

# TCAP Breakout Session Agenda

- ▶ TCAP background (Berg)
- ▶ AMF (Nitschke/Miller)
- ▶ Mobile Aerosol Observing System [MAOS] (Springston)
- ▶ AAF (Schmid)
- ▶ 4STAR (Flynn)
- ▶ Discussion/collaborations



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# The Two Column Aerosol Project (TCAP)

Carl Berkowitz, **Larry Berg**, James Barnard, Jerome Fast,  
Connor Flynn, Evgueni Kassianov, Phil Rasch, Rahul  
Zaveri, and Alla Zelenyuk

*PNNL*

Daniel J. Cziczo

*MIT*

Rich Ferrare, Chris Hostetler,  
Brain Cairns, and Philip Russell

*NASA*

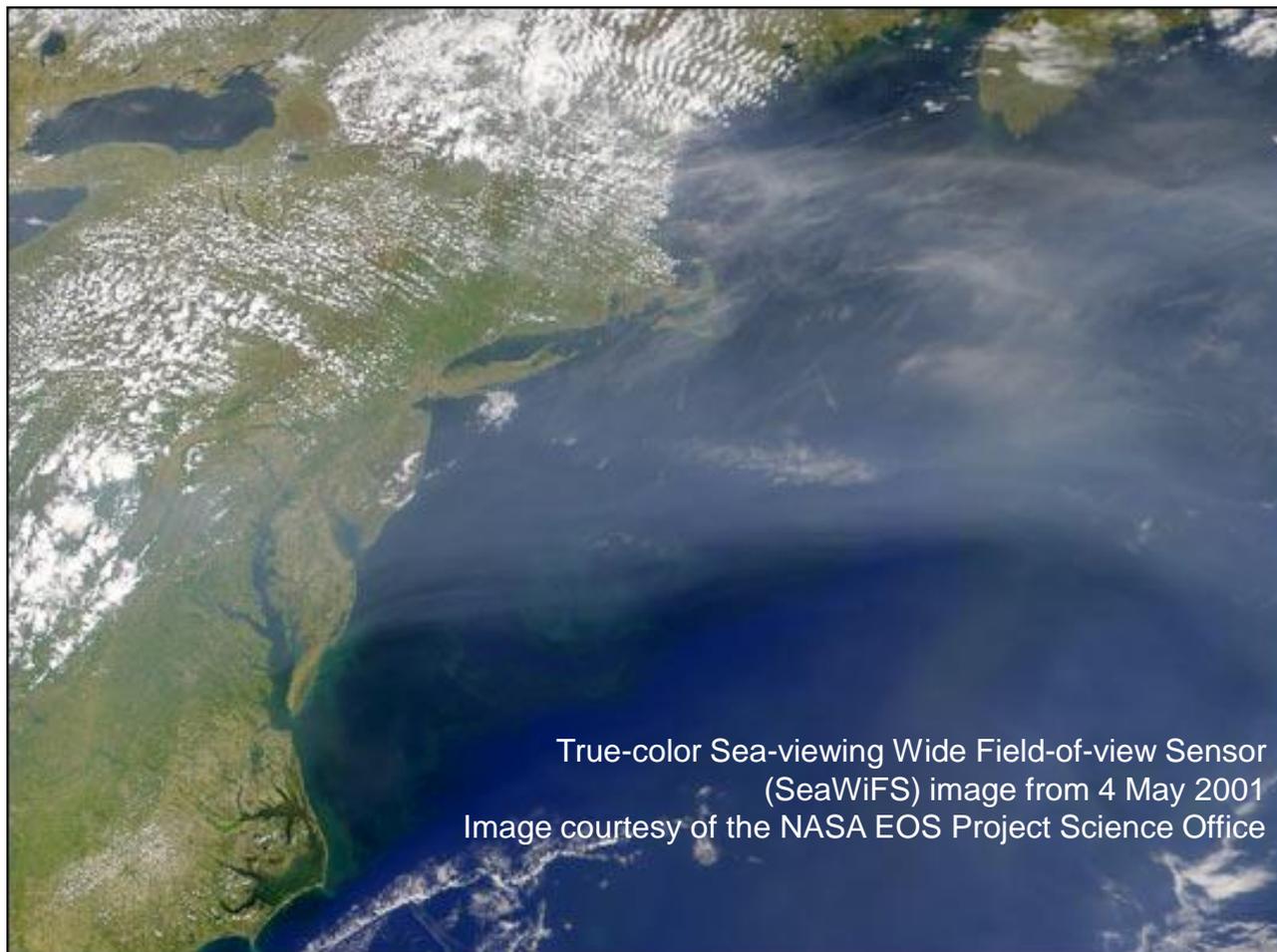
Barbara Ervens

*NOAA*



# Overarching Goal

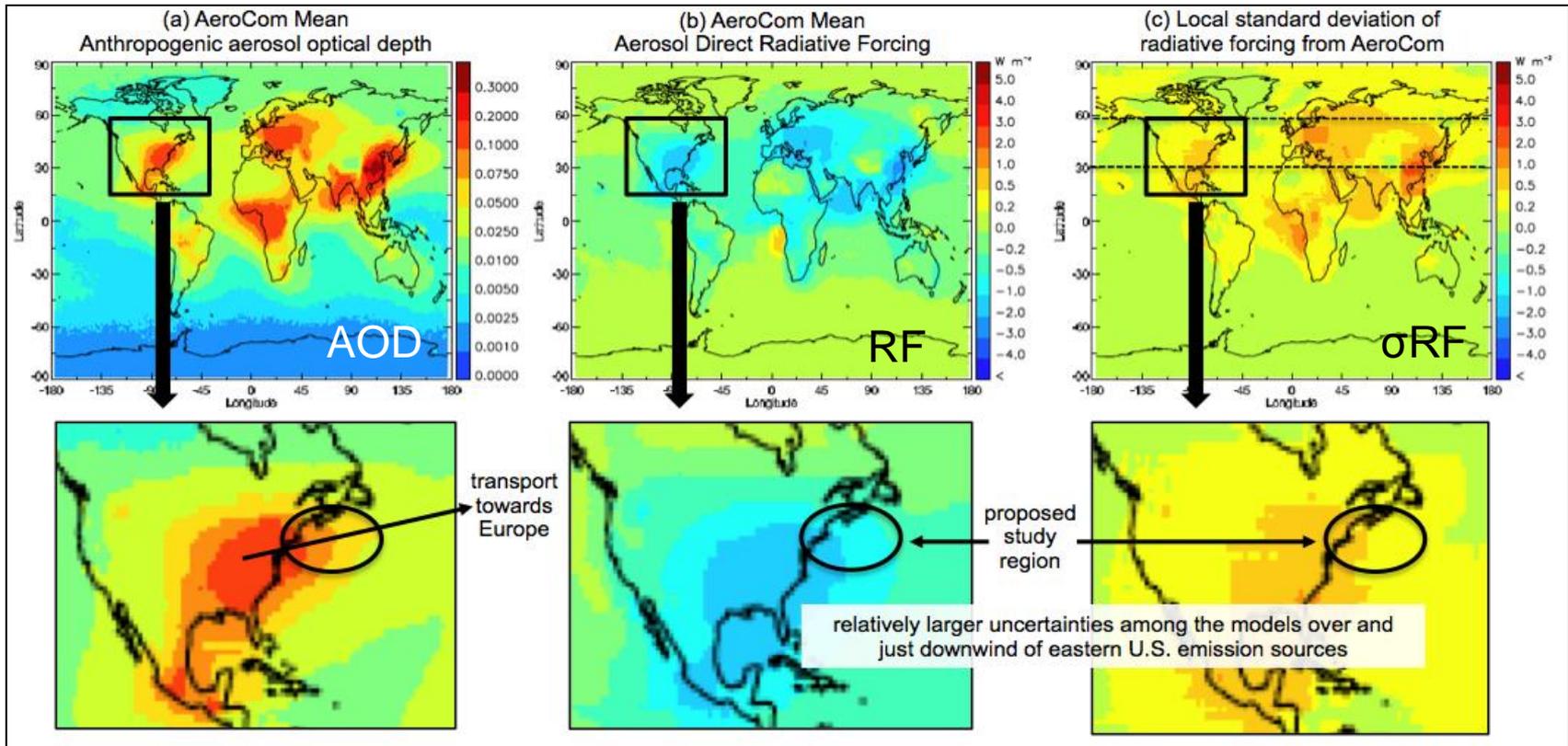
- ▶ To reduce modeling uncertainty associated with numerical treatment of aerosol transformation and cloud-aerosol interactions (CAI) in large-scale models



True-color Sea-viewing Wide Field-of-view Sensor  
(SeaWiFS) image from 4 May 2001  
Image courtesy of the NASA EOS Project Science Office

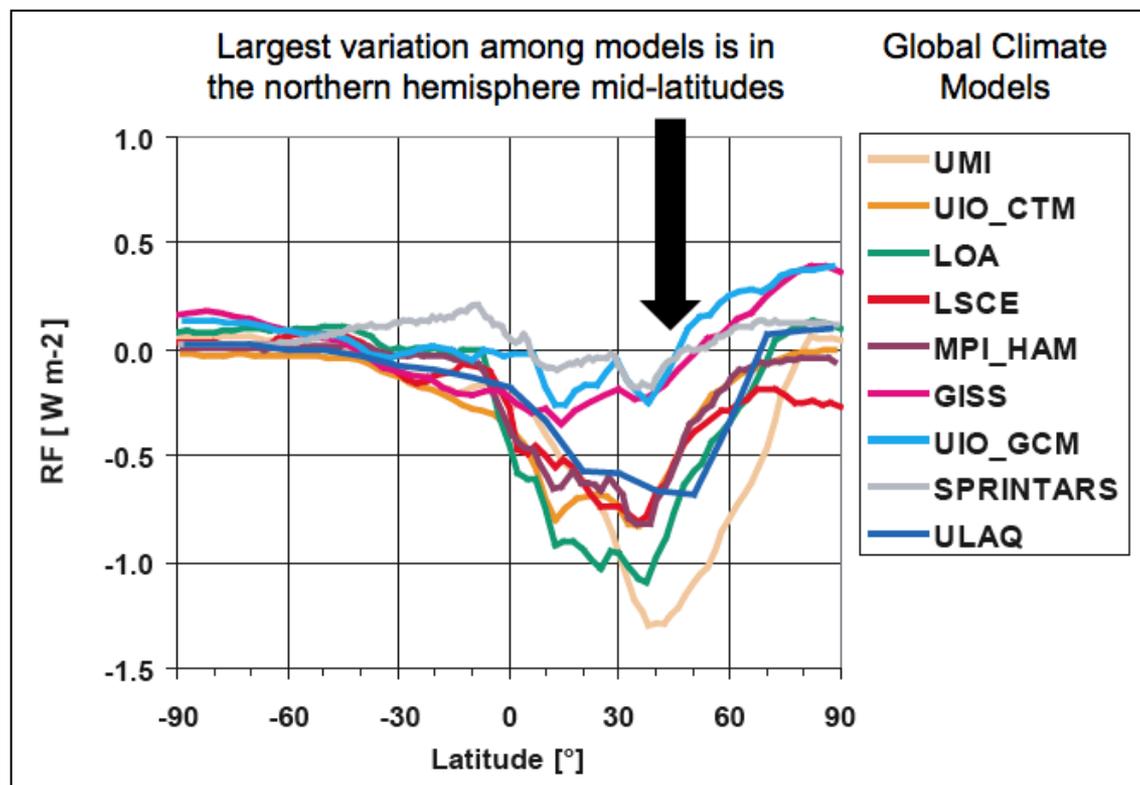
# Relevance To Climate Science: Predicted Forcing

- ▶ Large variations in the magnitude of predicted aerosol forcing



# Relevance To Climate Science: Predicted Forcing

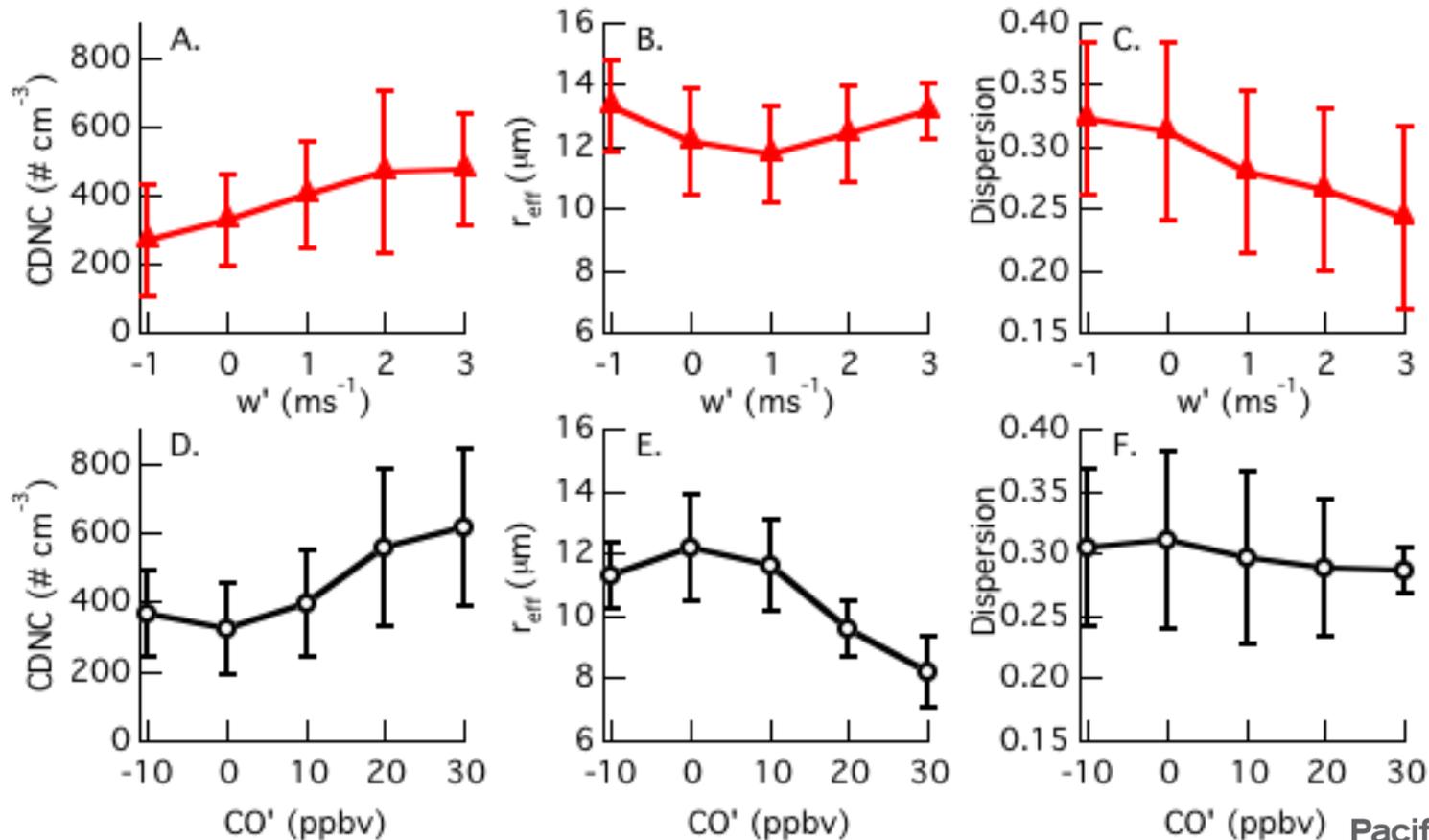
- ▶ Large variations in the magnitude of predicted aerosol forcing



# Relevance to Climate Science: Cloud Aerosol Interaction

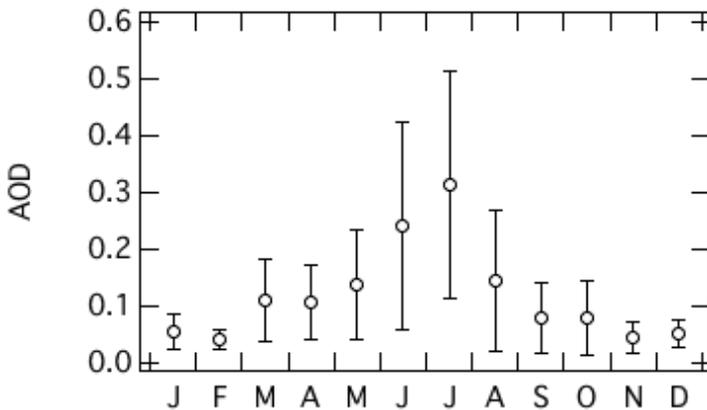
## ► CAI are highly uncertain

- Cloud dynamics and aerosol loading are important

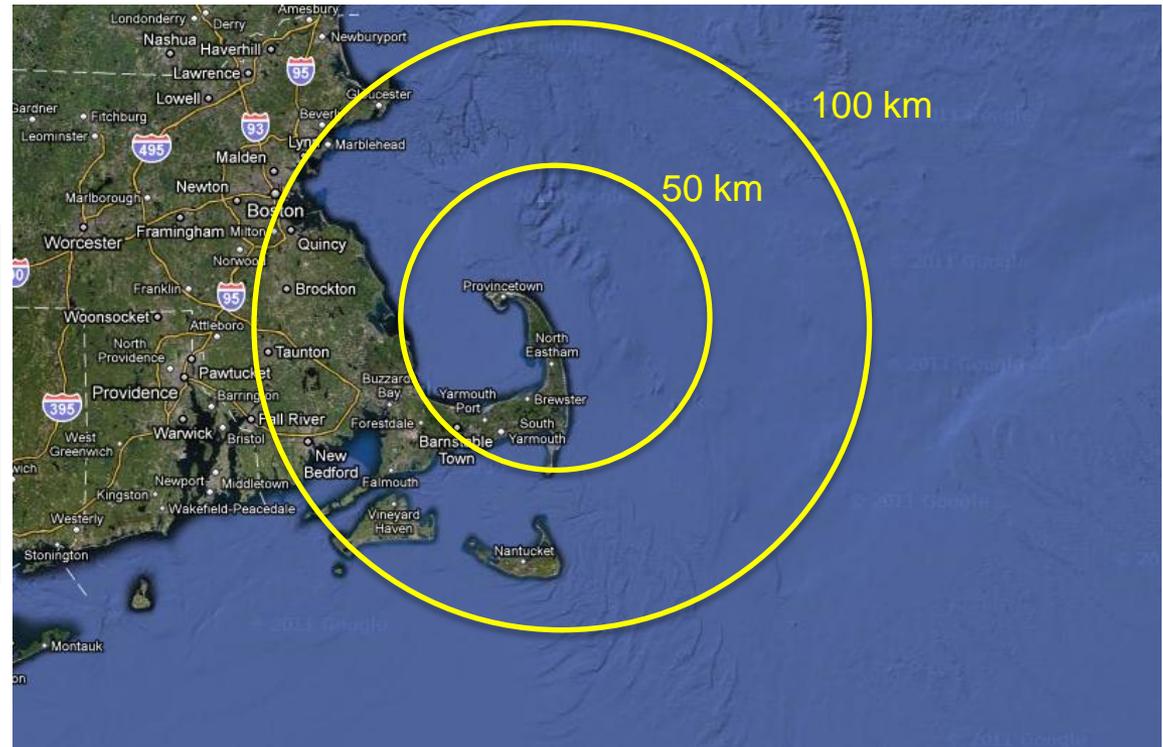


# Deployment details: Cape Cod

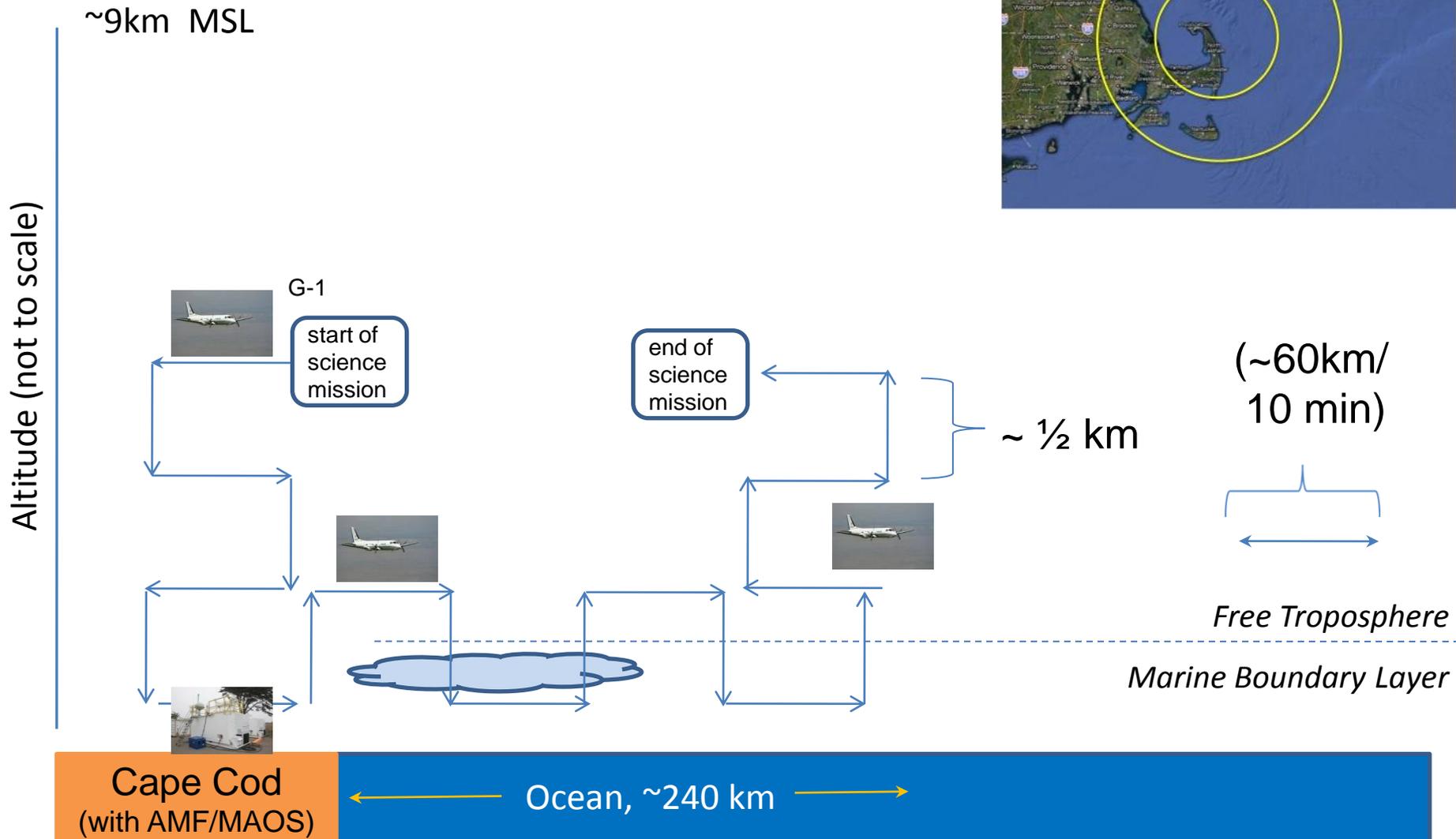
- ▶ One-year deployment of AMF1 and MAOS starting in the summer of 2012
  - Details from Kim and Mark
- ▶ Two aircraft intensive operation periods (IOPs)
  - One in summer
  - One in winter



AOD from MVCO AERONET site



# Deployment details: Flight pattern



# TCAP Science Goals

- ▶ A number of science questions could be addressed
  - CCN Chemical Closure Study
  - Local Radiation Closure Study
  - Columnar Radiation Closure Study
  - Cloud-Aerosol Interactions
  - High Resolution Modeling
  - GCM Modeling



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# Science Goal 1: CCN Chemical Closure Study

- ▶ Does size or composition matter?
- ▶ Single particle mass spectrometer
  - Details of the composition of individual particles, including mixing state
- ▶ CCN counter
- ▶ “Internal” pumped CVI (Pekour et al. 2008) downstream of CCN counter
  - Select particles that activate in the CCN counter
  - Has been applied in the lab—not yet on aircraft



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# Science Goal 2: Radiative Closure

## ▶ Local Closure

- Slab AOD measured by 4STAR will be compared to AOD estimates based on in situ aircraft measurements of:
  - scattering,
  - absorption,
  - size distribution and,
  - mixing state

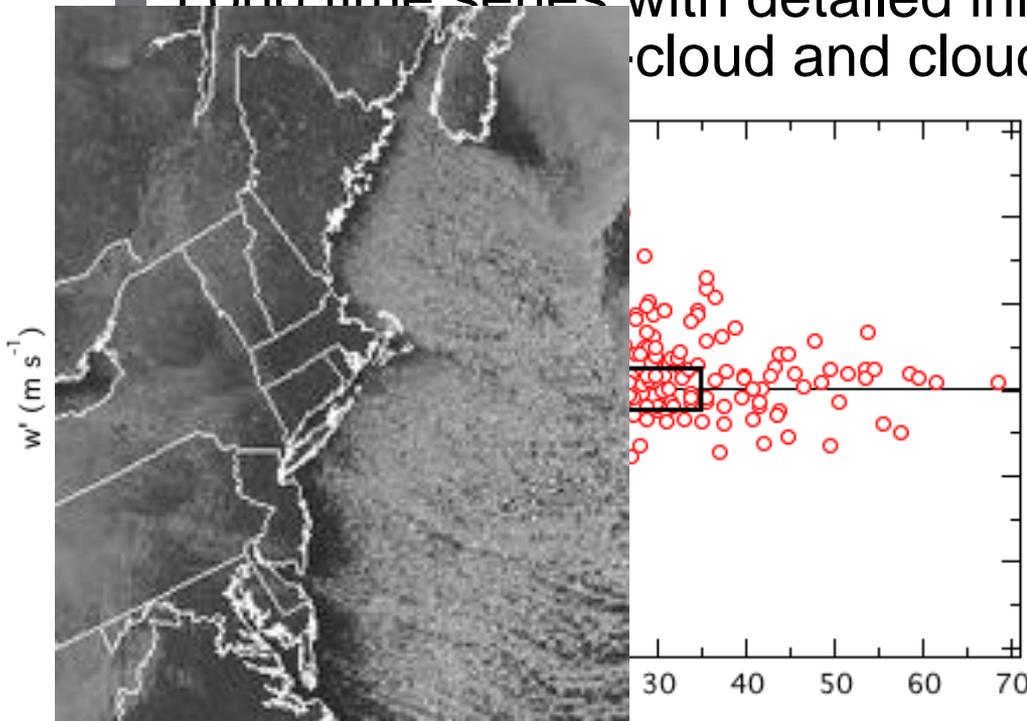


## ▶ Columnar closure

- Experiment 1: Integrate 4STAR AOD profiles & in situ profiles and compare to AMF MFRSR
- Experiment 2: Determine column-integrated values of SSA to SSA derived from the MFRSR

# Science Goal 3: Cloud-Aerosol Interactions

- ▶ Most past studies have been of short duration
  - AMF deployment to Azores is an exception
- ▶ Extend CHAPS analysis to observations from the AMF, MAOS and G-1
  - Long time series with detailed information about particles in cloud and cloud vertical velocity

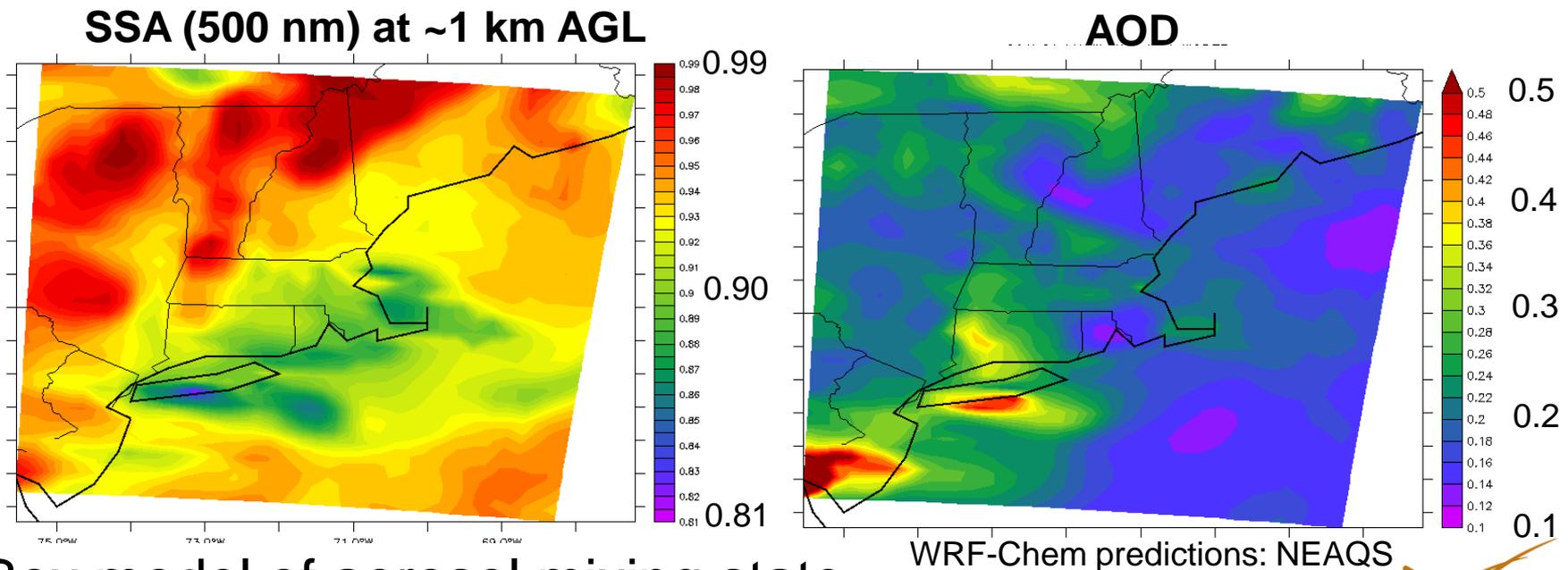


Data from CHAPS for shallow cumuli

Cold air outbreak—1/26/07 →

# Science Goal 4: High Resolution Modeling

- ▶ WRF-Chem and Aerosol Modeling Testbed (AMT)
  - Evolution of aerosols and its effect on CCN, aerosol direct and indirect radiative forcing
  - Emphasis on how radiative forcing within the two TCAP columns were affected by SOA, mixing state, and grid resolution



- ▶ Box model of aerosol mixing state
  - Recently developed model (Zaveri et al. 2010)

# Science Goal 5: Global Modeling

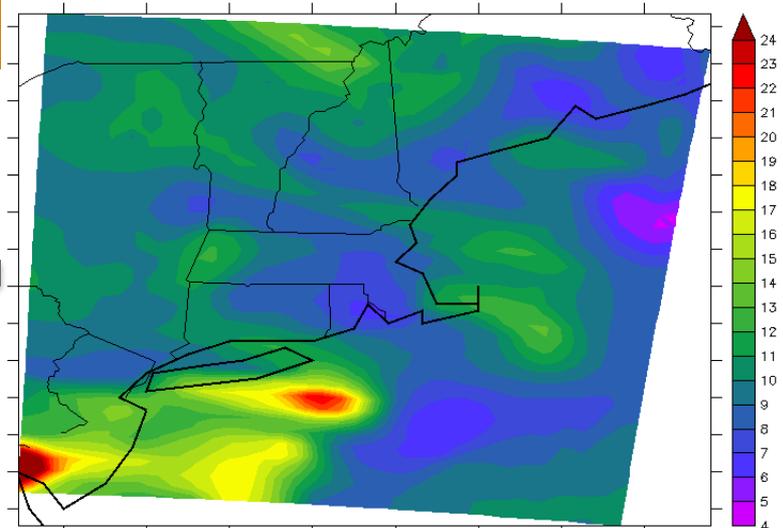
- ▶ Two primary questions:
  - How well does CAM5 represent the horizontal and vertical variability of anthropogenic aerosols and their impact on extinction and AOD?
  - What are the primary factors that can be used to explain differences between CAM5 simulations of direct and indirect radiative forcing and the TCAP measurements?



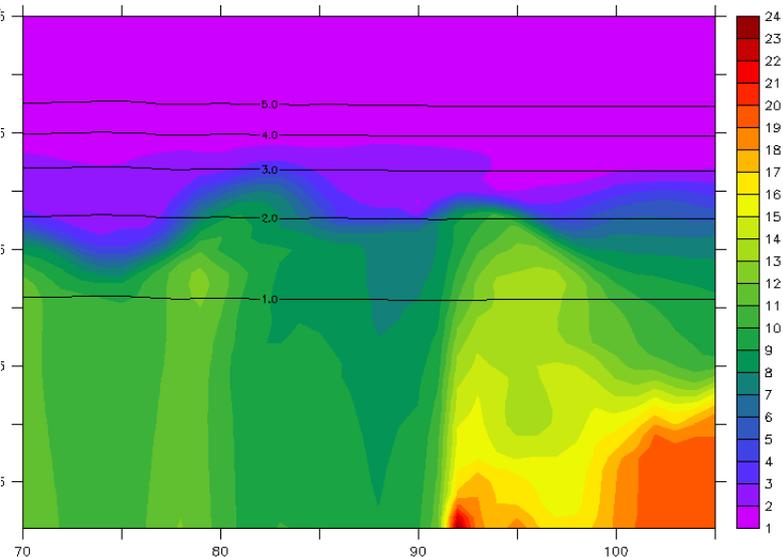
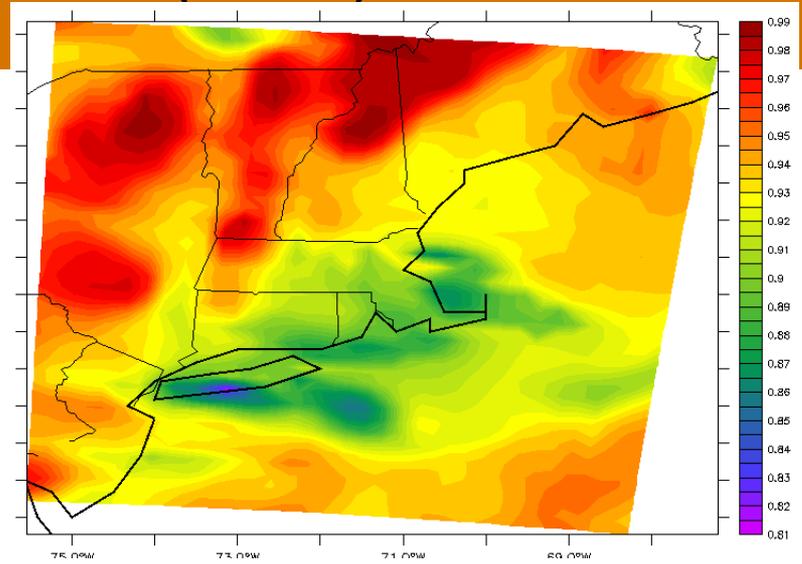
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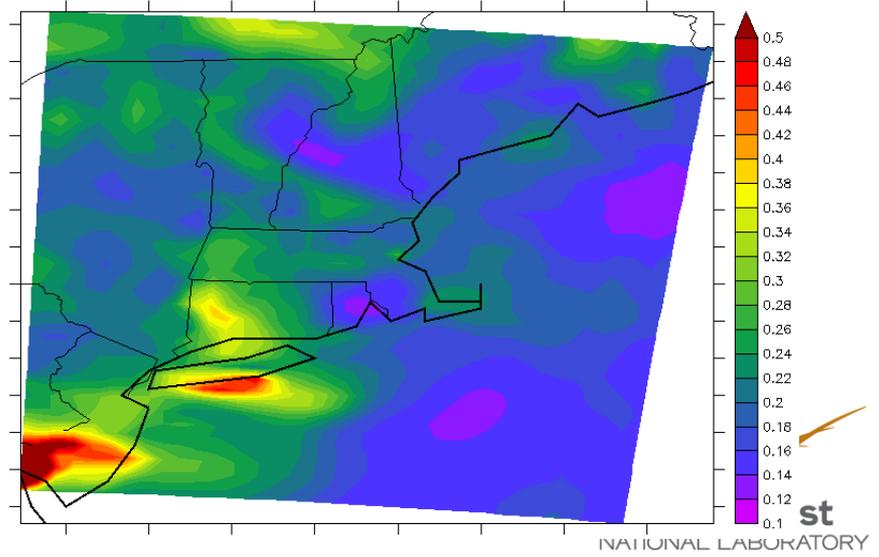
### PM2.5 at ~1 km AGL



### SSA (500 nm) at ~1 km AGL



### AOD



# Deployment details: Flight pattern

