Validation Science Team Meeting

14 Jan 2014

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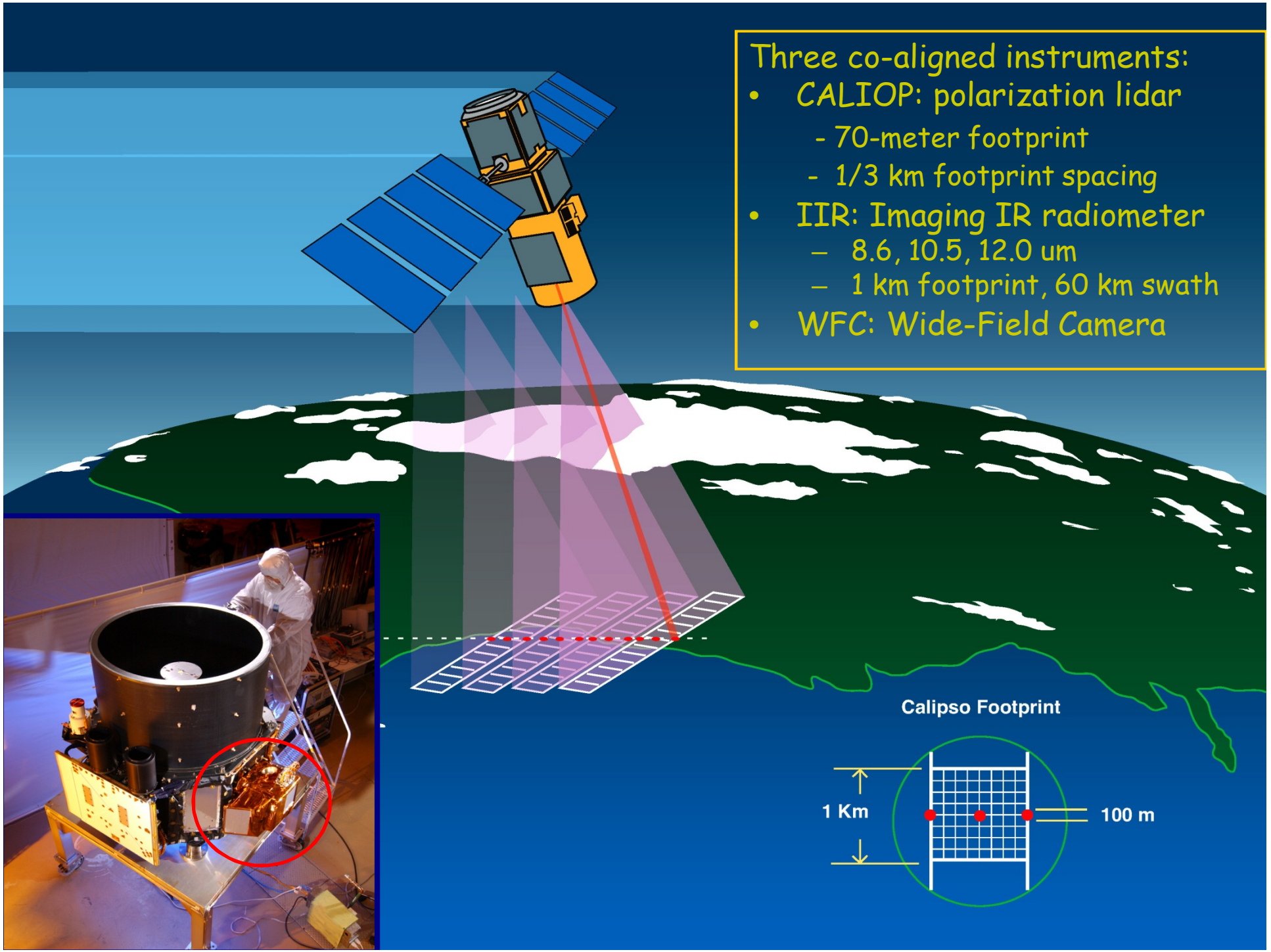
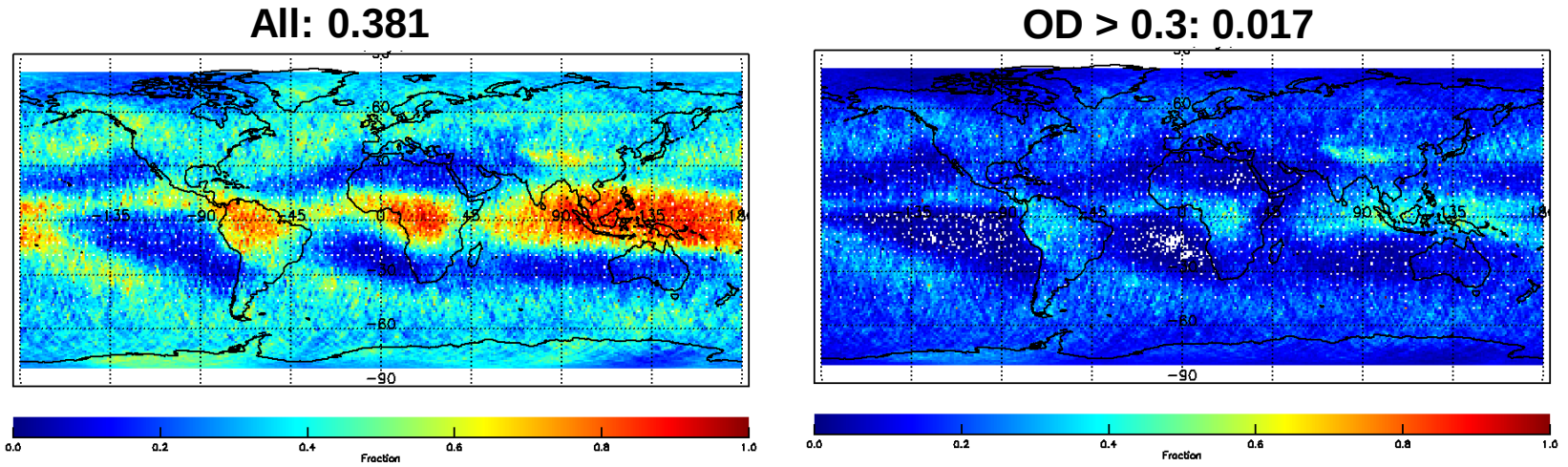
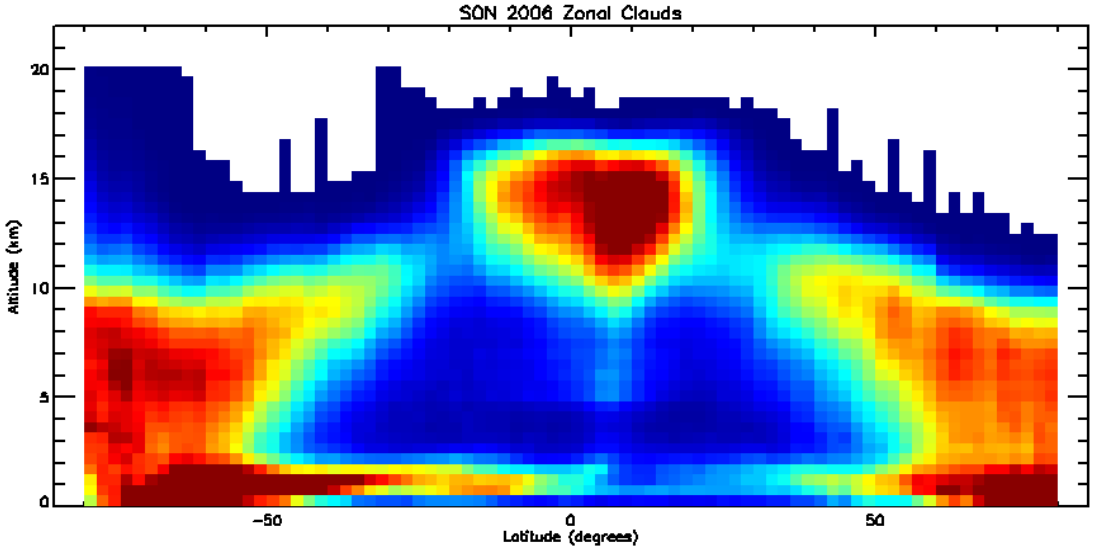
Our Proposal Objectives

- **CALIOP provides the only global profiles of clouds and aerosols and is thus an important validation resource for ATLID**
  - However, CALIPSO and EarthCARE are in opposing orbits
  - CALIOP and ATLID operate at different wavelengths, so we must account for spectral dependence of aerosol (and cloud?) properties
  - We will determine strategies for best comparison of CALIPSO and EarthCARE observations
- **LaRC HSRL used extensively for CALIOP validation**
  - New instrument has HSRL at both 355 nm and 532 nm
  - We will develop plans to validate ATLID aerosol extinction and typing
  - We will investigate relations between aerosol properties at 355 nm and 532 nm to relate the CALIOP data record to ATLID
- **Contribute to the development of the Validation Plan based on our experience with CALIPSO**


Three co-aligned instruments:
• CALIOP: polarization lidar
- 70-meter footprint
- 1/3 km footprint spacing
• IIR: Imaging IR radiometer
– 8.6, 10.5, 12.0 um
– 1 km footprint, 60 km swath
• WFC: Wide-Field Camera
Calipso Footprint
1 Km
100 m



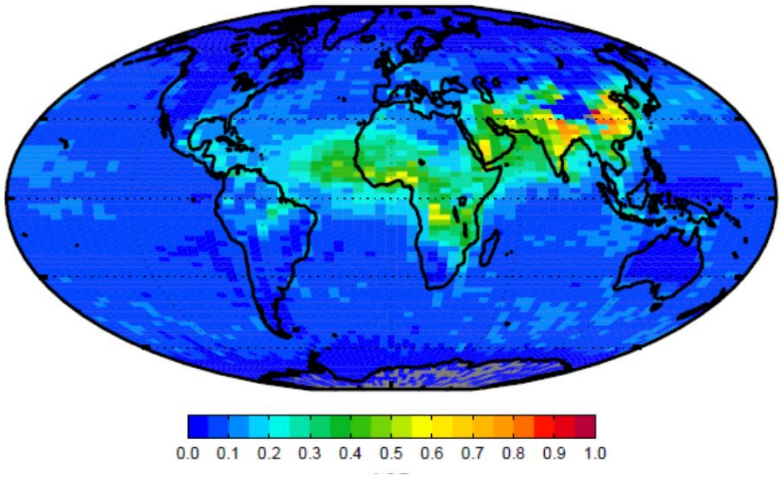
Annual mean cloud fraction of high cloud (> 6.5 km) from CALIOP



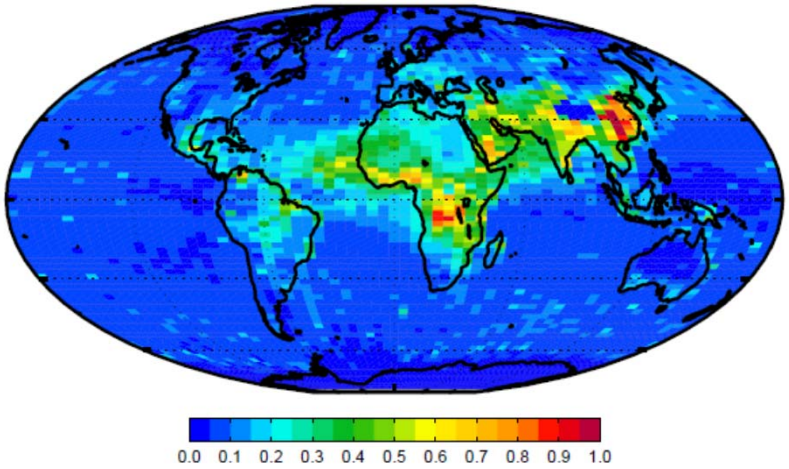
Zonal mean cloud fraction

Annual Mean AOD

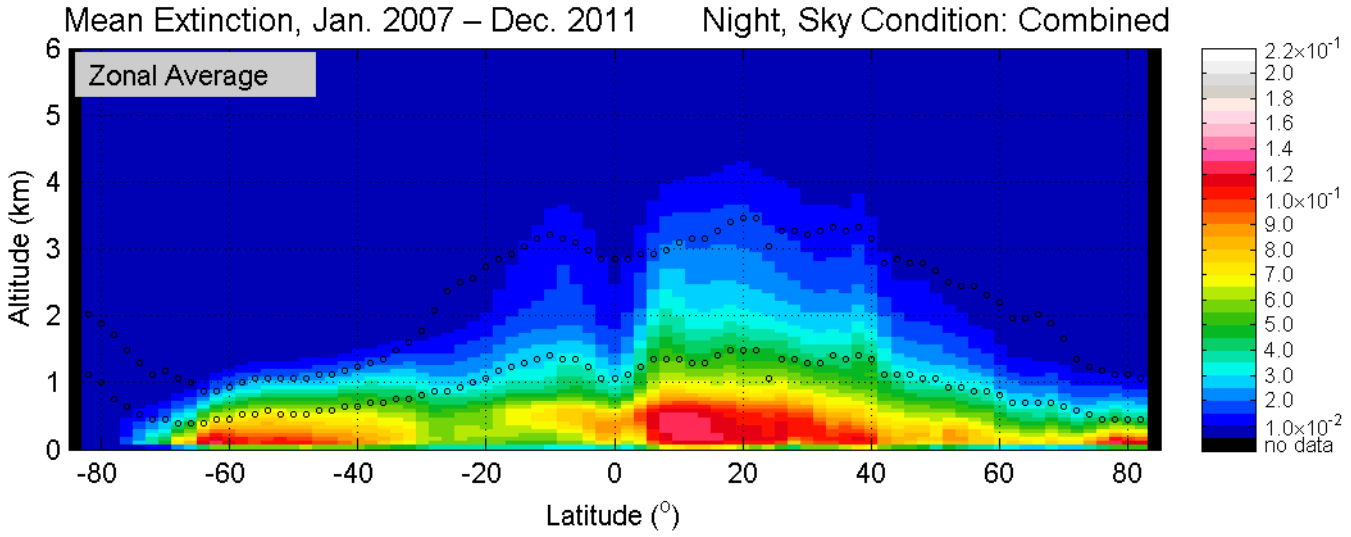
Day



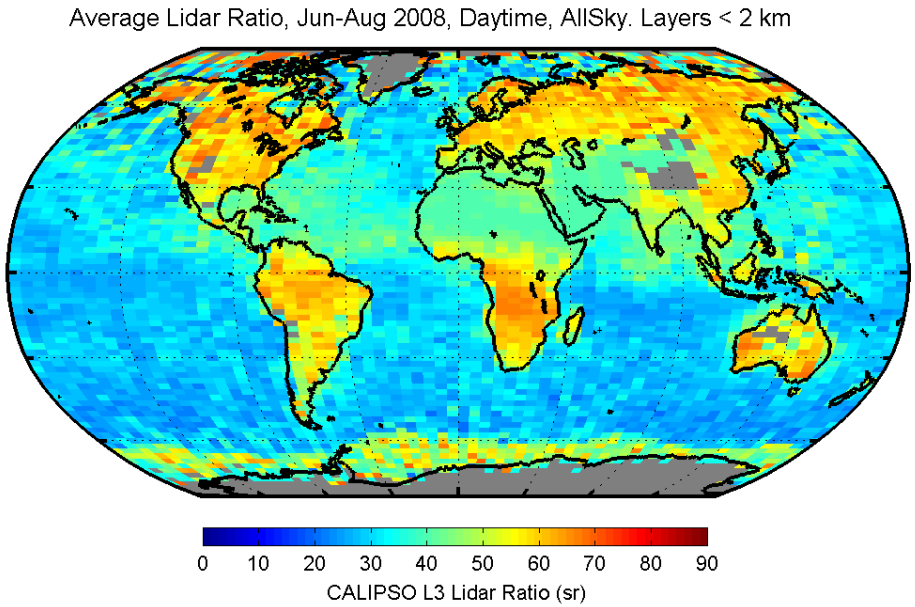
Night



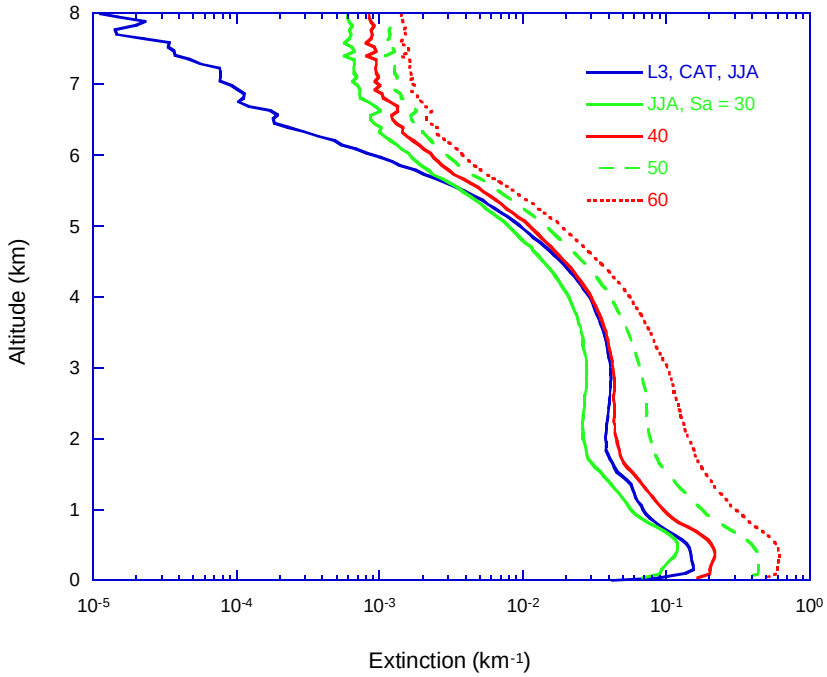
Zonal Mean Aerosol Extinction Profile



Aerosol Type



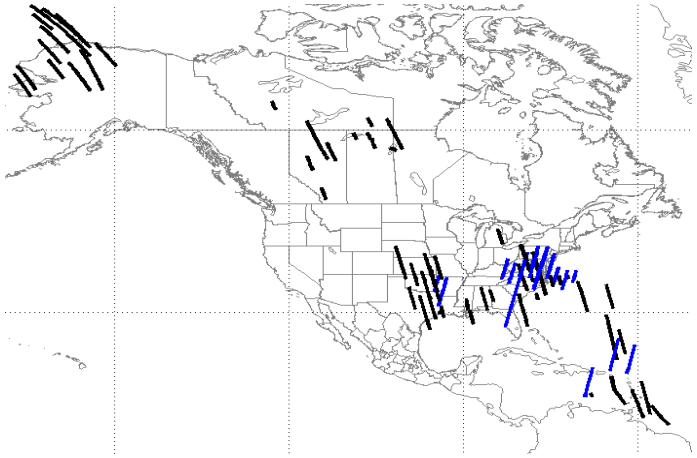
Profile uncertainties evaluated using independent algorithms

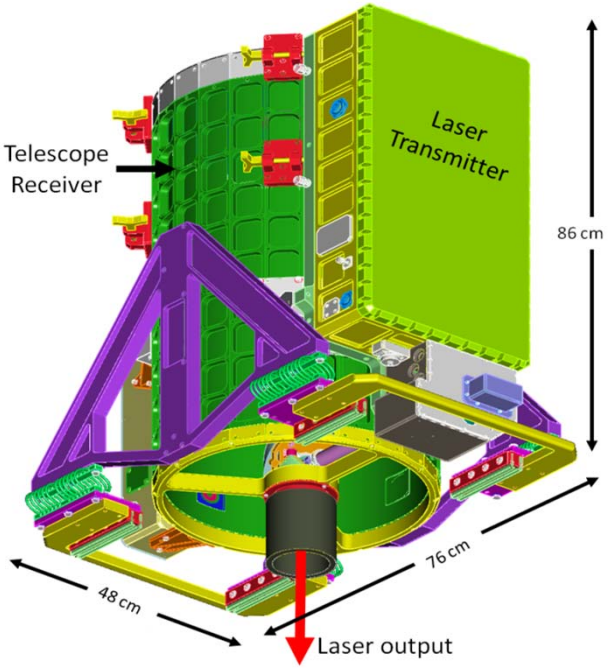


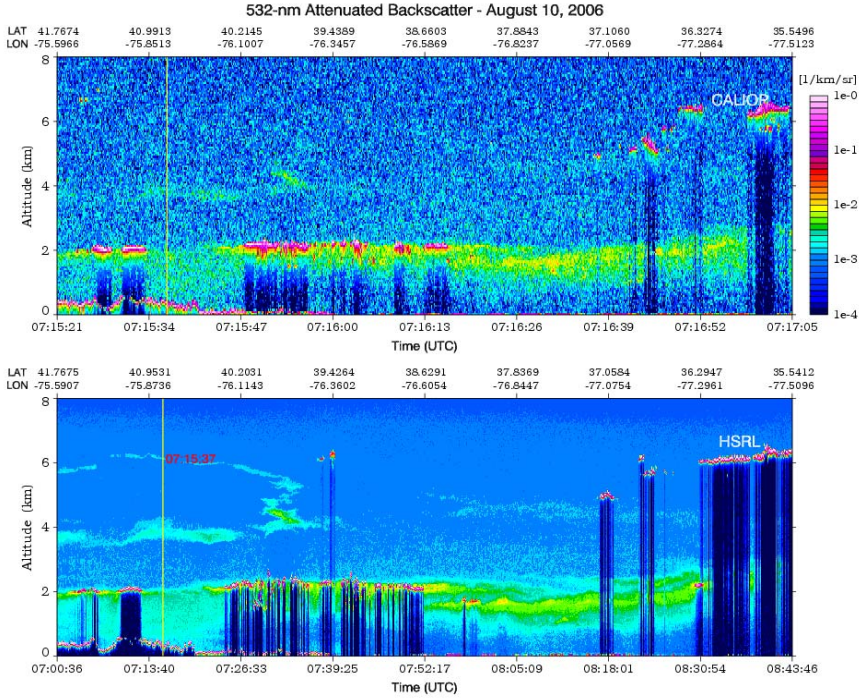
(Winker et al., ACP, 2013)

HSRL-1 used extensively to validate CALIOP

HSRL-1 on B-200:

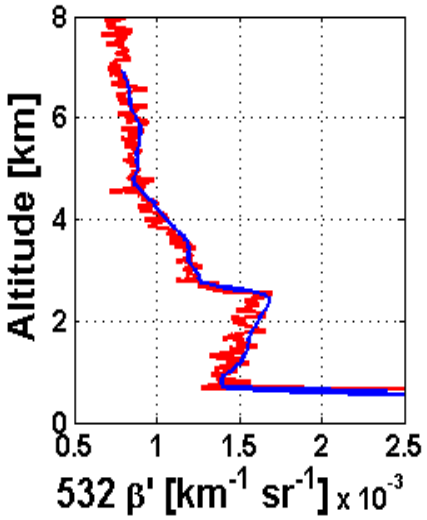


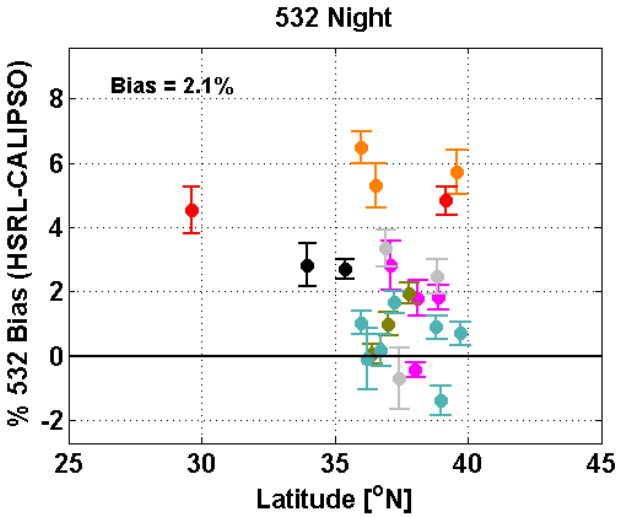




Validation Examples

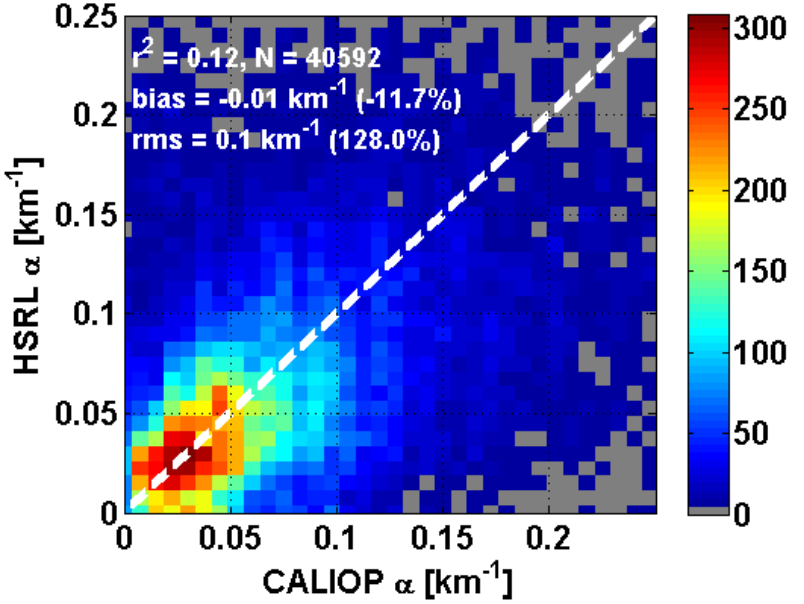
Calibration

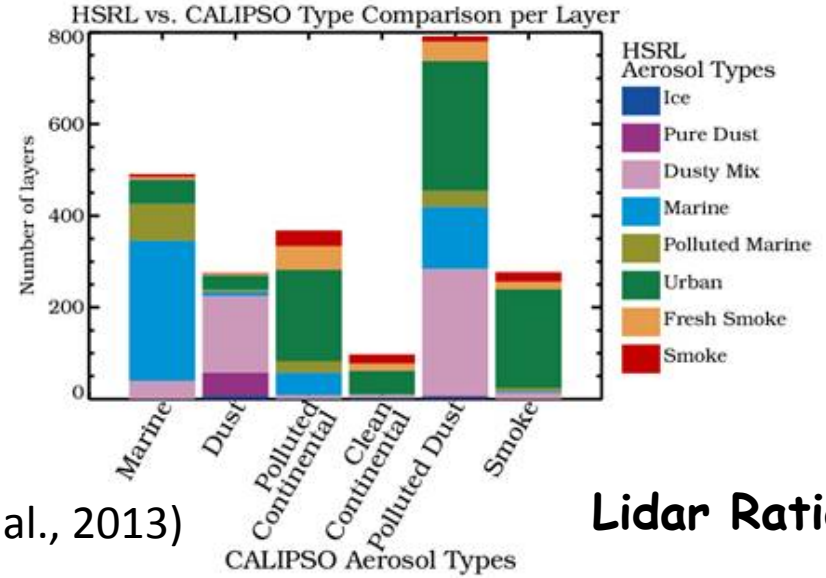




(Rogers et al., 2011)

Extinction





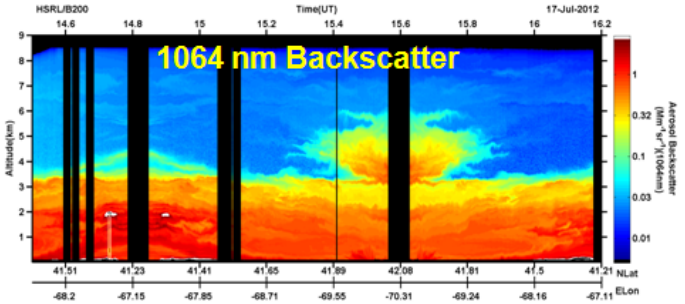
(Burton et al., 2013)

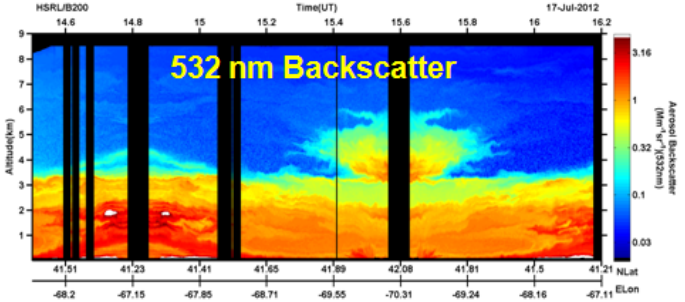
Lidar Ratio

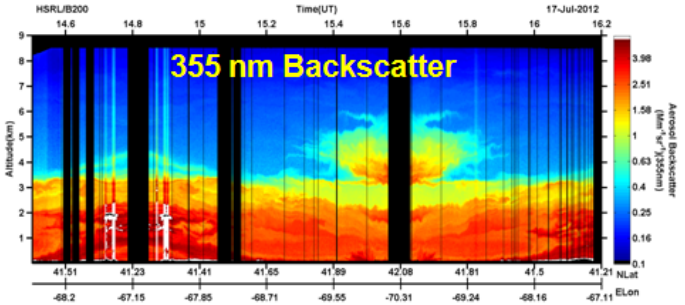
B-200: “HSRL-2” - adds 355 nm channels

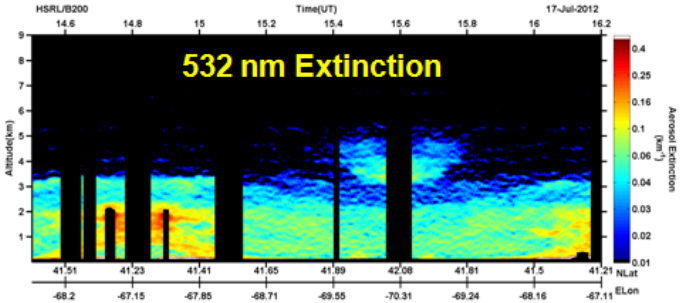
Laser	Nd:YAG
Laser Pulse Energy	36 mJ: 1064 nm 13 mJ: 532 nm 30 mJ: 355 nm
Laser Repetition Rate	200 Hz
HSRL	532 nm, 355 nm
Depolarization	1064 nm, 532 nm, 355 nm
Receiver Aperture	40 cm
Receiver FOV	1 mrad
Vertical Resolution	30 m

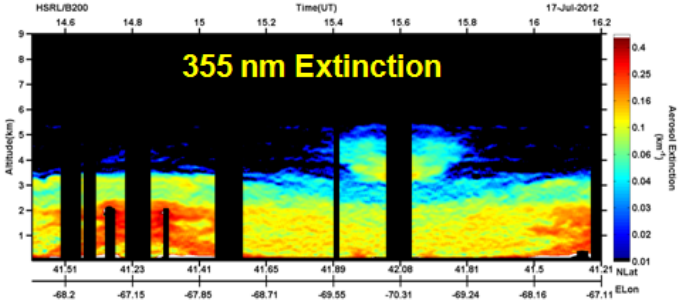
HSRL-2







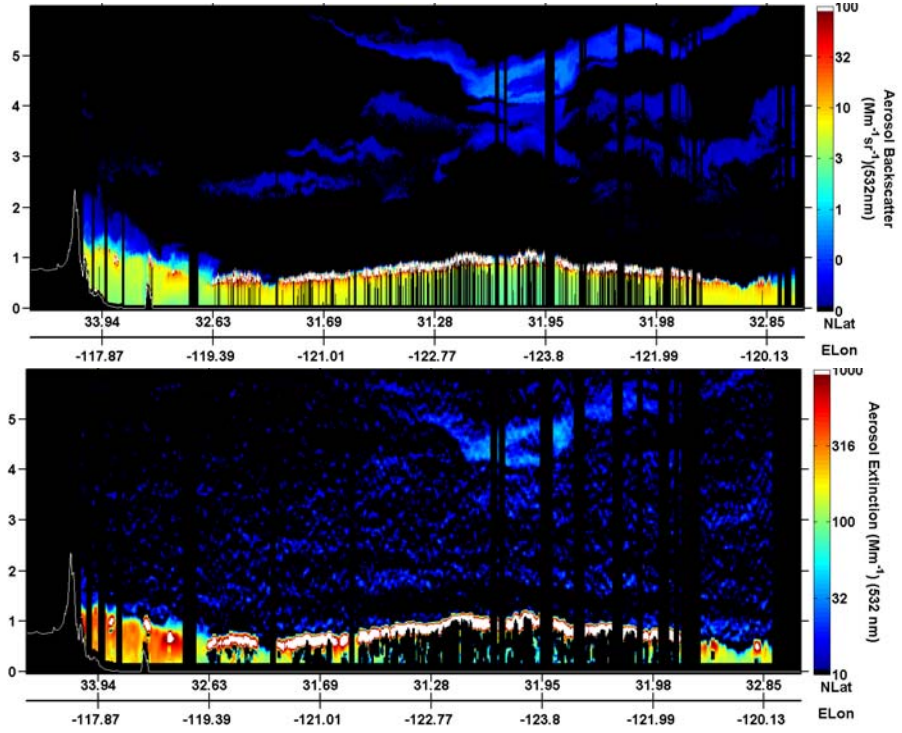


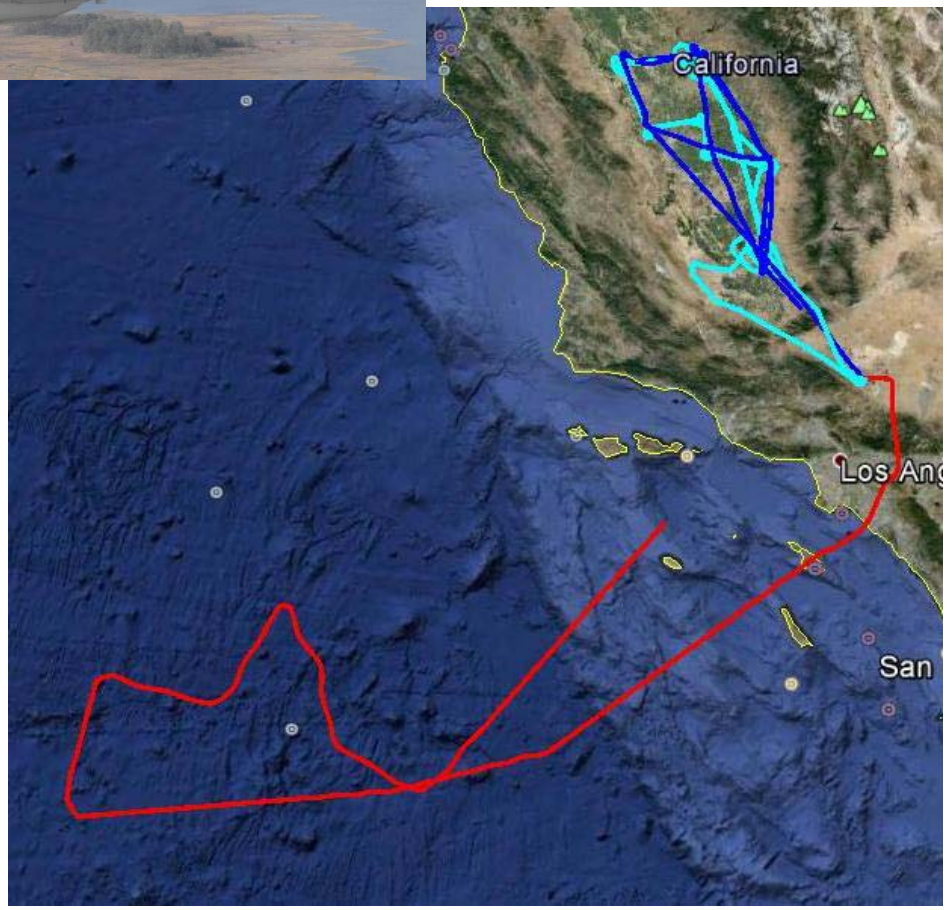


HSRL-2 Status

- We plan to use HSRL-2 to validate ATLID retrievals and to link ATLID (355 nm) aerosol retrievals to CALIOP (532 nm)
- HSRL-2 measures:
  - backscatter (355, 532, 1064)
  - extinction (355, 532)
  - depolarization (355, 532, 1064)
- Measurements and retrievals used to characterize:
  - aerosol extinction profiles and AOD
  - aerosol type (e.g. dust vs. smoke)
- Has flown on NASA B-200 in three campaigns in 2013:
  - California, Texas, US East Coast
- One campaign planned for 2014:
  - Colorado
- First test flights on NASA ER-2 in spring 2014
  - higher altitude, longer range than B-200

DISCOVER-AQ (California, Jan-Feb 2013)

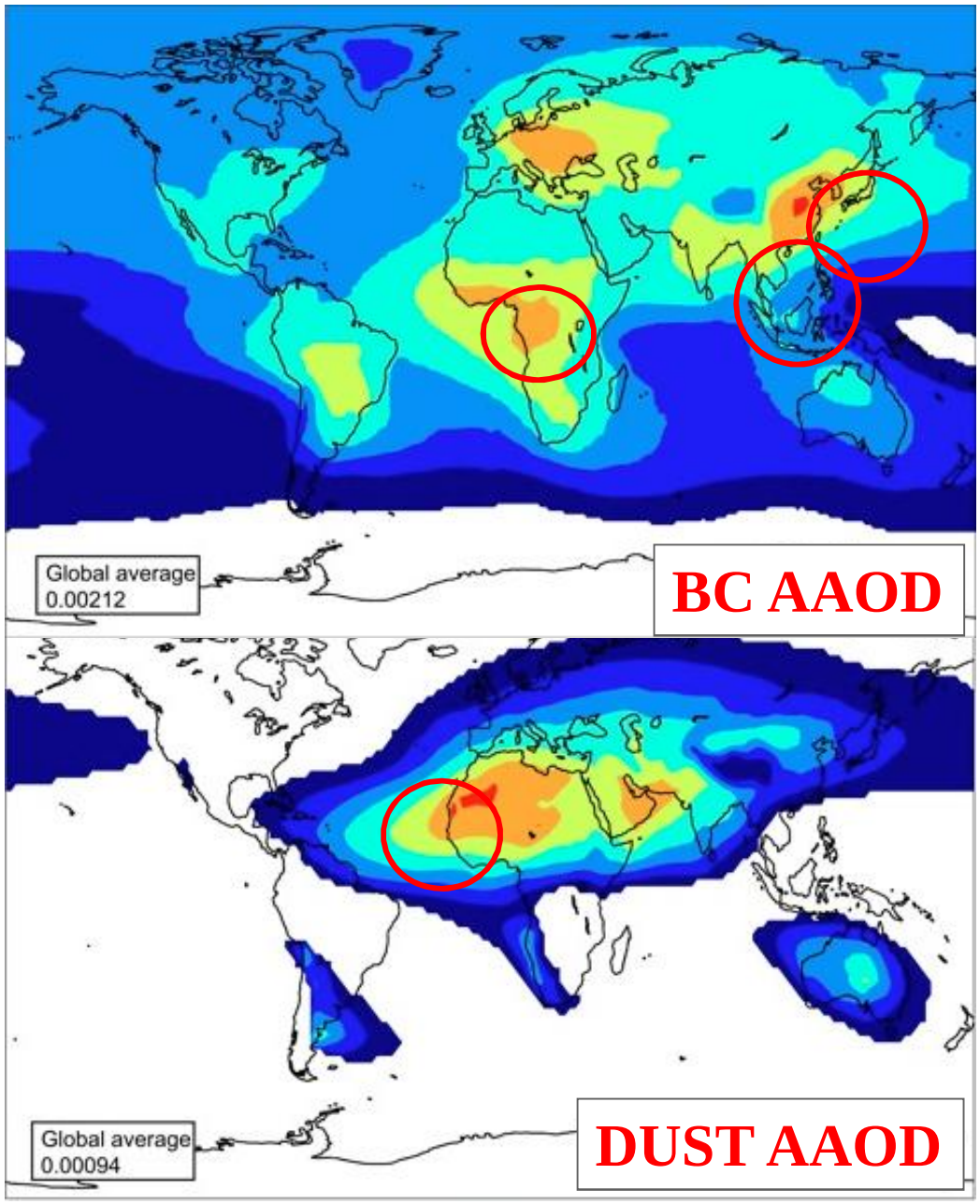




Proposed Series of Future Campaigns

- We have proposed to fly HSRL-2 under EarthCARE during future airborne campaigns
  - ABACUS campaign (AirBorne Aerosol and Cloud Survey)
  - submitted 10 January 2014
- Several campaigns proposed during 2016-2019
- Combination of in situ and remote sensing instruments carried on NASA P-3B or DC-8 aircraft
- Objective: study black carbon aerosols in key regions
  - 3-D distribution downwind of sources
  - Physical, chemical, and optical properties

Proposed ABACUS Study Regions

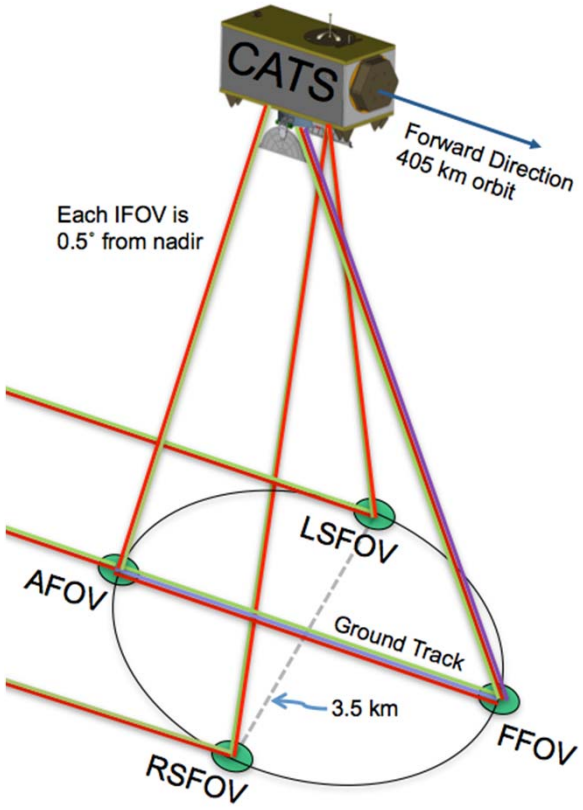


Will study key regions impacted by black carbon aerosols:

- Philippines (spring 2016)
  - smoke and pollution
- Namibia (spring 2017)
  - smoke
- Cape Verde (fall 2018)
  - smoke and dust
- Japan and Asia outflow (spring 2019)
  - pollution and dust

CATS Lidar

- NASA will place a cloud-aerosol lidar on ISS later this year (JEM platform)
- Launch: fall 2014 (Falcon-9)
- CALIPSO team will produce CALIPSO-like products from CATS mode 1 data
  - Coordinating with CATS team and developing software
  - Duplicate computer processing system being assembled
  - Products and file formats will be very similar to current CALIOP Level 2 products

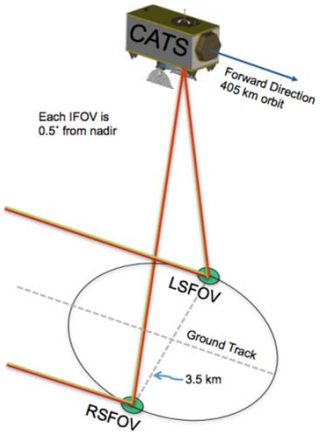
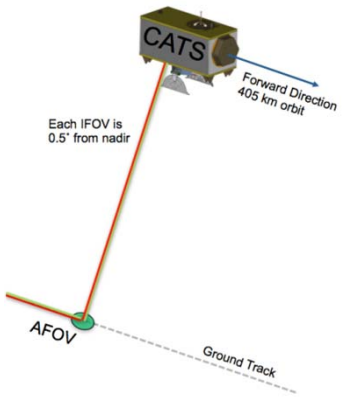
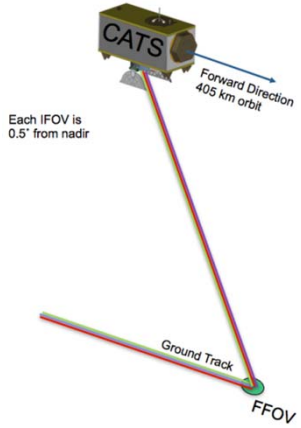
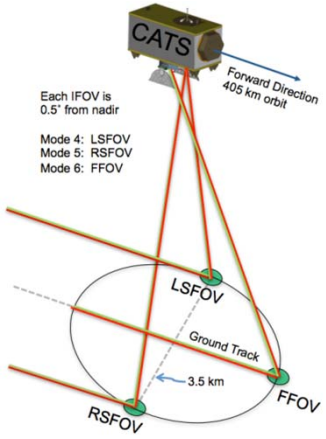


Configuration of CATS Lidar

- **To be operated on ISS JEM platform**

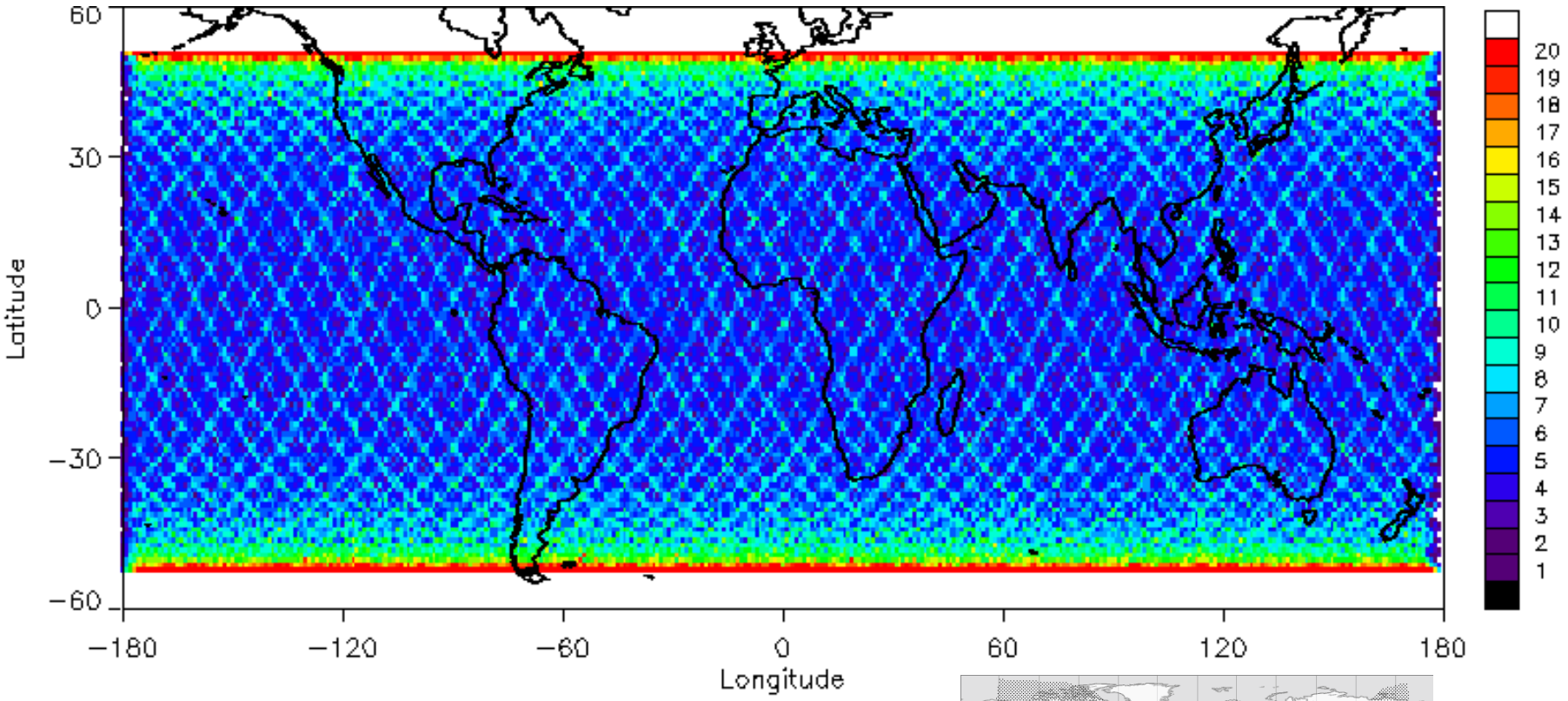
Two Nd:YAG lasers:
- **1064/532**
- **1064/532/355**

Receiver:
- **3-λ elastic backscatter/depolarization**
- **532 HSRL mode**
- **Range resolution: 60 meters**
- **Four different footprints**

Science Mode 1 1064, 532 nm backscatter lidar No HSRL Depolarization at 532, 1064 nm Mission Goals: A, B	**Science Mode 2** 1064, 532 nm backscatter lidar 532 nm HSRL Depolarization at 1064 nm Mission Goals: C, A (partial)	**Science Mode 3** 1064, 532, 355 nm backscatter lidar No HSRL Depolarization at 1064, 532, 355 nm Mission Goals: A, B, C	**Science Modes 4,5,6 (Backup)** Same capability as science mode 1, but using laser 2 and different FOV selections
			

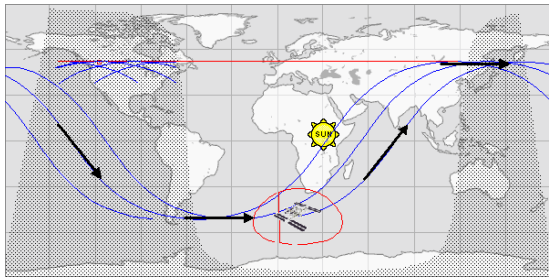
CATS ISS Orbital Coverage

- ISS Orbit: 51° inclination, precesses 24 hours in about 60 days
- Altitude varies between 350 – 410 km, ~3 day near repeat cycle



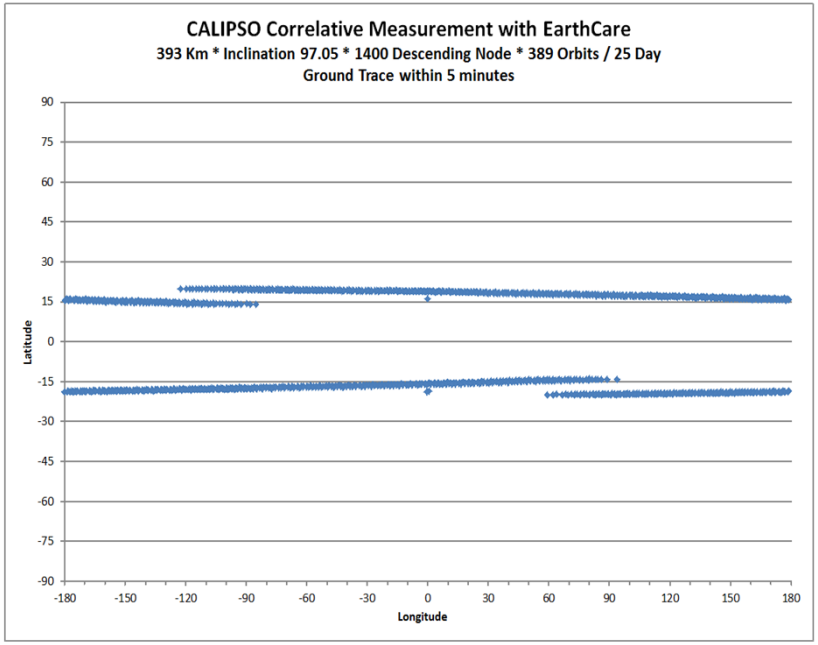
File size: ½ orbit

Frame size ~ 80 km (same as CALIPSO)

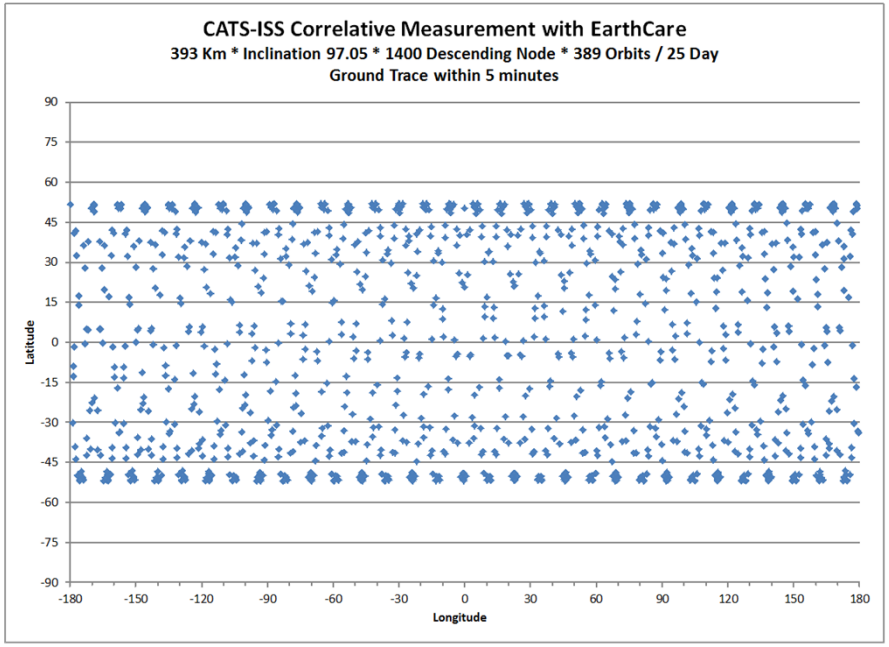


CATS provides better opportunities for comparison of data matched in space and time

CALIPSO



CATS



latitude →

longitude →

Parameter List

	Standard Products	Validation Instruments	Research Products	Validation Instruments
ATLID	Feature and target masks	**CALIOP, HSRL-2**	Aerosol extinction by type	**HSRL-2**
	Aerosol/cloud extinction, backscatter, depolarization	**CALIOP, HSRL-2**	---	**---**
	Aerosol/cloud lidar ratio	**HSRL-2**	---	**---**
MSI	Cloud flag, cloud phase	**CALIOP**	Cloud OD, cloud top, Reff	**CALIOP** **CALIOP** **IIR/CALIOP**
	Cloud top	**CALIOP**	AOD	**HSRL-2**
ATLID+CPR	IWC, R_{eff}	**IIR/CALIOP**	---	**---**
ATLID+MSI	---	**---**	Aerosol extinction by type	**HSRL-2**
ATLID+MSI+CPR	IWC, R_{eff}, IWP	**IIR/CALIOP**	**---**	**---**