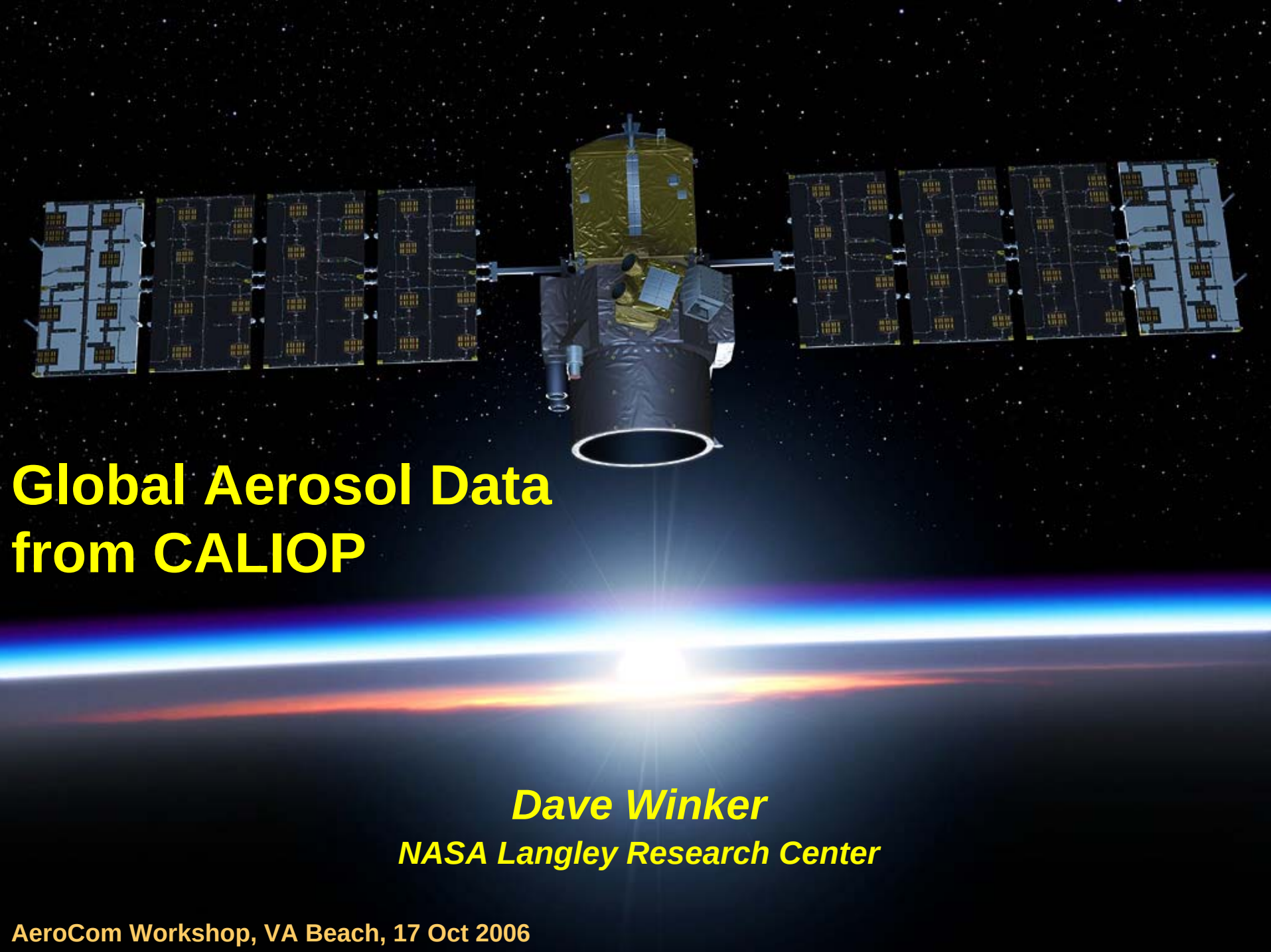
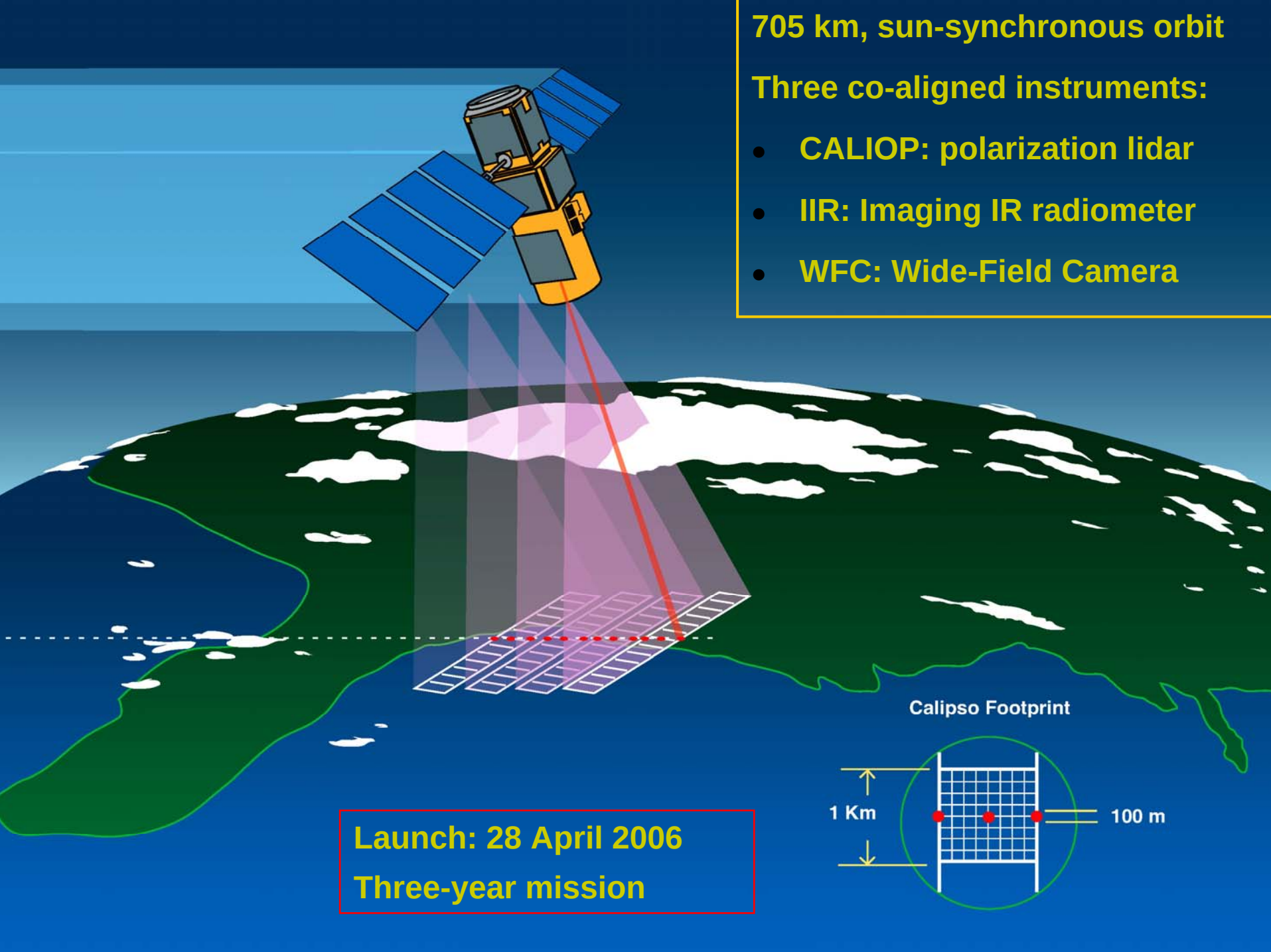


Global Aerosol Data from CALIOP

Dave Winker

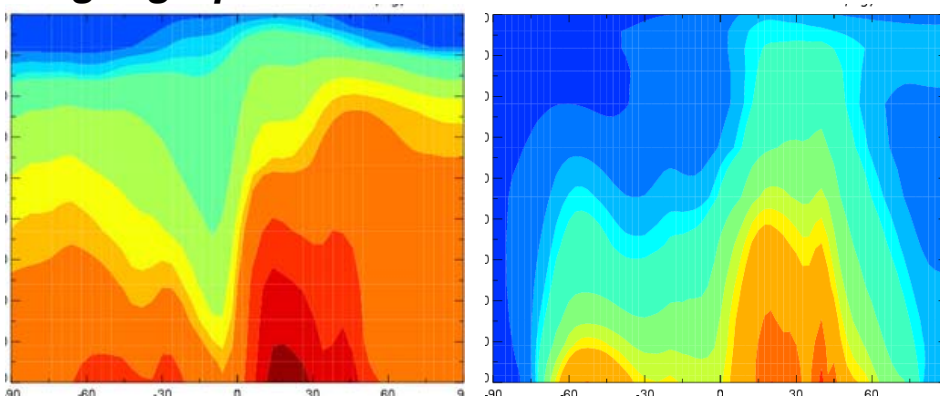
NASA Langley Research Center

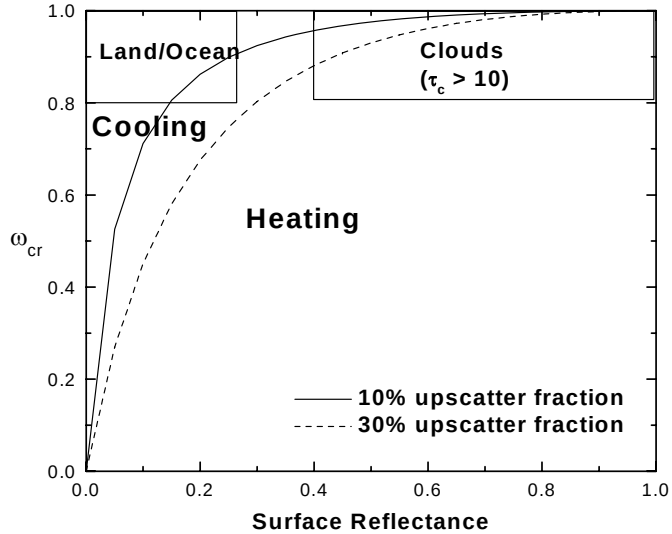
AeroCom Workshop, VA Beach, 17 Oct 2006


705 km, sun-synchronous orbit
Three co-aligned instruments:
• CALIOP: polarization lidar
• IIR: Imaging IR radiometer
• WFC: Wide-Field Camera
Calipso Footprint
1 Km
100 m
Launch: 28 April 2006
Three-year mission

(one) CALIPSO objective: Improvement of model-based assessments of Direct Aerosol Forcing

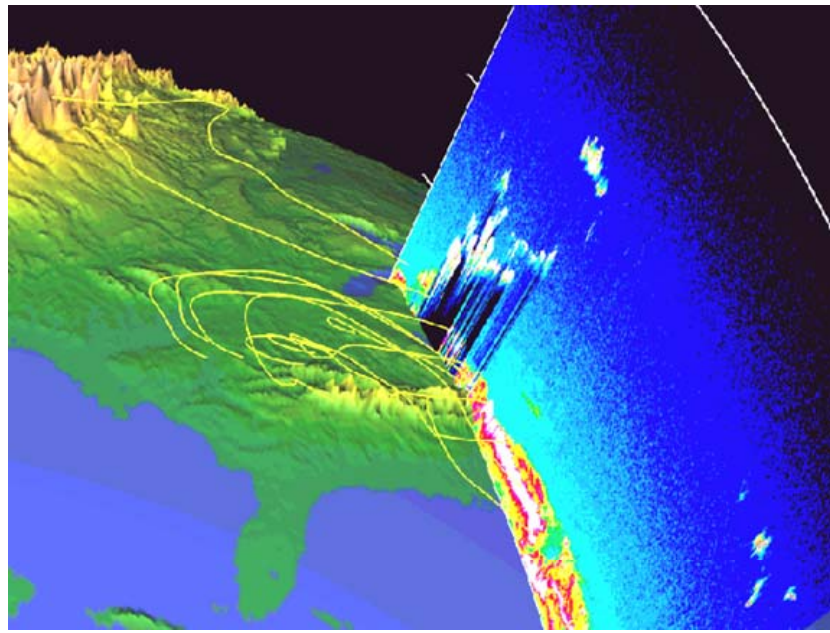
Models disagree wildly on the vertical and geographical distribution of aerosols





CALIPSO provides data to test model predictions of aerosol forcing:

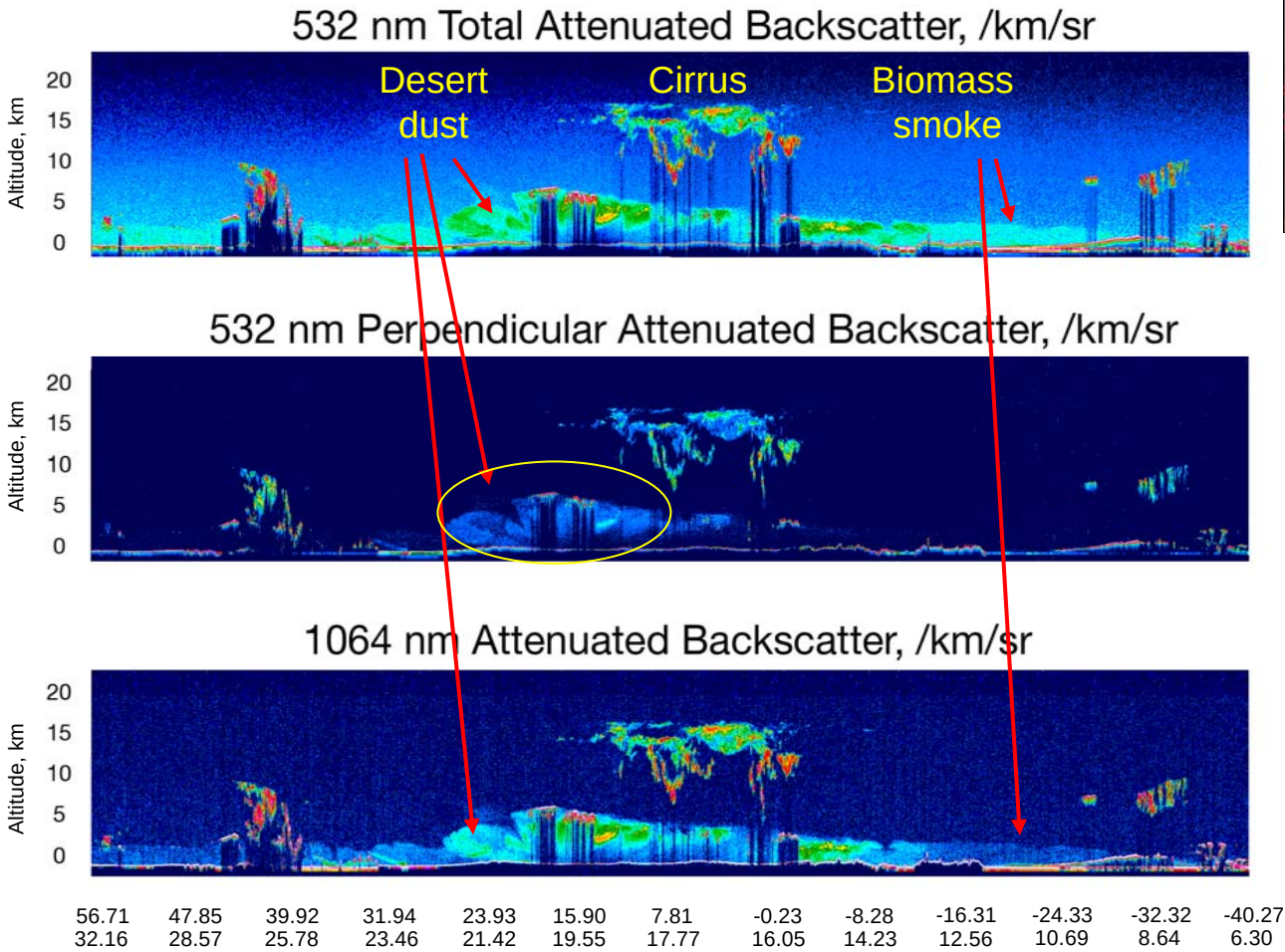
- **Aerosol height**
  - > Lifetime, geographic distribution (winds)
  - > Aerosol radiative effects above cloud are different than in clear skies
- **Profiles enable backtrajectories to identify aerosol sources and type**

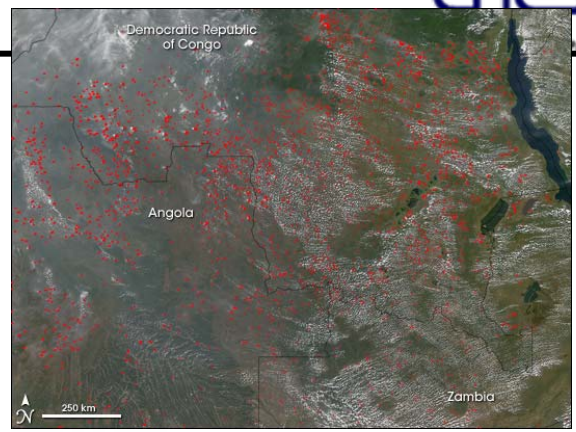


CALIPSO First-Light Observations

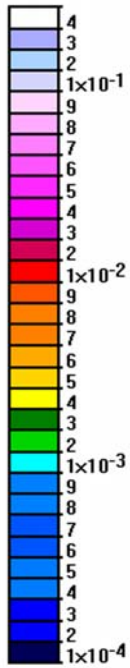
All 3 Lidar Channels

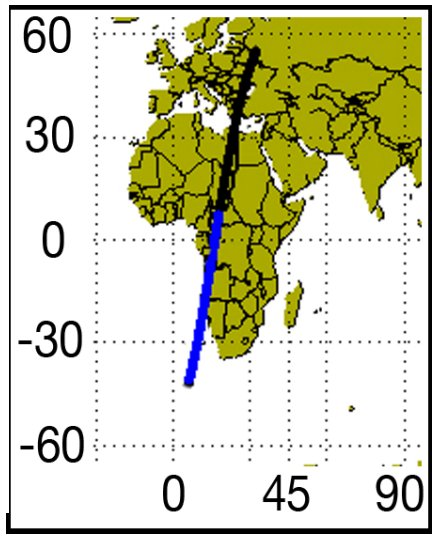
9 June 2006



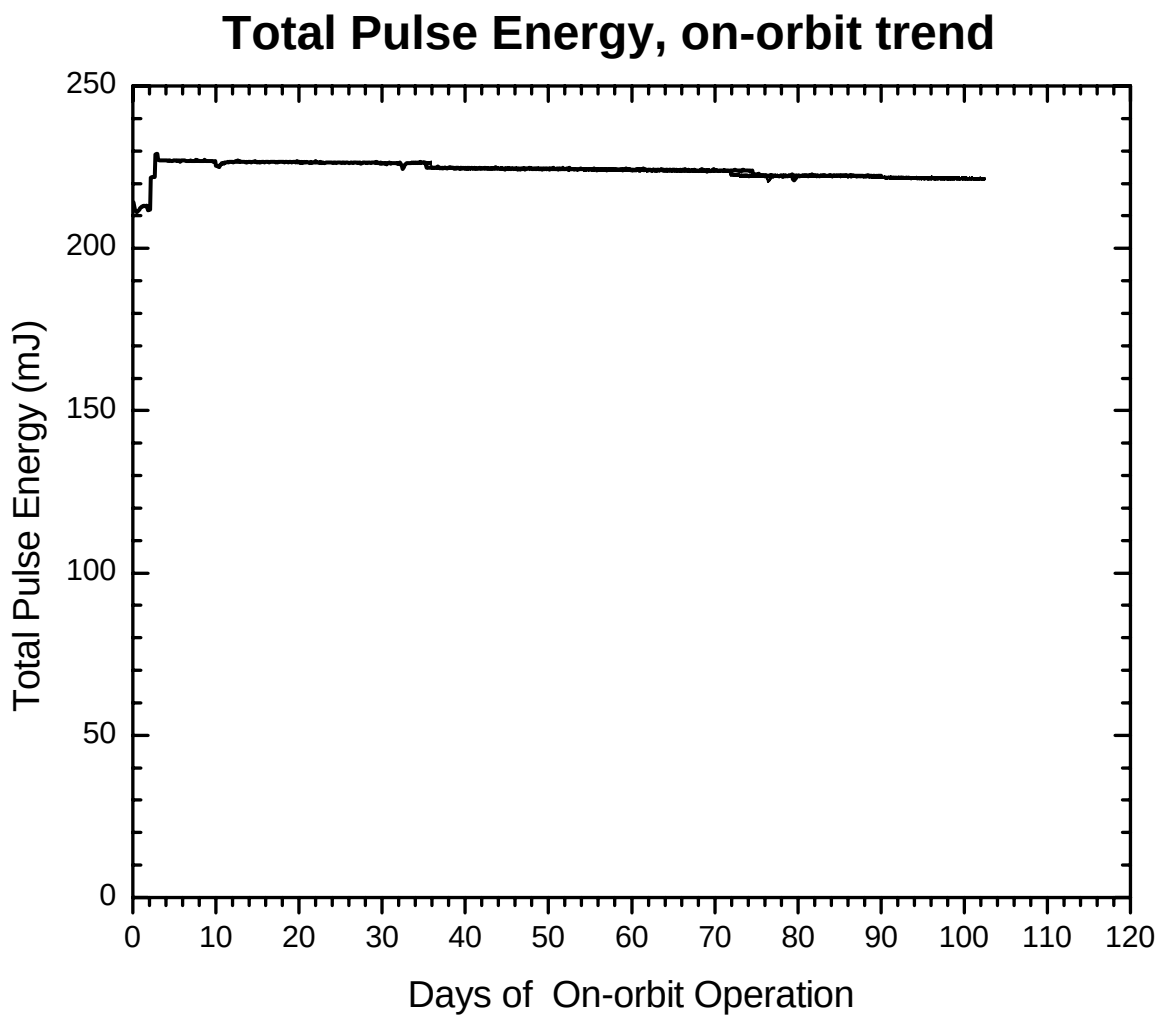


Fire locations in southern Africa from MODIS, 6/10/06

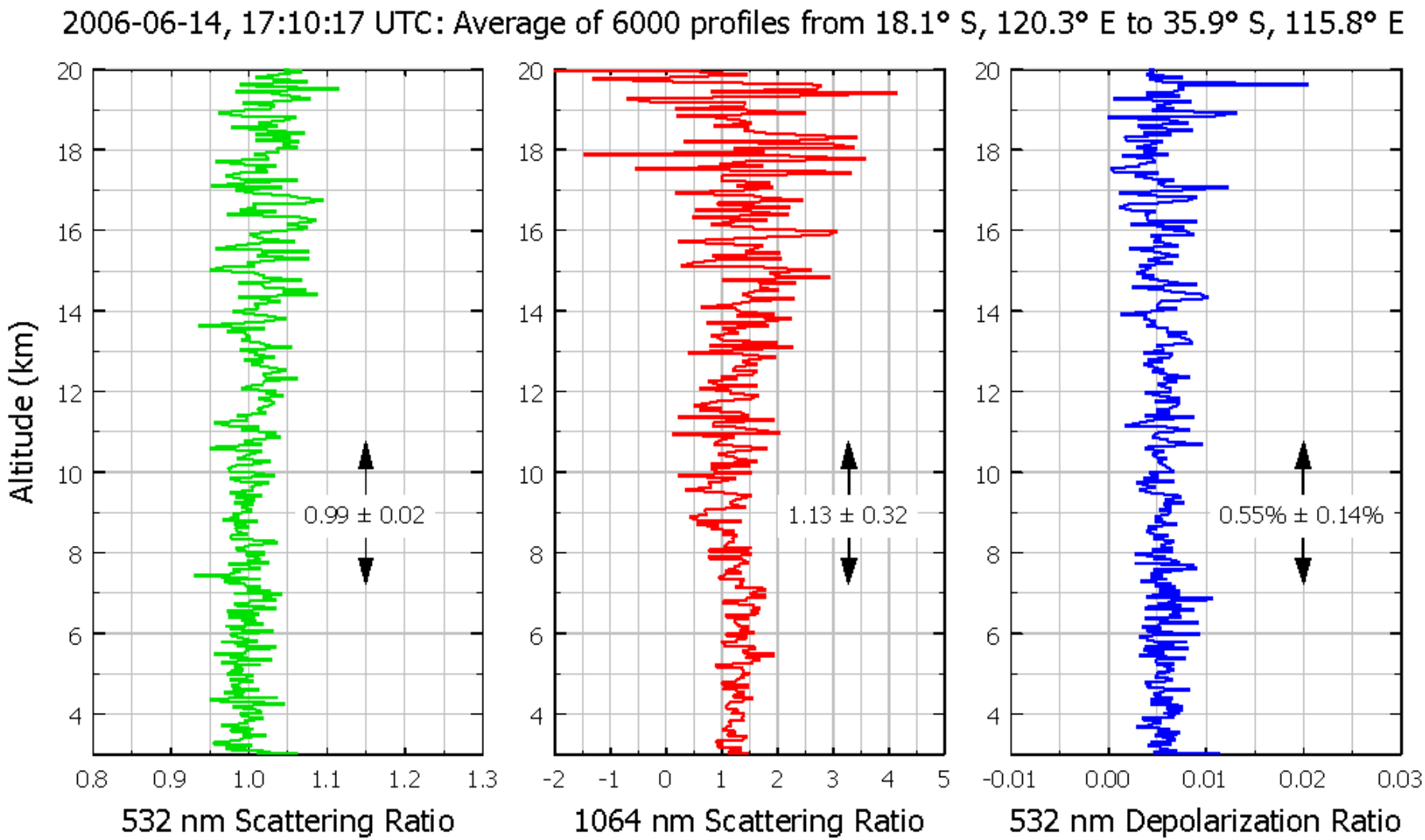




Laser: Healthy

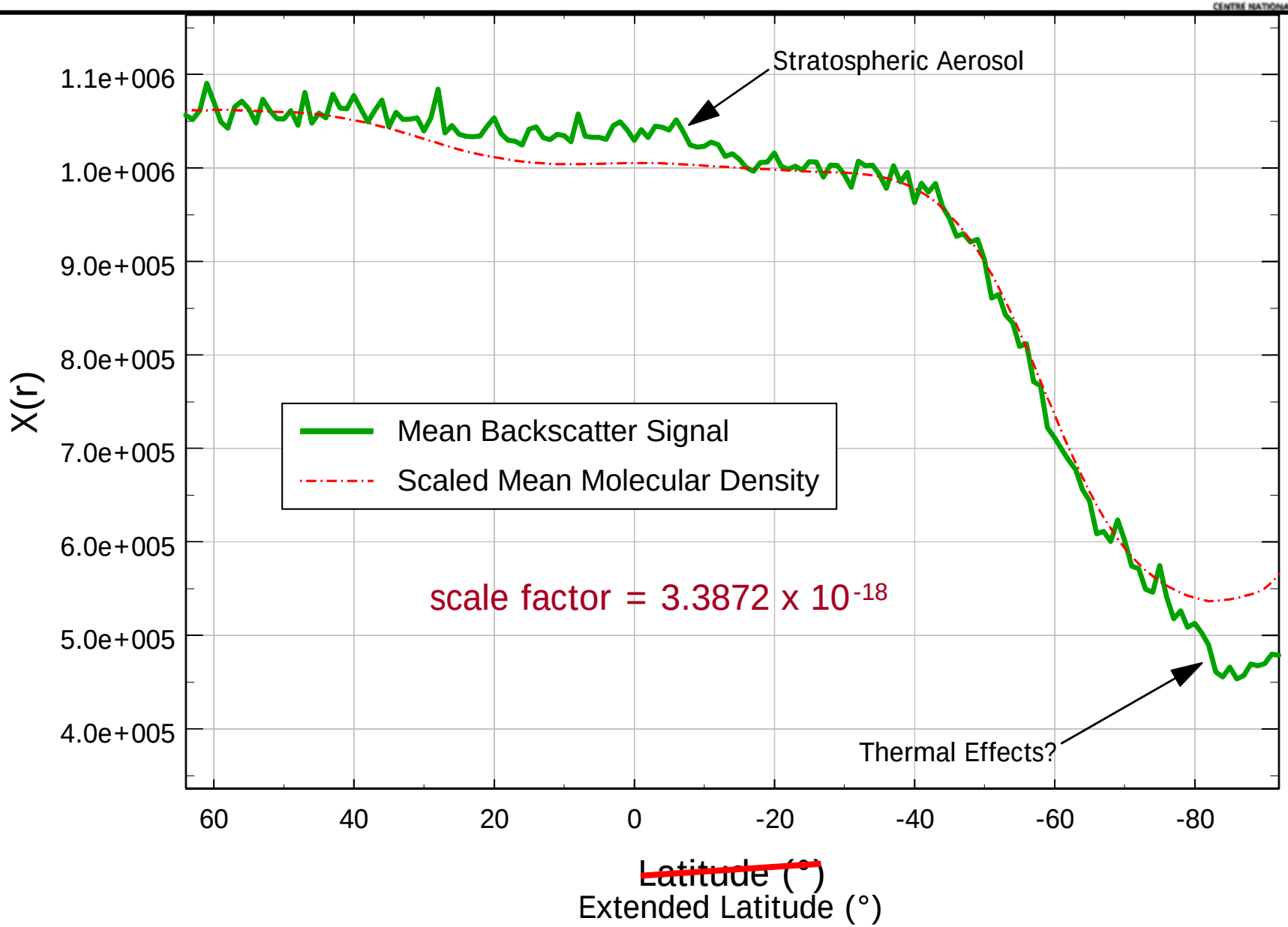


Small-signal linearity looks excellent



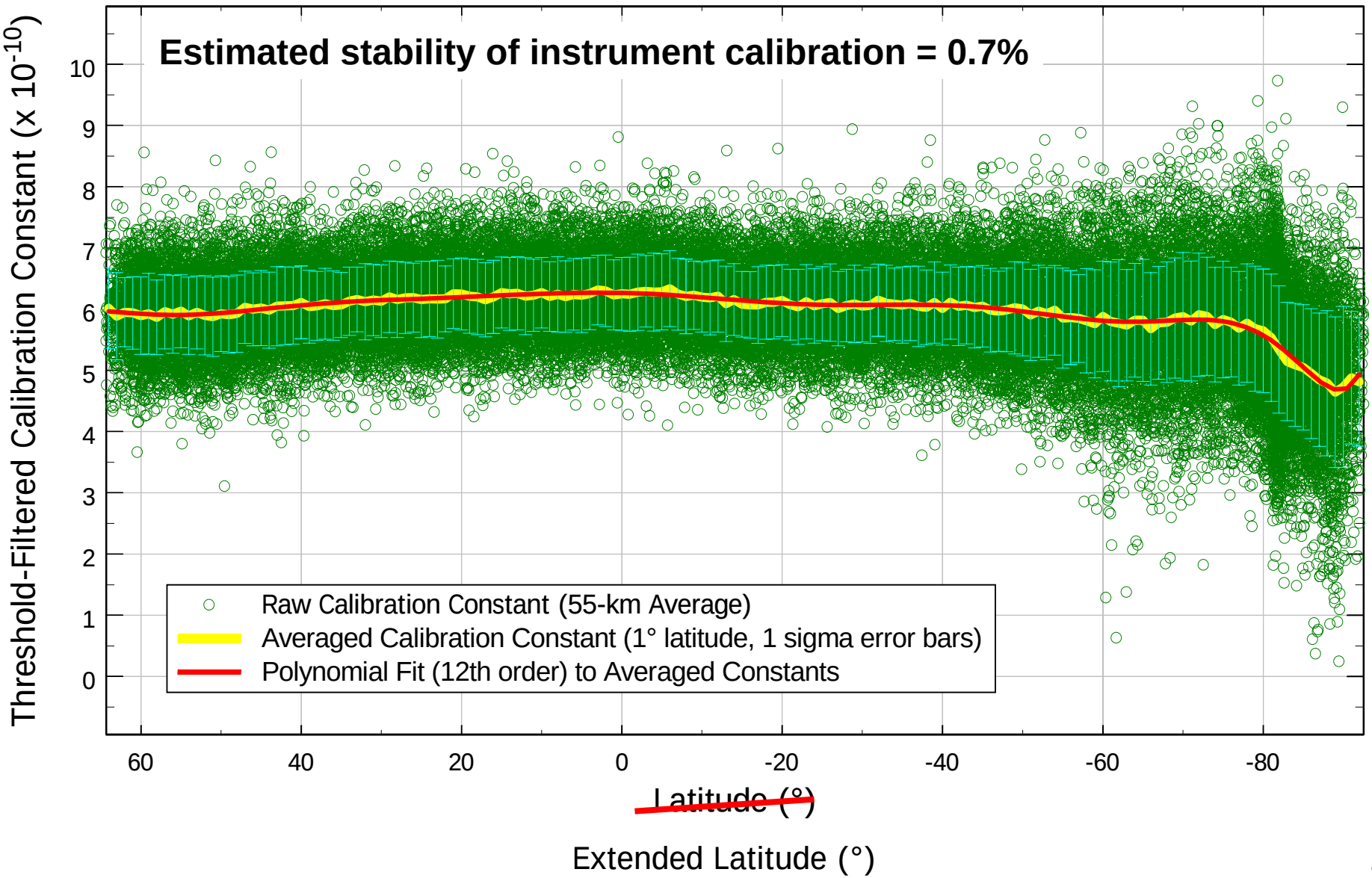
Clear-Air Profiles (June 14)

Calibration-region signal: 30-34 km



Initial Lidar Calibration Fit

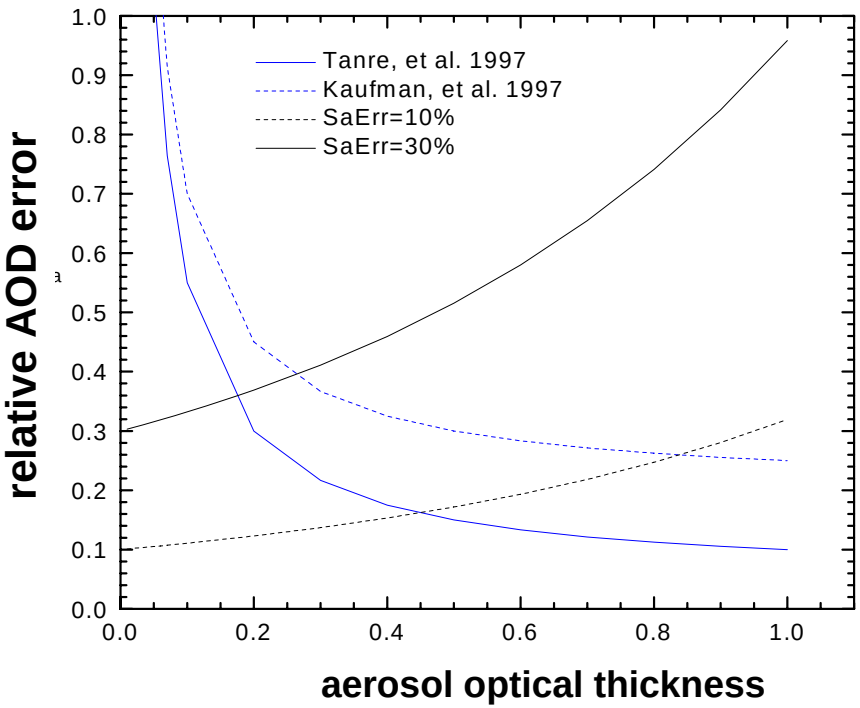
(200+ orbits, ~ 2 weeks)



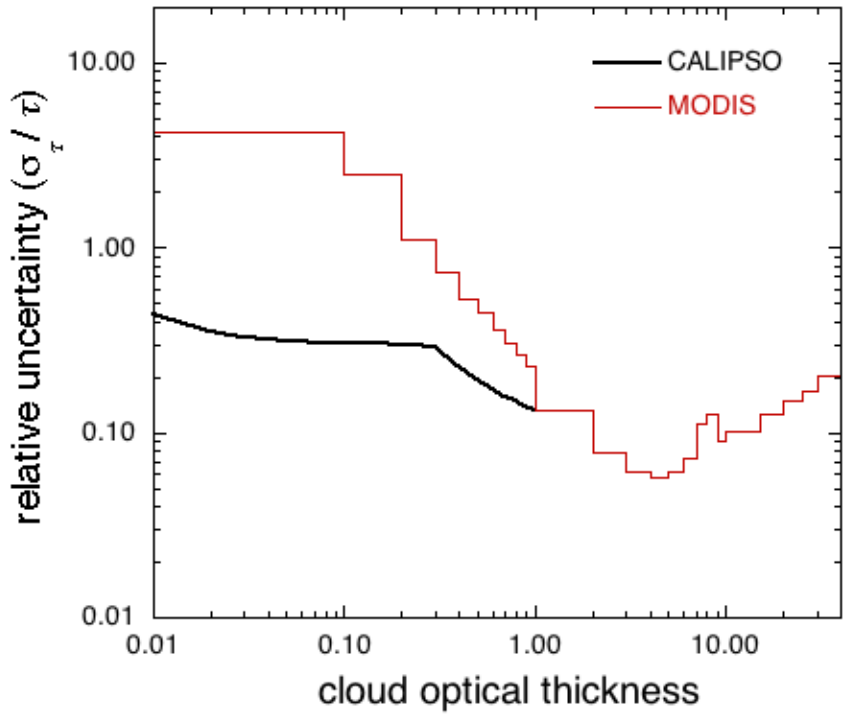
MODIS and CALIOP are complementary

lidar excels at low optical depths: $\tau_c < 1$, $\tau_a < 0.2$

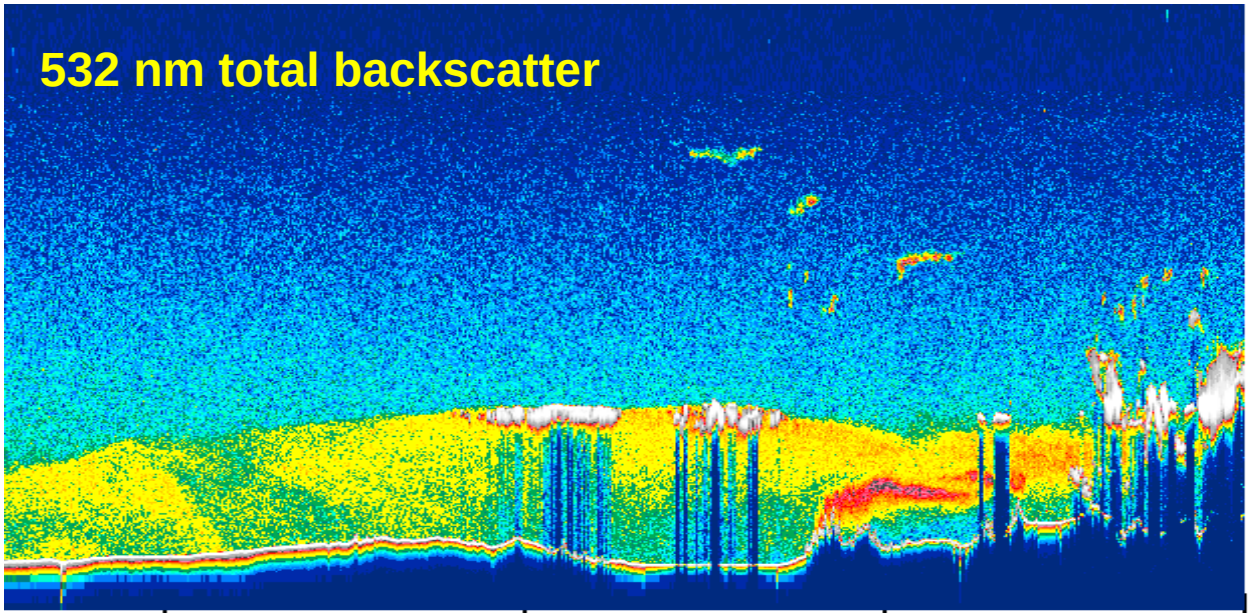
aerosol

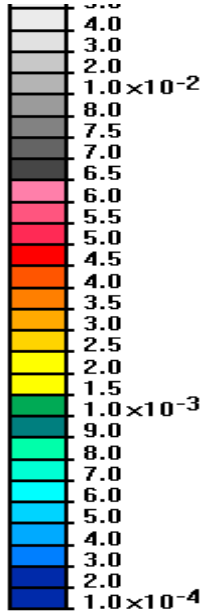


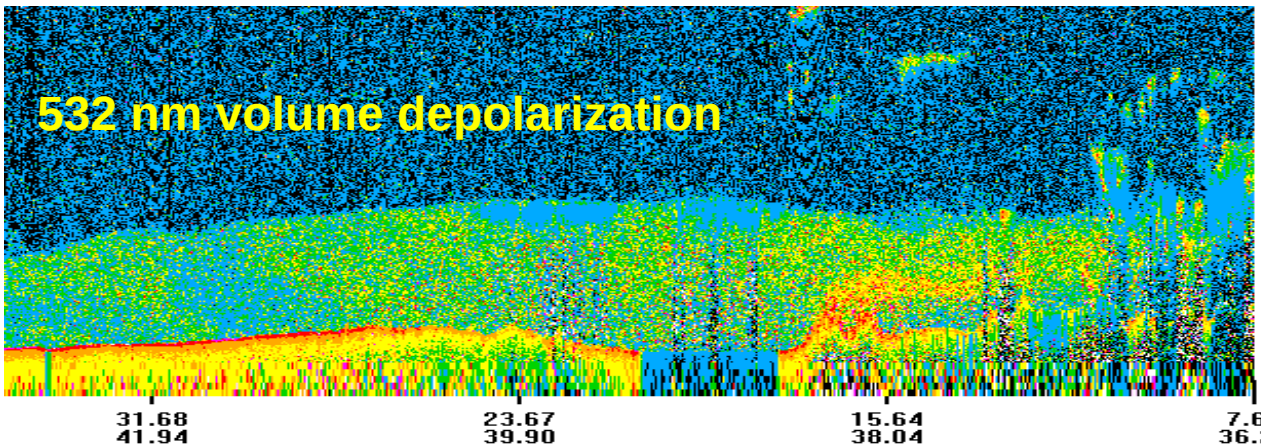
cirrus



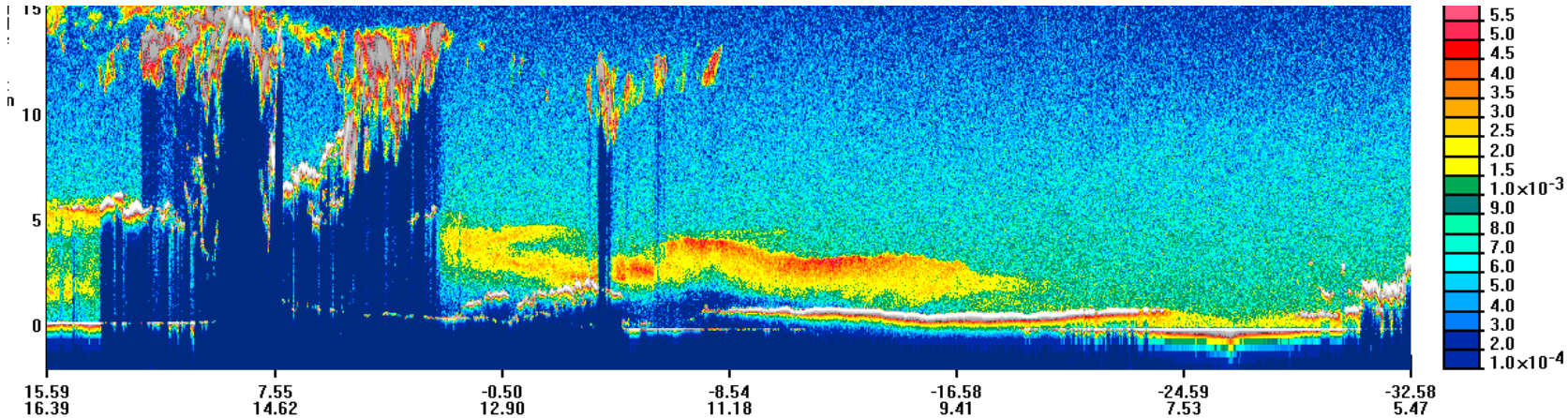
Sahara Dust with Embedded Clouds



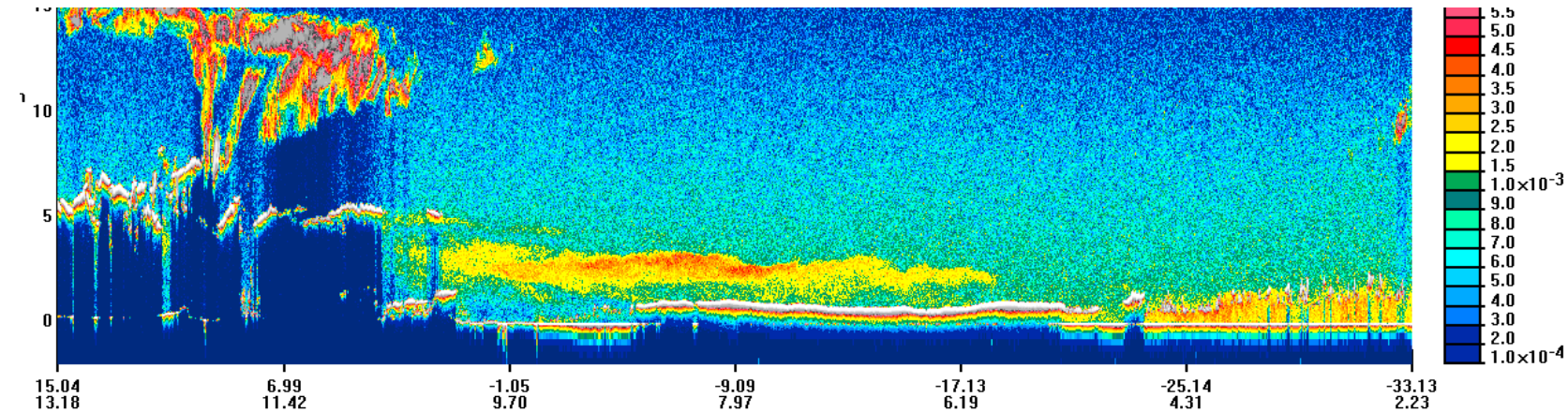




Smoke over stratus, off coast of West Africa



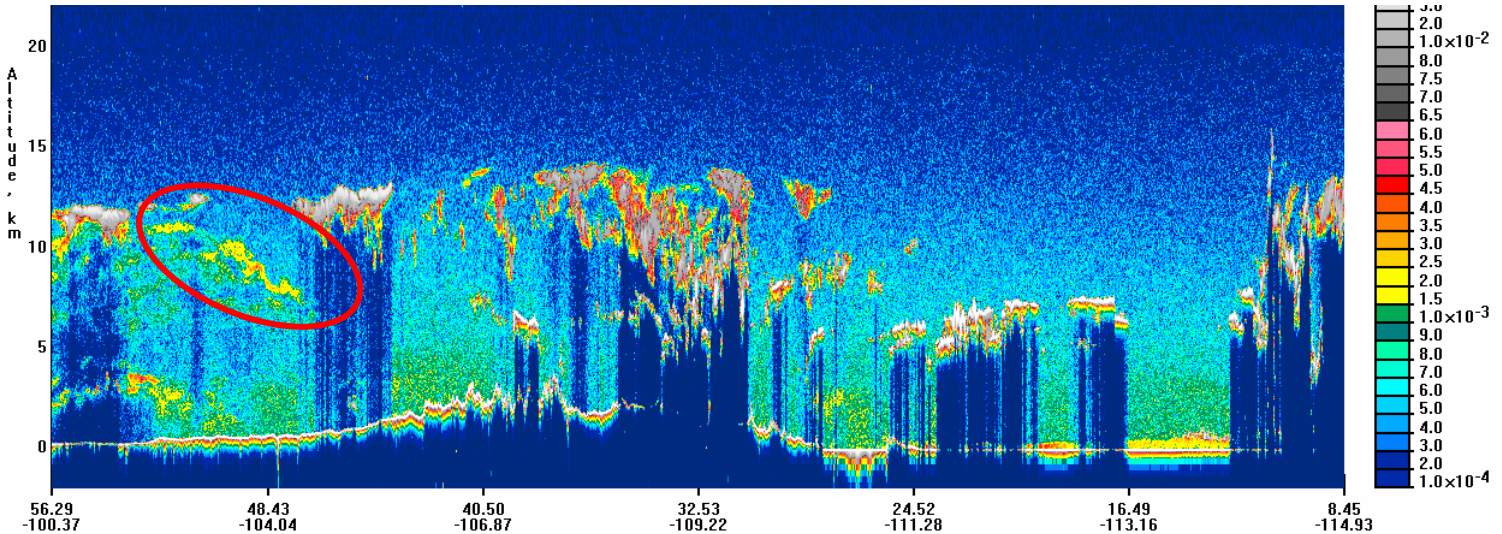
10 August



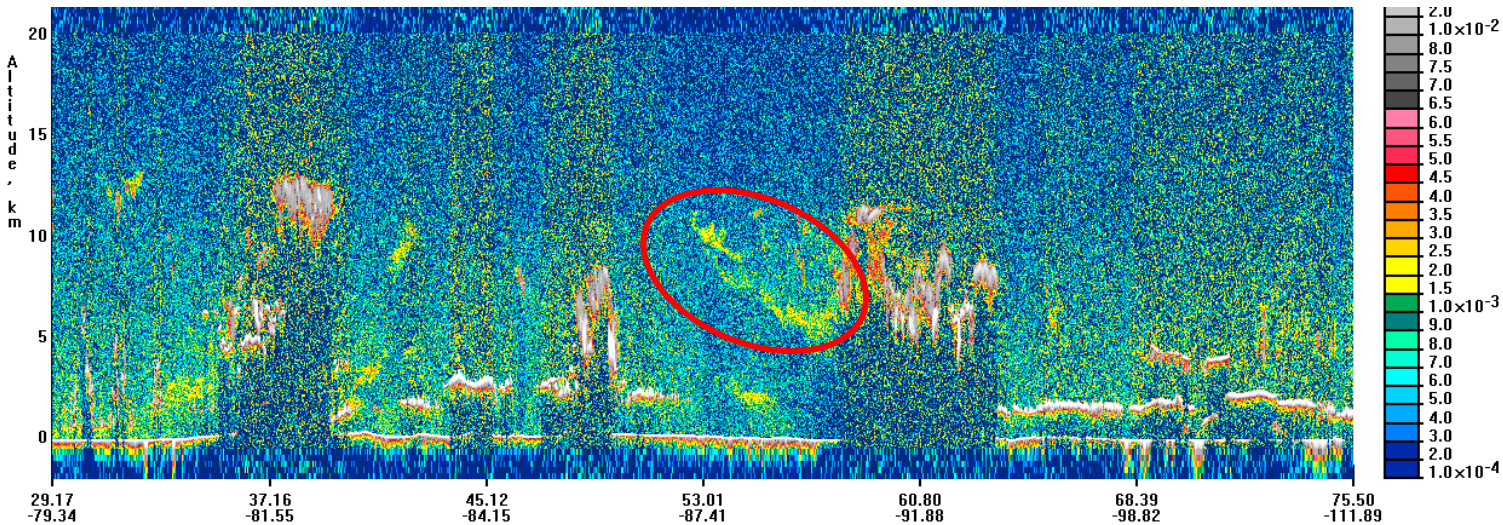
8 August

Smoke plumes over Canada – July 5

night

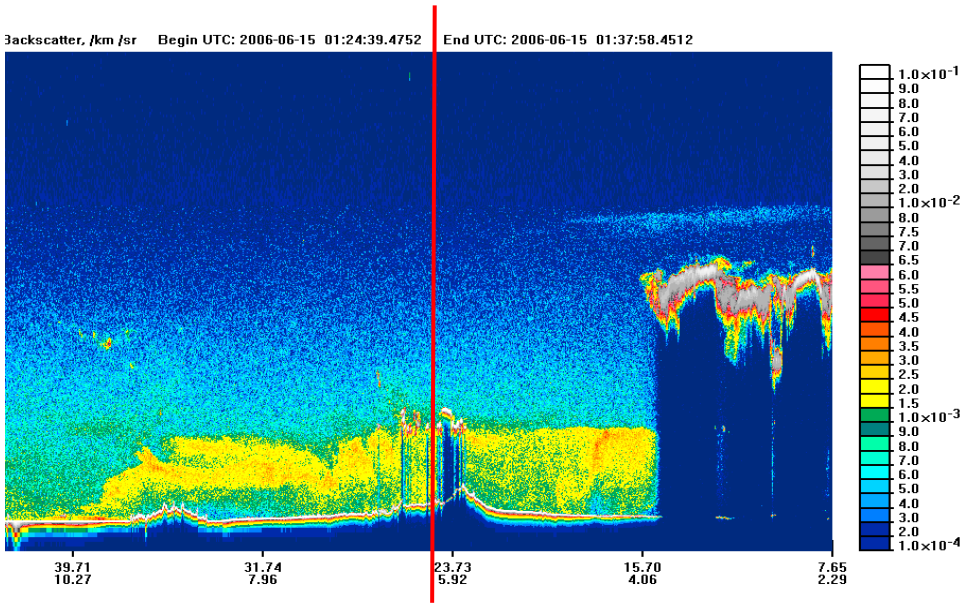


daytime

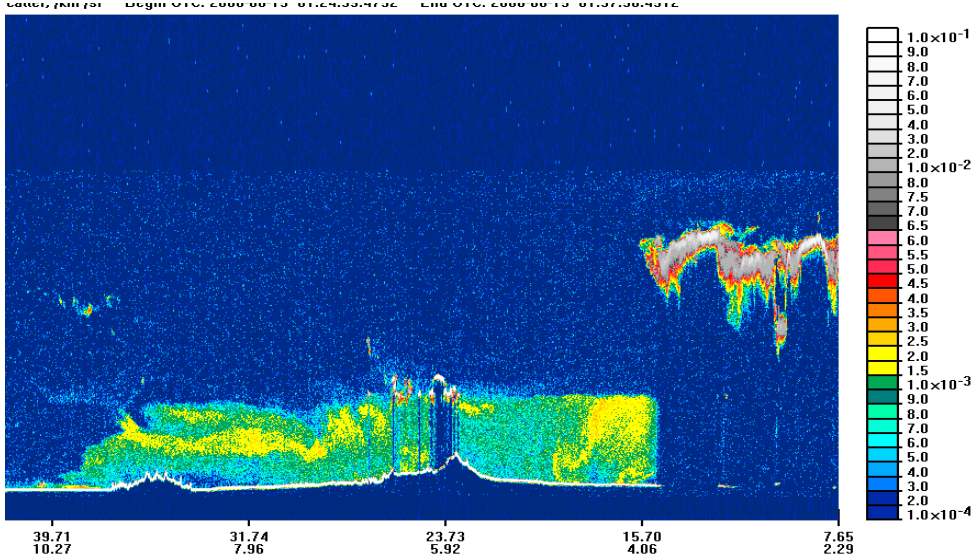


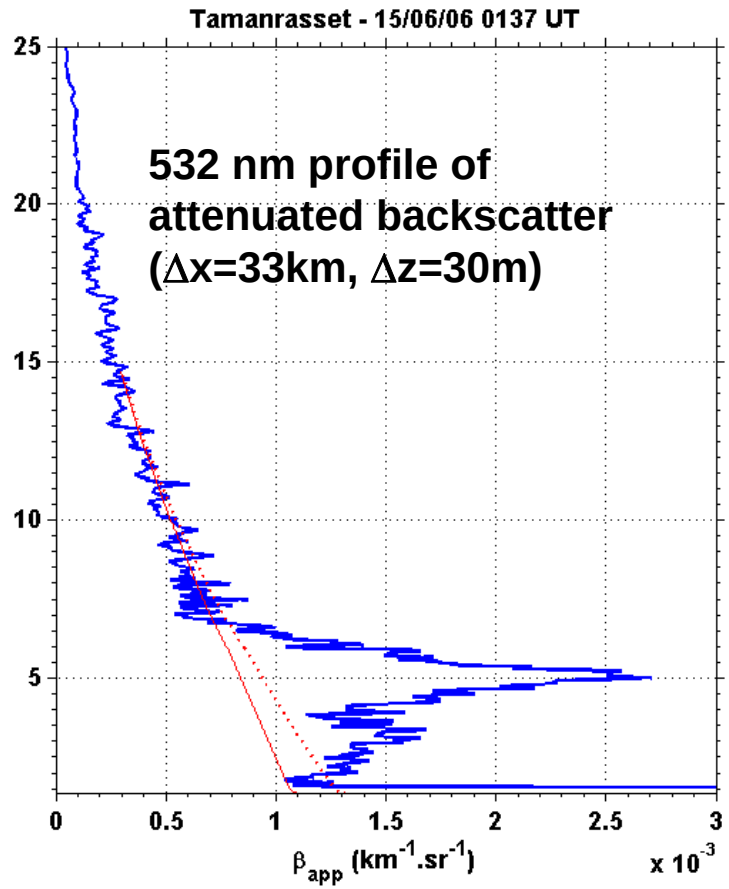
Profile over Tamanrasset: 15 June

532 nm



1064 nm





Lidar Data Products

Level 1 (geolocated and calibrated)

- DP1.1 - profiles of attenuated lidar backscatter (532, 1064, , $532_{\perp}$)
- DP 1.2 – IR radiances (8.65, 10.6, 12.05 μm)
- DP 1.3 – WFC radiances (650 nm)

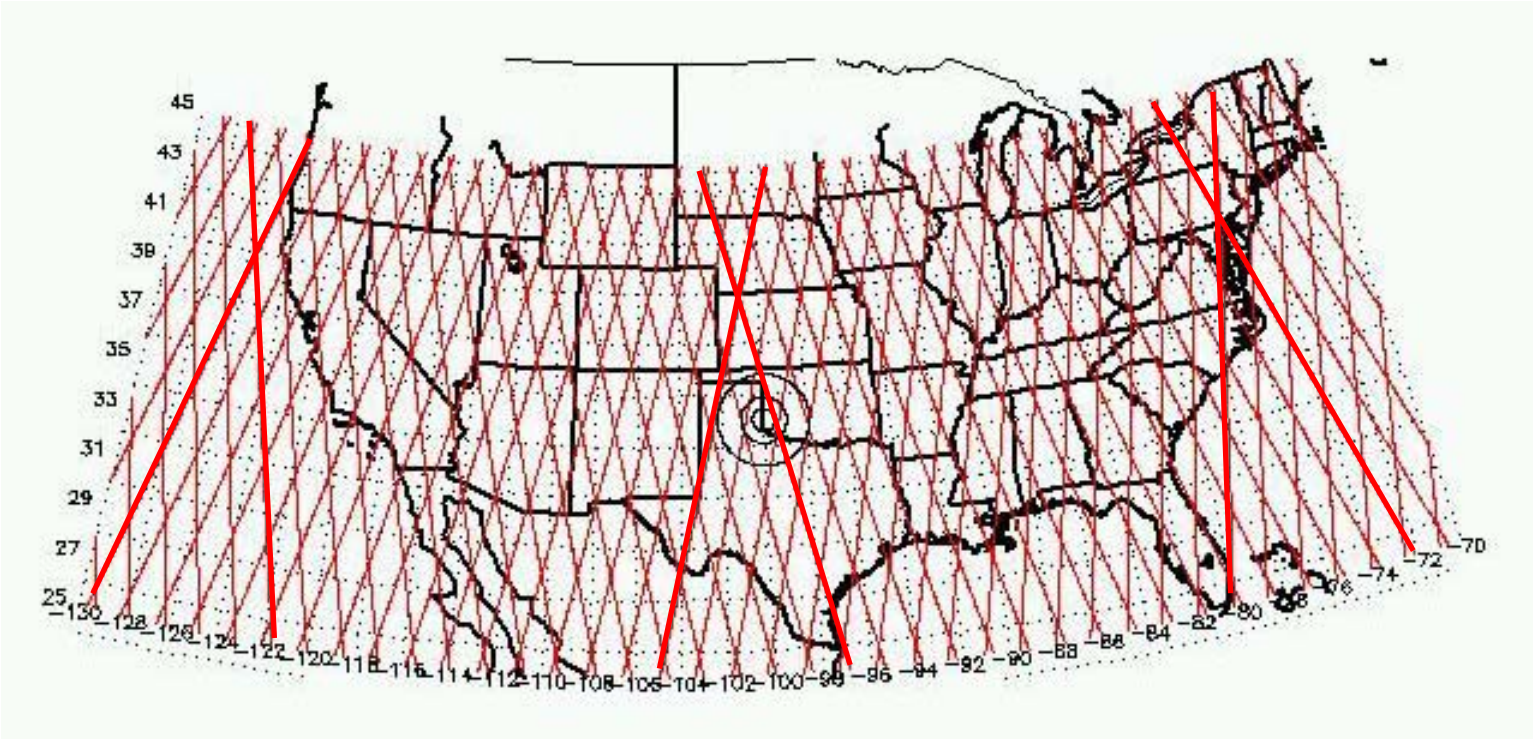
Level 2

- DP 2.1A – Cloud/Aerosol layer product
  - layer base and top heights, layer-integrated properties
- DP 2.1B – Aerosol profile product
  - backscatter, extinction, depolarization profiles
- DP 2.1C – Cloud profile product
  - backscatter, extinction, depolarization, ice/water content profiles
- DP2.1D – Vertical mask
  - cloud/aerosol locations
- Also: products from IIR + CALIOP + WFC: cloud $T_B(\lambda)$, emissivity, r_e

Level 3

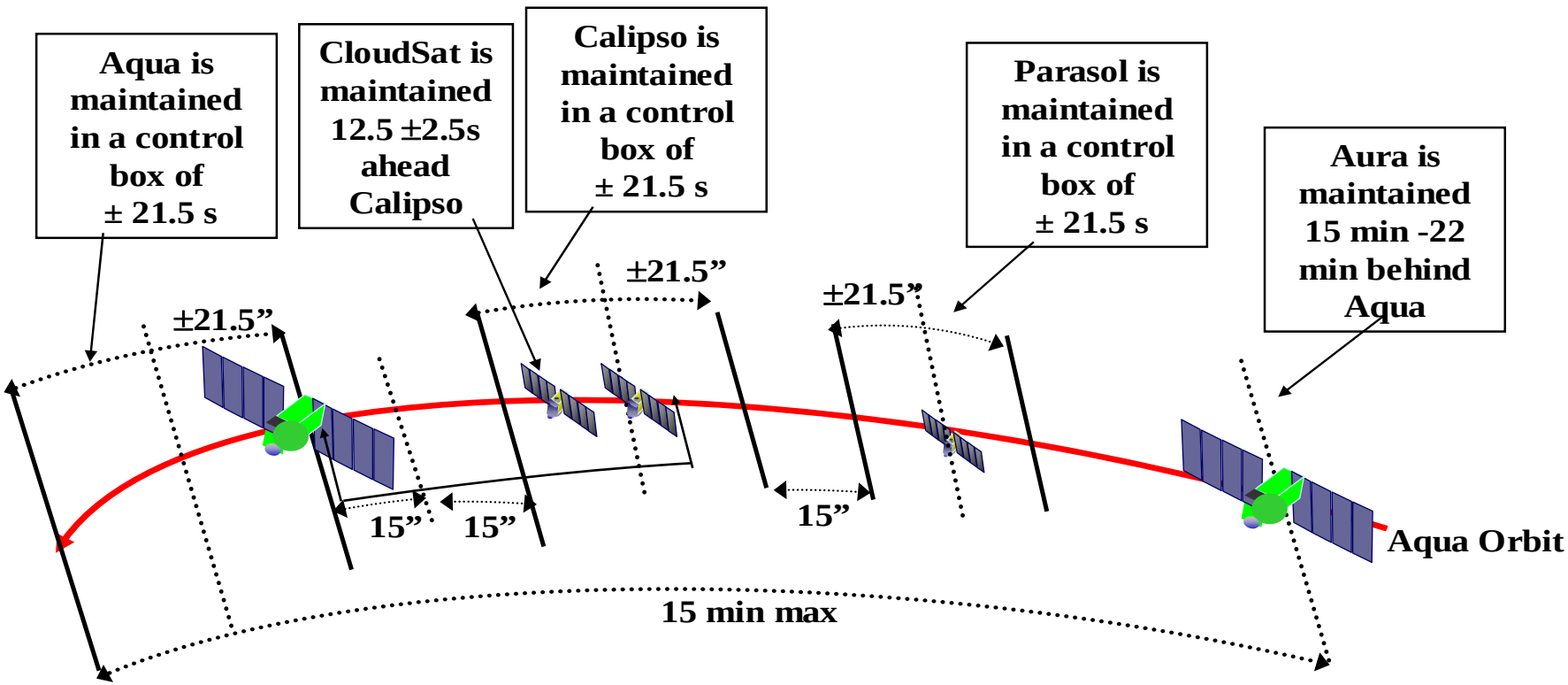
- Summary statistics on a global grid

CALIPSO 16-day Orbit Repeat Pattern

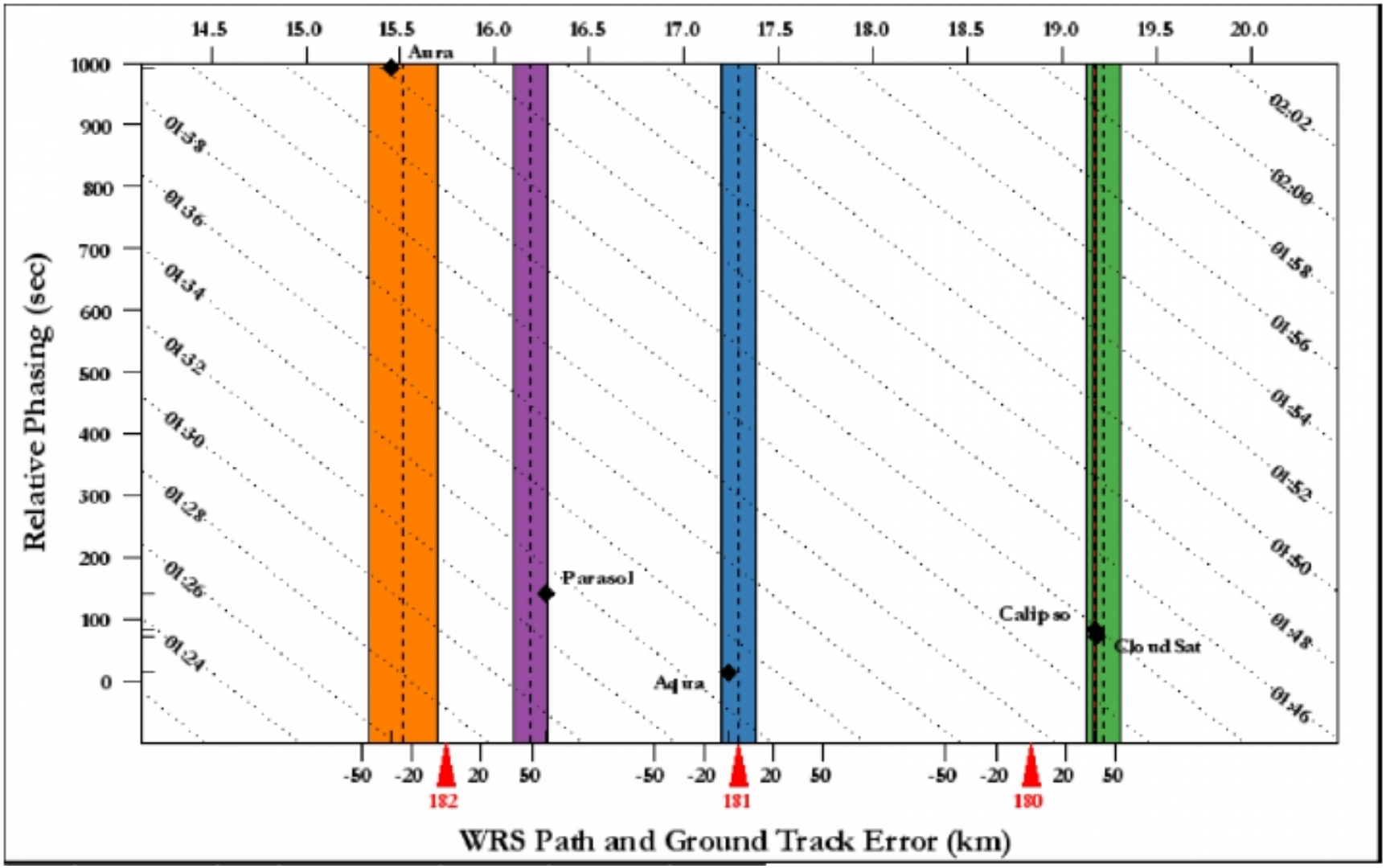


Current A-train Configuration

- A-train: 16-day repeat cycle
- CALIPSO controlled to +/- 10 km at Equator crossing
- CloudSat slaved to CALIPSO

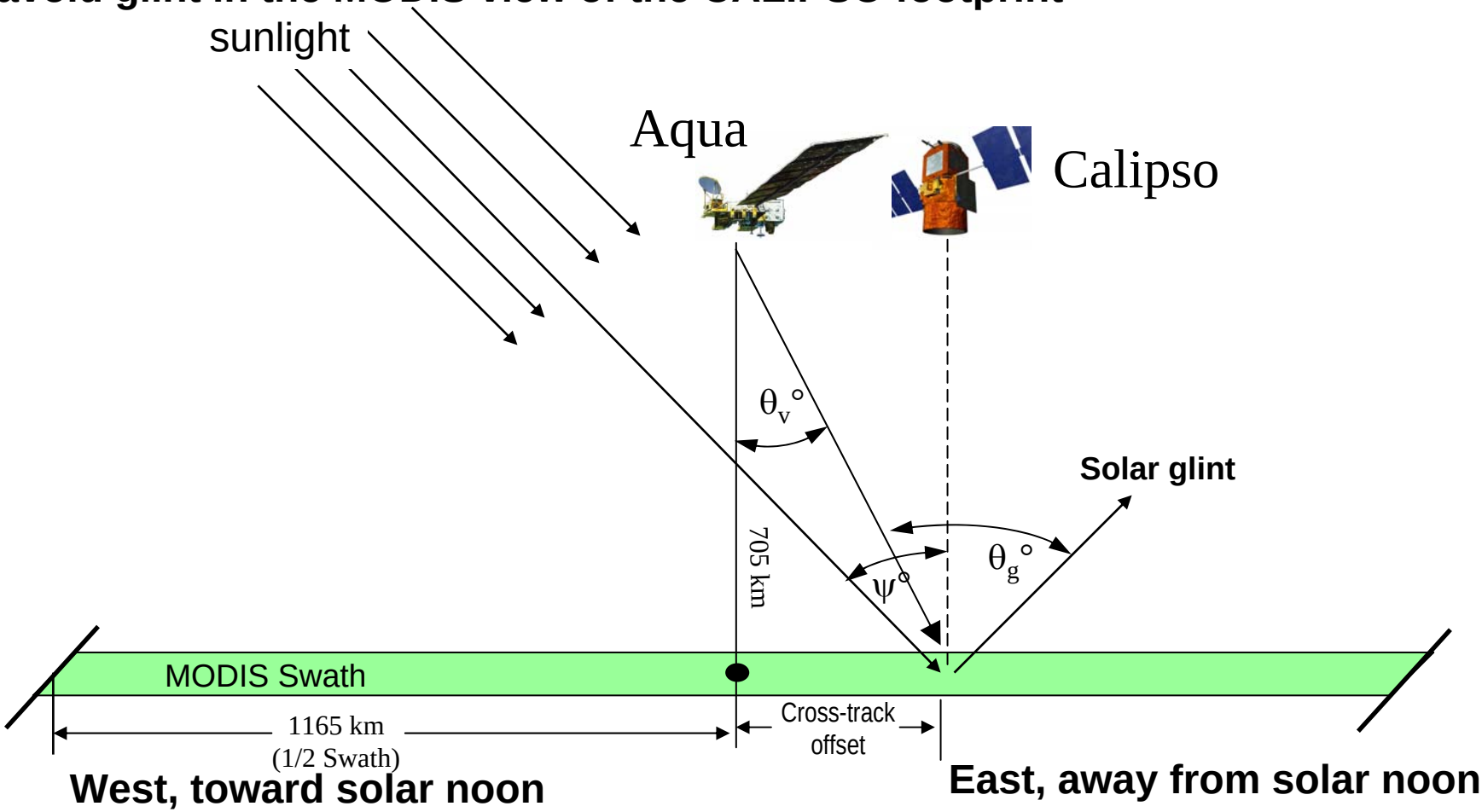


- **CALIPSO/CloudSat fly 215 km to the east of Aqua**
- **PARASOL, Aura fly to the west of Aqua**



Glint Avoidance

- **Sunglint impacts MODIS aerosol retrievals for glint angles $\theta_g < 40^o$**
- **CALIPSO flies east of Aqua during daytime (215 km offset at the equator) to avoid glint in the MODIS view of the CALIPSO footprint**



Summary: What can CALIPSO provide?

- Aerosol profiles/layering → constraints on model transport (V, H)
- Height, sphericity, size → information related to aerosol type
- Expands aerosol observations available from passive sensors
  - at night, under thin cirrus, polar regions
- Greater sensitivity to low AOD
  - Evaluate lower limit of sensitivity of MODIS, OMI, etc.
  - constraints on removal mechanisms
- Evaluate performance and limitations of cloud-screening algorithms used in passive aerosol retrievals
  - Location and frequency of thin cirrus
  - Use profile data to investigate the aerosol-cloud "continuum" (aerosol swelling, cloud-processing of aerosol, cloud fragments near cloud edges, etc.)