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Data:

The data here is the total particle counts from the TSI 3025 and particle size distributions (dN/dlogDp vs. Dp) from the SMPS data for the 6 research flights of Aristo 2016. Both are in ICARTT file format. Additional information about detection limits, flags, diameter bins, etc. are in the headers of the files. The 3025 did not operate during RF01, so the data is all filled in by -9999.

Background:

The SMPS (scanning mobility particle sizer) was designed in the early 2000's by Dave Rogers and Jim Smith and considered a "gap" instrument. It was built in 2011 prior to the DC3 Test campaign and was fully functional by 2012 when it flew on the NCAR GV during DC3. It also flew on NOMADSS (2013) and FRAPPE (2014). There are other aerosol instruments such as the wing-mounted and rack-mounted UHSAS, RAF CN counter and the University of Wyoming TSI 3025 CN counter. The original objective of this instrument was to be able to characterize particle number concentrations that were smaller than the detection limit of the UHSAS. By combining the SMPS, UHSAS, and CN counter, the entire particle size distribution and total particle concentration can, in theory, be determined. To my knowledge there hasn't been a systematic comparison of the instruments to see how well they agree with each other and if there are any systematic biases based on altitude, inlet, airplane speed or other conditions. We have used two different inlets during the previous campaigns: The HIMIL and the SMAI. So for this most recent campaign (ARISTO 2016) several of these instruments were all sampling ambient from the same inlet, which could be switched during flight. The overall goal of this exercise was to compare the different instruments and inlets from a wide-range of sampling conditions.

Instrumentation: The configuration for the instruments is shown in Figure 1. The original plan was to have a total of 2^3 (or 8) combinations by switching:

1. Instrument inlet (SMAI or HIMIL)
2. Particle counter for the SMPS (TSI 3025 or TSI 3010)
3. DMA (nano for small particles (~10-100 nm) or regular for larger particles (~20-300 nm))

During installation and pre-flight testing it was determined that comparing 8 combinations in 20 total flight hours was overly complex, so plans were altered to make the TSI 3025 a stand-alone counter similar to the RAF CN counter. The comparisons then became the different inlets and the different DMA columns for a total of 4. This change in plans had the added benefit of being able to compare the TSI 3025 to the RAF CN counter under more controlled conditions and to add to the experience gained by J. Snyder of the University of Wyoming during the 2015 ARISTO campaign. The instruments were all mounted in a rack at the back left of the C130 and the inlets were installed side-by-side in the belly of the plan ~1 m from the rack.

Figure 1: ARISTO 2016 Aerosol sampling diagram. In the valve configuration shown here (highlighted by the thick blue arrows), ambient air is taken in through the SMAI inlet and through the switching valves shown. The poly-disperse aerosol flow is directed into the short column (nano) differential mobility analyzer (NDMA). Monodispersed particles are then counted by the TSI 3010 condensation particle counter (CPC). The same air is directed through a 4-way flow splitter, and then sampled by the rack-mounted UHSAS (Univ. of Wyoming), TSI 3025 and the RAF CN counter. The pump stack on the left-hand side of the figure controls the flow through the TSI 3025 and the SMPS (including the 3010). The RAF CN counter and UHSAS have their own dedicated pumps.