ER-2 in TC-4
Subpanel Meeting Report

ER-2 instrument team:

G. Heymsfield, M. King, J. Myers, M. McGill, P. Pilewskie, J. Wang, F. Evans, A. Bucholtz, R. Hood, H. Revercomb, et al.

&

P. Newman, S. Platnick

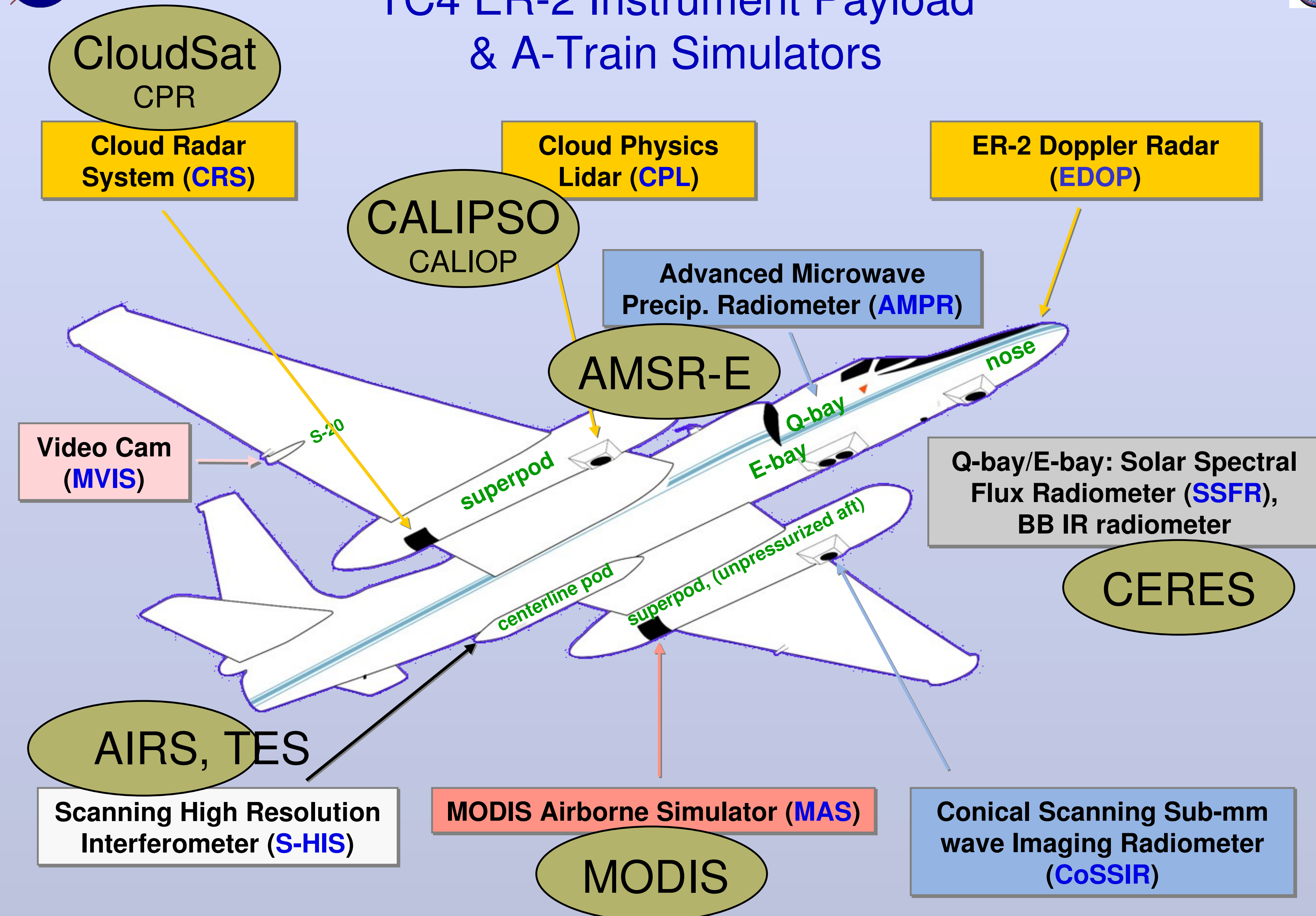
TC-4 Science Team Meeting

April 27, 2007

Format: Individual Instrument Team Presentations Addressing …

1. Instrument summary
2. Derived Products
3. Satellite Validation Capability and/or Goals (including desired satellite/aircraft coordination)
4. Science Goals (including desired satellite/aircraft coordination)

TC4 ER-2 Instrument Payload & A-Train Simulators



ER-2 Retrieval Summary (standard set)

	MAS	S-HIS	AMPR	SSFR, IR BB	CoSSIR	EDOP	CRS	CPL
cloud detection	X						X	X
cloud height/pressure	X	X					X	X
multilayer info						X	X	X
cloud phase	X	X						X
τ	Ξ	Ξ		Ξ				Ξ
ρ_ε	Ξ	Ξ		Ξ				
$\Delta_{\mu\varepsilon}$					Ξ			
ΙΩΠ	Ξ	Ξ			Ξ		Ξ	
ΛΩΠ	Ξ		Ξ					
φλυξηεατινγ ρατεσ				Ξ				
πρεχιπ.			Ξ			Ξ		
ϖ						Ξ	Ξ	
T(ζ)		Ξ						
$H_2O(\zeta)$		Ξ			Ξ			

Requires daytime observations

MAS (MODIS Airborne Simulator)

M. D. King, NASA GSFC; J. Myers, NASA Ames, et al.

Validation Goals:

- Provide high resolution cloud retrievals to enable examination of subpixel cloud retrievals from MODIS
- Compare cloud top height and multilayer cloud detection with CALIPSO, OMI, POLDER. Multilayer cloud detection algorithm during daytime only.
- Intercompare MAS/MODIS thermodynamic phase determination
  – CALIPSO and POLDER during the daytime
  – CPL during daytime on any flight, including coordination with Terra

Science Goals:

- Thin cirrus detection capabilities/algorithms and microphysical evolution.

Aircraft Coordination: Night flights not useful for science objectives.

Desired Satellite Coordination:

- Aqua: CALIPSO, CloudSat, and Aura/OMI during the daytime. Terra (MODIS and MISR) during the daytime.

S-HIS (Scanning HIS)

Hank Revercomb, Fred Best, Bob Knuteson, Dave Tobin, Steve Dutcher, Dan LaPorte, Joe Taylor, Ken Vinson, Bob Holz, Paolo Antonelli – U. Wisconsin/SSEC

Validation Goals:

- Radiance Validation with TES (Aura), AIRS (Aqua) & IASI (Metop)
- Tropospheric Ozone Validation for above satellites
- Previous work: AIRS: Mean differences generally <0.2 K with small standard deviations. TES: Better than 0.5 K agreement in most regions. IASI: Preliminary results very promising for validation results comparable to AIRS at higher spectral resolution & contiguous spectral coverage

Science Goals:

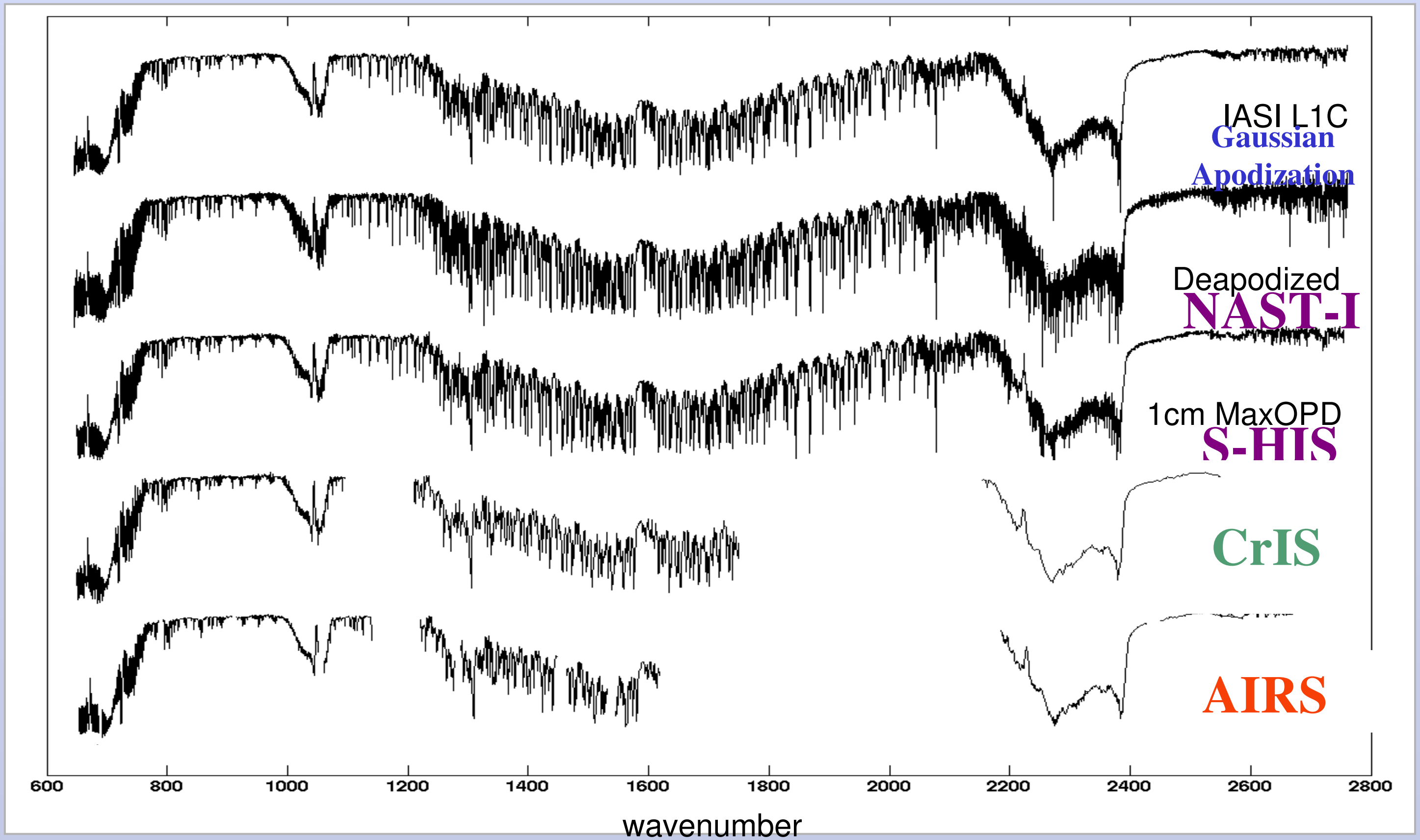
- Study of TTL Temperature and Water Vapor structure for convective and stable atmospheric states
- Study of lidar (CALIPSO), Radar (CloudSat) and IR cloud properties and the impact on OLR and flux)

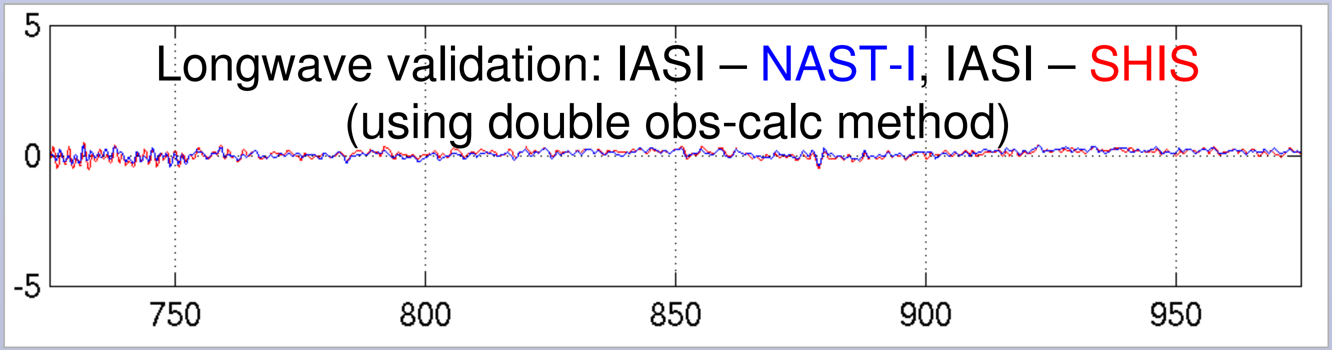
Aircraft Coordination: ?

Desired Satellite Coordination:

- A-Train: AIRS, TES

IASI T_b Spectrum: Processed to represent S-HIS & NAST-I, AIRS & CrIS





AMPR (Advanced Microwave Precip Radiometer)

Robbie Hood, NASA MSFC; Frank LaFontaine, Raytheon, Huntsville, AL

Science Goals:

- Quick-looks of 4 frequencies of calibrated brightness temperatures in raster format
- Real-time display of calibrated temperatures in RTMM (possible) - provides near real-time precipitation reports from ER-2
- Archived brightness temperature and AMPR precipitation index (API)
- Archived browse images of calibrated brightness temperatures and API in both raster and geo-located formats

Aircraft Coordination:

Coordination on precipitation:

Useful to have a AMSR-E overpass

SSFR (Solar Spectral Flux Radiometer) + DC-8

Peter Pilewskie, Sebastian Schmidt, CU; Warren Gore, NASA Ames

Science Goals:

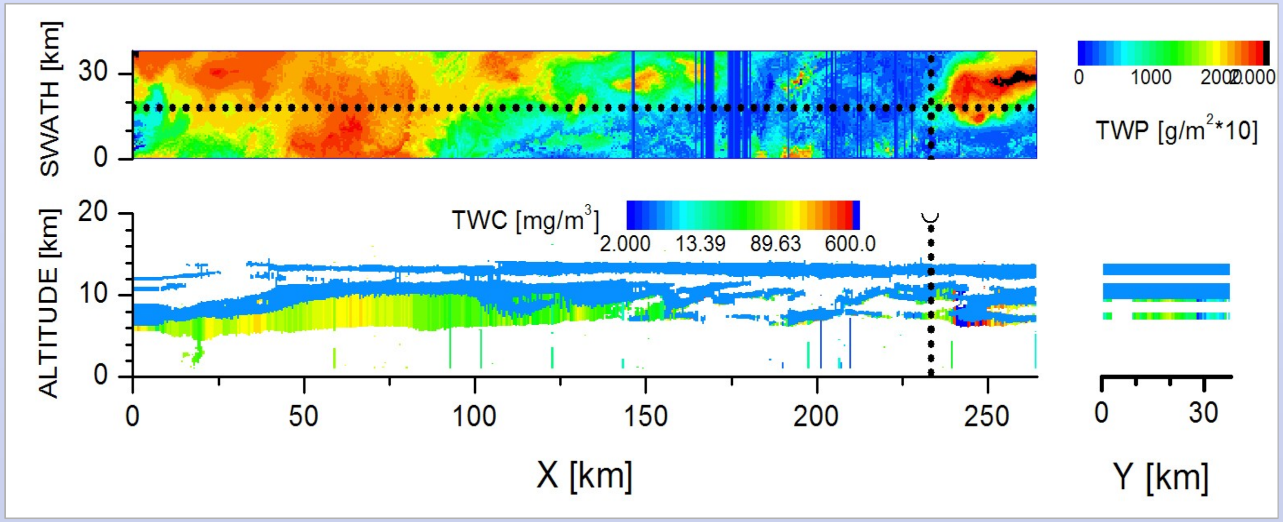
- Characterize radiation fields/budgets (cloud and cloud-free)
- Retrievals of cloud water phase, crystal/droplet radius effective radius, optical depth, and liquid water path.
- Test/validation/comparison with satellite/simulator cloud retrievals (MAS and MODIS) and in situ microphysical measurements.
- 3-D cloud radiation/cloud generator simulations. Examine 3-D influence on retrieved parameters.
- Examine aerosol influence on retrieved parameters.
- Characterize land/sea surface spectral albedo.

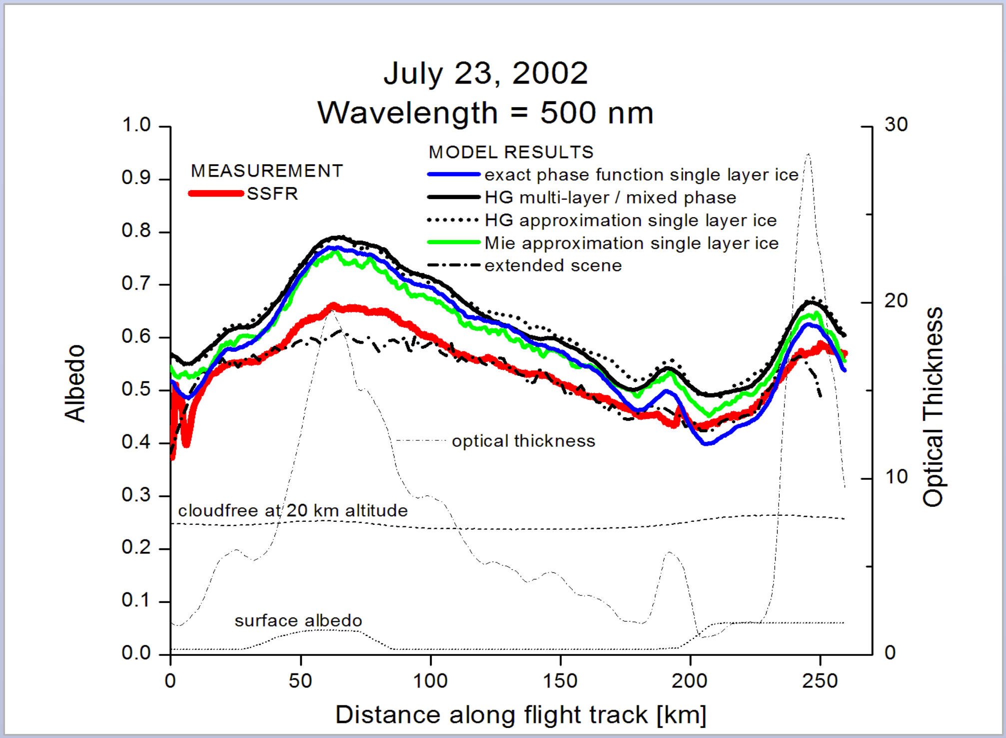
Aircraft Coordination:

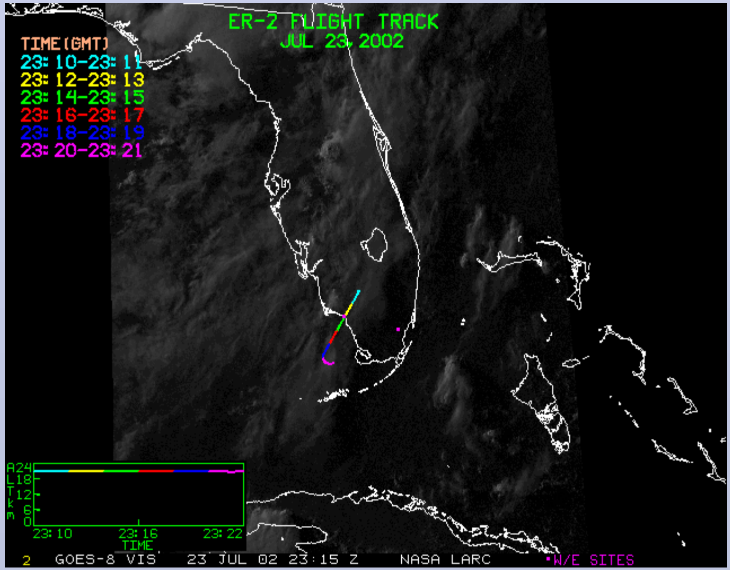
- Budget: ER-2 (above layer) / DC-8 (below) along same straight leg
- Retrievals: ER-2 or DC-8 above cloud layer
- 3D clouds/RTM: preferably additional in situ microphysical measurements from WB-57 (straight leg within cloud near cloud top; full cloud vertical profile)
- Surface spectral albedo: prefer “low” legs with DC-8, CLOUDY and CLEAR conditions (if we ever get them)

Under all circumstances, prefer to have a MODIS overpass while flying!

Result from CRYSTAL-FACE – thin cloud case







BBIRR (Broadband IR Radiometer) + DC-8

Anthony Bucholtz, Elizabeth Reid, NRL, Monterey, CA

Science Goals:

- Cirrus evolution
- Aerosol effects in the region (Saharan dust), utilize NRL Aerosol Model, Satellite Aerosol AOT
- Role of IR absorption on lifting and persistence of thin, subvisible, tropical cirrus

Aircraft Coordination:

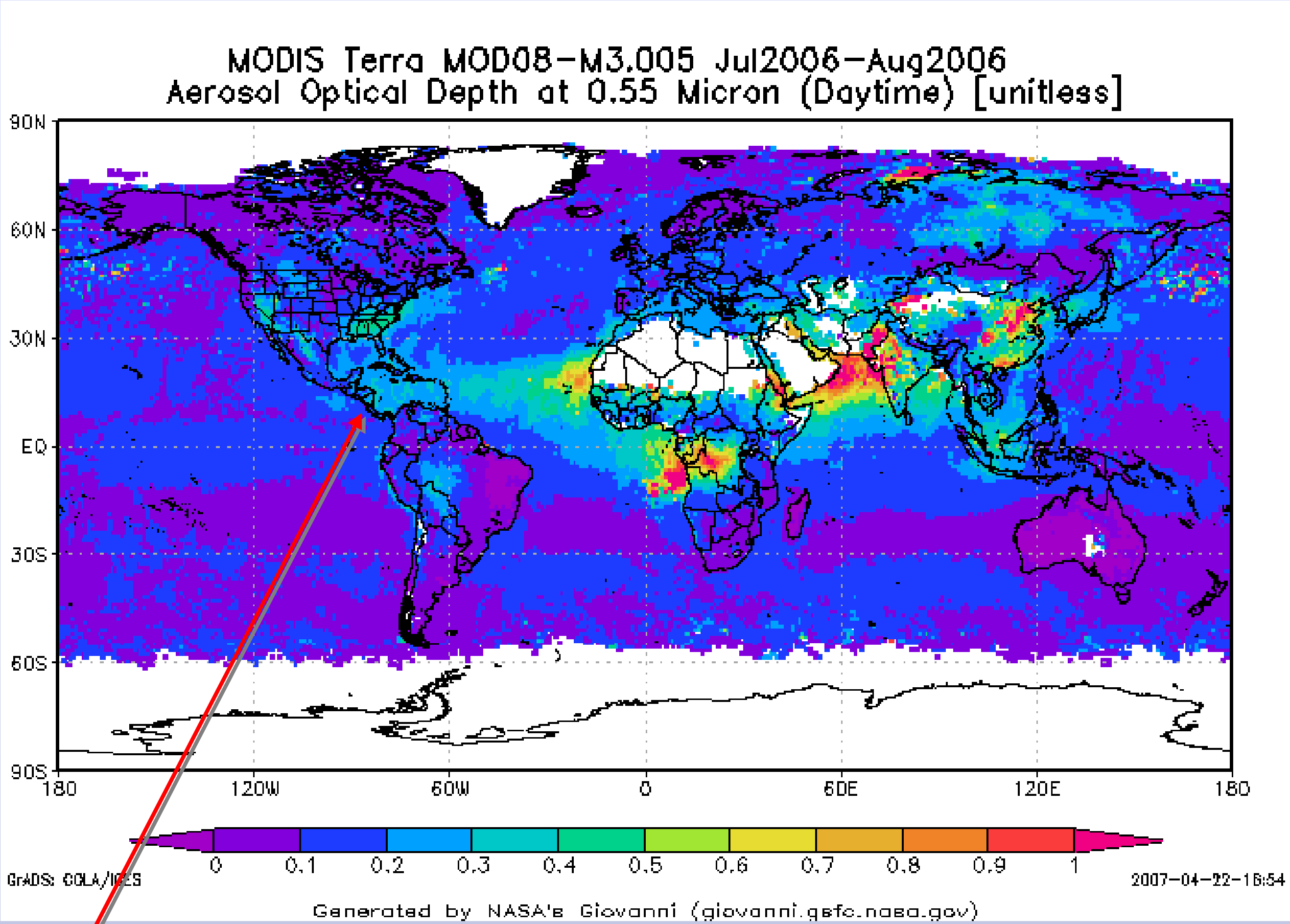
- ER-2: measured irradiances above cloud
- DC-8: measured irradiances below cloud
- WB-57: measured in situ microphysical cloud properties

Desired Satellite Coordination:

- Terra and/or Aqua for CERES val

Collaborations:

- SSFR, CPL, MAS, CERES, MODIS, MISR, in-situ μphys



Gradient in CA, real and/or sampling issue?

CoSSIR (Compact Scanning Submillimeter-wave Imaging Radiometer)

J. Wang, B. Monosmith, NASA GSFC; F. Evans, CU

Science Goals:

1. Measure ice cloud properties (ice water path and particle size)
2. Measure water vapor profiles in clear sky and cirrus
3. Further develop and *evaluate* the submillimeter ice cloud remote sensing technique, including developing a method to derive particle shape/orientation information from polarization.

Aircraft Coordination:

- WB-57 and DC-8 underflights of ER-2 in geometrically thin, homogeneous cirrus anvils (for goal 1).

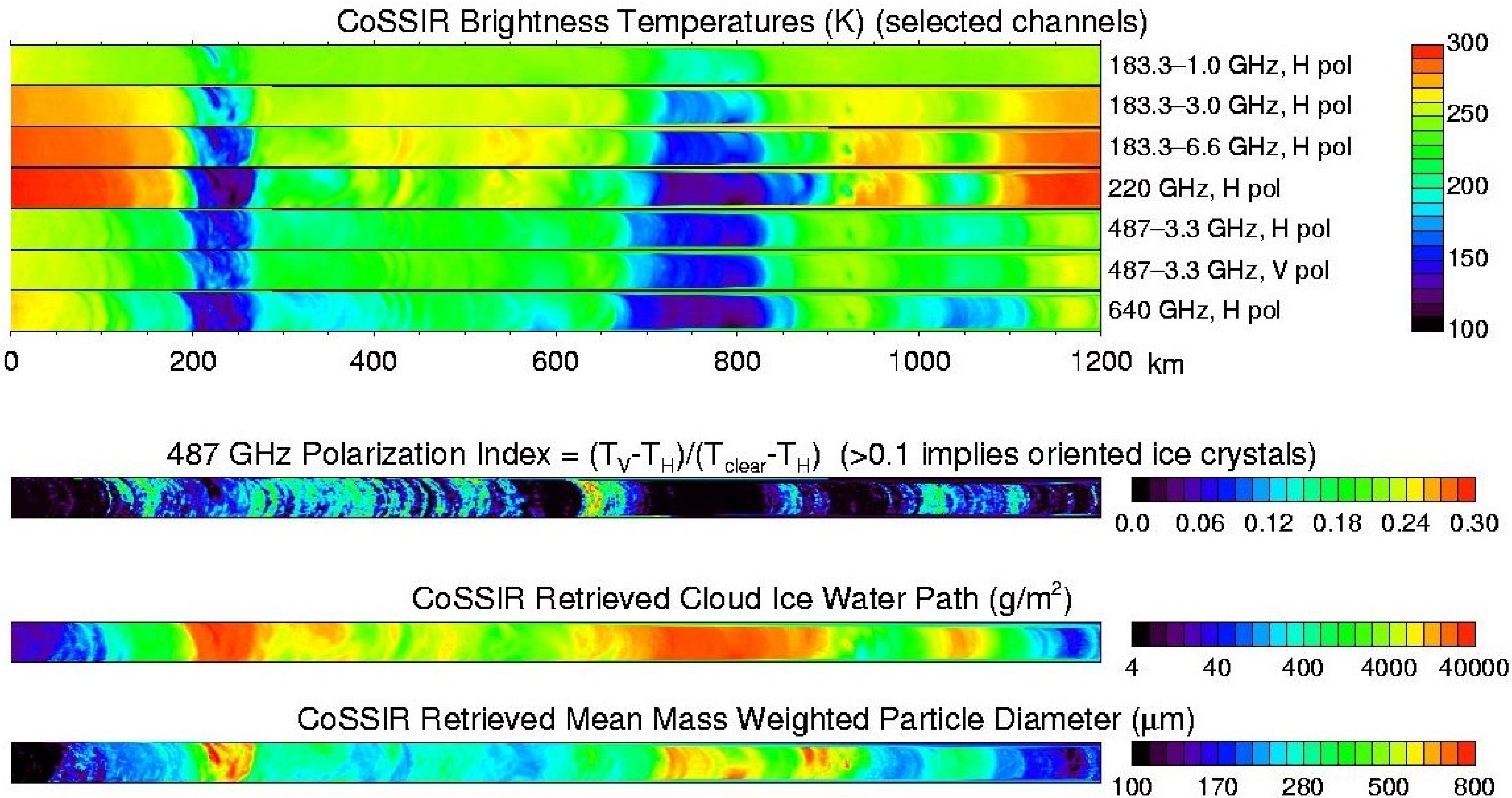
Desired Satellite Coordination:

- Evaluate CloudSat ice water content retrieval algorithms with the CoSSIR IWP retrievals using the CRS to simulate the CloudSat radar.

  Underflights of CloudSat would be useful, but are not required.
- Compare CoSSIR clear sky water vapor profiles with MLS products.

Compact Scanning Submillimeter-wave Imaging Radiometer

Results from CR-AVE (January 27, 2006)



EDOP (ER-2 Doppler Radar) & CRS (Cloud Radar System)

Gerry Heymsfield, NASA GSFC; Lihua Li, Lin Tian, UMBC GEST

Science Goals:

• Evolution of of convective systems in varied shear environments and through all stages of development (growth, mature, dissipating)

-Initial emphasis on convective tower vertical motions and hydrometeor structure with repeated passes over tower with short legs.Transition to microphysics of anvil structure using dual-frequency radar and lidar algorithms using longer legs covering full extent of anvil.

• ER-2-based retrievals of cirrus properties using new approaches: dual-wavelength radar (CRS-EDOP), radar-radiometer (CRS-CosSir), cloud radar-lidar (CRS-CLS), and radar-vis/NIR (CRS-MAS) (collaborative effort). [variety of cloud types]

•Statistics on vertical motions in intense convection

• CloudSat validation **1B CPR and 2B Geoprof Products.** Straight/level flight legs covering variety of cloud types. Desire deep convection and tropical storms w/CloudSat overpasses to examine multiple scattering in CloudSat data.

Other Aircraft Coordination:

• WB-57/DC-8 underflights of ER- for providing critical in situ and radar (APR-2, DC-8) measurements. Dropsondes in convective environment (DC-8).

Desired Satellite Coordination:

• A-Train

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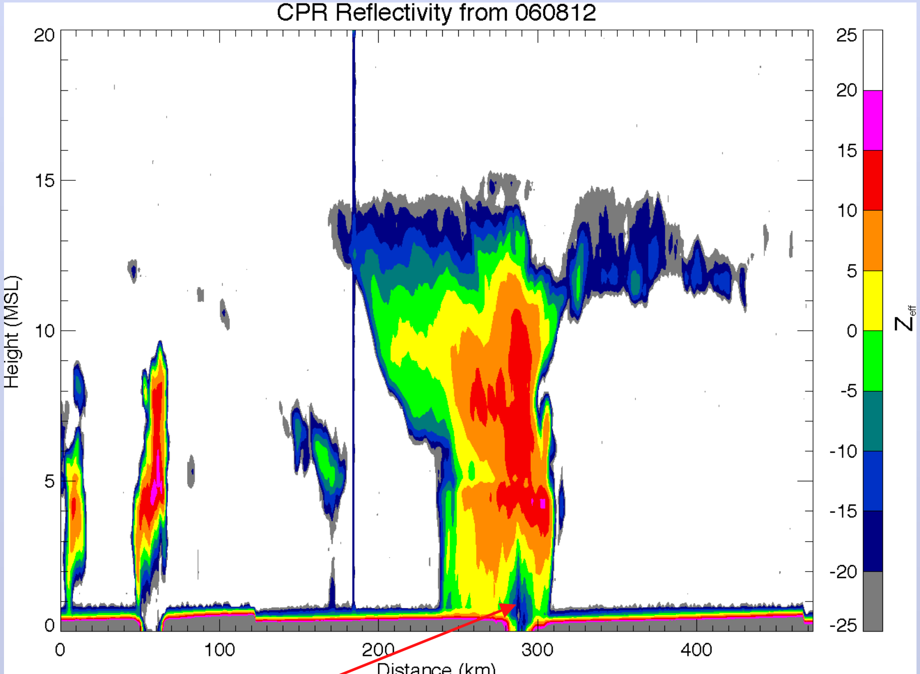
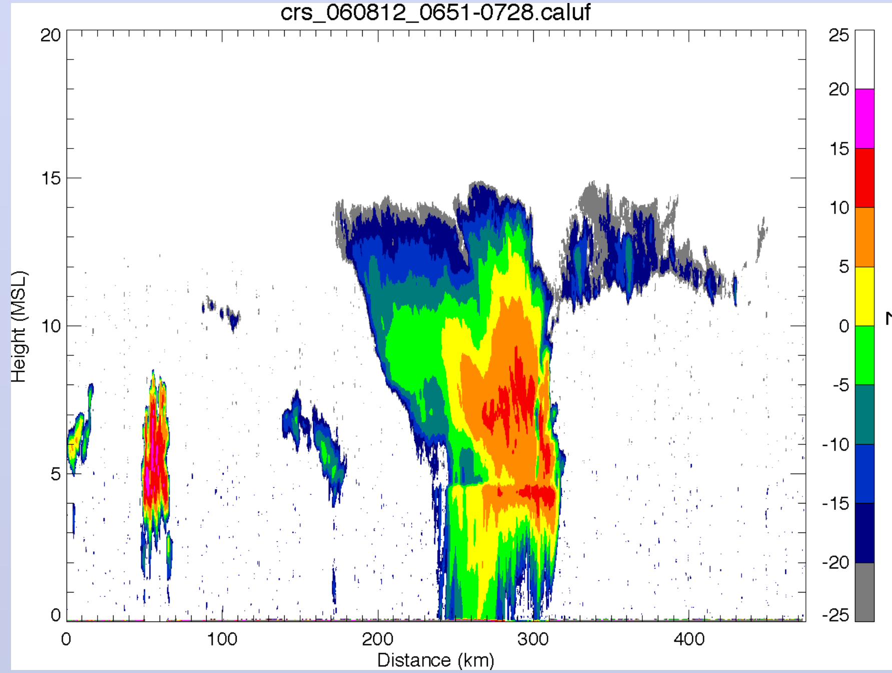
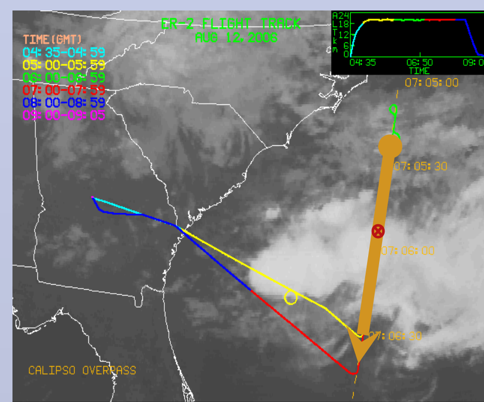




Multiple scattering effects?



Nighttime
Deep convection and cirrus over water

CPL (Cloud Physics Lidar)

Matt McGill, Dennis Hlavka, William Hart NASA GSFC

Science Goals:

- A primary goal for CPL is CALIPSO/A-Train validation.
- Profiling cirrus, especially in conjunction with CRS and coordinated with the WB-57 in situ instruments, is an important goal for the instrument team.

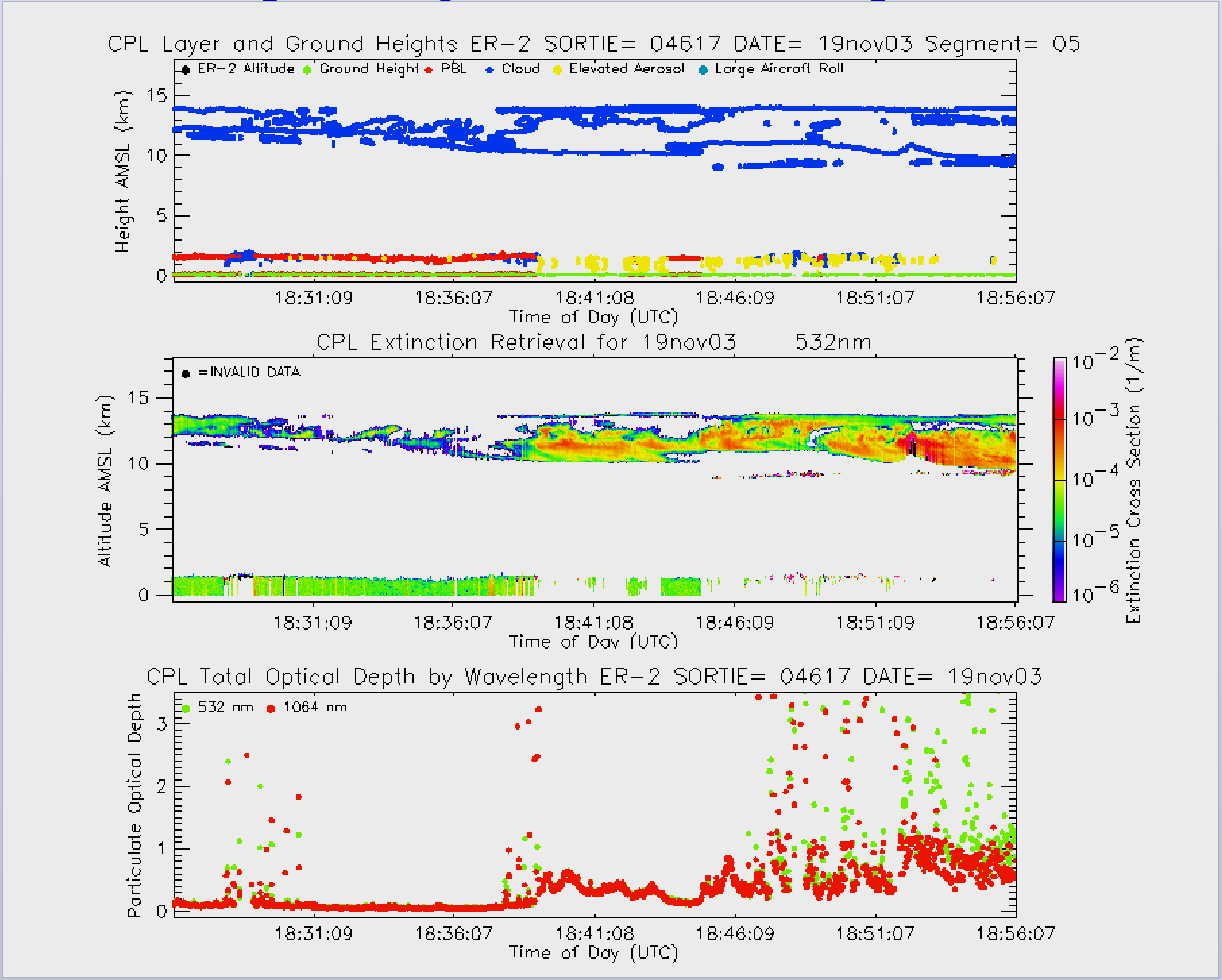
Aircraft Coordination:

- ER-2/WB-57 coordination for in situ particle information.

Desired Satellite Coordination:

- A-Train: CALIPSO, day or night

Example of higher level CPL data products



Summary: ER-2 & Satellites

- ER-2 Underflights of A-Train? No consensus interest.
  - MODIS: daytime underflight(s) w/similar track orientation as Aqua. With DC-8 in situ cloud microphysics (and WB-57 if feasible, e.g., delayed TO and low risk forecast)
  - CloudSat, CALIPSO: One day or night underflight is desirable (not a priority or focus)
  - Flight Track: line up on CloudSat/CALIPSO track (~215 km east of satellite ground track), MODIS daytime; use an overpass close to San Jose
- Terra
  - MODIS interest in having ER-2 underpasses, and DC-8 and WB-57 cloud microphysics profiling at time of overpass
  - Ought to be easily adapted into routine science plans

Summary: ER-2 & Satellites

- IASI (MetOp), 2000 km swath, 0930 LT
  - S-HIS: would like MetOp satellite tracks to be added to mission flight planning tools, no expected impact on routine science plans

Extras

Payload

Inst.	Spectral	Spatial	Products
CPL	532, 1064 nm backscatter lidar	nadir only, 30 m vert., 200 m horiz.	Cloud/aerosol and layer information (top/base altitudes, extinction)
CRS	94 GHz	Nadir	Radar refl., Doppler velocities, cloud layer water content
EDOP	X-band	Nadir	Radar refl., Doppler velocities, precipitation
MAS	VIS/NIR/SWIR/IR grating spectr., 50 ch.	cross-track scanner, 37 km swath, 50 m .	Cloud prop., ice and water (cloud top, optical thickness, effective particle size, WP)
SHIS	IR Hyperspectral, 3.3-18 μm	cross-track scanner, 40 km swath, 2 km resolution	Temperature/ moisture profiles, cirrus cloud properties (top pressure, optical thickness, effective particle size, IWP)
CoSSIR	183 – 874 GHz, 15 channels	conical scanner (53° fwd and aft), 45 km swath	IWP, ice cloud median mass particle diameter
AMPR	V/H ch.: 10.7 GHZ, 19.4 GHz (window), 37 GHz (H_2O), 89 GHz (window)	cross-track scanner, 40 km swath, 0.6-2.8 km resolution	Precipitation Index, Brightness Temperature imagery
SSFR	VIS–SWIR, 10 nm resolution	Zenith and nadir	Solar spectral fluxes and layer heating rate (w/SSFR on DC-8), ice cloud optical/microphysical properties
BB IR	4.5 – 42 μm	Zenith and nadir	IR radiative fluxes and layer heating rate (w/similar instr. on DC-8)