pump, how do you know that sample flow is split equally between the five CPCs? Do you measure total flow through each counter?

The NMASS CPC design is similar to that of a TSI3025, which includes a valve to regulate the ratio of aerosol sample to sheath flow; how is the flow split maintained in the NMASS CPCs? If the ratio is dictated by flow resistances instead of valves, how does it change as the filters get dirty? How sensitive is the CPC detection efficiency to variations in flow velocity through the condenser region?

Is Fluorinert hygroscopic? If so, how does the CPC performance change over time as H2O is absorbed into the working fluid? During ATOM, the aircraft often flies through very humid regionsâĂŤdo you dry the sample flow and if not, how often do you change the fluid in the counters?

Page 9, orifice discussion: Sample temperature will drop as flow is expanded across the orifice, which in very humid cases, may lead to vapor condensation and associated particle losses. Was this effect considered in your experiments and analyses?

Page 9, line 30: the by pass line is not clearly indicated in Figure 1.

Figure 7: the caption is cut off and thus doesn't make complete sense.

Page 20-21 discussion on NPF formation and growth: you might mention Rodney Weber's technique of using an OPC to measure the size of droplets coming out of an ultrafine CPC to infer new particle formation and growth: Weber et al., Measurements of enhanced H2SO4 and 3-4 nm particles near a frontal cloud during the First Aerosol Characterization Experiment (ACE 1), JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES , 106 (D20), 24107-24117, 2001.

Regarding use of SMPS instruments to study NPF from aircraft: even if they could be operated at fast scanning rates, standard SMPS systems lack sensitivity to nucleation mode particles at low pressure because of the particles's greatly increased electrical mobility. For example, at 100 hPa, a 10 nm particle has about the same electrical mobility as a 3 nm particle at sea level pressure.

Page 22, line 14: should be "than" instead of "then"

Page 22, lines 17-22: repeated text

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