CAR Measurements for Chesapeake Lighthouse and Aircraft Measurements for satellite (CLAMS) Experiment

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On behalf: Cloud Retrieval Group

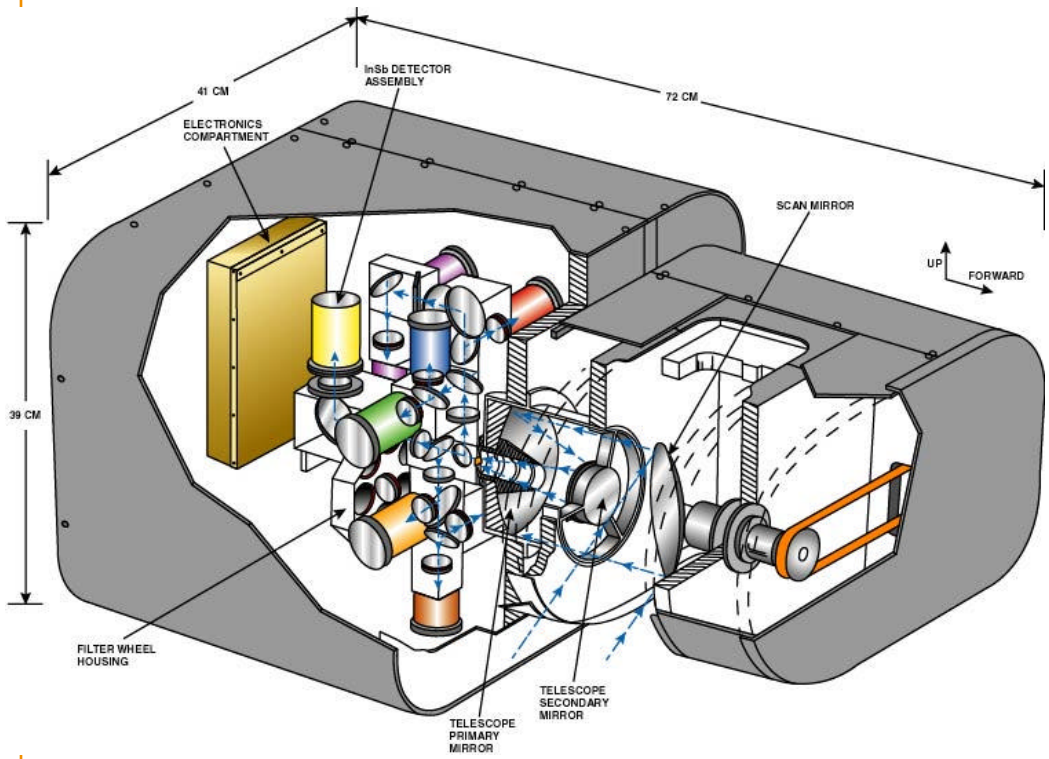
Outline

- **Overview of the Cloud Absorption Radiometer (CAR)**
- **Summary of CAR Measurements for CLAMS**
- **Conclusion and acknowledgments**

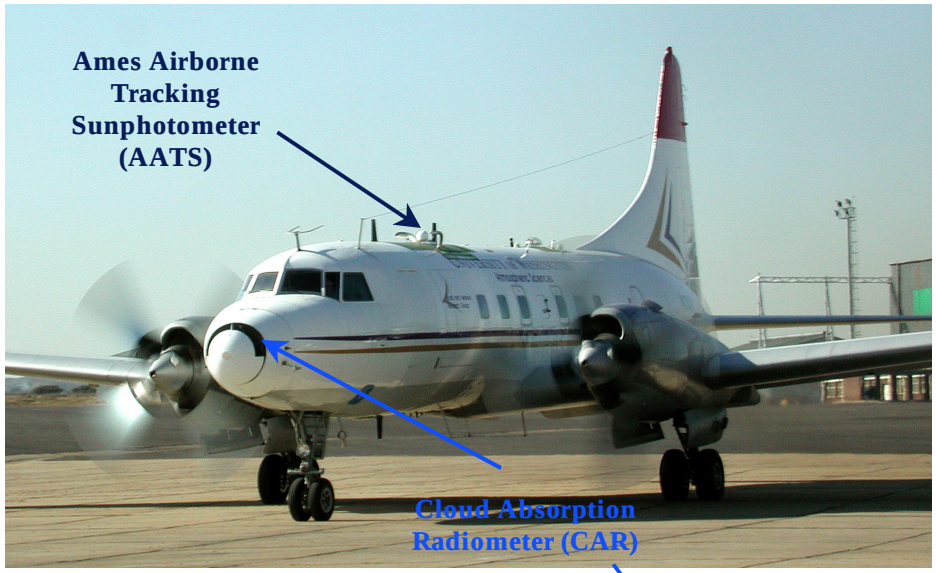
Cloud Absorption Radiometer

- **Sensor Characteristics**
  - **14 spectral bands ranging from 0.34 to 2.29 µm**
  - **scan ±95° from horizon on right-hand side of aircraft**
  - **field of view 17.5 mrad (1°)**
  - **scan rate 1.67 Hz (100 rpm)**
  - **data system 9 channels @ 16 bit**
  - **395 pixels in scan line**
  - **3% reflectance calibration accuracy**

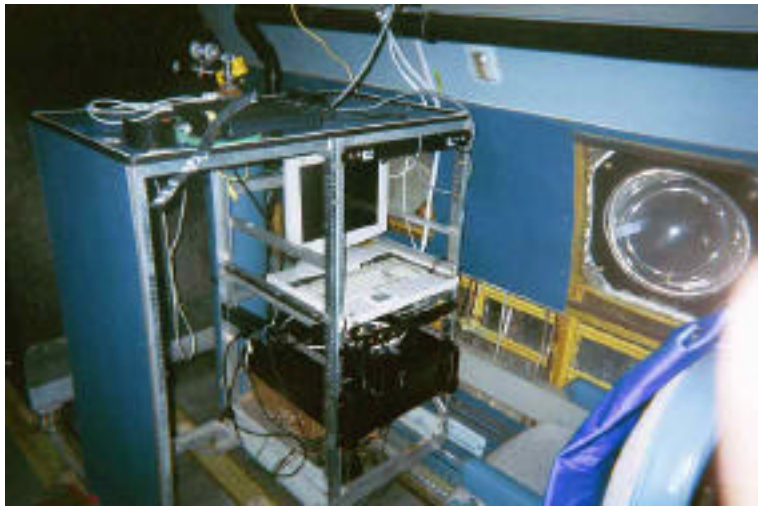
- **integrated & flown on University of Washington Convair CV-580**

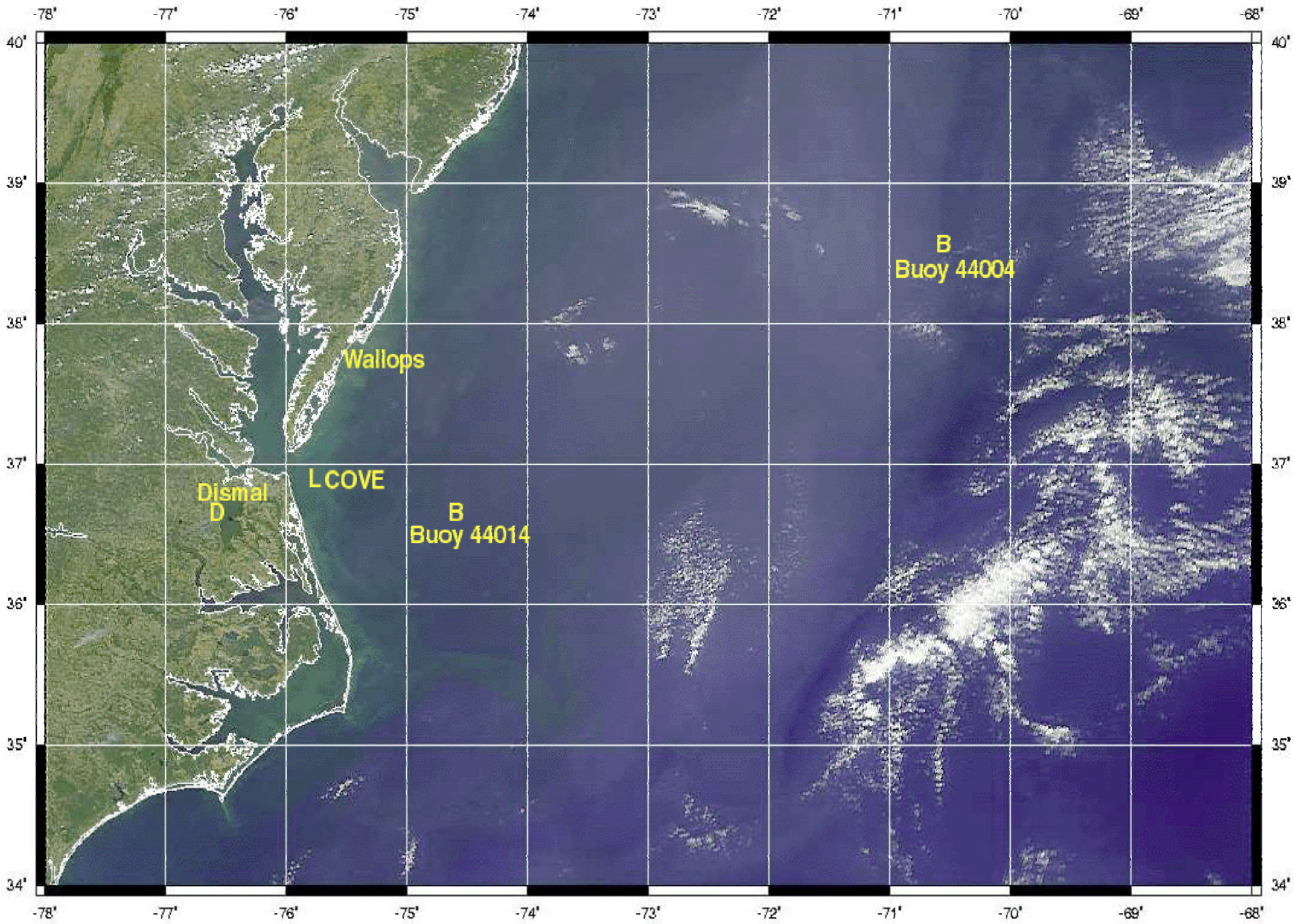


CAR Setup in the University of Washington CV-580



CAR Interface inside of the CV-580




-78'
-77'
-76'
-75'
-74'
-73'
-72'
-71'
-70'
-69'
-68'
40'
39'
38'
37'
36'
35'
34'
B
Buoy 44004
Wallops
L COVE
Dismal
D
B
Buoy 44014

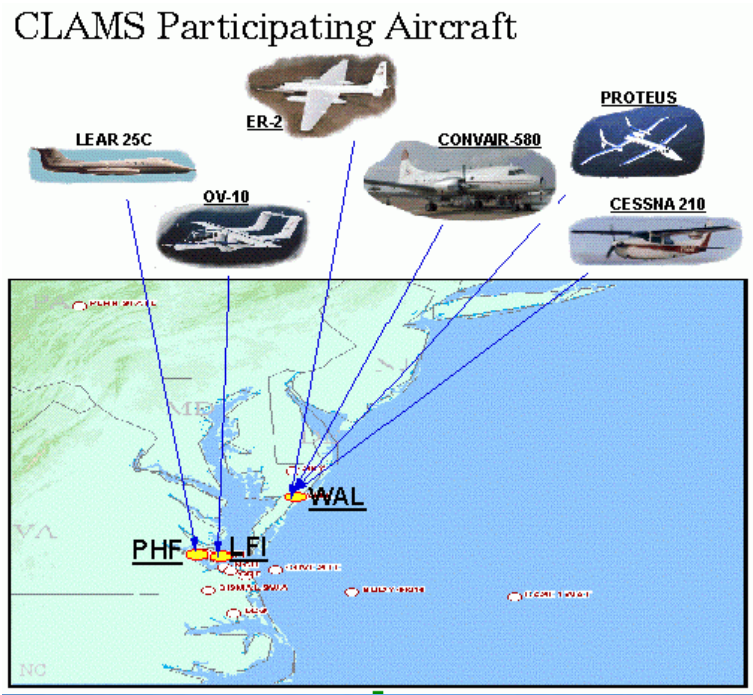
July 2001

Sun	Mon	Tue	Wed	Thu	Fri	Sat
01	02	03	04	05	06	07
08	09 ER-2	10 Cessna CV-580 🟢 OV-10 Proteus	11 Cessna	12 CV-580 🔴 ER-2 OV-10 Proteus	13 Cessna ER-2	14 Cessna CV-580 🔴 OV-10 Proteus (2x)
15 ER-2	16 Cessna CV-580 🔴	17 Cessna CV-580 🟢🔴 ER-2 OV-10 Proteus Lear Jet	18	19	20 ER-2	21 ER-2 Proteus
22	23 CV-580 🟢	24	25 Proteus Lear Jet	26 CV-580 🟢 OV-10 Proteus	27	28 Proteus
29	30 CV-580 🔴🔴🟢 ER-2 OV-10	31 CV-580 🟢 ER-2 OV-10 Lear Jet				

August 2001

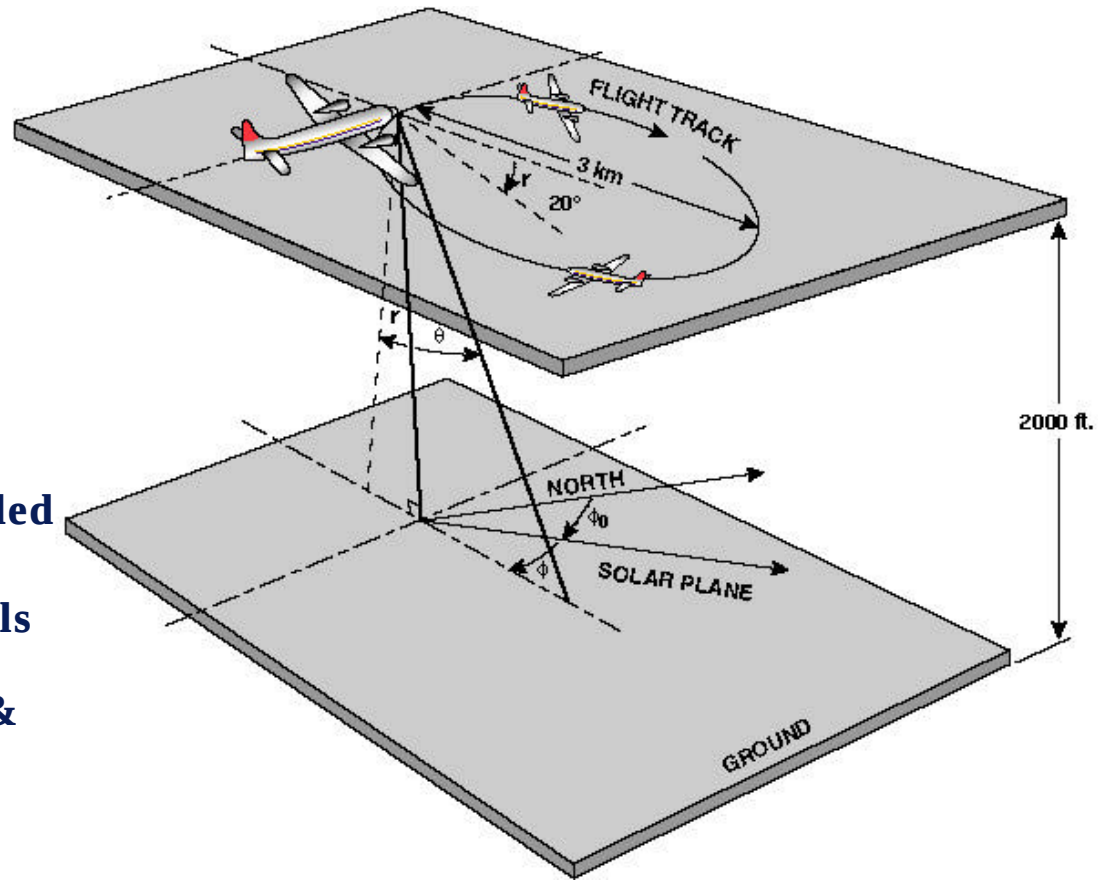
			01 ER-2 OV-10	02 CV-580 🟢 ER-2 OV-10	03	

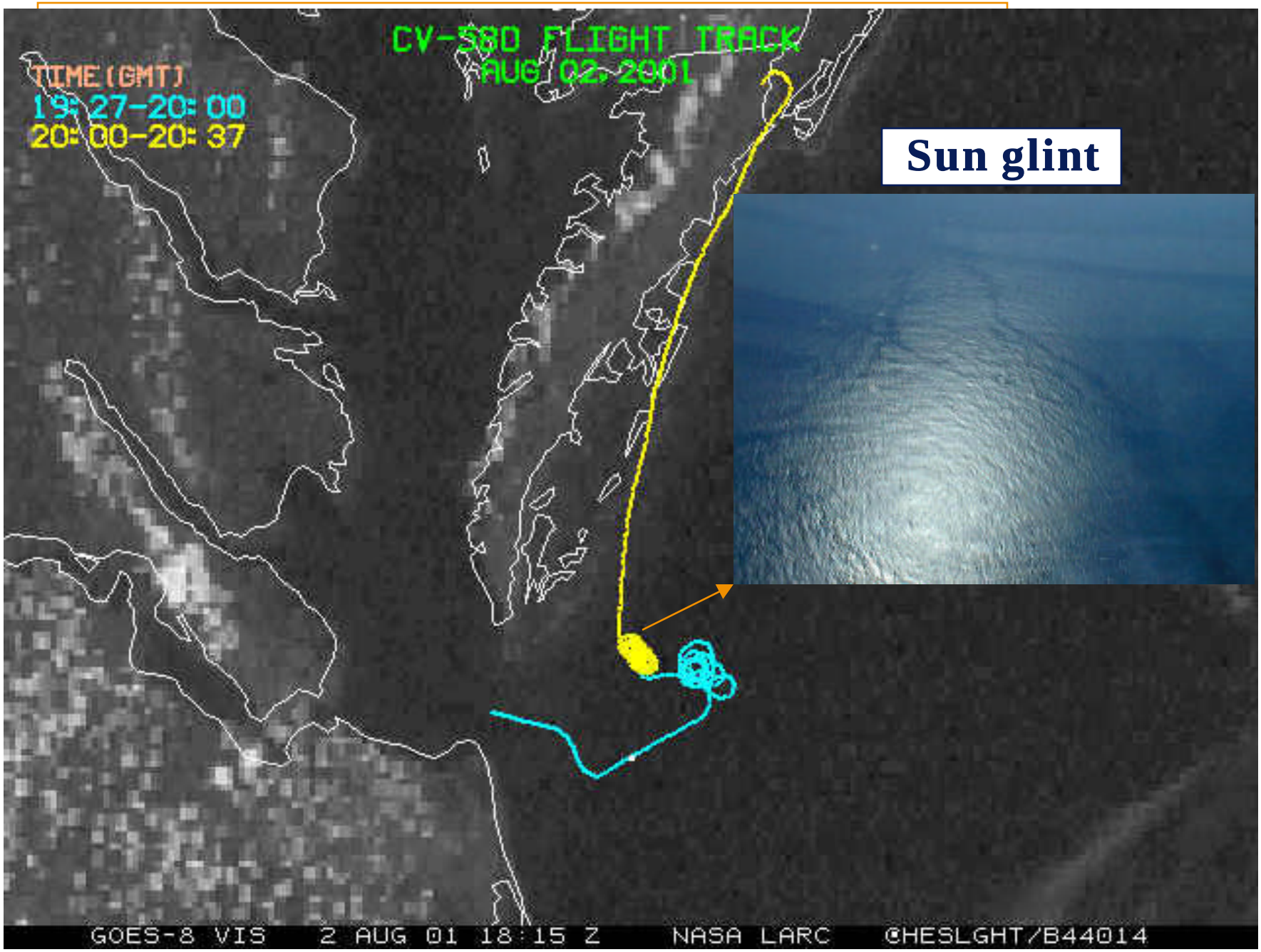
Key: 🟢 Good brdf measurements 🔴 Brdf cloud contaminated



Bidirectional Reflectance Measurements

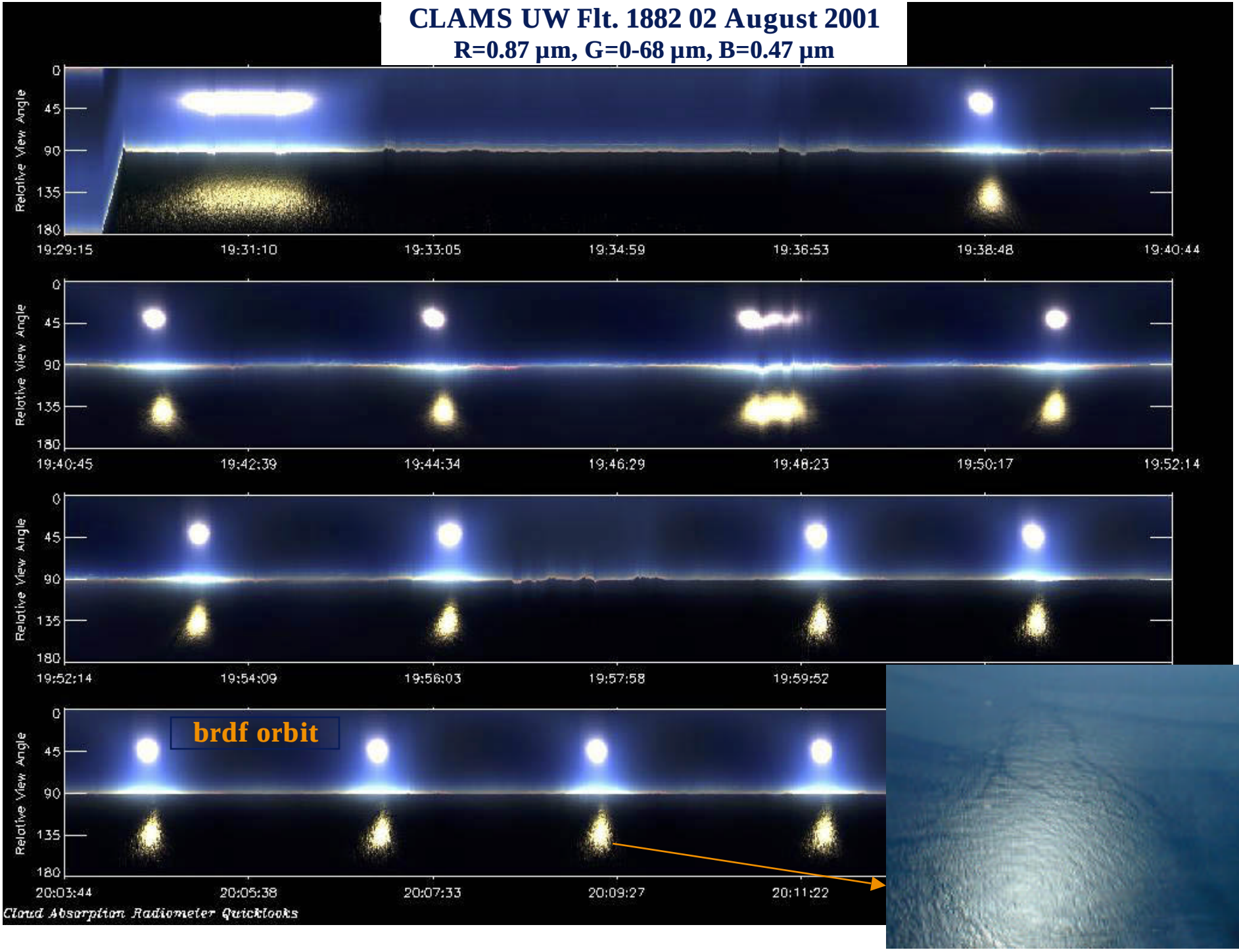
- Roll: ~20°
- Time: ~2 min
- Speed: ~80 m s^{-1}
- Height: ~30(600) m
- Diameter: ~3 km
- Resolution
  - 10 m (nadir)
  - 270 m (θ = 80°)
- Channels
  - 8 continuously sampled (0.34-1.27 µm)
  - 2 filter wheel channels used for BRDF measurements (1.66 & 2.20 µm)



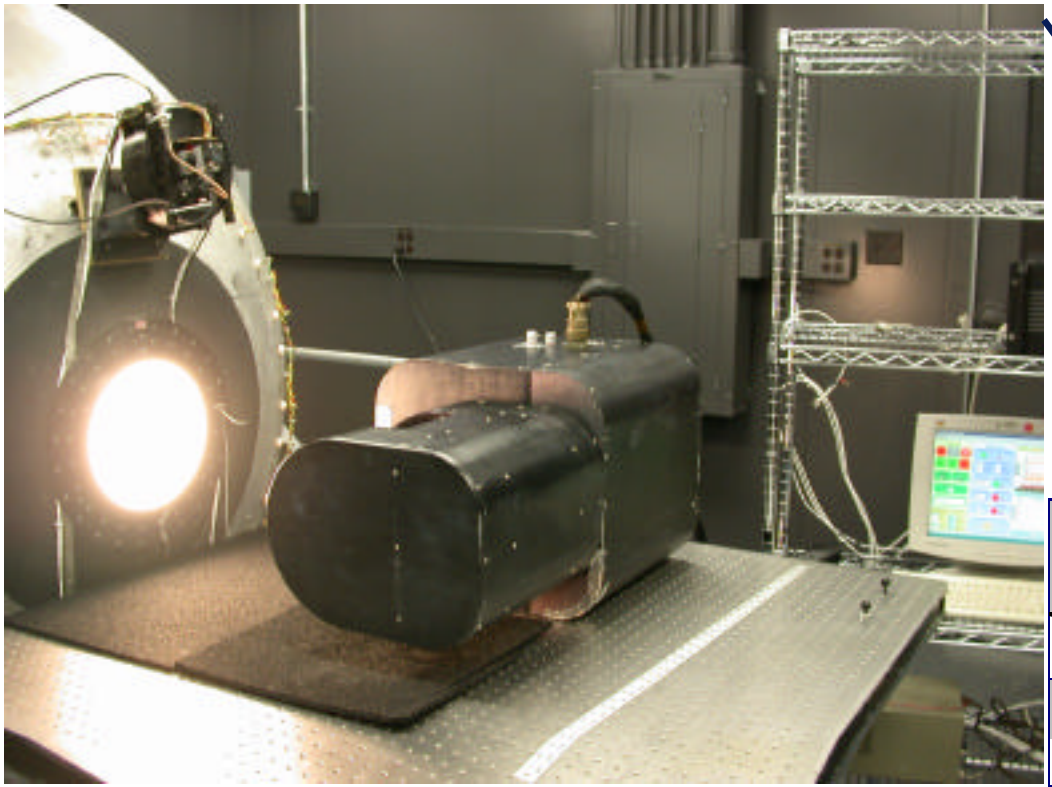

CV-580 FLIGHT TRACK
AUG 02, 2001
TIME (GMT)
19:27-20:00
20:00-20:37
Sun glint
GOES-8 VIS 2 AUG 01 18:15 Z NASA LARC ©HESLGHT/B44014

CLAMS UW Flt. 1882 02 August 2001

R=0.87 µm, G=0-68 µm, B=0.47 µm



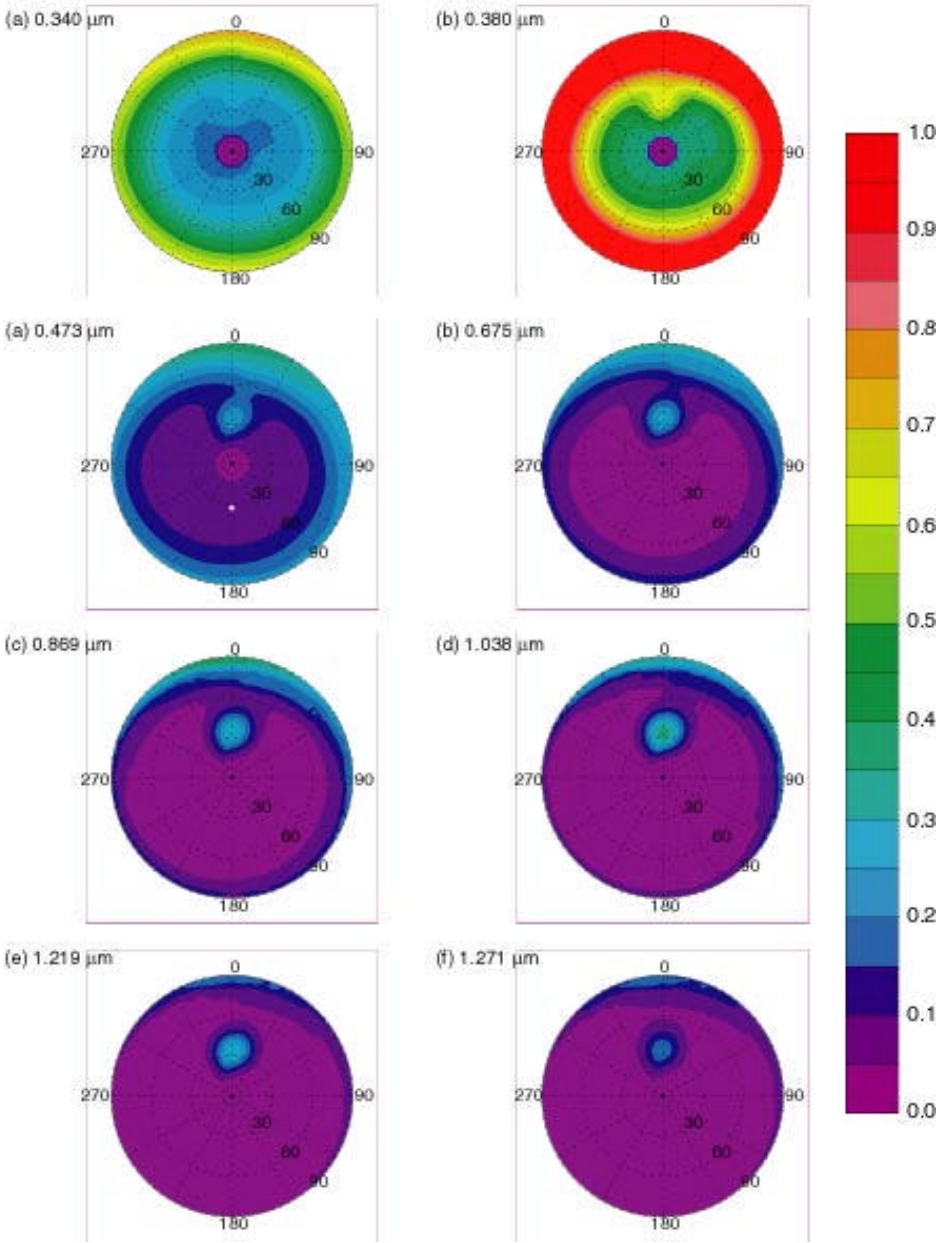
Radiometric Calibration



Results

Ch # (λ µm)	Pre-CLAMS [W/(m^2.sr.µm)] per count)	Post-CLAMS [W/(m^2.sr.µm)] per count)
Ch 1 (0.34)	pending	pending
Ch 2 (0.38)	pending	pending
Ch 3 (0.47)	0.0070	0.0069
Ch 4 (0.68)	0.0128	0.0140
Ch 5 (0.87)	0.0066	0.0066
Ch 6 (1.04)	0.0169	0.0176
Ch 7 (1.22)	0.0097	0.0097
Ch 8 (1.27)	0.0077	0.0077
Ch 9 (1.56)	0.0113	?
Ch 10 (1.66)	0.0075	?
Ch 11 (1.74)	0.0067	?
Ch 12 (2.10)	0.0041	?
Ch 13 (2.20)	0.0066	?
Ch 14 (2.30)	0.0089	?

July 10, 2001



λ (µm)	Band-width (µm)	Solar flux (W m^{-2} µm^{-1})	Solar zenith angle	Albedo	Nadir reflectance
0.472	0.021	2053.1	32.70° - 35.30°	0.102 ± 0.013	0. 055 ± 0.006
0.675	0.020	1444.0	32.70° - 35.30°	0.053 ± 0.007	0.022 ± 0.006
0.869	0.022	946.40	32.70° - 35.30°	0.041 ± 0.006	0.015 ± 0.006
1.038	0.020	675.70	32.70° - 35.30°	0.035 ± 0.004	0.012 ± 0.007
1.219	0.020	479.91	32.70° - 35.30°	0.024 ± 0.002	0.009 ± 0.006
1.271	0.021	426.03	32.70° - 35.30°	0.019 ± 0.001	0.009± 0.005

Recap!!

- **Number of flights flown during CLAMS were 10 (~40 hours)**
  - » **Measurements of coastal, offshore and deep ocean brdf were made (15 total; 8 uncontaminated by cloud) under a variety of sun angles and wind conditions for MODIS, CERES and MISR**

- **Calibration:**
  - » **Radiometric calibration is complete; looks good for most channels,**
  - » **Angular sensitivity measurements complete; signal drop discovered for the large CAR view angles; further investigations planned**
  - » **Level 1b processing in progress**
- **CLAMS data useful for validation of satellite-based retrievals**

Acknowledgments

- **Persons:**
  - **Dr. Michael King**
  - **Colleagues: Thomas Arnold, Paul Hubanks, and Jason Li**
  - **Peter Shu and team**
  - **Prof. Peter Hobbs and team**
  - **The CLAMS team - Bill Smith Jnr.**
- **Institutions:**
  - **NASA's EOS Project**
  - **GEST Center/UMBC**
  - **University of Washington, Seattle**

More information !!

http://car.gsfc.nasa.gov/data_clams