DC-8 Inlet Characterization Experiment (DICE)
Aerosol size distributions and optical properties

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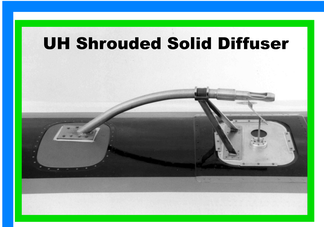
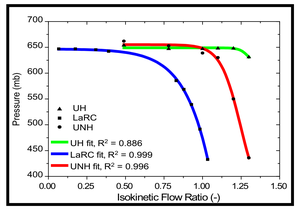
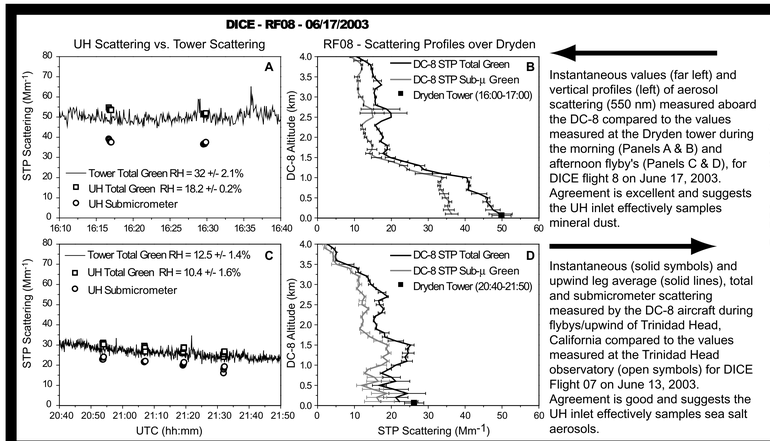
HIGEAR Hawaii Group for Environmental Aerosol Research



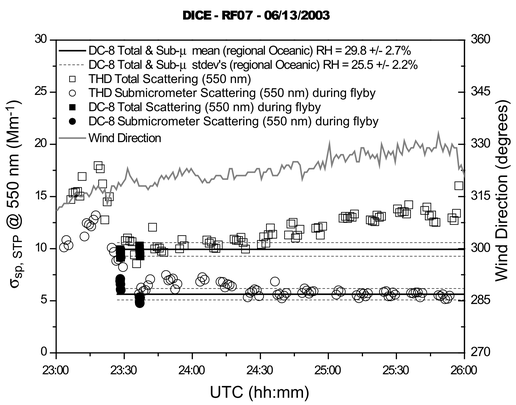


Each of the solid diffuser type inlets have been used previously on NASA GTE missions either aboard the DC-8 or the P3-B. Intercomparisons have been performed across platforms and with ground stations, highlighting sampling discrepencies. Thus, the inlets were deployed together aboard the DC-8 during DICE (Summer, 2003) in order to evaluate their relative performance prior to deployment during INTEX-NA.

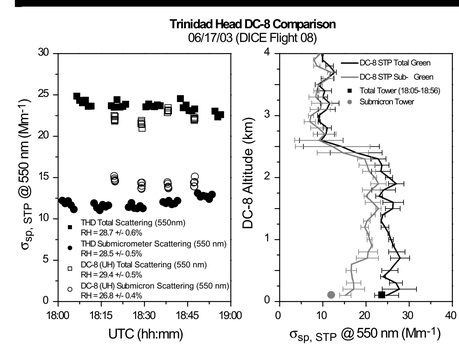


Instantaneous values (far left) and vertical profiles (left) of aerosol scattering (550 nm) measured aboard the DC-8 compared to the values measured at the Dryden tower during the morning (Panels A & B) and afternoon flyby's (Panels C & D), for DICE flight 8 on June 17, 2003. Agreement is excellent and suggests the UH inlet effectively samples mineral dust.

Instantaneous (solid symbols) and upwind leg average (solid lines), total and submicrometer scattering measured by the DC-8 aircraft during flybys/upwind of Trinidad Head, California compared to the values measured at the Trinidad Head observatory (open symbols) for DICE Flight 07 on June 13, 2003. Agreement is good and suggests the UH inlet effectively samples sea salt aerosols.

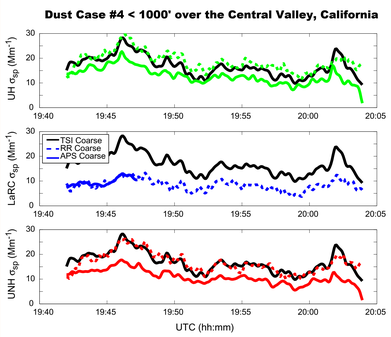


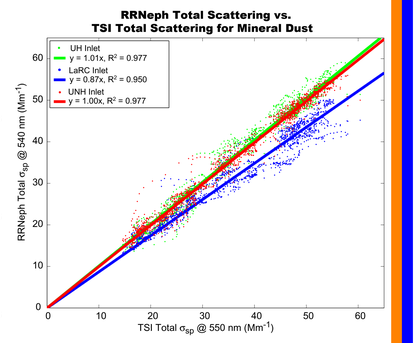
How did Total and Submicrometer scattering compare between the DC-8 and Ground Stations???



Instantaneous values (far left) and vertical profiles (left) of aerosol scattering at 550 nm measured aboard the DC-8 compared to the values measured at the Trinidad Head Observatory for DICE Flight 08 on June 17, 2003. In this case discrepancies between the DC-8 and the ground station are significant (α=0.05). However, the magnitude of the differences is small and is not likely to significantly alter conclusions regarding aerosol optical properties and the radiative effects.

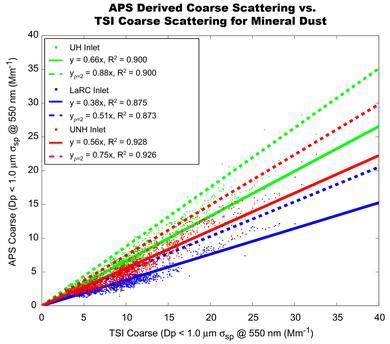
Do the inlets sample Mineral Dust aerosols the same???

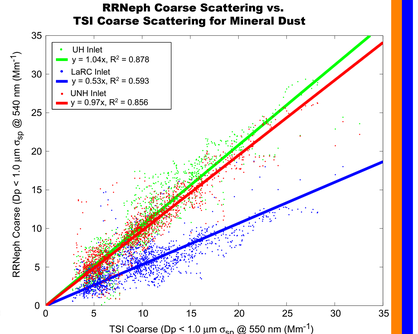




Time series of coarse mode (Dp > 1.0 μm) scattering as measured by the TSI nephelometers, RR nephelometers, and as calculated from the APS size distributions (ρ = 2.56 g cm-3, m=1.53-0.0006i). The TSI nephelometer data and the scattering calculated from the APS data have been smoothed using a 7-point box-filter with a Gaussian distribution.

RRNeph total scattering (540 nm) vs. TSI nephelometer total scattering (550 nm) during DICE flights 5, 6, and 8 when aerosol volume is dominated by mineral dust. There is excellent agreement between the Hawai`i and New Hampshire inlets while scattering measured by NASA Langley is underestimated by ~13% per Mm-1.

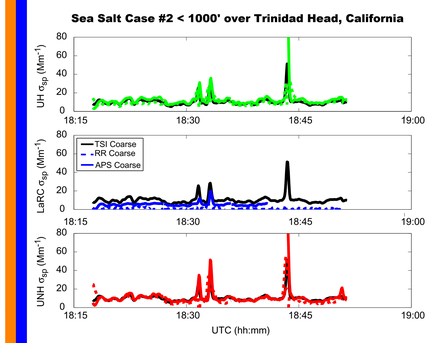


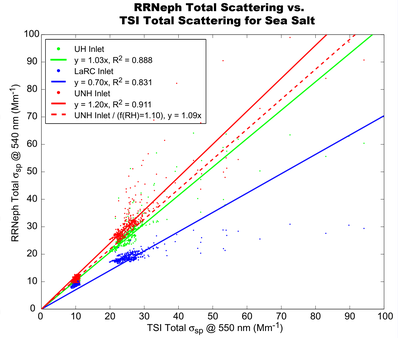


APS derived scattering (Dp > 1.0 μm, ρ_{dust} = 2.56 g cm-3, m=1.53-0.0006i) vs. TSINeph coarse scattering (550 nm) during DICE flights 5, 6, and 8 when aerosol volume is dominated by mineral dust (solid lines). APS derived scattering for ρ_{dust} = 2.00 g cm-3 (dashed lines). Correlation coefficients are excellent but suggest that our estimates of particle density and/or refractive index are inadequate. Plot also shows that the UH inlet captures ~ 18% more scattering particles than the UNH inlet for cases where aerosol volume is dominated by mineral dust.

RRNeph coarse (Dp > 1.0 μm) scattering vs. TSI nephelometer coarse scattering (for 550 nm) during DICE flights 5, 6, and 8 when aerosol volume is dominated by mineral dust. There is excellent agreement between the Hawai`i and New Hampshire inlets. However, by subtracting the submicrometer signal from the total scattering we see that the LaRC inlet captures only ~50% of the coarse mode scattering.

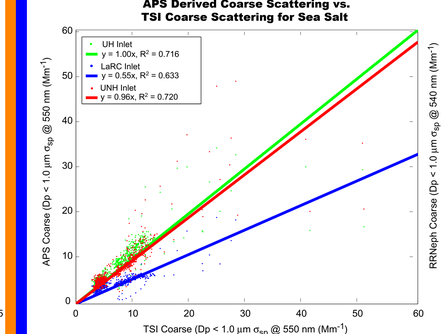
Do the inlets sample Sea Salt aerosols the same???

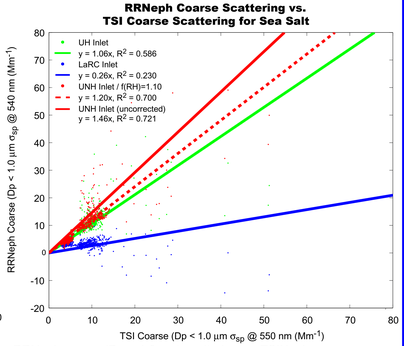




Time series of coarse mode (Dp > 1.0 μm) scattering as measured by the TSI nephelometers, RR nephelometers, and as calculated from the APS size distributions (ρ = 2.20 g cm-3, m=1. 5688 - 0.0i). The UNH RRNeph data has not been corrected for RH. The TSI nephelometer data and the scattering calculated from the APS data have been smoothed using a 7-point box-filter with a Gaussian distribution.

RRNeph scattering (540 nm) vs. TSINeph total scattering (550 nm) during DICE flights 7 and 8 when aerosol volume is dominated by sea salt. Solid lines indicate best fits of the data. The dashed line for the UNH scattering has been divided by f(RH)=1.10, to investigate enhanced scattering possibly due to relative humidity differences of 14% (23% vs 37%) between the UNH nephelometer and the remaining instruments.

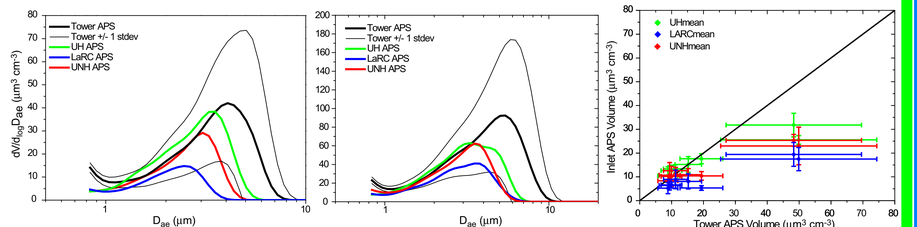




APS derived scattering (Dp > 1.0 μm, $\rho_{seasalt}$ = 2.20 g cm-3, m=1.5688-0.0i) vs. TSINeph coarse scattering (550 nm) during DICE flights 7 and 8, when aerosol volume is dominated by sea salt. The difference of only 4% between the UH and the UNH APS derived scattering indicates that these two inlets perform identically when sampling environments where the aerosol volume is dominated by sea salt.

RRNeph coarse (Dp > 1.0 μm) scattering vs. TSINeph coarse scattering (550 nm) during DICE flights 7 and 8 when aerosol volume is dominated by sea salt. UNH RRNeph total scattering data was divided by f(RH) = 1.10 before subtracting the submicrometer component of scattering. Solid lines indicate best fits of the uncorrected data. The dashed line indicates the best fit for the UNH data after correction and suggests that the UNH inlet captures ~14% more light scattering than the UH inlet for coarse aerosols dominated by sea salt.

How do DC-8 APS size distributions compare to the Dryden Tower???

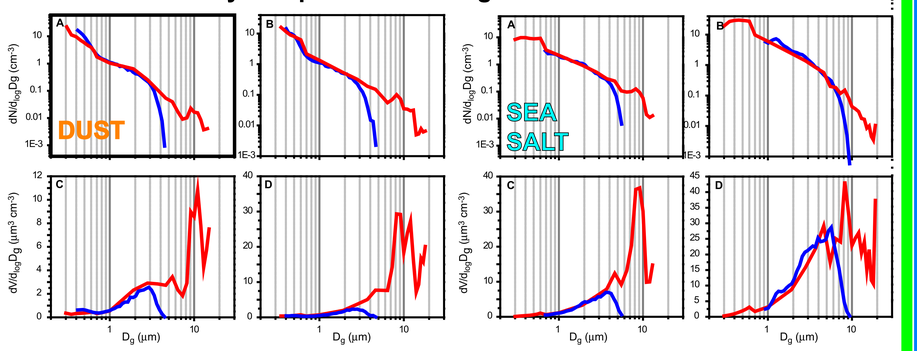


Volume distributions from tower pass #2 on DICE flight 6. Using the Student's T-test (α=0.05), the tower distribution and the UH distribution are indistinguishable. For the LaRC and UNH distributions we conclude that the integral volumes are statistically different than the tower.

Volume distributions from tower pass #1 on DICE flight 8. Using the Student's T-test (α=0.05), the tower distribution and the UH distribution are indistinguishable. For the LaRC and UNH distributions we conclude that the integral volumes are statistically different than the tower.

Scatterplot of integral volumes measured aboard the NASA DC-8 behind the UH, LaRC and UNH inlets, compared to integral volumes measured at the EDW tower during flights 6 and 8. In summary, DC-8 aerosol volumes were identical to ground measurements for 87.5% (7 of 8), 12.5% (1 of 8) and 50% (4 of 8) of the tower passes for the UH, LaRC and UNH inlets respectively.

How do they compare to the Wing Probes at ambient RH???



APS and FSSP-300 size distributions from DICE flight 05 (a and c) and flight 08 (b and d), averaged over the entire time segment from dust encounters over Edwards Air Force Base, CA. Log-log number distribution (a & b), and semilog-x volume distribution (c & d). This comparison to wing probe data indicates the UH inlet samples supermicrometer mineral dust aerosols effectively to approximately 3-4 μm.

APS and FSSP-300 size distributions from DICE flight 07 (a and c) and flight 08 (b and d), averaged over the entire time segment for sea salt cases near Trinidad Head, CA. Log-log number distribution (a & b), and semilog-x volume distribution (c & d). This comparison to wing probe data indicates the UH inlet samples sea salt aerosols with diameters at ambient relative humidity of 4-7 μm.

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This research was graciously funded under NASA Contract: *NCC-1-416*. Our thanks to the tireless efforts of the DC-8 ground crew, machine shop, mission managers and pilots.