FINAL PROJECT INSTRUCTIONS
22 May 2006

NOAA SHIP *RONALD H. BROWN*
Cruise RB-06-06
The Texas Air Quality Study (TexAQS)
and
Gulf of Mexico Atmospheric Composition and Climate Study (GoMACCS)

27 July – 12 September 2006

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NOAA RESEARCH CRUISE TexAQS/GoMAACS 2006

The Texas Air Quality Study and Gulf of Mexico Atmospheric Composition and Climate Study

Participating Organizations:

NOAA Pacific Marine Environ. Lab., Seattle, WA	(PMEL)
NOAA Earth System Research Lab., Boulder, CO	(ESRL)
NOAA Atlantic Ocean. Met. Lab., Miami, FL	(AOML)
Joint Institute Study Atmosphere Ocean, Seattle, WA	(JISAO)
Cooperative Inst. Res. in Environ. Sci., Boulder, CO	(CIRES)
University of New Hampshire, Durham, NH	(UNH)
University of Washington, Seattle, WA	(UW)
Scripps Institution of Oceanography, La Jolla, CA	(SIO)
Aerodyne Research Inc., Billerica, MA	(Aerodyne)
University of Colorado, Boulder, CO	(UC)
University of Manchester, Manchester, UK	(UM)

NOAA SHIP: *RONALD H. BROWN*
Cruise No: RB-06-06
Area: Gulf of Mexico

Itinerary:
Leg 1:
d. Charleston 27 July 2006
a. Galveston 18 Aug 2004
Leg 2:
d. Galveston 21 Aug 2004
a. Galveston 12 Sept 2004

Cruise Description and Objectives:

TexAQS/GoMACCS 2006 is an atmospheric chemistry and meteorology project centered in the Gulf of Mexico. Sampling will be coordinated with a ground based sampling in Texas and with multiple aircraft. Most of the research will be concentrated in the Houston/Galveston region. Sampling aboard *RONALD H. BROWN* will take place continuously with the following goals:

- To determine how coastal atmospheric dynamic processes (e.g., land breeze – sea breeze circulation, vertical and horizontal mixing) affect air quality in the study region.
- To characterize sources (local vs. distant), of the boundary layer gases and aerosols in the Gulf of Mexico and coastal waters
- To characterize transformation processes (day/night chemistry) that affect the levels of ozone and aerosols in the marine boundary layer of the study region,
- To characterize the chemical, physical and optical properties of aerosol in the air masses along the coast,
- 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 and regional climate in Texas and adjoining coastal areas.

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1.0 SCIENTIFIC OBJECTIVES

Research Areas

The research planned for the 2006 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 roles of local, regional, and long-range transport processes in the accumulation and spatial distribution of pollution in the boundary layer over Eastern Texas, and in the export to the free troposphere?

Chemical transformation - How do gaseous and aerosol emissions evolve chemically and physically as they are transported away from the source regions?

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 and chemical transport/climate models on local and regional scales? What improvements can be made to enhance the accuracy and extend the periods of these forecasts?

2.0 PERSONNEL

2.1 Chief Scientist

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, Chief Sci.	M	USA	PMEL	x	x
2.	Dr. Patricia Quinn	F	USA	PMEL	x	x
3.	Mr. Derek Coffman	M	USA	PMEL	x	x
4.	Dr. Kristen Schulz	F	USA	PMEL	x	x
5.	Dr. James Johnson	M	USA	JISAO/PMEL	x	x
6.	Mr. Drew Hamilton	M	USA	JISAO/PMEL	x	x
7.	Ms. Catherine Keil	F	USA	JISAO/PMEL	x	x
8.	Dr. David Covert	M	USA	UW	x	x
9.	Dr. Berko Sierau	M	Germany	UW	x	x
10.	Dr. Eric Williams	M	USA	ESRL/CIRES	x	x
11.	Mr. Paul Murphy	M	USA	ESRL /CIRES	x	x

12. Dr. Brian Lerner	M	USA	ESRL /CIRES	x	x
13. Dr. Jim Roberts	M	USA	ESRL	x	x
14. Mr. William Kuster	M	USA	ESRL	x	x
15. Dr. Jessica Gilman	F	USA	ESRL	x	x
16. Dr. Hans Osthoff	M	Canada	ESRL /CIRES	x	x
17. Dr. Roberto Sommariva	M	Italy	ESRL /CIRES	x	x
18. Ms. Elly Speicher	F	USA	UNH		x
19. Mr. Luke Knowles	M	UK	UNH	x	
20. Dr. Dan Welsh-Bon	M	USA	ESRL /CIRES	x	x
21. Dr. Scott Herndon	M	USA	Aerodyne	x	
22. Dr. Mark Zahniser	M	USA	Aerodyne		x
23. Dr. Tara Fortin	F	USA	ESRL /CIRES	x	x
24. Dr. Dan Lack	M	Australia	ESRL	x	x
25. Dr. Troy Thornberry	M	USA	ESRL/CIRES	x	x
26. Dr. Tim Onasch	M	USA	Aerodyne	x	
27. Dr. James Allan	M	UK	Univ. Mancheser		x
28. Dr. Paola Massoli	F	Italy	ESRL	x	x
29. Dr. Janet Machol	F	USA	ESRL/CIRES	x	x
30. Mr. Richard Marchbanks	M	USA	ESRL		x
31. Dr. Sara Tucker	F	USA	ESRL/CIRES		x
32. Dr. Alan Brewer	M	USA	ESRL	x	
33. Ms. Brandi McCarty	F	USA	ESRL	x	
34. Mr. Dan Wolfe	M	USA	ESRL (departs 8/2)	x	
35. Mr. Andrey Grachev	M	USA	ESRL		x
36. Mr. David Costa	M	USA	ESRL		x
37. Mr. Ludovic Bariteau	M	France	ESRL/CIRES	x	
38. Mr. David Welsh	M	USA	ESRL (boards 8/2)	x	
Total				**30**	**30**

3.0 SCHEDULE

The TexAQS/GoMACCS 2006 project will begin loading vans and equipment on July 19, 2006 in Charleston, SC. Leg 1 of the project will begin on July 27 and end in Galveston, TX on August 18. A small boat personnel transfer will take place when Brown reaches Galveston for the first time on or about August 2, 2006.

The port stop (August 18-21) will be used for meetings with scientists at the aircraft operations center and a public relations activity. We anticipate that our only loading/unloading during the stop between legs will be to replenish our liquid nitrogen supply. We are planning a media/VIP day on August 21 and a cruise on August 21 for some visitors.

Leg 2 will begin on Monday August 21 and end in Galveston on September 12, 2006. Vans will be offloaded in Galveston on September 12. Van frames and gas cylinders will be offloaded in Charleston on September 20.

4.0 OPERATIONS

4.1 General Operations

The project operations area is shown in Appendix A. Operations each day 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 tasks:

A. Characterization of transport and mixing processes

One of the most important aspects of atmospheric transport and mixing is the diurnal variation of the boundary layer (BL). Surface energy and mass fluxes are the basic driving forces for BL development and are fundamental parameters used for model validation. Instruments on Brown will provide continuous measurements of heat, moisture, and momentum flux measurements by several different methods. The flux instrument package also provides an accurate water surface temperature measurement which is one of the keys to understanding the land-sea breeze circulation. Radar profiler data will be used to determine the BL height and the wind and temperature structure in and above the BL. Radiosondes, launched approximately four times a day, will measure atmospheric temperature and moisture profiles. Winds measured by the radiosondes provide a check on the remote sensing instruments and vice-versa. The on board ceilometer will provide the height of the cloud base. All of these measurements will provide valuable input and constraints on models used for development Texas Air Quality State Implementation Plan (SIP).

In the Harris-Galveston-Brazoria (HGB) region the sea breeze is a recurring feature that we will examine in some detail. Though there is some regularity to this phenomenon, larger scale meteorological conditions can significantly alter the sea breeze timing and intensity. Since the ship will transit the Houston Ship Channel (HSC) from the Gulf of Mexico to Houston and back several times, we will time some of these transits to traverse the sea breeze front, examining its structure with the lidars. In addition we will position the ship in the Ship Channel and probe the boundary layer structure with the lidars and radar as the sea breeze front moves across the ship position. The return flow of the sea breeze may also be interesting to investigate. If the return flow to the Gulf is laden with pollution from the inland urban/industrial areas an important activity will be to examine the transformation of this material as it mixes into the cleaner marine air in the Gulf and perhaps is then transported back inland by the sea breeze the following day. An additional part of this study will be to determine how far offshore the sea breeze extends. Possible areas where this research can take place are shown in Appendix A Figure 2 with the captioned box labeled A.

Another key feature of the atmosphere that models must be able to duplicate accurately is layering, especially above the BL. The remote sensing instruments on the ship make continuous measurements of several quantities that together show the structure within and above the BL. The Doppler lidar measures the three-dimensional wind field with excellent vertical and horizontal resolution near the surface. The wind profiler measures the height and intensity of mixing in the various layers, and adds information about the winds above 500 m. The ozone/aerosol lidar directly measures the concentration of ozone and the backscatter from aerosols in the vicinity of the ship. These measurements show the location of layers and plumes of ozone and aerosols, providing a direct check on fine-scale modeling and helping to construct and validate the picture of the complex three-dimensional BL structure from the Gulf to well inland along the HSC.

B. Characterization of emission sources

Like any major metropolitan area the HGB region has a strong urban component to its emissions makeup. Species such as CO, NO_x, VOCs, and aerosols associated with diesel and gasoline combustion engines are readily observable. In addition, electric power generation plants in the region produce large quantities of NO_x, SO_2, and particles that add to the regional burden of pollution. However, the aspect that makes this area unique, in terms of emissions and photochemistry, is the emissions associated with the petrochemical and other industrial plants that are present in small and large clusters around the region from the Gulf of Mexico almost to downtown Houston. Not coincidentally much of this industry is located near waterways, particularly the Houston Ship Channel, which makes the use of an instrumented research ship especially attractive since it can be positioned very near to these sources. Such measurements will be valuable for evaluation of current emission inventories.

Of particular interest to the TexAQS will be the characterization of sources of highly reactive VOCs (HRVOCs). Previous work has demonstrated that emission of these compounds, notably ethene and propene, are responsible in large part for the most extreme O_3 events observed in the HGB region. What is less clear, though, is to what degree acute events (leaks, upsets, intentional venting) versus chronic emission (filling operations, leaking barges and pipelines, stack emissions) of HRVOCs contribute to the buildup of O_3 region-wide. The ship will be in a unique position to make measurements near to many of these sources and provide information about the source locations and concentrations of these species (and ratios of selected compounds) throughout the HSC and other areas such as Baytown and Texas City. We anticipate that these cruises will be most effective during northeasterly or southeasterly flow since the background air tends to be less polluted coming from those regions. Also we plan cruise legs into the HSC both day and night to evaluate the effects of changes in boundary layer heights and mixing on the composition and concentration of emitted species.

We will have the capability from Brown to characterize other emission sources. Mobile sources can be evaluated from the western end of the HSC (at the Port of Houston) during the morning rush hour when the surface wind is predominantly westerly and the boundary layer is low. Measurements of CO and NO_y during this time can provide data to ascertain whether Houston mobile sources exhibit the same downward trend in the CO/NO_x ratio that is observed in other cities. We have a special interest in characterizing emissions from commercial marine shipping because this is a non-negligible source of NO_x, SO_2, and particles in many ports and waterways. We intend to position Brown in proximity to sea-lanes near Galveston in the Gulf of Mexico to determine the composition of the vessel exhaust plumes against the relatively clean Gulf background air as these vessels transit in and out of the entrance to Galveston Bay. Under the appropriate meteorological conditions in the HSC, such studies can also be conducted to evaluate vessel emissions under idle conditions which can vary significantly from underway emissions. We further intend to evaluate the emissions of species such as NO_x and VOCs from off-shore oil platforms to determine whether these sources contribute significantly to background levels in air over the Gulf of Mexico, a potential emissions source region for the HGB area. Finally, on board measurements of acetonitrile will be used as a marker for the influence of biomass burning which can produce significant levels of CO and VOCs. Possible areas where this research can take place are shown in Figure 2 with the captioned boxes labeled B. We also intend to make measurements in other coastal regions, such as Port Arthur (up to Beaumont), Corpus Christi, and Brownsville.

C. Characterization of daytime and nighttime chemical processes

The photochemistry that produces O_3 in the troposphere is now reasonably well understood. Oxidation of VOCs (usually by OH) produces organic peroxy radicals that convert NO into NO_2. The NO_2 is subsequently photolyzed which produces O_3. The detailed mechanisms are considerably more complex than this with positive and negative feedback loops that depend on relative concentration ratios of many of the principal species. However, it is not necessary to measure all of the chemical compounds and rates involved in the mechanisms; knowledge of a carefully selected subset of key species and parameters is sufficient to constrain the photochemistry. The measurements on board Brown will provide much of this information which then can be used to test, validate, and constrain models used for SIP development.

We intend to take the ship into the HSC to examine the chemistry of O_3 production in this near-source region. This will be of interest since we expect to be able to distinguish plumes of different VOC reactivity (e.g., alkane vs alkene) and different O_3 production potentials. Another aspect of this part of the study will be to examine the chemistry associated with the mobile source emissions. Under conditions of westerly flow in the morning to early afternoon with the ship positioned at the west end of the HSC we will be able to observe the chemistry of O_3 production in this predominantly urban emission regime without the influence of industrial emissions. As a follow-on study we can then move the ship further east along the HSC and determine the changes to the chemistry as more of the industrial emissions are mixed into the air parcels.

An important use of Brown will be to examine the evolution of high O_3 episodes that occur when westerly airflow over the HSC stagnates over Galveston Bay upon meeting the incoming sea breeze. This stagnant air which is heavily laden with NO_x and reactive VOCs from the HSC region can be subject to intense photochemistry with the high actinic flux (i.e., cloud-free) and hot temperatures often seen in this region in summer. Positioning the ship in or near this region to observe the photochemistry as it proceeds is a key goal for the study. With the measurement capability on board we will be able to provide information about 1) the VOC composition that promotes these high O_3 episodes, 2) O_3 production rates and efficiency, and 3) how transport and mixing affects dilution of the air mass and thus the maximum O_3 levels.

We also intend to examine the chemistry that affects pollutants during the night. Under these conditions O_3 reacts with NO_2 to produce the NO_3 radical. During the day photolysis of NO_3 and reaction with NO combine to keep levels of NO_3 vanishingly small. At night and away from NO sources, NO_3 can accumulate to chemically significant levels. An important reaction pathway for this compound is to react with NO_2 and produce N_2O_5. Depending on the conditions

NO_3 or N_2O_5 can irreversibly react at surfaces, including aerosols, in which case the net effect is removal of both O_3 and NO_x from the atmosphere. In other cases NO_3 can react with VOCs, including oxygenated and sulfur-containing compounds. Again, these reactions are significant because O_3 and NO_x are removed from the atmosphere. Due to the wide variety of possible conditions of meteorology and pollution levels in the HGB region, we intend to position Brown in areas where significant nighttime chemistry should occur (e.g., away from strong sources of NO). Possible areas where this research can take place are shown in Figure 2 with the captioned boxes labeled C. We also intend to make use of off-shore oil platforms as stationary NO_x and VOC emission sources to characterize the evolution of these compounds in the marine environment both day and night. For this purpose, it will be necessary to position Brown at various distances (e.g., 500 m – 5000 m) downwind from oil platforms. This positioning will also allow additional studies of aerosol optical properties, including f(RH), utilizing the cavity ring-down and photoacoustic instruments. The information obtained from these studies will be used to validate and constrain the models used for SIP development.

D. Characterization of aerosol physical and chemical properties and their radiative effects

Of increasing concern in this region is the issue of regional haze. Increased atmospheric particle loading affect not only visibility, with the concomitant problem of aircraft safety, but also has adverse effects on human health. Moreover, it is not just the number or mass of particles that affect visibility but also the size distribution and the chemical composition of the aerosol. A further complication is that particles have primary sources and they are produced in the atmosphere by processes that are closely correlated with the chemistry of O_3 production. Instruments on the ship will be used to explore aerosol production, transformation processes, and transport. A fundamental goal of these measurements will be to examine the spatial and temporal distribution of aerosols throughout the HSC and into the Gulf of Mexico. These data will provide valuable input and constraints for models used in SIP development. All areas of the study region will be investigated, but a primary region where near-source aerosol research will take place is shown in Figure 2 with the captioned box labeled D. To develop a regional understanding of aerosol distributions, the ship will be positioned under satellite overpasses (Terra, Calipso) to further develop satellite aerosol retrieval algorithms.

4.2 Underway Measurements

TexAQS/GoMACCS 2006 Ronald H. Brown Measurements

Parameter	Method	Laboratory	PI
Photolysis rates (JNO2, JNO3, JO-1D)	Filter radiometer	ESRL	Lerner
Ozone	UV absorbance	ESRL	Williams
Ozone	UV absorbance	PMEL	Johnson
Ozone	NO chemiluminescence	ESRL	Williams
Carbon monoxide	UV fluorescence (AeroLaser)	ESRL	Lerner
Carbon dioxide	Non-dispersive IR	ESRL	Lerner
Sulfur dioxide	Pulsed fluorescence	ESRL	Lerner
Sulfur dioxide	Pulsed fluorescence	PMEL	Bates
Nitric oxide	Chemiluminescence	ESRL	Lerner
Nitrogen dioxide	Photolysis cell	ESRL	Lerner
Total nitrogen oxides	Au tube reduction	ESRL	Williams
PANs	GC/ECD & CIMS	ESRL	Roberts
Alkyl nitrates, hydrocarbons	GC/MS	ESRL	Kuster
NO3/N2O5	Cavity ring-down spect.	ESRL	Osthoff
HO2/RO2	PERCA	ESRL	Sommariva
Nitric acid/NH3	Automated mist chamber/IC	UNH	Dibb
Radon	Radon gas decay	PMEL	Johnson
Continuous speciation of VOCs	PTR-MS/CIMS	ESRL	Warneke
Formaldehyde	QCL spectroscopy	Aerodyne Research	Zahniser
Hg	Atomic Absorption Spectrometry	ESRL	Fortin
Seawater and atmospheric pCO2	Non-dispersive IR	PMEL/AOML	Feely/ Wanninkhof
Seawater DMS	S chemiluminesence	PMEL	Bates/Johnson
Aerosol ionic composition	PILS-IC	PMEL	Quinn
Aerosol WSOC	PILS-TOC	PMEL	Quinn/Bates
Organic aerosol speciation	PILS-LCMS	PMEL	Quinn
Organic aerosol speciation	PTRMS	ESRL	Thornberry/ D. Murphy
Aerosol size and composition	Quad- AMS	PMEL	Bates
Aerosol size and composition	W-TOF-AMS	Aerodyne	Worsnop/Onash
Aerosol OC/EC	On-line thermal/optical	PMEL	Bates
Aerosol 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

TexAQS/GoMACCS 2006 Ronald H. Brown Measurements

Parameter	Method	Laboratory	PI
Total and sub-micron aerosol absorption (450, 550, 700 nm) dry	Radiance Research PSAPs (2)	PMEL	Quinn
Aerosol light scattering hygroscopic growth	Twin TSI 3563 nephelometers	UW	Covert
Total and Sub-micron aerosol extinction, f(RH)	Cavity ring-down spect.	ESRL	Baynard
Sub-micron aerosol absorption	Photo acoustic	ESRL	Lack/Baynard
Aerosol number	CNC (TSI 3010, 3025)	UW/PMEL	Covert/Bates
Aerosol size distribution	DMA and APS	UW/PMEL	Covert/Bates
CCN	DMT	PMEL	Bates/Quinn
Radiative fluxes	Spectral radiometer	CU	Pilewski
Aerosol optical depth	Microtops	PMEL	Quinn
Ozone vertical profiles	Ozonesondes	ESRL	Fairall
Ozone aerosol backscatter	O3 Lidar (OPAL)	ESRL	Machol
BL wind/aerosol	Doppler Lidar (HRDL)	ESRL	Brewer
Wind/temp profiles	915 MHz wind profiler	ESRL	White
Temp/RH profiles	Sondes	ESRL	White
Cloud height	Ceilometer	ESRL	Fairall
Turbulent fluxes	Bow-mounted EC flux package	ESRL	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 tower will be mounted for gas sampling forward of the ESRL 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 in the Gulf of Mexico 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. The water system will be secured when operating in harbors and bays.

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. Balloons will be filled in the staging bay. Ozonesondes will be launched once per day at 1700 UTC.

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) for use in the Gulf of Mexico.

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) Realtime RS-232 feed of selected ship data for the ESRL 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 outboard 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 inboard port side 02 level, sampling mast mounted on roof
      Needs phone connection.
   c) PMEL 3 (AeroChem2 Van)
      wt 12,000 lbs
      size 8' x 16'
      power Power from PMEL 1
      location port side 02 level aft of PMEL 1 and 2,
      sampling line connected to PMEL 2
   d) ESRL 1 van
      wt 15,000 lbs
      size 20' x 8'
      power From ESRL 3 van
      location starboard side, 02 level, inlets and grated decking mounted on roof
      Needs phone connection
   e) ESRL 2 van
      wt 15,000 lbs
      size 20' x 8'
      power From ESRL 3 van
      location starboard side, 02 level, inlets mounted on roof
      Needs phone connection
   f) ESRL 3 van (pump van)
      wt 5,000 lbs
      size 8' x 8'
      power 70 amp 480 v three phase
      location starboard side, 02 level
   g) 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.
   h) ESRL 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.

i) ESRL OPAL van

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

j) PMEL spare parts/storage van

wt	12,000 lbs
size	8' x 20'
power	none
location	port side 01 level

k) ESRL spare parts/storage van

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

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:

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

No foreign research clearances are required.

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 and Derek Coffman 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 Ni^{63}, at a strength of 10 milli-Curies (mCi) will be used during RB-06-06. The detector is covered under NOAA/ESRL NRC license number #05-1197-01.

Two sealed ion sources containing Po^{210} at 10 mCi each will be used during the cruise. These are leased from NRD and are also covered under the NOAA/ESRL 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. Primary communication will be via email with the operations center in Houston. This will include the transfer of weather products, schedules and data recorded on the ship.

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. 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.

**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

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: 843-693-2082
- OOD CELLULAR: 843-297-1835

NOTE: For the RB-06-06 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

10.2 Non-ship systems

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.

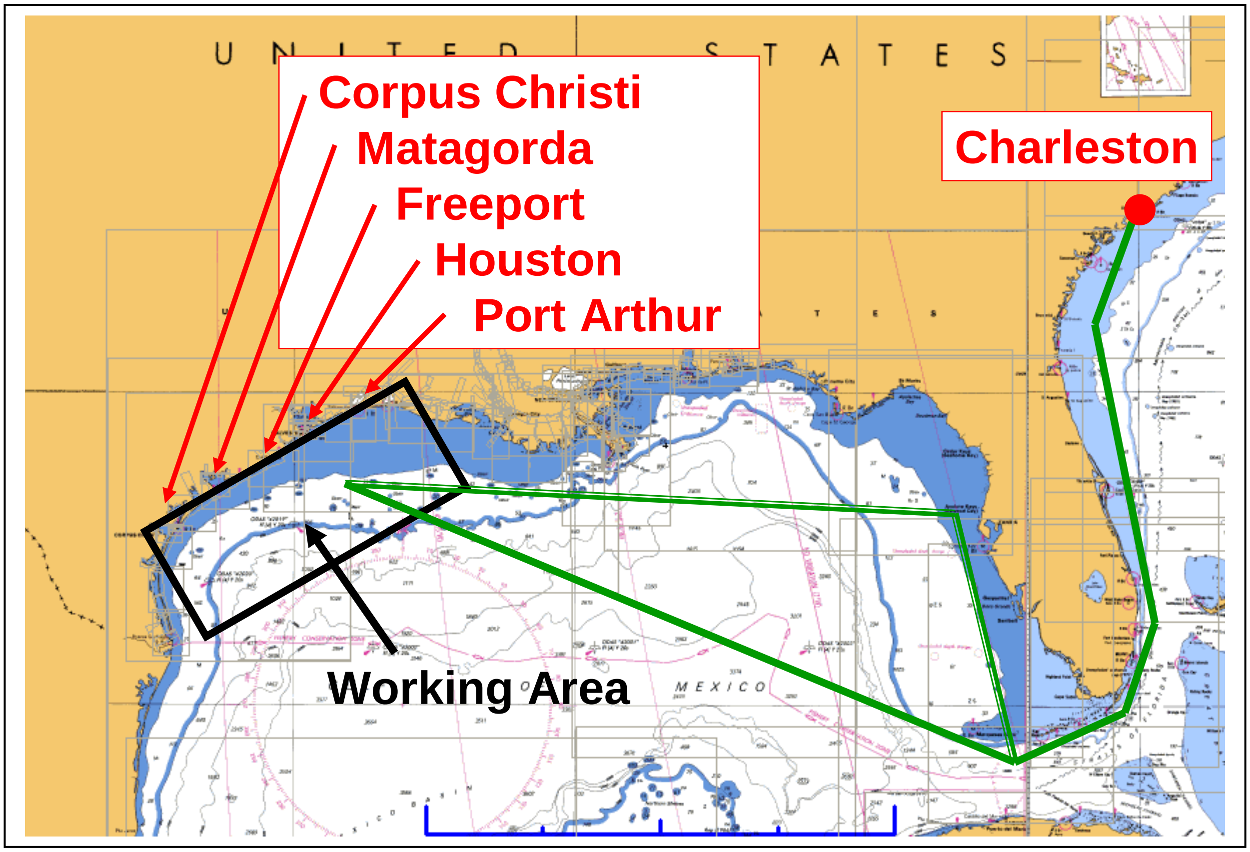
11.9 Port Agent Services/Billing

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.

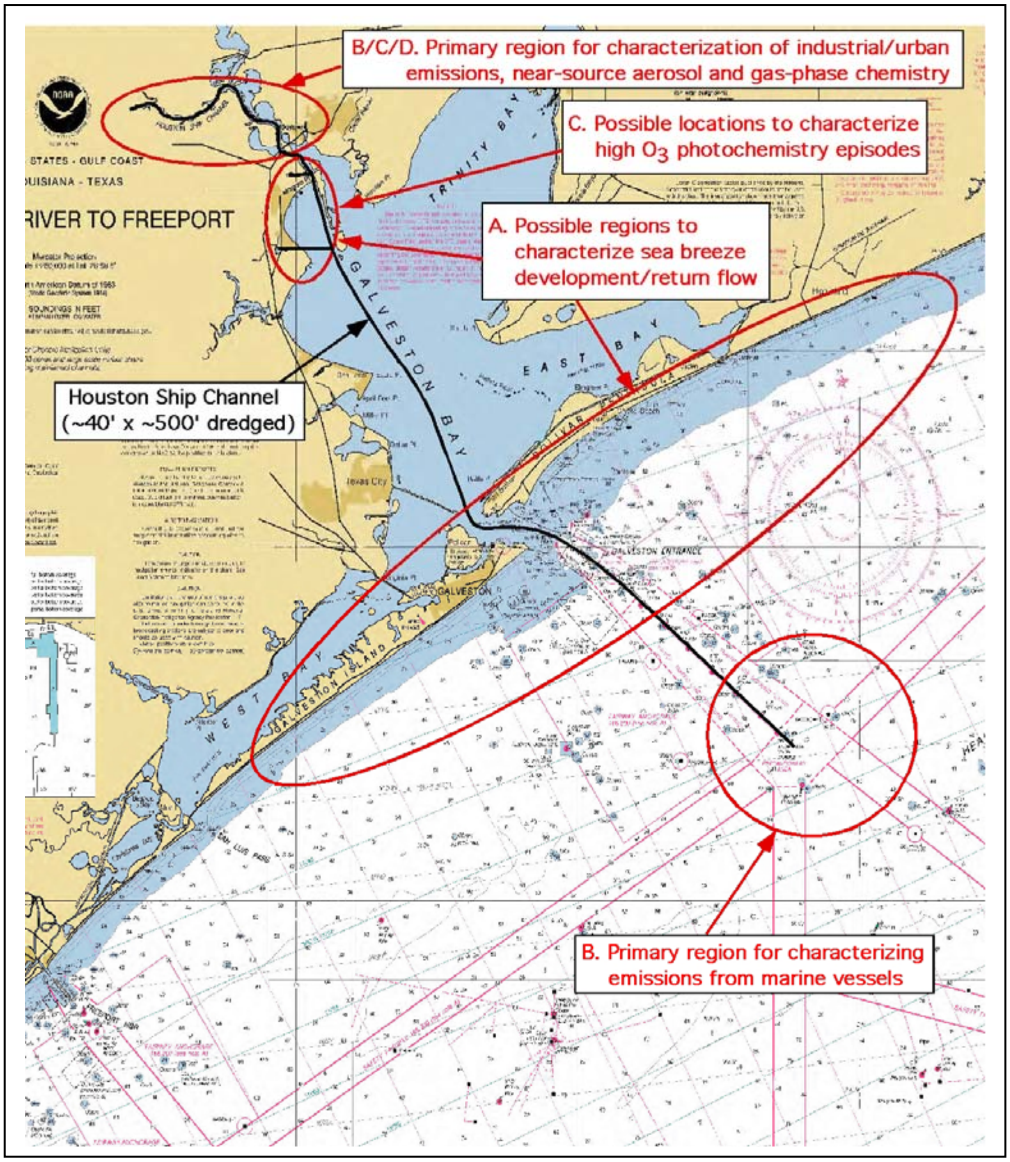
11.0 APPENDICES

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

Appendix A, Figure 1. Operations area. The initial cruise leg will follow the coast of Florida. Depending on wind direction the ship may head up the West Coast of Florida before heading to the working area. Operations will not include any harbors/bays along the Florida coast. During the experiment the ship will sample in the inter waterways of Corpus Christi, Matagorda, Freeport, Houston and Port Arthur.



Appendix A, Figure 2. Operations area in the Houston/Galveston region. The letters refer to the objectives outlined in Section



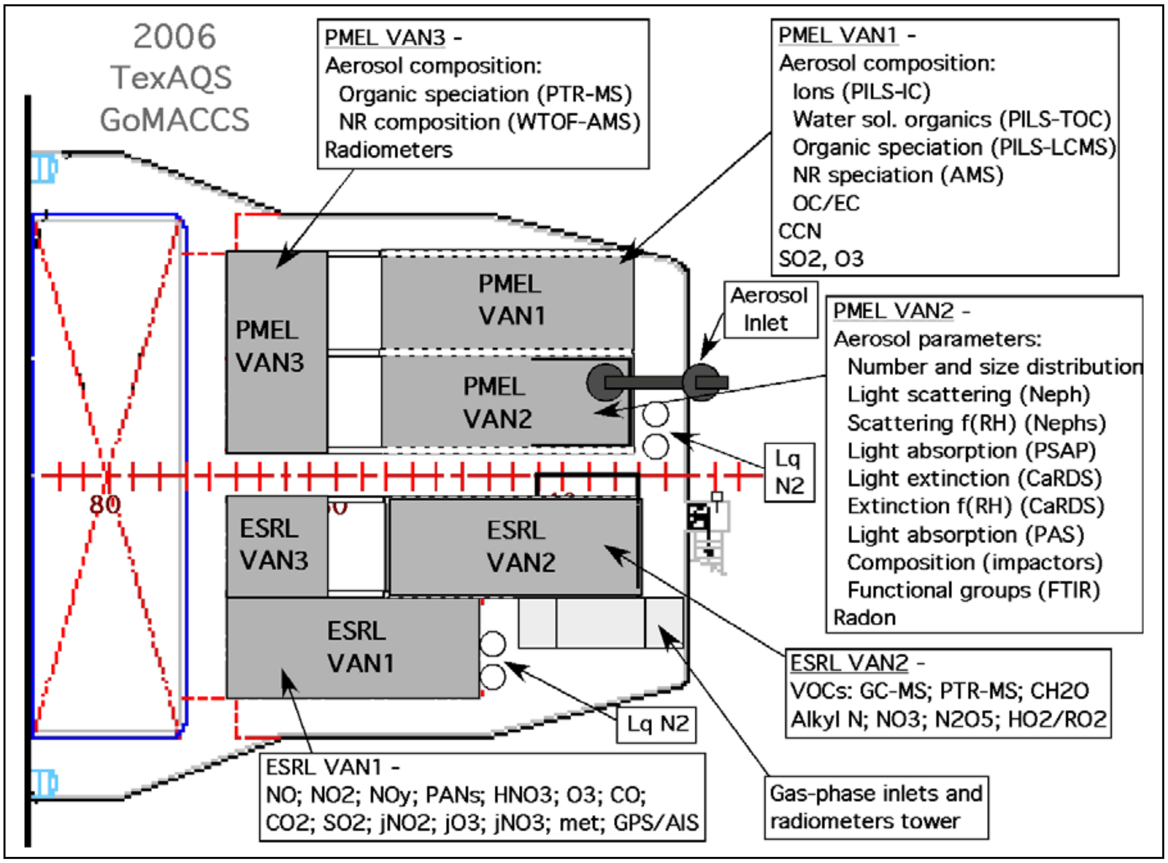
Appendix B. List of chemicals

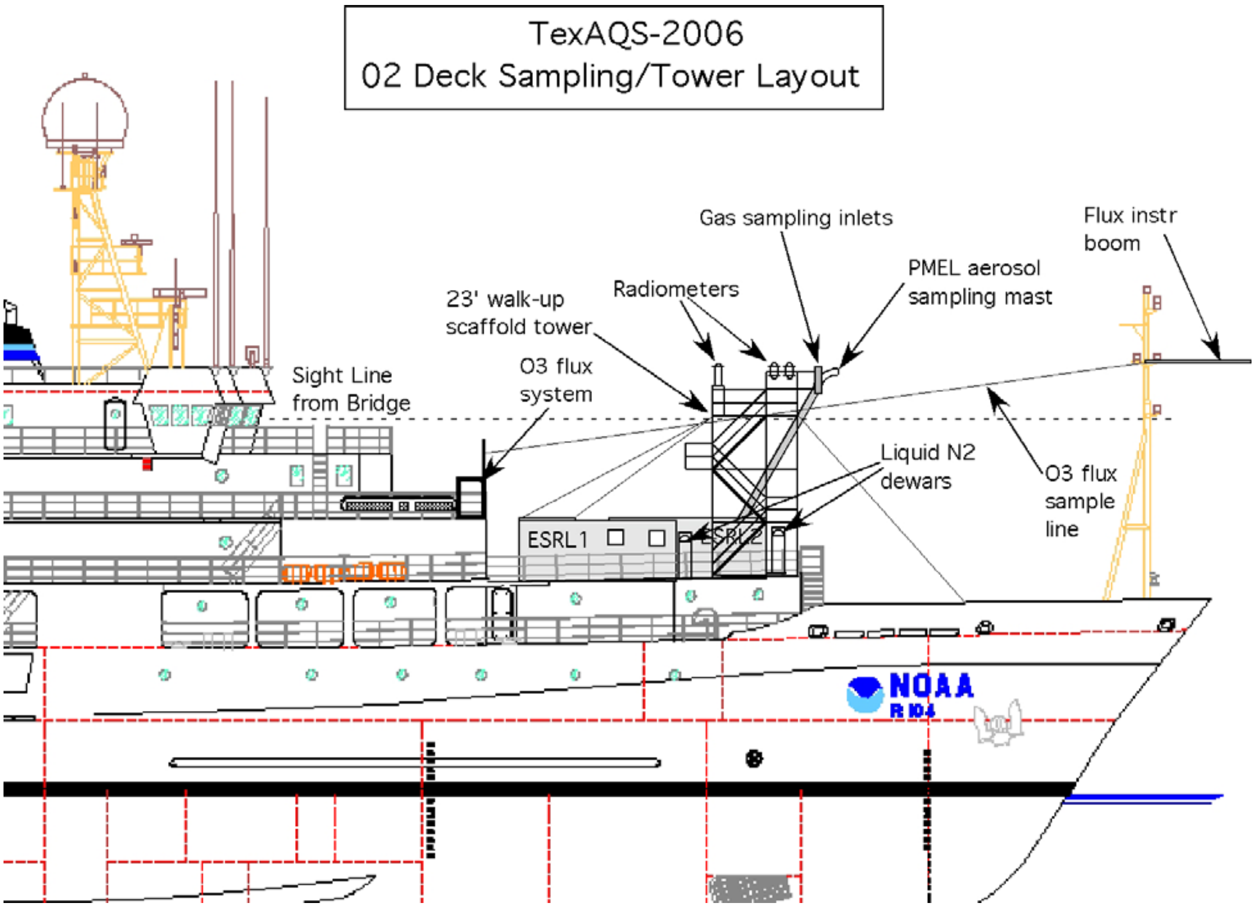
Compressed gases	Num. Cyls.	Quantity	Location	Chemicals	Quantity	Location
Tim Bates, Trish Quinn, Dave Covert, Derek Coffman, Kristen Schulz, Berko Sierau, Catherine Keil, Drew Hamilton, NOAA/PMEL Aerosol properties						
CO2 (Neph)	2	230 cf	PMEL 2 van	ammonium sulfate	500 g	Chem van
Breathing air (CO)	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
PP N2 (denuders)	2	230 cf	Main lab	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, Brian Lerner, Paul Murphy, NOAA/ESRL, NOx/NOy/O3/CO/SO2/met						
Zero air	12	150 cf	inESRL1; deck	Methanol	5 L	inESRL1 & 3
O2, UHP	6	220 cf	outESRL1; deck	Molecular sieve	500 g	inESRL1 & 3
NO 5 ppm in N2	3	50 cf	inESRL1 & 3	Charcoal	500 g	inESRL1 & 3
H2, UHP	1	28 cf	outESRL1	Pd 0.5% on alumina	1 kg	inESRL1 & 3
CO 200 ppm/SO2 5 ppm in N2	2	50 cf	inESRL1 & 3	PFPE vacuum pump oil	1 L	inESRL3
CO2 0.25% in Ar	2	150 cf	inESRL1	Magnesium perchlorate	1 kg	inESRL1 & 3
CO2 0.035% in Air	4	150 cf	in ESRL 1	Drierite	1 kg	inESRL1 & 3
NO 99%	1	8 cf	outESRL3	Ascarite	500 g	inESRL1 & 3
CO 99.5%	1	28 cf	outESRL1	Soda Lime	500 g	inESRL1 & 3
Zero Air	2	50 cf	inESRL1; deck	Sofnocat	100 g	inESRL1
Jim Roberts, NOAA/ESRL, PAN						
He, UHP	2	50 cf	inESRL1; deck	Tridecane	100 g	inESRL1
N2, UHP	2	50 cf	inESRL1; deck	Pentadecane	100 g	inESRL1
Zero Air	6	150 cf	inESRL1; deck	Acetone	1L	inESRL1
NO, 2 ppm in N2	2	150 cf	inESRL1; MLab	Dry ice	20 lbs	Main Lab
CH3I, 0.1% in N2	2	150 cf	inESRL1; deck			
Acetone, 20 ppm in air	4	150 ct	inESRL1; deck			
O2, UHP	2	220 cf	Main Lab			
Zero Air	2	50 cf	inESRL1; deck			

Compressed gases	Num. Cyls.	Quantity	Location	Chemicals	Quantity	Location
Hans Osthoff, NOAA/ESRL, NO3/N2O5						
Zero Air	16	150 cf	inESRL2; deck	Methanol	5 L	ESRL2
NO, 10 ppm in N2	3	150 cf	inESRL2 & 3	Acetone	1 L	ESRL2
NO2, 100% liquid	3	10 cc	Main Lab	DCM laser dye	1 g	ESRL2
NO2, 20 ppm in N2	1	150 cf	inESRL2	LDS 698 laser dye	1 g	ESRL2
O2, UHP	2	220 cf	Main Lab	DCM/LDS in Methanol	2.4 L	ESRL2
CO2, siphon	10	220 cf	Main Lab; deck			
Bill Kuster, Jessica Gilman NOAA/ESRL, VOCs/GCMS						
UHP He	3	150 cf	deck ESRL2 van	Sodium sulfite	150 g	AERO1 van
UHP H2	5	150 cf	deck ESRL2 van	Ascarite	500 g	AERO1 van
Zero air	7	150 cf	deck ESRL2 van	Methanol	500 ml	AERO1 van
Air (calibration standard)	1	50 cf	ESRL 2 van			
UHP Ar2	1	0.25 cf	ESRL 2 van			
Liquid N2	10	196 L	main lab (6) O2 deck (4)	Refill in Galveston		
Dan Welsh-Bon, NOAA/ESRL, VOCs/PTR-MS						
He, UHP	2	30 cf	inESRL2; deck			
VOC mix, 1 ppm in N2	1	2 cf	inESRL2			
He, UHP	3	50 cf	inESRL2; deck			
Tara Fortin, NOAA/ESRL, Hg						
Zero air	18	150 cf	inESRL1; deck	Iodated carbon	1 kg	inESRL1 & 3
Hg, 1 ppb in N2	1	150 cf	inESRL1			
Paola Massoli, Dan Lack, NOAA/ESRL, CRD extinction						
Zero Air	4	150 cf	inPMEL2; deck	Acetone	100 ml	PMEL 2
O2, UHP	3	220 cf	inPMEL2; deck	Methanol	100 ml	PMEL 2
Troy Thornberry, NOAA/ESRL, organic speciation						
UHP He	2	150 cf	deck PMEL3	Methanol	2 L	PMEL 3
UHP N2	2	150 cf	deck PMEL3			
Calibrations standard in Air	1	50 cf	PMEL3			
Richard Marchbacks, Alan Brewer, Janet Machol, Sara Tucker, Brandi McCarty, NOAA/ESRL, Aerosol/O3 profiles						
H2	1	220 cf	ESRL OPAL	Acetone	2 L	ESRL OPAL
D2	1	220 cf	ESRL OPAL	Methanol	2 L	ESRL OPAL
Ar	1	220 cf	ESRL OPAL	Isopropyl alcohol	2 L	ESRL OPAL
Dan Wolfe, NOAA/ESRL, Wind/temp/RH profiles (sondes)						
He	62	300 cf	Fantail			
Elly Speicher, Luke Knowles, UNH, HNO3/HONO						
UHP He	2	220 cf	deck ESRL 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

Compressed gases	Num. Cyls.	Quantity	Location	Chemicals	Quantity	Location
Roberto Sommariva, NOAA/ESRL, HO2/RO2						
CO, 99.5%	4	177 cf	outESRL2; deck	Luminol solution in H2O	14 L	inESRL2 & 3
NO, 0.06% in N2	3	50 cf	outESRL2; deck	Hopcalite	100 g	inESRL2
Zero air	6	150 cf	inESRL2; deck	Sofnafil	100 g	inESRL2
N2, UHP	20	150 cf	inESRL2; deck	Charcoal	100 g	inESRL2
				Molecular sieves	100 g	inESRL2
Scott Herndon, Aerodyne Res., CH2O, NH3						
Zero air	1	50 cf	inESRL1			
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.




TexAQS-2006
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boom
PMEL aerosol
sampling mast
Radiometers
23' walk-up
scaffold tower
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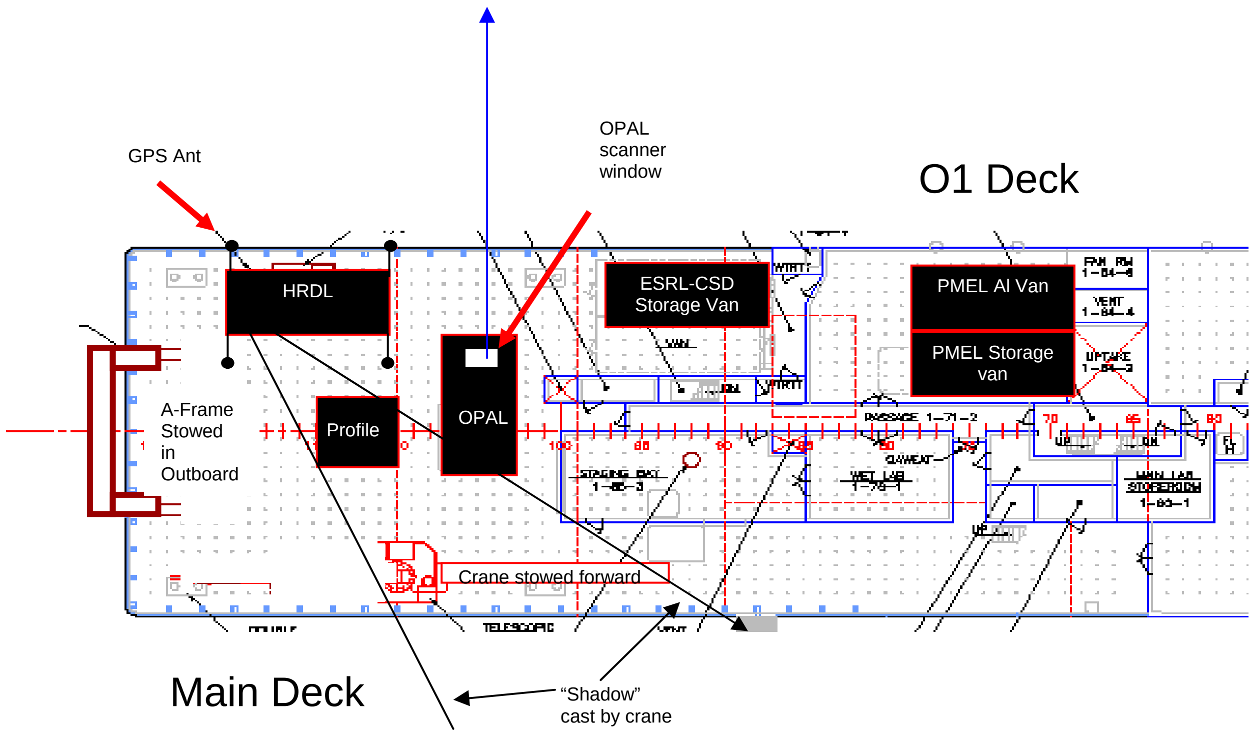
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Outboard
Profile
OPAL
Crane stowed forward
Main Deck
"Shadow"
cast by crane