# Comparison of airborne sunphotometer and OMI retrievals of aerosol optical depth during MILAGRO/INTEX-B 2006

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# Outline

- Jetstream 31 (J31) instrument payload and flight overview for MILAGRO/INTEX-B 2006

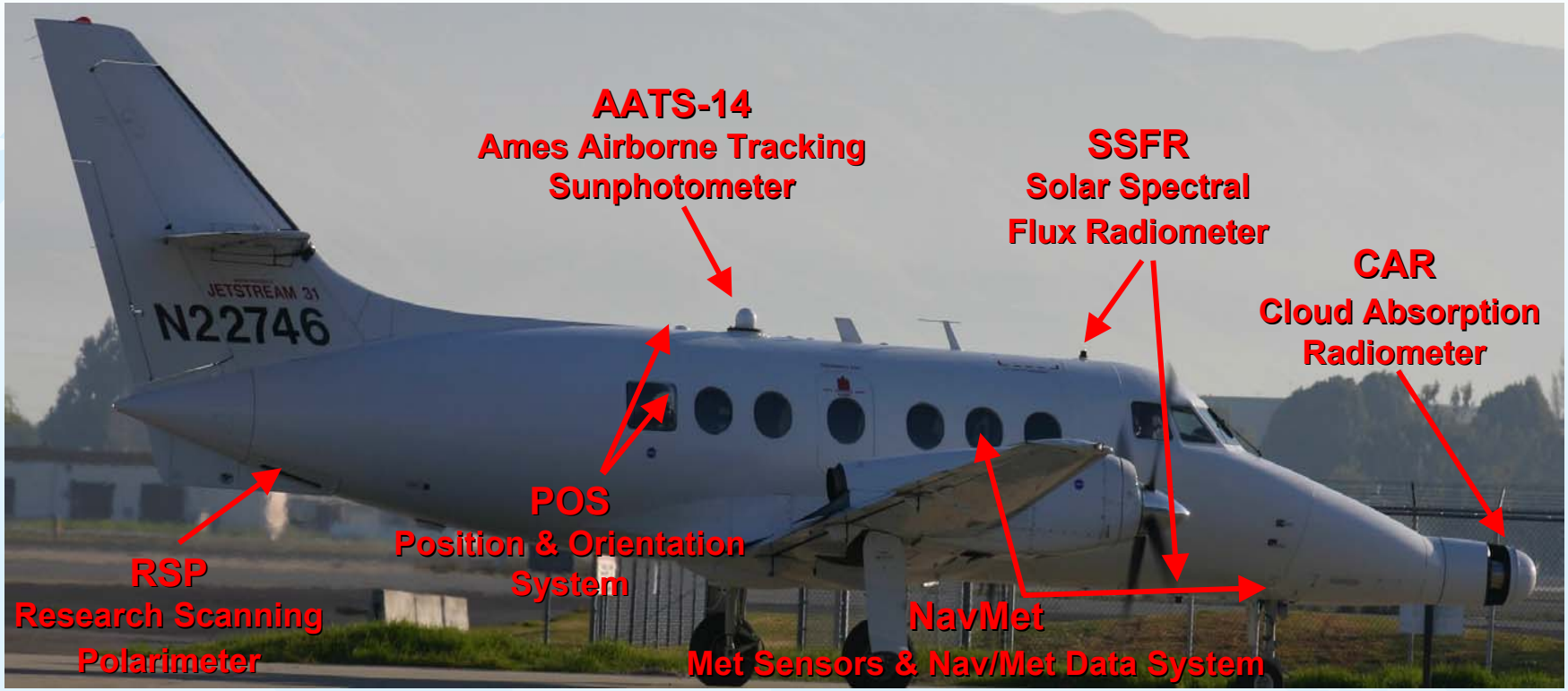
- Airborne, satellite, and ground-based AOD comparisons

  - AATS-14, OMI (UV and MW retrievals), & MODIS over water (3 cases)
    - -10 March (Aqua, Aura)
    - -03 March (Aqua, Aura) *(no coincident MODIS retrieval due to sun glint)*
    - -17 March (Aqua, Aura)

  - AATS-14, OMI, & AERONET over Mexico City (1 case)
    - -19 March (Aura)

- Summary/Conclusions

# Jetstream 31 in MILAGRO/INTEX-B: Instrument Locations




| | | |
|---|---|---|
| RSP | Total & linearly polarized reflectance | 412-2250 nm, 9 λ |
| SSFR | Upwelling & downwelling spectral hemispheric irradiance | 300-2200 nm, many λ<br>~8-12 nm resolution |
| CAR | Spectral & angular distribution of scattered light from clouds, aerosols, land and water surfaces; imagery of clouds & surface | 340-2130 nm |

# NASA Ames Airborne Tracking Sunphotometer: AATS-14

1. Measures direct solar beam transmission:

| | | | | |
|---|---|---|---|---|
| 353.5 | 380.0 | 449.0 | 499.4 | 525.0 |
| 605.7 | 675.1 | 778.4 | 864.5 | 939.7 |
| 1019.1 | 1241.3 | 1557.8 | 2139.0 nm | |

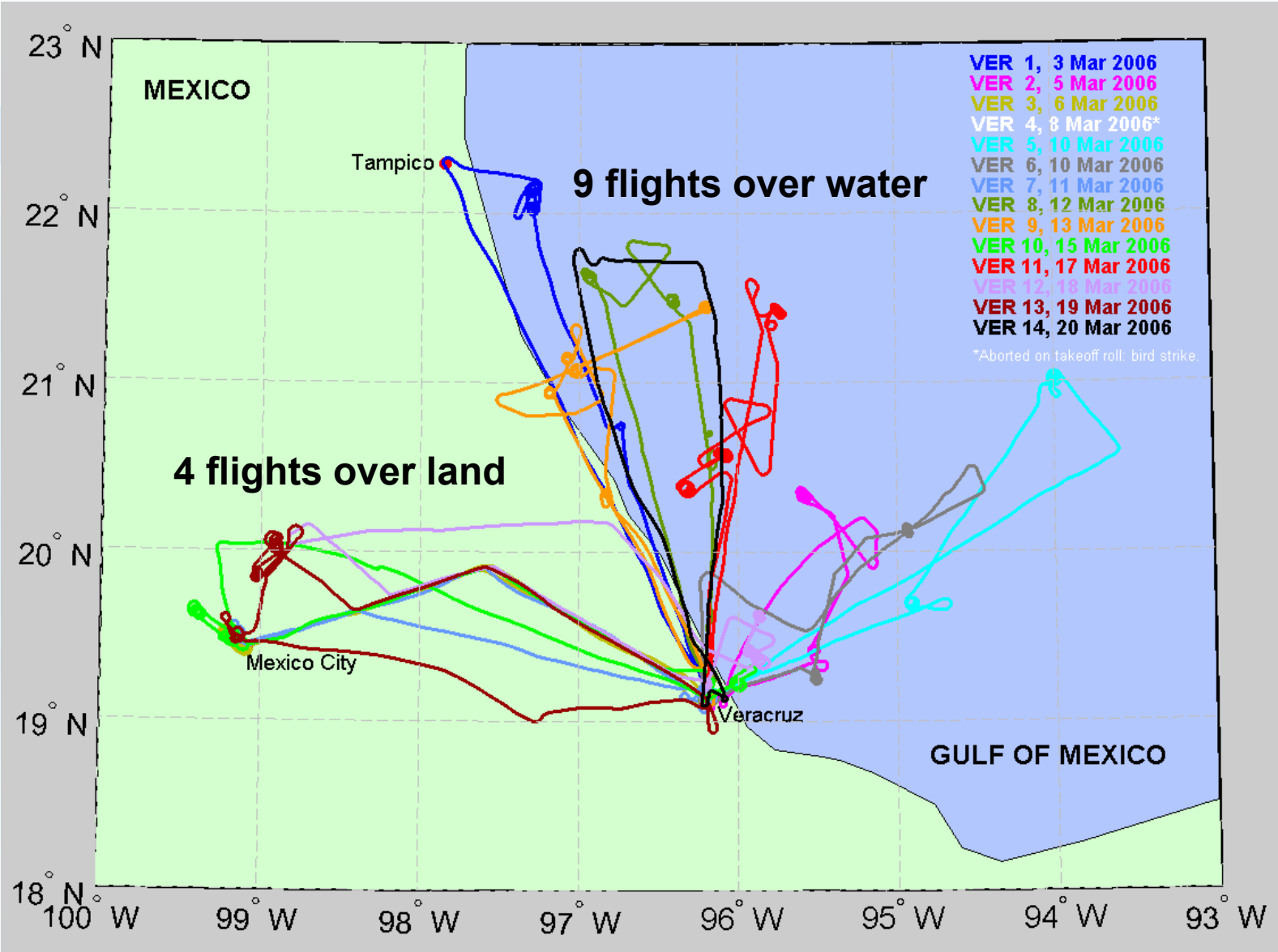
2. Yields:
   aerosol optical depth & columnar water vapor (ozone under certain conditions)

   aerosol extinction & water vapor (ozone) concentration when aircraft flies profiles

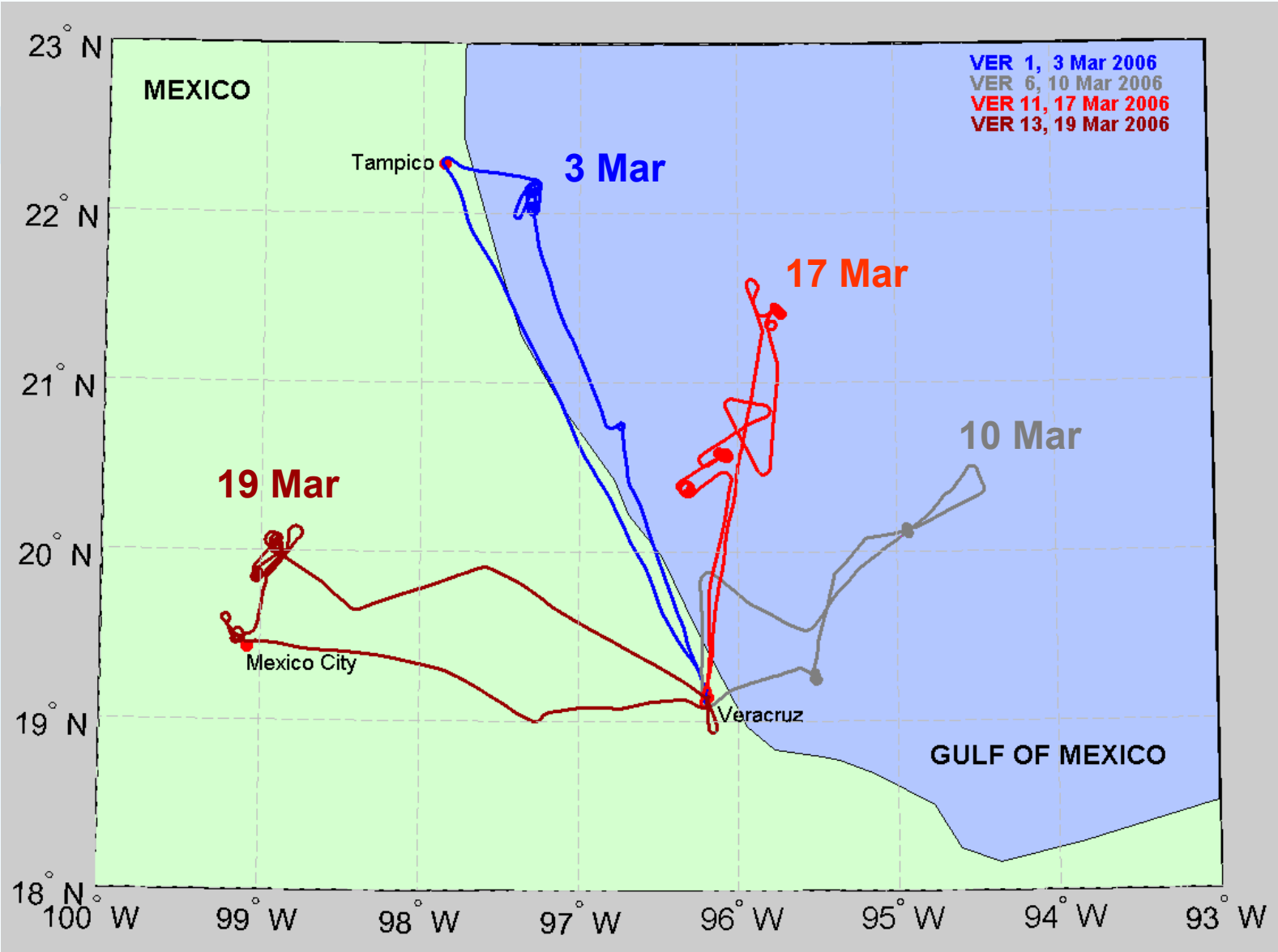
3. Size:
   Telescope dome 8" OD (hemisphere) atop 5" H pedestal. (Total H: 9" above A/C skin), Inside A/C: 12" D x 18" H cylinder.

4. Weight:
   131.6 lbs

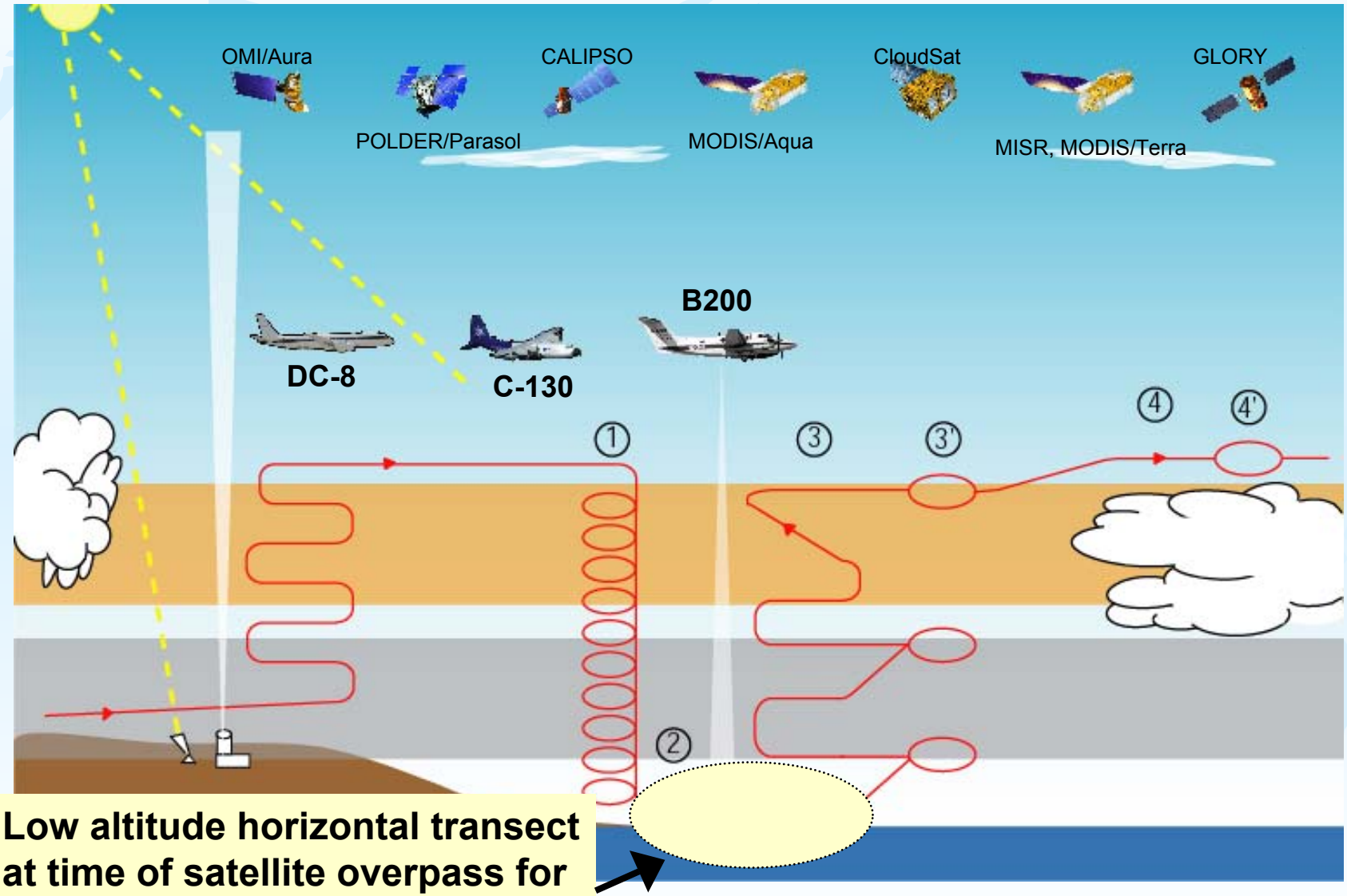
# J31 flight tracks: 13 flights out of Veracruz, Mexico



# Four J31 flight tracks coincident with OMI overpasses



# J31 flight patterns:
# Coordinated satellite, in-situ and radiative missions

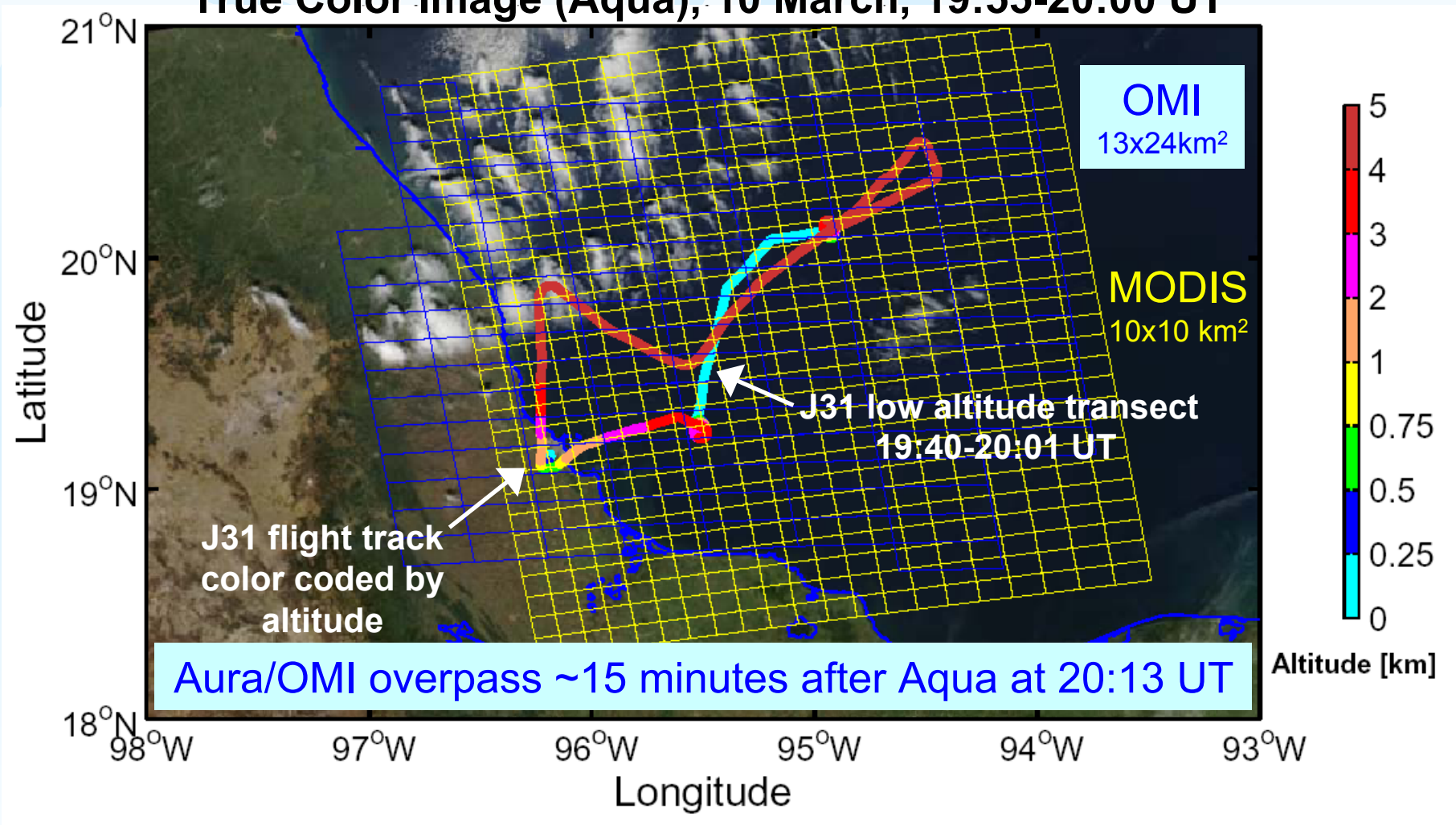



**Low altitude horizontal transect at time of satellite overpass for satellite sensor validation**

# AOD Comparisons, OMI - MODIS - AATS

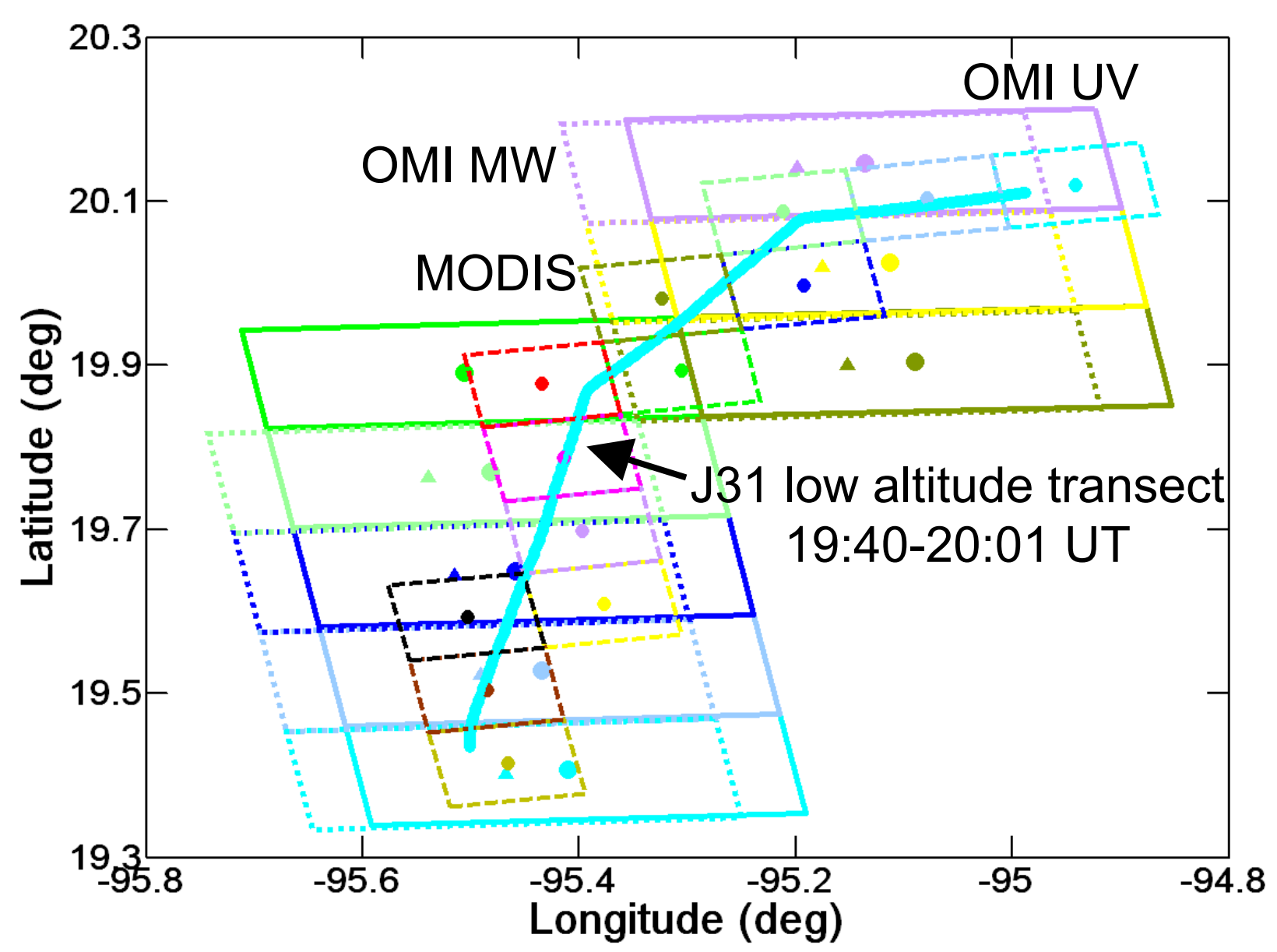
## INTEX-B/MILAGRO, 2006

**True Color Image (Aqua), 10 March, 19:55-20:00 UT**



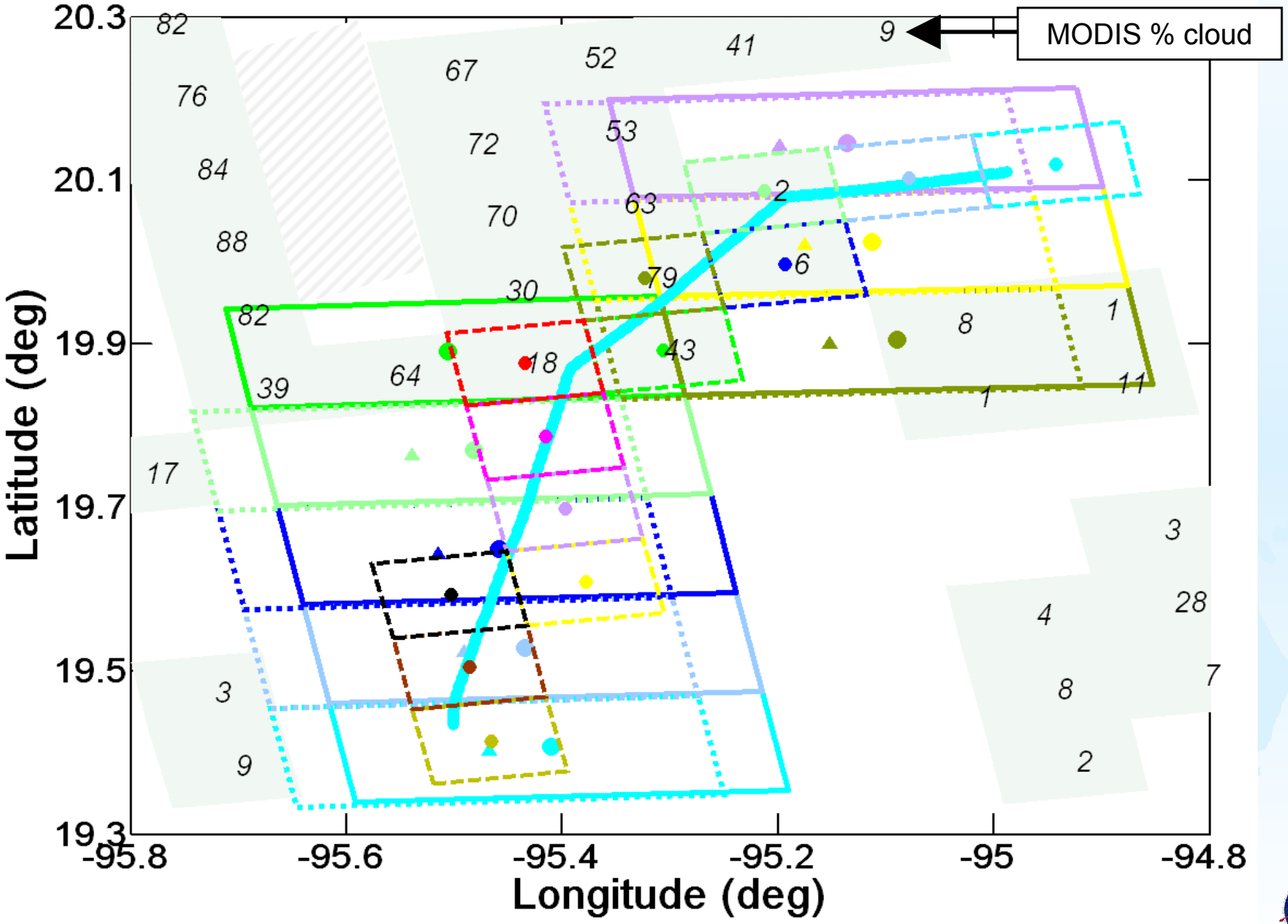
# AOD Comparisons, OMI - MODIS - AATS

## INTEX-B/MILAGRO, 10 March 2006

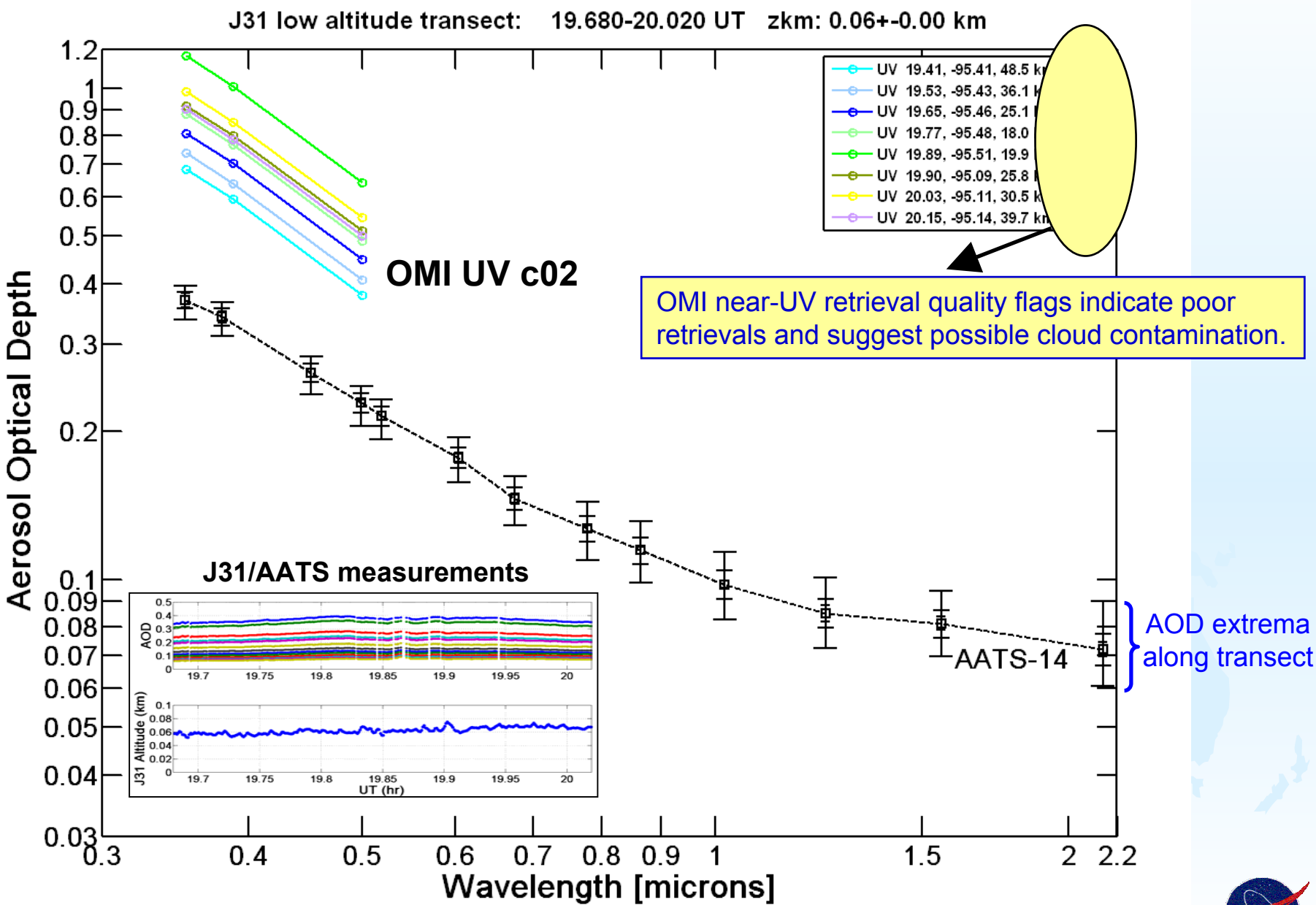


# AOD Comparisons, OMI - MODIS - AATS

## INTEX-B/MILAGRO, 10 March 2006



# 10 March 2006 *(over water)*



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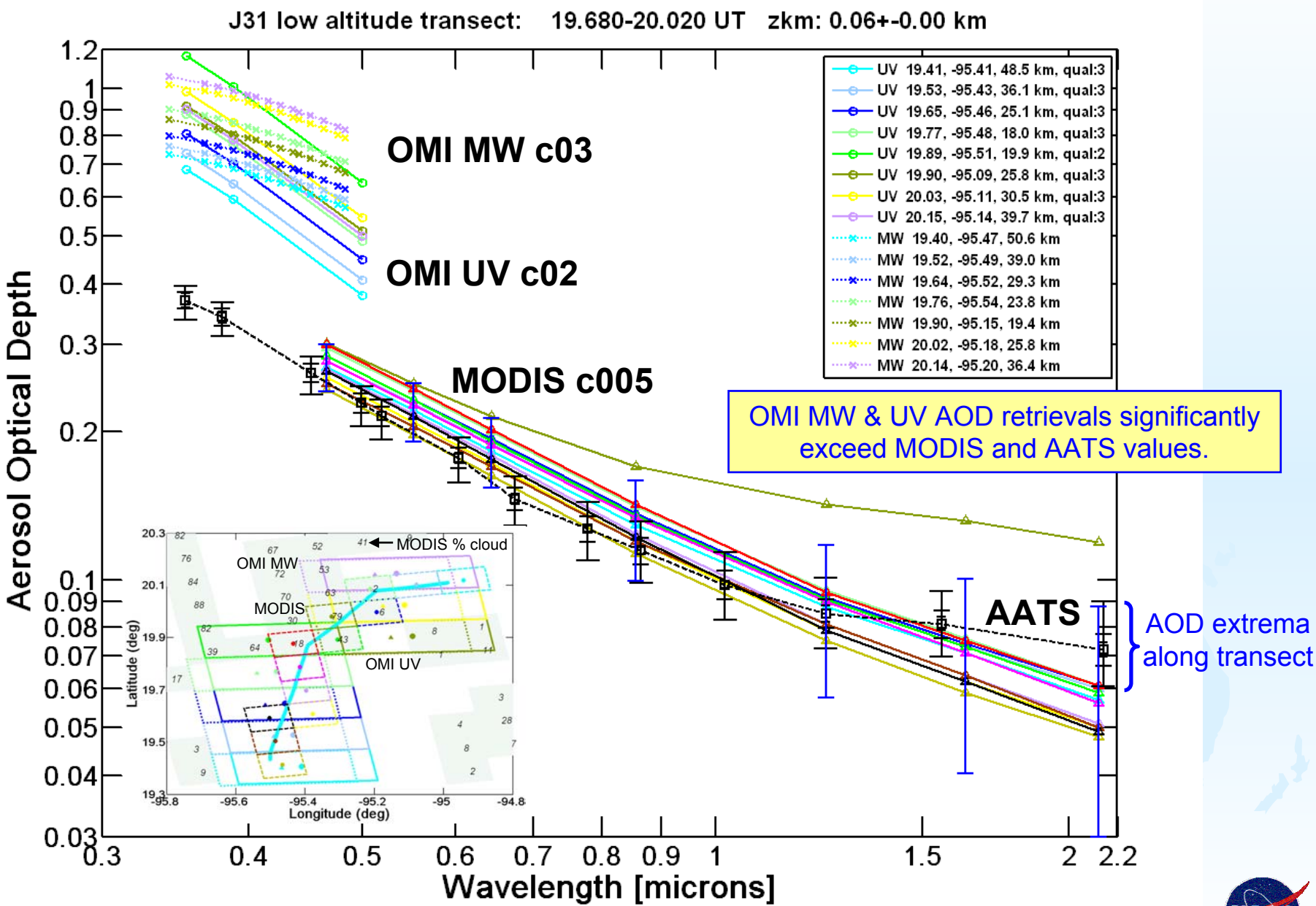
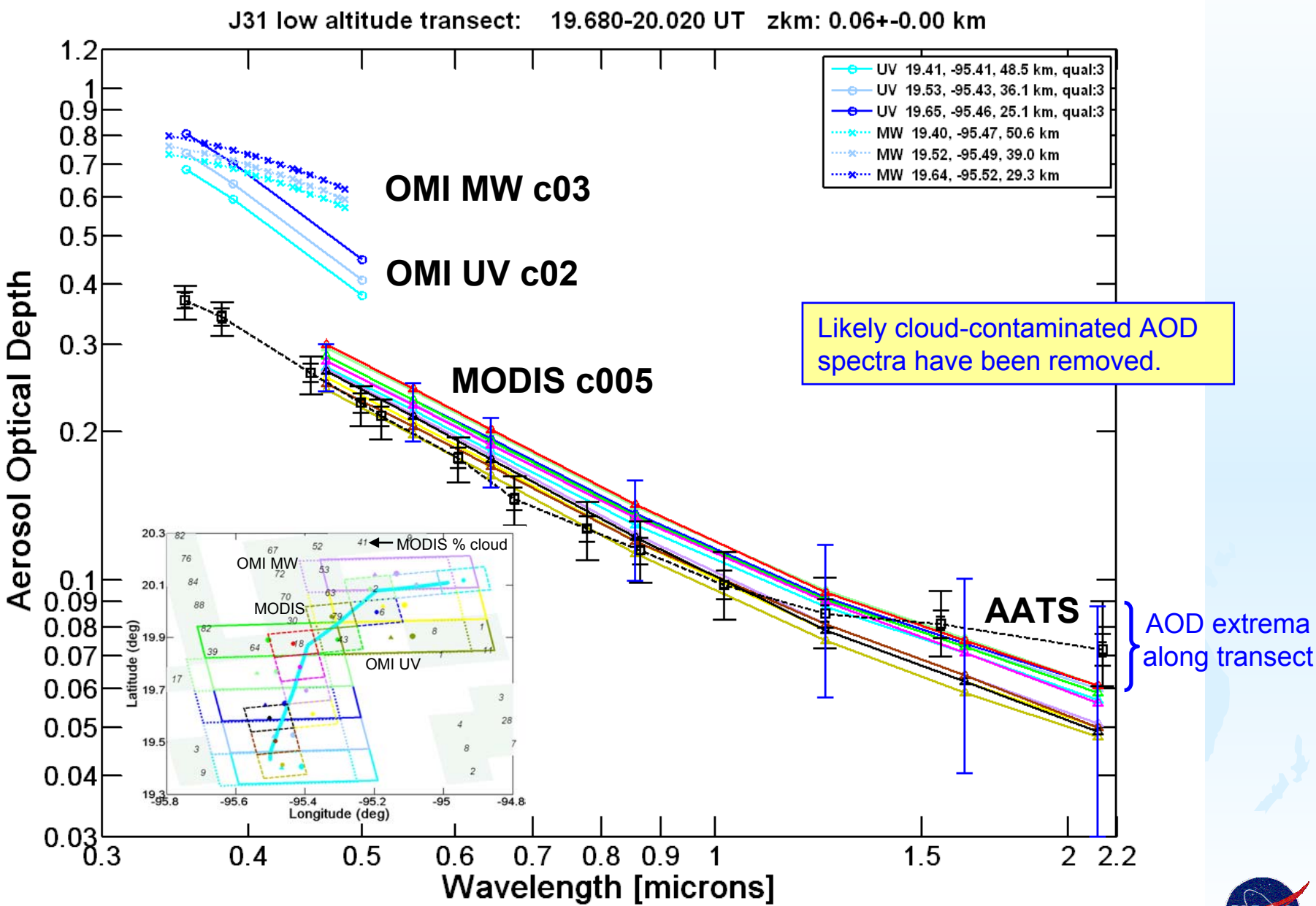
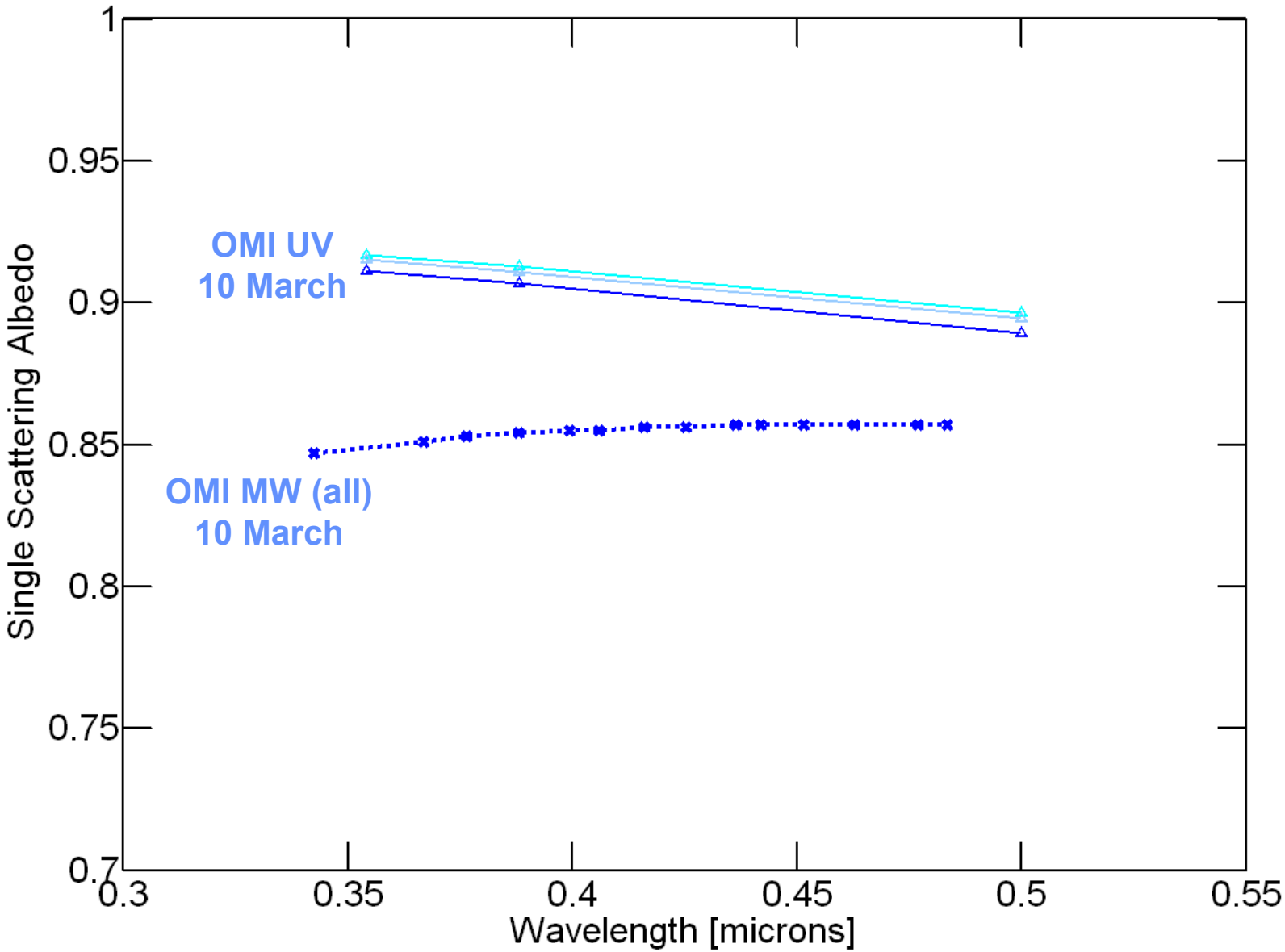


# 10 March 2006 *(over water)*



# Comparison of OMI SSA retrievals for 10 March to AATS/SSFR results from other field campaigns



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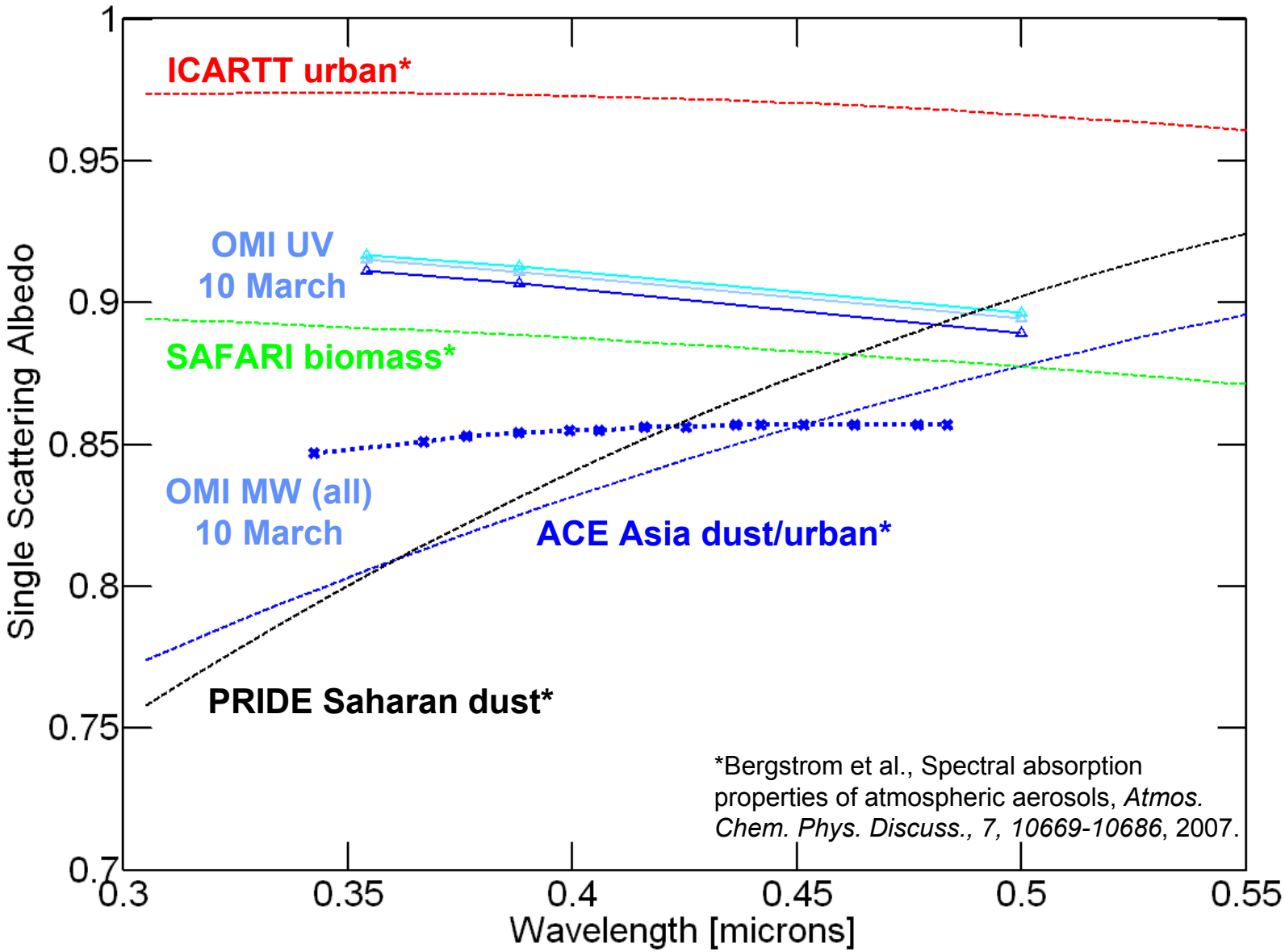
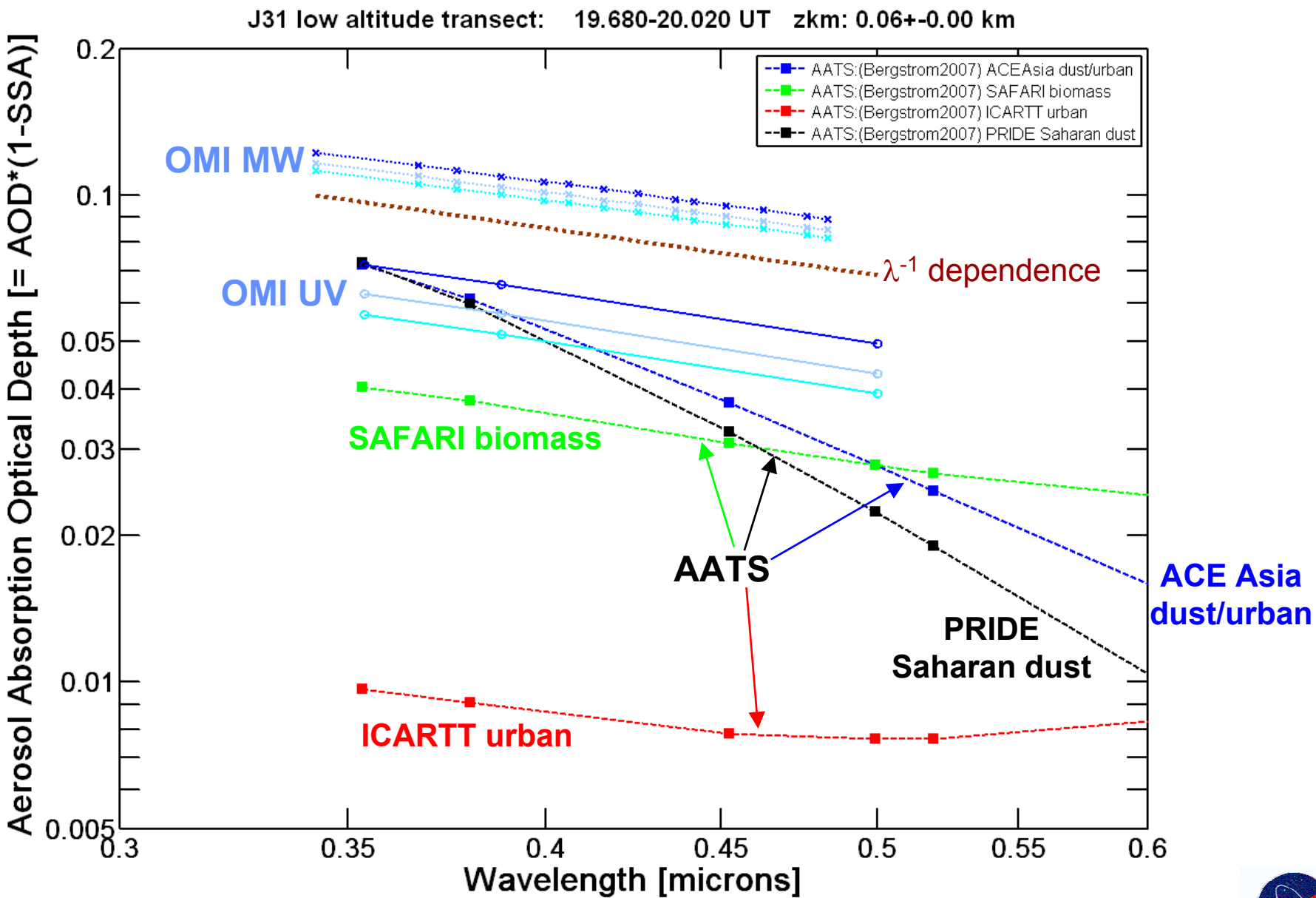
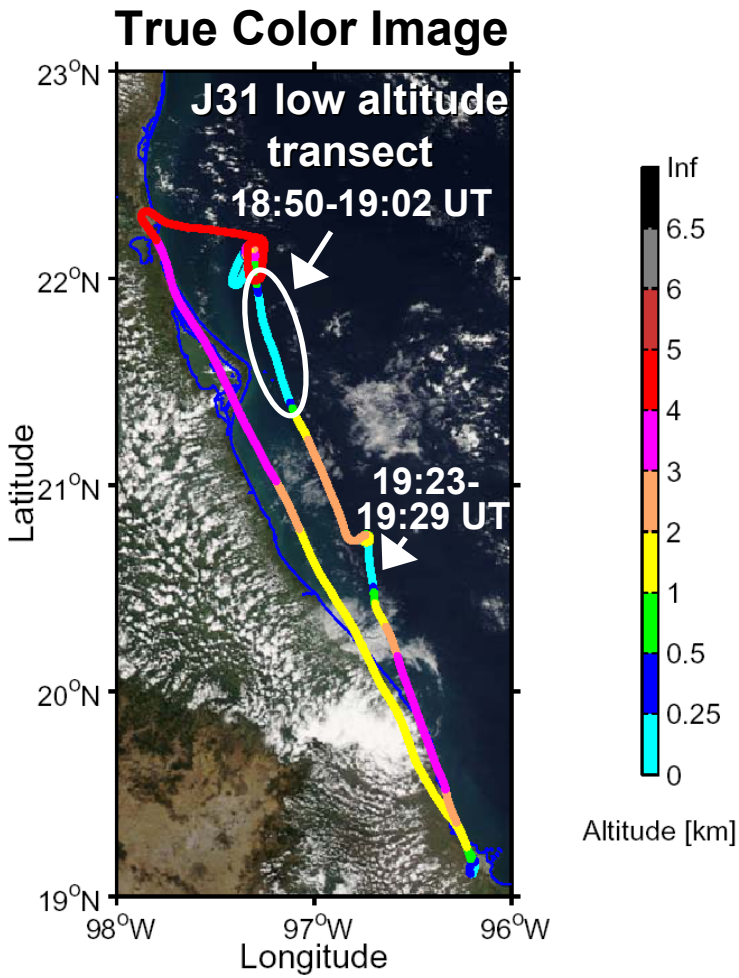
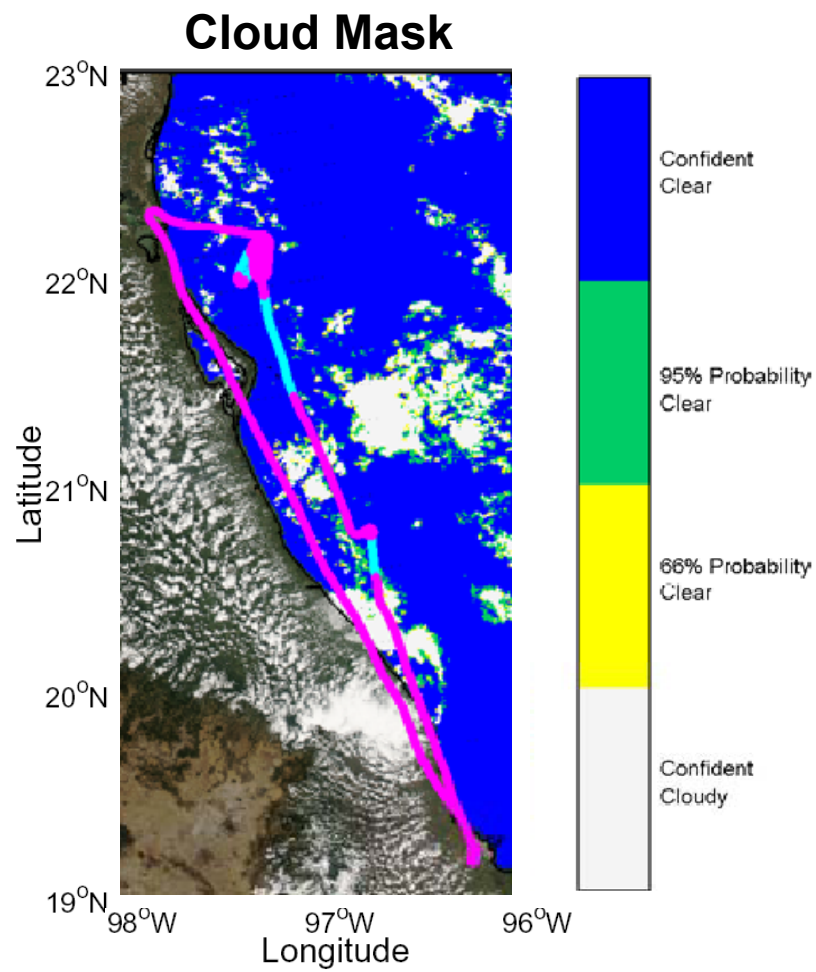


# Aerosol Absorption Optical Depth for 10 March 2006



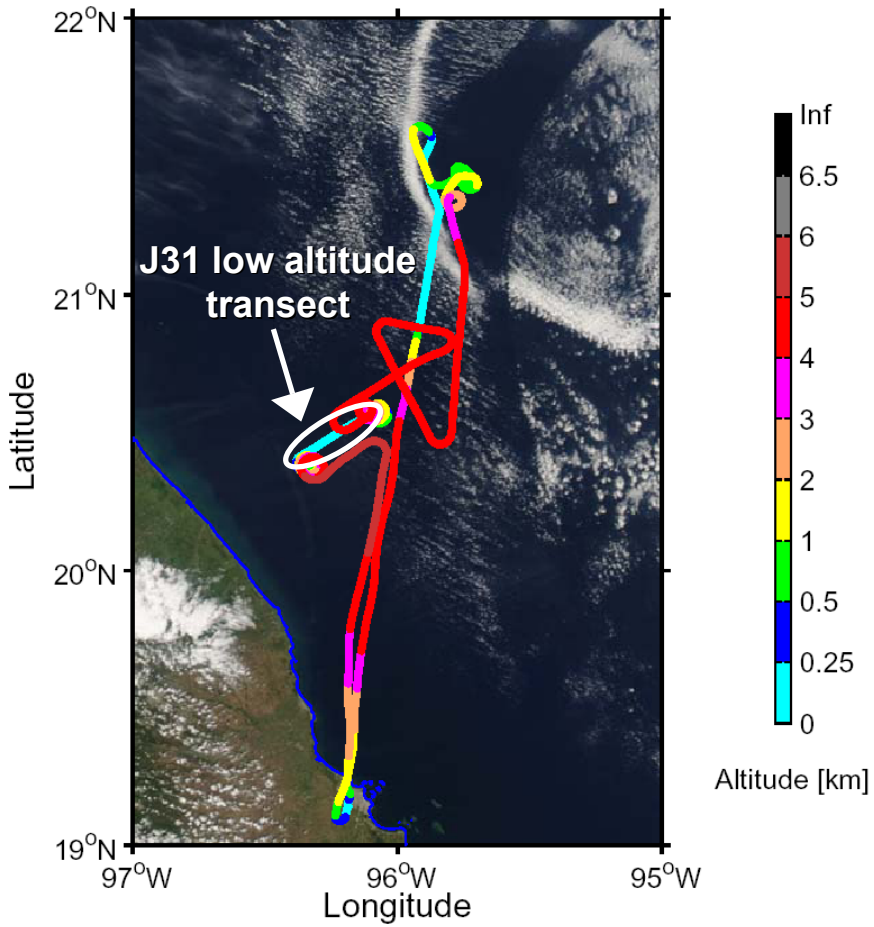
# Aqua MODIS 03 March 2006 19:50-19:55 UT



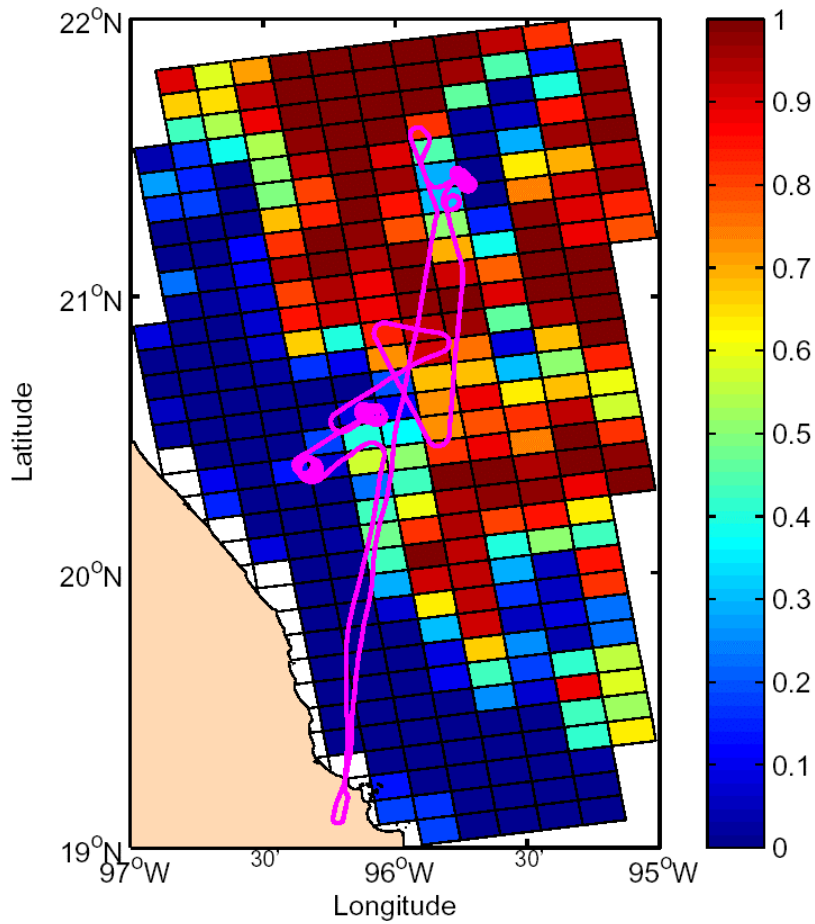



# Aqua MODIS 17 March 2006 20:00-20:05 UT

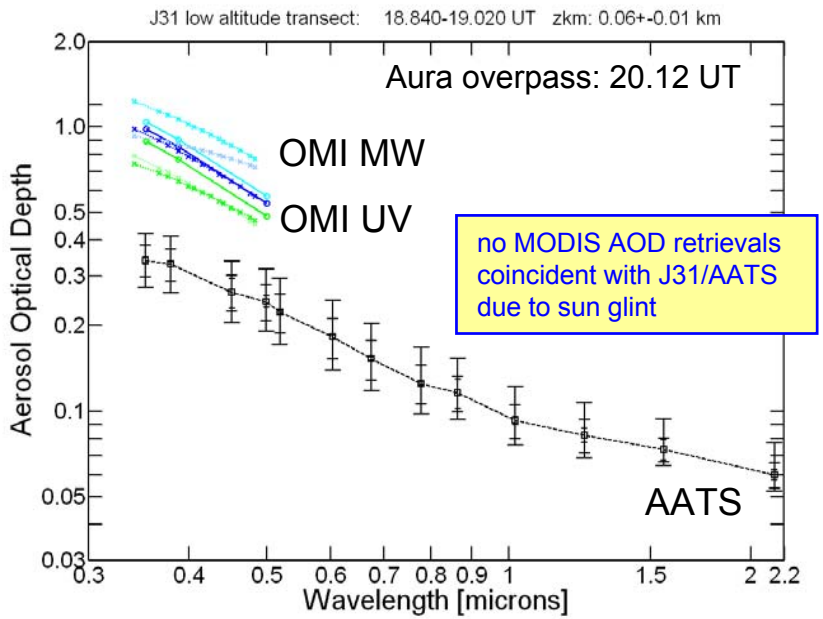
## True Color Image



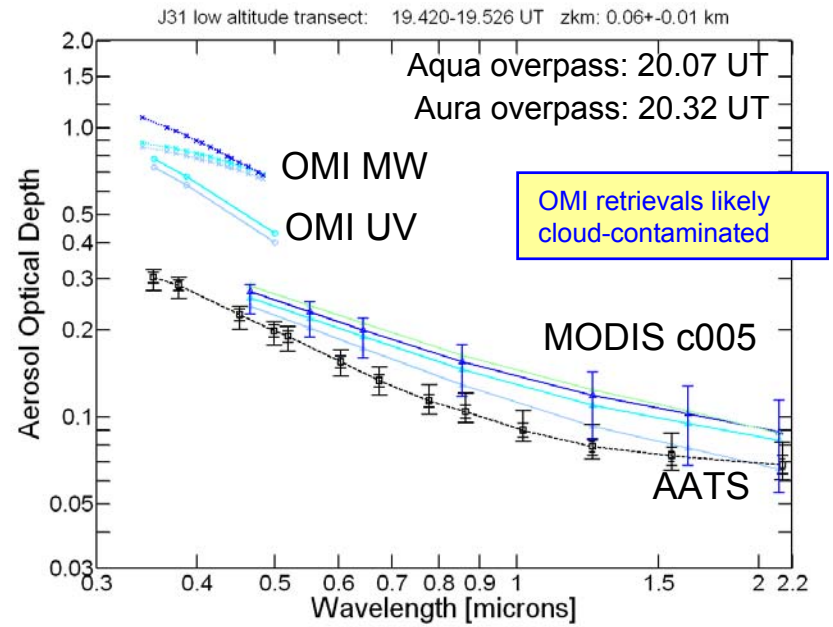

## Fraction of Cloud

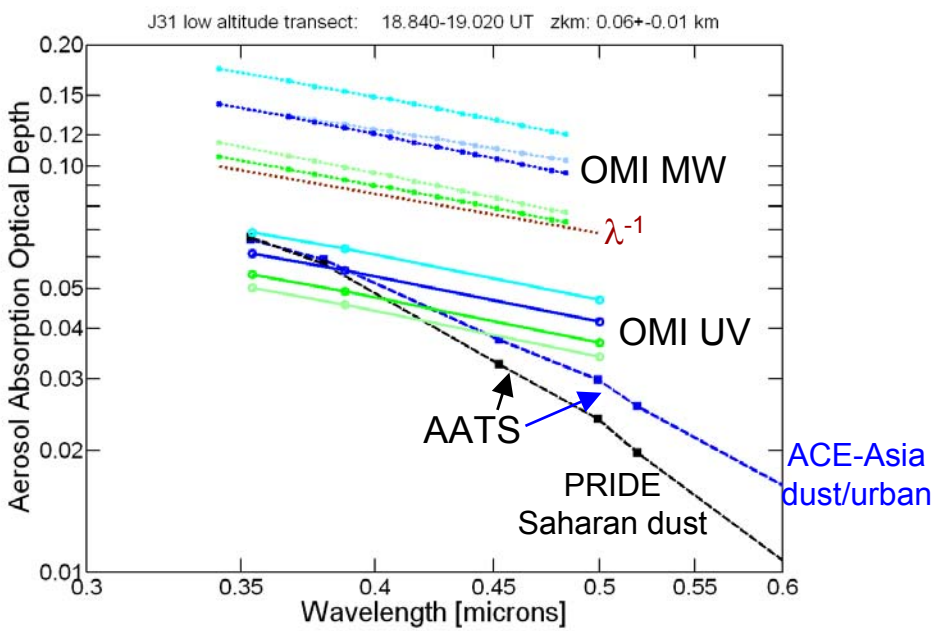


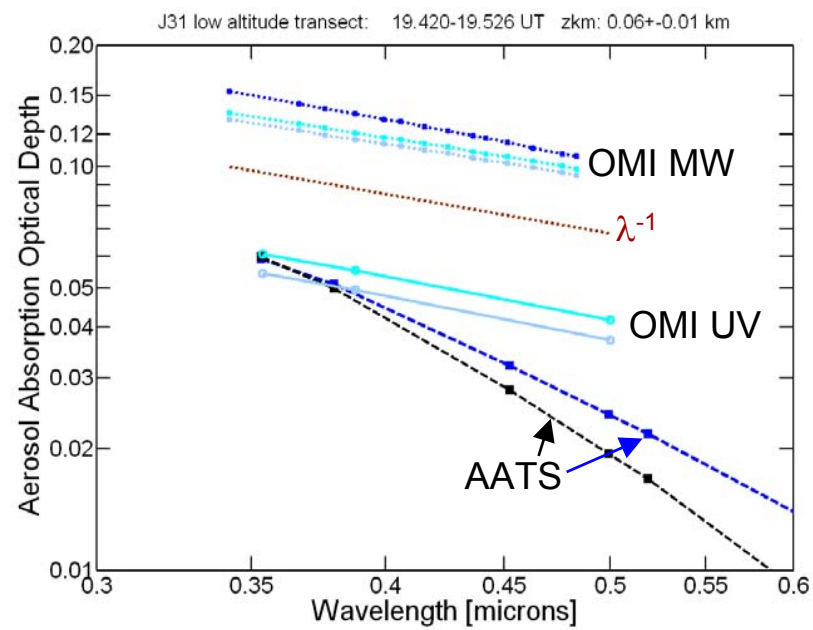
# 03 March 2006 *(over water)*




# 17 March 2006 *(over water)*



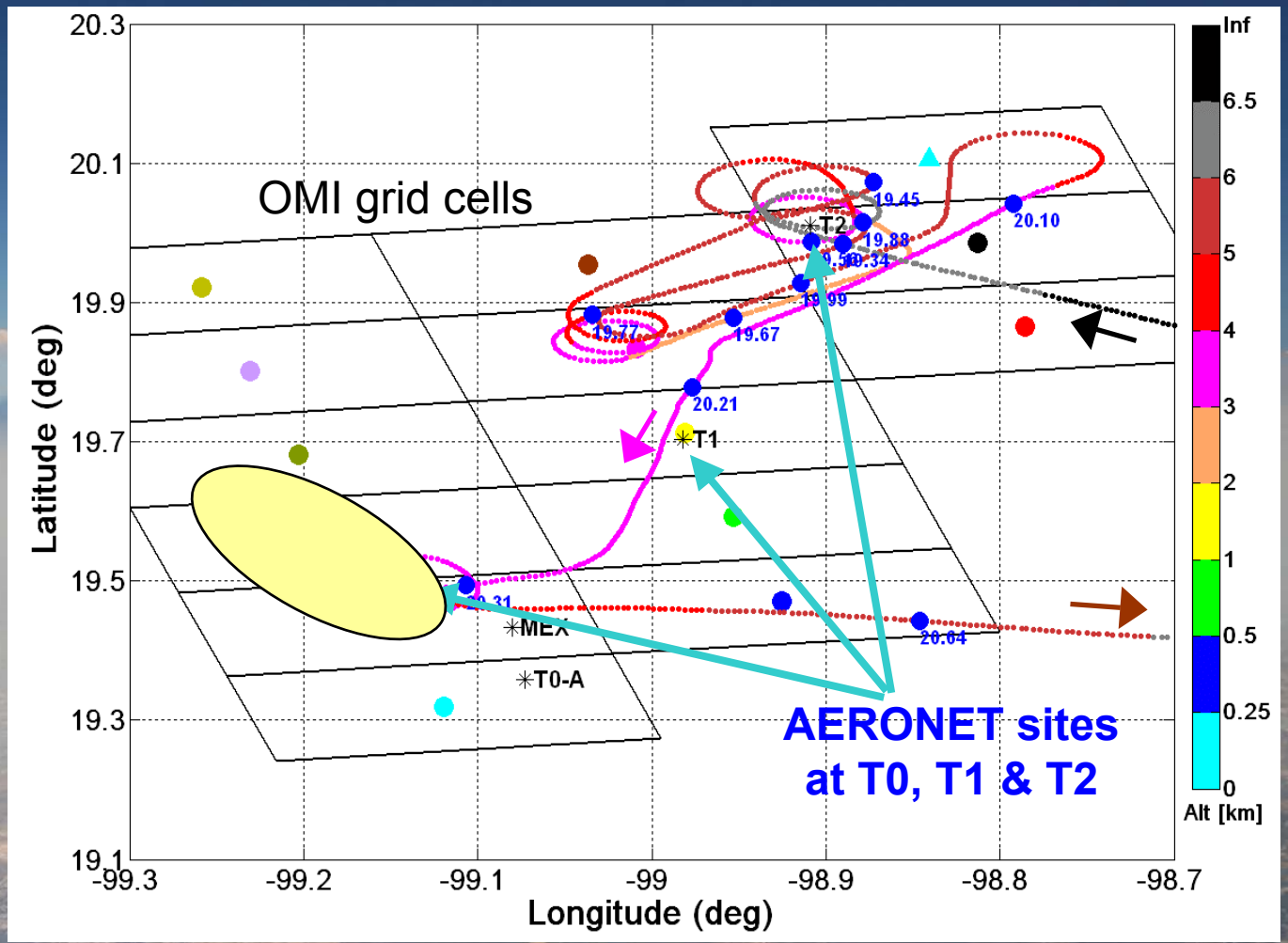



# Photo from DC-8 over Mexico City, 19 Mar 2006

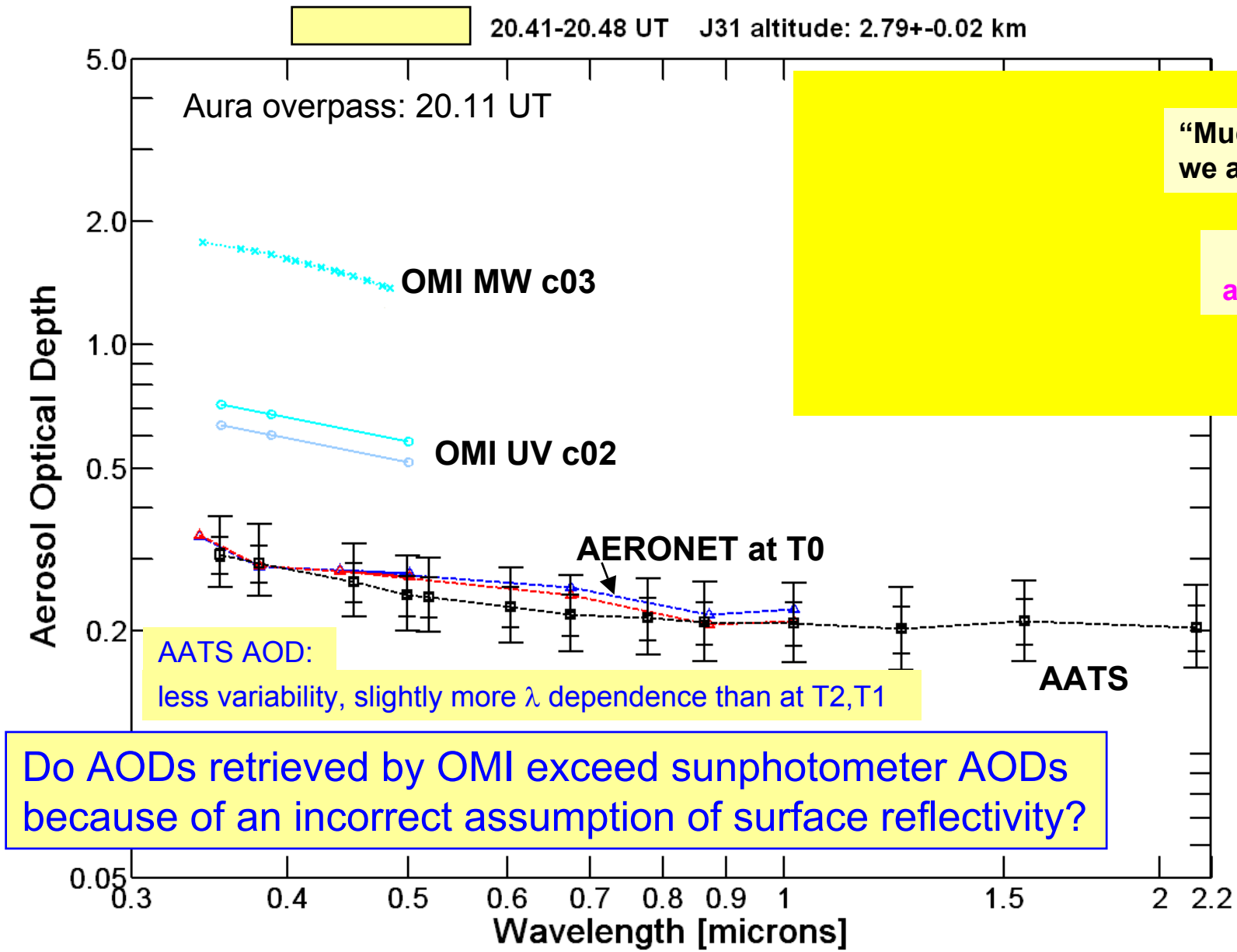
Courtesy of Cam McNaughton (Univ. of Hawaii)

# 19 March 2006 J31 flight to Mexico City

## (rendezvous with C-130, B200, DC-8)



# 19 March 2006 *(over land)*



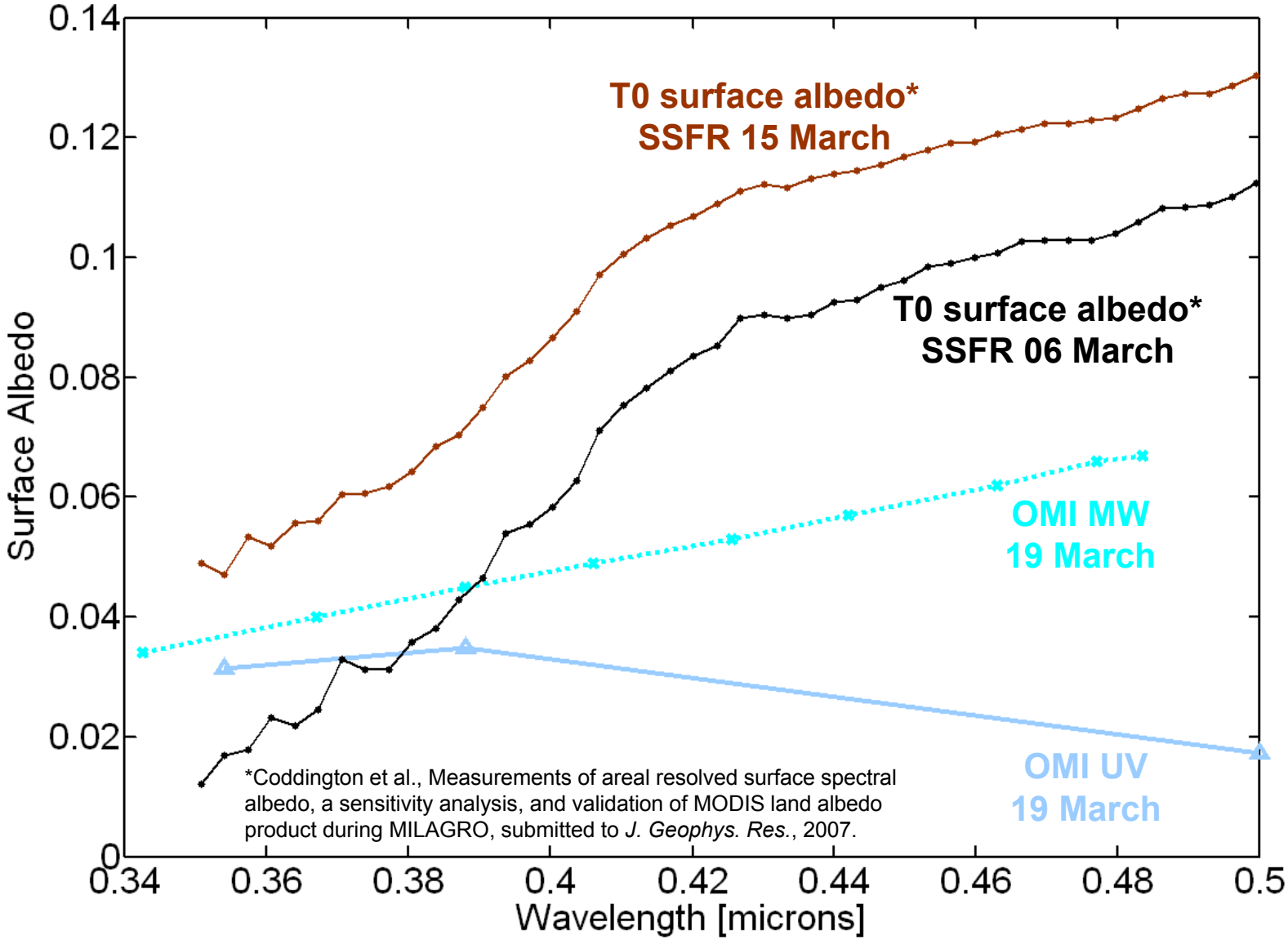

**"Much clearer as we approach T0."**

**J31 ~450 m above surface**

AATS AOD:
less variability, slightly more λ dependence than at T2,T1

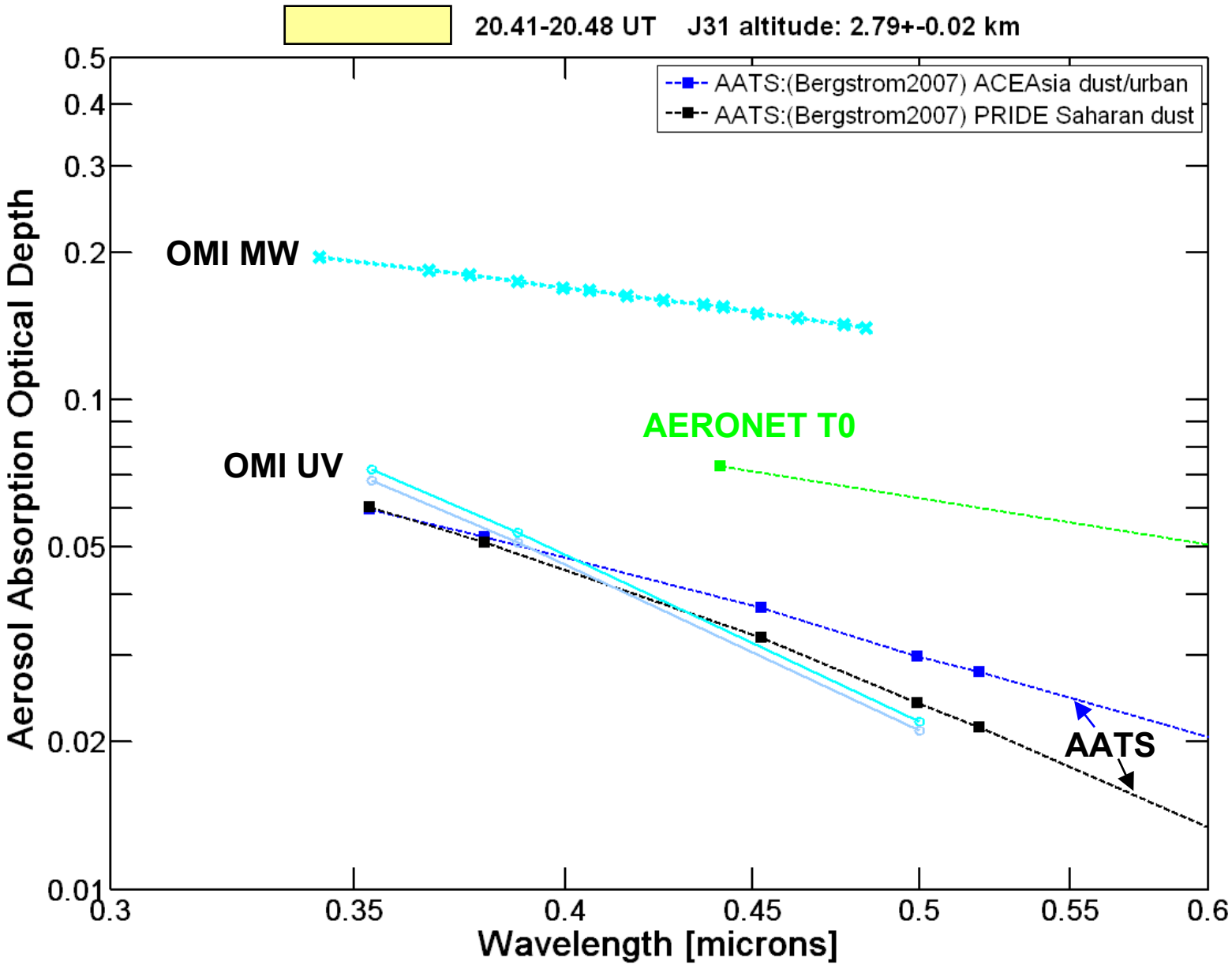
Do AODs retrieved by OMI exceed sunphotometer AODs because of an incorrect assumption of surface reflectivity?

# SSFR T0 Surface Albedo Retrievals for 06 & 10 March; OMI Retrieval Surface Albedo Assumptions for 19 March




*Coddington et al., Measurements of areal resolved surface spectral albedo, a sensitivity analysis, and validation of MODIS land albedo product during MILAGRO, submitted to *J. Geophys. Res.*, 2007.

# Aerosol Absorption Optical Depth for 19 March 2006



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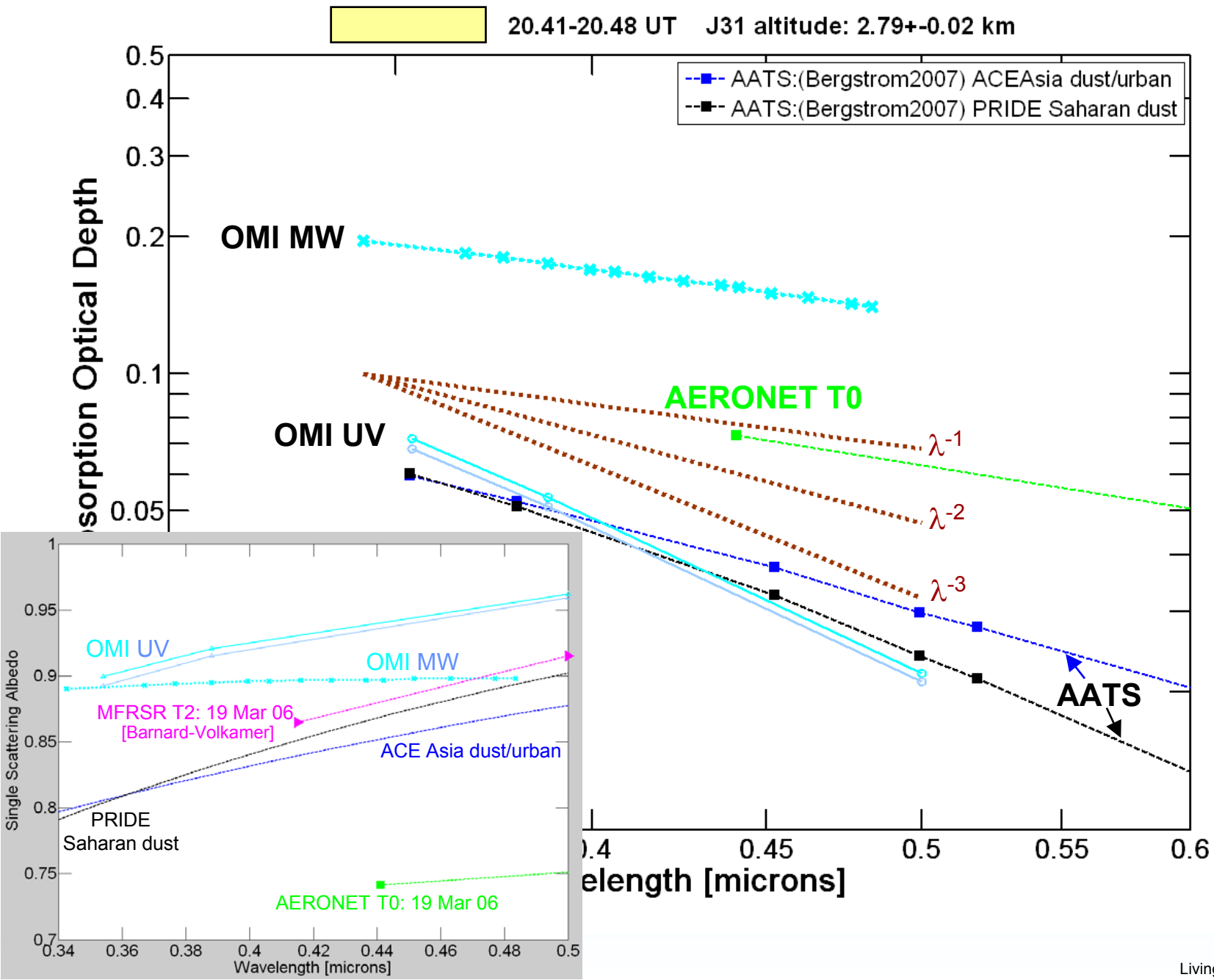
# Aerosol Absorption Optical Depth for 19 March 2006

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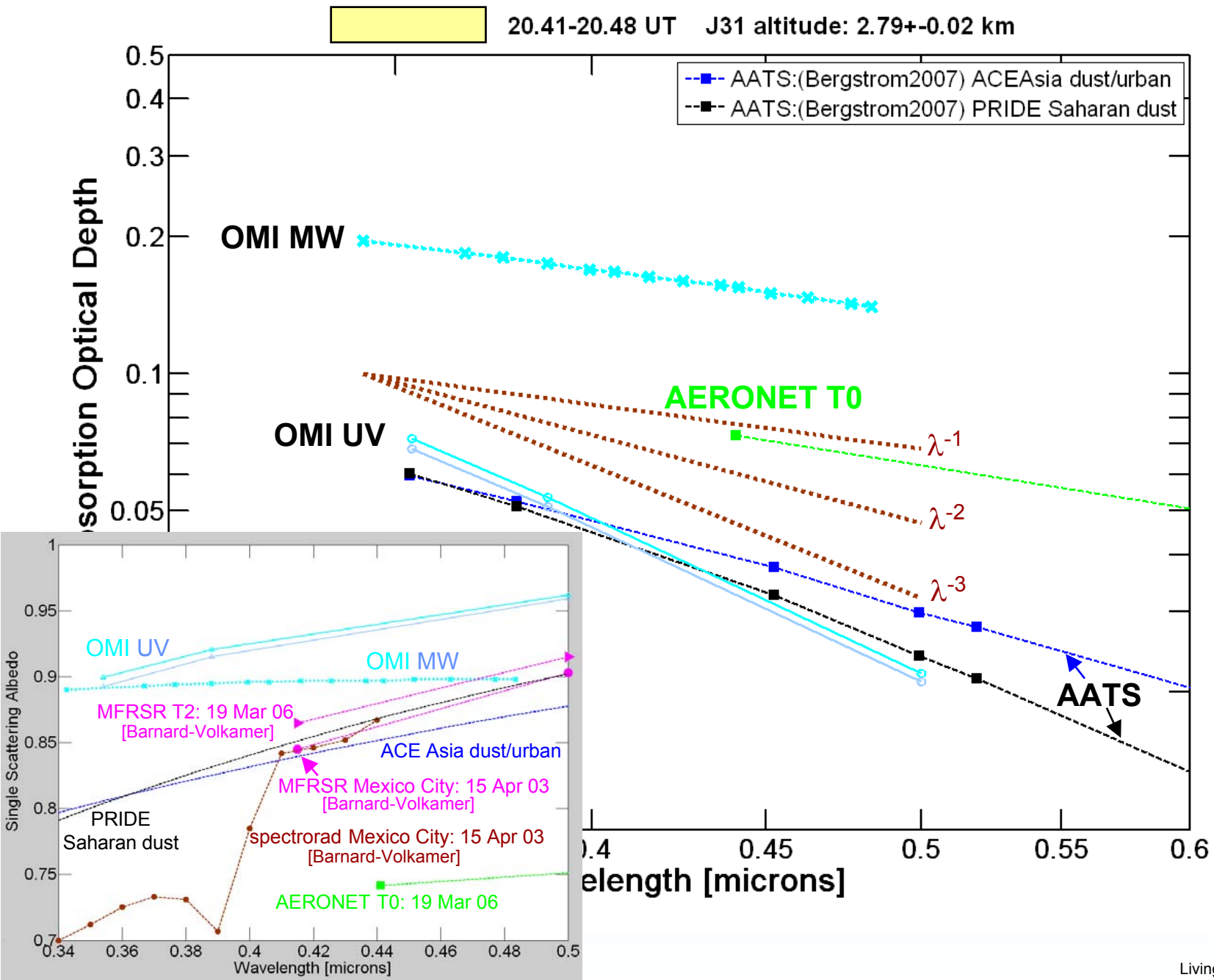
# Aerosol Absorption Optical Depth for 19 March 2006

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# Summary/Conclusions

- During MILAGRO/INTEX-B 2006, AATS-14 acquired near-surface AOD measurements coincident with four Aura OMI overpasses: 3 over the Gulf of Mexico and 1 over Mexico City.

- Aqua-MODIS AOD retrievals are available for 2 of the 3 over-water AATS/OMI events, and these agree well with the corresponding AATS AOD spectra. For the Mexico City event, AATS AOD spectra agree with coincident surface-based AERONET retrievals at the T0 site.

- For all AATS/OMI coincidences, OMI near-UV and MW AOD retrievals significantly exceed AATS AODs. Differences may be due to enhanced absorption in the UV due to organic aerosol, OMI instrument calibration, incorrect aerosol height assumption, incorrect surface albedo assumption over land, or cloud contamination over water.

- When expressed in terms of Aerosol Absorption Optical Depth (AAOD), OMI near-UV retrievals and estimated AATS spectra agree better than do the OMI near-UV and AATS AOD spectra. However, comparisons of OMI MW and estimated AATS AAOD spectra show little improvement in agreement over the OMI MW and AATS AOD comparisons.

- Inversions of AERONET direct sun and almucantar measurements acquired at the T0 site in Mexico City on 19 March near (~20 min before and 40 min after) the time of Aura overpass yield SSA values (0.733 and 0.758) at 441 nm that are significantly less than the OMI retrievals. The corresponding AERONET AAOD value of 0.073 falls between corresponding OMI UV and MW retrievals of AAOD.