

Aerosol Retrievals using Airborne Lidar and MODIS Measurements

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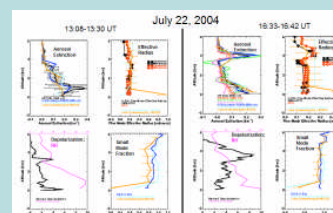
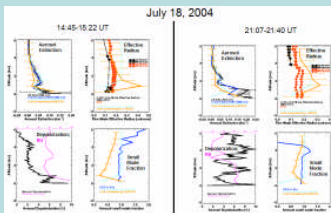
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Objectives

- Retrieve aerosol extinction and optical thickness profiles from lidar data
- Use combination of airborne lidar and MODIS to provide information regarding the vertical distribution of aerosol properties (size, fine mode fraction)
- Identify aerosol types vs. altitude
- Evaluate ability of GOCART model to simulate aerosol extinction profiles and aerosol type

MODIS+lidar Aerosol Retrievals

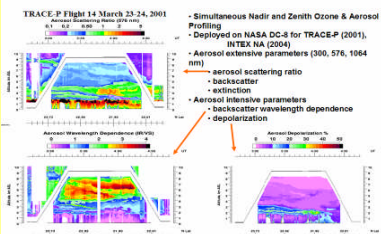
- Retrieval algorithms – (2 Wavelength)
 - Kaufman et al. IEEE 2003, ORL 2003, L&J, JGR, 2003
 - Aerosol size distribution – bimodal lognormal
 - MODIS aerosol models – 20 combinations of 4 fine, 5 coarse particles
 - Size of each mode is assumed to be altitude independent
 - Relative weight of each mode is determined as a function of altitude from lidar backscatter color ratio
- Retrievals are constrained to fit MODIS measurements
 - Spectral reflectance
 - Column AOT and τ_{500}
- Modifications – (3 Wavelength)
 - UV wavelength (300 nm) – more information on fine particle size
 - Constrain to MODIS AOT to account for lidar calibration uncertainties
 - Depolarization – adjust the backscatter phase function for nonsphericity
- Evaluation
 - Retrievals were evaluated using DC-8 in situ measurements



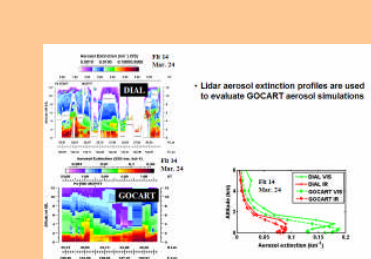
Summary

- MODIS data helped constrain airborne lidar retrievals of aerosol extinction profiles, and backscatter and extinction color ratios - TRACE-P (2001) and INTEx NA (2004)
- Combination of lidar+MODIS measurements over ocean used to retrieve profiles of fine mode fraction and effective radius
- Evaluated algorithms that use both 2 and 3 wavelength lidar measurements
- Good agreement with extinction, fine mode fraction for AOT (550 nm) > 0.15
- Evaluating GOCART simulations (TRACE-P and INTEx NA)
- Aerosol extinction – in general agreement with lidar profiles, but details differ depending on campaign
- Work in progress – using lidar measurements to identify & group aerosol types
- Use cluster analysis techniques to identify and group aerosols
- Some correspondence between TRACE-P clusters and GOCART aerosol types
- Future
 - Use aerosol extinction, backscatter, depolarization measurements from LaRC Airborne High Spectral Resolution Lidar (HSRL) – INTEx-SMILAGRO (Mexico City), TEXAQS/GoMACCS (Houston) for combined lidar+MODIS+PARASOL retrievals and identification of aerosol type

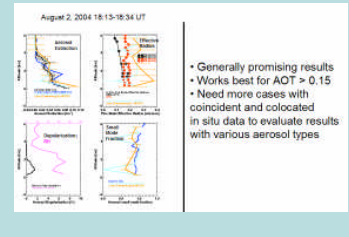
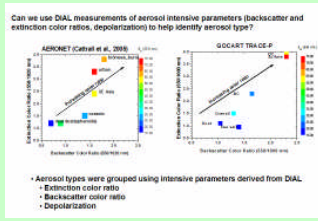
NASA Langley Airborne UV DIAL Measurements



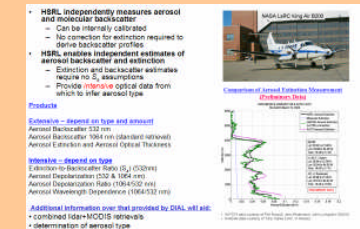
Comparison of Vertical Profiles – DIAL and GOCART (TRACE-P)



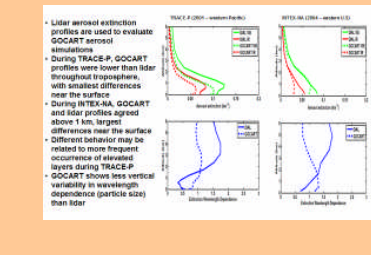
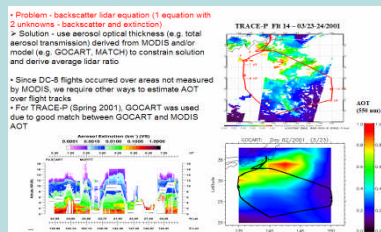
Aerosol Classification Using Lidar Measurements



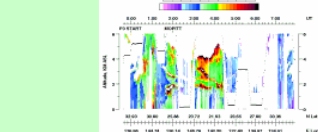
NASA Langley Airborne High Spectral Resolution Lidar (HSRL)



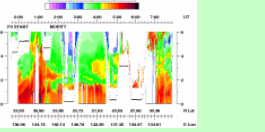
Aerosol Profile Retrievals



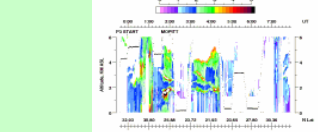
Aerosol Backscatter Color Ratio (550/660nm)



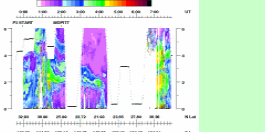
Aerosol Extinction (km^-1) (550 nm) (0.001 to 0.005 km^-1)



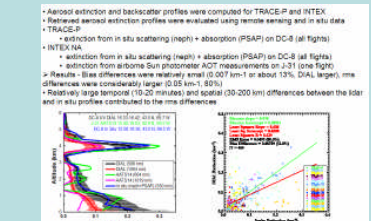
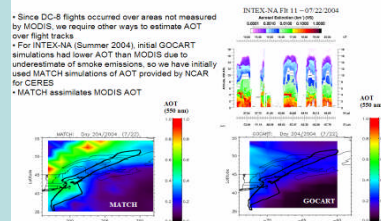
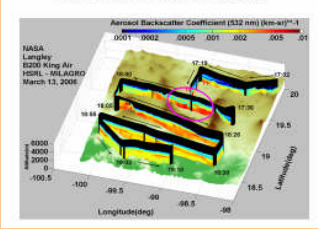
Aerosol Depolarization Ratio



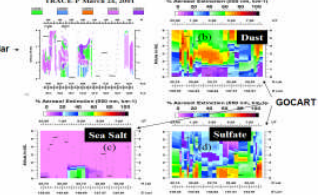
Aerosol Extinction Color Ratio (550/660nm)



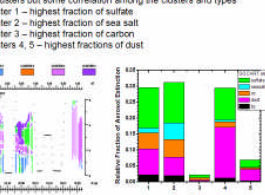
HSRL Measurements over Mexico City region



Use lidar profile measurements to evaluate GOCART model simulations of aerosol type



No one-to-one correspondence between GOCART aerosol types and aerosol clusters but some correlation among the clusters and types



Characterize the horizontal distribution of aerosol types

