Airborne Sun Photometer Measurements of Aerosol Optical Depth during SOLVE II: Comparison with SAGE III and POAM III Measurements

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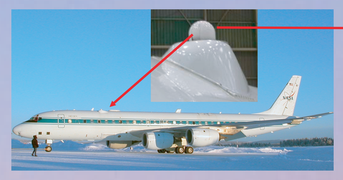
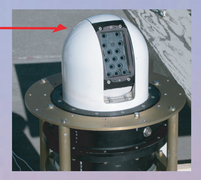
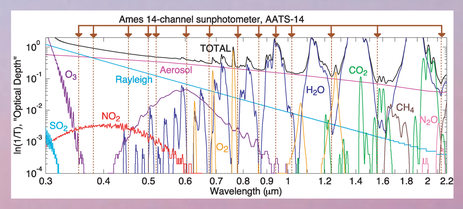
INTRODUCTION

The 14-channel NASA Ames Airborne Tracking Sunphotometer (AATS-14) was operated aboard the NASA DC-8 during the Second SAGE III Ozone Loss and Validation Experiment (SOLVE II) and obtained successful measurements during the sunlit segments of eight science flights. These included six flights out of Kiruna, Sweden, one flight out of NASA Dryden Flight Research Center (DFRC), and the Kiruna-DFRC return transit flight. Values of spectral aerosol optical depth (AOD), columnar ozone and columnar water vapor have been derived from the AATS-14 measurements. Livingston et al. (Thursday PM Poster 10) presents ozone results and comparisons. This poster focuses on AATS-14 AOD data. In particular, we compare AATS-14 AOD spectra with temporally and spatially near-coincident measurements by the Stratospheric Aerosol and Gas Experiment III (SAGE III) and the Polar Ozone and Aerosol Measurement III (POAM III) satellite sensors. We examine the effect on retrieved AOD of uncertainties in relative optical airmass (the ratio of AOD along the instrument-to-sun slant path to that along the vertical path) at large solar zenith angles. Airmass uncertainties result from uncertainties in requisite assumed vertical profiles of aerosol extinction due to inhomogeneity along the viewing path or simply to lack of available data.





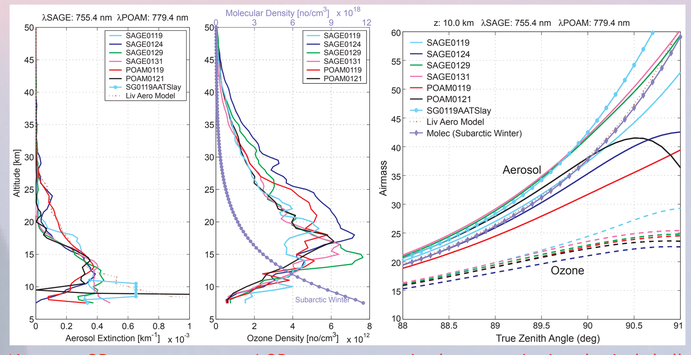


SUMMARY and CONCLUSIONS

- AATS-14 measurements on the DC-8 in SOLVE II provide AOD spectra for wavelengths 384-1550 nm, covering the full SAGE III wavelength range. The AATS-14 results show AOD spatial structure along the DC-8 flight path and provide AOD spectra for comparison to SAGE III and POAM III at their tangent points.
- A new airmass algorithm [Yee, 2003; Magistre and Yee, 2002] validates the Thomason et al. [1983] algorithm to within 2% for SZA<90°, and in addition provides results for SZA>=90°.
- AATS-14 AOD spectra have been compared to SAGE III and POAM III AOD spectra for 4 near-coincidences each. Differences were <= 0.004 for all λ>500 nm. RMS differences were 0.0024 for AATS-SAGE and 0.0034 for AATS-POAM
- Mean differences (AATS-SAGE) were 0.0022 for AATS-SAGE and 0.0007 for AATS-POAM.
- Tests for frost on the AATS-14 window (by scanning the instrument FOV across the sun) were negative for all cases shown here. Frost deposition was prevented by purging with dry nitrogen.
- AATS-14 water vapor columns and vertical profiles are retrieved from transmission in and around the 940-nm band. The AATS-14 water vapor profile measured on the 6 Feb 2003 descent into Edwards AFB agrees with the in situ diode laser heterodyne (DLH, Diskin et al.) profile to ~0.1 g/cm^3 generally.

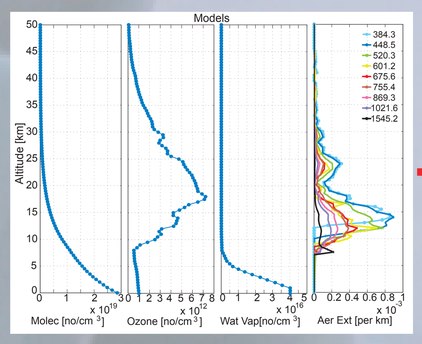
AIRMASS CALCULATIONS

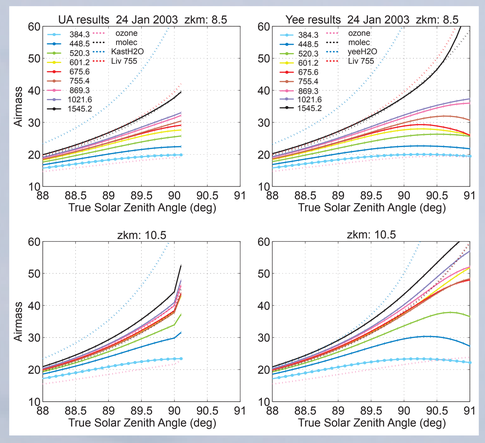
Airmass is very sensitive to vertical distribution when sun is near horizon (SZA > 89°)

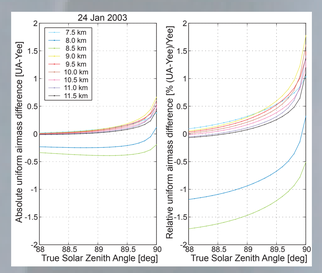


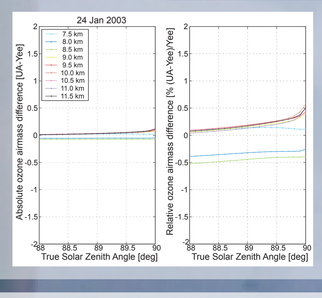
Airmass = $OD_{sun\text{-}viewing\ path}$ / $OD_{vertical}$, assuming homogeneity in spherical shells

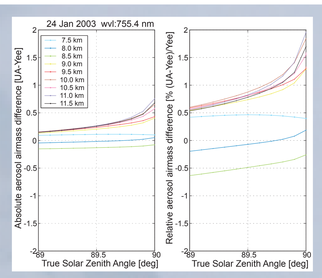
We have used a new airmass algorithm [Yee, 2003; Magistre and Yee, 2002] that accounts for species vertical profiles and accommodates SZA <, =, and > 90°. The comparisons below show that the algorithm of Thomason et al. [1983, called UA in our plots], used in our previous analyses, agrees with the Yee-Magistre algorithm in its range of applicability (SZA<90°), differing by < 1% for SZA<89°, and < 2% for SZA<90°.



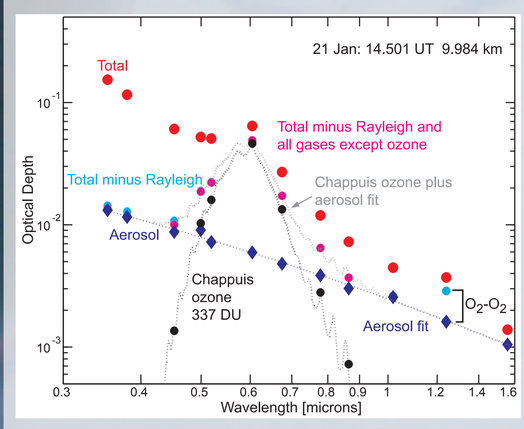








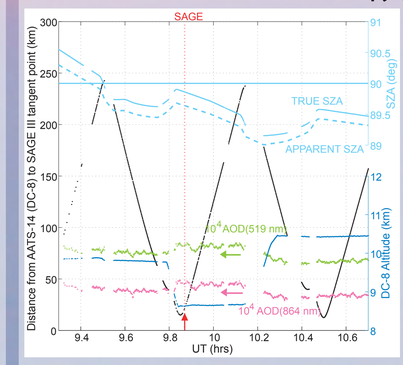
AEROSOL-OZONE SEPARATION

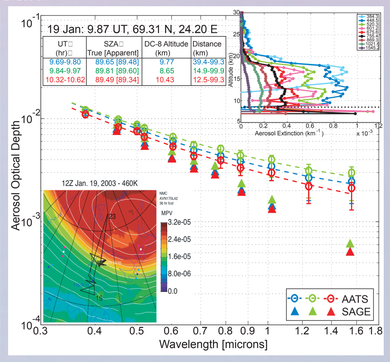


For ozone results see Livingston et al., Poster 10, Thursday PM

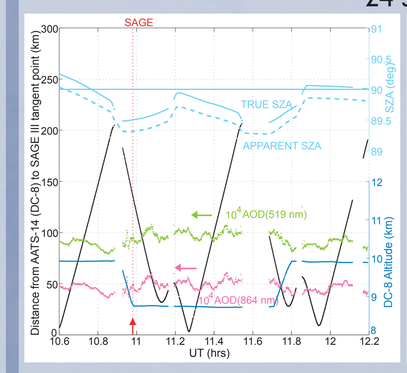
SAGE III

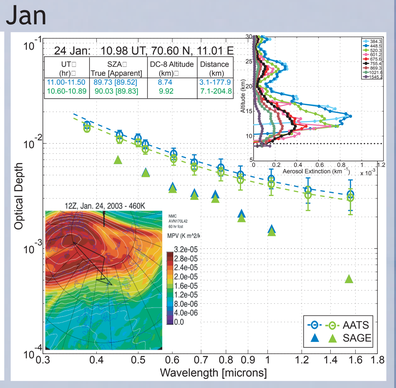
19 Jan





24 Jan





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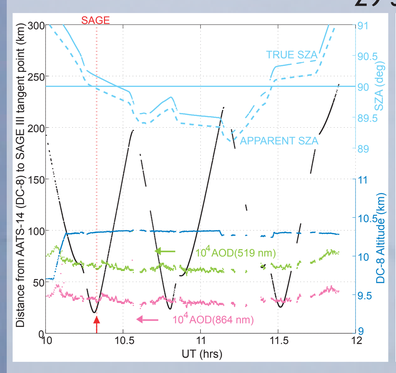

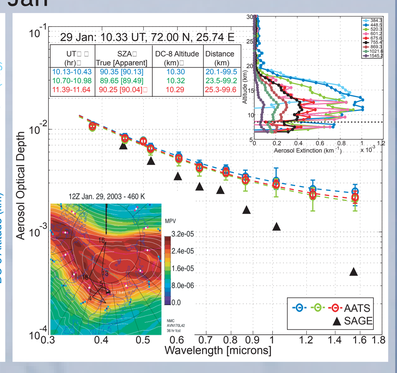

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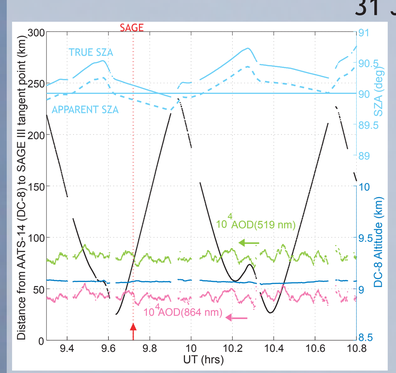

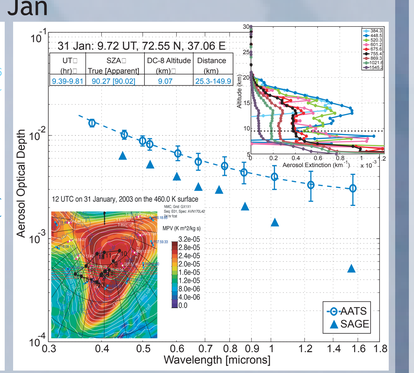

POAM III

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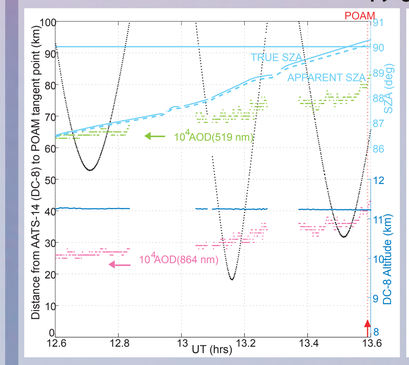

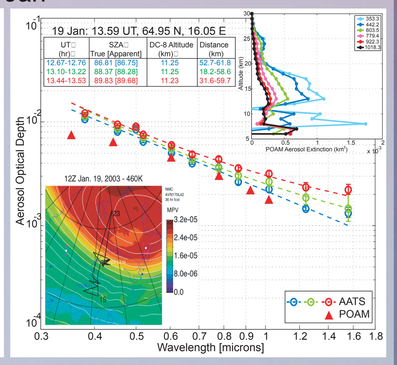

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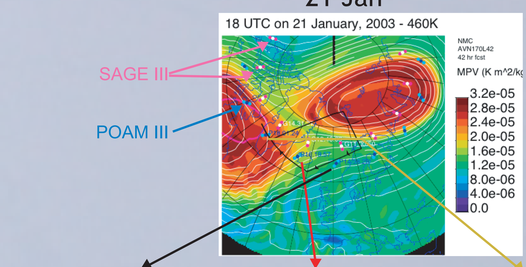
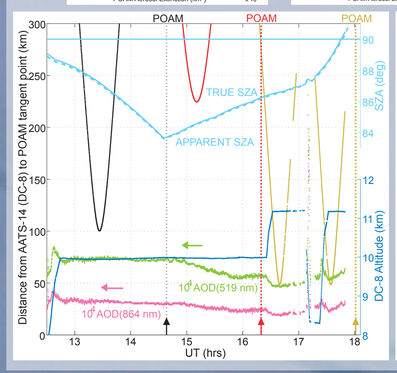
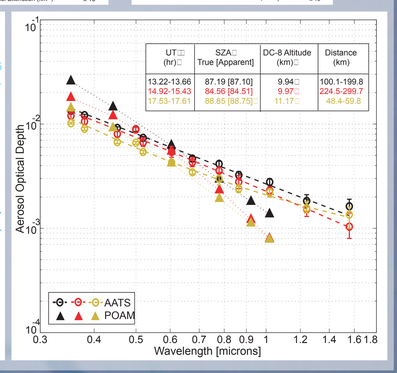
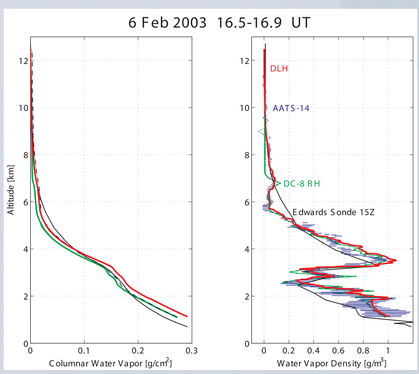






WATER VAPOR COMPARISON DURING DC-8 DESCENT INTO EDWARDS AFB



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