

Climatology of aerosol optical properties near the New England coast: preparation for the Two Column Aerosol Program (TCAP) field campaign

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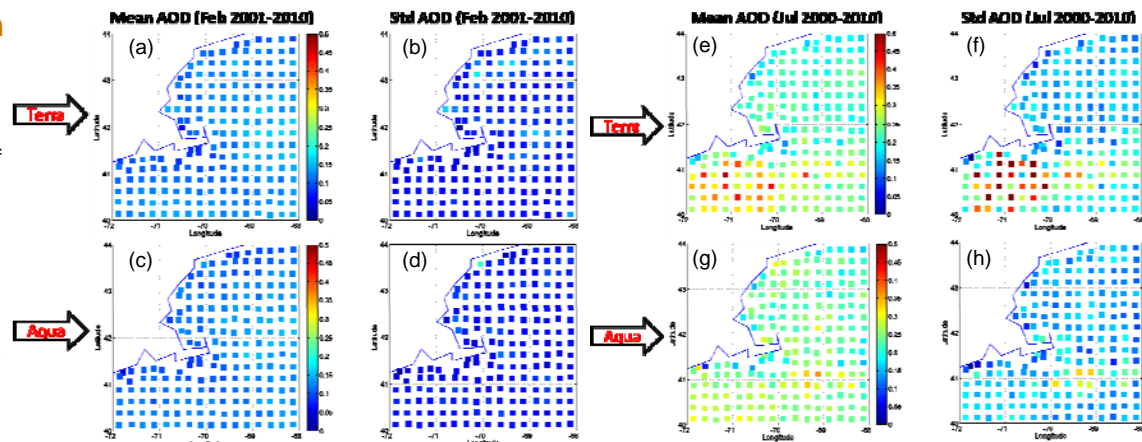
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1. Introduction and Motivation

A key objective of the U.S. Department of Energy's 2012-2013 Two Column Aerosol Project (TCAP) is to provide observations with which to evaluate the uncertainty in simulations of aerosol optical depth (AOD) and estimates of aerosol radiative forcing and climate change. Ground-based aerosol measurements will be made with the DOE Atmospheric Radiation Measurement (ARM) Mobile Facility (AMF) and Mobile Aerosol Observing System (MAOS) at Cape Cod, Massachusetts for a 12-month period starting in the summer of 2012. Two intensive sampling periods with aircraft are also planned. The results presented here use surface (AERONET) and satellite (MODIS and CALIPSO) observations to identify regions with high AOD in which observations will be made from two airborne platforms.

3. Results



Figures (a-h) Aerosol optical depth (AOD) averaged at every 0.25°x0.25° pixel over the TCAP region for February and July using MODIS Terra and Aqua satellites. Note geographic variability (std. dev.)

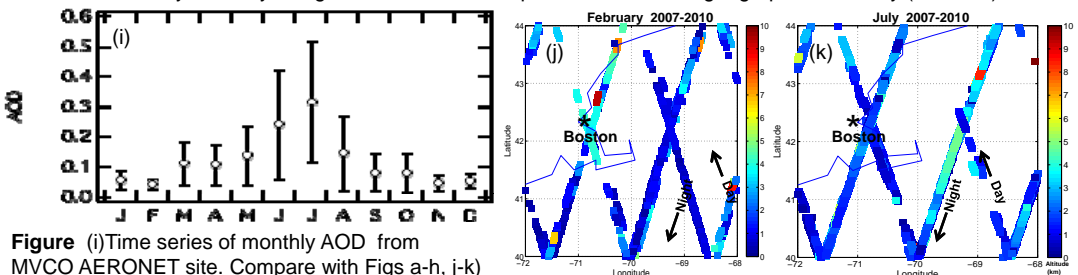


Figure (i) Time series of monthly AOD from MVCO AERONET site. Compare with Figs a-h, j-k)

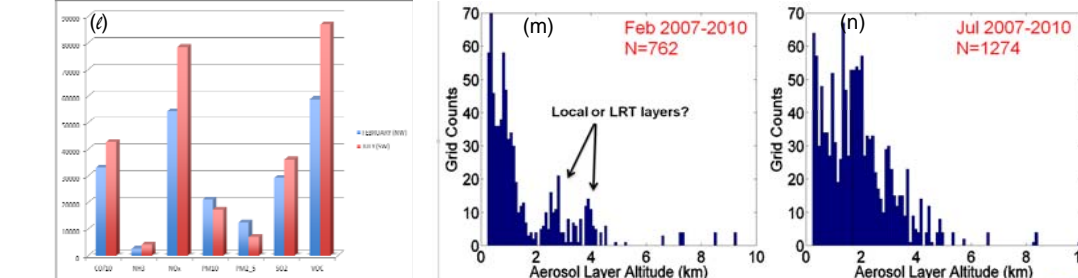


Figure (l) Total primary emissions (tons) of various gases and particulates from likely source regions within a 24-hr transit time from the TCAP study area. Source: EPA. Note small variation in PM.

Figures j-k: CALIPSO overpasses over TCAP region, (m, n) and PDFs of aerosol-layer altitudes for February (2007-2010) and July (2007-2010).

2. Observations

We used daily observations from: (a) MODIS Terra satellite 2000-2010 (b) MODIS Aqua satellite 2003-2010 (c) CALIPSO 2006-2010 satellite, and (d) AERONET 2004-2010 observations from Martha's Vineyard (MVCO) observatory (4 years of data) to develop AOD climatologies for July and February, the planned months of the intensive sampling periods with aircraft (in 2012 and 2013, respectively)



4. Science Summary

- Horizontal gradients with elevated AOD and variability are observed over the southwest corner of the TCAP region during July from MODIS Terra observations. This feature is not observed in the Aqua satellite data.
- The MODIS observations are consistent with the AERONET site at MVCO.
- CALIPSO observations indicated that the elevations of aerosol layers are higher in July than February. In both cases, most aerosol layers are below 5 km.
- Differences in primary anthropogenic emissions of PM10 and PM2.5 (Figure l) within 24 hrs transit time from the TCAP study area do not appear to explain the difference in observed February and July AODs.
- Diurnal variations in AOD are likely due to diurnal variation in RH.
- Distinct elevated layers (Figure m) are observed in winter season.

5. Logistical Conclusions

- Flight plans for the July 2012 IOP will be designed to sample in regions with large gradients and high standard deviation (Figures a-d).
- Most *in situ* sampling will be done below 5 km (Figure m).

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