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Cloud and Aerosol Measurements at the Clouds and the Earth's Radiant Energy System (CERES) Ocean Validation Experiment (COVE)

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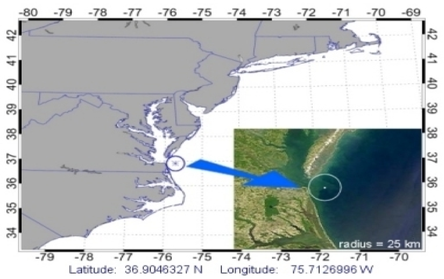
INTRODUCTION: The COVE site was developed to provide surface observations to benefit CERES in understanding atmospheric radiative transfer issues over the ocean. Aerosols, Micro-pulse Lidar (MPL) soundings and Long-Ackerman (LA) Cloud Fraction climatologies are presented to display observed climatological relationships.

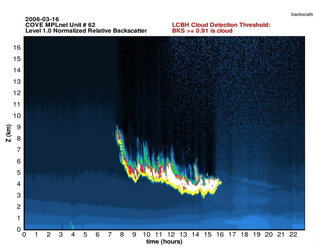
Here we analyze the data in an attempt to determine which mechanisms might be important in modulating Aerosol Optical Thickness (AOT) over the COVE site. The two mechanisms being considered are aerosol size increase due to uptake of water (Winkler, 1988) and the aerosol to cloud continuum concept introduced by Koren,et al (2007).

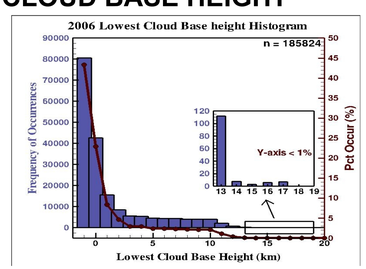
COVE LOCATION



COVE is located approximately 25 km off the coast of Virginia Beach,VA.

MPL AND DERIVED CLOUD BASE HEIGHT

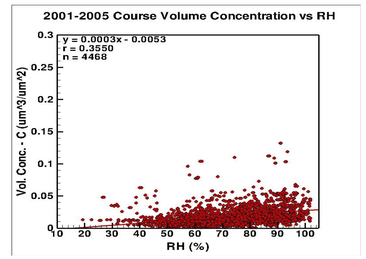


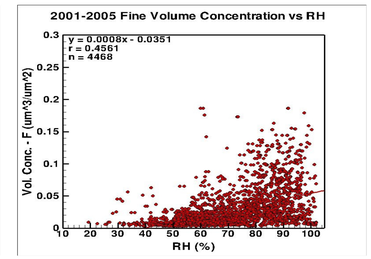


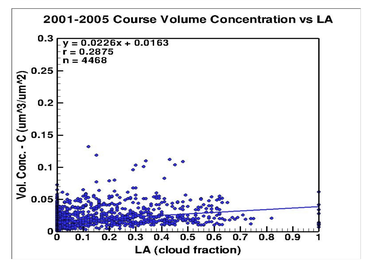
(Left) One day of MPL data taken in the late winter. (Right) 2006 distribution of cloud base measurements. -1 is point clear sky for the one minute interval. 0.90km and greater are clouds.

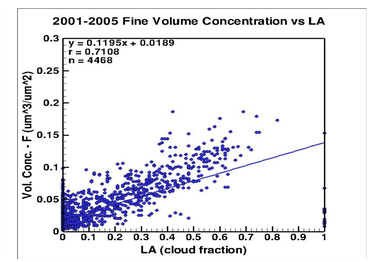
AEROSOL COURSE AND FINE MODE VOLUME CONCENTRATION

RELATIVE HUMIDITY – TOP, CLOUD FRACTION - BOTTOM





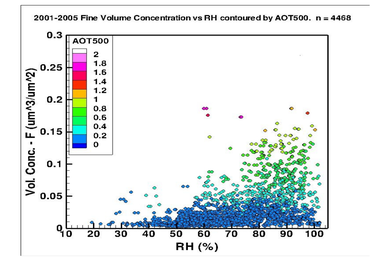


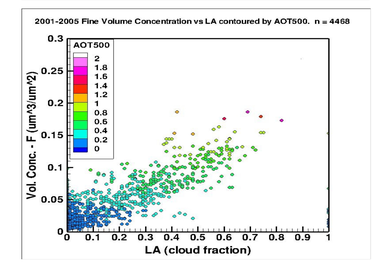


The above 4 plots show retrieved aerosol volume concentration vs Relative Humidity(RH) and Long-Ackerman (LA) cloud fraction from 2001-2005. The strongest relationship observed is between cloud fraction and fine mode volume concentration. In general, the fine mode volume concentration for aerosols having RH > 70% are observed to be higher than for the course mode aerosols. The change in cloud fraction and the change in RH seem to only affect the fine mode aerosol volume concentrations.

AOT 500 AND FINE MODE VOLUME CONCENTRATION

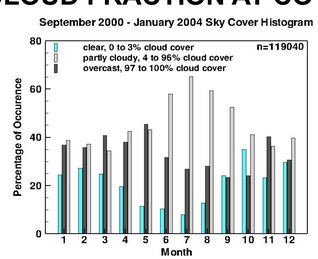
RELATIVE HUMIITY – TOP, CLOUD FRACTION - BOTTOM





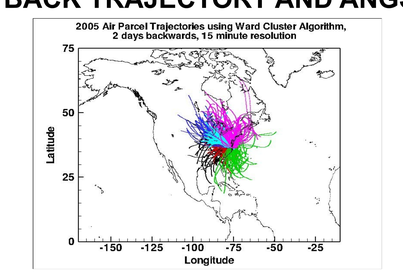
As fine mode volume concentrations increase, the aerosol optical thickness at 500nm increases. Of the two factors, cloud fraction and RH, the change in the cloud fraction parameter is more closely associated with change in AOT than RH.

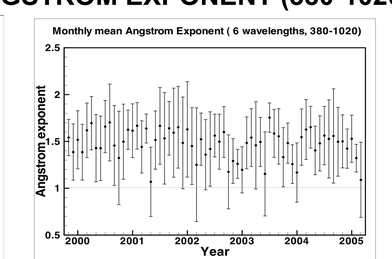
CLOUD FRACTION AT COVE



Cloud fraction climatology at COVE. Monthly mean percent clear, overcast and partly cloudy occurrences from September 2000 – January 2004.

BACK TRAJECTORY AND ANGSTROM EXPONENT (380-1020)





(Left) 2005 back trajectory data indicate most air masses originate over land before making their way to COVE. However, some commence over the ocean as shown in green. This amounts to about 17% (62 of 362 trajectories) available for 2005. Although polluted aerosols rule primarily, (Right) the monthly mean Angstrom Exponent (AE) calculated using the 380, 440, 500, 670, 870 and 1020 nm wavelengths illustrate coarse mode aerosols (as indicated by green line) sometimes influence COVE.

SUMMARY: We observe AOT to systematically co-vary with changes in cloud fraction as parameterized by the LA cloud index. This may suggest the aerosol to cloud continuum concept is important in controlling AOT over the COVE site (*Koren et al.*, 2007).

Back trajectory data and AE(380-1020) indicate coarse mode and clean maritime air affect COVE at times.

REFERENCES:

We thank AERONET and Brent Holben for their effort in establishing and maintaining the COVE site.

Koren, I.,et al (2007), On the twilight zone between clouds and aerosols, *Geophys. Res. Lett., V(34), L08805*, doi:10.1029/2007GL029253.

Winkler, P. (1988), The growth of atmospheric aerosol particles with relative humidity, *Phys. Scr., 37,* 223-230 doi:10.1088/0031-8949/37/2/008.