Impact of Aerosols and Clouds on Photochemistry during TRACE-P

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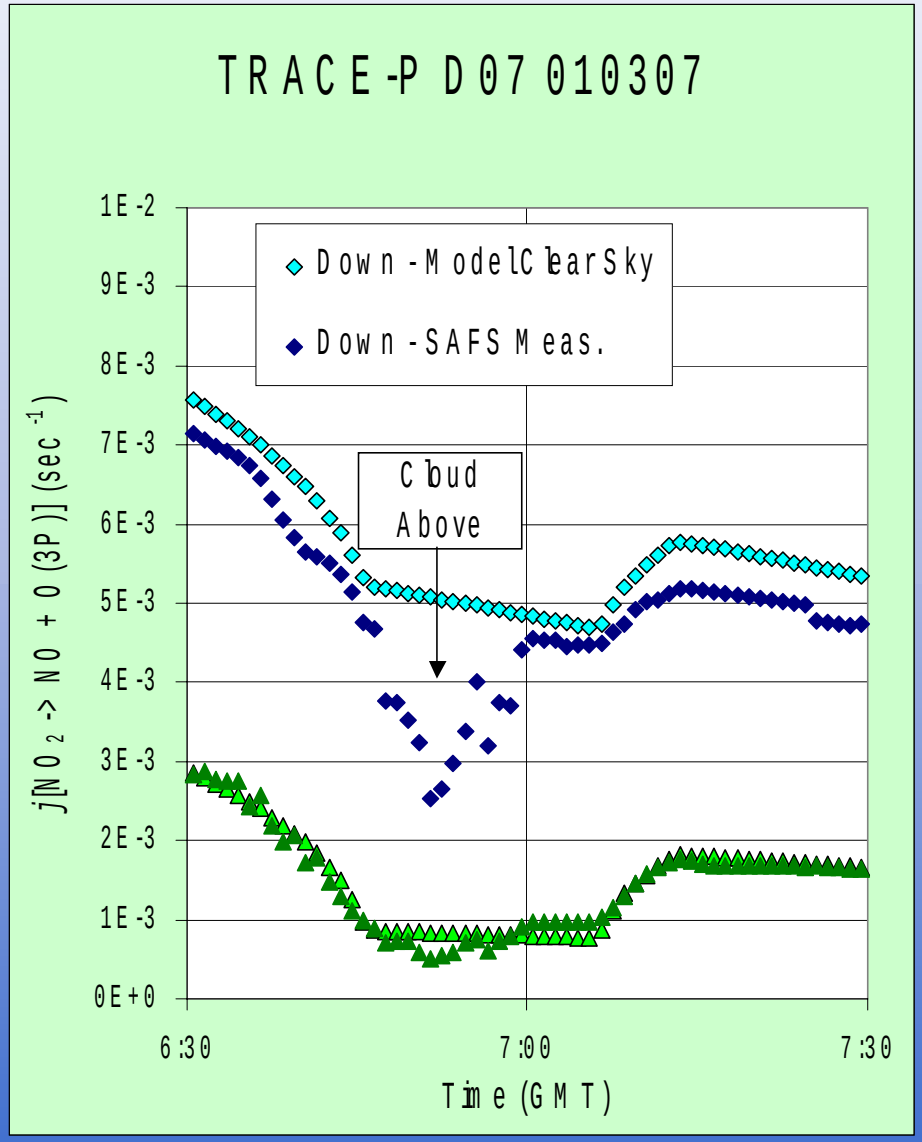
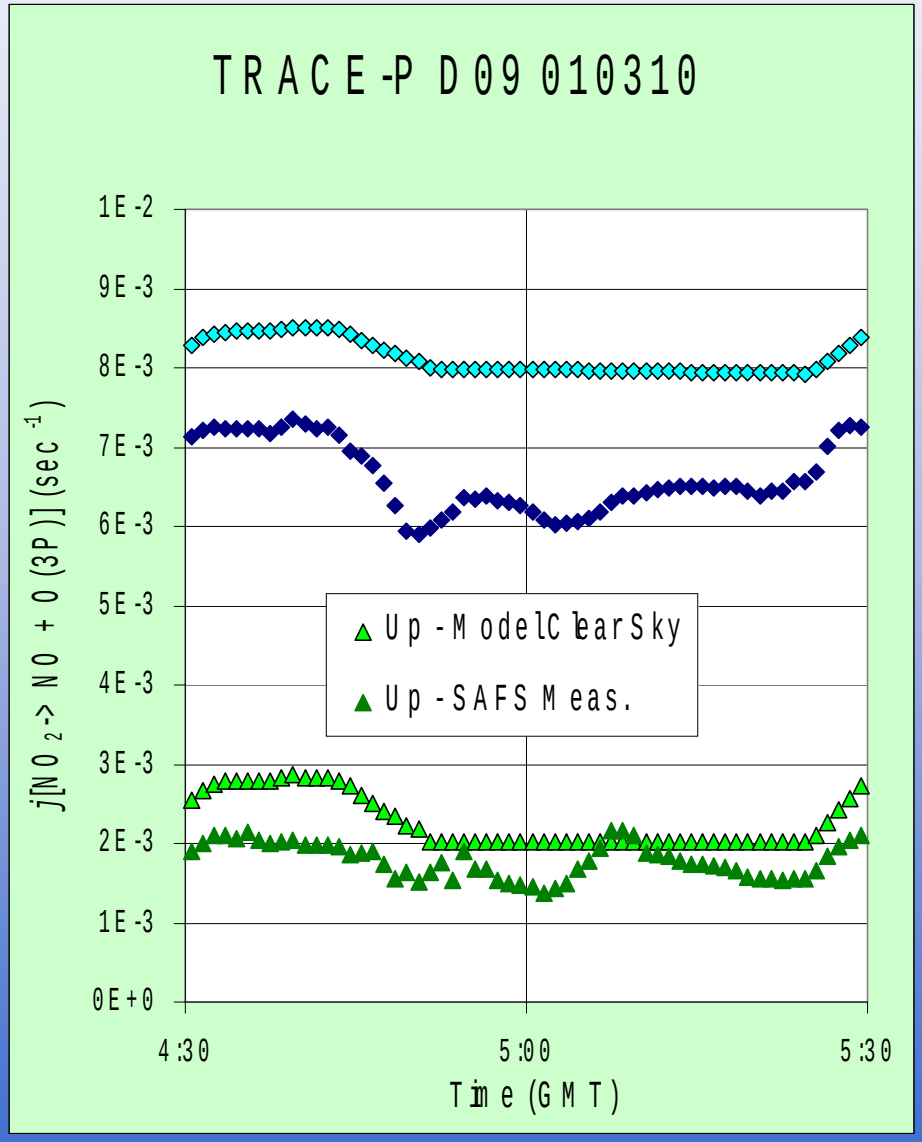
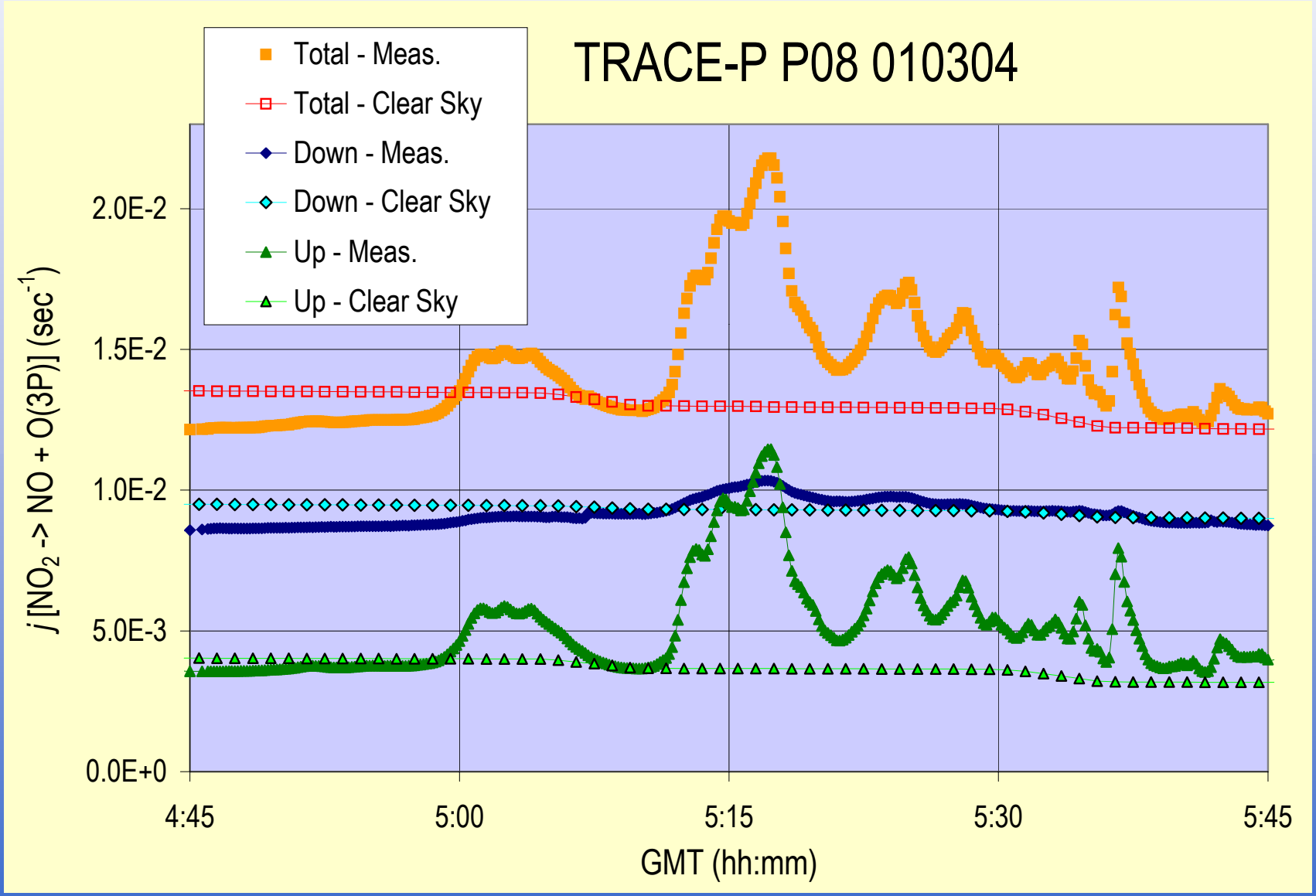
Impact on photolysis frequencies





Impact of clouds on photolysis frequencies



Question #1

How well can we model impact of aerosols / clouds on photolysis frequencies?

Tropospheric Ultraviolet and Visible (TUV) Radiation Model

TUV version 4.0a

8-stream discrete ordinate radiative transfer method with a pseudo-spherical modification

- Model Inputs:

  Latitude
  Longitude
  Altitude
  Surface albedo
  Vertical profiles of SO_2 and O_3
  Aerosol / cloud properties

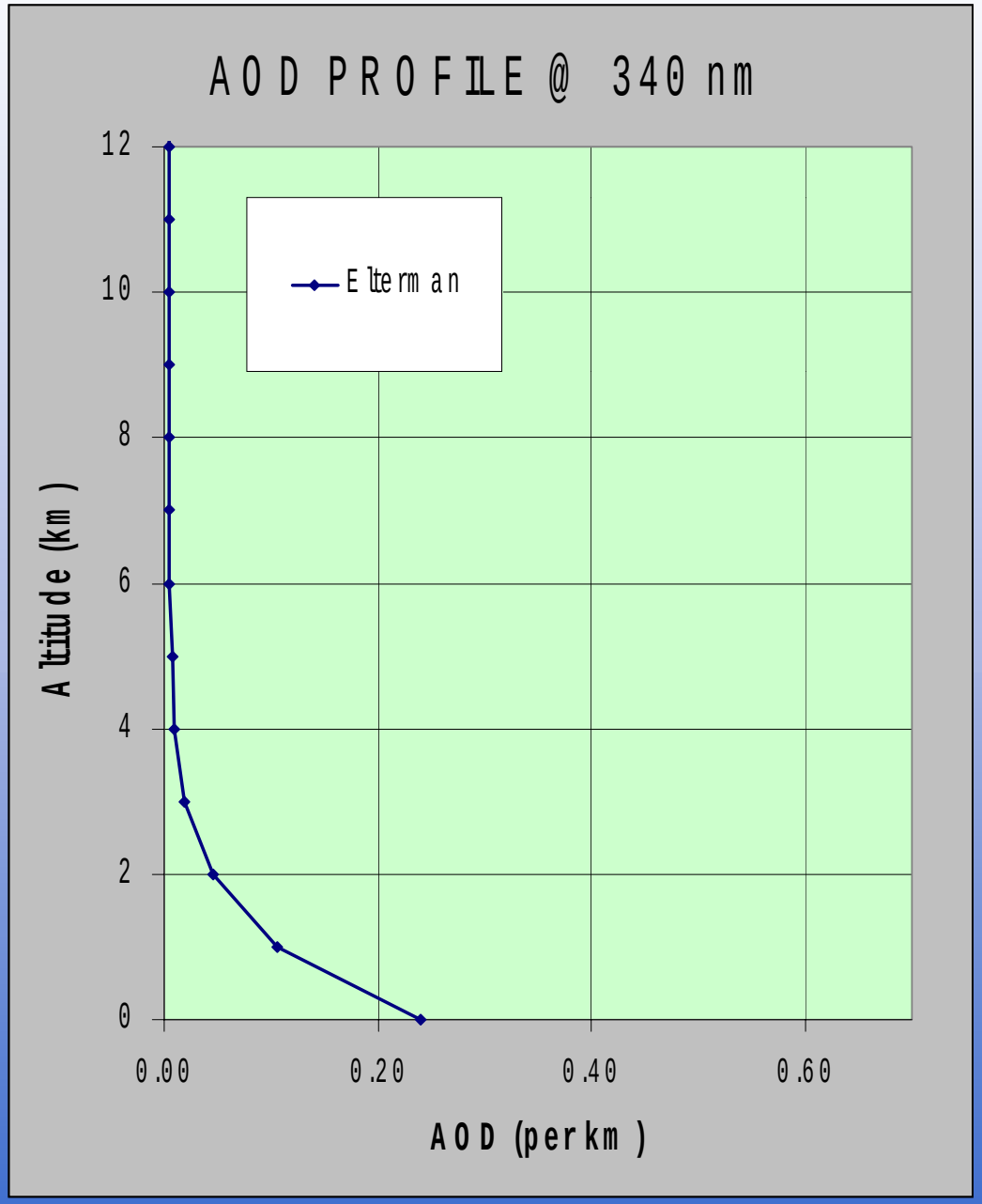
[http://www.acd.ucar.edu/TUV/]

Aerosol properties in TUV

- Aerosol optical depth (τ)
- Aerosol single scattering albedo (ω)
- Aerosol asymmetry factor (g)

Continental profile of AOD from Elterman [1968]

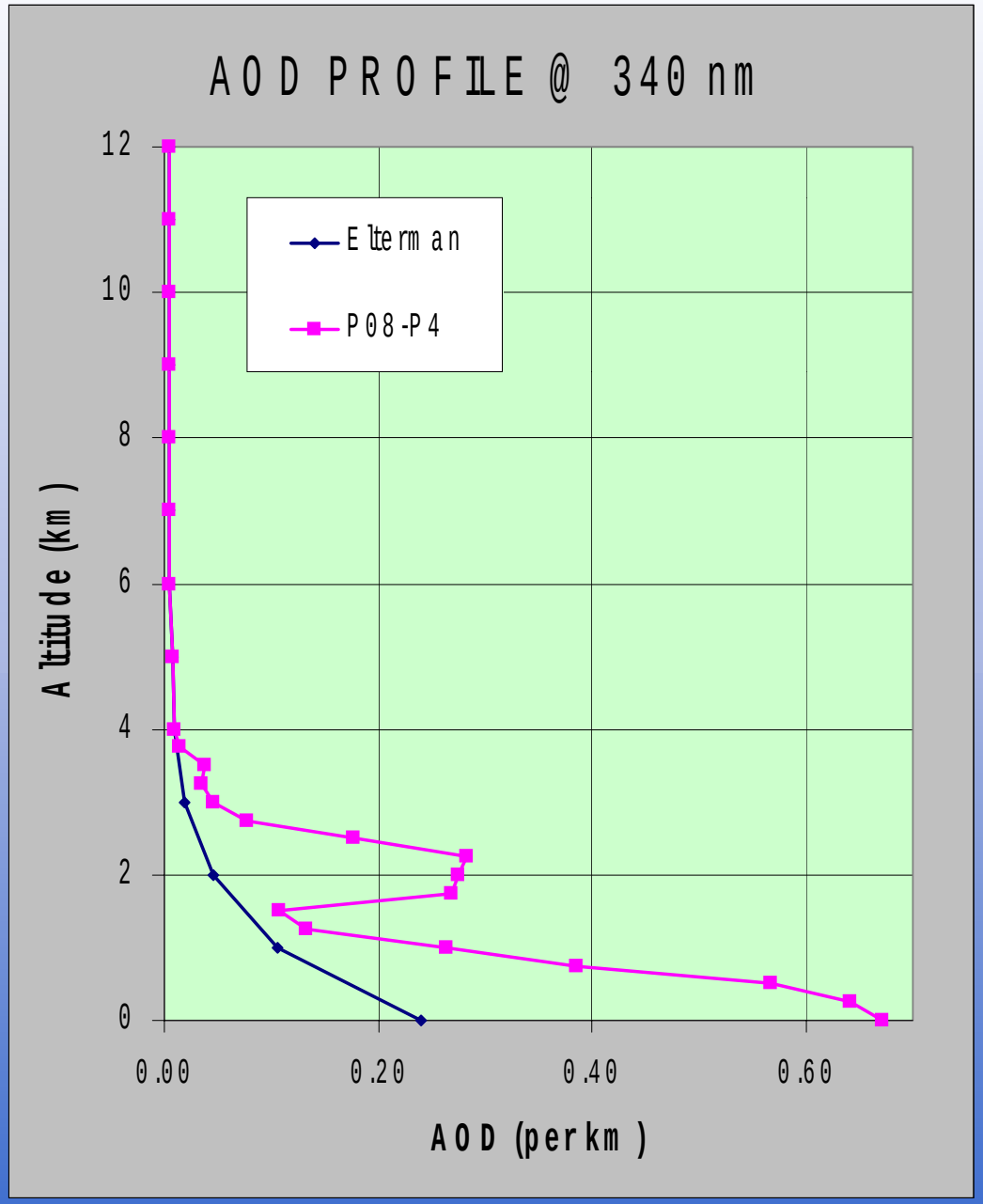
- τ = 0.38 at 340 nm
- ω = 0.99, 0.85
- g = 0.6



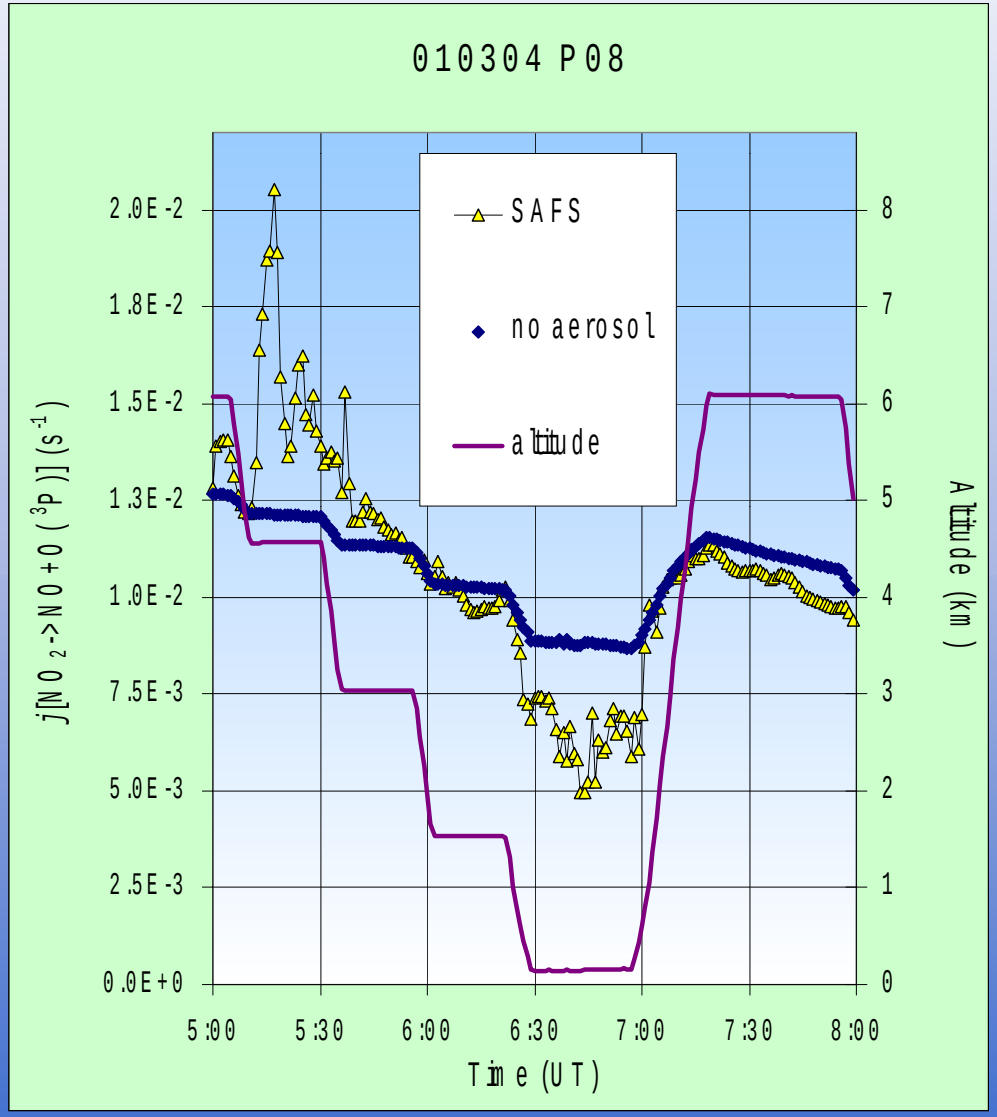
Elterman, L., *UV, visible, and IR attenuation for altitudes to 50 km*, Report AFCRL-68-0153, Air Force Cambridge Research Laboratories, Cambridge, Mass., 1968.

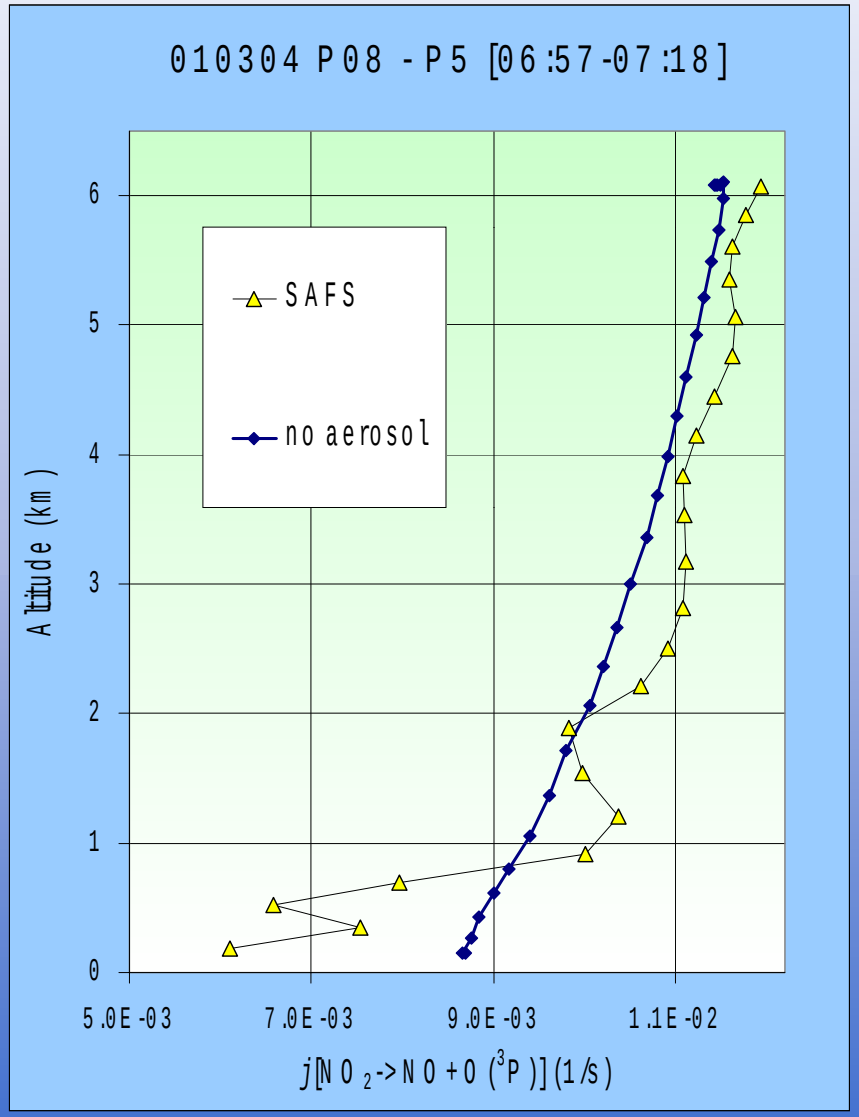
Modified profile of AOD scaled to aerosol ABS [Clarke et al.]

- τ = 0.56 at 340 nm
- ω = 0.85
- g = 0.6



Aerosol properties in TUV





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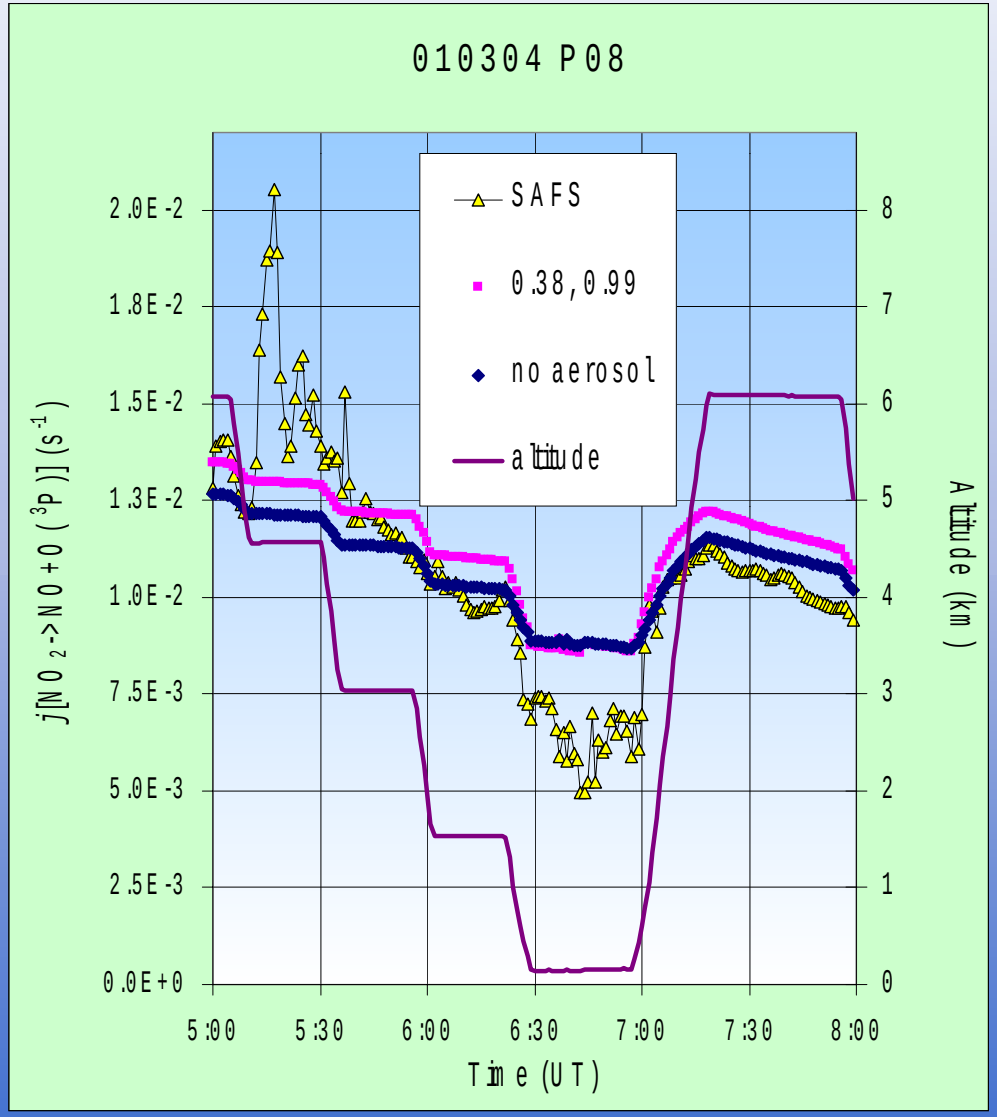

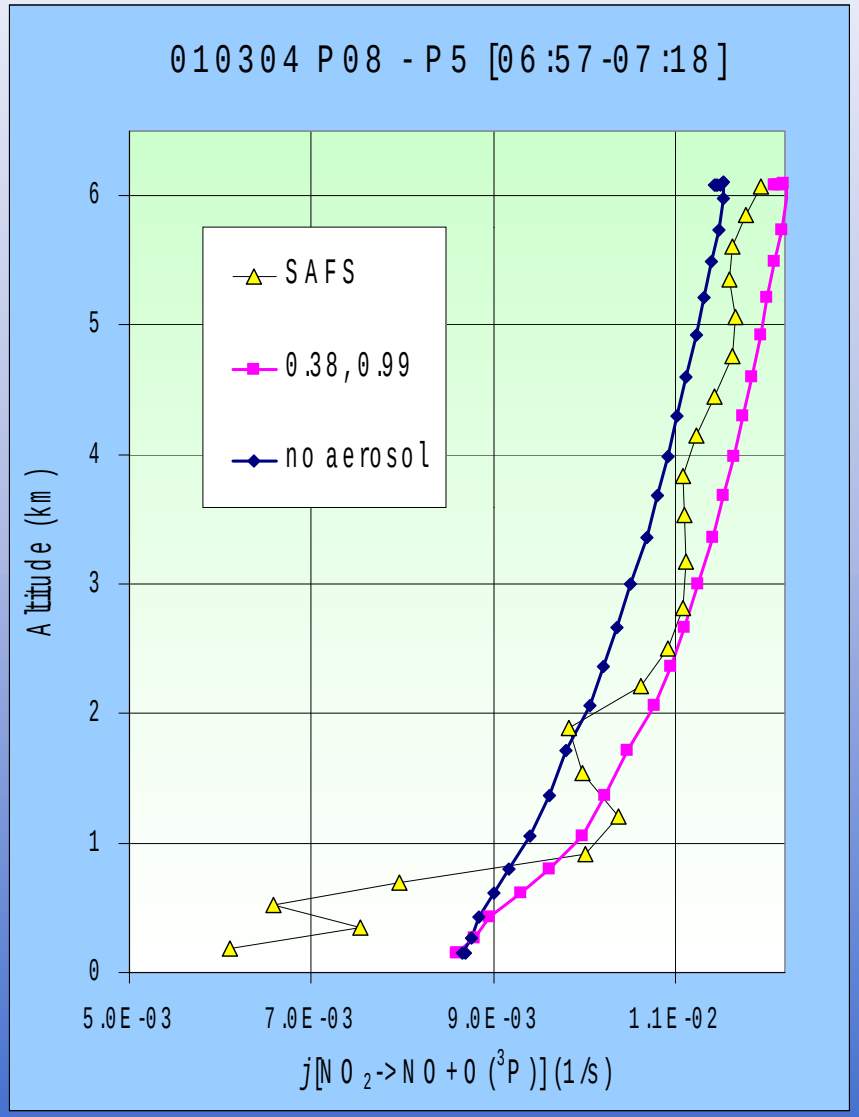

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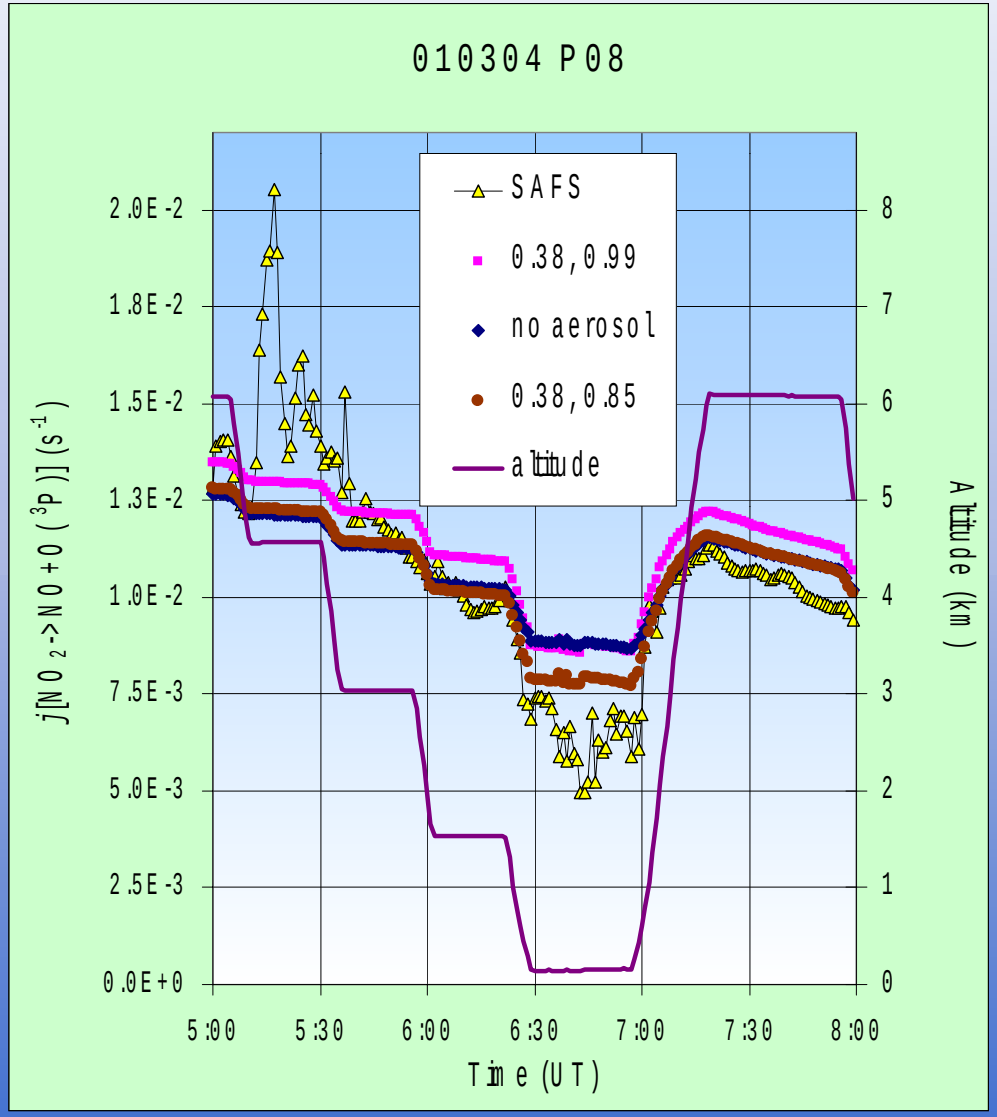
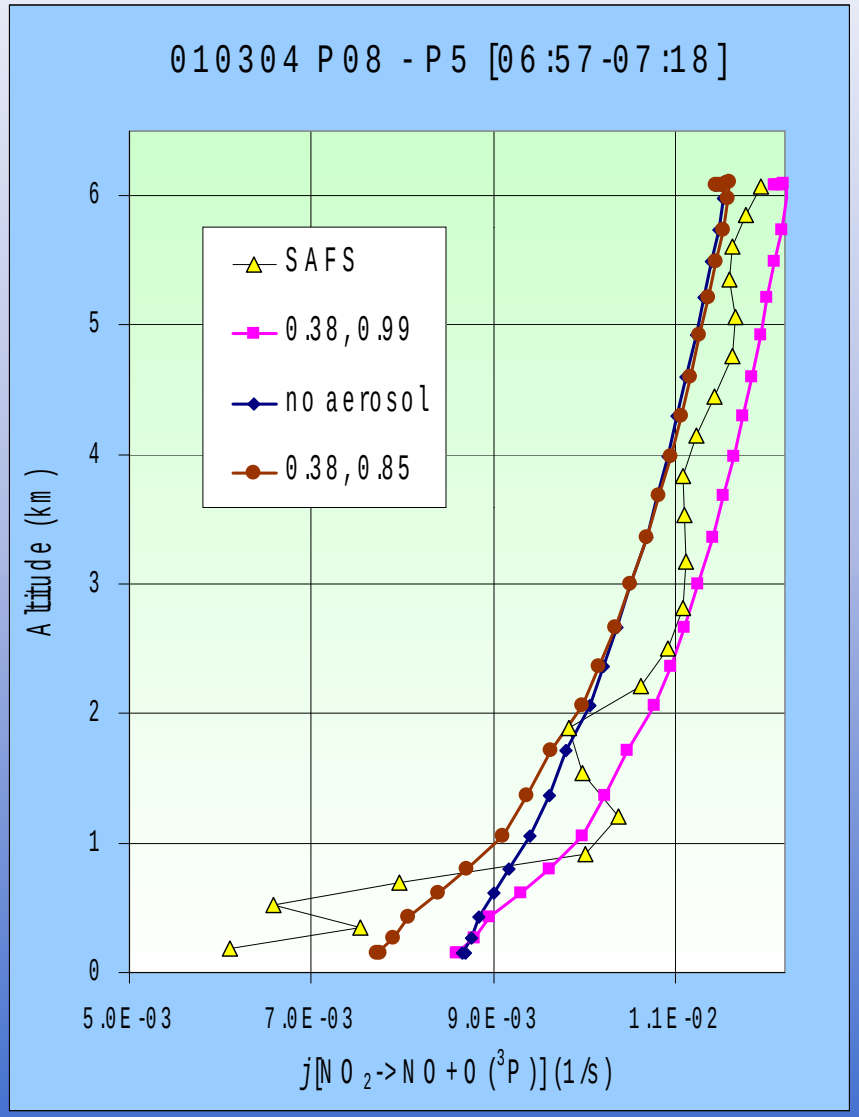
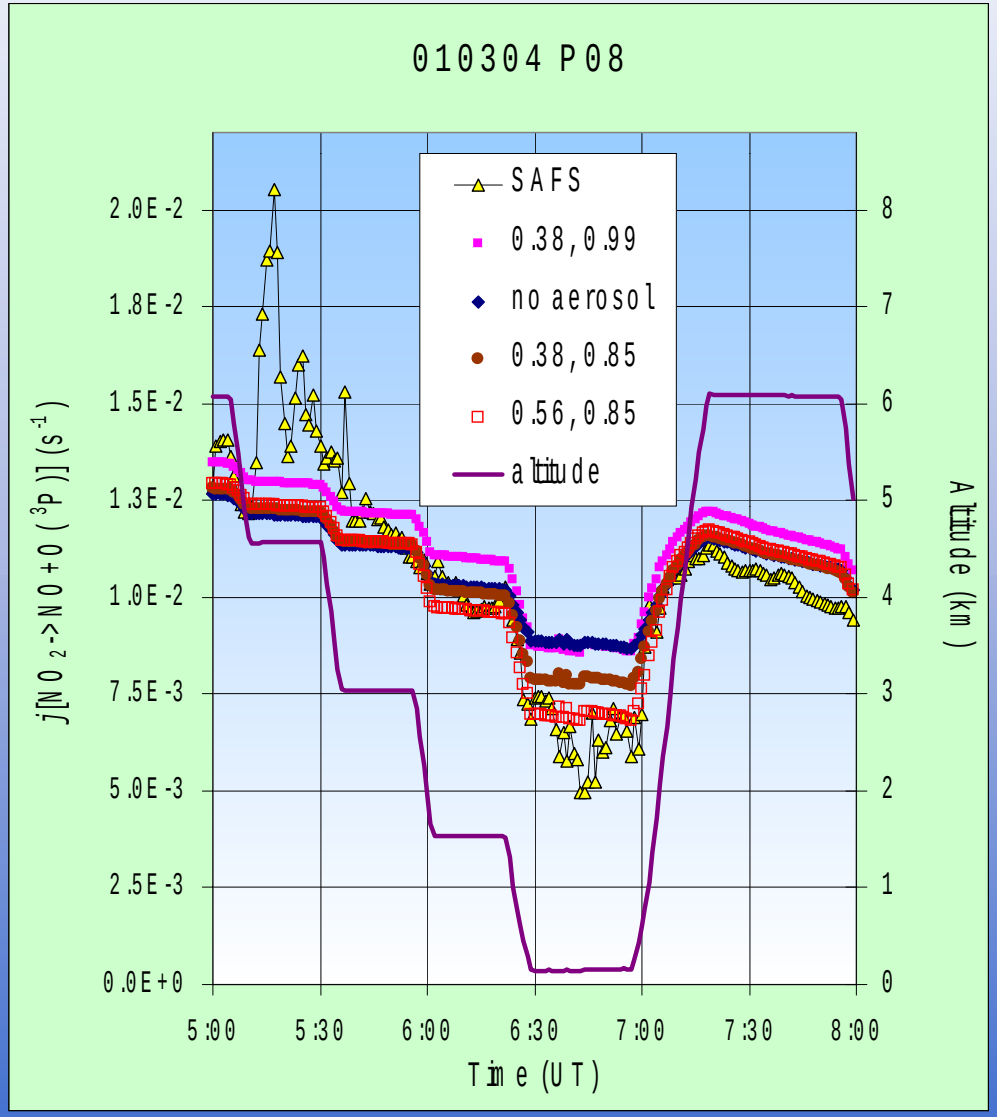
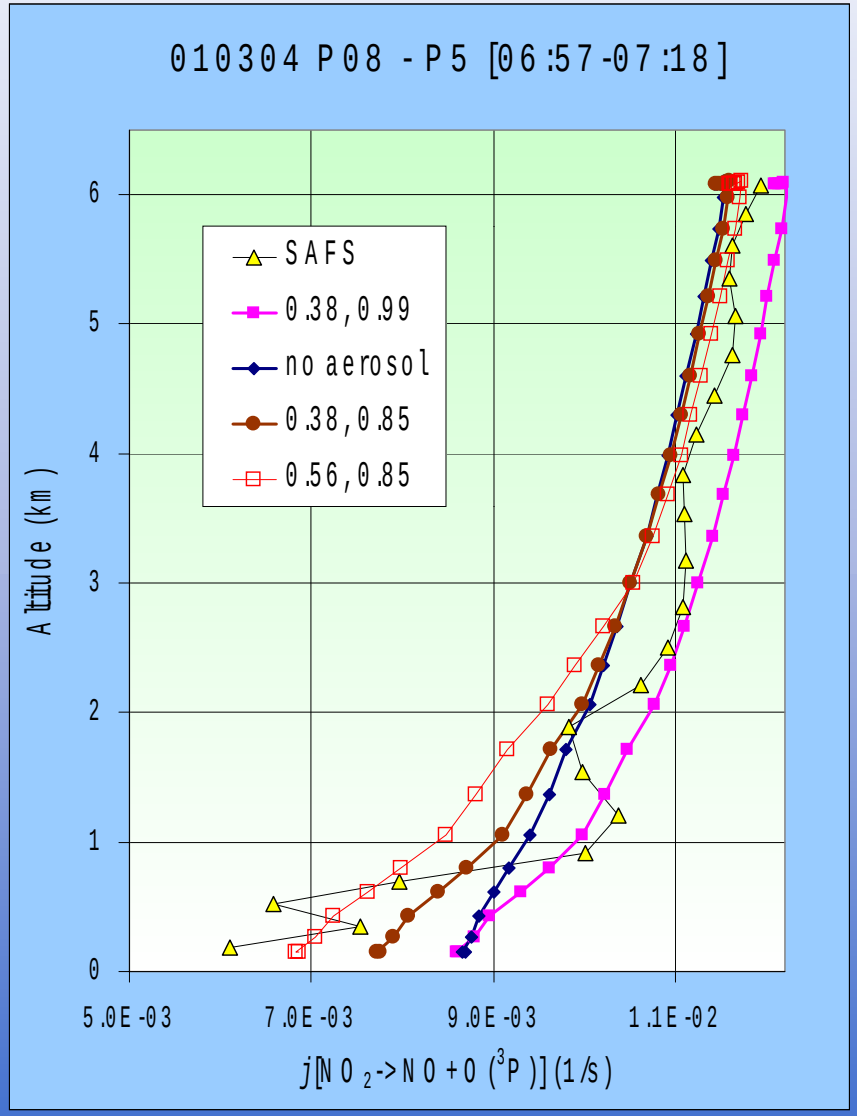




Aerosol properties in TUV





Question #2

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- Steady-State Box Model developed by Chris Cantrell

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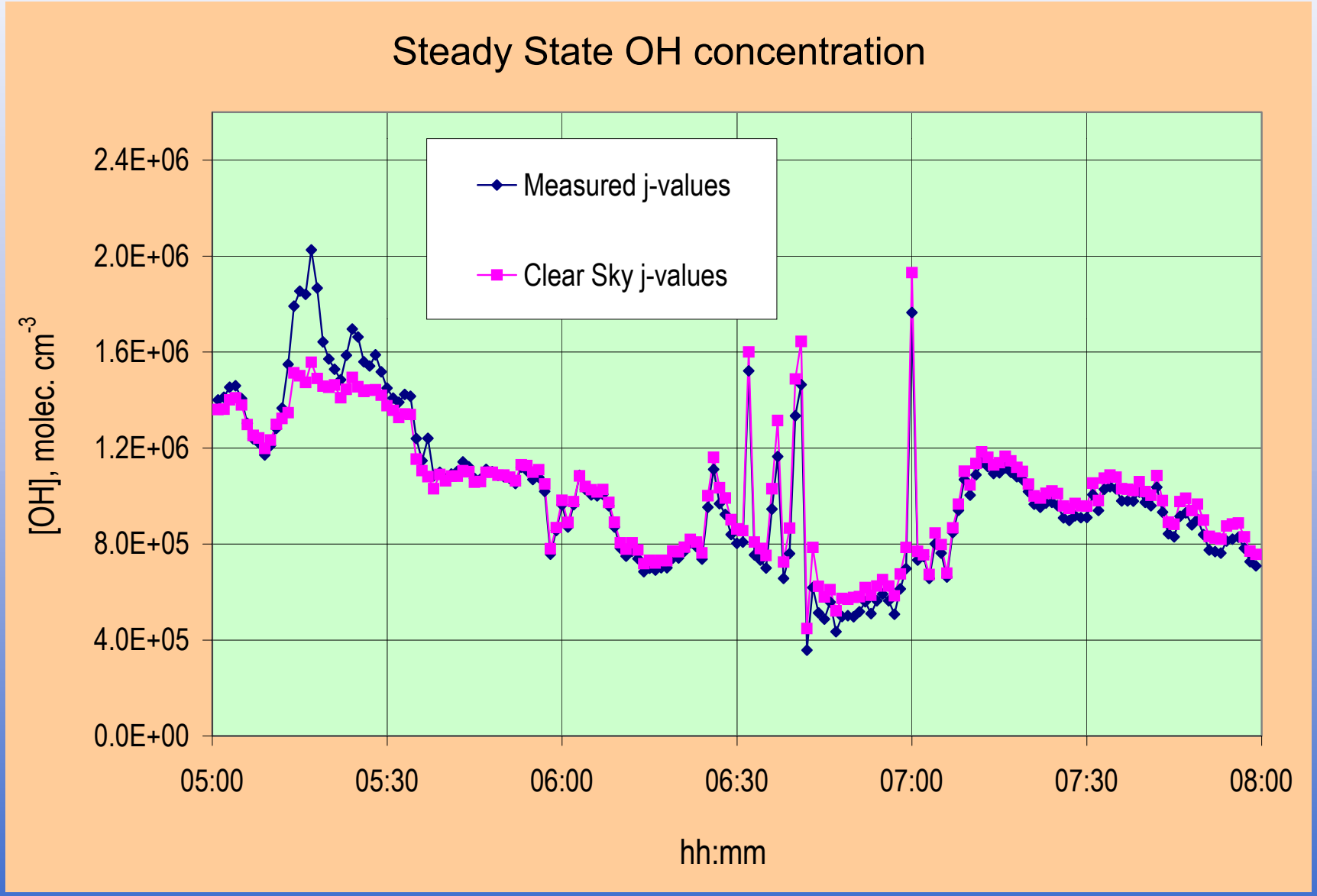
- Run for specific flights with:

a) measured photolysis frequencies

b) modeled (TUV) photolysis frequencies

- no aerosols / no clouds
- best estimate of AOD and ssa profiles
- simple clouds

Impact on Photochemistry



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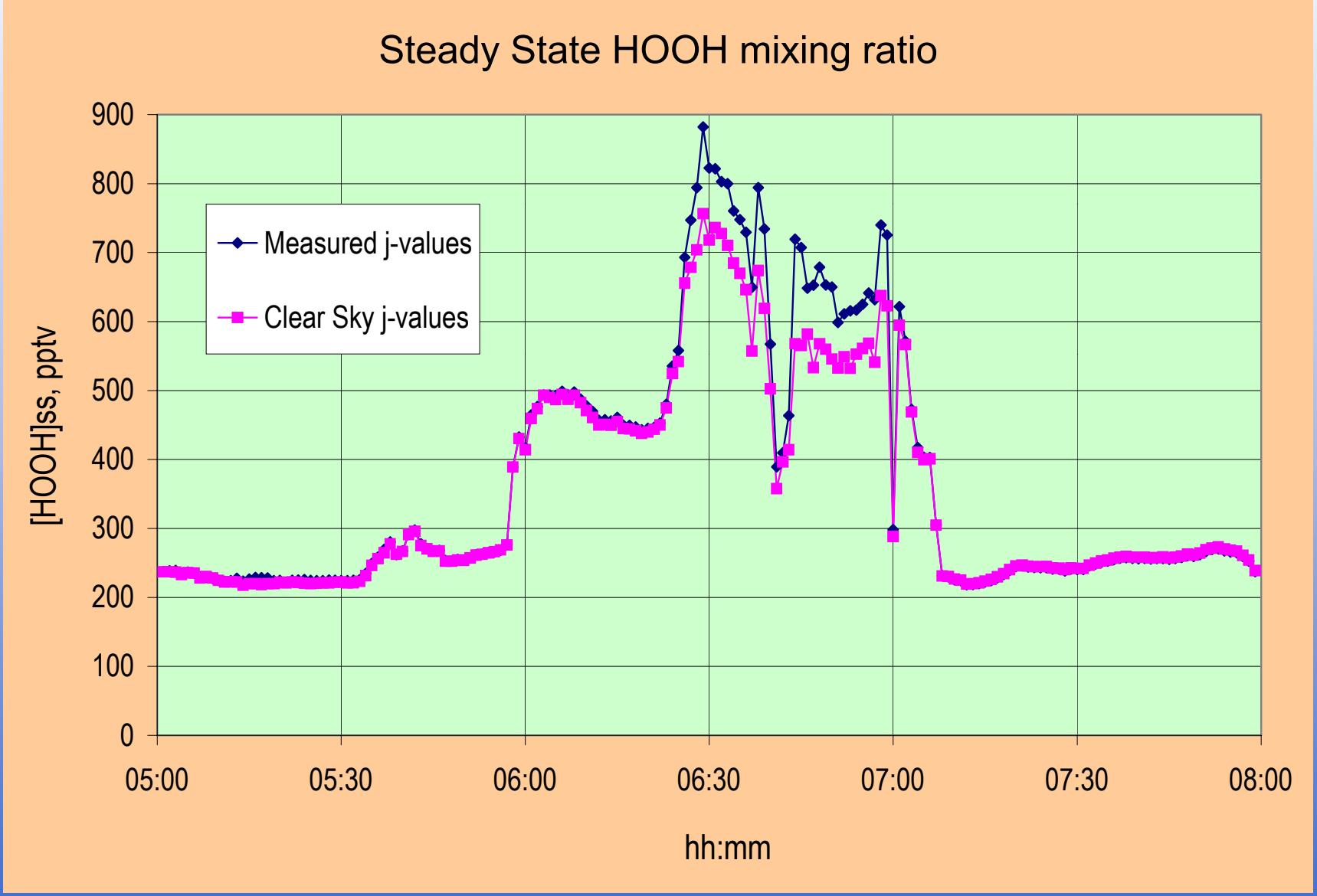

Challenges for Questions #1 and #2

- Separate impact of clouds from impact of aerosols
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Focus on data collected near profiles

- Case 1 - Cloud free conditions
  - clean vs. polluted airmass
  - absorbing vs. scattering aerosols
- Case 2 - Simple cloud layer
  - need “best” in-cloud indicator