CLOUD AND AEROSOL RESEARCH GROUP

Summary of Flights and Types of Data Collected Aboard the University of Washington's Convair-580 Research Aircraft in the CLAMS Field Study on the United States East Coast From 10 July Through 2 August 2001

Compiled
by
Peter V. Hobbs

November 2001

(The participation of the University of Washington in CLAMS was supported by NASA.)

FOREWORD

The Chesapeake Lighthouse and Aircraft Measurements for Satellites (CLAMS) field study was carried out off the Delmarva Peninsula, on the east coast of the United States, from 10 July through 2 August 2001. This report will serve as a guide to the measurements obtained aboard the University of Washington's (UW) Convair-580 research aircraft in CLAMS.

Contained herein are listings of the various types of measurements obtained on the research flights of UW Convair-580 in CLAMS, and their relationships to simultaneous measurements from satellites (particularly Terra), other CLAMS aircraft, and ground-based measurements. Summaries of the main accomplishments of each flight, provided by scientists aboard the Convair-580, are also given.

This report does not contain any of the large number of measurements obtained aboard the Convair-580. These will be available in due course through the CLAMS data archive.

This report is available at the ftp address:

ftp://cargsun2.atmos.washington.edu/clams_report/CLAMS-MASTER.pdf

Corrections and updates to this report will be posted at:

http://cargsun2.atmos.washington.edu/sys/research/clams/

Peter V. Hobbs
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1. CLAMS AND ITS OBJECTIVES

The principal goal of the Chesapeake Lighthouse and Aircraft Measurements for Satellites (CLAMS) field study was the validation of NASA EOS-Terra data products. More specifically, CLAMS was designed to obtain airborne measurements to validate products derived from remote sensing measurements from the Clouds and the Earth's Radiant Energy System (CERES), the MODerate-resolution Imaging Spectroradiometer (MODIS), and the Multi-angle Imaging SpectroRadiometer (MISR), all of which are aboard the Terra satellite.

The University of Washington's (UW) Convair-580 was one of several aircraft that flew in support of CLAMS.*

2. LOCATION OF STUDY

The field control site for CLAMS, and the base of operation for the Convair-580, was the NASA Wallops Flight Facility, Virginia. The main targets for the research flights were the Chesapeake Bay Lighthouse (36˚54.0' N/75˚42.6' W), buoy 44014 (36˚35.0' N/74˚50.2' W), "case 1 water" (36˚30.0' N/73˚00.0' W), buoy 41001 (34˚40.80' N/72˚13.80' W), buoy 44009 (38˚27.8' N/74˚42.12' W), buoy 44004 (38˚30.2' N/70˚28.3' W), and the Great Dismal Swamp (36˚36.1' N/76˚28.2' W)—see Figure 2.1.

* The other aircraft were the ER-2, OV-10, Proteus, Cesna-210 and Lear-25C.

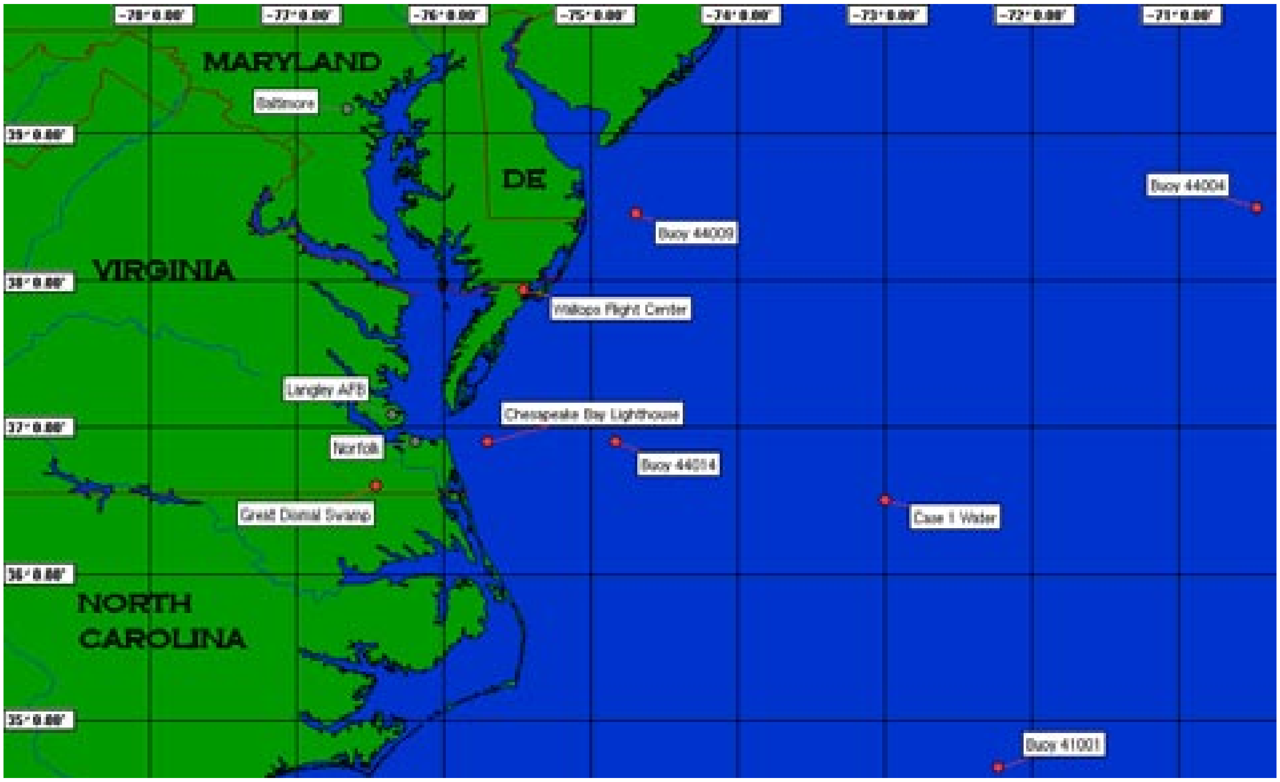

Figure 2.1. Main targets (in red) for the CLAMS research flights.

3. INSTRUMENTS ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 RESEARCH AIRCRAFT IN CLAMS

The instruments aboard the UW Convair-580 research aircraft for the CLAMS field study are listed in Table 3.1. In addition to the large number of instruments for which the UW was responsible, there were three guest instruments aboard.

4. CONVAIR-580 FLIGHTS AND FLIGHT TRACKS IN CLAMS

Table 4.1 lists the dates, times, principal locations, and main measurements obtained for each of the Convair-580 flights in CLAMS. Figures 4.1-4.11 show the aircraft flight tracks. (Note: UW flight number 1876 was cancelled before take-off and UW flight number 1877 was terminated before any data was collected. Therefore, flight tracks are not shown for these two cases.)

5. OVERVIEW OF DATA COLLECTED ABOARD THE CONVAIR-580 RESEARCH AIRCRAFT IN CLAMS

Thirteen UW-numbered flights[†], totaling 45 research flight hours, were flown by the UW Convair-580 research aircraft in CLAMS during the period July 10 through August 2, 2001. Table 5.1 gives an overview of some of the main accomplishments of these flights (see also Table 4.1).

[†] Two of the numbered flights (UW 1876 and 1877) did not produce any data (see Table 4.1).

TABLE 3.1. INSTRUMENTATION ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN CLAMS

(a) Navigational and Flight Characteristics

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
Latitude and longitude	Global Positioning System (GPS)	Trimble TANS/Vector	Global (~2-5 m)	tans-lat (deg) tans-lon (deg)
True airspeed	Variable capacitance	Rosemount Model F2VL 781A	0 to 250 m s^{-1} (<0.2%)	tasknt (kts)
True airspeed	Air computer	Shadin	0 to 250 m s^{-1} (<0.2%)	shadin_tas
Heading	From TANS/Vector	Trimble TANS/Vector	0 to 360° (± 1°)	tans-azimth (0 deg is true north)
Altitude	Global Positioning System (GPS)	Trimble TANS/Vector	0-9 km (±15-25 ft)	tans-altft (msl, ft)
Altitude above terrain	Radar altimeter	Bendix Model ALA 51A	Up to 0.75 km	ralt (agl, ft)
Pitch	Differential GPS	Trimble TANS/Vector	0 to 360° (±0.15°)	Tans-pitch (nose up positive)
Roll	Differential GPS	Trimble TANS/Vector	0 to 360° (±0.15°)	Tans-roll (right wing down negative)
Radar reflectivity	3 cm wavelength (pilot's radar)	Bendix/King (now Allied Signal)	250 km	(Not recorded)

(b) General Meteorological

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
Pressure	Variable capacitance	Rosemount Model 830 BA	1100 to 150 mb (<0.2%)	pstat
Pressure altitude	Computed from pstat assuming standard atmosphere	—	0-9 km (Error depends on atmospheric conditions.)	palt (ft)
Total air temperature	Reverse-flow	In-house	-60 to 40°C	ttotr (°C)
Static air temperature	Calculated from Rosemount total temperature	Rosemount Model 102CY2CG and 414 L Bridge	-60 to 40°C	tstat (°C)
Static air temperature	Reverse-flow thermometer	In-house	-60 to 40°C (<0.5°C)	tstatr (°C)
Dew point temperature	Cooled-mirror dew point	Cambridge System Model TH73-244	-40 to 40°C (<1°C)	dp (°C)
Absolute humidity	IR optical hygrometer	Ophir Corp. Model IR-2000	0 to 10 g m^{-3} (~5%)	rhovo = Ophir2k absolute humidity (g/m3). (Also, dp_o = Ophir dew point (degC). oairt = Ophir2k air temperature (degC). rh_o = Ophir2k relative humidity (%).)
Wind direction	Calculated from TANS/Vector and Shadin	Trimble	0-360° (0 deg is magnetic north).	wind_dir
Wind speed	Calculated from TANS/Vector and Shadin	Trimble	—	wind_spd (kts)
Video image	Forward-looking camera and time code	Ocean Systems Splash Cam	—	—

(Cont.)

TABLE 3.1 (continued)

(c) Aerosol

Parameter	Instrument Type	Manufacturer	Range	UW Computer Code
Number concentration of particles (continuous flow)	Condensation particle counter	TSI Model 3022A	0-10^7 cm^{-3} (d>0.003 μm)	cnc1 (/cc)
Number concentration of particles (continuous flow)	Condensation particle counter	TSI Model 3025A	0-10^5 cm^{-3} (d>0.003 μm)	cnc2 (/cc)
Size spectrum of particles	Differential Mobility Particle Sizing Spectrometer (DMPS)	TSI (modified in-house)	0.01 to 0.6 μm (21 channels)	dmpsdn = DMPS d(log D) spectrum (/cc).
Size spectrum of particles	35 to 120° light-scattering	Particle Measuring Systems Model PCASP-100X	0.12 to 3.0 μm (15 channels)	pcasprt = PCASP 100 total concentration (/cc). pcaspdn = PCASP 100 concentration spectrum (/cc).
Total particle concentration	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)	fsp3rt (/cc).
Size spectrum of particles	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)	fsp3dn = fsp300 d(log D) spectrum (/cc).
Aerodynamic size spectrum of particles and relative light scattering intensity	"Time-of-flight"	TSI Model 3320 APS	0.5-20 μm (52 channels)	tsirt = TSI 3320 (total concentration (/cc)).
Size spectrum of particles	Forward light-scattering	Particle Measuring Systems Model FSSP-100	2 to 47 μm (15 channels)	fsprt = fssp 100 total concentration (/cc). fspdn = fssp 100 particle concentration spectrum (/cc).
Light-scattering coefficient	Integrating 3-wavelength nephelometer with backscatter shutter	MS Electron 3W-02	1.0×10^{-7} m^{-1} to 1.0×10^{-3} m^{-1} for 550 (green) and 700 (red) nm channels. 2.0×10^{-7} m^{-1} to 1.0×10^{-3} m^{-1} for 450 nm channel (blue)	nepblu = total scatter blue (/m). nepgrn = total scatter green (/m). nepred = total scatter red (/m). bkspbl = backscatter blue (/m). bkspgr = backscatter green (/m). bksprd = backscatter red (/m).
Light-scattering coefficient (ambient and extinction cell)	Integrating nephelometer	CE	10^{-7} to 10^{-2} m^{-1} at 537 nm	cetspb (/m) cetspgr (/m) cetsprd (/m)
Light-scattering coefficient (for bag-house samples)	Integrating nephelometer	Radiance Research M903	1.0×10^{-6} to 2.0×10^{-4} m^{-1} or 1.0×10^{-6} m^{-1} to 1.0×10^{-3} m^{-1}	Neph bag (m^{-1})
Light absorption and graphitic carbon	Particle soot absorption photometer (PSAP)	Radiance Research	Absorption coefficient: 10^{-7} to 10^{-2} m^{-1}; Carbon: 0.1 μm m^{-3} to 10 mg m^{-3} (±5%)	rams (m^{-1})
Aerosol mass, elemental composition (Na to Pb), electron microscopy†	Nucleopore filters	University of Sao Paulo (V. Martins)	Mass >1 μg m^{-3} Elemental composition >1 ng m^{-3}	
Spectral reflectance of aerosol*	Aerosol spectroreflectometer	Univ. Sao Paulo/ NASA Goddard/ Analytical Spectral Devices (V. Martins)	Reflectance from 100-50%	

(Cont.)

* Guest instrument

TABLE 3.1 (continued)

(d) Cloud Physics

Parameter	Instrument Type	Manufacturer	Range	UW Computer Code
Liquid water content	Hot wire resistance	DMT	0 to 5 g m^{-3}	lwdmt = cloud liquid water content from DMT (g/m^3)
Liquid water content; effective droplet radius; particle surface area	Optical sensor	Gerber Scientific Ins. PVM-100A	LWC = 0.001-10 g m^{-3}	lwpvm = cloud liquid water from PVM (g/m^3). erpvm = PVM100A effective radius (μm). psapvm = PVM100A raw surface area (cm^2/m^3). sapvm = PVM100A surface area [corrected using fssp100 drop rate] (cm^2/m^3).
Total particle concentration	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)	fsp3rt (/cc). fsp3dn = fsp300 d(log D) spectrum (/cc).
Size spectrum cloud particles	Forward light-scattering	Particle Measuring Systems FSSP-100	2 to 47 μm (3 μm) (15 channels)	fsprt = fssp 100 total concentration (/cc). fspdn = fssp 100 particle concentration spectrum (/cc).

(e) Chemistry

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
SO_2	Pulsed fluorescence	Teco 43S (modified in-house)	0.1 to 200 ppb	so2 (ppb) = Teco 43S
O_3	UV absorption	TEI Model 49C	1-1000 ppbv (<0.5 ppbv)	o3 = Pressure corrected TEI49C ozone concentration (ppb). (o3tei = Raw TEI49C ozone concentration (ppb).)
CO	IR correlation spectrometer	Teco Model 48	0-50 ppb (~0.1 ppmv)	co (ppb) = Teco 48 (ppb)
CO_2	Infrared correlation spectrometer	Li-Cor Li-6262	0 to 300 ppmv (0.2 ppmv at 350 ppmv)	co2 (ppm) = Licor 6262
Total particulate mass and species $SO_4^{=}$, NO_3^-, Cl^-, Na^+, K^+, NH_4^+, Ca^{++}, Mg^{++}	37 Teflon filters, gravimetric analysis and ion exchange chromatography	Gelman Dionix (UW)	0.1 to 50 μg m^{-3} (for 500 liter air sample)	—
Carbonaceous particles (black and organic carbon)*	Quartz filters (Thermal Evolution Techniques)	T. Novakov and T. Kirchstetter (LBNL)	4-160 μg m^{-3} (±1.6 μg m^{-3}) for 1 m^3 sample	—

(Cont.)

* Guest instrument

TABLE 3.1 (continued)

(f) Radiation				
Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
UV hemispheric radiation, one upward, one downward	Diffuser, filter photo-cell (0.295 to 0.390 μm)	Eppley Lab. Inc. Model TUVR	0 to 70 W m-2 (±3 W m-2)	uvup = uv upward looking (W m-2) uvdn = uv downward looking (W m-2)
VIS-NIR hemispheric radiation (one downward and one upward viewing)	Eppley thermopile (0.3 to 3 μm)	Eppley Lab. Inc. Model PSP	0 to 1400 W m-2 (±10 W m-2)	pyrup = vis-nir upward looking (W m-2) pyrdn = vis-nir downward looking (W m-2)
Surface radiative temperature	IR radiometer 1.5˚ FOV (8 to 14 μm)	Omega Engineering OS3701	-50˚ to 1000˚C ±0.8% or reading	irtemp (degC) = surface temp. (˚C)
Absorption and scattering of solar radiation by clouds and aerosols; BRDF and albedo of surfaces	Fourteen wavelength all-directions scanning radiometer	NASA-Goddard/ University of Washington	14 discrete wavelengths between 340 and 2300 nm	—
Aerosol optical depth, water vapor, and ozone*	14-channel Sun-tracking photometer (AATS-14)	NASA Ames (J. Redemann)	14 discrete wavelengths, 350-1558 nm	—

* Guest instrument

TABLE 4.1. OVERVIEW OF UNIVERSITY OF WASHINGTON'S CONVAIR-580 RESEARCH FLIGHTS IN CLAMS

Date (2001)	University of Washington Flight Number	Period of Flight (UTC)*	Principal Locations†	Main Accomplishments	Other CLAMS Aircraft Flying	Satellite Overpass	Comments (For more details see section 6)
10 July	1870	1725-2220	Near Chesapeake Bay lighthouse	• BRDF near lighthouse. • Vertical profile over lighthouse. Full sets of measurements (filters, etc.) at 10,000 and 4,000 ft. • BRDF off southern tip of Delmarva Peninsula.	OV-10 (1815-1920 UTC) Proteus (Madison-1900 UTC?)	—	1) Generally clear, but with cirrus and altocumulus increasing toward end of flight. 2) Chang in coloration of ocean across area of second set of BRDF measurements. 3) Vertical profile could be used for "closure studies."
12 July	1871	1102-1640	Near Chesapeake Bay lighthouse	4) BRDF near lighthouse (patchy cirrus). 5) Vertical profile over lighthouse. 6) Passes at 100 ft beneath hole in cirrus near 38°20.71' N/ 74°16.25' W during Terra overpass at 1554 UTC.	ER-2 (1315-1751 UTC) OV-10 (1205-1420 UTC) Proteus (1133-1639 UTC)	Terra overpass at 1554 UTC	1) Postfrontal. 2) AOD low. 3) Cirrus and altocumulus present.

(Cont.)

* Local time = UTC – 4 hours.
† See Figures 4.1-4.11 for flight tracks.

TABLE 4.1 (continued)

Date (2001)	University of Washington Flight Number	Period of Flight (UTC)*	Principal Locations[†]	Main Accomplishments	Other CLAMS Aircraft Flying	Satellite Overpass	Comments (For more details see section 6)
14 July	1872	1433-1749	Near Chesapeake Bay lighthouse	1) Profile to 10,000 ft on transit to lighthouse. 2) Passes at 100 ft over lighthouse during Terra overpass at 1542 UTC. 3) BRDF near lighthouse. 4) Calibration of state parameter measurements against Wallops sonde.	OV-10 (1555-1750 UTC) Proteus (1415-1850 UTC) Cessna-210 (1345-1730)	Terra overpass at 1542 UTC.	1) Increasing cumulus clouds as flight progressed. 2) Low AOD.
16 July	1873	1630-1947	Near Chesapeake Bay lighthouse and buoys 44014 and 41001.	1) Passes at 100 ft between lighthouse and buoy 44014. 2) BRDF measurements at 35˚58.6' N/73˚59.68' W. 3) Profile to 10,000 ft at same location as BRDF measurements.	Proteus (1620-1933 UTC) Cessna-210 (1344-1708)	AVHRR overpass at 1908 UTC.	1) Flight in support of CIRES/ AVHRR retrivals. 2) Extensive cirrus cloud present. 3) Some filters for chemistry (not height resolved).

(Cont.)

* Local time = UTC – 4 hours.
[†] See Figures 4.1-4.11 for flight tracks.

TABLE 4.1 (continued)

Date (2001)	University of Washington Flight Number	Period of Flight (UTC)*	Principal Locations†	Main Accomplishments	Other CLAMS Aircraft Flying	Satellite Overpass	Comments (For more details see section 6)
17 July	1874	1228-1816	1) Near Chesapeake Bay lighthouse. 2) Great Dismal Swamp.	1) Profile to 11,000 ft over lighthouse. Full measurement set (filters, etc.) at 9,000 ft, 6,000 ft and 3,000 ft. 2) Passes at 100 ft over lighthouse during Terra overpass at 1614 UTC. 3) BRDF measurements near lighthouse. 4) BRDF measurements over Great Dismal Swamp.	ER-2 (1300-1701 UTC) OV-10 (1623-1812 UTC) Proteus (1431-1832 UTC) Cessna-210 (1330-1800 UTC) Lear-25C (1500-1800 UTC)	Terra overpass at 1614 UTC.	1) "Golden Day" for comparison of airborne measurements with MODIS-Air-MISR and MISR. 2) Essentially cloud-free. 3) Moderate AOD.
23 July	1875	1351-1646	About 70 miles east of Wallops Flight Center.	1) Passes at 100 ft in cloud-free region during Terra overpass at 1535 UTC. 2) BRDF measurements near same location. 3) Profile to 10,000 ft (good water vapor profile).	OV-10 (1517-1641 UTC)	Terra overpass at 1535 UTC.	Low AOD.

(Cont.)

* Local time = UTC – 4 hours.
† See Figures 4.1-4.11 for flight tracks.

TABLE 4.1 (continued)

Date (2001)	University of Washington Flight Number	Period of Flight (UTC)*	Principal Locations[†]	Main Accomplishments	Other CLAMS Aircraft Flying	Satellite Overpass	Comments (For more details see section 6)
25 July	1876	1439-1448	—	—	None		1) CLAMS Control aborted Convair-580 flight on runway due to cancellation of ER-2 flight.
26 July	1877	1145-1243	—	—	See below.	—	1) Flight terminated before collecting any data due to failure of on-board computer.
26 July	1878	1528-1909	1) Chesapeake Bay lighthouse. 2) Buoy 44014.	1) Passes at 100 ft between lighthouse and buoy 44014 with clear sky above beneath Terra overpass at 1607 UTC. 2) Slow climb to 10,000 ft then descent over buoy 44014. 3) BRDF measurements over buoy 44014. 4) AOD from 100 ft. 5) Full aerosol characterization (with filters, etc.) at 2,200 ft.	OV-10 (1316-1504 UTC and 1622-1830 UTC) Proteus (1357-1719 UTC)	Terra satellite overpass at 1607 UTC.	1) Overcast to west, but generally clear east of lighthouse. 2) Measurements should be good for comparisons with MISR and CERES.

(Cont.)

* Local time = UTC – 4 hours.
[†] See Figures 4.1-4.11 for flight tracks.

TABLE 4.1 (continued)

Date (2001)	University of Washington Flight Number	Period of Flight (UTC)*	Principal Locations†	Main Accomplishments	Other CLAMS Aircraft Flying	Satellite Overpass	Comments (For more details see section 6)
30 July	1879	1609-1951	1) Chesapeake lighthouse. 2) Buoy 44014	1) Pass beneath ER-2 at 100 ft in best cloud-free areas available between lighthouse and buoy 44014. 2) BRDF measurements under partly cloudy skies near lighthouse, near buoy 44014 and off southern tip of Delmarva Peninsula.	ER-2 (1628-1948) OV-10 (1420-1640 UTC) Proteus (1756-1915 UTC)		1) Cloudy. Air clean after frontal passage and heavy rain on previous day. 2) Terra overpass was prior to CV-580 flight.
31 July	1880	1424-2004	1) Buoy 44004 (dark water). 2) From buoy 44004 to Great Dismal Swamp via Chesapeake Bay lighthouse.	1) Passes at 100 ft in nearly cloudless skies at buoy 44004 during Terra and ER-2 overpasses. 2) BRDF measurements in almost cloud-free conditions near buoy 44004. 3) Profile to 10,000 ft over buoy 44004. 4) Transit from buoy 44004 to Great Dismal Swamp with sun-photometer and in situ aerosol measurements en route. 5) BRDF measurements over Great Dismal Swamp in nearly cloud-free conditions.	ER-2 (1259-1857 UTC) OV-10 (1607-1806 UTC and 1922-2039 UTC) Lear-25C (1520-1807 UTC)	Terra overpass at 1624 UTC.	1) Nearly cloudless skies. 2) Low AOD. 3) Measurements should be good for comparisons with MODIS and MISR or Terra satellite and/or ER-2, and for comparison with CERES BRDF of dark water with 10 ft waves.

(Cont.)

* Local time = UTC – 4 hours.
† See Figures 4.1-4.11 for flight tracks.

TABLE 4.1 (continued)

Date (2001)	University of Washington Flight Number	Period of Flight (UTC)*	Principal Locations[†]	Main Accomplishments	Other CLAMS Aircraft Flying	Satellite Overpass	Comments (For more details see section 6)
2 Aug.	1881	1521-1859 (1st flight of day)	1) Chesapeake Bay lighthouse. 2) Buoy 44014. 3) About 60 miles east of Wallops Flight Center.	1) In-flight intercomparison of measurements with OV-10 aircraft. 2) Passes at 100 ft near lighthouse under clear sky during Terra overpass at 1612 UTC. 3) Slow climb to 10,000 ft near Chesapeake Bay lighthouse, followed by fast descent. 4) Full set of measurements (filters, etc.) at 2,900 ft and 1,400 ft.	ER-2 (1459-Dryden) OV-10 (1530-1743 UTC and 1957-2140 UTC) Lear-25C (1520-1807 UTC)	Terra satellite overpass at 1612 UTC.	Clear above lighthouse. Cirrus and altocumulus to east and cumulus forming to west.
2 Aug.	1882	1914-2042 (2nd flight of day)	Chesapeake Bay lighthouse.	1) Profile to 10,000 ft NE of lighthouse followed by rapid descent in best cloud-free area. 2) BRDF measurements at low sun angle NE of lighthouse.	None.	—	Isolated cirrus in SE quadrant. Distant cumulus overland.

* Local time = UTC – 4 hours.
[†] See Figures 4.1-4.11 for flight tracks.

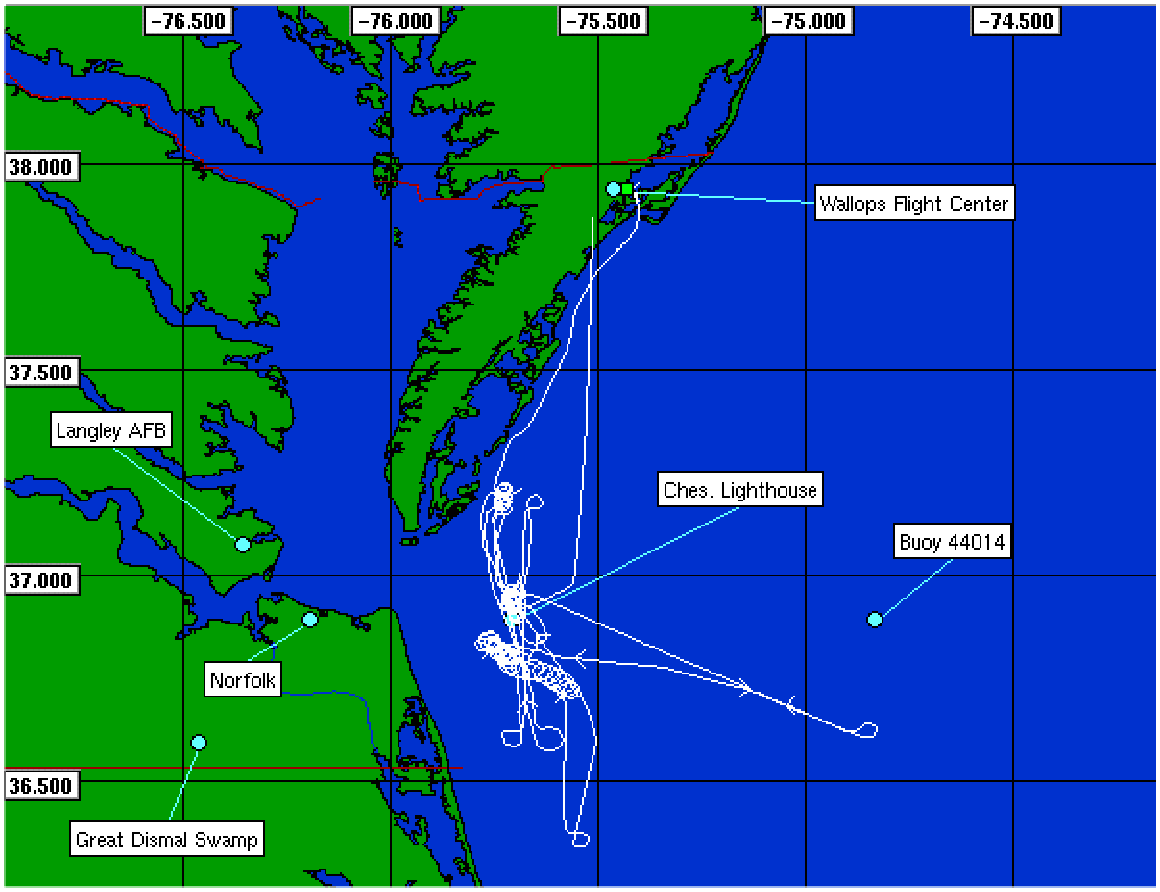

Figure 4.1. Flight track (white line) of the Convair-580 in CLAMS from 17:25 to 22:20 UTC on July 10, 2001 (UW flight 1870).

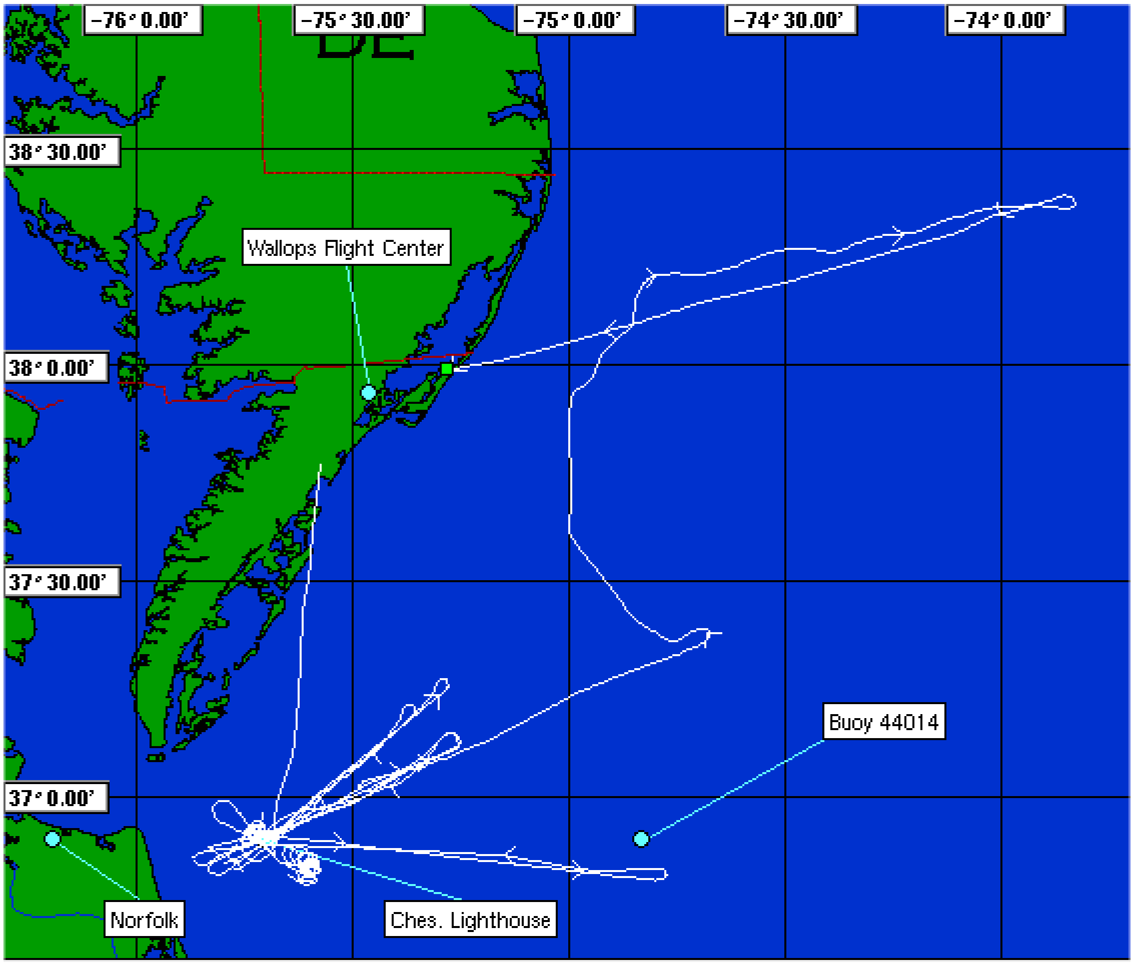

Figure 4.2. Flight track (white line) of the Convair-580 in CLAMS from 11:02 to 16:40 UTC on July 12, 2001 (UW flight 1871).

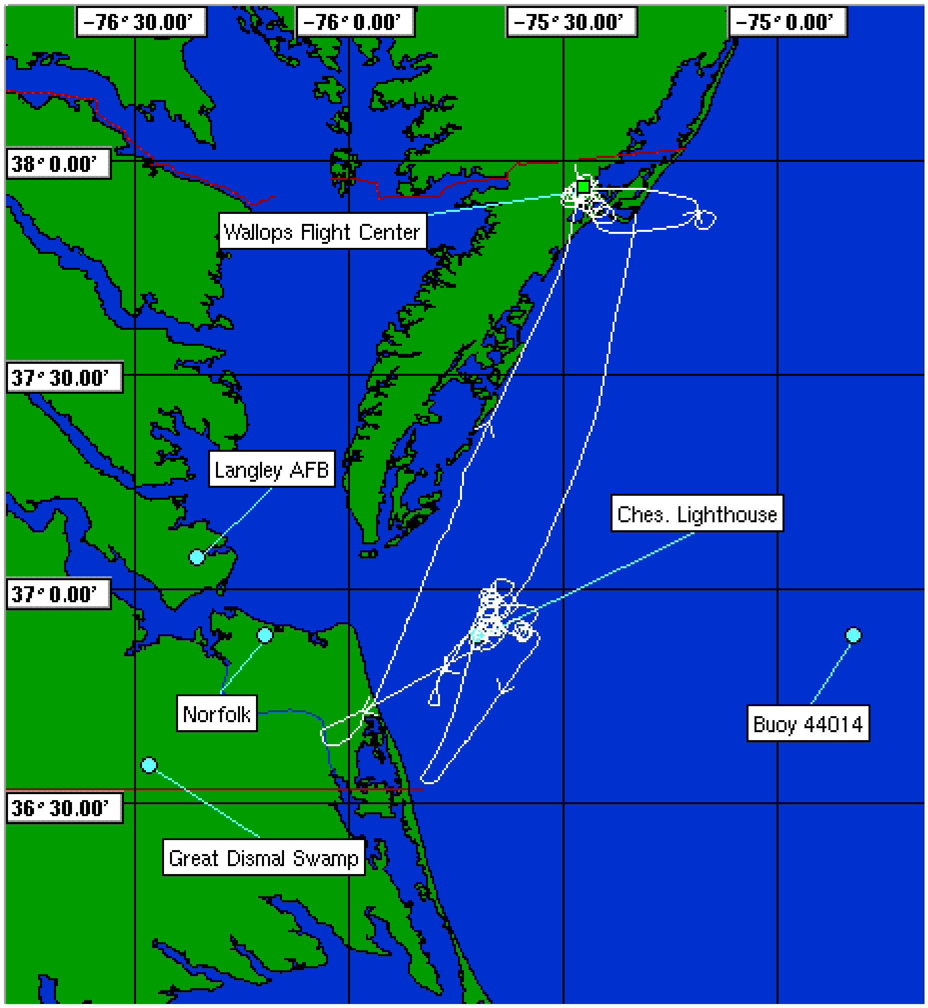

Figure 4.3. Flight track (white line) of the Convair-580 in CLAMS from 14:33 to 17:49 UTC on July 14, 2001 (UW flight 1872).

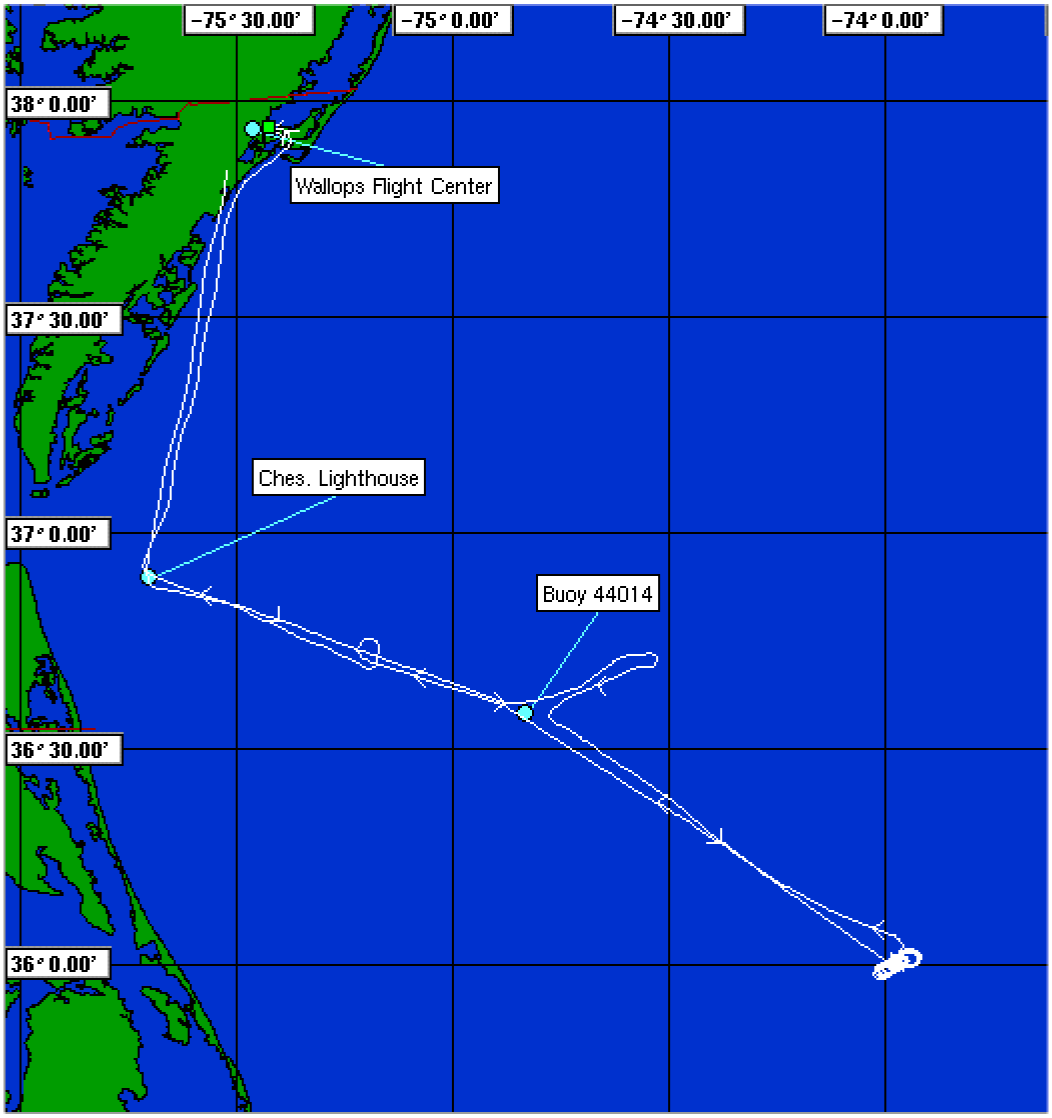

Figure 4.4. Flight track (white line) of the Convair-580 in CLAMS from 16:30 to 19:47 UTC on July 16, 2001 (UW flight 1873).

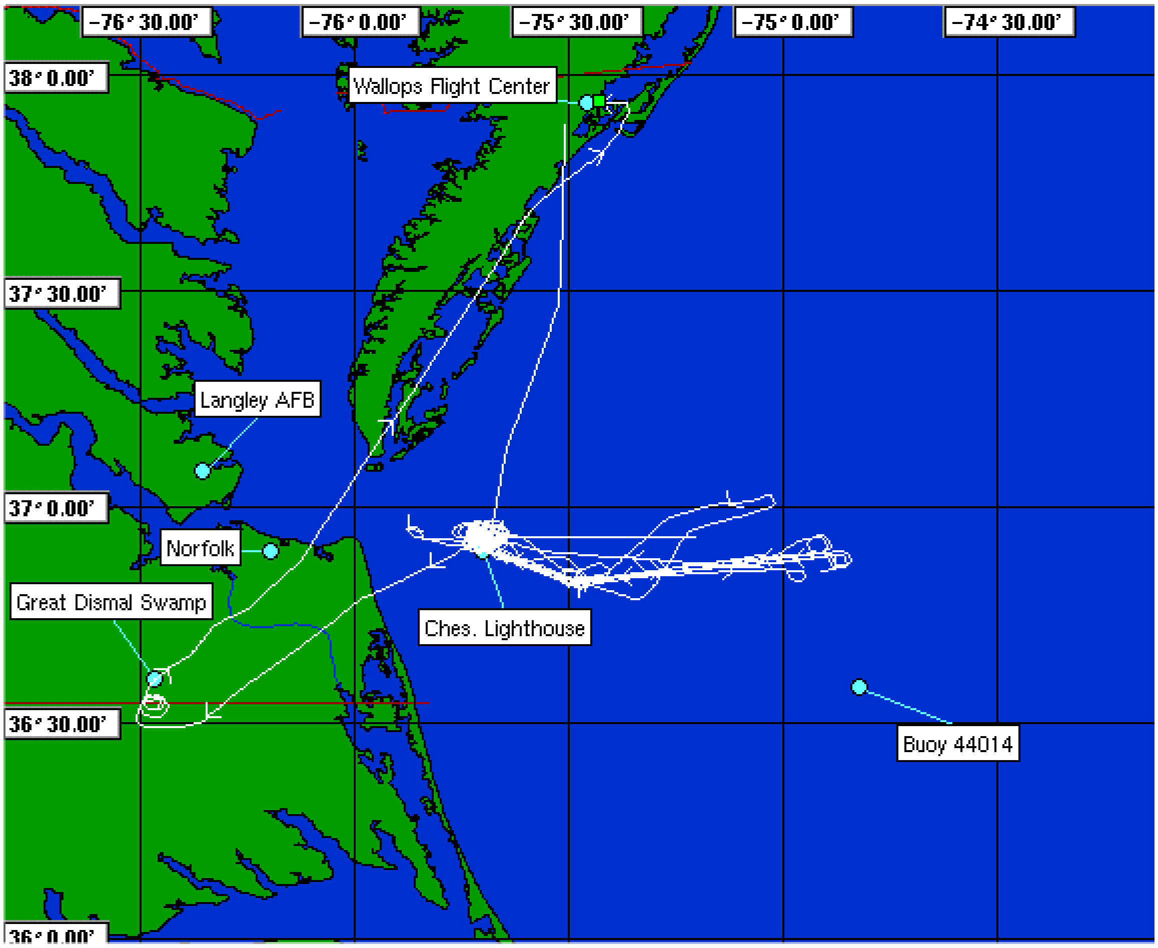

Figure 4.5. Flight track (white line) of the Convair-580 in CLAMS from 12:28 to 18:16 UTC on July 17, 2001 (UW flight 1874).

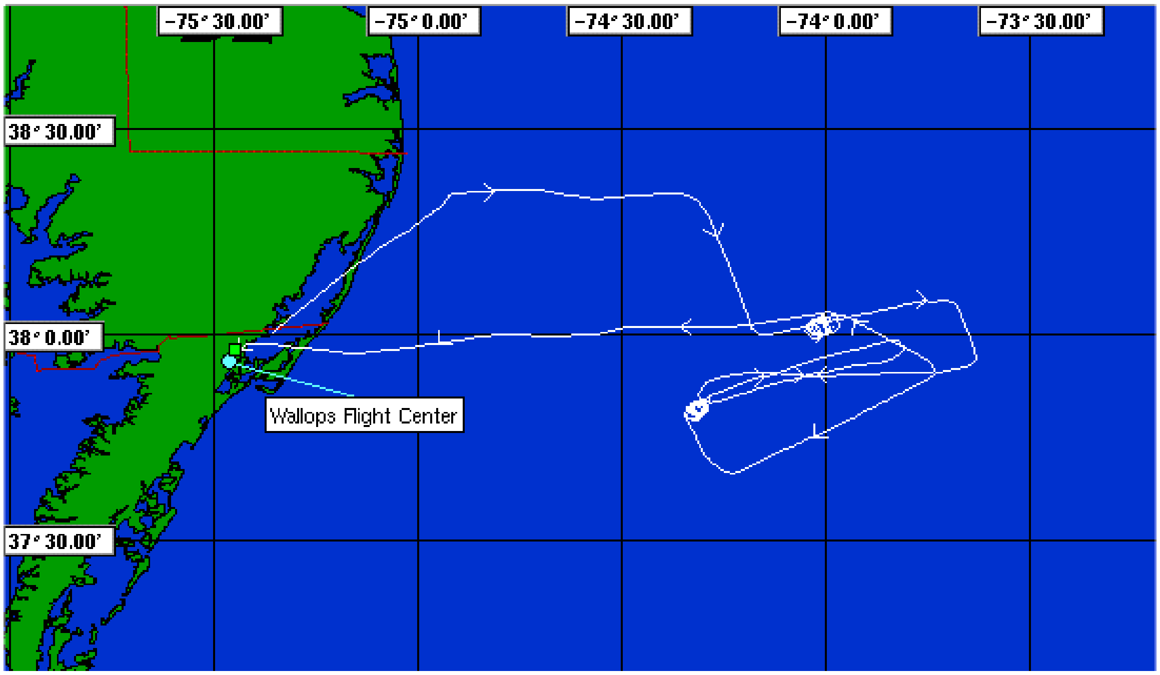

Figure 4.6. Flight track (white line) of the Convair-580 in CLAMS from 13:51 to 16:46 UTC on July 23, 2001 (UW flight 1875).

No flight path.
Convair-580 in CLAMS from 14:39 to 14:48 UTC on July 25, 2001 (UW flight 1876).
See Table 4.1.

No flight path.
Convair-580 in CLAMS from 11:45 to 12:43 UTC on July 26, 2001 (UW flight 1877).
See Table 4.1.

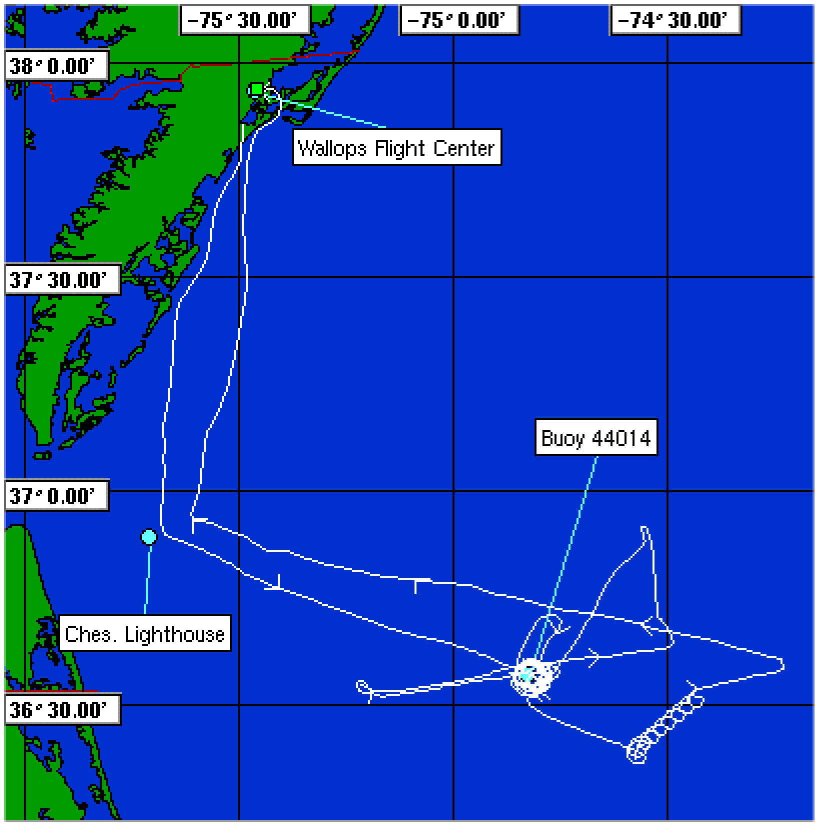

Figure 4.7. Flight track (white line) of the Convair-580 in CLAMS from 15:28 to 19:09 UTC on July 26, 2001 (UW flight 1878).

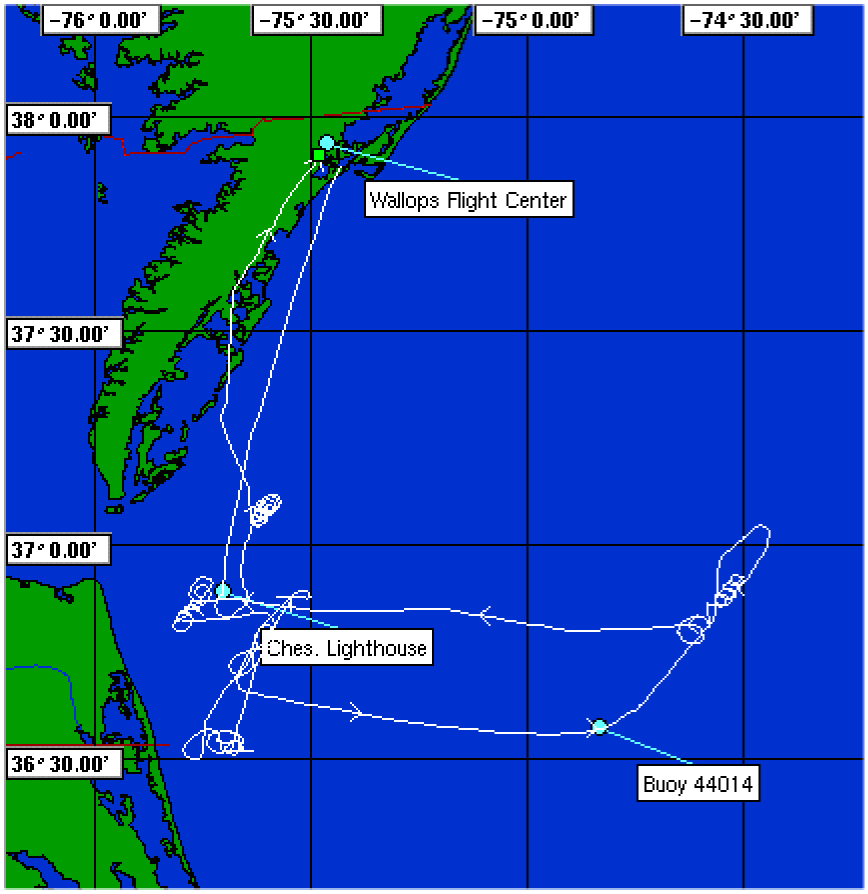

Figure 4.8. Flight track (white line) of the Convair-580 in CLAMS from 16:09 to 19:51 UTC on July 30, 2001 (UW flight 1879).

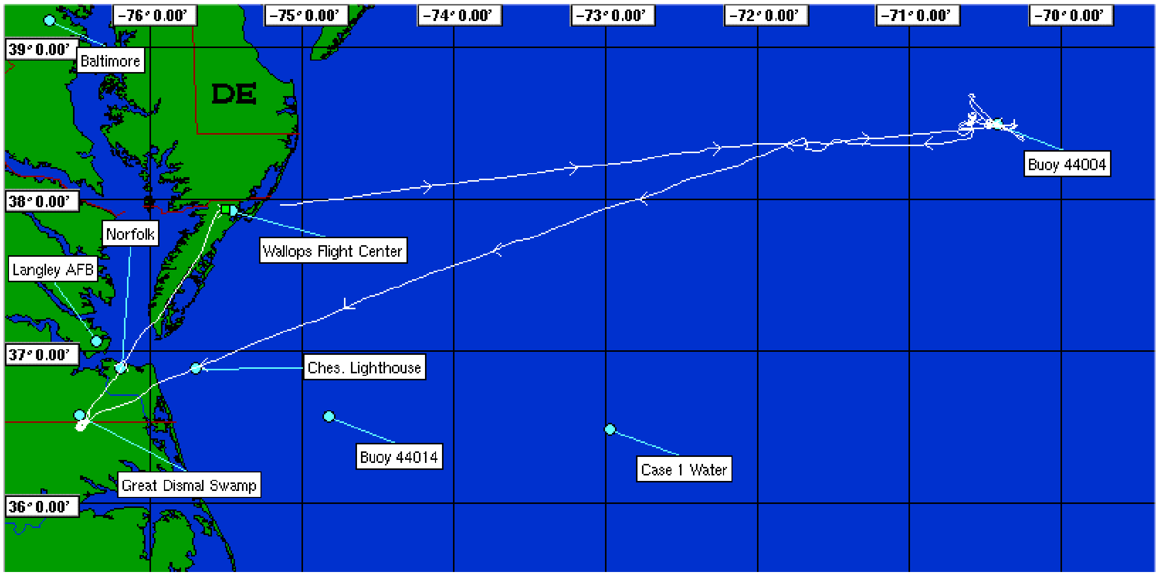

Figure 4.9. Flight track (white line) of the Convair-580 in CLAMS from 14:24 to 20:04 UTC on July 31, 2001 (UW flight 1880).

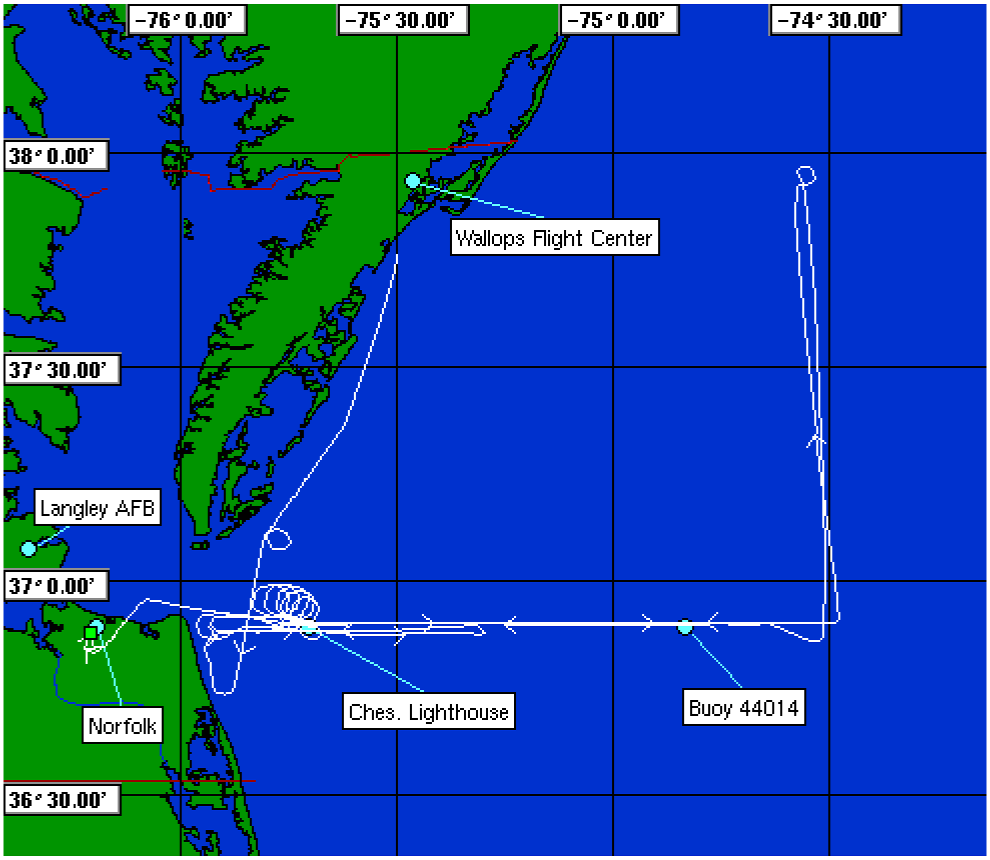

Figure 4.10. Flight track (white line) of the Convair-580 in CLAMS from 15:21 to 18:59 UTC on August 2, 2001 (UW flight 1881).

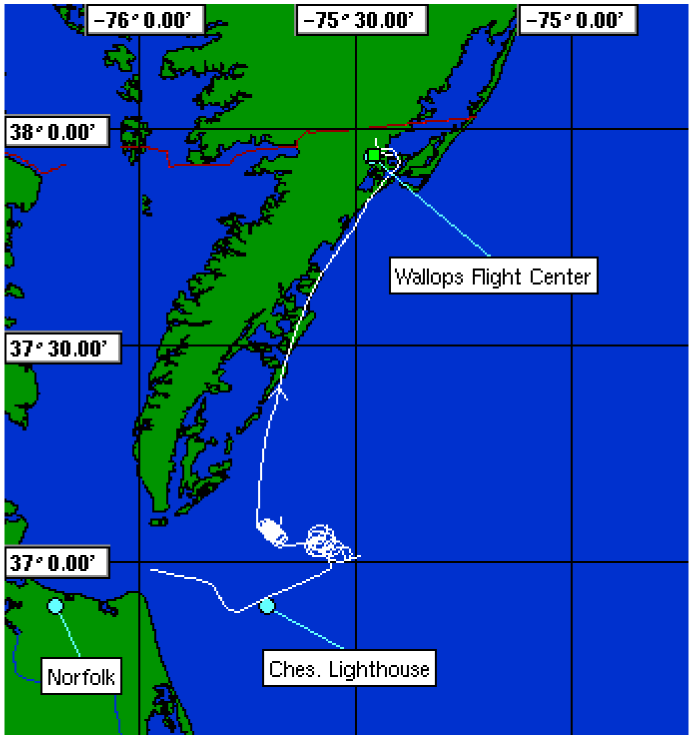

Figure 4.11. Flight track (white line) of the Convair-580 in CLAMS from 19:14 to 20:42 UTC on August 2, 2001 (UW flight 1882).

TABLE 5.1. OVERVIEW OF SOME OF THE MAIN ACCOMPLISHMENTS OF THE CONVAIR-580 FLIGHTS IN CLAMS

- Aerosol and trace gas measurements and sunphotometer measurements of aerosol optical depth and column water vapor and ozone from close to ocean surface to ~10,000 ft off Delmarva Peninsula on various occasions from July 10-August 2, 2001.
- Measurements of aerosol properties on seven occasions beneath the Terra satellite, once beneath AVHRR, and five times beneath the ER-2 aircraft.
- Measurements of aerosol properties in the vicinity of the (CERES instrumented) Chesapeake Bay lighthouse (COVE) on nine occasions.
- Measurements of BRDF of the ocean surface on fifteen occasions and over Great Dismal Swamp on two occasions.
- Measurements of aerosol properties over instrumented buoys 44014, 44004 and 41001.
- On July 17 (a CLAMS "Golden Day") six aircraft, including the Convair-580 and ER-2, were stacked above the Chesapeake Bay lighthouse under clear skies at the time of the Terra overpass.

Table 5.2 lists the occasions on which vertical profiles, generally between 100 and 10,000 ft, were made for the specific purpose of characterizing the physical and chemical profiles of the aerosol and to obtain height-resolved aerosol optical depth, and column water vapor and ozone measurements from the Ames sunphotometer aboard the Convair-580.

Table 5.3 lists the occasions on which the Convair-580 obtained measurements beneath targeted research satellites.

Table 5.4 lists the locations and times at which filters were exposed for measuring the types and concentrations of ionic and carbonaceous aerosols.

Table 5.5 lists the occasions on which measurements of the bidirectional reflection distribution function (BRDF) of various surfaces were obtained aboard the Convair-580.

Table 5.6 lists photographs taken by Peter Hobbs aboard the Convair-580 in CLAMS.

TABLE 5.2. UNIVERSITY OF WASHINGTON FLIGHTS IN CLAMS ON WHICH VERTICAL PROFILES WERE MADE FOR THE SPECIFIC PURPOSE OF OBTAINING HEIGHT-RESOLVED AEROSOL OPTICAL DEPTHS WITH THE NASA AMES AATS-14 SUNPHOTOMETER AND AEROSOL IN SITU MEASUREMENTS

Date (2001)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	AATS-14 Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons With Other Platforms
10 July	1870	1739/2214	Redemann	R10Jul01.AA	Chesapeake Bay Lighthouse to point south of buoy 44014.	Flight delayed until after TERRA overpass. 2 x 15 min. 100 ft legs at ~1830 UTC, AOD 0.2-0.3. Spiral ascent to 12,000 ft at 1900 UTC.	Window cleaned before transit flight and not unparked during transit.	Chesapeake Bay lighthouse instrumentation, 1800 – 1801 UTC.
12 July	1871	1116/1630	Redemann	R12Jul01.AB	~38˚20.71' N/ 74˚16.25 W	Clouds during first 4 hrs. TERRA overpass at 1554 UTC, found clear spot at 1545-1555 UTC. AOD: 0.075-0.01 with small gradient.	No window cleaning.	
14 July	1872	1456/1747	Redemann	R14Jul01.AD	Chesapeake Bay lighthouse	Vertical profile (spiral descent) at 1503 UTC near Chesapeake Bay lighthouse, AOD=0.01 (clouds) to 0.1. Low-level runs 1529 – 1553 UTC. Clouds after 1700 UTC.	Window cleaned.	Chesapeake Bay lighthouse instrumentation. Pre-flight comparison to Cimel and Microtops on runway at ~1437 UTC.
16 July	1873	1635/1940	Redemann	R16Jul01.AD	Between Chesapeake Bay lighthouse and buoy 44014	Clouds throughout most of the flight. Vertical profile (spiral descent) at 1906 UTC.	No window cleaning.	Pre-flight comparison to Cimel and Microtops on runway at ~1625 UTC.

(Cont.)

Table 5.2 (continued)

Date (2001)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	AATS-14 Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons With Other Platforms
17 July	1874	1252/1808	Redemann	R17Jul01.AE	Around Chesapeake Bay lighthouse	"Golden day." AATS-14 data recording rate set to 0.33 Hz (0.5 Hz max). Spiral ascent profile over Chesapeake Bay lighthouse at 1305 UTC up to 11,000 ft. TERRA overpass at 1614 UTC. Low-level run through Chesapeake Bay lighthouse from 1600 – 1615 UTC.	No window cleaning.	Chesapeake Bay lighthouse instrumentation at 1306 and 161313 UTC and 1620 UTC. Other aircraft at Chesapeake Bay lighthouse at ~1614 UTC.
23 July	1875	1413/1641	Redemann	R23Jul01.AA	About 70 miles east of NASA Wallops Flight Facility	AATS-14 data recording rate set to 0.5 Hz (max) for rest of the experiment. Extremely low AOD's again. TERRA overpass at 1535 UTC. Low level runs at 100 ft from 1526 – 1554 UTC. Ascent spiral profile at 1554 UTC (38.0N/74.0W), completed to 12000 ft for water vapor.	Window cleaned on July 21.	
25 July	1876	1325/1542	Eilers	R25Jul01.AA	—	Flight aborted on Wallops runway due to cancellation of ER-2 flight. Recorded 174kB of ground data.	Window cleaned before flight.	Window cleaning test in R25Jul01.AA.
26 July	1877	1211/1214	Eilers	R26Jul01.AA	—	Flight aborted soon after take-off (UW data system).		

(Cont.)

Table 5.2 (coontinued)

Date (2001)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	AATS-14 Operator	Raw Data File	Location	General Comments[†]	Notes	Potential Comparisons With Other Platforms
26 July	1878	1544/1835	Eilers	R26Jul01.ALL		TERRA overpass at 1607 UTC. Low level runs at 120 ft from 1557 – 1613 UTC. Ascent spiral profile at 1613 UTC (36.6N/74.8W), completed to 11000 ft.		
30 July	1879	1629/1940	Eilers	R30Jul01.AA	Around Chesapeake Bay lighthouse	Low level runs at 120 ft near Chesapeake Bay lighthouse from 1634 – 1639 UTC. Ascent spiral profile at 1706 UTC (due S of Chesapeake Bay lighthouse), with considerable cloud contamination. AOD around 0.1.	Window cleaned.	Chesapeake Bay lighthouse instrumentation. ER-2 underflight.
31 July	1880	1428/1958	Eilers	R31Jul01.AB	Near buoy 44004	Flight to buoy 44004 (Northern Deep Water). TERRA overpass at 1626 UTC. Low level runs at 100 ft from 1602 – 1626 UTC. AOD at overpass time ~0.08. Ascent spiral profile at 1707 UTC (36.6N/74.8W), completed to 10000 ft.	Window cleaned before flight.	Window cleaning test in R31Jul01.AA
2 Aug.	1881	1542/?	Eilers	R02Aug01.ALL	Around Chesapeake Bay lighthouse	TERRA overpass at 1613 UTC. Low level runs at 100 ft from 1605 – 1627 UTC. AOD between 0.1 and 0.12. Slow ascent spiral profile from 1627 - 1656 UTC (at Chesapeake Bay lighthouse), completed to 10000 ft.	Window cleaned before flight. Window cleaning test in R01Aug01.AB	Comparison with OV-10 en route to Chesapeake Bay lighthouse at 1613 UTC.

(Cont.)

Table 5.2 (continued)

Date (2001)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	AATS-14 Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons With Other Platforms
2 Aug.	1882	?/2038	Eilers	R02Aug01.ALL	Chesapeake Bay lighthouse	Spiral profile from 1936 - 1947 UTC (at Chesapeake Bay lighthouse), completed to 10000 ft.		Considerable AOD changes in BRDF circles starting at 1958 UTC.

* Local time = UTC – 4 hours
† All AODs for 500 nm

TABLE 5.3. OCCASIONS ON WHICH THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 AIRCRAFT FLEW BENEATH TARGETED RESEARCH SATELLITES IN CLAMS

Date (2001)	University of Washington Flight Number	Period of Flight (UTC)*	Satellite (and Time of Overpass)*	Location of Convair-580 at Time of Satellite Overpass	Notes (For more details see Sec. 6)
12 July	1871	1102-1640	Terra (1154 UTC)	Passes at 100 ft beneath cloud-free hole to north of Chesapeake Bay lighthouse.	Full vertical profile (with filters).
14 July	1872	1433-1749	Terra (1542 UTC)	Passes at 100 ft near Chesapeake Bay lighthouse.	Cloudy. Climbed to 10,000 ft during transit to lighthouse. Descended to 100 ft over lighthouse.
16 July	1873	1630-1947	AVHRR (1908 UTC)	Partial descent between Chesapeake Bay lighthouse and buoy 44014.	Extensive cirrus. Flight cut short by CLAMS Control.
17 July	1874	1228-1816	Terra (1614 UTC)	Passes at 100 ft over Chesapeake Bay lighthouse.	"Golden Day." Cloud free. Vertical profile (with filters) over lighthouse.
23 July	1875	1351-1646	Terra (1535 UTC)	Passes at 100 ft in cloud-free region about 70 miles east of Wallops.	Low AOD ($\simeq$ 0.05). Vertical profile to 10,000 ft in cloud-free region. Generally clear over lighthouse. Climb to 10,000 ft over buoy 44014 with cloud-free sky. Descent to 100 ft over buoy 44014 filters.
26 July	1878	1528-1909	Terra (1607 UTC)	Passes at 100 ft between Chesapeake Bay lighthouse and buoy 44014.	Flight terminated early by CLAM Control due to thunderstorm threat.

(Cont.)

* Local time = UTC – 4 hours

TABLE 5.3 (continued)

Date (2001)	University of Washington Flight Number	Period of Flight (UTC)*	Satellite (and Time of Overpass)*	Location of Convair-580 at Time of Satellite Overpass	Notes (For more details see Sec. 6)
31 July	1880	1424-2004	Terra (1624 UTC)	Passes at 100 ft over buoy 44014 with nearly cloudless skies.	1707-1718 UTC: ascent to 10,000 ft over buoy 44014. Low AOD (~0.033).
2 Aug.	1881	1521-1859	Terra (1612 UTC)	Passes at 100 ft over Chesapeake Bay lighthouse.	Clear over lighthouse. Slow ascent to 10,000 ft followed by fast descent to 2900 ft.

* Local time = UTC – 4 hours

TABLE 5.4. SAMPLING OF IONIC AND CARBONACEOUS AEROSOLS WITH TEFLON AND QUARTZ FILTERS ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN CLAMS

Date (2001)	University of Washington Flight Number	Teflon Filter Number	Quartz Filter Holder Number	Baghouse Sample Times (UTC, hhmmss)*	Filter Sampling Start Time (UTC, hhmmss)*	Filter Sampling Stop Time (UTC, hhmmss)*	Comments
10 July	1870	1	1	195255	195700	200630	Upper level haze, 3100m, minimal pollution
				200643	200905	201712	
				201755	201910	202240	
				202326	202600	203530	
10 July	1870	2	2	204740	204905	210000	Low level haze, 700m, elevated pollution
				210033	210200	211303	
				211334	211500	212622	
12 July	1871	3	3	125101	125220	130400	Low level haze, 1900m, slightly elevated pollution
				130459	130624	131700	
				131905	132046	133130	
				133247	133400	134529	
12 July	1871	5	1	135907	140053	141143	Low level haze, 600m, minimal pollution
				141219	141350	142530	
				143920	144050	145043	
				145115	145225	150545	
				150601	150713	151930	
				151939	152035	153127	
14 July	1872	7 and 8	N/A	N/A	151358	161331	Continuity test
	1872	N/A	2 and 4	N/A	161530	173330	Continuity test
16 July	1873	9	1	165942	170230	171250	Lower level haze, 100-400m, slightly elevated pollution
				171317	171447	172432	
				172452	172607	173730	
				173807	173915	174840	
				174926	175105	180249	

(Cont.)

* Local time = UTC – 4 hours

TABLE 5.4 (continued)

Date (2001)	University of Washington Flight Number	Teflon Filter Number	Quartz Filter Holder Number	Baghouse Sample Times (UTC, hhmmss)*	Filter Sampling Start Time (UTC, hhmmss)*	Filter Sampling Stop Time (UTC, hhmmss)*	Comments
17 July	1874	11	2	134050	134230	135350	Upper level haze, 2800m, slightly elevated pollution
				135408	135540	140650	
				140706	140813	142330	
		12	3	143145	143309	144327	Middle level haze, 2000m, slightly elevated pollution
				144346	144503	145605	
				145626	145744	151106	
17 July		13	1	151818	151938	153050	Lower level haze, 1000m, slightly elevated pollution
				153119	153243	154440	
				154503	154619	155620	
		14	4	160520	160622	161530	Surface level haze, 70m, elevated pollution
				161555	161726	162510	
				162809	162935	163925	
				164025	164230	165115	
23 July	1875	16	1	141500	141930	142850	Low level haze, integrated for the entire flight, 300m, minimal pollution
				142856	142958	144329	
				144430	144540	145911	
				145933	150048	151500	
				151743	151956	153315	
				153705	153850	154649	
				154716	154830	160125	
				160225	160342	161620	
26 July	1878	18	4	154618	155130	160120	Surface level haze, 160m, slightly elevated pollution
				160147	160250	161245	
				161257	161350	162630	
		19	5	170005	170110	171339	Low level haze, 900m, slightly elevated pollution. NOTE: Teflon filter was damaged.

(Cont.)

* Local time = UTC – 4 hours

TABLE 5.4 (continued)

Date (2001)	University of Washington Flight Number	Teflon Filter Number	Quartz Filter Holder Number	Baghouse Sample Times (UTC, hhmmss)*	Filter Sampling Start Time (UTC, hhmmss)*	Filter Sampling Stop Time (UTC, hhmmss)*	Comments
				171355	171454	172508	
				172533	172650	173740	
				173805	173916	175120	
				181456	181610	182636	
				182711	182834	183820	
				183849	184003	185030	
30 July	1879	21	2	163600	163905	165102	Low level haze, 100m, minimal pollution. Intermittent ship plumes in the sample area may affect results
				165139	165245	170258	
				170317	170520	171908	
				173333	173438	174230	
				174247	174350	175822	
				181502	181620	182712	
				182732	182834	184042	
31 July	1880	25	2	145800	150119	151258	Low level haze, maritime, 100-1000m, minimal pollution
				151328	151440	152558	
				152650	152759	154120	
				154547	154700	155700	
				155752	155920	161050	
				161151	161330	162544	
				162624	162736	1629	
				162624	163330	164346	
				165218	165614	170707	
				170816	170940	172217	
				174323	174450	175418	
				175650	175810	181015	
				181052	181247	182330	
				182430	182614	183810	
				183845	184005	185220	
2 Aug.	1881	27	4	161152	161330	162349	Low level haze, maritime, 100m., minimal pollution
				162433	162539	163634	

(Cont.)

* Local time = UTC – 4 hours

TABLE 5.4 (continued)

Date (2001)	University of Washington Flight Number	Teflon Filter Number	Quartz Filter Holder Number	Baghouse Sample Times (UTC, hhmmss)*	Filter Sampling Start Time (UTC, hhmmss)*	Filter Sampling Stop Time (UTC, hhmmss)*	Comments
2 Aug.	1882	27	4	193550	193705	194832	Continued sampling on same filters
				195823	195935	200638	
				200703	200827	201742	
				202056	202210	203210	
2 Aug.	1881	28	5	170655	170810	172427	Low level haze, maritime, 900m, minimal pollution
				172441	172547	173555	
				173614	173720	174746	
				174801	174908	180210	
		29	2	180404	180526	181601	Low level haze, maritime, 500m, minimal pollution
				181604	181740	182735	
				182758	182859	183645	
				183730	183900	185053	

* Local time = UTC – 4 hours

TABLE 5.5. MEASUREMENTS FROM THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 AIRCRAFT OF THE BIDIRECTIONAL REFLECTION DISTRIBUTION FUNCTION (BRDF) WITH THE NASA GODDARD CLOUD ABSORPTION RADIOMETER (CAR) IN CLAMS.

Date (2001)	University of Washington Flight Number	Target	Latitude (deg. N)	Longitude (deg. W)	Time (UTC, hhmm)*	Satellite/ Other Airplanes	Comments
10 July	1870	Chesapeake Lighthouse	36.94	–75.70	1804-1820	Terra/ OV-10	Good measurements.
		Chesapeake Lighthouse	37.18	–75.72	2142-2157		Some cirrus contamination.
12 July	1871	Chesapeake Lighthouse	36.95	–75.62	1218-1225	Proteus, ER-2, OV-10	Heavy cloud contamination.
14 July	1872	Chesapeake Lighthouse	36.95	–75.66	1555-1618	Proteus, Cessna-210, OV-10	Some cumulus contamination.
16 July	1873	Buoy 44001	35.98	–73.99	1756-1814	Proteus, Cessna-210	Cirrus contamination and data corruption.
17 July	1874	Chesapeake Lighthouse	36.95	–75.68	1646-1708	Terra/ Proteus, ER-2, Cessna-210, Lear-25C	Good measurements.
		Dismal Swamp	36.54	–76.46	1727-1735		Cirro-cumulus contamination.
23 July	1875	Buoy 44009	37.83	–74.34	1500-1519		Good measurements.
26 July	1878	Buoy 44014	36.46	–74.74	1748-1804	Terra/ Proteus, OV-10	Good measurements.

(Cont.)

* Local time = UTC – 4 hours

TABLE 5.5 (continued)

Date (2001)	University of Washington Flight Number	Target	Latitude (deg. N)	Longitude (deg. W)	Time (UTC, hhmm)*	Satellite/ Other Airplanes	Comments
30 July	1879	Chesapeake Lighthouse	36.88	–75.77	1645-1654	Terra/ Proteus, ER-2, OV-10	Heavy cloud contamination
		Buoy 44014	36.90	–74.55	1817-1827		Some cumulus contamination.
		Chesapeake Lighthouse	37.13	–75.5	1905-1920		Good measurements.
31 July	1880	Buoy 44004	38.56	–70.61	1652-1706	Terra\ ER-2, OV-10, Lear-25C	Good measurements.
		Dismal Swamp	36.55	–76.43	1855-1915		Good measurements.
2 August	1882	Chesapeake Lighthouse	37.04	–75.70	2001-2019	Terra\ ER-2, OV-10, Lear-25C	Good measurements.

* Local time = UTC – 4 hours

TABLE 5.6. PHOTOGRAPHS TAKEN BY PETER V. HOBBS ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 AIRCRAFT IN CLAMS.

Date (2001)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (UTC, hhmmss)*†	Subject of Photograph
10 July	1870	MVC-001X.JPG	214048	Nice photo of ocean surface on which BRDF measurements were obtained.
10 July	1870	MVC-002X.JPG	215338	Nice photo of ocean surface on which BRDF measurements were obtained.
10 July	1870	MVC-003X.JPG	220418	Poor photo.
12 July	1871	MVC-004X.JPG	134008	Haze layer in which detailed measurements were obtained.
12 July	1871	MVC-005X.JPG	154922	Nice photo of ocean surface taken a few minutes prior to Terra overpass time at 1554 UTC.
14 July	1872	MVC-006X.JPG	160354	Ocean surface on which BRDF measurements were obtained.
16 July	1873	MVC-001X.JPG	175536	Ocean surface on which BRDF measurements were obtained.
16 July	1873	MVC-002X.JPG	183244	Haze layers.
16 July	1873	MVC-003X.JPG	183412	Haze and cloud.
16 July	1873	MVC-004X.JPG	183832	Nice photo of haze that was sampled.

(Cont.)

* Local time = UTC – 4 hours

† Times given here are those recorded by the digital camera; these times could differ by a few minutes from the actual UTC time.

Table 5.6 (continued)

Date (2001)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (UTC, hhmmss)*[†]	Subject of Photograph
17 July	1874	MVC-005X.JPG	165236	Nice photo of ocean surface on which BRDF measurements were obtained.
17 July	1874	MVC-006X.JPG	172734	Poor photo.
23 July	1875	MVC-001X.JPG	150316	Nice photo of ocean surface on which BRDF measurements were obtained.
26 July	1878	MVC-002X.JPG	175154	Photo of ocean surface on which first set of BRDF measurements were obtained.
30 July	1879	MVC-003X.JPG	164728	Photo of ocean surface on which first set of BRDF measurements were obtained.
30 July	1879	MVC-004X.JPG	171228	Cloudy and clear regions.
30 July	1879	MVC-005X.JPG	182020	Nice photo of ocean surface on which BRDF measurements were obtained.
30 July	1879	MVC-006X.JPG	191042	Photo of ocean surface on which BRDF measurements were obtained.
30 July	1879	MVC-007X.JPG	191148	Photo of ocean surface on which BRDF measurements were obtained.

(Cont.)

* Local time = UTC – 4 hours

[†] Times given here are those recorded by the digital camera; these times could differ by a few minutes from the actual UTC time.

Table 5.6 (continued)

Date (2001)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (UTC, hhmmss)*†	Subject of Photograph
30 July	1879	MVC-008X.JPG	191734	Nice photo showing change in ocean color in region where BRDF measurements were obtained.
30 July	1879	MVC-009X.JPG	191756	Even better photo showing change in ocean color in region of BRDF measurements.
30 July	1879	MVC-010X.JPG	191820	Low level haze.
31 July	1880	MVC-001X.JPG	161652	Nice photo of sea surface near buoy 44004.
31 July	1880	MVC-002X.JPG	162700	Nice photo of small cumulus that encroached on our sampling region.
31 July	1880	MVC-003X.JPG	162816	Nice photo of ocean surface.
31 July	1880	MVC-004X.JPG	163412	Nice photo of ocean surface.
31 July	1880	MVC-005X.JPG	164122	Small cumulus south of our sampling area.
31 July	1880	MVC-006X.JPG	164446	Nice photo of buoy 44004.
31 July	1880	MVC-007X.JPG	185556	Photo of Dismal Swamp on which BRDF measurements were obtained.
31 July	1880	MVC-008X.JPG	185802	Better photo of Dismal Swamp on which BRDF measurements were obtained.

(Cont.)

* Local time = UTC – 4 hours

† Times given here are those recorded by the digital camera; these times could differ by a few minutes from the actual UTC time.

Table 5.6 (continued)

Date (2001)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (UTC, hhmmss)*†	Subject of Photograph
2 August	1881	MVC-001X.JPG	165540	Cumulus field over land taken from near Chesapeake Bay lighthouse.
2 August	1881	MVC-002X.JPG	182008	Haze.
2 August	1881	MVC-003X.JPG	193240	Ocean heading toward Chesapeake Bay lighthouse from Norfolk.
2 August	1881	MVC-004X.JPG	195818	Photo of ocean on which BRDF measurements were obtained.
2 August	1881	MVC-005X.JPG	195824	Photo of ocean on which BRDF measurements were obtained.

* Local time = UTC – 4 hours

† Times given here are those recorded by the digital camera; these times could differ by a few minutes from the actual UTC time.

6. SUMMARIES OF GOALS AND ACCOMPLISHMENTS OF THE CONVAIR-580 FLIGHTS IN CLAMS

Two types of summaries for the Convair-580 flights in CLAMS are provided in this section.

The first set of summaries (given in Section 6.1 below) are those written by the Convair-580 Flight Scientist. These contain brief statements on the main goals of each flight, the general location of the flight, weather conditions, the main accomplishments of each flight, the main instrument malfunctions, and (in most cases) a detailed timeline of activities during the flight.

Complete typed transcriptions are available for all of the in-flight voice recordings made on the Convair-580 in CLAMS. These "blow-by-blow" accounts provide detailed information on what transpired on each flight. However, because of their large bulk, these transcriptions are not reproduced here in their entirety.[*] Instead, we give in Section 6.2 typed transcriptions of the verbal *summaries* that crew members recorded aboard the aircraft toward the end of each of the flights. Although subsequent data analyses might reveal important aspects of a flight, and of the data collected, that were unknown to crew members at the time of the flight, these summaries have the advantage of spontaneity.

6.1. Flight Scientist's Summaries

(a) University of Washington Flight 1870 (July 10, 2001)

Period of Flight (UTC): 1725-2220

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[*] Requests for copies of the complete transcriptions for specific flights should be sent to:
Professor Peter V. Hobbs
University of Washington
Department of Atmospheric Sciences
Box 351640
Seattle, Washington 98195-1640

Original Goals of Flight:

1) BRDF near Chesapeake Bay (COVE) lighthouse
2) Vertical profile over buoy 44014
3) BRDF over buoy 44014

Actual Accomplishments of Flight:

1) BRDF near Chesapeake Bay lighthouse
2) Run at 100 ft (for AOD) from lighthouse out to east and return to lighthouse
3) Ascent to 12,000 ft over lighthouse
4) Descent over lighthouse with full filters at 10,000 and 4,000 ft
5) BRDF off southern tip of Delmarva Peninsula

Weather Conditions:

Generally clear, with patchy cirrus and altocumulus increasing toward end of flight.

Instrument Problems:

1) Pilot's GPS out during most of flight (came up toward end of flight)
2) No communication link between cabin and pilot
3) CNC-2 intermittent

Additional Comments:

1) Plans to coincide CV-580 flight with Terra overpass were scrapped earlier in day due to delay in Langley approval of CLAMS flight plans.
2) Due to instrument problems #1 and #2, original goals of flight were modified in flight as noted above.

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1725	Engines on.
1733	Take off.
1738-1759	Transit to Chesapeake Bay lighthouse at 2,000 ft.
1759-1805	Descent over lighthouse to 600 ft.
1805-1819	Six circles at 600 ft near lighthouse for BRDF measurements.
1819-1823	Descent to 100 ft.
1823-1858	Run at 100 ft (for column AOD) from lighthouse to point south of buoy 44014 and return to lighthouse.

1858-1925	Climb over lighthouse at 500 ft/min to 12,000 ft (climb revealed horizontal variations in aerosols over short distances, with more polluted air on landward side).
1925-1942	Dwelled at 12,000 ft to fix baghouse before starting descent over lighthouse.
1942-1947	Descent to 10,000 ft.
1947-2036	Full set of filters at 10,000 ft (for chemical composition).
2036-2044	Descent to 4,000 ft over lighthouse.
2044-2127	Full set of chemical measurements at 4,000 ft.
2127-2139	Descent to 600 ft over lighthouse. Repositioned aircraft to get cloudless view of sun for BRDF measurements.
2139-2158	Six circles off southern tip of Delmarva Peninsula for BRDF measurements. (Circles crossed a change in coloration of ocean, with darker green-blue (deeper?) water to east and lighter green water to west—see photos listed in Table 5.6.)
2158-2215	Return to Wallops at 100 ft and then 1,000 ft.
2215	Land.
2220	Engines off.

(b) University of Washington Flight 1871 (July 12, 2001)

Period of Flight (UTC): 1102-1640

Goals of Flight:

Coordinated flight with ER-2, Convair-580, Proteus, OV-10. Terra satellite overpass at 1554 UTC.

Goals for Convair-580 were:

1) BRDF near Chesapeake Bay lighthouse
2) Vertical profile, with full chemistry, over lighthouse
3) Low pass over lighthouse at Terra overpass time (1554 UTC)
4) BRDF near lighthouse

Accomplishments of Flight:

1) Done, but under partly cloudy skies

2) Done, sampled for one hour at about 6,000 ft and 2,400 ft
3) Done, but at about 100 ft beneath cloud-free hole well to north of lighthouse
4) Done, but extensive cirrus cloud cover

Weather Conditions:

Postfrontal conditions. AOD low. Cirrus and altocumulus covering large regions of sky.

Instrument Problems:

A couple of short periods of data loss (during runs at 2,400 ft) due to inverter failure.

Additional Comments:

1) Communication problems within aircraft, and from air to ground, encountered on first flight solved. Also air conditioner working.
2) Filter for PIXIE measurements integrated over flight.

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1102	Engines on.
1110	Take off.
1115	At 6,000 ft heading from Wallops to Chesapeake Bay lighthouse.
1134	Over lighthouse at 6,000 ft.
1134-1203	Descend at 2,000 ft/min over lighthouse.
1203-1217	Level runs for TANS "lock-on" and set up for BRDF circles.
1217-1225	Four circles for BRDF measurements of ocean at 36˚57.2' N/75˚37.5' W (about 2 nm NE of lighthouse). Cloudy.
1225-1240	Ascend over lighthouse to 10,000 ft.
1240-1250	Descend near lighthouse at 500 ft/min to 6,000 ft.
1250-1348	Horizontal legs across wind at 6,000 ft over lighthouse for first set of filter measurements via baghouse.
1348-1357	Descent over lighthouse at 500 ft/min to 2,400 ft.
1357-1534	Horizontal legs across wind at 2,400 ft over lighthouse. During latter portion of these legs occasionally intercepted black smoke from fire on land; descending to 1,500 ft in attempt to avoid intercepting this smoke.

1357-1534 (cont.)	Smoke should not have affected the ionic/carbonaceous filters, since these came from intermittent bag-house samples, but may have affected the continuous PIXIE filters and may show up on the Goddard aerosol spectroreflectometer. Other plumes from ships and land intercepted (see neph and CN measurements) at this low altitude. Couple of short computer outages during these legs.
1534-1538	Descend to 100 ft beneath fairly large hole in cirrus.
1538-1600	Horizontal leg at about 100 ft above ocean beneath hole in cirrus. AOD only about 0.1. Terra satellite overpass at 1554 UTC, at this time aircraft was at about 38˚20.71' N/74˚16.25' W.
1600-1605	Climb to 2,000 ft.
1605-1635	Return to Wallops at 2,000 ft.
1635	Touchdown.
Engines off.	

(c) University of Washington Flight 1872 (July 14, 2001)

Period of Flight (UTC): 1433-1749

Goals of Flight:

1) Climb to 10,000 ft and transit to Chesapeake Bay lighthouse
2) Underfly Terra at Chesapeake Bay lighthouse at 100 ft (Terra overpass at 1542 UTC)
3) BRDF near Chesapeake Bay lighthouse at 36˚57.3'/75˚37.5'
4) BRDF over Dismal Swamp
5) Calibrate pressure, temp, and winds against Wallops special sonde

Accomplishments of Flight:

1) Done
2) Done (CV-580 at lighthouse at Terra overpass time)
3) Done at location slightly offset from prescribed point to avoid cloud
4) Cancelled due to clouds over Dismal Swamp
5) Done

Weather Conditions:

Clear at take off except for small cumulus on horizon. Increasing cumulus during flight, with about 50% cumulus over Wallops at end of flight.

Low AOT (about 0.1 from surface)

Instrument Problems:

Some problems with TANS locking onto satellite (affects pitch and roll angle measurements).

Additional Comments:

Other aircraft flying: Cessna, Proteus, OV-10

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1433	Engines on.
1440	Take off.
1440-1504	Climb to 10,000 ft on transit to Chesapeake Bay lighthouse.
1504-1530	Descend at 500 ft/min then 1,000 ft/min to 100 ft.
1530-1554	Runs at 100 ft through lighthouse. At lighthouse at Terra overpass time of 1542 UTC.
1554-1559	Look for cloud-free spot near designated point for BRDF measurements.
1559-1617	Seven CAR turns at 600 ft near designated spot.
1617-1623	Climb to 4,000 ft to talk to CLAMS control. Advised that it was cloudy over Dismal Swamp but to proceed there to inspect.
1623-1632	Transited part way to Dismal Swamp. In view of considerable cloud in direction of Dismal Swamp, decided to cancel BRDF over swamp.
1632-1715	Transit back to Wallops.
1715-1735	Followed special radiosonde launched from Wallops to 12,000 ft for temp, humidity and wind comparisons.
1745	Touchdown at Wallops.
1749	Engines off.

(d) University of Washington Flight 1873 (July 16, 2001)

Period of Flight (UTC): 1630-1947

Goals of Flight:

To support CERES/AVHRR retrievals under cloud-free conditions.

1) BRDFs at Chesapeake Bay lighthouse, buoys 44014 and 41001
2) Underfly AVHRR satellite at buoy 41001 at AVHRR satellite overpass time of 1908 UTC
3) Continuous vertical profile over buoy 4100 (no height resolved chemistry)

Accomplishments of Flight:

(Extensive cirrus clouds did not permit goals to be achieved. Also, the safety communications aircraft for Convair-580, namely Proteus, had an instrument problem that required them to cut mission short. Therefore, CLAMS Control required Convair-580 to cut short its transit flight to buoy 41001 and return to Wallops.)

1) Some runs at 100 ft between lighthouse and buoy 44014 (in intermittent cirrus).
2) Did BRDF in best cloud-free area available (still some cirrus) at 35˚58.6' N/73˚59.68' W. Also climbed to 10,000 ft at this location for continuous sunphotometer and in situ aerosol measurements.
3) Continuous sunphotometer and aerosol, etc., measurements in profile too100 ft on return to Wallops.
4) Some filters, for chemistry, but not height resolved.

Weather Conditions:

Extensive cirrus.

Instrument Problems:

1) UV up and down?
2) CNC-1 short of butanol, unreliable.

Additional Comments:

None

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1630	Engines on.

1638	Take off.
1638-1640	Climb to 1400 ft heading to Chesapeake Bay lighthouse.
1640-1708	To lighthouse at 1400 ft.
1708-1721	From lighthouse to buoy 44014 at 100 and 500 ft.
1721-1728	Looked for cloud-free area for BRDF near buoy 44014: unable to find.
1728-1734	Return to buoy 44014.
1734-1753	Head to buoy 41001. Widespread cirrus.
1753-1813	Held by CLAMS Control at 35˚58.6' N/73˚59.68' W because of Proteus instrument problem. Did seven turns at this location for BRDF measurements. Partly cloudy.
1813-1844	Still on "hold" by CLAMS Control, therefore, climbed at same location to 10,000 ft for AOD and aerosol measurements.
1844-1905	Started return to Wallops (as instructed by CLAMS Control) in haze layer near 9,000 ft.
1905-1910	Started descent at 36˚43.68' N/75˚13.64' W (between lighthouse and buoy 44014) for AOD and BRDF measurements beneath cloud-free region. Instructed by CLAMS Control to stop descent and return to Wallops.
1910-1944	Proceeded to Wallops on descending path, with some runs at 100 ft, but still extensive cirrus.
1944	Land.
1947	Engines off.

(e) University of Washington Flight 1874 (July 17, 2001)

Period of Flight (UTC): 1228-1816

Goals of Flight:

To support Terra overpass of Chesapeake Bay lighthouse at 1614 UTC with:

1) Vertical spiral 2 nm NW of lighthouse (26˚57.3'/75˚37.5').
2) Chemical measurements via filters and other aerosol measurements at several selected levels in L-shaped pattern.

3) Run at 100 ft through location given above at time of Terra satellite overpass (1614 UT).
4) BRDF measurements at above location.
5) BRDF over Dismal Swamp.

Accomplishments of Flight:

All goals achieved in essentially cloud-free conditions. Excellent data set. ER-2 and several other NASA aircraft stacked over lighthouse at Terra overpass. "Golden day" for comparing MODIS, MISR and Air-MISR with airborne and ground-based measurements.

Weather Conditions:

Essentially cloudless (except for scattered cumulus over land).
Moderate AOD and light-scattering values.

Instrument Problems:

1) CNC-1 (too warm).
2) DMPS (because associated CN counter not working because of heat).
3) Aerosol spectroreflectometer intermittent.
4) FSSP-300 may be reading low (compared to FSSP).
5) TANS-vector altitude data lost between 1716 and 1750 UTC.

Additional Comments:

See under Accomplishments above.

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1228	Engines on.
1235	Take off.
1235-1259	To 2 nm NE of Chesapeake Bay lighthouse (36˚57.3'/75˚37.5'), hereafter referred to as "lighthouse," at 2,000 ft.
1259-1305	Descend to 100 ft over lighthouse.
1305-1336	Spiral to 11,000 ft over lighthouse.
1336-1425	Descend to 9,000 ft and level runs near this level for first set of chemical filters. Roughly an L-shape flight pattern east of lighthouse, with westerly portion near lighthouse.
1425-1430	Descend to 6,000 ft.

1430-1512	Second set of filters exposed near 6,000 ft in approximately same L-pattern as at 9,000 ft.
1512-1517	Descend to 3,000 ft.
1517-1549	Third set of filters exposed near 3,000 ft in approximately same L-pattern as at 9,000 ft and 6,000 ft.
1549-1601	Descend to 100 ft.
1601-1633	East to west, and west to east, tracks at 100 ft, through lighthouse but with track east of lighthouse longer than track west of lighthouse. At lighthouse at 1613 UTC. Terra satellite overpass at 1614 UTC.
1633-1640	Climb to 600 ft over lighthouse. St up for BRDF turns.
1640-1704	Eight CAR turns for BRDF.
1704-1727	Climb to 5,500 ft over lighthouse and head to Dismal Swamp descending to 2,000 ft.
1727-1735	Three CAR turns for BRDF over Dismal Swamp (cut short by dwindling fuel). Cessna should have been overhead at 12,000 ft. Location of turns: 3 miles west of 36˚32'/76˚23'.
1735-1812	Return to Wallops.
1812	Land.
1816	Engines off.

(f) University of Washington Flight 1875 (July 23, 2001)

Period of Flight (UTC): 1351-1646

Goals of Flight:

1) Underfly Terra satellite overpass at 1535 UTC in cloud free or scattered cloud conditions at least 50 miles from shore.

2) BRDF under cloud-free conditions at ("near-Delaware") buoy 44009 at 38˚27.8'/74˚42.12'.

Accomplishments of Flight:

1) Goal #1 done: Runs from SW to NE at 100 ft in cloud free region about 70 miles east of Wallops before, during and after Terra overpass at 1535 UTC. Low aerosol optical depths (about 0.05).

2) Goal #2 not accomplished due to clouds over buoy.

3) Six turns for BRDF measurements at 600 ft over ocean at SW point of 100 ft runs (done just prior to low-level runs).

Weather Conditions:

Building cumulus over land. Broken cloud over ocean with large cloud-free regions east of Wallops.

Instrument Problems:

1) CNC-2.

Additional Comments:

1) Good for MODIS low AOT calibration.

2) NASA OV-10 flew.

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1351	Engines on.
1402	Take off.
1402-1500	Transit toward northeast climbing to 3200 ft and then southeast and east looking for cloud-free region.
1500-1517	Six circles for BRDF measurements at 600 ft over calm ocean in cloud-free region. Circles at SW point of 100 ft runs that followed.
1517-1520	Descend to 100 ft.
1520-1554	Runs about 25 miles long at 100 ft above ocean in SW-NE direction about 70 miles east of Wallops in cloud-free region. Low AOD, 0.04-0.06. Terra satellite overpass at 1535 UTC.
1554-1614	Climb to 10,000 ft at 1,000 ft/min in cloud-free region. Good water vapor profile.
1614-1639	Return to Wallops descending steadily en route from 10,000 ft.
1639	Land.
1646	Engines off.

(g) University of Washington Flight 1876 (July 25, 2001)

Period of Flight (UTC): 1439-1448

Goals of Flight:

Underfly Terra and ER-2 in JFK corridor in region of high AOD.

Accomplishments of Flight:

Flight cancelled on runway due to ER-2 canceling due to potential for thunderstorms in Wallops area during day.

Weather Conditions:

Scattered Cloud.

Instrument Problems:

None.

Additional Comments:

None.

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1439	Engines on.
1448	Engines off.

(h) University of Washington Flight 1877 (July 26, 2001)

Period of Flight (UTC): 1145-1243

Goals of Flight:

Underfly Terra near Chesapeake Bay lighthouse plus BRDF and aerosol characterization.

Accomplishments of Flight:

Terminated flight before reaching Chesapeake Bay lighthouse due to data recording and display problem.

Weather Conditions:

Overcast at Wallops and en route to Chesapeake Bay lighthouse. Clear to east.

Instrument Problems:

Convair-580 computer for data recording and display.

Additional Comments:

ER-2 scratched due to weather.

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1145	Engines on.
1154	Take off.
1154-1215	Transit toward Chesapeake Bay lighthouse. Computer for recording and displaying scientific data not working.
1215-1236	Return to Wallops.
1236	Land.
1243	Engines off.

(i) University of Washington Flight 1878 (July 26, 2001)

Period of Flight (UTC): 1528-1909

Goals of Flight:

1) Low-level run in cloudless conditions beneath Terra satellite overpass at 1607 UTC.
2) Slow climb to 10,000 ft over buoy 44014 (36˚34.98'/74˚50.16').
3) Fast descent to 600 ft over buoy.
4) BRDF at buoy 44014 in cloud-free conditions.
5) AOD at 100 ft.
6) Chemical characterization of aerosol.

Accomplishments of Flight:

1) Goal #1 achieved with 100 ft run between Chesapeake Bay lighthouse and buoy 44014 from 1556-1612 UTC.
2) Goal #2 done.
3) Goal #3 done, with descent to 100 ft over buoy 44014.
4) Goal #4 done near buoy 44014.

5) Goal #5 done.
6) Goal #6 partly achieved with filters, for chemical characterization, at 2200 ft (obtained in triangular pattern centered on buoy 44014 to explore spatial variations) and at lower levels.

Weather Conditions:

Overcast to west, but generally clear from Chesapeake Bay lighthouse eastwards.

Instrument Problems:

Goddard aerosol spectroreflectometer did not work properly in slow ascent and stopped working after slow ascent.

Additional Comments:

Convair-580 flight cut short by CLAMS Control due to deteriorating weather at Wallops and return to base of "communication" aircraft required by Langley for low-level flights.

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1528	Engines on.
1535	Take off.
1535-1556	Rapid transit to Chesapeake Bay lighthouse at cruise speed.
1556-1612	Descend to 100 ft. Head east from lighthouse to buoy 44014 with clear skies above. Terra satellite overpass at 1607 UTC. Surface wind estimated to be 20 to 25 knots.
1612-1643	Climb to 10,000 ft at 300 ft/min over buoy 44014 with cloudless skies.
1643-1655	Descend at 1,000 ft/min to 100 ft over buoy 44014.
1655-1700	Ascend to 2,200 ft.
1700-1739	Flew triangular pattern centered on buoy to explore (considerable) spatial variations in aerosol: AOD = 0.15-0.4. Filters for chemical characterization at this level (also exposed another set of filters at lower levels).
1739-1746	Descend to 600 ft over buoy 44014 and searched to SE for best cloudless region for BRDF.

1746-1807	6-8 circles for BRDF SE of buoy 44014 in cloudless region.
1807-1811	Descend to 100 ft for last low0level run under cloudless sky for AOD.
1811-1815	Climb to 200 ft over buoy.
1815-1904	Return to Wallops at 2200 ft then 1100 ft. Exposed same filters previously exposed at 2200 ft to more aerosol during this period.
1904	Land.
1909	Engines off.

(j) University of Washington Flight 1879 (July 30, 2001)

Period of Flight (UTC): 1609-1951

Goals of Flight:

1) Underfly ER-2 off coast for sunphotometer and aerosol profiles in cloud-free holes.
2) BRDFs near Chesapeake Bay lighthouse and buoy 44014 in best cloud-free areas that can be found.

Accomplishments of Flight:

1) Goal #1 achieved in various locations beneath ER-2 and off Delmarva Peninsula.
2) BRDFs in partly cloudy conditions near Chesapeake Bay lighthouse, near buoy 44014 and off southern tip of Delmarva Peninsula.
3) Integrated filters over low altitudes.

Weather Conditions:

Cloudy.

Instrument Problems:

CE neph.

Additional Comments:

1) ER-2, Proteus, and OV-10 flew.
2) Terra satellite overpass prior to Convair-580 flight.
3) Air quite clean after frontal passage and heavy rains previous day.

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1609	Engines on.
1617	Take off.
1617-1634	Climb and head toward Chesapeake Bay lighthouse at 2,000 ft.
1634-1640	Run at 100 ft toward lighthouse in cloudy conditions.
1640-1645	Search for best cloud-free area near lighthouse.
1645-1655	Five circles at 600 ft for BRDF measurements near lighthouse. Some cloud present.
1655-1706	Run at 100 ft looking for best cloud-free hole in which to do vertical profile near lighthouse.
1706-1719	Climb at 1,000 ft/min from 100 ft to 10,000 ft.
1719-1739	Slow descent to 100 ft near lighthouse.
1739-1743	Run at 100 ft east of lighthouse.
1743-1801	Climb to 5,500 ft and head to buoy 44014 in and out of altocumulus cloud for some cloud structure measurements.
1801-1807	Search for best cloud-free region for BRDF measurements near buoy.
1807-1816	Descend from 5,500 ft to 600 ft northeast of buoy 44014.
1816-1831	Five circles at 600 ft for BRDF measurements northeast of buoy 44014 in partly cloudy conditions.
1831-1837	Climb to 5,500 ft through cloud-free region near buoy 44014.
1837-1854	Head back to Chesapeake Bay lighthouse in clean, cloud-free air at 8,000 ft (looking for cloud-free regions).
1854-1900	Descend to 1,500 ft near lighthouse in cloud-free region.
1900-1904	Search for cloud-free region near lighthouse for BRDF measurements.
1904-1921	Six circles for BRDF measurements at 600 ft (at 37˚6'/75˚35') in best cloud-free region of the flight.
1921-1946	Return to Wallops (with run at 100 ft from about 1925-1928 in good cloud-free region).

1946	Land.
1951	Engines off.

(k) University of Washington Flight 1880 (July 31, 2001)

Period of Flight (UTC): 1424-2004

Goals of Flight:

1) Underfly Terra and ER-2 at 1624 UTC at dark water buoy 44004.
2) BRDF at buoy 44004.
3) Vertical profile at buoy 44004.

Accomplishments of Flight:

1) Goal #1 achieved under almost clear sky conditions but low AOD.
2) Goal #2 achieved under almost clear sky conditions but low AOD.
3) Goal #3 achieved to 10,000 ft.
4) Transit from buoy 44004 to Dismal Swamp with sunphotometer and aerosol measurements en route.
5) BRDF at Dismal Swamp under almost clear sky conditions.

Weather Conditions:

Largely cloud-free at target areas.

Instrument Problems:

1) CE neph for most of flight.
2) DMPS.

Additional Comments:

1) ER-2 flew in region of buoy 44004 from about 1515-1615 UTC.
2) Lear and OV-10 flew.
3) Should be good measurements for comparison with MODIS and MISR on Terra and/or ER-2, and for CERES BRDF of dark ocean with 10 ft waves and considerable whitecaps.

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1424	Engines on.
1433	Take off.
1433-1438	Climb to 4,500 ft.

1438-1540	Transit toward buoy 44004 at 4,500 ft.
1540-1545	Descend to 500 ft.
1545-1600	Continue heading toward buoy at 500 ft.
1600-1625	Passes at 100 ft through buoy 44004. Terra overpass at 1624 UTC. Nearly cloudless. AOD = 0.08.
1626-1632	Climb to 600 ft and return to buoy.
1632-1652	Four circles for BRDF measurements of ocean close to buoy 44004; interrupted by encroaching cloud. Searched for better cloud-free area a few miles from buoy.
1652-1707	Six circles for BRDF measurements of ocean in almost cloud-free conditions.
1707-1718	Climb at 1,000 ft/min to 10,000 ft over buoy 44004. At 10,000 ft AOD = 0.033.
1718-1738	Commenced return trip to Wallops decreasing altitude steadily. At 1738 UTC received message from CLAMS Control that Dismal Swamp was clear on satellite and to proceed to swamp.
1738-1853	Proceeded to Dismal Swamp passing over Chesapeake Bay lighthouse en route.
1853-1916	Six circles at 2,000 ft over Dismal Swamp for BRDF measurements of fairly uniform trees under nearly cloudless conditions.
1916-1956	Return to Wallops.
1956	Land.
2004	Engines off.

(l) University of Washington Flight 1881 (August 2, 2001)

Period of Flight (UTC): 1521-1859

Goals of Flight:

1) Intercomparison with the OV-10 while in transit to the Chesapeake Bay lighthouse.
2) Two BRDFs at Chesapeake Bay lighthouse, first at high sun angle, second at low sun angle at end of flight.
3) 100-foot run above sea level in clear sky under Terra overpass at 1612 UTC.
4) Aerosol and sunphotometer profile in slow climb to 10,000 ft ASL.
5) Chemical characterization of aerosol.

Accomplishments of Flight:

1) OV-10/Convair-580 intercomparison accomplished (OV-10 flew within 200 feet of Convair-580 while in transit to Chesapeake Bay lighthouse).
2) 100-ft run over 28-min time span in E-W direction under clear skies centered on Terra satellite overpass at 1612 UTC.
3) Slow climb for aerosol/sunphotometer vertical profile, followed by fast descent.
4) "L" legs of 45-22 min each in E-W, N-S directions following Terra overpass. Legs were performed at 2900 feet and about 1400 feet ASL. (Aerosol loading "too small" for filters at higher levels, probably marginal at 1400 feet as well.)

Weather Conditions:

Clear above Chesapeake Bay lighthouse. Cirrus, altocumulus at east end of E-W legs. Cumulus forming over land to west.

Instrument Problems:

1) CAR door would not open. Therefore could not do BRDFs. (Did BRDF on flight 1882 on same day.)
2) UV down intermittent.
3) NO_x pump current draw high. Popped breaker later in flight.

Additional Comments:

None.

Flight Scientist: Arthur Rangno

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1521	Engines on.
1530	Take off.
1530-1539	Climb to 6000 ft for OV-10 intercomparison during transit to Chesapeake Bay lighthouse.
1550-1558	CAR door would not open. Control decides to continue with flight but without the BRDFs.
1558-1605	Descent from 6,000 to 100 ft ASL.
1605-1627	Level flight at 100 ft ASL. Photos (on film) of sea at 1610 and 1620 UTC. Terra satellite overpass at 1612 UTC. Abeam lighthouse at 1624 UTC.
1627-1655	Slow ascent to 10,000 ft ASL.

1655-1700	Level flight at 10,000 ft ASL. Digital photo of cumulus toward Norfolk at 1657 UTC.
1700-1706	Descent to maximum haze level at 2900 ft ASL.
1706-1729	E-W leg flying eastbound.
1729-1750	North bound leg. (CLAMS Control agrees that we should land at Norfolk to fix CAR door.)
1750-1816	South bound leg at 1700-1400 (fine tuning the little haze present).
1816-1838	West bound leg at 1400 ft. Digital photo at 1822 UTC.
1838-1852	Transit to Norfolk.
1852	Land.
1859	Engines off.

(m) University of Washington Flight 1882 (August 2, 2001)

Period of Flight (UTC): 1914-2042

Goals of Flight:

1) BRDF of ocean at low sun angle near Chesapeake Bay lighthouse.
2) "Fast" profile to 10,000 ft.

Accomplishments of Flight:

1) Transit from Norfolk to Chesapeake Bay lighthouse at 1,000 ft.
2) Climb to 10,000 ft about 9 nm northeast of lighthouse.
3) Rapid descent to 600 ft in best cloud-free area about 9 nm north of lighthouse.
4) BRDF of ocean, at low sun angle in best cloud-free area about 9 nm north of lighthouse.

Weather Conditions:

Surface winds less than 10 kts. Isolated cirrus line SE quadrant, distant cumulus clouds over the land.

Instrument Problems:

1) UV down intermittently.

Additional Comments:

CAR nose opened manually prior to takeoff.

Flight Scientist: Arthur Rangno

Approx. UTC Time (UTC = local time plus 4 hours)	Activity
1914	Engines on.
1922	Take off.
1922-1934	Transit from Norfolk to lighthouse at 1,000 ft.
1934-1946	Ascent to 10,000 for aerosol and sunphotometer profile. Digital photo of ocean from 100 ft at 1934 UTC.
1946-1958	Descend from 10,000 to 600 ft.
1958-2019	BRDF circles in best cloud-free area, located about 9 nautical miles north to north-northwest of Chesapeake Bay lighthouse. Low sun angle.
2019-2023	Transit to Wallops and land.
2042	Engines off.

*6.2. Transcriptions of In-Flight Verbal Summaries**

(a) University of Washington Flight 1870 (July 10, 2001)

10:06 PM

CG: Peter, I want to do a quick summary of our measurements.

PH: Go ahead.

CG: Thank you. This is Charles Gatebe summarizing on July 10 during UW flight 1870. We were doing radiometric measurements for characterizing the BRDF over the lighthouse. We did two sets of BRDF and the first set was at ____ PM local and the second set of BRDF was at 12:58. So that is for different solar angles. When we were doing the BRDF measurements, we corrected 1.6 ______. Secondly, we…

TAPE 2, SIDE 2

* Speakers: AC = Andrea Castanho, AR = Art Rangno, BM = Brian Magi, CG = Charles Gatebe, DS = Don Spurgeon, GG = Grant Gray, HJ = H. Jones, JE = Jim Eilers, JR = Jerry Rhode (pilot), JR2 = Jens Redemann, KM = Ken McMillen (pilot), LR = Lorraine Remer, PH = Peter Hobbs, RK = Ralph Kahn, RW = Ray Weiss, TA = Tom Arnold, TW = Tom Wilson

CG: …generally we had a few problems. The first one was there seemed to be a problem in the server control. The server is affected when we ascend to very high altitude. The CAR software, the portion that is called 2.__ VI seems to have a problem in ___ so I worked with it and I've been learning to use it from the beginning. Other than that, the instrument behaved well throughout. Thank you Peter.

PH: What times did the CAR turns finish?

CG: The second finished at around 5:58 PM.

10:09 PM

PH: The next one up, Jens?

JR2: Okay. The NASA Ames 14-channel sunphotometer was tracking properly. All channels looked good. All dark current ____ (gap). We got some very good data in an original descent and during two low-level 15-min legs at 100____(gap) __2040. We had some cirrus cloud contamination at 2140. For the purpose of the BRDFs, in the second set of BRDFs there was a large variation within the circles of about 10% or so. All together the instrument worked well ____(gap).

PH: Brian, give your summary.

BM: I can go. How much time do I have?

PH: Go. Whatever you need.

BM: Filter sets and by filter sets I mean quartz-quartz and Teflon. At 195700 I started the first set and with intermittent pauses for bag-house refills and finished at 203530. The second set was three bag-house samples, and the first set was four bag-house samples as a note. The second set was 204905 and was fully completed at 212622. The filter pairs that I'm taking care of are quartz-quartz and Teflon filters. But in addition to those, the Nucleopore filters are being taking care of by Vanderlei's student. Those were being run simultaneously next to the quartz-quartz filters and the Teflon filters at the same time. The first bag-house sample was high haze and the second bag-house sample was low haze. I think at 10,000 ft and 3,500 to 4,000 ft in the second bag house. That's the quick summary that I have.

PH: Good. We did essentially what we planned, even though it was late in terms of the Terra satellite overpass because of a delay in getting approval from Langley. We didn't go out over the buoy 44014 for the vertical profile. We did that over the Chesapeake Bay lighthouse, also BRDF measurements and chemistry measurements at two levels. We did another BRDF off the Delmarva Peninsula.

We had quite a few problems that made the flight difficult: lack of communication, initial bag house problem which was subsequently fixed, and a few other things that seemed to have gone awry in the transit flight from Seattle. Ray, can you summarize?

RW: Yes. I've got PSAP, two CN counters, preheater for the neph ____, TSI neph or the CE neph and another neph. The CNC-2 seems to have an overheating problem. It's down now again and there seems to be we've got to get more flow to the ________, but pretty much everything worked other than that.

PH: Good. So you'll be working on those. Art, a quick summary.

AR: Roger. This was a day with weak offshore flow that was southwest to west-southwest up to about 6,000 ft and then turning northwest above 6,000 ft. Below 6,000 ft averaging about 5 to 10 knots and about 15 to 25 knots estimated at 10,000 ft out of the west-northwest. Interesting haze distribution was that it was well-mixed in the landward portion of the BRDF circles and noticeably stratified within a few miles offshore of the coast.

END OF TAPE

(b) University of Washington Flight 1871 (July 20, 2001)

PH: We're going to be landing fairly shortly, so let's start the brief summaries. Brian, you go first. Brian or Ray. Okay. I'm going to go.

We pretty much followed the plan that was laid out for this flight, which was a coordinated flight with several other aircraft including the ER-2, which focussed on the Convair-580 doing a vertical profile over the lighthouse. As planned, we went out at 6,000 ft, dropped down over the lighthouse to 600 ft, and did four CAR turns at 600 ft. I should mention we had significant cloud coverage, cirrus, today. So that affected the flight, but we did the best we could given the situation. Then we climbed up to 10,000 ft and subsequently did horizontal legs for chemistry measurements at 6,000 ft and then 2,400 ft, each of which was about an hour long. Very low aerosol loadings today. A total optical depth clear of the clouds of about 0.1. Then we descended to 100 ft, got beneath a hole in the cloud prior to and at satellite overpass time. We are now, after the satellite overpass time, trying to pick out a hole for total OD measurements. Shortly, we'll be heading back at 2,000 ft to Wallops.

The next one up for a summary.

BM: I can go, Peter.

PH: Good.

BM: For the filter summary, Teflon filter #3 and quartz-quartz filter holder #3 sampled 2,800 liters of the haze at 6,000 ft. This was the haze that had a characteristic scattering of about 3×10^{-5} per meter. The sample times were basically start and stop times anyway were

12:52:20 to 13:45:29 with intermittent times where the sampling was paused for bag house refills. The second filter set we used today was the Teflon filter #5 and quartz-quartz filter holder #1, 4,000 liters of haze sampled at the 2,400 ft haze level, which had a characteristic scattering of about 1 to 2×10^{-5} per meter. It was a little lower than the 6,000 ft layer. The start and stop times for the total sampling were 14:00:53 to 15:31:27. So we had a considerable amount of time on that layer and, in fact, six bag-house samples were passed through those filters, whereas only four I think were passed through the first set. So hopefully that extra time got enough mass on the filters for analysis. The computer did go down during the second filter set, but basically it was right in the middle. I had already reached a steady state and just let the filters do their work. So the flow rates can be easily extrapolated and just with the assumption that the flows were the same. I don't that that will be a problem.

BM: Teflon filter #6 is a chemical blank that's sitting in the flow meter manifold that started at 15:32:50 and I'll probably remove it shortly. As far as the trace gases, the carbon monoxide or CO looks fairly bad. I don't know what's wrong with it. I'll e-mail Ricky Sinha about that. SO_2, CO_2 and O_3 are all looking okay. They are at least registering some values. The CO_2 is maybe a little bit high, but again I'll check with Ricky who knows quite a bit more about that than I do. That's the filter summary.

PH: Okay. I'll just mention that one of the five inverters broke down. That was the reason for the computer going out a couple of times for short periods. It was during that long horizontal leg at 2,400 ft. Things were pretty uniform there. I don't think it affected any of the measurements very much, although they were lost from the computer at that time. Then we switched the inverter and got back on track. Jens, do you want to summarize?

JR2: Sure Peter. Well, the sunphotometer was turned on at 11:11 UTC. Our broad summary is that we only got a few brief moments of data that were not cloud contaminated before the satellite overpass time. During Terra satellite overpass time, we were at the surface and got about 8 min of continuous good data with optical depth as Peter said about 0.1 or so. The instrument looks very good. It's working flawlessly. That's it.

CG: Peter, I can go now.

PH: Okay. Go.

CG: Thank you Peter. This is the summary of CAR measurements today, July 12, on flight 1871. Also my colleague Tom Arnold was flying for the first time. Now the measurements that we did include BRDF at the lighthouse. We did four orbits and we locked the filter at 1.6 micron. As Peter noted, there were significant amounts of cirrus clouds above us, but nevertheless we will see what we can do that. The rest of the flight I did the starboard measurements especially when we were doing the vertical profiling. That will also be useful. During and near the Terra overpass, we were doing the downward imaging measurements and this will be good for characterizing the whitecaps and also at some stages during the circling. Now physically that was very good. Overall the instrument never had any problem. The only problem to report was the navigation data, which of course was something that was out of our control. Let me turn it over to Tom Arnold so he can say a point or two based on his experience.

TA: Thanks Charles. Charles pretty much covered the science points. I just want to add that I've worked with CAR data and data from this aircraft for a long, long time and never had a chance before to fly on it. It's nice to have that experience and I think it's useful from a standpoint of using data…(END OF TAPE 2, SIDE 1)…I admire you guys the skill that you have for that and the skill of the pilots and it gives me a better appreciation when I'm using the data. So that's all. I say thank you for a great flight.

PH: Thanks Tom. Nice to have you onboard. Ray or maybe Andrea wants to do a summary.

RW: I don't have anything to say. Everything worked just fine.

PH: All the instruments worked pretty good today. I wasn't aware of any dropouts. We'll look at those in post analysis. Andrea? Speak up Andrea. Get it right up against your lips otherwise we won't be able hear it when we transcribe it.

AC: Can you hear me?

PH: Yes. Speak as loud as possible. Get the mike right on your lips.

AC: I sampled one filter while waiting the hole to fill and two more coming to the lighthouse in an order and going back to the lighthouse. The reflectometer worked well. But the ASD I have some problems with the software. It stopped it sometimes. That's it.

PH: Good. Art, you go ahead.

AR: Yes. You're seeing this post-frontal day, the frontal passage yesterday afternoon. The wind shifted to the northwest. The wind shift, that northwesterly wind, continuing this morning at least along the coastline. Then out over CLAMS during our BRDF we noticed the drift of the aircraft was toward the southwest indicating northeasterly winds at the surface by the lighthouse. Further up the winds backing to the west at 10,000 ft at the top of our climb there. The sky condition today was generally overcast in cirrus. At first glance, it looked broken, but even such as right now if you look at the thin spots at what appear to be blue spots such as over the aircraft as right wing right now you see it's actually filled with a vellum of ice crystals and that's pretty much what plagued us all day in terms of trying to find a good spot for Charles' BRDF and for Jens' sunphotometer measurements, until true tiny holes popped up here at the end and some of them are getting a little bit larger now as we end our flight toward shore. One thing I did notice was a lot of gradient in this. I guess I shouldn't be surprised that as we flew to the north the air cleaned up and that was especially so in our long-range trek to find a hole. The air cleaned up quite a bit. Visibility improved to probably greater than 40 nautical miles here near the surface, whereas down at the lighthouse it was really quite hazy, visibility probably less than 20 nautical miles and haze and smoke down there. So that was a recurring feature that when we went northbound or northeast the air cleaned up all the way up to 6,000 ft and when we went toward the southwest or south the air tended to be a little more dirty. The layers again as mentioned before topping out around 6,000 to 7,000 ft that being the main haze layers and then below that stratification until about 2,000 to 2,500 ft where there was something in the way of a marine boundary layer and pretty well mixed below that level. I did not see any inversion, however, in the temperature trace. Plotting and vertical profile temperature was not capped as it sometimes is. The marine boundary layer by some strong inversion looks like any strong inversion or at least stronger inversion was up around 6,500 to 7,000 in this sort of post frontal subsidence mode at least in the middle troposphere.

AR: I think that's about all I've got to say. The surface winds are pretty consistent throughout the whole flight and velocity being estimated something around 10 to 20 knots, something like that, on the surface. Scattered whitecaps.

4:17 PM

AR: This is an addition to my summary, which I didn't mention. At 2,400 ft I observed something that looked like a tire fire go off on the coastline upwind about 15 miles or so.

AR: It probably only burned for about 15 to 20 min and then went out, but the plume it left actually had quite an impact on our flight track because it then drifted downwind and I tried to follow it visually, but it got ahead of me. It thinned out enough where I couldn't see the leading edge was in our track. So we got burned up in our sampling by what appeared to be a very black like a tire fire-type fire that burned momentarily, produced a little cumulus on the top there at its heated peak and then went out. It caused us quite a bit of problems.

4:18 PM

AR: Peter, on my summary I added a little note about what appeared to be a tire fire and the effects it had on our flight.

(c) University of Washington Flight 1872 (July 14, 2001)

4:49 PM

PH: I'm going to do my summary for this flight. We took off from Wallops at 10:40 local time as planned and climbed to 10,000 ft as we headed out toward the COVE lighthouse. Over the COVE lighthouse we descended initially at 500 ft/min in clear sky conditions. Because there wasn't much aerosol around we increased the descent rate to 1,000 ft/min and ended up at 100 ft above the ocean surface. We then did 100-ft runs oriented roughly from southwest to northeast just going a little distance beyond northeast beyond the lighthouse. We cut that northeast leg short because of cumulus clouds popping up. So we were over the lighthouse about a minute before the Terra satellite overpass time, which was at 15:42. We continued the 100-ft legs backward and forward for another 10 min or so. We then headed out to the designated site northeast of COVE for the BRDF CAR measurements. We had to shift the location a little bit away from the designated site because of cumulus; but we did six turns there, and apparently the CAR was working okay. We then climbed up to 2,000 ft and started to head out toward the Great Dismal Swamp where we had planned to do another series of BRDF measurements. But we were told by Control that it was clouding over there and we saw that as we headed out toward the Great Dismal Swamp. So I agreed with Control to cut that portion of the flight out and instead to save flight time and head back to Wallops, which we're now doing, currently at about 3,500 ft. We intend to try to do the radiosonde calibration over Wallops. We'll try to follow the balloon up to about 10,000 ft and then we will land.

Anyone else want to jump in to do a summary?

4:56 PM

JR2: All right. I'll go ahead and summarize the AATS-14 sunphotometer measurements for today. I unparked the instrument at 14:37 on the tarmac at Wallops to take measurements coincident and co-located with the Cimel Aeronet sunphotometer that's somewhere on base. I don't know the exact location. I can't report any AODs here because we were not getting a pressure feed from the aircraft at that point yet because the data system wasn't up, but they seemed to roughly between 0.1 and 0.2. So low aerosol optical depth on the ground. We got a good profile at the lighthouse. At about 15:03 optical depth at the ground were still no larger than 0.1. Then we did these horizontal legs at the lighthouse during which optical depth varied from 0.08 to 0.1. The instrument performed beautifully. It was tracking well even in turns and I'm looking forward to possibly another spiral here in conjunction with the balloonsonde calibration. That's it for the AATS-14.

PH: Is anyone else on the headset that wants to do a summary, Charles?

CG: Give me a few minutes please.

PH: Ray or any of the engineers, Brian, Andrea?

RW: Yes.

PH: Want to do a summary?

RW: Okay. The only problem with the aerosol rack really is on warm-up the MS 3-wavelength backscattering nephelometer seems to have some trouble at low concentration. I can't change the time constant because the switch is broken, but we'll fix that. Other than that, everything seemed to work pretty well.

PH: Yes. I wasn't aware of any instrument problems. At the beginning there was some problem with the UV up and down, but that got sorted out and it was making more sense fairly soon into the flight. I was just looking at the neph and the CN readings and the radiometers all looked reasonable. Art will do a squawk list following this flight, although he's not on board.

4:59 PM

PH: Is Andrea on the headset or Brian?

AC: Yes. I integrated one filter for the whole profile for about 1 hr and another one coming back.

PH: So that was a pixie or filter. What did you call…(END OF TAPE 1, SIDE 1) …those for Vanderlei for pixie and other particle analysis. Is Brian on the headset?

BM: Yes.

PH: Okay. Summarize.

BM: At 15:13:58, I started Teflon filter #7 and Teflon filter #8 on the new continuous ports that Steve Domonkos installed between SAFARI and this field campaign. Teflon #7 was sampling off continuous port #1, flow meter #2. Teflon filter #8 was sampling off continuous port #2, flow meter #3. The start time was 15:13:58. The stop time was 16:13:31. They sampled about 5,000 liters of haze during the photometer legs and the CAR turns. The second filter set I'm exposing is just another simultaneous filter pair except this time two quartz pairs. So quartz-quartz filter holder #2 and quartz-quartz filter holder #4 are being exposed currently. They're on continuous port #1 and flow meter #2 and continuous port #2 and flow meter #3. The start time was 16:15:30 and the stop time, well, I'll stop it after the vertical descent following the balloon. This is just a sample of, I guess, it pretty much started right after the CAR turns and then it went over the land just basic haze kind of sample. Nothing too interesting, but just sampling for the sake of continuity.

PH: Good. Any comments from the engineers on the flight?

DS: Everything seems to be working pretty well. Still having some minor problems with the TANSvector staying locked onto a single satellite for a pitch and roll, but we are working on a method for dealing with that.

CG: I can give my summary on the CAR measurements, Peter.

PH: Go ahead.

CG: Thank you. This is the flight summary for the CAR measurements on flight 1872, which was initially tended for BRDF at the lighthouse and second BRDF at the Dismal Swamp. The BRDF at the Dismal Swamp, which was done at 36.94˚ S and 75.69˚ W, was successful. We had a very clear spot over the lighthouse; no clouds and everything went well. Now the second type of measurements that I think were useful during this flight were for the sun glint measurements. These were done on the return from the area where we turned back from the Dismal Swamp. So on our way back to Wallops, we had a very good heading, which delivered the sun glint measurements. Now overall the instrument performed well other than a small few problems initially. The power to the computer had no power. That needed to be started up, but other than that ready for the measurements. Also, I had filter wheel problems and they remained. The filter wheel failed for around 10 min and then came back on again. I suspect that I had a power failure and so after fiddling around with the cables it seemed that the power came back and started working again. So other than that, I'm disappointed that I was not able to get clear weather over the Dismal Swamp and I hope to get another opportunity to repeat or to do those measurements. Thank you, Peter.

PH: I think that's the end of the summaries.

(d) University of Washington Flight 1873 (July 16, 2001)

7:15 PM

PH: I'm going to start the summary. The purpose of this flight was to try to get into some clear sky conditions to do BRDFs and AOD measurements beneath the AVHR satellite overpass, particularly out over buoy 41001. However, because of increasing cirrus cloud, both in thickness and in coverage, we didn't achieve very much of that. We went out to the lighthouse. It was too cloudy there to do anything, so we proceeded out to buoy 44014 and we looked for a clear spot there for BRDF measurements, but couldn't find one. We then proceeded on toward buoy 41001, the far buoy. It was still pretty cloudy and about a third of the way out toward that buoy, from the near buoy, the Proteus had problems and so we had to stay at that location, where we're now doing a 100-ft run at this time. Got a clear spot here. We're still trying to get good AOD as we approach Wallops, but clouds are still around. Anyway, to continue, because of the Proteus problems, we weren't able to proceed out to buoy 41001 plus it was pretty cloudy, cirrus clouds. While we were waiting for word from Control on what to do, we did do seven BRDF turns at 35˚58.6'/73˚59.68'. We also climbed up to 10,000 ft at that location to get a vertical profile of aerosol measurements, but still too cloudy to get good AODs. We're still running at 120 ft here. Then Control told us to return to Wallops, which we proceeded to do at 9,000 ft, which was an upper-level haze layer. At a point some distance east of the lighthouse, we found an open clear sky area and we started to do a descent to get AODs, but then Control indicated that they didn't want to spend the aircraft time doing that. We had hoped to do an AOD and a BRDF in that hole. So, against my better judgement, we stopped before we had completed the AOD and BRDF and instead we're heading back toward Wallops. We have descended from 9,000 ft down to 100 ft but still encountering patchy cloud en route.

Other summaries step in.

BM: I can do a summary.

PH: Go ahead.

BM: For the filter summary, we exposed one set of filters, quartz-quartz filter holder #1 and Teflon filter #9. Began at 17:02:30 and the total process was stopped at 18:02:49. This was five bag-house samples each lasting about 10 min or so. The total volume was about

4,000 liters of air sampled and the air was the low-level haze that we were flying through en route to the buoy. So that's the only one we exposed. I exposed two blanks as well and this was simply loading Teflon filter #10 and quartz-quartz filter holder #5 onto the filter on the flow meter manifold and just letting them sit there for about 30 min it looks like. So the start time there was 18:04:50 and the stop time was 18:40:15. Other notes, the bag house wasn't operating toward the end of it because of the high pressure inside the cabin. The cabin was slightly pressurized compared to the outside environment. So we weren't able to really do any sampling of the upper-level haze, only the lower level haze today. Another note, CNC-1 is also out of butanol, so the results are the data from that are not valid for flight 1873. Just to summarize the trace gas chemistry for the sake of Ricky, I sent an e-mail to him including data from the first few flights and his analysis was that basically CO_2, SO_2, and O_3 are all steady. CO_2 is a little bit noisy, but he says the fluctuations seem to have a mean value that's to be expected. The CO, however, is not operating very well. There were negative voltages. So on Ricky's advice, I increased the CO zero (electrical zero) to 25 higher than what it was before. Before it was reading 552 and now it's reading 577. So it still doesn't look like CO is working very well if you happen to look at the CO data for this flight. It's very noisy. Voltages are positive most of the time or close to zero anyway, but they're just very noisy. So I'll talk to Ricky again. Maybe I'll just increase the zero again, which he also recommended, if the first increase didn't work. That's pretty much the summary for trace gases and filters I think.

PH: Even though the CNC-1 was not working in an absolute sense, it was following tracking pretty well the CNC-2 fluctuations. Jens?

JR2: This is summary for AATS-14 measurements on board the CV-580, flight 1873. Due to the kind collaboration of the pilots, we were able to run the instrument on the tarmac over at Wallops. We collected some ground data that I don't know the quality of at this point without looking at a screening. The optical depth there seemed to indicate to be around 0.14 or so. During almost all of the rest of the flight until about 1,845, there were cirrus clouds present in the data, some of which might be filterable and others not. We started a profile at about 1,900 that was cut short as Peter indicated and we still might have salvaged it by descending on our way to Wallops, although toward the end there were some clouds…(cross-talk)…give any indication of optical depth at the end of that. Altogether the instrument was tracking well and that's the summary for the AATS-14.

PH: I don't think you mentioned the AODs that we did get were higher than we've seen previously.

JR2: That's correct, although it's a little hard to put a lot of confidence into them at this point.

PH: What would be your estimate of the aerosol depth today?

JR2: At the end of this last descent, it looked to me it was somewhere around 0.25 maybe.

PH: Okay. Charles?

CG: Yes.

PH: Summary.

CG: Yes. I'm going to give a summary of the CAR measurements today, flight 1873, on July 16. I started measurements at 16:47 UTC. The instrument worked at the starboard for most of the time during this flight. The filter wheel was set to automatic mode to sample five times at each of the six filters of the wheel. We did one BRDF at 17:56 UTC at 35.98˚ N/73.99˚ W, 600 ft above the ocean surface. The filter wheel was locked at 2.2 microns during the first three circles and then changed to 1.6 microns for the last of the circles. The ocean surface looked pretty uniform, but we had deep cirrus above us especially during the last three circles. Overall the instrument was working, but we seemed to experience data corruption. However, it appears to me that we didn't experience any data dropout of the kind we experienced during SAFARI-2000. I discussed this problem with Grant Gray and Grant is willing to discuss it further with Horace Jones, our engineer, to explore possible fix of the problem. Now this problem was initially noticed towards the end of flight 1872, but it was not clear to me what was going on until after the flight when I did the processing of the data. Our engineers have been informed and my assessment of the problem at the moment is that it should not stop the show and I'll continue to take measurements unless the situation deteriorates. So this brings me to the end of my summary for today. Thank you.

PH: Ray?

RW: The nephelometers worked real well. They laid on top of each other for the entire flight. As Brian mentioned, CNC-1 looks like it ran out of butanol partway through the first part of the flight. It's been pretty much been reading zero. Everything else seems to have worked just fine. Single-scattering albedos seemed to be around 0.9.

PH: Andrea?

RW: She's doing something right now.

7:31 PM

DS: Well, on the engineers' side, everything looks pretty well. We'll have to take a look at the upward UV radiometers and see if we're having a problem with the pre-am. On a bright note, at least we didn't go through an entire audiotape.

PH: Good. Yes. Up and down UV.

DS: The downward looks to me like it might be fine. I'll take a look at it as well. It's more reasonable than the other one.

PH: I think it's too low. It's way down near zero watts per square meter and it should be up near many tens.

DS: Okay. Anyway there are a couple of things that I'll look at as far as those two are concerned.

PH: Do you want to put anything on the tape, Andrea, about this flight?

AC: Yes. I've got one sample, the gradient basically the whole flight, and another one coming back.

PH: Good. I think that's it for summary.

PH: We had a different vertical profile on the way back than the one on the way in. On the way back closer to the lighthouse, it was a more uniform neph readings up to 10,000 or 9,000 ft compared to the more structure that we saw farther out where there was a higher neph reading up to about 5,000 ft, then falling off, and another layer at about 9,000 ft.

7:42 PM END OF TAPE

(e) University of Washington Flight 1874 (July 17, 2001)

5:05 PM

PH: I'm going to start the summary here. This mission was in support of the Terra overpass, which took place at 1614 UTC. We essentially did everything that was planned and on time, which included the following: proceeded out to the lighthouse (when I say "the lighthouse" I always mean 2 nautical miles northeast of the lighthouse), proceed to that point, which was 36˚57.3'/75˚37.5'. There we spiraled up to 11,000 ft over that point. We then descended and did height-resolved chemistry measurements near 9,000, 6,000, and 3,000 ft, and again near the surface, but the surface measurements were integrated horizontally over quite a distance and also incorporated the CAR turns at 600 ft. After descending from the chemistry measurements to 100 ft, we did a pass at 100 ft oriented east to west and back again through the lighthouse. We were very close to the lighthouse at the time of the Terra satellite overpass. We did a BRDF over the lighthouse and we're now preceding to Dismal Swamp to see if we can get a BRDF there.

BACK TO MAIN TEXT

5:14 PM

BM: Peter, can I go ahead with the summary for the filters?

PH: Yes. Please do.

BM: Filter summary for this flight. The first filters exposed were quartz-quartz filter holder #2 and Teflon filter #11. It was started at 134230. The whole thing stopped at 142330. This was three bag-house samples of the upper layer haze, 9,000 ft level or so. The second filter set was quartz-quartz filter holder #3, Teflon filter #12, started at 143309, stopped at 151106, three bag-house samples of 6,000…

BM: Filter summary continued. So that second filter set was the 6,000-ft haze level. The third filter set we sampled with was quartz-quartz filter holder #1 and Teflon filter #13. It started at 151938, stopped at 155620, and this was three bag-house samples of 3,000-ft haze level. The fourth filter set was quartz-quartz filter holder #4 and Teflon filter #14. Started at 160622 and stopped at 165115. This was four bag-house samples of the 100 to approximately 400 or 500 ft haze level, so very lowest layer. The fourth filter set was a chemical blank started at 165216 and it will be stopped at about 30 min after that point, which hasn't happened yet. So that's the filter summary. Just a couple of quick notes. The CO's zero was reset again for this flight. This is something that has to be re-calibrated each time the zero is reset. It was set to 630 wherever it was last time, 575, I think. Still CO is very noisy and the results don't look any good at all. No DMPSs were taken on this flight due to problems with the DMPS's CN counter. That's all I have.

PH: Jens, your summary?

JR2: This is the summary for ATTS-14 measurements on July 17, UW flight 1874. Above the never frozen tundra of the Virginia swampland, the blue and enforced Husky 1 team was able to take excellent aerosol measurements. The exact magnitude of aerosol optical depth during overpass time of the Terra satellite will be disclosed in a science paper to follow. On a more serious note, we have excellent measurement during all three chemical sampling legs. We went down to 100 ft at about 250 and got a beautiful aerosol optical depth gradient that in aerosol optical depth extended from 0.36 to about 0.46 on a low-level transit leg roughly oriented east to west hitting the COVE lighthouse 45 s before satellite overpass.

JR2: Sunphotometer summary continued. At 1613 UTC, we did another COVE flyby with about optical depth of 0.46 again and after that we did a nice zigzag pattern in the vicinity of the lighthouse.

JR2: On that zigzag pattern, sunphotometer measurements also looked very good. Finally during the CAR turns at 1705 UTC, aerosol optical depth was somewhat variable between 0.38 and 0.43. That concludes the sunphotometer measurements.

PH: Good. Anyone else want to give a summary? Art?

AR: Okay. I'll just do the weather here. I won't talk too much.

(PH: That will be a change!)

AR: Pretty typical east-coast weather. A Bermuda high, lobe extending into the southeast producing a southwesterly flow in the low levels along the coast, humid southwesterly flow. Above that a 700 mb trough with westerly flow over us and higher up the cirrus also embedded in the trough, but the apex of the trough being a little bit further offshore and the flow at cirrus level being more from the west-northwest. Generally with no disturbances around, however, the sky was generally clear. There were two moisture streams generally far to the north and far to the south of us, so the experimental area worked out to be nicely clear with the exception of a few isolated patches of cirrus and altocumulus.

AR: Surface winds were surprisingly strong considering the models weren't forecasting much gradient offshore. We had something like 10 to 20 knots in the vicinity of the lighthouse and 15 to 25 knots at the surface out at the east endpoint. Those values tended to I didn't notice them decreasing at the east endpoint, but at least during the day possibly with the onset of the sea breeze regime the west end became very calm with no whitecaps visible whatever near the coastline. Probably about 5 knots of wind there from a direction I actually couldn't tell, but probably might have been turning to onshore. There was a shallow inversion right near the ocean surface, 600 ft to 1,000 ft somewhere in there. That trapped the true marine boundary layer down there, but there was a minimal slot between that and the next haze layer, which was very well mixed and extended up to just above 6,000 ft as I recall. Then above that it was very layered and many, many fine slivers all the way up to about 12,000 ft and very complicated structure. I didn't see any temperature perturbations with those layers, but anyway it was very complicated. Probably the last thing that I noticed was that flying level that some of the layers we tried to center on the bases would tend to rise and then fall giving the impression of perhaps more horizontal inhomogeneity than was actually there just because…

PH: Hold on, Art. Charles?

AR: Anyway it was complicated with the real horizontal gradients that existed. The fact that the airplane sometimes was flying a level path and the haze layers lifted and descended to give the impression of more horizontal inhomogeneity than there may have been.

BACK TO MAIN TEXT

5:36 PM

PH: Continuing the summaries. Ray or any of the engineers, anyone else want to come on.

GG: Just wanted to point out that the UV down was scared into submission. Apparently there was a bad connection in there. Everything else seemed to work pretty well.

PH: So was it working?

GG: It's been working all day. No. It wasn't working before.

PH: Do you think it was not working on any of the previous flights?

GG: It was up to a certain point. I can't say exactly when because we were getting data from it. But when I looked at it a couple of flights ago, it wasn't working. We tried a couple of things. Then Don tightened up a screw yesterday we thought we'd see how that worked and it was still intermittent, but we did a little bit more probing around and it came back online.

PH: Good.

RW: Just one comment, two of the CN counters are not working, CNC-1 and the DMPS counter. It could be heat.

PH: No idea why CNC-1 is not working?

RW: No. It's just a reading off scale just like the DMPS one is.

DS: The only thing they have in common is that it's pretty warm right there.

5:38 PM

CG: Peter, I can give a very short summary.

PH: Okay. Go.

CG: This is flight summary for CAR measurements. I started the CAR measurements at around 1245 UTC. This was a flight with a mixed track. Initially I started with two problems. Now the first one was data corruption and the second problem I experienced was the cryo-pump not cooling the detector at #9. There was a definite improvement after the first one of our measurement. The cryo-pump started working again remaining that way up to the time we were doing the first BRDF over the Dismal Swamp. I lost it again and after 1 min it came back again. So it was behaving erratically throughout, but nevertheless I think we can get some data from it. Now at around 1608 UTC for the 20 min before overpass time, the data corruption problem vanished and I had things working even the time we did the two BRDF, the first one at the COVE lighthouse and the second one at the Dismal Swamp. Generally it has been a flight that was difficult for me, but I hope I'll have data for the two places we did the BRDF. So thank you, Peter.

PH: Good.

5:40 PM

PH: Andrea, do you want to give a summary?

AC: I sampled five filters. The first one integrating the whole profile going up until 10,000 ft. The other four, one for each level and two 100 ft.

PH: Just repeat the last sentence.

AC: The first one I integrated the whole profile until 10,000 ft and the other four filters I integrated one for each level and two at 100 ft, the last one.

PH: Okay. Fine. Do you want to say anything about any problems you had with the other continuous filter?

AC: The reflectometer worked well at the beginning until 10,000 ft and then I could make some measurements not continuously and then above the continent it started to work continuously again.

PH: Okay. Thank you. I think that's the end of the summaries.

5:43 PM

(f) University of Washington Flight 1875 (July 23, 2001)

3:56 PM

PH: I'm going to do the summary. This was a rather short flight and the basic objective was to get beneath the Terra satellite, out over the ocean, for the overpass at 11:35 LT or 1535 UTC. We climbed to 5,000 ft on the way out. We then descended and looked for a clear area, which we found out about 80 miles or so more east of Wallops. We then did our low-level run beneath the satellite for about 35 min. For about 35 min from 1520 to 1554, we were running at 100 ft backwards and forwards on about 25-mile tracks. We're now climbing to 10,000 ft over that same area.

So the satellite underpass was done successfully. Prior to that at the southwesterly point of our 100-ft transects, we did six circles for BRDF measurements over the ocean between 1500 and 1617 UTC. We're now climbing to 10,000 ft to complete the mission. We had very low aerosol optical depths here, estimated to be about 0.05, but quite a bit of water vapor above us. So we're climbing up primarily to the water vapor profile. Then we'll be heading back to base. Anyone else can step in.

CG: Let me do the summary for the CAR.

PH: Go ahead.

CG: I'm going to give a flight summary for our measurements today, July 23. We accomplished several things. First of all it was an excellent opportunity for us to test the instrument since it was repaired yesterday, July 22. From the measurements we've done and from our visual inspection, it appears that all the changes are now back to normal. So we'll be ready to do the BRDF over the Dismal Swamp once we get that opportunity. The second thing that we have accomplished is the BRDFs that we did over very clear skies, 600 ft above the ocean, done between 1502 and 1517 UTC at latitude 97.83˚ N and longitude 74.34˚ W. For most of the other times, we were doing the starboard imaging and this also was true during the time of satellite overpass. So that's the end of my summary. Thank you.

PH: Jens?

JR2: These are the sunphotometer measurements, the summary thereof for flight 1875. The instrument was unparked and was tracking as of 141230. I'm running the instrument today at the highest data rate, which essentially gives a data point every 2 s. Optical depth, as Peter mentioned, were very low during the first set of BRDFs. Optical depths were 0.04 to 0.05. At these very low optical depths, the error bars are about 20% or more. So that's a very preliminary value. During the satellite overpass we did not see much of a gradient per se, although there was variation between 0.05 and 0.08 in optical depth. Currently, as of 1605, we are working on a very nice water vapor profile. I think that will be it.

PH: It looks nice. A linear profile there.

JR2: Meaning very well mixed or homogeneous profile.

PH: What about the ozone?

JR2: Don't have that in flight.

PH: Okay. Brian or anyone else who wants to jump in.

BM: I'm still running the filters, but I'll go ahead and summarize since it's only one. Started Teflon filter #16 on flow meter #3, bag-house port #2, and quartz-quartz filter holder #1 on flow meter #2, bag-house port #3. At 141930 UTC, this is intended to be an integrated sample of whatever haze that we were flying through for the entire flight generally at low levels. I'm on the seventh bag-house refill that I'm passing through the filters now. All the bag-house samples have had very low scattering in the order of 10^{-6} to even 10^{-7} in their last sample. So I can't imagine that there's very much loading on the filters. Incidentally, Tom Kirchstetter, the fellow who is doing the quartz filter analysis, has e-mailed back and said that the quartz filters are receiving just barely above the minimum for the signal-to-noise in order for the filters to be analyzed. So it would be helpful to have more on the filters. He said that Song Gao, who does the Teflon filters, is happy with what he has so far. So I'll just keep on doing the same thing with him, but I'll have to think about what to do for the quartz filters.

BM: One other point to mention is that the bag-house nephelometer is on the data system now. It's under "bagnep". It's interesting to look at that only because it's reading ambient values basically at ambient RH, so we're actually getting a sense of the humidification factor of the aerosol since the MS neph, the neph green variable in the data system, is reading dried aerosols. So we can actually more or less gauge humidification factor by combining the bag neph and the MS neph together.

PH: Yes. That's good. At what flight was that put on? Is this the first flight it has been on?

BM: This flight is the first flight that the bag neph is on the data system.

PH: Andrea or Ray?

AC: Like Brian, I integrate only one filter for the whole flight from the bags.

PH: Okay. So that's one filter for the pixie and electron photographs.

4:14 PM

AR: I think with the weather situation the light variable winds all the way up where in the middle of an upper-level trough, a very, very weak one with northerly flow in the western part of the state of Virginia and southerly flow on the eastern part. It's a very narrow if high amplitude trough that extends all the way down into Florida and along with that we say almost no wind on the water out here. It was probably less than 5 knots for most of the flight and very little cloud movement. The altocumulus that I was watching barely changed position during the whole duration of the flight. The only thing I've noticed as far as haze layers go, which is probably of no consequence, is that we just barely underflew a haze layer on the way out here until we cleared the coastline and then it seemed to just disappear. We didn't intersect it, it didn't slope down, it just ended and, what there was, was all below us. So that was a little different than we've seen before. That is not having the haze layer change heights and still be present during all of our legs. It just seemed to end and that was toward the coastline. That maybe reflecting the light variable winds, the continentally produced plumes are just not getting offshore very much. The wind was supposed to be southerly at altocumulus level of about 5 knots today or so. So whether that actually happened or not is hard to say, but you can see that higher up from the very biggest cumulonimbus plumes and that tops that is of taking off toward the southeast showing that aloft wind was say at cirrus levels from the northwest. I guess that's about it. Of course, a very tropical day. The dew point is back around 70˚ at Wallops Island, which we hadn't seen for quite a few days. They were showing themselves now with the upper-level trough overhead and a rather steep laps rate and you set off that latent heat and off they go in these big turrets you see, which are probably going to compromise any chance to fly over the Dismal Swamp.

PH: Any comments, Tom, on the flight?

TW: Everything looked like it was running okay.

PH: Is someone looking at the video and the audio and make sure that's all okay after each flight?

AR: I looked at some video. I guess it was the before yesterday I looked at one of the flights. We have not checked the audio as we should probably be doing.

PH: Yes. Please do that.

AR: Roger.

JR2: Also for the record, we cleaned the sunphotometer and the upward-looking Eppley radiometer the day before yesterday, so before this flight essentially.

PH: So this should be a good calibration flight for the Terra/MODIS very low aerosol levels. I think basically a good set of in situ aerosol measurements as well as sunphotometer measurements.

(g) University of Washington Flight 1876 (July 25, 2001)

Flight aborted on runway due to ER-2 canceling because of thunderstorm potential in Wallops area.

(h) University of Washington Flight 1877 (July 26, 2001)

12:13 PM

PH: Because of the problems in not recording roll angle or lat/long and various other measurements, we're heading back. It's a marginal situation here anyway. It's broken cloud. Also, the ER-2 flight is scraped. I don't know why. Anyway, we're going to head back and try to fix the problem and get back up in the air as quickly as we can. So no one should leave the hangar until we've decided what the rest of the day is going to be.

[Problem with computer recording data. Turned back to Wallops before reaching Chesapeake Bay lighthouse. No data recorded.]

12:32 PM END OF TAPE

(i) University of Washington Flight 1878 (July 26, 2001)

6:22 PM

PH: I'm going to start the summary of UW flight 1878, the second flight today, on the 26th of July. We finally got our computer problem fixed. The engineers did a great job on the ground and we got up again at 1535 UTC. Headed out in somewhat of a rush to get under the satellite underpass, which we did, just east of the COVE lighthouse. We then headed out toward the buoy 44014. We did a 100-ft run before, during and after the Terra satellite overpass, which was at 1607 UTC. We lucked out in getting clear skies. The cloud was to our west and didn't really interfere with us for most of the flight. After getting out to the buoy, we did a slow climb at 300 ft/min up to 10,000 ft. Unfortunately, Vanderlei's absorption measurements, which that slow climb was intended to accommodate, apparently wasn't working fully and those measurements were terminated sometime during that ascent to 10,000 ft. Anyway, it gave us a good vertical profile of all the rest of the things we were measuring including a good sunphotometer profile. We then did a descent at 1,000 ft/min down to 100 ft. We got another OAD measurement. Because we could not do any more work at low levels, because the OV-10 was now in the area, we went up to 2,200 ft, which was a region of relatively high light-scattering values. We did some chemical sampling there in a triangular pattern going intercepting the buoy for about 40 min or so. We then descended just southeast of the buoy to about 600 ft, found a cloud-free area and did a whole set of BRDF turns, maybe 6 or 8 turns there for BRDF measurements. We then went down to 100 ft and did a level run east in clear skies at 100 ft to get a final AOD measurement. At that time, we were informed through CLAMS Control that we should return to base because the OV-10, which was our communication aircraft, was going back to base. Also, weather conditions were deteriorating at Wallops. So we climbed back up to 2,200 ft over the buoy and are now heading back at 2,200 ft and collecting more samples on our filter to supplement those that we collected earlier on at 2,200 ft. That's my summary. People can jump-in in turn and give their summary for the tape.

AR: Well, finding a clear spot today wasn't too difficult with a nice satellite imagery that we had. The edge of the clouds when we took off was right by the COVE lighthouse, Wallops being covered by stratocumulus clouds and a few altocumulus clouds above that. Then east of the lighthouse it was pretty much clear in an elongated sort of elliptical clear area probably running 50 miles wide by maybe 100 nautical miles long. So it would have taken some bad meteorology on my part to have missed the clear air. The unusual thing today was the surface winds being 20 to 30 knots on the water, numerous whitecaps, and at 2,200 ft we were indicating 220 at about 40 knots. So it's an unusually strong wind situation for this area this time of the year.

JR: Is everybody sick back there yet?

PH: Have you finished with the waggles there?

JL: Yes. I say I'm finished now.

PH: Okay. We're all sick back here, so you can level off, Jerry.

AR: I don't know whether we'll see any large particles down in those 100-ft passes that are of greater concentration than we've seen before will be of interest. The other thing, along with that clearing, it seemed to me to resemble one that we saw in TARFOX, which was not surprisingly a mesoscale area of clearing being associated with some downwelling and maybe some changes in the haze height. That was very pronounced in the vicinity of the buoy. When we got up to about 10,000 ft you could see very clearly the hump and the higher shelving and higher haze layers from the eastern semi-circle from the buoy. Then apparently an area of suppressed haze, in height that is, suppressed in height off toward the northwest quadrant and then as you came around and looked to the south it seemed to be elevated again. So that almost certainly was something associated with the meteorological factors producing that clearing. So there was quite a lot of at least visual gradient. I don't know about the intensity of these haze layers. They didn't look particularly strong, but that would be my comment for today.

PH: Thanks Art. Yes. We saw a lot of spatial variability when we were doing our "L" or triangle shape track over the buoy. I might add that although we only got chemical characterization near the surface, perhaps we got enough to sample on the filters at 2,200 ft. There wasn't a great deal of structure up to 10,000 ft in the aerosols. So it wasn't as if there were any distinct layers or clean areas. So maybe the chemical measurements we got will characterize the air below 10,000 ft or at least maybe down to 1,000 ft or so. All of the measurements looked good as far as I could tell today. Did anyone notice any measurements that seemed to be incorrect?

AR: I noticed several GPS altitude dropouts.

PH: We've had the bag-house neph up and that's making a lot of sense. It's running just somewhat higher than the other two dry nephs. So that's a good measurement to note that's continuous measurement giving us some idea of the humidification factor of the aerosol. Who else wants to give a summary, Jim?

JE: Sunphotometer appeared to work well the entire time and we managed to stay out of clouds on the way down here so the window should have been clean. In fact, we've stayed out the whole time. We got the satellite underpass. Optical depths at that time were about 0.3 and less. There was some structure around. There was a bit of a gradient effect right at the satellite underpass and there was gradient in the area of the buoy at one point. Optical depths got up as high as a little bit above 0.4. Also at one point, they dropped toward the end of the last leg of the "L"s. Dropped about 50% in a period of 2 min. In fact right now, we appear to be in a gradient heading back west-northwest, I guess is about what we're doing. It's been climbing steadily ever since we turned back home. That's about it I guess.

PH: Jason, are you ready for your summary?

JL: Yes. The CAR instrument performed well today. Basically we did two things. One is that we test out the server controller. The other thing that is more on the science part is doing the BRDFs. My conclusion for the server control we were heading to the right direction, but there is still room for improvement. A couple of times when we waggled the wing, I see the horizon actually shifted with it. So probably we'll have more discussion later on. The BRDF we did is over the buoy like southeast at a short distance southeast of the buoy. I would characterize it as average quality because there are still small cloud contamination, although not to a great significance, but it is still there. That's it for my summary.

PH: Okay. Ray or Brian or Andrea?

RW: Actually this is real good. Every single thing back here seemed to work just great. So that's about it. Single-scattering albedos look like they're around 0.9, maybe a little lower. Bigger particles we can easily see. They're obviously lower. That's about it.

PH: For the most part, the ambient neph tracked the dry except for when I pointed out to you sometime in the flight where there was a big falloff in the dry and a much smaller one in the ambient. Any ideas on that? It looks as if the RH effect is just smoothing out the falloff.

RW: Yes. That could be it. They're different time constants and also the one neph doesn't have any pressure or temperature correction. It will have to be post analyzed so I don't know.

BM: I've still got to do a summary, Peter. So the filter summary. We exposed two filter sets today. The first was exposed at a low level near between 100 and 500 ft. The start of the sample times were 155130, the complete stop was at 162630. It was three bag-house samples. The first filter set was quartz-quartz filter holder #4 and Teflon filter #18. The second filter set was quartz-quartz filter holder #5 and Teflon filter #19 started at 170110 and is actually still finishing. I'm just completing a final bag-house sample and I estimate it will be finished by about 1850 even though I should double-check here at the end. That consisted of six bag-house samples and we're getting pretty good amount of mass flowing across the filters, so I think this one will be a pretty good sample of the 2,200 ft haze. The first one was a little low on mass and may not be good enough for analysis. Other things, lets see. Trace gas chemistry just a quick summary. CO_2 looked fine it was up in the 300s as far as parts per million, so pretty reasonable. CO still very noisy. SO_2 a little bit higher than normal. Seeing values of about 8 ppb and hopefully it was pretty reasonable around 50 ppb.

BM: Some final points for the record as far as filters. After we came down from the BRDF circles, I refilled the bag house for the fifth time at 1815. The filter vacuum was on at 181610. The filter vacuum was off at 182636. Bag-house refill #6 was at 182716. Scattering was about 3×10^{-5} m^{-1}. The filter vacuum was on at 182834. The filter vacuum was off at 183820. The final bag-house refill was #7. Scattering was about 2.7×10^{-5} m^{-1}. It was as we descended a little bit to 1,200 ft to avoid contact with clouds. This was at 183850. Scattering was about the same anyway. The filter vacuum was on at 184003 and I stopped Teflon filter #19 and quartz-quartz filter holder #5 at 185030; 5,500 liters of haze, basically all similar to the 2,200 ft haze with the exception of the last bag, which was about 1,000 ft lower. That's it.

(j) University of Washington Flight 1879 (July 30, 2001)

6:37 PM

PH: I'm going to start the summary. This was sort of a long shot flight. It was fairly overcast conditions at Wallops, but some holes were seen in the satellite over the ocean, so we gave it a shot. Basically, what we did was to transit out to the COVE lighthouse at 2,000 ft. We did a run at 100 ft near the lighthouse in scattered clouds, at least two layers and maybe more. We got some clear sky measurements maybe for a few minutes during those runs. Then around 1640 UTC, we looked for the best clear area for BRDF measurements near the lighthouse. We did five BRDF circles in broken cloud and broke off at that point because the cloud was increasing as we proceeded through the circles. We then did a 100-ft run looking for clear areas in which to do a vertical profile. Then starting about 1706

UTC we climbed at 1,000 ft/min from 100 ft to 10,000 ft in a pretty good hole. It should have given us a fairly good sunphotometer profile. In that same hole, which was then closing in on us a bit, we descended at 100 ft/min and then 500 ft/min back down to 100 ft. We then ran toward the east away from the COVE site at 100 ft trying to get some sunphotometer measurements in the broken cloud. At about 1745 UTC we climbed to 5,500 ft and headed toward buoy 44014 in and out of cloud at that level in order to get some cloud structure measurements. At about 1800 we were looking for a clear area near buoy 44014 and, a few minutes later, we descended from 5,500 ft to 600 ft. Some distance northeast of the buoy, where we found the best hole that we could in that area, we did five BRDF measurements in not a bad hole, but again some cloud around. We're now returning back to the lighthouse to avoid flying in cloud. We're up to 8,000 ft now. It's very clean up here. If we flew below cloud, we'd have pretty much continuous cloud cover above us though. There's not much else we can do but go back to the lighthouse at this level, see if there's a broken area around the lighthouse. If not, we'll head straight back to Wallops. All these measurements should have been beneath the ER-2, which was flying today; also a few other aircraft, Proteus, OV-10, etc. were up at various times today. So given the synoptic and weather situation here, we got the best out of what nature divvied up to us today.

PH Anyone else for a summary?

AR: I could talk about the weather for a minute, 2 min.

PH: Okay Art.

AR: Well, it's an unusual situation here. In the summertime, we had a wave cyclone developing off the northern coast of North Carolina about 200 miles out. You could see that swirl in the satellite image. Along with that, we had strong northeasterly winds along the coast and winds at the surface level running 20 to 30 knots pretty much in all the experimental areas that we overflew. Along with those winds, we had a good three layers of clouds. We had the stratus fractus in some places, in other places stratocumulus in the boundary layer, and then there was another layer of stratocumulus based around 5,000 to 6,000 ft, most of the time that being pretty thin. Then we also had a layer up around, well, that layer actually was off to the east so it's not worth mentioning. Anyway, it was really a two-layer type day and most of the haze today looked like the turbidity associated with strong winds on the sea surface. A lot of large particles, fairly low concentrations, but because they're so large producing that turbid murky look of the disturbed ocean. The winds aloft, I should mention that they're kind of complicated things. Because from time to time we would have a mesoscale clearing, but it was the strong movement of the stratus and the lowest level clouds from the northeast and the higher layer from the west or southwest that really complicated tracking these holes. They were also very ephemeral in that the clouds would begin appearing out of the blue and become wisps, little cumulus fractus, and then even longer stratus clouds. Larger patches of stratus clouds just sort of appeared out of the blue and these holes would just disappear right before your eyes within a period of 10 min or so. So anyway it was an interesting day.

PH: I just want to mention a couple of other things here. There was no Terra satellite overpass during the time that we were doing our measurements. It was earlier, prior to the flight. Also July here has been unusually wet. I think they had 4 inches of rain in July, therefore, cloudy, unusually cool also. So it hasn't been a very good period for this project. It wasn't the best place in the world to be looking for cloudless skies!

PH: Jim, do you want to do a summary?

JE: Sure. The sunphotometer looked like it worked pretty good the whole time. Again, we managed to stay out of clouds all the time that we tried to stay out of clouds. We got some good low-level data, certainly adequate, and pretty good profiles over some clouds in and out, but they should be fine. Everything looked pretty clean. The highest optical depths I was seeing were around 0.11 to 0.12 and at altitude it was about 0.03 to 0.04 and right now I haven't seen any evidence of any horizontal structure particularly. We've been at about 0.04 now since we started back toward the lighthouse and it's holding pretty steady. We'll see what happens the rest of the way back.

PH: Yes. That's at 8,000 ft. Charles, summary?

CG: A short summary for CAR measurements on flight 1879 of July 30. I started my measurements at 1623 UTC and accomplished the following. I did two sets of BRDF measurements. The first BRDF were done west of COVE, the Chesapeake lighthouse. That took place around 1645 to 1657 UTC. Now the second one, which was supposed to be done on buoy 44014, was done instead at latitude 36.90° N and longitude 74.55° W. This took place from around 1813 to 1833 UTC. Also I was doing the starboard imaging and generally we had a couple of problems that we were fixing. The first problem was the GPS data. It appears that the roll and pitch and other parameters that are useful for our measurements are not updating as they should. Instead they are updating once in a while. So that is a problem to take into account. The other problem was intermittent. A problem with the filter wheel channels. It would work for a short time and it would go off and come on again. So that's a problem that was also affecting our measurements today. Other than that everything else looks okay and we hope for the best for the remaining few days. Thank you, Peter.

PH: Brian.

BM: The filter summary for this flight we basically did one filter set at low levels sampling intermittently levels about 100 to 700 ft above the surface. Scattering was typically about 1×10^{-5}/m on the dry neph anyway. The sampling started at 163905 and was completed at 184042. This was quartz-quartz filter holder #2 on flow meter #2, bag-house port #3; and Teflon filter #21 on flow meter #3, bag-house port #2. There were seven bag-house samples between the start and stop time that I said. As I said before, we were challenged with the fact that there were ships in the area. There were many more ships than I'd seen on previous flight. The ship plumes, in fact, probably interfered slightly with some of the sampling only because the bag would be open and I'd try to close it before the ship plume truly passed by us, but who knows if there was a delay or whatever. So that might be something to keep in mind when analyzing these filters. Currently, I'm exposing just the other three filter sets that I have that I brought on board as a precaution as chemical blanks since we do have ample filters and it's a good idea to narrow down the noise. So two sets of those filters will be on the flow meter manifold itself but capped and protected from the cabin air that is. Then one filter set will just be a simple load/unload type of blank to test where some of the noise is coming from. So as far as the aerosols, almost all the aerosol was below 1,500 ft from what I could tell from the instruments. So that's why we're not sampling now. DMPS is still not working only because the CN counter associated with the DMPS is always maxing out and it won't be able to give us a measurement. Trace gases all looked okay except for CO, which is always noisy, but I've been told that that's okay I guess. The only other interesting thing is that I just noticed that the O_3 levels have to be slightly elevated at this level, compared to the lower levels that is. So I don't know what to make of that, but it is. That's all I have for filters and trace gases.

PH: Yes, 55 ppb ozone up here. Good Brian. Ray?

RW: The aerosol measurements are pretty noisy because they're so clean. The CE neph is dead. So I'm going to have to look at that when we get back. That's about it.

PH: Okay. Lorraine, do you want to say something for the tape by way of summary of the flight?

LR: I'd be happy to. In tandem with Brian's filter measurements, we exposed one of Andrea's filters for the entire flight and that was sampling the bag measurements in tandem with the other ones. As for the reflectometer, there's a pretty steep learning curve and I didn't start collecting data until we began our first upward spiral, but that was a very good spiral and I have data all the way through it. We were plagued through the whole flight with a flow rate that is about a third what Andrea told me to expect. Don looked at it and could not find a reason for it other than perhaps the incorrect filter was put into the reflectometer, but there is nothing I can do about that on the plane. So we just proceeded and I have data through most of the flight for the reflectometer, although I don't know how good it will be at the low flow rate. That's basically it. I really enjoyed the flight. I think it's wonderful.

PH: Thanks Lorraine.

7:21 PM

PH: So just to add that to the summary, we just completed at least six BRDF turns a few miles north of the Chesapeake Bay lighthouse or the COVE lighthouse in the best cloud-free area that we've found today. We're now heading back to Wallops.

(k) University of Washington Flight 1880 (July 31, 2001)

6:33 PM

PH: Let's do our summaries here. This plan went almost exactly according to the sketch for plan #1 in my "CLAMS Flight Profiles," which had us going out to the buoy 44004, which is the northern dark-water buoy. We took off from Wallops at 1430 UTC or thereabout and proceeded out at altitude of 4,500 ft for an hour or so. Then dropped down to 500 ft, did a run for about 30 min at 500 ft still heading for the buoy, dropped to 100 ft when we were some half an hour out from the buoy. We spotted the buoy, went backward and forward over the buoy at 100 ft. We were over the buoy at time of the Terra overpass, which was at 1624 UTC. We then set up at 600 ft to do CAR turns very close to the buoy, did four turns, but some clouds started to creep in on us. So we repositioned a little further away from the buoy but still within a few miles of it. We did a second set of six CAR turns in pretty good conditions and the CAR seemed to be working pretty well for those. We then climbed at 1,000 ft/min up to 10,000 ft over the buoy and then started to return directly to Wallops. About a third of the way back to Wallops or maybe a quarter, we got word from the CLAMS Operation Center that the Great Dismal Swamp was clear and they asked us to proceed to there. So we proceeded directly to there and we're now approaching the lighthouse. Most of this run toward the lighthouse has been below cloud base and we've now cleared that cloud anyway, so we're getting good sunphotometer measurements here and we're running at 1,300 ft above the ocean. So we'll be at the lighthouse in a few minutes, then we'll go straight to the Dismal Swamp and see if we can get some CAR measurements or BRDF measurements there. That's my summary. Art, would you like to go?

AR: All right, I'll just do the weather here. An unusually deep trough aloft just east of the Atlantic seaboard and a receding low-pressure center out in the Atlantic with a high building in over New England produced moderate northeast surface winds here at the beginning of the flight just offshore. They're probably in the 15- to 25-knot range. Lots of whitecaps all the way out to our buoy and also at the buoy. Then, of course as it has been noted, the winds have dropped off during our flight. Along with that northeast wind, the fact that the cloud bases have continued to be around 1,400 to 1,500 ft indicates that that air mass has had a long maritime fetch. So not surprisingly, it's pretty clean except here when we've gotten closer to where the trajectory might be curling off the land and then not quite so long a maritime trajectory here as we approach the COVE lighthouse. Aloft the winds were northerly, northwesterly and vigorous as well. I didn't see actually what the value was at 700 mb come to think of it. But anyway as we approach the COVE lighthouse here, we're having some cirrus move in and some of that strong northwesterly flow that at least up at cirrus level, 300 mb, was about 70 knots out of the northwest this morning. The other thing that I noticed during our profile was the very, very fine layering of the haze layers as we approached our peak altitude of 10,000 ft. There must have been at least three and possible four clean spots and I'll end there.

PH: We're just over the lighthouse. The profile of light scattering from the surface up to 10,000 ft was pretty steady falling off and then it increased again as we approached 10,000 ft. We didn't quite top it out at 10,000 ft, but we had very low AODs at that height anyway: about 0.03.

PH: Why don't you go, Jim?

JE: The instrument, AATS-14, seemed to work well today. Started out on the ground as it was clear at Wallops with an optical depth of about 0.11 and had it tracking all the way through the climb and basically all the way out to the buoy. Got a good low-level run at satellite overpass and a good profile. Then heading back we were in and out of clouds quite a bit as we were just under the cloud base for most of the trip back, but that should clean up okay. Then it cleared up a little ways, about 15 min out of the lighthouse, and it's getting cloudy again now as I speak. That's about it I think.

CG: Okay, Peter. Let me give a short summary for the CAR measurements on UW flight 1880 of July 31. I started the measurements at around 1441 UTC. I sampled throughout the entire flight. No major problems were observed except for the intermittent problem of the filter wheel channels on the on/off behavior also experienced in the previous flights. Accomplishments today are BRDF at deep-water buoy 44004. Two good orbits were done right over the buoy at latitude 38.51˚ N/longitude 70.54˚ W, 600 ft above the ocean surface, the filter wheel locked at 2.2 micron. Because of the clouds during our fourth orbit, we relocated to a new location northwest of the buoy at around latitude 38.52˚ N/ longitude 70.61˚ W. Six circles were done, 600 ft above the ocean surface with the first three orbits without the filter wheel and then the last three orbits the filter wheel was working okay. We are now heading for the Dismal Swamp. We expect to do our usual six turns, this time not at 600 ft above the surface. We will try it at 2,000 ft above the surface.

CG: At Dismal we expect to do the six turns at 2.2 microns and at 1.6 microns. The first three orbits at 2.2 microns and the last three orbits at 1.6 microns. Now these are our usual filter wheel filters that we use for the BRDFs. So other than that, the instrument seems to perform well except for that one problem that I mentioned.

CG: The instrument seems to perform well. So as we head for the Dismal the filter wheel is working and all the channels are performing, so let's hope for the best. Thank you, Peter.

PH: Good. Brian.

BM: Okay. One second. So the filter summary for this flight. Just exposing one set of filters the entire flight, so it's just a whole mess of bag-house samples basically integrated onto the filter. This is quartz-quartz filter holder #2 and Teflon filter #25. The quartz filters are on flow meter #2, bag port #3; and Teflon filter is on flow meter #3, bag-house port #2. Currently, I'm on my fourteenth bag-house sample, but surprisingly enough since it's still very clean here that it doesn't really have the minimum for Tom Kirchstetter to really do an analysis even after all that sampling just to give you an idea how clean it is. So either way, we'll just get the sample out there and I'm sure they can do some analysis it's just that he gives me numbers that are good signal-to-noise ratios when he's doing analysis. So the bag-house samples basically started at around 4,500 ft. There are several, five of them are at low levels between 100 and 500 ft. The last ones were all made at about 1,200 ft as we were transiting to the Dismal Swamp area. That's about it I guess. Aerosols, let's see. CE neph is still not working. I think Ray Weiss reported that. The DMPS is still not working.

The CN counter is down. The trace gas chemistry all looks pretty normal, status quo. That's about it.

PH: Have we got any DMPS measurements on this mission, or on the whole of CLAMS?

BM: I believe we had a couple on the first couple of flights actually had some DMPS runs on them, but how reliable they are is a big question mark.

PH: Is the problem with the CN counter on the DMPS?

BM: That's what it seems like. It's just maxing out in counts and the DMPS doesn't like that, so it doesn't know what to make of it. You won't get a good size distribution. It will just be flat rather than the typical log-normal distribution.

PH: Okay. Ray or Andrea, anything to say?

AC: I sampled one filter with Brian for the whole flight. The ASG worked well for 2 hr and that's it.

END OF TAPE 1, SIDE 2

PH: Ray, anything to say? Or the engineers anything to add?

DS: Most everything seemed to have functioned pretty well today.

BM: One more note on the nephelometers. The pumps for the nephelometers and for the Nucleopore filters and the Teflon and quartz filters all went down for just a brief moment. It seemed like they overheated. This is when we were flying low at about 1630 UTC in my notes. So there are little blips on the MS nephelometer for instance that would correspond to when the pump went down. That's just a note though.

PH: Yes. I noted that on the tape earlier on.

7:16 PM

CG: Just for the purpose of the records. As we did these BRDFs, I watched closely the upper ones of my filter wheel channels and they appear stable. One other fear I had was the GPS data. It was very stable during the BRDFs, so I do expect to have good measurements.

PH: Good. Okay. We kept trying to do Dismal Swamp and we finally got it. We'll add that to the summary that we just did six good turns for BRDF measurements at 2,000 ft above the Dismal Swamp. There is a little cloud creeping into the view, but not very much.

7:18 PM

PH: Is Ralph on the headset?

RK: Yes, I am.

PH: Do you want to add anything to the tape?

RK: Not at this point. No. I'm sure glad we got that Dismal Swamp sequence though.

PH: You don't want to say something about the Air-MISR measurements?

RK: I can say what was planned. I don't know what actually was executed. What we had planned for today was two star patterns. The second one being completed shortly before we reached the far buoy. The first one was over the COVE site. One leg was essentially in the principal plain, one normal to it and a third one was at some angle in-between those. I have no idea at this point how much of that data was actually acquired.

PH: Thanks.

RK: Peter, it's Ralph. I realized that I should probably add one or two things for the record. Those star patterns are primarily to support Tom Charlock's BRDF measurements that we were doing near the surface. Each one of those sequences was one of our nine-angle observations. So we'll have a series of nine angles from emission angles plus 70 to minus 70 going through nadir along each path at three azimuth. So just want to add that to your record.

PH: Which will give you what?

RK: An additional set of measurements of the combined atmosphere surface reflectivity obviously from the height of the ER-2 down to the surface both along the principal plain, across it and through another angle. So it's just more angles which we're getting the radiances.

PH: Okay. You're not worried about the low aerosol loadings?

RK: No. I think for Tom's purposes the lower the aerosol the more characteristic the measurements will be at the surface. With MISR of course, we can actually determine the aerosol loading consistently with the surface properties and an optical depth of 0.1 is enough for us to do a pretty good analysis. So those are good conditions for us.

PH: Good. All this will be transcribed and will be available probably in a few months time it takes to transcribes all the tapes.

7:23 PM

(l) University of Washington Flight 1881 (August 2, 2001)

6:32 PM

CG: I can give a short summary of what we have achieved this flight. Today, August 2, 2001, flight 1881, I had an unfortunate beginning. I started the instrument at 1536 UTC just 6 min after takeoff. I performed all the procedures in opening up and preparing the CAR instrument, but the last one, which involves opening the CAR door, it didn't execute the way it should execute. So while the instrument seemed okay in all the channels, for some strange reason the door would not open. For about 1 1/2 hr I tried all sorts of tricks including restarting the LabVIEW program that controls the instrument, restarting the instrument, rebooting the computer, restarting the server control, but none of these tricks opened the door. Apparently it appeared to me that no power was going to the door motor. Since the door-opening switch on LabVIEW remained _____ a condition one would expect when the door-opening switch is not getting the trigger. So we sought permission from the Project Control Office to land so that we can close the door open at least to be able to do one BRDF in the next flight. So basically there are no measurements for the CAR instrument because the door never opened and therefore the only thing that we were able to see is the dark current and that is of no use to the science that we wanted to do today. So that is the end of this short summary for the CAR instrument.

AR: Anybody else want to say anything before I give a huge spiel on weather and other stuff?

JE: I can go for the sunphotometer. The instrument worked pretty well with the exception of anomaly on the climb out of Wallops. I don't know what happened, but the instrument froze up for a little while and I restarted it and it's been working fine ever since. So we had maybe 3 to 4 min of no data there on the climb out. Very clean today, optical depths at Wallops were about 0.163 on the ground and at 6,000 ft 0.034. The lowest we saw today was at 10,000 ft at the end of the profile up at 0.018 and at the satellite overpass we were getting good data and the optical depths were 0.1 to 0.12. It's interesting today that the optical depths tended to decrease as we went to the west toward the shore and increase as we went east away from shore. That's even true right now as we head to the west they're decreasing a little bit. That's it I think.

AR: That's interesting because the smog at this level has been increasing. But yet at the same time as you say that, the sky above is actually getting a little blue or darker looking say above the right wing. So, yes, it's kind of interesting how there's an opposite sense in the pollution down here at this level versus higher up overall.

JE: Yes.

AR: I'll just mention a quick summary of the flight as best I can. When we took off, we made a rapid ascent to 6,000 ft for a comparison with the OV-10, who quickly linked up with us and flew southbound. However, as we approached the lighthouse, the OV-10 still had some instruments that weren't warmed up. So we did a 360° and hung out a little bit, not more than a couple of minutes really, waiting for their instruments to come online and warm up. Then we continued on to the lighthouse and began our descent to 100 ft in preparation for the Terra overpass at 1213 UTC. We began that descent about 1156 UTC I believe it was, plus or minus a couple of minutes. Then we performed the 100-ft 30-min run in an east-west line as suggested by Jim Eilers. That seemed to go well in that we did not have any clouds, although we had a little cirrus off to the south that didn't bother us and so that looked pretty good. Then after that we did our slow spiral ascent to 10,000 ft at 300 ft/min and found at least three layers, if you count the extremely clean free troposphere as the topping layer. Then there was kind of an intermediate layer between I guess it was around maybe 7,500 to 3,000 ft as sort of a minimal layer, definitely a haze layer, but not of sufficient intensity to fulfill our requirement for getting enough substance on the filters. Then the main bang, so to speak, was between about 3,500 to 4,000 ft and about 1,500 to 1,000 ft. That one sort of bottomed out. Then below that, the marine boundary layer that was also again kind of minimal. So the main layer that we sampled in probably got some material on the filters, and Brian will elaborate more, was at the 3,000 to 2,900-ft level. Also as we got up to 10,000 ft, there was often the marked slope in the haze layers that we've noticed by the coastline in previous episodes. They were seeming to slope downward to a very sharp top off to the south and then kind of frizz out to the north, not having a sharp top and, that being, that occurring, that visual description occurring sometime around 6,500 to 7,500 ft as best I recall. So, again, lots of heterogeneity in the haze layers out here near the coastline. In our long legs to collect samples, however, things were pretty darn homogeneous along each east-west and north-south leg at each level with the exception of the fact that on our westbound last leg at about 1,400 ft here, we're seeing the local concentrations. That is local being at this flight level, of concentrations in the PCASP anyway gradually increase as we have headed westbound with some sharper increases here over the last couple of minutes actually. So it's not surprising as we head closer to the coastline of Virginia. We're only a few miles out now. That's about all I can think of. If anybody wants to fill in some blanks there, that would be great.

BM: A quick filter summary while we're landing. We sampled one filter set at 3,000 ft and a second filter set at 1,700 ft. At 3,000 ft was quartz-quartz filter holder #5 and Teflon filter #28, 1,600 ft on tans-alt. It was quartz filter holder #2 and Teflon #29. Start and stop times for the 3,000 ft are 170810 and 180210. Start and stop times for the 1,600 ft filter set are 180526 and a few minutes before we land whenever that is. We also have an incomplete filter set that was sampled at low levels and I'm just kind of holding off on that and seeing what happens with the BRDF. If possible I'll just fill the filters up then during the BRDF circles or something and Andrea has a similar sampling. We're doing parallel sampling, but we're having problems with the NO_x pump, the pump that she uses to pull air from the bag house through her filters. So it's been kind of off and on in the last bag-house samples anyway. That's all for filters.

(m) University of Washington Flight 1882 (August 2, 2001)

AR: A little flight summary here. We took off from Norfolk and went out to the lighthouse. Due to the warm-up time required by the CAR instrument, we decided to do a profile first beginning at 100 ft for a couple of minutes. When we had enough sunphotometer readings down there we executed our climb to 10,000 ft at 1,000 ft/min and did a minute level up there for a good solid reading at 10,000 ft well on top of all the haze. Optical depth was very, very low, 0.022 according to Jim. Then we came down and did some BRDFs about 10 to 15 miles north-northeast of the lighthouse having it go a little bit further away because of the little filaments of cirrus off to the east and east through south that were looking like they were gradually encroaching. Other than those clouds, there were no other clouds. So we formed actually about eight circles. The first two were impacted by some missing roll data I think it was. Anyway the surface was nice and calm, no whitecaps. The only things down there disturbing the surface were a lot of porpoises plopping around on top of the water. The top of the haze was 7,500 to 8,500 ft again looked tilted higher to the north, hard top to the south as we started to emerge from it and then got on top of all of it about 8,500 ft. The winds today light and variable down near the surface becoming easterly 850 up through 700 mb and then turning toward the northeast as we have a quasi-stationary upward low to the southeast of Virginia just off the North Carolina coast. That's about it. If anybody has any comments they want to make, you've got to put them in here pretty fast.

JE: For the sunphotometer, a summary for this flight. The instrument appeared to work well again. We got good data at low altitude and good profiles all the way up to 10,000 ft. Low altitude AOD was 0.12 and at altitude was 0.022 as Art mentioned. I guess that's about it.

CG: Also on my side, I just want to throw in one statement. This second part of the flight 1882, I started measurements at 1913 UTC and about 20 min or so the channels had stabilized. Now at this time the door was open. So the CAR now has worked. Everything worked perfect even the time we were doing the BRDFs and, therefore, I think Tom Charlock will realize out of this flight which started rather oddly when we were flying the flight 1881. So generally everything worked well. In fact, even after closing the door open during the shutdown, I managed to shutdown the instrument automatically. So I think things kind of went back to normal. So other than that, I want to thank everybody else for their understanding and also the help in making the goal. Thank you so much.

BM: Just a quick filter summary. Finished up Teflon filter #27 and quartz-quartz filter holder #4 along with a simultaneous Nucleopore filter from Vanderlei's set that Andrea runs. This is just from three additional bag-house samples. They basically started at 193705 here on flight 1882 and will end in a couple of minutes here before we land. Also hooked up a chemical blank, Teflon #30 and quartz-quartz holder #3 are those chemical blanks. The first filter set was just a finishing of the 500-ft lower-level haze with scattering at about 1.5×10^{-5} m^{-1}. That's it.
