FINAL PROJECT INSTRUCTIONS
9 June 2004

NOAA SHIP *RONALD H. BROWN*
Cruise RB-04-07
The New England Air Quality Study (NEAQS)
and
Intercontinental Transport and Chemical Transformation Study (ITCT)

5 July – 13 August 2004

Chief Scientist
Timothy S. Bates

NOAA/Pacific Marine Environmental Laboratory
Ocean Climate Research Division
7600 Sand Point Way, NE
Seattle, Washington 98115

ENDORSEMENTS:

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Dr. Eddie N. Bernard
Director, Pacific Marine Environmental Laboratory
Seattle, WA 98115

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Capt. John Clary, NOAA
Acting Director, Marine Operations Center
Seattle, WA 98102

NOAA RESEARCH CRUISE NEAQS/ITCT 2004

The New England Air Quality Study and Intercontinental Transport and Chemical Transformation Study

Participating Organizations:

NOAA Pacific Marine Environ. Lab., Seattle, WA	(PMEL)
NOAA Aeronomy Laboratory, Boulder, CO	(AL)
NOAA Environ. Technology Laboratory, Boulder, CO	(ETL)
NOAA Forecast Systems Laboratory, Boulder, CO	(FSL)
NOAA Atlantic Ocean. Met. Lab., Miami, FL	(AOML)
University of New Hampshire, Durham, NH	(UNH)
Brookhaven National Lab., Upton, NY	(BNL)
University of Washington, Seattle, WA	(UW)
Joint Institute Study Atmosphere Ocean, Seattle, WA	(JISAO)
Cooperative Inst. Res. In Environ. Sci., Boulder, CO	(CIRES)
Aerodyne Research Inc., Billerica, MA	(Aerodyne)
University of Miami, Miami, Fl	(UM)
University of Illinois, Urbana-Champaign, IL	(UIUC)
NASA Goddard Space Flight Center, Greenbelt, MD	(GSFC)
Peking University, Beijing, China	(PU)
University of Heidelberg, Heidelberg, Germany	(UH)
Scripps Institution of Oceanography, La Jolla, CA	(SIO)

NOAA SHIP: *RONALD H. BROWN*
Cruise No: RB-04-07
Area: Gulf of Maine

Itinerary:

Leg 1:
d. Portsmouth 5 July 2004
a. Portsmouth 23 July 2004

Leg 2:
d. Portsmouth 26 July 2004
a. Portsmouth 13 Aug 2004

Cruise Description and Objectives:

NEAQS/ITCT 2004 is an atmospheric chemistry and meteorology project centered in the Gulf of Maine. Sampling will be coordinated with a ground based sampling in New England and Nova Scotia and with multiple aircraft. Most of the research will be concentrated in the Boston, MA and Portsmouth, NH region. Sampling aboard *RONALD H. BROWN* will take place continuously with the following goals:

- To characterize sources (local vs. distant), pollutant mix, and reactivity of the boundary layer along the New England seacoast and adjacent waters
- To characterize transport (vertical and horizontal mixing) and transformation processes (day/night chemistry) that affect the levels of ozone and aerosols in the marine boundary layer of the study region,
- To determine how coastal atmospheric dynamic processes (e.g., land breeze – sea breeze circulation) affect air quality in the study region.
- To characterize the chemical composition of regional air masses along the East Coast of the United States,
- To determine the direct and indirect radiative effect of aerosols on climate.

The proposed research will address significant information gaps and deliver sound science leading to an improved understanding of the processes that influence the air pollution levels in New England and the intercontinental transport of chemical species from North America to Europe.

Ship Operations Contact:
LCDR James Meigs (757-441-6842)
Jim.Meigs@noaa.gov (fax 757-441-6495)
NOAA/MOA
439 West York Street
Norfolk, Virginia 23510

Scientific Operations Contact:
Timothy Bates (206-526-6248) tim.bates@noaa.gov
LCDR Brian Lake (206-526-4485) brian.lake@noaa.gov
NOAA/PMEL (R/PMEL)
7600 Sand Point Way N.E., Bldg. 3
Seattle, WA 98115

1.0 SCIENTIFIC OBJECTIVES

Until recently NOAA's research programs in global climate change and regional air quality have been conducted as separate, albeit related, activities. Much of the NOAA research related to climate change is funded out of and directed by the Office of Global Programs in the Office of Oceanic and Atmospheric Research (OAR). One focus of this research has been global-scale transport and transformation processes, which is linked to other U. S. based research and international efforts through the International Global Atmospheric Chemistry Program (IGAC). NOAA organized major field campaigns to study pollutant transport from North America to the North Atlantic under the North Atlantic Regional Experiment (NARE) in 1993, 1996 and 1997. NOAA also co-organized major field campaigns to study regional distributions of aerosol properties and their radiative effects as part of the IGAC Aerosol Characterization Experiments (ACE) in 1995, 1997, and 2001. More recently, the transport of Asian pollution to the U. S. west coast was studied in 2002 under the Intercontinental Transport and Chemical Transformation (ITCT) program.

NOAA's Health of the Atmosphere (HoA) research is focused on the atmospheric science that underlies regional and continental air quality, with the goal of enhancing our ability to predict and monitor future changes, leading to improved scientific input to decision-making. The HoA program is a collaborative effort involving several NOAA laboratories and university scientists. Under this program NOAA joined with other federal agencies, university research groups, and interested parties from the private sector to study factors controlling the formation and distribution of ozone and fine particles in a number of settings including: Nashville, TN (1994, 1995, 1999), Atlanta, GA (1999), and Houston, TX (2000). During the summer of 2002 NOAA deployed *Ronald H. Brown* to the Gulf of Maine as part of the New England Air Quality Study (NEAQS), equipped with a comprehensive set of chemical and meteorological instruments to develop the information needed to plan the current effort.

Clearly, the distinction between the research objectives of these two programs is, at least in part, simply a matter of perspective and scale. Many of the chemical and meteorological processes of interest are common to both. Also, intercontinental transport is either the starting point or the end point of regional air quality concerns depending on whether you are on the west coast (inflow) or east coast (outflow) of the U. S. Thus, in recognition of this strong linkage NOAA will conduct a joint regional air quality and climate change study in the summer of 2004. The study will combine the elements of the previous ITCT and NEAQS studies and will be known as the **NEAQS - ITCT 2004**. The study will focus on air quality along the Eastern Seaboard and transport of North American emissions into the North Atlantic. NOAA will deploy 2 aircraft in addition to *Ronald H. Brown* to support the objectives of both research programs.

Research Areas

The research planned for the 2004 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?

2.0 PERSONNEL

2.1 Chief Scientist

Dr. Tim Bates (PMEL)

The Chief Scientist is authorized to alter the scientific portion of this cruise plan with the concurrence of the Commanding Officer, provided that the proposed changes will not: (1) jeopardize the safety of the personnel or the ship; (2) exceed the allotted time for the cruise; (3) result in undue additional expense; or (4) change the general intent of the cruise.

2.2 Participating Scientists

	Name	Gender	Nationality	Affiliation	Leg1	Leg2
1.	Dr. Tim Bates	M	USA	PMEL	x	x
2.	Dr. Patricia Quinn	F	USA	PMEL	x	x
3.	Dr. Theresa Miller	F	USA	JISAO/PMEL	x	x
4.	Dr. James Johnson	M	USA	JISAO/PMEL	x	x
5.	Mr. Derek Coffman	M	USA	JISAO/PMEL	x	x
6.	Mr. Drew Hamilton	M	USA	JISAO/PMEL	x	x
7.	Dr. Kristen Schulz	F	USA	JISAO/PMEL	x	x
8.	Dr. David Covert	M	USA	UW	x	
9.	Dr. Berko Sierau	M	USA	UW		x
10.	Dr. Eric Williams	M	USA	AL/CIRES	x	x
11.	Mr. Paul Murphy	M	USA	AL/CIRES	x	x
12.	Dr. Brian Lerner	M	USA	AL/CIRES	x	x
13.	Dr. Jim Meagher	M	USA	AL		x
14.	Dr. Jim Roberts	M	USA	AL	x	
15.	Dr. Paul Goldan	M	USA	AL	x	x
16.	Mr. William Kuster	M	USA	AL	x	x
17.	Dr. Shao Min	M	China	PU.	x	x
18.	Dr. Carsten Warnecke	M	Austria	AL/CIRES		x

19. Dr. Shuji Kato	M	Japan	CIRES	x	
20. Dr. Hans Osthoff	M	Canada	AL/CIRES	x	x
21. Dr. Tahllee Baynard	M	USA	AL/CIRES	x	x
22. Dr. Anders Petterson	M	Sweden	AL/CIRES	x	x
23. Dr. Christoph Senff	M	Germany	ETL/CIRES	x	
24. Mr. Richard Marchbanks	M	USA	ETL	x	
25. Dr. Sara Tucker	F	USA	ETL/CIRES		x
26. Dr. Alan Brewer	M	USA	ETL	x	
27. Dr. Wynn Eberhard	M	USA	ETL		x
28. Ms. Brandi McCarty	F	USA	ETL		x
29. Mr. Dan Law	M	USA	ETL	x	
30. Mr. Dan Wolfe	M	USA	ETL		x
31. Dr. Chris Fairall	M	USA	ETL		x
32. Dr. Jeff Hare	M	USA	ETL/CIRES	x	
33. Ms. Michelle Ratterree	F	USA	ETL	x	
34. Dr. Pavlos Kollias	M	Greece	ETL/CIRES	x	
35. Mr. Tom Snowden	M	USA	UM		x
36. Mr. Jo Ieng	M	Cuba	UM		x
37. Ms. Sallie Whitlow	F	USA	UNH	x	x
38. Dr. Anne Thompson	F	USA	NASA/GSFC	x	
39. Mr. Jeff Liesch	M	USA	NASA/UMD		x
40. Dr. Tim Onasch	M	USA	Aerodyne	x	x
41. Ms. Wei Wang	F	USA	UIUC	x	x
42. Mr. Frank Filsinger	M	German	UH		x
43. Mr. Christoph Kern	M	USA	UH	x	
44. Kirk Beckendorf	M	USA	Teacher-at-sea	x	
45. Kevin McMahon	M	USA	Teacher-at-sea		x
Total				**32**	**32**

3.0 SCHEDULE

The NEAQS/ITCT 2004 project will begin loading vans and equipment on June 29, 2004 in Portsmouth, NH. Leg 1 of the project will begin on July 5 and end in Portsmouth, NH on July 23.

The port stop will be used for meetings with scientists at the Pease International Trade Center (aircraft operations center), the University of New Hampshire and the regional ground stations. We anticipate that our only loading/unloading during the stop between legs will be to replenish our liquid nitrogen supply. Arrival and departure from Portsmouth, NH, will be scheduled in consideration of currents.

Leg 2 will begin on Monday July 26 and end in Portsmouth on August 13, 2004. We will plan to off-load our containers on Saturday, August 14.

4.0 OPERATIONS

4.1 General Operations

The project operations area is shown in Appendix A. The actual transect will depend on meteorological conditions. The scientific party aboard *RONALD H. BROWN* will meet twice each day at 0800 (brief update) and 1930 (main science team meeting) to discuss the plan for the next few days and results from the previous day. Operations during the cruise will address the following scientific questions:

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?**
   Meteorological requirement: southwesterly flow
   Deployment strategy: Under southwesterly flow, we will conduct repeated cross wind transects close to Cape Ann, 30 nm downwind of Cape Ann and 60 nm downwind of Cape Ann. The transects at each location will cover a full diurnal cycle with a 2-3 hour repeat time.
2. **How do gas and aerosol species from biogenic emissions evolve during transport over the Gulf of Maine?**
   Meteorological requirement: North/northwesterly flow
   Deployment strategy: Under northwesterly flow, we will conduct repeated cross wind transects close to the Maine coast, 30 nm downwind of the Maine coast and 60 nm downwind of Maine The transects at each location will cover a full diurnal cycle with a 2-3 hour repeat time.
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?**
   Meteorological conditions: Offshore flow from southwesterly to northwesterly directions
   Deployment strategy: Under westerly flow conditions we will follow the offshore flow in a "zigzag" pattern to approx. 50 miles offshore and then return in a straight line towards shore. We will start this pattern in the morning and conclude in the evening. Under southwesterly or northwesterly flow, we will employ a similar sampling strategy as mentioned under objectives 1 and 2, except that we will extend the afternoon transect to a distance of approximately 50 miles to reach regions of colder water temperatures and enhanced atmospheric stability. If we encounter offshore flow from the southwesterly to northwesterly sector during the return journey from Chebogue Point, Nova Scotia (see objective 10) we will have the opportunity to study the interaction between the continental and marine boundary layer over a much longer transect and a greater range of atmospheric conditions.
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?**
   Meteorological requirement: Clean background air, northerly or marine flow

Deployment strategy: We envision two scenarios for addressing these questions. The first scenario is to position *RONALD H. BROWN* on-station heading into a light wind approximately 0.5-2 miles downwind of a defined shipping lane into a major port. As target vessels pass back-and-forth upwind, the exhaust plumes are brought to our sampling point. Ideally, the upwind air composition will be considerably cleaner (clean marine or continental flow) than the measured exhaust plumes which provides the best chemical resolution of the exhaust plume constituents. This scenario allows us to sample a large number of vessels and, because of proximity to a port, should allow us to obtain vessel ID and other information from the Port Authority. Opportunities for this type of scenario could also take place in other locations as target vessels pass reasonably closely upwind of *RONALD H. BROWN*, whether she is underway or not. The second sampling scenario is to intercept the exhaust plume from a target vessel and follow it as far as possible. This could occur either as a chase of a target vessel or as an interception of the target vessel, following the exhaust plume in the opposite direction to the vessel heading. In both cases the ideal wind situation would be light-to-calm. Rather than track into the plume directly, it would be preferable to tack repeatedly across the plume. Most of the plume tracking will have to be done visually, but the chemical and meteorological sensors on board could be used for guidance when the plume is no longer visible.

5. **What is the clear-sky radiative impact of the aerosols advecting from North America out over the Northwestern Atlantic Ocean?**

   Meteorological requirement: cloud free sky above ship

   Deployment strategy: A combination of chemical forecast models and surface and airborne lidars will be used to determine the location and vertical distribution of aerosol plumes. The ship and aircraft (NASA J1 and NOAA P3) will be positioned to make *in situ* measurements of aerosol size distributions, chemical composition, f(RH), and scattering and absorbing properties within the plumes at the surface (ship and ground station) and aloft (aircraft). Optical depth and radiances will be measured at the surface (ship), vertically resolved (aircraft) and at the top of atmosphere (satellite). The measurements will be coordinated with satellite overpasses.

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)?**

   Meteorological requirement: clouds with anthropogenic perturbation (possibly in post frontal northerly flow with ship positioned south of Boston).

   Deployment strategy: Measurements of in-situ aerosol properties and remotely sensed cloud properties (e.g., liquid water path, cloud droplet effective radius) will be made aboard *RONALD H. BROWN*. Aircraft will be coordinated below, within and above cloud to simultaneously measure in-situ aerosol properties used to calculate CCN (physical size distribution, chemical size distribution, f(RH)), CCN, cloud droplet number concentration, size distributions and chemistry, updraft velocities, liquid water content, and cloud radiative properties.

7. **What is the composition of primary anthropogenic aerosol emitted from the urban NE?**

   Meteorological requirement: Ship must be downwind of urban sources.

Deployment strategy: Sample at night or early morning as close to urban sources as possible (Boston inner harbor?).

8. **What is the role of aerosol acidity in secondary aerosol formation?**
   Meteorological requirement: Ship must be downwind of urban sources and power plant plumes (these conditions were encountered in 2002 off Cape Ann–question 1).
   Deployment strategy: Sample across power plant plumes imbedded in larger urban plumes.
9. **What is effect of fog on gas and aerosol evolution?**
   Meteorological requirement: Fog.
   Deployment strategy: Sample in fog under clean and polluted conditions if conditions permit.
10. **How directly comparable are the measurements on the various platforms used during NEAQS/ITCT?**
   Meteorological requirement: Well mixed marine boundary layer.
   Deployment strategy: Coordinate sampling during each aircraft overflight (day and night flights are currently planned). Position the ship near Chebogue Point, Nova Scotia and the Isles of Shoals, NH for an extended intercomparison (24 hours).

4.2 Underway Measurements

NEAQS/ITCT 2004 Ronald H. Brown Measurements - 5 February 2004

Parameter	Method	Laboratory	PI
Data and systems management	PCs; Ship's LAN; e-mail; ftp	PMEL	Johnson
Data and systems management	Macs; PCs	AL	Murphy
Photolysis rates (JNO2, JNO3 and J O-1D)	Spectral radiometer	AL	Jakoubek
Ozone	UV absorbance	AL	Williams
Ozone	UV absorbance	PMEL	Johnson
Ozone	NO chemiluminescence	AL	Williams
Ozone, NO2,CH2O, halogens	DOAS	UH	Platt
Ozone vertical distributions	Ozonesondes	NASA	Thompson
Carbon monoxide	UV fluorescence	AL	Lerner
Carbon dioxide	Non-dispersive IR	AL	Lerner
Water vapor	Non-dispersive IR	AL	Lerner
Sulfur dioxide	Pulsed fluorescence	AL	Lerner
Sulfur dioxide	Pulsed fluorescence	PMEL	Bates
Nitric oxide	Chemiluminescence	AL	Lerner
Nitrogen dioxide	Photolysis cell	AL	Lerner
Total nitrogen oxides	Au tube reduction	AL	Williams
PANs	GC/ECD	AL	Roberts
Alkyl nitrates	GC/MS	AL	Goldan
NO3/N2O5	Cavity ring-down spect.	AL	Brown
Nitric acid/NH3	Automated mist chamber/IC	UNH	Dibb

NEAQS/ITCT 2004 Ronald H. Brown Measurements - 5 February 2004

Parameter	Method	Laboratory	PI
Radon	Radon gas decay	PMEL	Johnson
VOC speciation	GC/MS	AL	Kuster
Seawater and atmospheric pCO2	Non-dispersive IR	PMEL/ AOML	Feely/ Wanninkhof
Seawater DMS	S chemiluminesence	PMEL	Bates/Johnson
Continuous speciation of VOCs	PTR-MS/CIMS	AL	Warneke
Aerosol ionic composition	PILS-IC	PMEL	Quinn
Aerosol WSOC	PILS-TOC	PMEL	Quinn/Bates
Organic aerosol speciation	PILS-LCMS	PMEL	Quinn
Aerosol size and composition	Aerosol mass spectrometer	PMEL/Aero dyne	Bates/Worsnop
Aerosol OC/EC	On-line thermal/optical	PMEL	Bates
Aerosol organic functional groups	FTIR	SIO	Russell
Aerosol composition,2 stage (sub/super micron) & 7 stage at 60% RH	Impactors (IC, XRF and thermal optical OC/EC, total gravimetric weight)	PMEL	Quinn/Bates
Total and sub-micron aerosol scattering & backscattering (450, 550 and 700 nm) at 60% RH	TSI 3563 nephelometers (2)	PMEL	Quinn
Total and sub-micron aerosol absorption (450, 550, 700 nm) dry	Radiance Research PSAPs (2)	PMEL	Quinn
Sub-micron aerosol extinction	extinction cell	UW	Covert
Total and Sub-micron aerosol extinction	Cavity ring-down spect.	AL	Ravishankara
Aerosol number	CNC (TSI 3010, 3025)	UW/PMEL	Covert/Bates
Aerosol size distribution	DMA, OPC and APS	UW/PMEL	Covert/Bates
Total and sub-micron aerosol light scattering hygroscopic growth	Twin TSI 3563 nephelometers	UI	Rood
Irradiance	PRP	BNL	Reynolds
Aerosol optical depth	Microtops	PMEL	Quinn
Ozone aerosol backscatter	O3 Lidar (OPAL)	ETL	Senff
BL wind/aerosol	Doppler Lidar (HRDL)	ETL	Brewer
Wind/temp profiles	915 MHz wind profiler	ETL	White
Temp/RH profiles	Sondes	ETL	White
LWP	Microwave radiometer	ETL	Fairall

NEAQS/ITCT 2004 Ronald H. Brown Measurements - 5 February 2004

Parameter	Method	Laboratory	PI
Cloud height	Ceilometer	ETL	Fairall
Cloud drop size, updraft velocity	3mm doppler radar	Miami	Albrecht
Turbulent fluxes	Bow-mounted EC flux package	ETL	Fairall
Low altitude temperature profiles	60 GHz scanning microwave radiometer	ETL	Fairall
High resolution turbulence	Mini-sodar	ETL	Fairall
Wind profiles/microturbulence	C-Band radar	ETL	Fairall

Air samples will be collected using equipment mounted on the forward part of the 02 level. A mast will extend approximately 8 meters above the deck as the main aerosol sampling inlet on the AeroPhys van (PMEL 2). A second sampling mast will be mounted for gas sampling forward of the AL 1 van. Equipment will be mounted on top of the AL 1 van.

Ship and scientific personnel must constantly be aware of potential sample contamination. Work activities and smoking forward of the main stack must be secured during sampling operations. This includes the bow, boat deck forward of the stack, bridge deck and flying bridge. The scientists on watch must be notified of any change in ship course or speed that will move the relative wind abaft the ship's beam or if anyone needs access to the bow. The scientists on watch should also be notified when the ship enters a rain squall and when the rain subsides.

Continuous water sampling will be made from the ship's bow intake system. This system must be capable of delivering 50 liters per minute through the main deck piping. Seawater will be drawn off this line to the CO2 equilibrators and DMS system in the hydro lab. Care must be taken to prevent contamination from smoke, solvent, cleaning solutions, etc.

4.3 Balloon Launches

Atmospheric temperature, humidity and wind profiles will be obtained from rawindsondes released four times per day at 0500, 1100, 1700 and 2300 UCT. Additional launches may be added during intensive measurement periods. The data from these launches will be sent from the ship to the National Weather Service. Atmospheric ozone profiles will be obtained from ozonesondes released from the ship once per day. Balloons will be filled in the staging bay.

4.4 Personnel Changes

Scientific personnel aboard *RONALD H. BROWN* will be responsible for equipment on the ship and at the ground stations. Personnel changes may be required by small boat when the ship is in the vicinity of Star Island, NH.

5.0 FACILITIES

5.1 Equipment and capabilities to be provided by ship

The following systems and their associated support services are essential to the cruise. Sufficient consumables, back-up units, and on-site spare parts and technical support must be in place to assure that operational interruptions are minimal. All measurement instruments are expected to have current calibrations and all pertinent calibration information shall be included in the data package.

1) Navigational systems including high resolution GPS.

2) Thermosalinograph calibrated to within 0.1°C and 0.01 ppt.

3) Dry compressed air (120 psi, 4 CFM) to the O2 deck. Power, water, telephone, and ethernet connections to vans (see section 5.2).

4) Continuously flowing seawater to the CO_2 equilibrator and DMS system (minimum of 50 liters per minute).

5) Laboratory/work space.

6) Freezer space for air samples.

7) Refrigerator space (10 cubic feet) for air samples (no chemicals).

8) Radiosonde deployment system.

9) Hood for use of solvents.

10) Ceiling mounted projection screen at the forward end of the conference room.

11) Realtime RS-232 feed of selected ship data for the ETL flux system and PMEL data logger system.

5.2 Equipment, capabilities and supplies provided by scientific party

Measured weights from a truck scale or similar will be provided for all science vans. It is understood that vans without current measured weights will not be accepted aboard.

1) Vans (van locations are shown in appendix C)

a) PMEL 1 (AeroChem Van)

wt	15,000 lbs
size	8' x 20'
power	70 amp 480 v three phase
location	port side 02 level, sampling line connected to PMEL 2 Needs phone connection.

b) PMEL 2 (AeroPhys Van)

wt	17,000 lbs
size	8' x 20'
power	70 amp 480 v three phase
location	port side 02 level, sampling mast mounted on roof Needs phone connection.

c) Aeronomy Lab 1 van

wt	15,000 lbs
size	20' x 8'
power	From AL 3 van
location	starboard side, 02 level, inlets and grated decking mounted on roof Needs phone connection

d) Aeronomy Lab 2 van

wt	15,000 lbs
size	20' x 8'
power	From AL 3 van
location	starboard side, 02 level, inlets mounted on roof Needs phone connection

e) Aeronomy Lab 3 van (pump van)

wt	5,000 lbs
size	8' x 8'
power	70 amp 480 v three phase
location	starboard side, 02 level

f) PMEL Chemistry van

wt	12,000 lbs
size	8' x 20'
power	30 amps 480 v three phase
location	port side 01 level Needs freshwater line, Ethernet connection and phone.

g) ETL HRDL van

wt	17,000 lbs
size	8' x 20'
power	70 amp 480 v three phase
location	fantail aft port side Needs phone connection and RS422 serial line from the ship's Seapath INU (similar to connection during EPIC). The ship fantail starboard crane will need to be stowed boom forward to minimize obstructions to the

HRDL field of view. The A-frame will need to be stowed in its upright position to minimize interference with the HRDL field of view.

h) ETL OPAL van

wt	17,000 lbs
size	8' x 20'
power	70 amp 480 v three phase
location	fantail port side
	Needs phone connection.

i) ETL Doppler Radar/microwave radiometer van

wt	15,000 lbs
size	8' x 20' + 10' x 10' fenced area around antenna
power	70 amp 480 v three phase
location	fantail port side forward
	Needs phone connection.

j) PMEL spare parts/storage van

wt	12,000 lbs
size	8' x 20'
power	none
location	fantail center aft

k) AL spare parts/storage van

wt	12,000 lbs
size	8' x 20'
power	none
location	fantail center aft

2) Chemical reagents, compressed gases, and liquid nitrogen. A complete listing of all chemicals to be brought onboard is included in Appendix B. Material Data Safety Sheets will be provided to ship before any chemicals are loaded. Tanks will be secured vertically in tank racks. Hydrostatic test dates on gas cylinders will follow DOT regulations.

3) Other consumable- i.e. pens, pencils, paper, data storage media, etc.

6.0 DISPOSITION OF DATA AND REPORTS

6.1 Data responsibilities

The Chief Scientist is responsible for the disposition, feedback on data quality, and archiving of data and specimens collected on board the ship for the primary project. The Chief Scientist is also responsible for the dissemination of copies of these data to participants on the cruise and to any other requesters. The ship will assist in copying data and reports insofar as facilities allow. The ship will provide the Chief Scientist copies of the following data:

Sightings log (position, speed, course, distance upwind) of other vessels
Navigational log sheets (MOAs)

Weather observation sheets
Thermosalinograph calibration reports
SCS data CDs

The Chief Scientist will receive all original data gathered by the ship for the primary and piggy-back projects, and this data transfer will be documented on NOAA form 61-29 "Letter Transmitting Data". The Chief Scientist in turn will furnish the ship a complete inventory listing of all data gathered by the scientific party, detailing types and quantities of data.

The Commanding Officer is responsible for all data collected for ancillary projects until those data have been transferred to the projects' principal investigators or their designees. Data transfers will be documented on NOAA Form 61-29. Copies of ancillary project data will be provided to the Chief Scientist when requested. Reporting and sending copies of ancillary data to NESDIS (ROSCOP) is the responsibility of the program office sponsoring those projects.

6.2 Ship operation evaluation form

A Ship Operations Evaluation Form will be completed by the Chief Scientist and given to the Director, PMEL, for review and then forwarded to OMAO.

6.3 Foreign research clearance reports

A request for research clearance in foreign waters (Canada) has been submitted by PMEL. Copies of clearances received will be provided to the ship before departure. The Chief Scientist is responsible for satisfying the post-cruise obligations associated with diplomatic clearances to conduct research operations in foreign waters. These obligations consist of (1) submitting a "Preliminary Cruise Report" immediately following the completion of the cruise involving the research in foreign waters (due within 30 days); and (2) ultimately meeting the commitments to submit data copies of the primary project to the host foreign countries (due within 2 years).

7.0 ADDITIONAL INVESTIGATIONS AND PROJECTS

Any ancillary work done during this project will be accomplished with the concurrence of the Chief Scientist and on a not-to-interfere basis with the programs described in these instructions and in accordance with the NOAA Fleet Standing Ancillary Instructions.

Personnel assigned to ancillary projects and participating in the cruise may be assigned additional scientific duties in support of the project by the Chief Scientist.

Synoptic weather reports will be handled in accordance with NC Instruction 3142D, SEAS Data Collection and Transmission Procedures.

Any additional work will be subordinate to the primary project and will be accomplished only with the concurrence of the Chief Scientist and Commanding Officer on a not-to-interfere basis.

8.0 HAZARDOUS MATERIAL

RONALD H BROWN will operate in full compliance with all environmental compliance requirements imposed by NOAA. All use, storage, cleanup, removal and disposition of scientific hazmats must conform with the requirements stated in BROWN's Standing Orders, Appendix "Scientific Hazardous Materials and Waste." A copy of the appendix was provided to the Chief Scientist prior to the cruise. **All hazardous materials/substances needed to carry out the objectives of the embarked science mission, including ancillary tasks, are the direct responsibility of the embarked designated Chief Scientist, whether or not that Chief Scientist is using them directly.** The *RONALD H BROWN* Environmental Compliance Officer will work with the Chief Scientist to ensure that this management policy is properly executed, and that any problems are brought promptly to the attention of the Commanding Officer.

All hazardous materials require a Material Safety Data Sheet (MSDS). Copies of all MSDSs shall be forwarded to the ship at least two weeks prior to sailing. The Chief Scientist shall have copies of each MSDS available when the hazardous materials are loaded aboard. **Hazardous material for which the MSDS is not provided will not be loaded aboard.**

The Chief Scientist will provide the Commanding Officer with an inventory indicating the amount, concentrations, and intended storage area of each hazardous material brought onboard, and for which the Chief Scientist is responsible (see Appendix B). This inventory shall be verified at time of departure from port, and again upon completion of the cruise, accounting for the amount of material being removed, the amount consumed in science operations, and the amount being removed in the form of used or dirty chemicals. A list of chemicals and gases that will be brought onboard the ship for this cruise is shown in Appendix B.

The ship's dedicated HAZMAT Locker contains two 45-gallon capacity flammable storage cabinets and one 22-gallon capacity flammable storage cabinet. Unless there are dedicated storage lockers (meeting OSHA/NFPA standards) in each van, all HAZMAT, except small amounts for ready use, must be stored in the HAZMAT Locker. [Storage on deck is not approved].

The scientific party, under the supervision of the Chief Scientist, shall be prepared to respond fully to emergencies involving spills of any mission HAZMAT. This includes providing properly-trained personnel for response, as well as the necessary neutralizing chemicals and clean-up materials. Ship's personnel are not first responders and will act in a support role only, in the event of a spill. Drew Hamilton, Derek Coffman, and Theresa Miller have been trained in hazardous material response.

The Chief Scientist is directly responsible for the handling, both administrative and physical, of all scientific party hazardous wastes. No liquid wastes shall be introduced into the ship's drainage system or disposed of over the side. No solid waste material shall be placed in the ship's garbage.

All scientific hazardous materials will be removed from the ship at the end of the cruise.

9.0 RADIOACTIVE ISOTOPES

A sealed radioactive source in an ECD detector containing Ni63, at a strength of 10 milli-Curies will be used during RB-04-07. The detector is covered under NOAA/AL NRC license number #05-1197-01.

10.0 COMMUNICATIONS

10.1 Ship systems

Good communications of data and weather products between the operations center and the ship will be critical to the success of this project. Email transfers will take place four times per day at approximately 0700, 1100, 1500 and 1830 LT. Weather data transferred at 0700 and 1830 (FTP connection) will be essential for the science team meetings scheduled for 0800 and 1930. Scientific data from the ship will also be sent to the project operations center during these transfers to update the project web page.

Good communications between the ship and aircraft will be critical for coordinating intercomparisons. Initial contact from the aircraft to the ship will likely be by INMARSAT phone to relay timing and position. Further contact concerning data intercomparisons will be via marine and aircraft radio (see section 10.2 below).

The Chief Scientist or designated representative will have access to ship's telecommunications systems. Direct payment (e.g. by credit card) to the communications provider (e.g. the telephone company) shall be used as opposed to after-the-fact reimbursement. Specific information on how to contact Ronald H. Brown and all other fleet vessels can be found at http://www.moc.noaa.gov/phone.htm.

Ship's systems include:

INMARSAT-B provides high quality voice and fax communications (9600 baud) and high speed data transmission, including FTP; it is the primary means of transferring email. Cost is $2.60/min for voice and fax; $7.25/min for high speed. INMARSAT-B calls may be made collect or charged to credit card; cost is approximately $2.60/min **.

INMARSAT-M (or Mini-M) provides medium quality voice communications. Cost is $2.15/min. INMARSAT-M may be charged to credit card or collect.

INMARSAT-A provides high quality voice communications as a backup system. It can also provide fax communications (9600 baud) and high speed data transmission, including FTP. Cost varies from $2.65/min to $5.60/min for voice and fax depending on vendor and peak vs off-peak rates. High speed costs $10.80 - $15.60/min. INMARSAT-A may be charged to credit card or collect.

**Note: All rates listed are 2001 rates based on direct-dialed business calls to the US. Collect, or calls charged to credit calls are charged higher rates, subject to additional fees, and may have minimum charges.

E-MAIL
An e-mail account for each embarked scientist will be established by the ship's LET. The account name will use the person's first and last name as listed in Personnel Section. The e- mail address for scientists will use the format:
firstname.lastname.atsea@rbnems.ronbrown.omao.noaa.gov

Example: tim.bates.atsea@rbnems.ronbrown.omao.noaa.gov

Each member of the ship's complement (crew and scientists) will be authorized to send/receive up to 15 KB (approximately 3 pages of text) of data per day ($1.50/day or $45/month) at no cost. E-mail costs accrued in excess of this amount must be reimbursed by the individual. At or near the end of each leg, the Commanding Officer will provide the Chief Scientist with a detailed billing statement for all personnel in his party. Prior to their departure, the chief scientist will be responsible for obtaining reimbursement from any member of the party whose e-mail costs have exceeded the complimentary amount.

CONTACTS
Important phone numbers, fax numbers and e-mail addresses: (Up-to-date phone numbers can be found on the MOC web site at www.moc.noaa.gov/phone.htm#RB). To call RONALD H. BROWN from the US:

- INMARSAT-B VOICE: 011-OAC-336-899-620 (approx $2.60/min)
- INMARSAT-B FAX: 011-OAC-336-899-621
- INMARSAT "M" VOICE: 011-OAC-761-831-360 (approx $2.99/min)
- INMARSAT-A VOICE: 011-OAC-154-2643 (approx $5.60/min)
- CELLULAR: 757-635-0678
- OOD CELLULAR: 206-910-3584

NOTE: For the RB-04-07 cruise, the ship will be operating in range of the Atlantic Ocean Satellite (West) with Ocean Area Code (OAC) = 874.

E-mail addresses:

MOP radio room:	Radio.Room@noaa.gov
Commanding Officer, RHB	CO.Ronald.Brown@noaa.gov
Executive Officer, RHB	XO.Ronald.Brown@noaa.gov
Field Operations Officer, RHB	FOO.Ronald.Brown@noaa.gov
Medical Officer, RHB	Medical.Ronald.Brown@noaa.gov

10.2 Non-ship systems

Hourly automated data transfers to shore will be made via an Iridium satellite modem (2400 baud) of up to 50 parameters of 1 min averaged data (10Kb file, 2min/hr, $60/day).

Regular voice communications between the ship and shore will made using a Globalstar satellite phone. Communications between the ship and aircraft will be via the Globalstar phone, marine band radio (Government channel 82A), and an Ship's ICOM IC-A4 Airband (118-137 mHz) handheld aircraft radio.

11.0 MISCELLANEOUS

11.1 Radio interference

Radio transmission can interfere with several of the continuous data streams. If this becomes a problem, the Commanding Officer and Chief Scientist will work out a transmission schedule to minimize data interferences to the extent that vessel communication needs allow. Nothing will preclude or interfere with the use of VHF radio for communications related to the safe navigation of the vessel.

11.2 Pre & post-cruise meetings

A pre-cruise meeting between the Commanding Officer and the Chief Scientist will be conducted either the day before or the day of departure, with the express purpose of identifying day-to-day project requirements, in order to best use shipboard resources and identify overtime needs.

A post-cruise debriefing will be held between the Chief Scientist and the Commanding Officer.

11.3 Scientific berthing

The Chief Scientist is responsible for assigning berthing for the scientific party within the spaces approved as dedicated scientific berthing. The ship will send stateroom diagrams to the Chief Scientist showing authorized berthing spaces. The Chief Scientist is responsible for returning the scientific berthing spaces back over to the ship in clean and ready-to-use condition for the next scientific party, for stripping bedding and for linen return; and for the return of any room keys which were issued.

The Chief Scientist is also responsible for the cleanliness of the laboratory and storage areas used by the science party, both during the cruise and at its conclusion prior to departing the ship.

11.4 Implied consent

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy dated May 7, 1999 which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels.

11.5 Emergency contacts

Prior to departure, the Chief Scientist will provide a listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: name, address, relationship to member, and telephone number.

11.6 Shipboard Safety

A discussion of shipboard safety policies is in the "Science User's Guide" which is available on *RONALD H. BROWN* and is the responsibility of the scientific party to read. This information is also available on the ship's web page: www.moc.noaa.gov/rb/science/welcome.htm. A meeting with the Operations Officer will be held for the scientific party at the beginning of the cruise which will include a safety briefing. All members of the scientific party are expected to be aware of shipboard safety regulations and to comply with them.

Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. Steel-toed shoes are required to participate in any work dealing with suspended loads, including CTD deployments and recovery. The ship does not provide steel-toed boots. Hard hats are also required when working with suspended loads. Work vests are required when working near open railings and during small boat launch and recovery operations. Hard hats and work vests will be provided by the ship when required.

11.7 Wage marine dayworker working hours and rest periods

Chief Scientists shall be cognizant of the reduced capability of *RONALD H BROWN*'s operating crew to support 24-hour mission activities with a high tempo of deck operations at all hours. Wage marine employees are subject to negotiated work rules contained in the applicable collective bargaining agreement. Dayworkers' hours of duty are a continuous eight-hour period, beginning no earlier than 0600 and ending no later than 1800. It is not permissible to separate such an employee's workday into several short work periods with interspersed nonwork periods. Dayworkers called out to work between the hours of 0000 and 0600 are entitled to a rest period of one hour for each such hour worked. Such rest periods begin at 0800 and will result in no dayworkers being available to support science operations until the rest period has been observed. All wage marine employees are supervised and assigned work only by the Commanding Officer or designee. The Chief Scientist and the Commanding Officer shall consult regularly to ensure that the shipboard resources available to support the embarked mission are utilized safely, efficiently and with due economy.

11.8 Medical Forms

The NOAA Health Services Questionnaire must be completed in advance by each participating scientist. It should reach the marine center no later than 4 weeks prior to the cruise. This will allow time to medically clear the individual and to request more information if needed. All personnel should bring any prescription medication they may need and any over-the-counter medicine that is taken routinely (e.g. an aspirin per day, etc.). The ship maintains a stock of medications aboard, but supplies are limited and chances to restock are few.

11.9 Port Agent Services/Billing

Contractual agreements exist between the port agents and the Commanding Officer for services provided to NOAA SHIP *RONALD H. BROWN*. The costs or required reimbursements for any services arranged through the ship's agents by the scientific program, which are considered to be outside the scope of the agent/ship support agreement, will be the responsibility of that program. Where possible, it is requested that direct payment be arranged between the science party and port agent, as opposed to after-the-fact reimbursement to the ship's accounts.

Shipping Address:

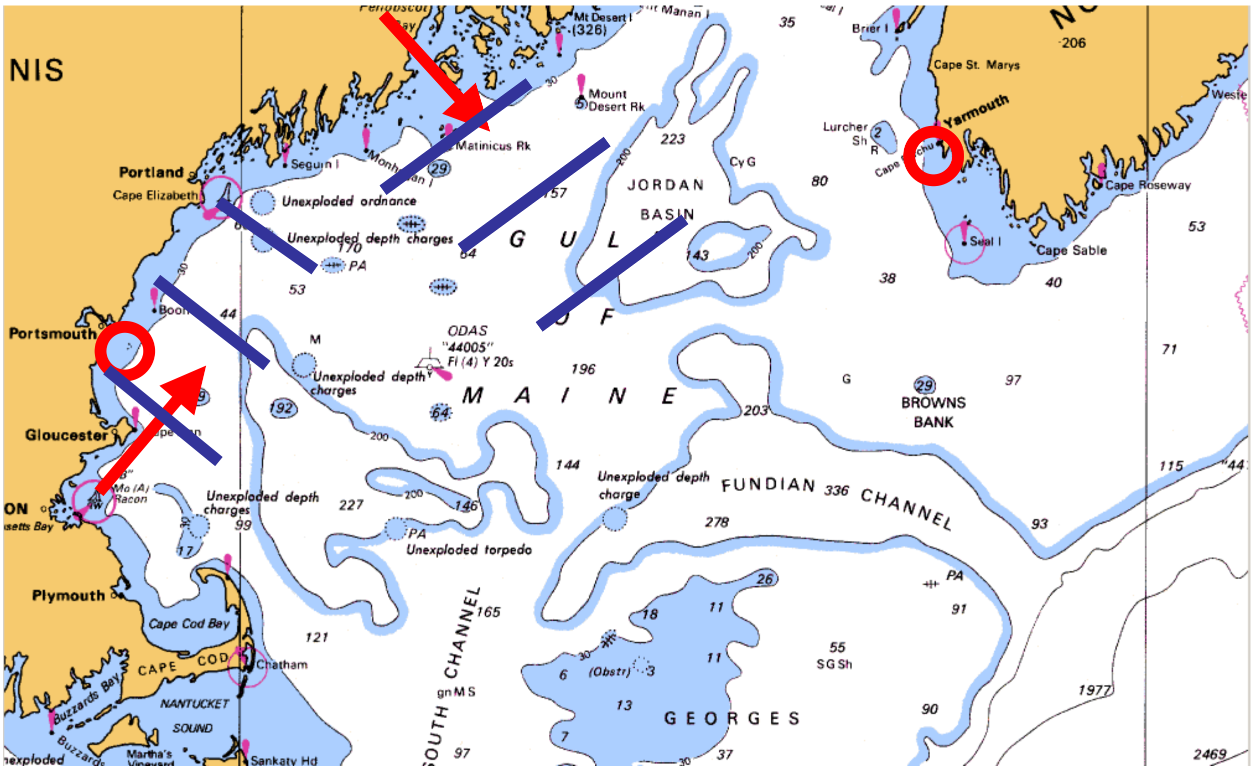
Commanding Officer
NOAA Ship RONALD H. BROWN
c/o PDA - Division of Ports & Harbors
P.O. Box 369
Portsmouth, NH 03802

Our point of contact will be: Al Cumings 603-436-8500

11.0 APPENDICES

(A) Cruise track
(B) List of gases and chemicals onboard
(C) Van locations

Appendix A. Operations area. Cross wind transects (blue lines) will be conducted downwind of Cape Ann and the coast of Maine. Measurement intercomparisons will be conducted with the ground stations located at Chebogue Point, Nova Scotia and the Isles of Shoals, NH (marked with circles).



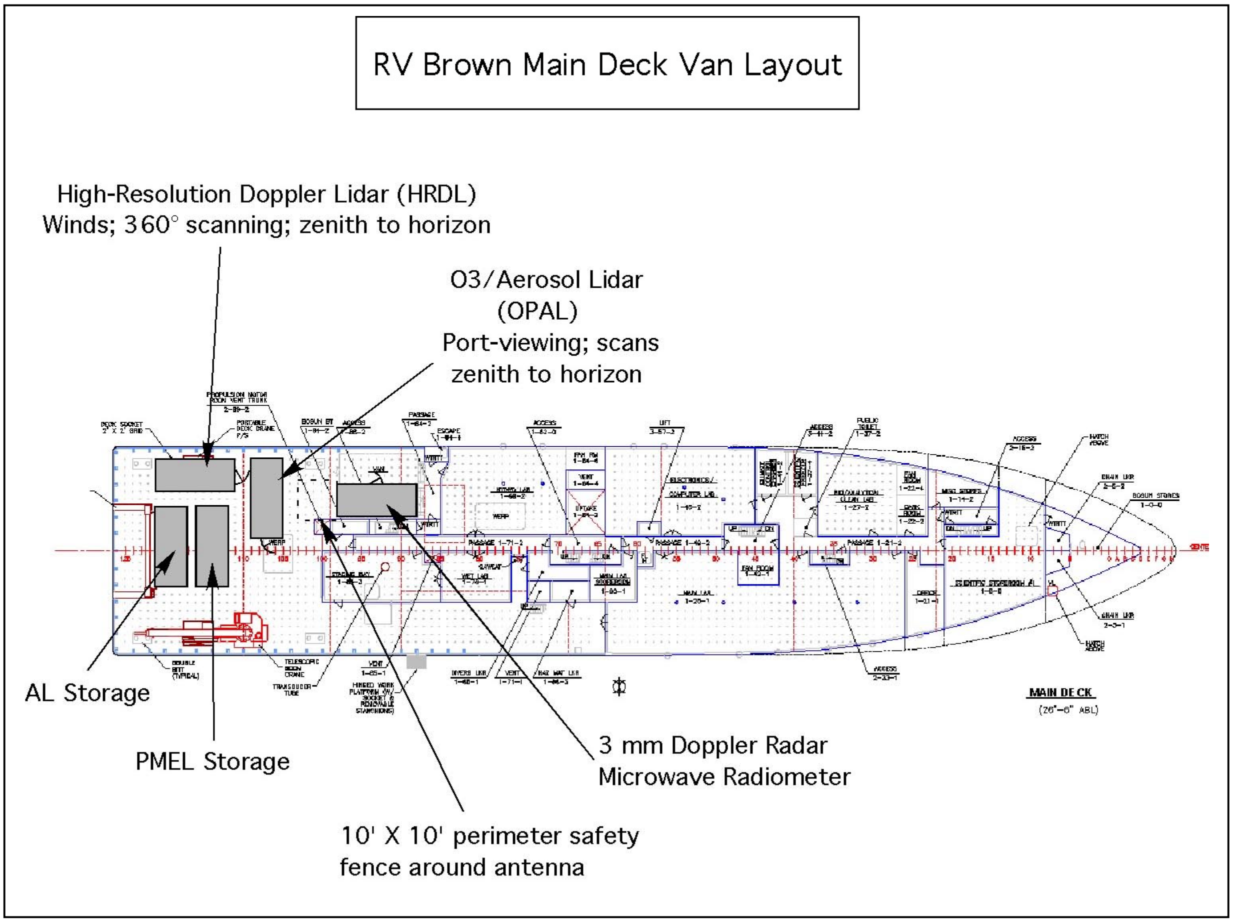
Appendix B. List of chemicals

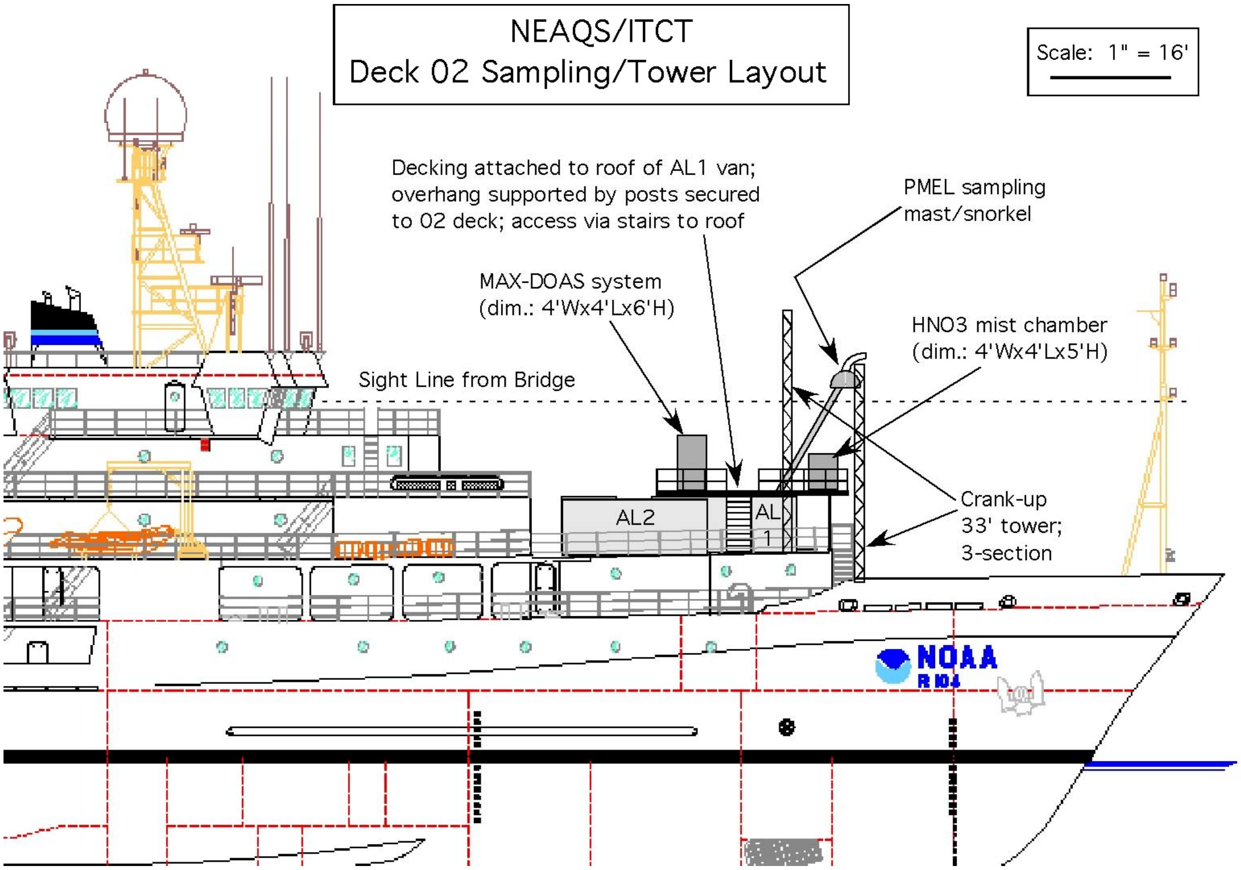
Compressed gases	Num. Cyls.	Quantity	Location	Chemicals	Quantity	Location
Tim Bates, Trish Quinn, Dave Covert, Derek Coffman, Theresa Miller, Drew Hamilton, NOAA/PMEL Aerosol properties						
CO2 (Neph)	2	150 cf	PMEL 2 van	ammonium sulfate	500 g	Chem van
Breathing air (CO)	2	230 cf	PMEL 1 van	butanol	32 L	Chem van
UHP H2 (OC/EC)	2	230 cf	PMEL Chem van	calcium sulfate (drierite)	10 kg	Chem van
O2 10% balance He (OC/EC)	2	230 cf	PMEL Chem van	charcoal	500 g	Chem van
CH4 5% balance He (OC/EC)	2	230 cf	PMEL Chem van	citric acid	2 kg	Chem van
UHP He (OC/EC)	2	230 cf	PMEL Chem van	Dipicolinic acid	500 g	Chem van
Breathing air (OC/EC)	3	230 cf	PMEL Chem van	hexane	2 L	Chem van
O2 10% balance He (OC/EC)	2	230 cf	PMEL1 van	hydrochloric acid	500 ml	Chem van
CH4 5% balance He (OC/EC)	2	230 cf	PMEL1 van	hydrogen peroxide	500 ml	Chem van
UHP He (OC/EC)	2	230 cf	PMEL1 van	methanesulfonic acid	1 L	Chem van
				methanol	4 L	Chem van
				phosphoric acid	1 L	Chem van
				Potassium bicarbonate	500 g	Chem van
				potassium carbonate	2 kg	Chem van
				sodium hydroxide (50% w/w)	1 L	Chem van
				sulfuric acid (0.1 M)	500 ml	Chem van
Eric Williams, Paul Murphy, NOAA/AL, NOx/NOy/O3/CO/SO2/met						
Zero air	20	150 cf	In AL 3 + deck	Methanol	5 L	AL 1
UHP Oxygen	6	144 cf	In AL 3	Molecular sieve	500 g	AL 1
NO 5 ppm in N2	2	150 cf	in AL 1	Charcoal	500 g	AL 1
NO 5 ppm in N2	1	50 cf	In AL 3	Pd 0.5% on alumina	1 kg	AL 1
CO 200 ppm/SO2 5 ppm in N2	2	150 cf	in AL 1	PFPE vacuum pump oil	1 L	AL 3
CO2 .25% in Air	2	150 cf	in AL 1	Magnesium perchlorate	1 kg	AL 1
CO2 3.5% in Air	2	50 cf	in AL 1			
NO 99%	1	8 cf	deck AL 3			
CO 99.99%	1	30 cf	deck AL 3			
Jim Roberts, NOAA/AL, PAN						
UHP He	2	230 cf	deck AL 2 van			
UHP N2	2	230 cf	deck AL 2 van			
NO 2 ppm in N2	1	150 cf	AL 2 van			
CO/Acetone 20 ppm in Air	1	150 cf	AL 2 van			

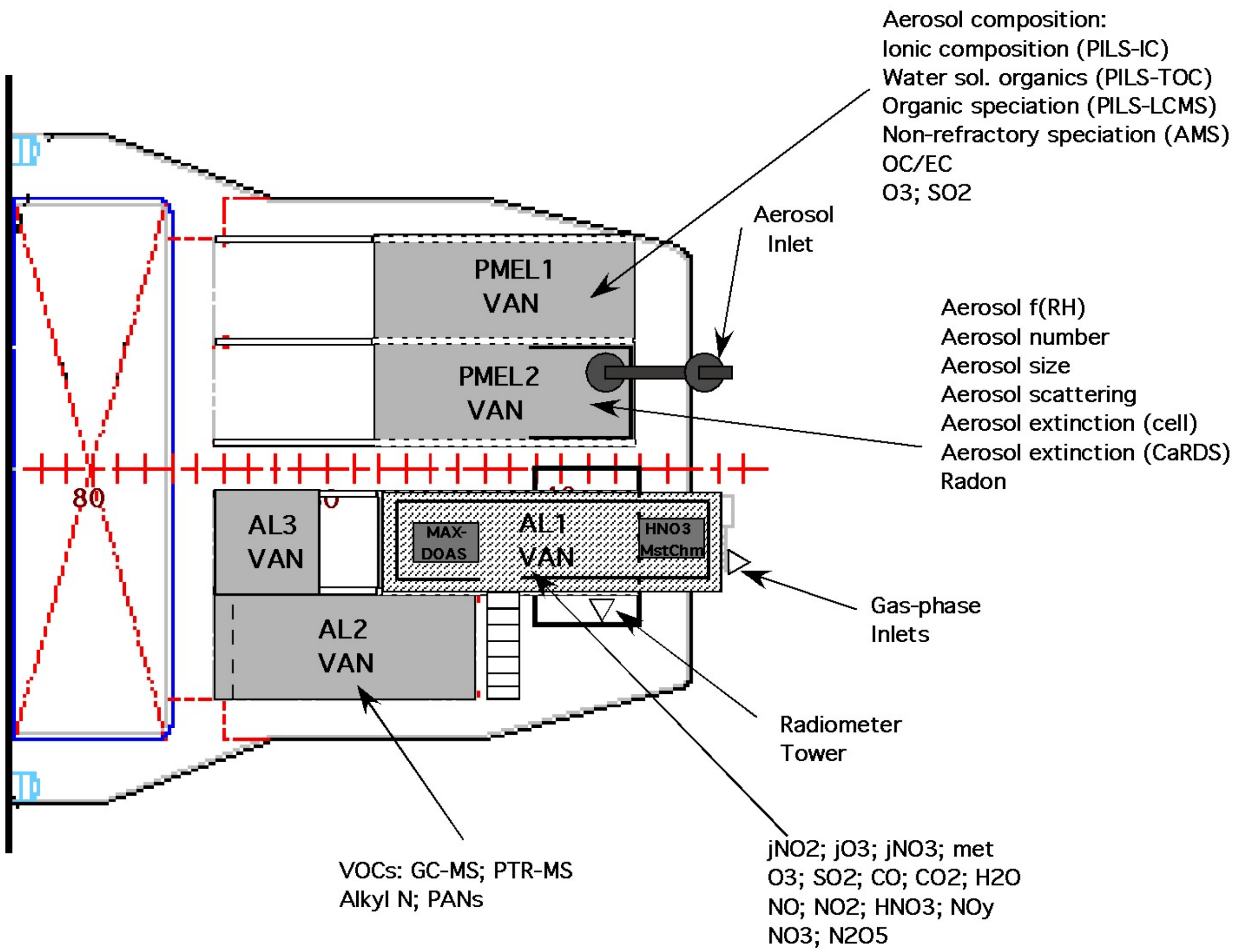
Compressed gases	Num. Cyls.	Quantity	Location	Chemicals	Quantity	Location
Steve Brown, Hans Osthoff, NOAA/AL, NO3/N2O5						
Zero Air	5	230 cf	AL 1 + deck	Methanol	10 L	AL 1
NO 10 ppm in N2	3	28 cf	Al 1	Acetone	1 L	AL 1
				DCM laser dye	1 g	AL 1
				LDS 698 laser dye	1 g	AL 1
Paul Goldan, Bill Kuster, Shao Min NOAA/AL, VOCs/GCMS						
UHP He	3	150 cf	deck AL2 van	Sodium sulfite	150 g	AERO1 van
UHP H2	3	150 cf	deck AL2 van	Ascarite	250 g	AERO1 van
Zero air	4	150 cf	deck AL2 van	Methanol	500 ml	AERO1 van
N2	10	300 cf	deck AL2 van			
Air (calibration standard)	1	50 cf	AL 2 van			
UHP Ar2	1	0.25 cf	AL 2 van			
Liquid N2	6	160 L	main lab	Refill in Portsmouth		
Karsten Warnecke, Shuji Kato, NOAA/AL, VOCs/PTR-MS						
Zero air	2	230 cf	deck AL2 van			
N2 (calibration standard)	1	2 cf	AL 2 van			
UHP He	1	2 cf	deck AL2 van			
Tahllee Baynard, Anders Pettersson, NOAA/AL, CRD extinction						
Air	5	300 cf	deck PMEL2	Acetone	100 ml	PMEL 2
N2	1	220 cf	deck PMEL2	Methanol	100 ml	PMEL 2
Christoph Senff, Richard Marchbacks, Alan Brewer, Janet Machol, Wynn Eberhard, Brandi McCarty, NOAA/ETL, Aerosol/O3 profiles						
H2	1	220 cf	ETL OPAL	Acetone	2 L	ETL OPAL
D2	1	220 cf	ETL OPAL	Methanol	2 L	ETL OPAL
Ar	1	220 cf	ETL OPAL	Isopropyl alcohol	2 L	ETL OPAL/HRTL
Dan Law, Dan Wolfe, NOAA/ETL, Wind/temp/RH profiles (sondes)						
He	32	300 cf	fantail			
Sallie Whitlow, UNH, HNO3/HONO						
UHP He	1	220 cf	deck AL 1	Sodium carbonate solution	1 L	Main lab
				Sodium bicarbonate solution	1 L	Main lab
				Aqueous standards (0.1 w/w)	1 L	Main lab
Anne Thompson, NASA, ozone profiles (sondes)						
He	56	300 cf	fantail			

Compressed gases	Num. Cyls.	Quantity	Location	Chemicals	Quantity	Location
Anne Thompson, Jacquelyn Witte, NASA/GSFC, Ozonesondes						
Balloon He	25	230 cf	Near staging bay			
Rik Wanninkhof, Dick Feely, NOAA/AOML/PMEL, underway pCO2 system						
Standard air tanks	5	230 cf	hydro lab	acetone	4 L	hydro lab
				coulometer solution	8 L	hydro lab
				isopropyl alcohol	2 L	hydro lab
				magnesium perchlorate	2 kg	hydro lab
				Malcosorb	2 kg	hydro lab
				potassium iodide	500 g	hydro lab

Appendix C. Van locations on the Main and O2 decks. Not shown is the PMEL chem. van on the O1 deck port side.




NEAQS/ITCT
Deck 02 Sampling/Tower Layout
Scale: 1" = 16'
Decking attached to roof of AL1 van; overhang supported by posts secured to 02 deck; access via stairs to roof
PMEL sampling mast/snorkel
MAX-DOAS system (dim.: 4'Wx4'Lx6'H)
HNO3 mist chamber (dim.: 4'Wx4'Lx5'H)
Sight Line from Bridge
Crank-up 33' tower; 3-section
AL2
AL 1
NOAA
R 104


Aerosol composition:
Ionic composition (PILS-IC)
Water sol. organics (PILS-TOC)
Organic speciation (PILS-LCMS)
Non-refractory speciation (AMS)
OC/EC
O3; SO2
Aerosol Inlet
PMEL1 VAN
PMEL2 VAN
Aerosol f(RH)
Aerosol number
Aerosol size
Aerosol scattering
Aerosol extinction (cell)
Aerosol extinction (CaRDS)
Radon
80
AL3 VAN
MAX-DOAS
AL1 VAN
HNO3 MstChm
Gas-phase Inlets
AL2 VAN
Radiometer Tower
VOCs: GC-MS; PTR-MS
Alkyl N; PANs
jNO2; jO3; jNO3; met
O3; SO2; CO; CO2; H2O
NO; NO2; HNO3; NOy
NO3; N2O5