ICARTT - International Consortium for Atmospheric Research on Transport and Transformation

Mobile Platforms
Payloads and Performance

June, 2004

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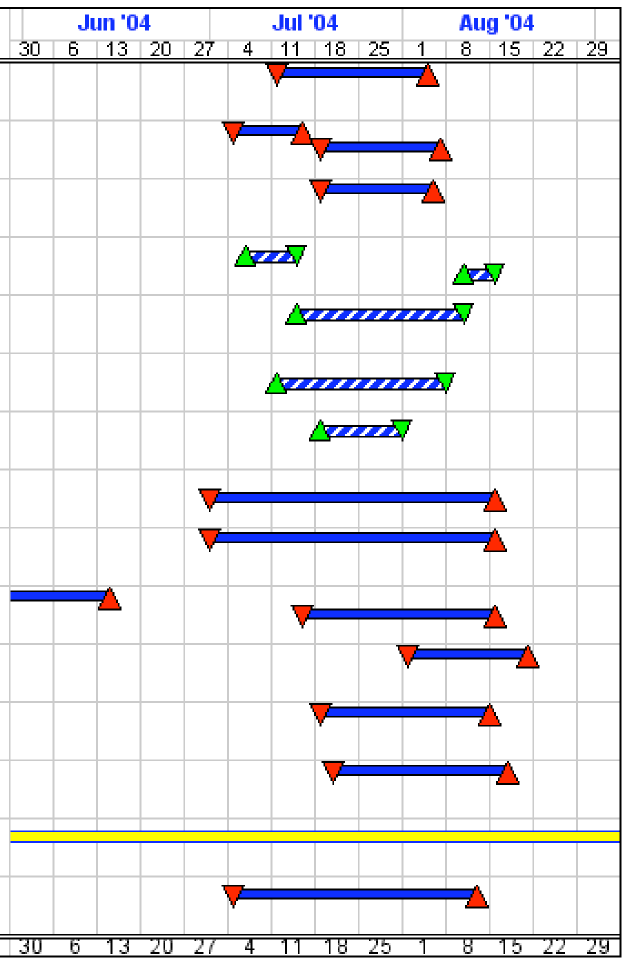
ICARTT Mobile Platforms
Payloads and Performance

The measurement capabilities that will be deployed by the ICARTT consortium during the 2004 summer intensive will allow an unprecedented characterization of the critical atmospheric processes. A key element of this deployment is the collection of mobile platforms --12 instrumented aircraft and a research vessel. These platforms will be outfitted with state of the art instrumentation to characterize the physical, chemical, and optical aspects of the atmosphere.

The deployment schedule for the mobile platforms is shown in the table below. Additional information on the individual platforms is also provided.

Platform Deployment Schedule

Activity Name	Start Date	Finish Date
NERC BAe 146-300	7/12/04	8/4/04
DLR Falcon Oberpfaffenhofen Creil	7/5/04 7/19/04	7/16/04 8/6/04
CNRS Mystere/Falcon	7/19/04	8/6/04
NASA DC-8 St. Louis	7/7/04 8/11/04	7/15/04 8/15/04
Pease	7/15/04	8/11/04
NASA/SkyResearch BAe J-31	7/12/04	8/8/04
NASA Proteus	7/19/04	7/31/04
NOAA Lidar aircraft	7/1/04	8/15/04
NOAA WP-3D	7/1/04	8/15/04
NSF/Harvard/U. Wyoming King Air	5/16/04 7/16/04	6/15/04 8/15/04
CIRPAS Twin Otter	8/2/04	8/20/04
DOE G-1	7/19/04	8/15/04
NRC-IAR Convair 580	7/21/04	8/18/04
U. Maryland Aztec	5/15/04	9/30/04
NOAA R/V RONALD H. BROWN	7/5/04	8/13/04



FAAM BAe 146-300

Contacts: Claire Reeves, UEA

Research Areas:
The ITOP project has two overall objectives:

1. a study of the free radical, reactive carbon and nitrogen oxides chemistry that is occurring within up-lifted air undergoing long range transport
2. a study of the impact of this chemistry when coupled with global atmospheric transport in determining the fate of continental boundary layer pollution exported to mid and upper troposphere regions over the North Atlantic, particularly with respect to ozone production and destruction.

Project: ITOP (http://www-users.york.ac.uk/~chem89/ITOP_homepage.htm**)**

Flight Hours:	180 hrs (including transit flights, anticipated ~ 80 hrs on station)
Deployment:	July 12th – August 4th, 2004
FBO:	Horta, Faial, Azores, Portugal
Operating Theater:	within 5-700 nm of Horta on Faial, Azores

Aircraft Facility:

Organization:	http://www.faam.ac.uk/
Aircraft:	http://www.faam.ac.uk/public/aircraft.html
Capabilities:	http://www.faam.ac.uk/public/capability_brochure.pdf

Standard Aircraft Specifications:

- *Length*	31 m
- *Wingspan*	26 m
- *Height*	8.4 m to top of tail — 4.4m to top of fuselage
- *Max Altitude*	35 000 ft (10 600 m) for maxmum of 2.5 hours
- *Min Altitude*	50 ft (bottom of profile) 100 ft (up to 2 hours) over sea, 250ft over land where permitted
- *Range*	1400 nm (at 27 000 ft , 220 kts) ##
- *Cruise Altitude*	27 000 ft
- *Endurance*	5 hours ##

- *Speed* Max operating 305 kts (IAS)

Typ. min manoeuvring speeds: 220 kts at max. TO weight; 200 kts mid-weight,175 kts low weight

- *Payload* 4000 kg for instrumentation + 10 scientific crew for 5-hour duration

Depending on flight pattern, payload, wind

Science Payload

Parameter	Method	Institute
Ozone	UV	FAAM
Water vapour	Lyman-α fluorescence and dew point	FAAM
Position, wind, u, v	INS, GPS, wind vanes	FAAM
Temperature	Rosemount PRT	FAAM
NO2 photolysis, j(NO2)	Photometer	Leicester
O3 photolysis, j(O1D)	Fixed bandwidth radiometry	Leicester
CO	VUV fluorescence	FAAM
CO2 and CH4	NIR-TDLAS	NPL
Non methane hydrocarbons	ORAC in-flight GC	Leeds / York
Oxygenates	PTR-MS	UEA
Non methane hydrocarbons, oxygenates and semi-volatile VOCs	Whole air sampler (WAS) and 2D-GC	York / Leeds
Halocarbons	WAS and GC-MS	UEA
Organic Nitrates	WAS and GC-MS	UEA
NO, NO2, HNO3, NOy	NOxy	UEA
PAN	GC	Leeds / York / FAAM
Peroxides	Fluorometric	UEA
Fomaldehyde	Fluorometric	UEA
RO2 + HO2	PERCA	Leicester / UEA
OH and HO2	FAGE	Leeds
Aerosol size and composition	Aerosol Mass Spectrometer	UMIST
Particle number concentration > 3nm	TSI3025 condensation particle counter	UMIST
Particle soot, black carbon	PSAP	FAAM
Scattering	Nephelometer TSI3563	FAAM

DLR Falcon

Contact: Hans Schlager, DLR

Research Areas:

The DLR Falcon will be deployed during ITOP to study

- the chemical characteristics of the inflow over Europe from North America
- optical properties and composition of aerosols in the inflow from North America
- chemical evolution in the air masses during transport away from the source regions (e.g. NOx/NOy and CO/NOy ratios, VOC)
- aerosol nucleation and aging during intercontinental transport
- impact of North American outflow on land-based air quality in Europe
- use of satellite data for investigations of long-range transport (including validation of satellite-based tropospheric NO_2 columns from SCIAMACHY)

Project: ITOP
(http://www-users.york.ac.uk/~chem89/German_ITOP_homepage.htm)

Flight Hours: 40 hrs each phase (~10 flights)
Operating Theater: Eastern North Atlantic, Central Western European Coast
FBO: Oberpfaffenhofen near Munich, Germany and Creil, France (co-located with CNRS Falcon)
Deployment: July 5th – 16th (Oberpfaffenhofen) and July 19th – August 6th, 2004 (Creil near Paris, France, simultaneous with CNRS Falcon)

Aircraft Facility: DLR Oberpfaffenhofen, Germany
http://www.dlr.de/oberpfaffenhofen

Standard Aircraft Specification from:
http://www.dlr.de/ipa/Forschung/Instrumente/Flugzeuge
http://www.dlr.de/FB/OP/d-cmet_dat_d.html

Length	17.15 m	
Wingspan	16.32 m	
Height	5.32 m	
Max range	1150 nm / 10kft;	2000 nm / 41 kft

Max endurance	4:10 hrs / 10kft	5:00 hrs / 41 kft
Ceiling	42 000 ft	12 800 m
Max speed	380 KCAS	0.865 Mach
Speed for max range	410 KTAS	0.720 Mach

Science Payload

Parameter	Method	Institute
O3	UV-Absorption	H. Schlager, DLR
SO2	Pulsed Fluorescence	H. Schlager, DLR
H2O	Lyman-alpha	A. Giez, DLR
CO2	IR-absorption	H. Fischer, MPI-C
CO	TDL	H. Fischer, MPI-C
CH4	TDL	H. Fischer, MPI-C
NO	Chemiluminescence	H. Schlager, DLR
NOy	Chemiluminescence + Au-converter	H. Schlager, DLR
J(NO2)	Filterradiometer	H. Schlager, DLR
HCOH	TDL + Hantzch reaction	H. Fischer, MPI-C
Acetone	CIMS	F. Arnold, MPI-K
CH3CN	CIMS	F. Arnold, MPI-K
SO2	CIMS	F. Arnold, MPI-K
VOC	Grab samples + GC analysis	FZK-IFU
Aerosol size distribution: ultrafine particles Aitken mode Accumulation mode, dry state Accumulation + coarse mode, ambient state Coarse mode, ambient state	CPSA: 4 condensation particle counters (CPCs) with different lower cut-off diameters (4 -20 nm) Differential Mobility Analyzer (DMA) 0.01 < D < 0.2 µm Passive Cavity Aerosol Spectrometer Probe –100X: 0.1 µm < D < 3.0 µm Forward Scattering Spectrometer Probe FSSP 300: 0.3 µm < D < 20 µm FSSP 100 ER: 1 µm < D < 100 µm	A. Petzold, DLR
Fraction of volatile/ semi-volatile/ refractory particles	Thermodenuder (T = 20°C/125°C/350°C) Connected to CPCs	A. Petzold, DLR
Volume absorp. coefficient λ = 0.55 / 0.67 µm	Absorption Photometer	A. Petzold, DLR
Meteorological parameter: P, T, wind	Standard probes	A. Giez, DLR

DLR: Deutsches Zentrum fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany
MPI-C: Max-Planck-Institut für Chemie, Mainz, Germany
MPI-K: Max-Planck-Institut für Kernphysik, Heidelberg, Germany

CNRS Mystere/Falcon

Contacts: Cathy Law, Gerard Ancellet, Francois Ravetta, Philippe Nedelec, CNRS

Research Areas:

- To improve understanding about the dynamical processes controlling pollutant transport across the North Atlantic and to determine the role of interactions between dynamical and chemical processes governing the photochemical reactivity of polluted air masses arriving over Europe.
- Determination of photochemical ozone production/loss rates in polluted plumes transported from North America to Europe in order to quantify the net contribution of North American pollutants to the ozone budget over the North Atlantic and Europe.
- Study of import of anthropogenically produced ozone into the lower troposphere over Europe and the potential for influencing background ozone concentrations and regional air quality.

Aircraft to be operated at 8-10 km altitude as "pathfinder" for DLR Falcon

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Project: ITOP
(http://www-users.york.ac.uk/~chem89/France_ITOP_homepage.htm**)**

Flight Hours: 30 hrs
Deployment: July 19th – August 6th, 2004 (simultaneous with FAAM BAe 146 & DLR Falcon)
FBO: Creil, France (co-located with DLR Falcon)
Operating Theater: Europe and Eastern North Atlantic
Payload: Nadir view ozone lidar (ALTO) in downward looking position
In-situ O3 – MOZAIC type
In-situ CO – MOZAIC type

Aircraft Facility: http://icare.dt.insu.cnrs.fr:9000/porteurs/mystere20/split.htm

NASA DC-8

Contacts: Jim Gleason, Mike Craig, Hanwant Singh, NASA

Science goals:

INTEX-NA seeks to understand the transport and transformation of gases and aerosols on transcontinental/intercontinental scales and their impact on air quality and climate. The principal science objectives of INTEX-NA during Phase A (summer 2004) are to:

- Quantify the outflow of radiatively and chemically important trace gases and aerosols from North America to the Atlantic, and relate this outflow to our understanding of sources and sinks over North America and elsewhere
- Understand the transport and chemical evolution of the North American outflow over the Atlantic, and assess the impact and implications of the intercontinental transport of pollution on the global atmosphere and on regional air quality and climate
- Utilize INTEX-NA airborne platforms and observational strategy to validate key satellite observations in the troposphere especially from the Terra, Aqua, Aura, and Envisat platforms.

Above objectives are to be achieved by a synthesis of the ensemble of observation from surface, airborne, and space platforms, with the help of a hierarchy of models.

Project: INTEX-NA (http://cloud1.arc.nasa.gov/intex-na/)

Flight Hours:	Approx. 170 hrs / 21 flights (including test & transit flights, anticipated 13 hrs for three test flights)
Deployment:	July 1st – August 15th, 2004
FBO:	July 7-15 & Aug 11-14, 2004: MidAmerica Airport, Mascoutah, Illinois **(**Scott AFB) July 15 – Aug. 11, 2004: Pease International Tradeport Airport, Portsmouth, NH
Operating Theater:	Eastern North Pacific, North America, and Western North Atlantic

Science Payload

Parameters	Method*	PIs
O_3	NO/O_3 Chemiluminescence	M. Avery, NASA LaRC
O_3 & aerosol profile	UV Lidar	E. Browell, NASA LaRC
NO, NO_2, HCHO	Laser Induced Fluorescence	D. Tan, Georgia Institute of Technology
NO_2, NO_y	Laser Induced Fluorescence & thermal dissociation	R. Cohen, UC Berkeley
PANs, OVOCs, nitriles	GC-ECD/PID/RGD	H. Singh- NASA ARC
HNO_3, H_2O_2, organic acids	Chemical Ionization Mass Spectrometry	P. Wennberg, Cal Tech
H_2O_2, CH_3OOH, HCHO	Derivative HPLC & fluorescence	B. Heikes, Univ. of Rhode Island
HCHO	Tunable Diode Laser Absorption Spectrometry	A. Fried, NCAR
OH, HO_2, naphthalene	Laser Induced Fluorescence	W. Brune, Penn State Univ.
SO_2, HNO_4	Chemical Ionization Mass Spectrometry	G. Huey, Georgia Institute of Technology
VOCs (NMHC, halocarbons, alkyl nitrates)	Whole air sample collection; GC-FID/EC/MS analysis	D. Blake, UC Irvine E. Atlas, U. Miami
CO, CH_4, N_2O	Tunable Diode Laser Absorption Spectrometry	G. Sachse, NASA LaRC
CO_2	Non-Dispersive Infrared	S. Vay, NASA LaRC
H_2O	Open path Tunable Diode Laser Absorption Spectrometry	G. Diskin, NASA LaRC J. Podolske, NASA ARC
H_2O, $J(NO_2)$	Cryogenic hygrometer, actinometer	J. Barrick, NASA LaRC
Aerosol bulk ionic composition	Particle Into Liquid Sampling (PILS)/IC	R. Weber, Georgia Institute of Technology
Bulk aerosol composition, HNO_3	Mist chamber/IC	R. Talbot, Univ. of New Hampshire
Aerosol composition, microphysics, and optical properties	Particle measuring probes, differential mobility analyzer, CN counters	A. Clarke, Univ. of Hawaii
Aerosol number density, size, and light scattering properties; cloud liquid water content	CN counters, cloud aerosol & precipitation Spectrometer, soot photometer	B. Anderson, NASA GSFC
Actinic fluxes & photolytic frequencies	Spectrally resolved radiometer, Zenith & Nadir	R. Shetter, NCAR

Aircraft Facility: http://www.dfrc.nasa.gov/airsci/DC-8/index.html

Standard Aircraft Specifications:

Aircraft specs from NASA DC-8 Airborne Laboratory Experimenter's Handbook

Length:	157" 5"
Width:	148" 5"
Normal cruise Speed:	480 knts TAS (above 30 kft altitude)
Range:	> 5000 nautical miles (9,200 Kilometers)
Ceiling:	41,000 feet (12,500 meters)
Experimental payload:	30,000 lbs. (13,600 kilograms)

SKY Research BAe J-31 (NASA contracted)

Contact: Jim Gleason, Phil Russell, NASA

Research Areas: Aerosol radiative effects, satellite validation, aerosol absorbing fraction spectra, cloud-top albedo and aerosol optical depth spectra, tests of closure and of chemical-transport models, regional radiative forcing

Project: INTEX-NA (http://cloud1.arc.nasa.gov/intex-na/) and
NEAQS-ITCT 2004 (http://www.al.noaa.gov/2004/)

Flight Hours: 50 hrs at Pease ITA
Deployment: July 12 – August 8, 2004
FBO: Pease International Tradeport Airport, Portsmouth, NH
Operating Theater: within 400 nm

Aircraft Facility: http://www.skyresearchinc.com/index.html
http://www.skyresearchinc.com/aircraft/

Science Payload

Parameter	Method	PIs
Aerosol Optical Depth (13 wavelengths, 353-2139 nm), Water vapor column content	Tracking Sunphotometer (AATS-14)	P. Russell, B. Schmid, J. Redemann, NASA Ames/BAERI
Solar Spectral Irradiance	Solar Spectral Flux Radiometer (SSFR)	P. Pilewskie, NASA Ames
Temperature, Relative humidity, Dew point temperature	Vaisala HMP 243	W. Gore, J. Eilers, NASA Ames
Pressure	Setra Model 470	W. Gore, J. Eilers, NASA Ames
Position, Orientation	Applanix POS AV	W. Gore, J. Eilers, R. Dominguez, NASA Ames/SAIC

NASA Proteus

Contacts: Mike Alsbury
Scaled Composites, Inc
Tel: 661-824-6388
(Alsbury@scaled.com)

Science Goal:
AQUA, TERRA, AURA Validation; Examine impacts of heavily polluted aerosol on sounding retrievals, focusing on the thermodynamic profiles and the chemical composition of the Planetary Boundary Layer.

Project: INTEX-NA (http://cloud1.arc.nasa.gov/intex-na/)

Flight Hours: 40
Deployment: July 19st – July 31, 2004
FBO: NASA Langley Research Center, Hampton, VA

Science Payload - NPOESS Simulator
NAST-I: IR Temp and Water, NAST-M: μ-wave Clouds Detection
FIRSC: Far IR for Cirrus, Scanning HIS: IR Temp and Water Vapor
MicroMAPS: Mid-Tropospheric CO

Aircraft Facility: http://www.dfrc.nasa.gov/Newsroom/FactSheets/FS-069-DFRC.html

Aircraft Specifications

Wingspan:	77 ft, 7 in; 92 ft with removable tips installed.
Canard span:	54.7 ft; 64.7 ft with removable tips installed.
Length:	56.3 ft
Height:	17.6 ft (on landing gear)
Crew:	2, single-pilot operation.
Empty weight:	6,800 lb
Gross weight:	12,500 lb; 15,800 lb in military usage.
Payload:	1,800 to 7,260 lb, depending on mission.
Electrical:	19kw up to 30kw, depending on payload requirements. (800 Amps at 28VDC total ~ 22.4kW)
Propulsion:	Two Williams Research/Rolls FJ44-2 turbofan engines, 2,300 lb thrust each.
Airspeed:	190 kt at 20,000 ft, 280 kt at 40,000 ft, true air speed. Mach 0.42 at cruise.
Altitude:	Up to 65,000 ft at 7,000 lb; 58,000 ft at 12,500 lb. (demonstrated service ceiling of 63,200 ft with no external payload)
Endurance:	Up to 18 hr, depending on payload and altitude.

NOAA Lidar Aircraft

Contacts: Mike Hardesty, Bob Banta, NOAA

Aircraft: DC-3

Science Questions to be addressed:

- How are ozone and aerosols transported into and out of the region?
- What is the fine scale vertical structure of aerosols, and how is pollution at different heights transported and mixed?
- How is plume structure altered at the land/sea interface?
- What is the effect of the sea breeze and low level jet in transporting ozone and aerosols inland?
- How does the 3-D distribution of ozone and aerosols over the region vary under different meteorological conditions?
- How well do air quality models predict ozone and aerosol plume characteristics and transport?
- Could assimilation of ozone profiles improve air quality forecasting*?*

Project: NEAQS-ITCT 2004 (http://www.al.noaa.gov/2004/)

Flight Hours:	100-120 hrs
Deployment:	July 1st – August 15th, 2004
FBO:	Pease International Tradeport, Portsmouth, NH
Operating Theater:	Within about 350 km from Portsmouth, NH
Science Payload:	Nadir viewing boundary layer differential absorption lidar for Ozone and aerosol backscatter In-situ TECO ozone analyzer Dropsondes Infrared radiometer skin surface temperature sensor GPS system
Aircraft facility:	Dynamic Aviation, Bridgewater, Va.
Aircraft:	DC-3
Requested Endurance:	8 hours
Maximum range:	1000 miles (for lidar sensing missions)
Flight Altitude:	10000 – 12000 ft AGL
Airspeed	130 knots
Wingspan	95 ft

Length	64 ft 6 in
Height to top of fin	16 ft 11 in
Ceiling	23000 ft
Lidar operations airspeed	130 knots at 10000 ft altitude
Normal cruise speed	160-170 knots (total speed range is approximately 100-200 knots depending on load and altitude)
Max takeoff weight	27000 lbs
Useable science load	6000 lbs

NOAA Lockheed Orion WP-3D

Contacts: Fred Fehsenfeld, Jim Meagher, Gerd Hübler, D. Parrish, NOAA

Research Areas:

The research planned for the 2004 NOAA field campaign has been organized around the following five research areas, each with an associated science question.

- **Emissions verification** - How well do current inventories represent actual emissions for: cities, point sources, ships, and vegetation?
- **Transport and mixing** – What are the relative amounts of pollution imported to New England and exported from the continental boundary layer to the marine boundary layer and the free troposphere?
- **Chemical transformation** – How do gaseous and aerosol emissions evolve chemically and physically as they are transported away from the source regions to the remote atmosphere?
- **Aerosol properties and radiative effects** – What are the chemical, physical, and optical properties of the regional aerosol and how do these properties affect regional haze and aerosol direct and indirect radiative forcing of climate?
- **Forecast models** – What is the current skill of air quality forecast models on local, regional and global scales and what improvements can be made to enhance the accuracy and extend the periods of these forecasts?

Project: NEAQS-ITCT 2004 (http://www.al.noaa.gov/2004/)

Flight Hours:	180 hrs (including test & transit flights, anticipated ~ 160 hrs on station)
Deployment:	July 1st – August 15th, 2004
FBO:	Pease International Tradeport Airport, Portsmouth, NH
Operating heater:	within about 800 nm from Portsmouth, NH

Science Payload

Parameter	Method	PIs
Ozone (O_3)	NO/O_3 Chemiluminescence	T. Ryerson NOAA-AL
Nitric Oxide (NO)	NO/O_3 Chemiluminescence	T. Ryerson NOAA-AL
Nitrogen Dioxide (NO_2)	Photolysis & NO/O_3 Chemiluminescence	T. Ryerson NOAA-AL
In-situ volatile organic compounds, VOCs	Proton Transfer Reaction Mass Spectrometer	J. de Gouw NOAA-AL
Canister VOCs	Canister Sampling, GC/FID, GC-MS	E. Atlas, U. Miami
Total Nitrogen Oxides (NO_y)	Au Converter & NO/O_3 Chemiluminescence	T. Ryerson NOAA-AL
Carbon Dioxide (CO_2)	Non-Dispersive InfraRed (NDIR)	A. Andrews, P. Tans NOAA-CMDL; J. Smith AOS
Sulfur Dioxide (SO_2)	UV Pulsed Fluorescence	J. Holloway NOAA-AL
Carbon Monoxide (CO)	VUV Resonance Fluorescence	J. Holloway NOAA-AL
Formaldehyde (CH_2O)	Tunable Diode Laser Absorption Spectrometry	M. Zahniser, S. Herndon Aerodyne Inc.
PAN's (PAN, PPN)	Chemical Ionization Mass Spectrometer (CIMS)	F. Flocke NCAR-ACD
HNO_3, NH_3	CIMS	A. Neuman, J. Nowak NOAA-AL
Hydroxyl Radical (OH)	CIMS	G. Huey, D. Tanner GIT-EAS
Sulfuric Acid (H_2SO_4)	CIMS	G. Huey GIT-EAS
NO_3, N_2O_5	Cavity Ring-Down Spectroscopy (CARDS)	S. Brown NOAA-AL
Aerosol Single Particle Composition	Particle Analysis by Laser Mass Spectrometry (PALMS)	D. Murphy NOAA-AL
Aerosol Bulk Ionic Composition	Particle Into Liquid Sampling (PILS)	R. Weber GIT-EAS
Aerosol Bulk Composition	Aerosol Mass Spectrometer (AMS)	A. Middlebrook NOAA-AL
Small Aerosol Size Distribution	Nucleation Mode Aerosol Size Spectrometer	C. Brock NOAA-AL
Aerosol Size Distribution	LASAIR	C. Brock NOAA-AL
Large Aerosol Size Distribution	White Light Scattering (WL-OPC)	A. Wollny NOAA-AL
Large Aerosol Sampling	Low Turbulence Inlet	C. Brock NOAA-AL; C Wilson U. Denver
Cloud Condensation Nuclei Concentration	Cloud Condensation Nuclei Counter (CNC)	A. Nenes, G. Huey GIT-EAS
Aerosol Size Distribution	Fast Forward Scattering Probe (FSSP 100)	T. Garrett U. Utah
Cloud Particle Size	OAP-2DC	T. Garrett U. Utah
Condensation Particle Abundance	Condensation Particle Counter	D. Covert, S. Doherty U. Washington
Sub-micron Aerosol Scattering & Backscattering (450, 550, 700 nm)	TSI 3563 Nephelometer	D. Covert, S. Doherty U. Washington
Sub-micron Aerosol Absorption (450, 550, 700 nm) dry	Modified Particle Soot Absorption Photometer (PSAP)	D. Covert, S. Doherty U. Washington
Cloud Particle Scattering	Cloud Integrating Nephelometer CIN 100	T. Garrett U. Utah
Actinic Flux	Spectrally Resolved Radiometer, Zenith & Nadir	H. Stark, R. Jakoubek NOAA-AL
Broadband Radiation	Pyrgeometer	NOAA AOC
Broadband Radiation	Pyranometer	NOAA AOC
Solar Spectral Irradiance	Solar Flux Radiometer	P. Pilewski NASA AmesRC
SO_2, O_3, NO2, H2O column	Miniturized Differential Absorption Spectroscopy (MIDAS)	A. Langford, J. Daniel, M. Melamed, R. Miller AL

Aircraft Facility:

http://www.aoc.noaa.gov/
http://www.aoc.noaa.gov/aircraft_lockheed.htm

Standard Aircraft Specifications

Dimensions (external):		
Wingspan	99 ' 8"	
Length	116' 10"	
Height to top of fin	34' 3"	
Ceiling:	25,000'	
Operational Airspeeds:	200 KIAS	(range 170 - 250 KIAS)
Max. Takeoff Weight:	135,000 lbs	
Useable Science Load:	Approximately 5,000 lbs	
Max Range / Duration:	Low altitude - 2500 nm or 9.5 hrs	
	High altitude - 3800 nm or 11.5 hrs	

In reality the science payload weight will be on the order of 5000 lbs plus 6 scientists. Because of increased drag due to the 4 wing pods, the window mounted inlets, the wing mounted aerosol probes and the fact that we will be operating at max zero fuel weight, with the pods counting against the fuel capacity, we expect to have a more limited range/duration.

NSF Wyoming King Air

Contacts: Bill Munger, Steve Wofsy, Harvard

Research Areas:

- Regional-scale budgets of CO and CO2
- Forest-atmosphere exchange of CO and CO2

Project: COBRA (http://www-as.harvard.edu/chemistry/cobra/index.html)

Flight Hours: 156 hrs on station + 36 hrs for ferry = 192 hrs

Deployment: May 16th- June 15th, July 16th - August 15th, 2004

FBO: Bangor, ME

Operating Theater: Within ~500 nm of Bangor, Maine including, but not limited to, New England, Quebec, Nova Scotia, New Brunshwick, Ontario, and off-shore.

Aircraft Facility: http://flights.uwyo.edu/

Scientific Payload

Parameter	Method	PIs
Carbon Monoxide (CO)	VUV Fluorescence	S. Wofsy, Harvard
Carbon Dioxide (CO_2)	NDIR – Modified Licor	B. Munger, Harvard
CH_4, N_2O and others	Flask Sampler	B. Munger, Harvard
Ozone (O_3)	TEI model 49	U. Wyoming
Standard Meteorological Parameters		U. Wyoming

Standard Instrument list: http://flights.uwyo.edu/base/InstList.html

CIRPAS Twin Otter

Contacts: John Seinfeld, Bill Conant, Cal. Tech.
Haflidir Jonsson, NPS

Research Areas: Aerosol indirect forcing; Aerosol and CCN physics and chemistry

Flight Hours: 75 hrs
Deployment: August 2 – August 20, 2004
FBO: Cleveland, OH
Operating Theater: Cleveland area: N. OH, Lake Erie, W. PA, SW Ontario

Aircraft Facility: http://web.nps.navy.mil/~cirpas/

Standard Aircraft Specification:
http://www.fas.org/man/dod-101/sys/ac/uv-18.htm

Wingspan	19.8 m
Length	15.1 m
Height	5.7 m
Cruise speed	297 km/h
Speed Range	65-165 KIAS
Cruise ceiling	3050 m
Ceiling	25,000 ft. (Oxygen installed)
Range with maximum payload	200 km
Endurance - Maximum	4.2 hrs @ Sea Level, 4.4 hrs @ 10,000'
Payload	4500 lbs.

Scientific Payload

Quantity	Instrument	PI
Aerosol Size & Concentration	NMASS (total conc. > 5nm) DACADS (10 – 800 nm) at ambient and dry RH (0.01 Hz) PCASP- 100X (0.1-3.0 µm) APS (0.5-15 µm)	Jonsson/Buzorius (NPS) Varutbangkul/Flagan/Seinfeld (CIT) Jonsson (NPS) Jonsson (NPS)
Aerosol Chemical Properties	CCNC-3 concentration (0.1%,0.2%,0.5% supersat.) Aerosol Mass Spectrometer (SO4, NH4, NO3, OC) (0.05–0.8 µm) Aerosol functional group analysis Particle Into Liquid Sampler (PILS)	Rissman/Flagan/Seinfeld (CIT) Bahreini/Flagan/Seinfeld (CIT) Russell (SIO) Brechtel/Flagan/Seinfeld (CIT)
Aerosol Absorption	3 λ PSAP SP2 – Black carbon incandescence Photoacoustic Light Absorption Spectrometer	Jonsson (NPS) Kok (DMT) Arnott (DRI)
Cloud Microphysics	CVI (counterflow virtual impactor) CAPS - Cloud Aerosol and Precipitation Spectrometer (0.6 µm - 1.6 mm) PVM-100A - Particulate Volume Monitor (liq H_20 conc and drop surface area) FSSP 100X (0.5 – 47 µm)	Rissman/Flagan/Seinfeld (CIT) Jonsson (NPS) Jonsson (NPS) Jonsson (NPS)
Meteorology	Precision T, T_d INS/GPS 5-hole turbulence probe	Jonsson (NPS)

DOE Gulfstream G-1

Contact: Peter Daum, BNL

Research Areas:

- Process level studies of aerosol/oxidant formation in plumes from various sources.
- Characterization of regional differences in aerosol distribution, composition, and microphysics in relation to aerosol sources and processing history.
- Characterization of the contribution of "mid-western" sources of aerosols, oxidants and their precursors to O_3/aerosol burdens in the Northeast US

Project: **Northeast Aerosol Experiment (NEAX)**

Flight h\Hours: ~ 60 hrs
Deployment: July 19st – August 15th, 2004
FBO: Latrobe, PA
Operating Theater: within about 300 nm from Latrobe, PA

Aircraft Facility: http://www.pnl.gov/atmos_sciences/as_g1_2.html

Standard Aircraft Specifications:

Gulfstream-1 Research Aircraft Technical Information from
http://www.atmos.anl.gov/ACP/G-1page.html

Aircraft length:	63.75 ft (19.44 m)
Aircraft wingspan:	78.33 ft (23.88 m)
Aircraft height:	23.33 ft (7.11 m)
Nominal operating altitude:	1,000 to 25,000 ft (7.5 km)
Nominal cruise speed:	160 - 290 knots (80 - 200 m s-1)
Nominal sampling speed:	200 knots (100 m s-1)
Endurance with max fuel:	6 hours
Cabin payload at max gross weight:	2,800 lb (1,300 kg) including scientific crew and instruments

Science Payload (subject to change)

Parameter	Time Resolution	Method	Det. Limit
Ozone (O3)	10 s	UV Absorption	2 ppb
Fast CO (FCO)	5 s	VUV Resonance Fluor	5 ppb
Sulfur Dioxide (SO2)	2s	UV Pulsed Fluorescence	200 - 300 ppt
Nitric Oxide (NO)	< 10 s	NO/O3 Chemiluminescence	20 ppt
Nitrogen Dioxide (NO2)	< 10 s	Photolysis NO/O3 Chem.	50 ppt
Total Nitrogen Oxides (NOy)	< 10 s	Mo Converter NO/O3 Chem.	300 - 400 ppt
VOCs	30 s	Canister Sampling, GC/FID	variable
VOCs	1 s	PTRMS	variable
Total peroxides	60 s	Fenton reagent	0.2 ppb
Aerosol composition	3 min	PILS	0.1 µg/m3
Aerosol composition	variable	Aerodyne AMS	variable
Aerosol size 0.1 – 3 µm	1 s	PCASP	NA
Aerosol size 2 – 47 µm	1 s	FSSP	NA
Aerosol size 3 – 800 nm	30 s	Differntial Mobility analyzers	NA
Aerosol scattering	10 s	Integrating nephelometry	10^{-7} Mm^{-1}
Particle Number	1 s	CNC (two)	(> 7 nm, > 3 nm)
UV Radiation	1 s	Eppley Pyranometer	(295 -385 nm)
Short-wave Irradiance	1 s	Eppley PSP	(285 - 2800 nm)
Long-wave Irradiance	1 s	Eppley PIR	(4 - 50 microns)
Water Vapor (H2O)	1 s	Lyman Alpha Absorption	±0.1 g m-3(est.)
Air Temperature	1 s	Platinum Resistance	±0.5 °C
Dewpoint/Frostpoint	1 s	Chilled Mirror	D.P. ±0.2 °C, F.P. ±0.4 °C
Wind Components(u-,v-,w-)	1 s	Gust Probe	< 0.5 m s-1
Altitude	1 s	Barometric	< 1 mb
Position	1 s	GPS	< 3 m
Air Speed	0.1 s	Barometric	< 20 cm s-1

NRC-IAR Convair 580

Contact: Richard Leaitch, MSC

Broad Research Questions:

- How do clouds process trace gases and PM?
- What is the contribution of LRT to summertime pollution levels in the Canadian Maritimes provinces?

It is anticipated that the measurements made in support of these general questions will also support the broad ICARTT objectives of understanding regional air quality in Eastern North America, intercontinental transport of pollution from eastern North America and the direct and indirect radiative forcing by anthropogenic aerosols.

Project: Chemical transformation and Transport by Clouds (CTC) and Transport Into the Maritimes (TIMs)

Flight Hours:	85 hrs
Deployment:	July 21 - August 18, 2004
FBO:	Cleveland, OH Bangor, Maine (?)
Operating Theater:	Ohio, Michigan, Southwestern Ontario Canadian Maritime Provinces

Standard Aircraft Specifications:

Length:	81 feet 6 inches
Wing Span:	105 feet 4 inches
Max Take-Off Wt.:	58,156 lbs.
Max Cruising Speed:	360 mph 313 kts
Normal Cruising Speed:	325 mph 282 kts
Service Ceiling:	25,000 feet
Range:	2866 miles

Aircraft Facility: http://iar-ira.nrc-cnrc.gc.ca/flight_5.htm

Science Payload

Parameter	Instrument	PI
Aerosol Particles		
Aerosol Particle Chemical Composition	Aerosol Mass Spectrometer Particle In Liquid Sampler	Hayden, Leaitch Toom-Sauntry, Halpin
Aerosol Particle Light Scattering	3 λ volume nephelometer (Alqhuist)	Sharma, Leaitch
Aerosol Particle Light Absorption	PSAP	Sharma
Aerosol Particle Number Size Distributions	PCASP-100X (0.14-3 µm OD) ASASP-100X (0.17-3 mm OD) FSSP 300 (0.3-20 µm OD) SMPS (10-500 nm MD) APS (0.5-20 µm AD) 3022 CPC (#cn > 6 nm)	Strapp, Leaitch
Trace Gases		
SO_2	Modified Teco 43C	Anlauf
CO	Aerolaser	Anlauf
O_3	Teco 49	Anlauf
VOCs	SS Canister sampling	Bottenheim, Dann
NH_3, CO	TDLAS	Harris, York U.
NO_x		Anlauf, Hayden
H_2O_2		Anlauf
Hg		Banic
HNO_3 (NH_3?)	Gas into liquid coil sampler and IC	Li, Leithead, Toom-Sauntry
HCHO	Aerolaser	Macdonald
Cloud		
Cloud Droplet Residuals	CVI – residuals fed to AMS, PILS & SMPS	Macdonald, Leaitch, Noone
Bulk Cloudwater	Slotted rod teflon CW collector	Macdonald, Li, Toom-Sauntry
Droplet Liquid Water Content	PMS King Probe (long version) PMS King Probe (short version) Johnson Williams LWC Meter Nevzorev LWC probe	Strapp
Total water content and phase ratio	Nevzorev TWC/LWC probe	Strapp
Cloud Droplet Spectrum	FSSP 100 Probe (2-30 um) FSSP 100 Probe (5-95 um)	Strapp
Cloud Particle Spectrum and images	2D-C (25-800 um) 2D-C Grey (25-1600 um) DMT Cloud Imaging Probe (12.5-800 um)	Strapp
Precipitation Spectrum and images	2D-P mono (200-6400 um)	Strapp
Cloud light extinction	Nevzorov (direct measurement)	Strapp
Radiation		
Up- and downwelling UV	Eppley UV radiometers (295-385 nm)	
Up- and downwelling Vis	Kipp and Zonen pyranometers (305-2800 nm)	
Surface infrared temperature	Barnes PRT-5 radiometer	
Video Systems		
Surface video – forward downlooking and side looking	Narrow and wide angle cameras	

UMD Piper Aztec

Contacts: Bruce Doddridge, Lackson Marufu, U. Maryland

Project:

Regional Atmospheric Measurement Modeling and Prediction Program (RAMMPP)
Goals:
1) to gain an improved understanding of the factors - including local/regional atmospheric dynamics and synoptic-scale transport - controlling near-surface pollution events observed in the Mid-Atlantic and Northeast areas, and
2) to provide input (initial and boundary condition) and evaluation data for parallel mesoscale and regional scale modeling efforts

Research Areas:

1) Characterization aloft of meteorological scalars and key players involved in photochemical smog and regional haze formation and transport
2) Indentification of major transport processes and pathways influencing near-surface ozone exceedences and visibility impairment
3) Evaluation of satellite techniques for studying the Earth system

Flight Hours:	TBD (40-60 hrs)
Deployment:	May 15th – September 30th, 2004
FBO:	Frederick, MD (FDK) with as-needed remote deployments as appropriate
Operating Theater:	mid Atlantic region

Aircraft facility: http://www.atmos.umd.edu/~umdair/rammpp01.html

Standard Aircraft Specifications:

Groundspeed range	160-250 km h^{-1}
Ceiling	6.1 km unpressurized (supplemental O2 required above 3.8 km)
Research payload/crew	1000kg (instruments & crew) / 3 (2 pilots; 1 mission scientist)
Research endurance	Typically 3.5 hours

Science Payload

Parameter	Temporal Resolution	Detection Limit	Technique (Instrument)
Position	10 s	15m	GPS (Garmin GPS90)
Static Pressure	10 s	5 mb	Transducer (Rosemont 1008)
Temperature	10 s	0.5^oC	Thermistor (Rustrack RR2-252)
Relative Humidity	10 s	2 %	Thin capacitive film (Rustrack RR2-252)
U, V wind components	1 s	$0.2\ ms^{-1}$	Differential GPS (AIMMS-10)
O_3	4 s	1 ppbv	UV photometry (TEI 49C)
NO_2[¶]	TBD	TBD	Custom TDL/CDR sensor
NO	10 s	50 ppb	O_3 Chemiluminescence (modified TEI 42C)
CO	1 min[*]	20 ppbv	Modified NDIR/GFC (TEI 43C)
SO_2	1 min[*]	30 pptv	Modified pulsed-fluorescence (TEI 43C)
Aerosol Absorption	1 min	$0.9x10^6\ m^{-1}$	Modified photometric (Radiance Research PSAP)
Aerosol Scattering	1 min	$0.1\text{-}0.4x10^6m^{-1}$	Integrating Nephelometer (TSI 3563)
Particle counts	10 s	0.01µm	Condensation Particle Counter Model 3007
Aerosol size (0.3-10µm)	1 min	N/A[a]	Custom laser based optical (Met One 9012)

NOAA R/V RONALD H. BROWN

Contacts: Tim Bates, Eric Williams, Jim Meagher, NOAA

Research Areas:

1. How do gas and aerosol species from the urban corridor of New York and Boston evolve during transport over the Gulf of Maine? What is the effect of the sea breeze circulation on their transport?
2. How do gas and aerosol species from biogenic emissions evolve during transport over the Gulf of Maine?
3. How does the convectively turbulent continental boundary layer interact with the stable atmosphere over the Gulf of Maine? What is the effect on vertical mixing and transport of pollutants?
4. What is the total amount of nitrogen, sulfur, and carbon gases and aerosols emitted in the exhaust plumes from large ocean-going vessels, principally commercial ships such as container vessels, car-carriers and large tankers? How do the emitted species evolve over time?
5. What is the clear-sky radiative impact of the aerosols advecting from North America out over the Northwestern Atlantic Ocean?
6. How do the continental aerosols over Northeastern North America and those advecting out over the Northwestern Atlantic Ocean affect cloud drop size distributions and cloud reflectance (first indirect effect)?
7. What is the composition of primary anthropogenic aerosol emitted from the urban NE?
8. What is the role of aerosol acidity in secondary aerosol formation?
9. What is effect of fog on gas and aerosol evolution?
10. How directly comparable are the measurements on the various platforms used during NEAQS/ITCT?

Project: NEAQS-ITCT 2004 (http://www.al.noaa.gov/2004/)

Days at Sea:	38 days
Deployment:	July 5th – August 13th, 2004
Operating Theater:	East Coast, Boston MA to Yarmouth N.S.

Ship Facility:

http://www.moc.noaa.gov/
http://www.moc.noaa.gov/rb/index.html

Performance specifications and facilities for RONALD H. BROWN.

Parameter	Specification
Length (ft/m)	274 / 83.5
Range (nm/km)	11,300 / 20,900
Endurance (days)	35
Cruising speed (kts / mps)	12 / 6.2
Maximum speed (kts / mps)	15 / 7.7
Officers / Engineers / Crew	5 / 4 / 16
Scientific staff	34 (maximum)
Laboratory/office space (sq. ft.)	4100
Telecommunications, data	INMARSAT-A
Telecommunications, voice	Cell, Comsat and Iridium phones, INMARSAT-M,A, Radio (to aircraft)

Science Payload

Parameter	Method	PI
Photolysis Rates (jNO2; jO(1)D; jNO3)	Filter photometry	R. Jakoubek/NOAA-AL
Ozone	UV Absorbance	E. Williams/NOAA-AL
Ozone	NO Chemiluminescence	E. Williams/NOAA-AL
Ozone	UV Absorbance	J. Johnson/NOAA-PMEL
Carbon Monoxide	UV Fluorescence	B. Lerner/NOAA-AL
Carbon Dioxide	Nondispersive IR	B. Lerner/NOAA-AL
Sulfur Dioxide	UV Fluorescence	E. Williams/NOAA-AL
Sulfur Dioxide	UV Fluorescence	T. Bates/NOAA-PMEL
Nitric Oxide	Chemiluminescence	B. Lerner/NOAA-AL
Nitrogen Dioxide	Photolysis Cell/chemiluminescence	B. Lerner/NOAA-AL
Total Nitrogen Oxides	Au Tube Reduction/chemilumnescence	E. Williams/NOAA-AL
PANs	GC/ECD	J. Roberts/NOAA-AL
Alkyl Nitrates	GC/MS	P. Goldan/NOAA-AL
Nitric acid	Mist chamber/IC	J. Dibb/UNH-AIRMAP
NO3/N2O5	Cavity ring-down spectrometry	H. Osthoff/NOAA-AL
Continuous Speciation of VOCs	PTR-MS/CIMS	C. Warneke/NOAA-AL
VOC Speciation	GC/MS	W. Kuster/NOAA-AL
Radon	Rn gas decay	J. Johnson/NOAA-PMEL
Seawater/atmospheric pCO2	Non-dispersive IR	R. Wanninkhof/NOAA-AOML
Seawater DMS	S Chemiluminescence	J. Johnson/NOAA-PMEL
Aerosol Ionic Composition	PILS	P. Quinn/NOAA-PMEL
Aerosol Size and Composition	Aerosol Mass Spectrometer	T. Bates/NOAA-PMEL D. Worsnop/Aerodyne
Aerosol OC/EC	On-line thermal/optical	T. Bates/NOAA-MEL

Parameter	Method	PI
Ionic aerosol composition, 2 stage (sub/super micron) & 7 stage at 55% RH	Impactor (IC, XRF, and thermal-optical OC/EC, total gravimetric weight)	P. Quinn/NOQQ-PMEL T. Bates/NOAA-PMEL
Total and sub-micron aerosol scattering and backscattering (450, 550, 700 nm) at 60% RH	TSI Model 3563 Nephelometers (2)	P. Quinn/NOAA-PMEL
Total and sub-micron aerosol absorption (450, 550, 750 nm) dry	Modified Radiance Research PSAPs (2)	P. Quinn/NOAA-PMEL
Aerosol water-soluble OC	PILS-TOC	P. Quinn/NOAA-PMEL
Aerosol organic speciation	PILS-LCMS	P. Quinn/NOAA-PMEL
Aerosol functional groups	FTIR	L. Russell/SIO
Sub-micron aerosol extinction	Extinction cell	D. Covert/UW
Sub-micron aerosol extinction	Cavity ring-down spectrometry	T. Baynard/NOAA-AL
Aerosol number	CNC (TSI 3010, 3025)	D. Covert/UW T. Bates/NOAA-PMEL
Aerosol size distribution at 60% RH	DMA, OPC, and APS	D. Covert/UW T. Bates/NOAA-PMEL
Total and sub-micron aerosol light scattering hygroscopic growth	Twin TSI 3563 nephelometers	R. Rood/UI
Irradiance	Portable radiation package	M. Reynolds/BNL
Vertical ozone profiles	Ozonesondes	A.Thompson/NASA
Aerosol optical depth	Microtops	P. Quinn/NOAA-PMEL
Ozone & Aerosol backscatter	Lidar (OPAL)	C. Senff/NOAA-ETL
Vertically resolved O_3, NO_2, SO_2, CH_2O	Multi-angle DOAS	U. Platt/U. Heidelberg
Wind/temperature profiles	915 MHz wind profiler	A. White/NOAA-ETL
Temperatue/relative humidity profiles	Radiosondes	A. White/NOAA-ETL
Liquid water path	Microwave radiometer	C. Fairall/NOAA-ETL
Cloud height	Ceilometer	C. Fairall/NOAA-ETL
Cloud drop size distribution, updraft velocity	K-band radar	B. Albrecht/U. Miami
Turbulent fluxes/energy balance	Bow-mounted eddy covariance package	C. Fairall/NOAA-ETL
Low altitude temp profiles	60 GHz scanning microwave	C. Fairall/NOAA-ETL
High-resolution turbulence	Mini-sodar	C. Fairall/NOAA-ETL
Wind profiles/microturbulence	C-band radar	C. Fairall/NOAA-ETL
BL wind/aerosol profiles	Doppler lidar (HRDL)	A. Brewer/NOAA-ETL

Abbreviations

AGL	Above Ground Level
AL	Aeronomy Laboratory
AmesRC	Ames Research Center
AOC	Aircraft Operations Center
AOS	Atmospheric Observing Systems
ARC	Ames Research Center
BAe	British Aerospace
BAERI	Bay Area Environmental Research Institute
Cal Tech	California Institute of Technology
CIRPAS	Center for Interdisciplinary Remotely-Piloted Aircraft Studies
CIT	California Institute of Technology
CMDL	Climate Monitoring & Diagnostics Laboratory
CNRS	Centre National de la Recherche Scientifique
COBRA	CO2 Budget and Rectification Airborne study
CTC	Chemical transformation and Transport by Clouds
DLR	Deutsches Zentrum für Luft- und Raumfahrt
DMT	Droplet Measurement Technologies
DOE	Department of Energy
DRI	Desert Research Institute
Envisat	ENVIronment SATellite
FAAM	Facility for Airborne Atmospheric Measurements
FBO	Fixed Base of Operation
FZK-IFU	Institut für Meteorologie und Klimaforschung - Bereich Atmosphärische Umweltforschung (Germany)
GIT-EAS	Georgia Institute of Technology – Earth and Atmospheric Sciences
GSFC	Goddard Space Flight Center
HRS	Hours
IAS	Indicated Air Speed
ITA	International Tradeport Airport
ICARTT	International Consortium for Atmospheric Research on Transport and Transformation
INTEX-NA	Intercontinental Chemical Transport Experiment - North America
ITOP	Intercontinental Transport of Pollution
KIAS	Knots, Indicated Air Speed
LaRC	Langley Research Center
LRT	Long Range Transport
Max	Maximum
MPI-C	Max-Planck-Institut für Chemie (Germany)
MPI-K	Max-Planck-Institut für Kernphysik (Germany)
MSC	Meteorological Service of Canada
NASA	National Aeronautic and Space Administration
NCAR	National Center for Atmospheric Research
NCAR-ACD	NCAR - Atmospheric Chemistry Division

NEAQS-ITCT	New England Air Quality Study - Intercontinental Transport and Chemical Transformation
NEAX	NorthEast Aerosol Experiment
NERC	Natural Environment Research Council (United Kingdom)
NPL	National Physical Laboratory (United Kingdom)
NPS	Naval Postgraduate School
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NRC-IAR	National Research Council - Institute for Aerospace Research (Canada)
NSF	National Science Foundation
ONR	Office of Naval Research
PI	Principal Investigator
PM	Particulate Matter
RHB	Ronald H. Brown
R/V	Research Vessel
SCIAMACHY	Scanning Imaging Absorption SpectroMeter for Atmospheric ChartographY
SAIC	Science Applications International Corporation
SIO	Scripps Institution of Oceanography
TAS	True Air Speed
TBD	To Be Determined
TIMs	Transport Into the Maritimes
TO	Take Off
Typ.	Typical
UC	University of California
UEA	University of East Anglia
UM	University of Maryland
UMIST	University of Manchester Institute of Science and Technology
U.	University
Univ.	University