NBP-1102 / O-287-N / S04P Support from RPSC and ECO - Comments from Jim Swift, Chief Scientist

> **OVERALL SUPPORT RATING: "Satisfied" (diminished from "more than satisfied" only due to the very serious pre-cruise problems with "do not freeze" cargo.**

About the Author

I am a Research Oceanographer at the Scripps Institution of Oceanography. I have been going to sea since 1974, with most experience in the Arctic and the Southern Ocean. I help coordinate the academic field work for the US Global Ocean Carbon and Repeat Hydrography Program. I was the principal science team point of contact for NBP-1102, including before I was appointed chief scientist. I represent 16 coordinated science programs participating in NBP-1102, an education and outreach program, and as chief scientist am also responsible for carrying out mooring work assigned to the cruise by NSF. I have worked with most of the measurement and sample collection teams previously. This is my third cruise on the Nathaniel B. Palmer.

Introduction

The S04P cruise for the NSF/NOAA-funded US Global Ocean Carbon and Repeat Hydrography Program was proposed to NSF in 2002 as part of the overall global program, and the program began in 2003. (Approximately two cruises per year are carried out, nominally one with NSF ship support and one with NOAA ship support.) Efforts to schedule a ship for S04P were unsuccessful during the first six years of the program (2003-2008) and so the cruise was carried over into the grants for the second six years (2009-2014). A tentative schedule for 2010 was informally discussed by NSF in late 2008. That soon became a more nearly firm schedule for 2011 that mostly held. The science team was aware from early on that the proposed science plan was ambitious. Quoting from an email one year ahead of the cruise, "We already know that we have more possible work than there is time to do it. This is not a problem. Based on the dates previously given us, we will have enough time to get all of our highest priority work done, and to then do a reasonable amount of the extension of our sampling east across the Amundsen area and on to the peninsula. It's actually a very good cruise plan from a science standpoint and we are delighted that NSF has provided this ship time."

All 15 prior cruise legs for the program were carried out on UNOLS global-class ships or NOAA's R/V Ronald Brown. This was the first icebreaker cruise for the program, the first USAP cruise for some of the teams, and the first icebreaker or USAP cruise for some of the individual participants at sea.

Notes on pre-cruise planning

Our cruise is an interesting test of the USAP pre-cruise planning process. First, although we are composed of 16 groups from around the US, most of us have worked together previously and nearly every group is experienced in performing their work at sea, the standard requirements of marine operators, how to carry out international shipping to and from a cruise, dealing with

hazmats in shipping and on board, and so forth. Second, each team is essentially self-contained, in the same sense that any group who uses UNOLS ships is familiar with providing and supporting their own laboratory equipment and personnel. But, third, few of the teams have extensive USAP experience.

Ideally, the RPSC pre-cruise planning process would (1) present standard information for investigators new to work at sea (but not burden sea-experienced teams with it), (2) present investigators new to the USAP with information that was unique to the USAP (but not burden USAP-experienced teams with it), and (3) mutually determine special requirements from the standpoints of both ECO/RPSC and the science teams.

Ship scheduling was effortless for the science team, because this was handled 100% by NSF. The schedule was mostly in place by July 2009.

Initial contacts with RPSC were by telephone and email; Bob Kluckholn was the chief contact at RPSC in the early going.

Emails during October 2009 established contact between RPSC and myself regarding an "Operational Requirements Worksheet". I have, however, no "ORW" for NBP-1102 on my computer, and so I do not know if this was done or not. Looking recently at sample "ORWs" which I found on my computer from an NSF logistics review not connected with this program, I can see that the ORW would have been a confusing document to fill out, especially so far in advance. The form seems to have been designed for teams already experienced in the USAP and on the Palmer. For example, nomenclature is highly specific yet mostly undefined on the form. It would seem wise for RPSC to fill out the ORW as part of an interview (via teleconference) with program PIs.

> *Recommendation: If the ORW is to be made more nearly accurate, it should be filled out by experienced polar logistics experts familiar with supporting the type of research intended, who interview program participants via teleconference.*
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> *Recommendation: If the present system of having the PI fill out the ORW is retained, NSF should provide the ORW forms to a team of marine and polar researchers with no prior experience with the USAP for review and comments on how it could be improved.*

By early 2010 I was working with Patricia Jackson of RPSC, who was our initial Point Of Contact. Having a POC is essential, and Patricia fit the bill well. Later (June, 2010) she was replaced by Adam Jenkins, and he also was a pleasure to work with. During pre-cruise planning Adam was usually quick to respond to emails and questions. [The only time there was an issue with his role was at McMurdo: he was present on site from well before our arrival yet either never did anything about our cargo problems there or was unaware of them. Whichever, as our POC and sole representative at McMurdo, we expected more, especially in hindsight.]

In mid-April 2010 I was asked to log into PolarICE with respect to working on the Science Information Package (SIP). This was the clumsiest, least helpful pre-cruise planning method our program has ever encountered, and hopefully we will never again encounter its like. We ended

up working on the SIP on and off until RPSC finally made it final in January 2011. I had to give access to the SIP to every member of the science party, because we, and the information required by RPSC, are scattered all over the US. The SIP, however, is not set up for multiple semi-independent groups. It was difficult at times to locate the information for one's own group within the overall jumble. One team would find their information overwritten or edited by another team (this happened to me several times). Much of the SIP pertained to non-marine science, yet had to be gone through. Little of the SIP pertained to a marine science expedition loading at McMurdo. If the SIP had a section specifically related to marine support out of McMurdo, this could have helped both the science team and RPSC. There were also one or two areas of the SIP that were impossible to complete to RPSC specification, because certain units of measurement one team or another in our group used for items on the HAZMAT page (and possibly the radioisotope page) did not fit the choices, and it was impossible to simply type in the correct information. Therefore it was impossible to clear that page with the SIP-checking application (and thus I was never able to submit the SIP and had to have RPSC IT do this for me). Another problem was that important aspects of our operations did not fit the SIP. In an attempt to more accurately describe our operations and requirements we made extensive use the comment boxes. (It is not clear if RPSC paid full attention to what we wrote in the comment boxes.) Another significant problem was that the language we used to describe our work sometimes differed from the language an RPSC reader might use. For example, one of our data experts described on the SIP how she would set up a web site on the ship (this is how our teams handle data on every cruise). But RPSC appears to have missed this - perhaps because the exact computer specialist words RPSC IT would have used were not there. Despite the fact that our intent to set up a web site also came up without negative comment in a pre-cruise teleconference, RPSC came very close to forbidding this after we were on the ship and had set sail.

The process the SIP was supposed to enable would have been much more effective for both RPSC and our teams, and hugely easier, if the main element of pre-cruise planning were teleconferences (including face to face sessions when feasible), such as are used by virtually all other marine operators. "One size fits all" forms such as the SIP are nearly guaranteed to be incomplete or misleading. **Communication is established effectively only by actually talking together.** If RPSC requires something akin to a SIP, *they* should be filling it out, and getting the information from the science teams via repeated conversations between technically savvy people from each area of expertise. (Please note that chief scientists, in particular, are not technically knowledgeable about all areas of operation on their cruises.)

The SIP often as not asked if we wished to use specific (name and model number) pieces of RPSC or ship's equipment. Often we had no clear idea what these were, or what were the alternatives. We bring most of our own equipment. Were these items going to be for emergency back-up? We knew, however, what *functions* we wanted. The SIP questions should thus relate to what types of support facilities and functions are required, and extensive use should be made of fill-in boxes and <u>especially interviews</u>. Again, it should be RPSC, working with the science team, who helps decide, after going back and forth in conversations with the science team, whether a science team does or does not need item X, and exactly what level of RPSC support is needed for item X.

Here is another comment on the SIP from a team member: "The PolarICE interface for gathering pre-cruise information is very cumbersome and much of it is irrelevant for ocean work, but must still be waded through. A much better system would be for Grantees to state their needs and then have RPSC personnel check for additional needs/issues that the grantees might miss. The SIP process is particularly annoying and time consuming and fails miserably when multiple PIs access it. It needs a serious overhaul and simplification."

We were asked to list every piece of laboratory and other electronic equipment, including its size, power draw, etc., that we planned to bring to sea. We were asked to list every computer brought on board including personal laptops. No other marine operator requires that level of detail. If a science team member is bringing item Y, what RPSC really needs to know are the special requirements attending to item Y and what RPSC is going to be expected to do, if anything, to support and maintain item Y. A phone call with each team would have quickly identified standard requirements and special needs, such as use of hoods, amount of refrigerator and freezer space needed, compressed air, non-standard power, extensive use of solvents, use of propane, unusually large items in shipments or in the labs, and special environmental sensitivity. Surely the Palmer has done CTD/chemistry cruises before NBP-1102 (I can think of two that I was on!). What RPSC needs to know is basically "what's different?" in addition to the normally-required information.

One PI on the science team said this: "RPSC is a very large bureaucracy where responsibility for the different aspects of cruise preparation and personnel needs are shared out amongst a large number of sub-organizations. As with any such operation the quality of internal communications can be rate and outcome limiting. To ameliorate this problem a POC helps guide grantees through the system, this is a good idea and the ones I worked with were very helpful. However, these people do not sail with the cruise and so there is a significant opportunity for information loss."

> *Recommendation: As soon as possible, the SIP system for USAP marine science should be replaced with an interview format, such as is used universally elsewhere in marine science support. If RPSC needs the exact information on the SIP - such as which USAP-provided equipment will be used - RPSC should be filling that out themselves based on their understanding from the interviews. (Of course, RPSC's recommendations should be reviewed by the science teams and discussed yet again in teleconference.) The SIP for USAP marine science should include information relevant to the start and end ports*

Cargo

We normally send ca. 5-7 20-foot containers to the start port of a CO2/repeat hydrography cruise: 2-3 lab vans packed with cargo, 2 storage vans packed with cargo, and ca. 1-2 vans worth of other cargo. No other marine operator requires RPSC's level of detail about the cargo. I agree that discussions about cargo types, sizes, etc. are required. I completely agree that all hazmats must be identified and MSDS sheets provided, and all hazmat wastes must be identified for USAP cruises. I also agree that for shipments to McMurdo "do not freeze" items must be identified. And of course it is logical to require a specified label format, so that items that go together stay together and are delivered together. (There may be other special categories, too.)

One significant fault in the cargo labeling system is that PI/group information is not retained on the "TCN" list and on the official box labels. PI information is presented on the master cargo list (e.g., see list beginning on the 17th page (numbered "Page 14") of the RSP), but is completely absent from the cargo "TCN" list on the 35th page (numbered "Page 32"). How does one sort out their own cargo?

Recommendation: Include group names/IDs and other helpful information with the TCN list.

There were serious instances of cargo mishandling for this cruise:

1. The major shipping problem was the improper handling of the expedition's "do not freeze" cargo. All shipped items which were designated as not to be stored in temperatures colder than 0°C were identified and labeled as "do not freeze" following RPSC procedures. But when the science team arrived in McMurdo we found major problems. This arose immediately: One of the SIO/STS techs asked at the first meeting, the first day in McMurdo, to see the containers, equipment and supplies. On the second day, this was brought up again and when the SIO team leader felt resistance, the team leader insisted to see the containers and air shipments. The science team was then taken to see the containers that came from the cargo ship. It was immediately obvious that "do not freeze" loose cargo items were sitting out in the cold: RPSC "DNF" labels were clearly visible to any passerby. And when the cargo containers were opened, nearly every container contained properly labeled "do not freeze" items. (Most if not all of those containers had RPSC "DNF" labels on the exterior.) [Some cargo was not there - specifically one "DNF" container and the air shipments. It appeared to the SIO team leader that the POC did not know where that part of the equipment/supplies had been stored in McMurdo. All cargo was located eventually.]

The DNF cargo sitting in the cold contained DNF hazmats. For example, there were 30 bottles of specially prepared, closely calibrated acid, essential (no special acids = no go) for the SIO alkalinity program (worth $200/bottle for a total value of $6000). All 30 of them froze to some degree. For most of them half froze but some were all slush. None burst. The PMEL DIC group also had DNF hazmats left on the ice dock in the cold in a cargo container labeled DNF, including several 500 mL glass bottles of concentrated phosphoric acid and several bottles of acetone that were labeled 'do not freeze'. All were OK. Both the acetone and the phosphoric acid had originally been shipped from Seattle to Port Hueneme in a black collapsible 'D-Container' that was successfully shipped onward as 'Do Not Freeze' to McMurdo - stored in the one heated van - but the acetone and phosphoric acid had been removed from the D-container by RPSC in Port Hueneme and shipped separately without temperature control. The ODF hazmats, including concentrated acids, that were shipped "DNF" were also found in unheated cargo containers on the ice dock. Setting aside the potential damage to the science programs , consider the hazmat mess that would have resulted from many burst bottles of frozen acids.
burst either.)

This shipping blunder on RPSC's part came a hair's breadth from causing immediate cancellation of this multi-million dollar expedition. That hair's breadth was the apparent blind good fortune that the expedition's cases of seawater standards for salinity and ocean carbon happened to be in

the one 20-foot container that was properly constructed to keep items above freezing - it had heaters and was plugged in. The expedition would have been cancelled on the spot without these thousands of dollars of international standards.

Comment: I can think of no acceptable excuse for this mishandling of our "do not freeze" cargo. If RPSC could not ship our DNF cargo in temperature controlled cargo containers, the science team should have been told. For example, if there was only one appropriate RPSC cargo container, the science team, if brought into the picture at Port Hueneme, could have figured out exactly what cargo must go into it, and take chances on the rest, or make last-minute arrangements for rental of a second heated container.

2. One major science program - the Argo floats - was cancelled outright due to unknown effects on the lifetime of the float's lithium batteries caused by prolonged exposure to sub-freezing conditions. Here is the incident report from the PI:

> Report on RPSC Handling of Argo Floats Prior to NBP-1102 Expedition
> Stephen Riser, University of Washington
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> Eighteen Argo profiling floats were delivered by ship to McMurdo approximately 11 days prior to the staging of the cruise NPB-1102 at McMurdo. There were 9 plywood crates delivered, with 2 floats per crate. The crates were inside a larger container with other cruise supplies, including chemicals for running nutrient analyses. Both the large container and the individual float crates were covered with stickers that said "DO NOT FREEZE". Nonetheless, the container and floats were left outside for 11 days prior to the cruise; the float batteries and some internal components were affected, rendering them inoperative. It was necessary for the floats to be shipped back to Seattle for repair. The floats were tested in McMurdo by University of Washington engineer Rick Rupan, who discovered the damage. As it turned out, no one from Raytheon or at McMurdo had ever checked on this shipment during the 11 day period that it sat at McMurdo. The Raytheon rep at the site, Adam Jenkins, was on site at McMurdo for the entire 11 day period prior to staging and was aware of all deliveries of equipment for the cruise, but he never bothered to check on the floats until Rick Rupan arrived just prior to staging. These floats are collectively worth nearly $400,000, yet neither Mr. Jenkins or anyone else ever checked on their whereabouts or condition. As a result, the floats were shipped back to Seattle, where we estimate that approximately $2000 per float might be required to get them back to a deployable condition. But it was not just the cost in time and money that is unfortunate here. We lost the scientific opportunity to deploy these floats along the track of NBP-1102, which would have provided important ancillary data to the cruise for years to come. It took years to arrange this opportunity, and it will not come again soon, if ever. Both the financial and scientific losses accrued from this negligence are large and were seemingly unnecessary.

3. RPSC opened vans in Port Hueneme which were shipped to Port Hueneme in secure, ready-for-sea condition. But the contents were then disturbed and left unsecured by RPSC. The primary example is the NOAA CO2 van from Seattle, which was shipped ready for heavy seas. When the

van was opened in McMurdo, boxes which had been secured on the floor in Seattle were found opened and in unsecured stacks, with one or more on bench tops (photos are available). Almost unbelievably, none of the boxes had fallen en route and so no damage was done. If damage had occurred this could have cancelled or at least limited the DIC program (a key program on an "ocean carbon" cruise). The SIO/STS cargo van was also opened and originally-secured items were left unsecured. These instances shows lack of expertise and care from the persons who opened the vans and went through their contents.

4 All chemicals shipped in support of nutrients and oxygen were shipped DNF ("do not freeze"). They arrived in 20' containers both labeled DNF, but stored unheated in freezing conditions. The main concern was freezing and subsequent rupturing of glass concentrated acid bottles and glass columns packed with cadmium metal and liquid imidazole buffer. Luckily, the acid bottles did not appear to freeze. The plastic jar filled with glass Cadmium columns was frozen into a block of ice and near rupturing. The ODF chemist preformed a slow (~24 hour) thaw at the laboratory at McMurdo. Thankfully, all glass columns were intact and sealed. Column efficiencies were checked and used successfully on the cruise. Incidentally, the instrument tech/lab manager at McMurdo kindly provided raw Cadmium metal and glass from McMurdo stock just in case ODF needed to re-treat and re-pack columns aboard the ship.

5. Until the steam to port, water damage to the contents of one container - the SIO/STS cargo container - was a mystery. The contents of several plastic totes in the SIO/STS cargo container were water damaged, including subsequent mold damage and then freezing damage:

a. Three plastic boxes with flip-top lids (ODF SS-2, CE-4, SS-3) contained computer and processing manuals and stationary supplies belonging to ODF. The paper contents had to be discarded due to mold. All contents of these boxes with the still intact items that could be salvaged were wiped with bleach so as to remove the mold. There was a financial loss of $500-$700. The lost items did not stop ODF from completing its cruise goals although it was a hindrance.

b. One plastic box (tote) of laboratory plastic ware was completely frozen into a block of ice. The tote was located in the STS 20' shipping container. Various beakers, funnels, graduated cylinders, Nalgene reagent bottles, etc were completely encased in ice. One plastic flask was ruined (~$100) but everything else was salvaged. Luckily, it was the box with the plastic ware which got nearly full of water and then froze and not the glassware or electronics totes.

c. A non-ODF tote in the sea container, with sea clothes belonging to the chief scientist, was received damp, frozen, and moldy. Multiple washings of the clothing and boot liners with hot water and bleach eliminated most of the odor. A second non-ODF tote of office and professional supplies (again belonging to the chief scientist) was received with about 4-6" of frozen-in-ice contents which had first molded, and many of the remaining contents not in the block of ice were mold-covered and frozen. The Chief Scientist's loss was at least $240, including a 500 GB back-up drive (which was frozen solid inside a block of moldy water) (photos and list available). [Note added later: At cruise end the hard drive was hooked up and it actually worked! As a backup device, however, it can no longer be trusted.]

Until the steam to port, this damage was a mystery. But then it was found that improper repairs to the cargo container's roof - presumably done by SIO personnel at some point prior to shipping - had left a route for water on the container's roof to drain into the container's interior. Hence all the water/mold damage to the contents was caused by SIO personnel, and RPSC was not to blame.

There were other cargo-related snafus: One example had to do with the gas chromatographs which are required for the CFC analysis systems. These each contain small sealed low-level radioactive sources. For a period of months the forms and questions went around between the CFC teams and RPSC; finally everything seemed set. Then I was told that RPSC was refusing to load the boxes with the gas chromatographs onto the ship because they contained radioactive items. RPSC eventually figured out once again that the GCs were indeed non hazardous, and did allow the boxes containing them onto the McMurdo cargo ship. But we may have had to cancel the expedition if RPSC had refused to ship the GCs.

Another snafu had to do with hazmat repackaging. To our surprise, in Port Hueneme RPSC unpacked the hazmats from different groups and mixed them together without identifying whose were whose. This also had the effect of disturbing the MSDS identification: each box shipped to Port Hueneme was a properly packed self-contained unit which included its MSDS as required, and was meant to be shipped as that self-contained unit. The hazmat cargo was not packaged and labeled in a manner to be broken down and reshuffled. At the very least, if RPSC is going to repackage hazmats, they should be telling the science teams far enough ahead so that the teams can plan for it.

Recommendation: The cargo mishandling experienced by this expedition is very serious. There were multiple instances of potential expedition-ending outcomes, and one major science program was cancelled. It thus seems essential that RPSC undertake a thorough overhaul of RPSC's cargo identification and handling procedures.

Recommendation: Accurate descriptions of RPSC cargo procedures such as limits and procedures on handing do-not-freeze cargo, consolidation and repackaging of hazmats and other cargo, and securing of cargo for heavy seas should be spelled out in pre-cruise documentation.

Recommendation: Unless or until RPSC can demonstrate that it has successfully revamped its Port Hueneme cargo handling, it may be wise to fund travel and time for shipping experts from the science teams to be present at the Port Hueneme facility at the time their cargo is handled there in order to assure that key scientific cargo is handled properly.

Information Technology

RPSC provided two computer/IT techs, Chris Linden and Kris Merrill. Both were capable, friendly, and helpful at all times. Their chief overt support for our program consisted of keeping email working and switching over the winch displays. They also were helpful getting the XBT

system going. In fact, it should be stressed that both were helpful at any time. Chris was also aboard to assist with multibeam mapping of the Yuan/Sprintall mooring site.

Science team comments on IT services on the cruise varied widely, except that all persons rated Chris and Kris highly. Negative comments focused mostly on unnecessary or unreasonable practices the shipboard techs were required to implement. One person wrote, "The IT system on the ship and the rules surrounding it is the worst I have ever seen at sea. The organizing principle behind it appears to be a fanatical obsession with security and not much interest in being a support system to facilitate scientist's work. ... The extremely poor quality IT system on this ship will dissuade any grantee from requesting to use this otherwise very capable and well equipped ship [if it is] part of the UNOLS pool."

There was universal agreement on password requirements: "over the top", "12 characters?", "expiring every 60 days?", "the mindless security issues are all justified as being required by NSF, but NSF's own FastLane web site does not have these requirements", "12 digit passwords that expire and have to be changed during the cruise-no exceptions allowed for a long cruise", "this is oceanography, not nuclear weapons construction" are examples. One person mentioned, "no WiFi on the ship--again we are told because of security ... makes no sense--we are at sea!"

The science team felt in general that the email system seemed adequate for personal email, though the size limits were somewhat of a problem. But those who needed off-ship science support were hampered. For example, "Very low size limits for attachments means that sensitive and confidential information like references etc have to go through the shipboard administrators account." [An aside: This seems strange for a security obsessed IT system - apparently the creators were not so concerned about the *users* IT security.]

The lack of internet support created some problems on the science side: "No direct internet access from public computers hampers the science mission- try dealing with FastLane from this ship." The small file size limits and lack of internet can be especially hard on early-career scientists, who on a long cruise such as this risk losing important ground on their quest for recognition, positions, and advancement. For example, consider this, written by an early career scientist on the cruise: "... having a public terminal with internet access onboard would be extremely useful for science. I had to submit a paper through the IT admin and this was very cumbersome. Fortunately, the editor was very understanding. But now I cannot review the proofs and this delays the publication of my work. Furthermore, in several instances during this cruise, I needed to download journal articles from my home university library website. I had to ask one of my colleagues back home to download them for me, shrink the PDFs to less than 300kb and email them to me one by one. ... I consider that having an internet terminal (even if it is slow) is an essential tool on a research vessel."

Science team members who experienced problems with their computers were grateful for the help from the RPSC IT staff, though in general most groups did not seem to have computer problems that required RPSC IT support.

Regarding IT services in general, there are too many fixed installations of computers on the ship. They fill up nearly every available work spot in the forward dry lab, computer lab, and

conference room, leaving little space for people to set up their computers. Nearly every person along has a laptop, often separate work and personal ones. It was handy to have the monitors from the RPSC computers - they were used with the laptops. But most of the fixed installation computers themselves were ignored. More of that space should be open computer desk space for people to set up their own laptops, perhaps with RPSC monitors if desired. If there are some large groups of users who do not bring their own computers, then the ship's computers should be put into storage and brought out only for those few cruises. Several people commented that one specialty group of users should not be permitted to dominate the Palmer's lab layouts and installations.

Instruments/Electronics

RPSC provided one instrument/electronics technician, Tony D'Aoust. Tony was capable, friendly, and helpful. He earned high praise solving problems with the trace metal CTD especially and also with the XBT system. He exhibited good initiative. Because there are a large number of fixed installations aboard the ship, there are other instrument and electronics support activities - not so directly for our measurement program - that Tony worked on.

Lab support

Our groups provide their own equipment, chemicals, and standards, and the trained analysts to run the samples in a 24/7 operation. We run salinity, oxygen, nutrients, total inorganic carbon, total alkalinity, pH, and CFC (F11, F12, F113, SF6) samples on board, and process samples for helium and HPLC pigments on board to return to shore laboratories for analyses. We collect water samples to return to shore laboratories for other parameters, including radiocarbon, tritium, oxygen isotopes, dissolved organic carbon and nitrogen, CDOM, and others. We provide our own CTDs and rosettes and ancillary equipment, spares, and diagnostic equipment. Support lab facilities (which we bring with us) include electronics and water bottle lab support. The trace metal group provides its own rosette, CTD, laboratory and supplies, and a back-up winch and cable. The aerosol group provides its own equipment.

The Palmer's labs and lab facilities are in great condition, true. But one notices that the labs are not quite as general purpose as one first thinks. Ideally each lab except the two forward-most labs would have at least one sink and one hood, 220 V power, compressed air lines, unistrut on bulkheads and overhead and 2-foot bolt pattern in the deck, etc. as needed for versatile, full-featured labs. It was, however, a bit challenging to find labs for some science operations with the combination of facilities needed. That said, the ECO engineers are terrific, and simply made happen what needed to happen, and our expedition was provided with all that was needed.

When we laid out our lab assignments we used the on-line lab diagrams, as requested by the POC. The lab diagrams on-line do not include dimensions or at least scales. This led to a misunderstanding in that we asked the dimension of the lab benches on the diagrams and were told via email they were 4'x8'. When we arrived on board we found they were 2.5'x4'. We were able to set up without problem, but the bench size was a surprise. The lab diagrams also need to be brought up to date. For example, there are lab locations labeled as having unistrut that do not have unistrut. (The ECO engineers kindly added some where we really needed it.)

The Palmer's salinometer lab is perhaps the best of its type in our experience, in terms of providing a stable temperature environment for the AutoSals, especially with use of fans to help assure uniform air temperature distribution. The room is a bit damp and musty, but perhaps that is a side effect of its isolation and stability. Whatever, the bottle salinities from this cruise were among the best I have ever seen, and the room shares with the skill of the analysts in credit for this outcome.

The oxygen and nutrient rigs were set up in the hydro lab. Both functioned very well in this space. Special note should be made of the large central table, which when used for our nutrient autoanalyzer provided more than ample space to work all around the machine. The automatic shut-off on the ice machine in that laboratory did not work. This was only a minor problem.

The helium extraction rig was set up in the biochemical laboratory. Helium extraction has many requirements, including 208-volt power, compressed air, use of propane, extensive use of isopropanol, installation of gas cylinders, bench space, unistrut, etc. The ECO engineers were excellent at providing the ship's facilities needed for this activity. Thanks!

The HPLC filtering rig was set up without problem in the wet lab, along with the ODF electronics and bottle workshop area.

The pH, alkalinity, and CFC rigs were set up in the aft dry lab, along with the HEPA-filtered work areas for the aerosol and trace metal groups, the mooring workbench, the DOC/DON and 14C staging area, and a flow cytometer. "220"-volt power was brought to the CFC rig by the ECO engineers. There was no running underway seawater supply in this lab, but the CFC group was able to obtain their fresh seawater from the hydro lab. All in all, this lab worked well for the groups.

The ODF data acquisition and processing computers were set up in the forward dry lab without difficulty. Other computers which needed to be installed in this area were set up by working around the numerous RPSC fixed installations.

There were no science team set-ups in the computer lab, which would have been difficult anyway due to nearly all space being used by RPSC installations.

Aerosol equipment was set up in the helo hangar without difficulty.

Two science team lab vans (total inorganic carbon and trace metals) were installed on the fantail. These were capably supported by the ECO engineers.

Mooring equipment was staged on the fantail and the aquarium room.

Deck support

RPSC provided two deck technicians (MTs), Mike Lewis and Barry Bjork. They were both capable, friendly, helpful, energetic individuals, one of whom (the one on watch) was present

during every over-the-side activity. This was helpful in that it freed up time for the two on the SIO team with the most deck experience to attend to running salinities and carrying out maintenance functions. Unlike UNOLS ships, the Palmer requires an MT to be present 100% of the time during a cast, and so having the RPSC MTs along was useful. If this were a UNOLS research ship, without the MT-always-on-deck policy, either of the SIO deck techs could have at least somewhat increased their deck responsibilities without undue difficulty, although having ship's MTs aboard would still have been useful. (Also, our expedition experienced very few problems, so the SIO techs had more time to do MT and salinity analysis duties than on some cruises.) RPSC MT activities were safely and professionally carried out 100% of the time, both Mike and Barry were pleasant to work with, and both contributed much to the success of the expedition. The RPSC MTs were essential to the mooring operations. RPSC also received high marks in terms of helping teams with securing items in the labs.

MST support

MST lab support was fine. It was appreciated to have someone (MST Lily Glass) look after the chemical wastes for the team, although the team could have done most of the work for this at sea if the containers and logging system were set up and explained at the start port, with RPSC again taking charge at the destination port. That said, it was also pointed out that the most stressed lab teams (e.g., alkalinity) benefitted greatly from having Lily do the waste support so that the analyses could continue without interruption. Lily was also helpful in working through the intricacies of the RPSC post-cruise shipping system. If a less bureaucratically-oriented shipping system were used, this support might not have been needed.

[This is the case with several aspects of RPSC support. RPSC appears to use far more paperwork, phone calls, odd regulations and other aspects of bureaucracy than do UNOLS operators. This creates a need for more employees simply to satisfy the bureaucratic requirements. For example, there is no such position as an "MPC" on a UNOLS ship, nor is there work or need for such a person. The cost of operations - salaries are a huge part of costs - could be substantially decreased by replacing an inefficient commercial bureaucracy with an efficient, UNOLS-style operation. The problem is not the people at sea - these are good people who have the knowledge and attitude needed for their positions. The problem is the system itself.]

Comments on overall RPSC staffing

If this cruise had taken place on a UNOLS ship - as have all 15 previous to this - we would have had only two technicians who "came with the ship". Admittedly there is too much to do for those two, and even NSF program managers acknowledge that three or perhaps even four would be justified. During pre-cruise planning, RPSC repeatedly insisted upon supplying **11** technicians, and it was only by "going over heads" (so to speak) that I was able to get RPSC staffing reduced, and then only to 7 persons. I had consistently maintained in my pre-cruise emails that 4 RPSC techs would have been sufficient. What I would say now, post-cruise, is that (1) every tech RPSC sent to sea with us was very good in their position, helpful, friendly, pleasant to sail with, and an asset to the cruise; and (2) if the RPSC techs were not burdened with the RPSC bureaucratic system and excessive paperwork and telephone calls, their science support activities could indeed have been carried out by four persons, probably 2 MTs (one with some MST experience),

one IT/systems, and one IT/electronics. Buzz as MPC was fine, a very pleasant person, and an asset to the cruise on a personal level, but the MPC position itself is much more a matter of RPSC bureaucracy than science need. It should also be mentioned, however, that it was explained to me that RPSC does not permit its techs to perform maintenance activities when the ship is sitting at the dock, but only during periods when a cruise is being directly supported. Of course this makes no sense fiscally, but it does drive a need to carry excess techs at sea to do what UNOLS techs do when the ship is at the dock for a spell.

Port call operations

The McMurdo staff showed their experience at handling new arrivals. There was a lot of "where's (this)?" from the science team, and some confusion regarding picking up luggage (which is not easy to lug around the base), but with a bit of help from the staff one soon figured out that the whole business wasn't all that complicated. It was possible to use the Ethernet right away, no sign up needed, which was much appreciated.

Housing at McMurdo was OK-to-very-good for those who were not staying in the men's dorm, and substandard for those in the men's dorm. Regarding that dorm, one understands that deluxe accommodations for transients are not needed, but heading towards something closer to 4-person rooms in a building well designed for transients would be worth considering, especially since there must be a significant transient population at any given time.

Food at McMurdo was excellent-plus. The bread baker was a super-pro highlight - fantastic! - but the entire galley staff there deserves kudos. Really top notch quality/quantity of food for such a remote location. All other services seemed fine, and the McMurdo staff were pleasant and helpful.

Individual staff at McMurdo were very good. As chief scientist I attended a pre-arrival briefing relating to the Palmer and was impressed with what was not only a "can do" attitude, but a "I'll do it right now" attitude exhibited by every McMurdo staffer present. Great!

The science team enjoyed the relaxed off-hours environment at McMurdo - for example existence of an after-hours bar and a coffee house serving alcohol. Compared to the treatment of wine and beer on the Palmer or any other US research ship - total banning with punitive consequences - it was welcome to be treated there as a self-responsible adult. The science team also enjoyed the recreational opportunities at the base. Many team members took memorable hikes. All hands are also very appreciative of RPSC for providing a group/guided tour to the Scott Discovery Hut. Thanks!

Two matters related to McMurdo services which negatively impacted the cruise should, however, be mentioned:

1. Possibly for good local reasons related to imminent end-of-season McMurdo personnel transfers, some official at McMurdo insisted on refueling the Palmer the day of the ship's arrival. However much sense that made to McMurdo, it cost the S04P expedition a full day at sea, because normally pre-sailing lab set-ups are done on board during fueling, but in this case the

equipment could not be moved on board until the day after fueling. One wonders if the well over $100k/day cost of this expedition had been charged to that McMurdo official's budget if that person would have been so insistent. Also, at an average of 4.5 hours per station, that McMurdo official's decision cost the S04P expedition 5 stations. (Perhaps RPSC should be charged for that day of ship time?)

2. To the extent that personnel or policies at McMurdo were involved in the RPSC fiasco with the expedition's "Do Not Freeze" cargo, this points to a very serious problem. It would have been impossible for some of the DNF cargo to have been placed by RPSC McMurdo staff in the exact position we found it - in the cold - without the persons handling the cargo seeing the obvious DNF labels. Apparently McMurdo has no above-freezing storage place for entire 20-foot containers full of DNF cargo, and very little storage space for loose DNF cargo, but, if that is the case, why was this not communicated to the science team many months in advance? If we had known, we could have made arrangements for a heated van for the most crucial items and we could have decided exactly which items were to go into it, for example. (One heated van - only one - was provided by RPSC, and apparently by chance that saved the expedition.) Why isn't this near the top of a list of "things you need to know about staging your cruise out of McMurdo"? And when cargo for "O-287-N" was found labeled "DNF" when it arrived at McMurdo (of course it should have been expected, because RPSC in Port Hueneme presumably tells McMurdo precisely what is coming on the ship), why was the RPSC POC not immediately contacted, and why were some sort of corrective measures not immediately put into place? The science team could have been contacted in order to help RPSC locate the most sensitive items so that they could be moved into heated areas. This would have been a huge hassle for the McMurdo staff, but these people are all RPSC employees and should be working together. We remain dumbfounded that RPSC could, as a whole, be so blatantly inept at handling something so very common as "do not freeze" items in a known cold environment, and that RPSC had no mechanisms in place to try to solve the situation when it developed. As noted before, this did cause cancellation on one major NBP-1102 science program and came a hair's breadth from cancelling the entire multi-million dollar science mission.

> *Recommendation: Procedures for dealing with environmentally-sensitive scientific cargo - every step of the process - must be widely and clearly understood both inside RPSC and also in on-line documents and communications with science groups. Special environmental considerations for Antarctic cargo must be much more clearly spelled out in pre-cruise documentation and must reflect fact. McMurdo and Port Hueneme facilities and procedures for handling environmentally-sensitive scientific cargo must be improved.*

Other issues

The wider implications and effects of an incident during the cruise deserve further thought: One of the science party suffered muscle spasms in the back while at sea and was removed from full duty. One result of this was that when the person recovered, and received medical advice (USAP doctor at McMurdo via phone and email) stating that the person could assume regular duties in the step-wise fashion typical of medical advice, the person was forbidden by the Captain and ECO from resuming full duties (presumably until actually seeing a physician), and was placed on

restricted duty for the remainder of the cruise. The reason stated to the chief scientist for this refusal was fear of liability on the part of the captain and ECO. [Important: The incident reports and statements from the persons should be examined rather than accepting only the statements in this paragraph.] The point to be made here is that, regardless of the facts, this did create an atmosphere where science team members felt that should a similar issue arise in their case - but I know of none - the issue should not be called attention to for fear the science team member would not be permitted to do their work when they felt better. This is exactly the wrong approach to use, nearly completely defeating the purpose of seeking advice and treatment regarding medical issues. It is a safe bet that on a UNOLS ship a person in a similar situation would have been permitted to follow medical advice and resume duties. [It may also be that corporate fear of liability at least partially drives RPSC's insistence that the science team move off the ship very soon after the ship comes into port, regardless of work to be done. (When a UNOLS ship is in a foreign port, the science team may stay on board through unloading, basically.) *I note especially that the RPSC techs and the crew are not required to leave the ship at the same time the science team is asked to leave.* They are at least at the same risk level (e.g., from partying) that any science team member is. This double standard does not help one whit to justify the practice of having science team members move off ASAP.] NSF may want to examine whether fear of liability is becoming a driving force - to the detriment of research support - when academic research teams are working with commercial operators.

Travel assistance

All persons in our team were self-ticketed save one - the PolarTREC teacher. The comments following in this paragraph relate to this mode of travel with RPSC. There were continual minor mix-ups regarding travel information. For example, when the travel packets arrived, they contained letters of transit for Chile, and other information pertaining to the cruise departing from Chile. Some on our team received revised travel packets. Others (such as I) did not. I was asked at least three times, perhaps four, for the exact same New Zealand arrival information that was on the form I sent to RPSC. (Others had similar experiences.) We seemed to deal with different people all time. Perhaps they were in the same office, or the same country, or perhaps they were not. One cannot tell from email. Once on the scene in New Zealand, things seemed to work well enough, and whatever confusion there was before arrival seemed to dissipate quickly. Individual RPSC travel assistance staff, when dealt with one-on-one, were competent, helpful and friendly. Most problems seemed to arise from communications problems within RPSC.

When the PolarTREC teacher arrived in Auckland and attempted to check in for his domestic connecting flight to Christchurch the domestic airline had no record of his ticket. It took more than an hour of back and forth telephone conversations with RPSC to clear this up.

Medical processing

The medical requirements and tests for sailing on the Palmer are more regimented than those for other US research ships operating in the Southern Ocean, other US research ships in general, and on the US Coast Guard icebreakers even in remote regions in the Arctic. The reasons for this difference are not explained to participants. That said, the USAP process itself works well enough for individuals who follow the instructions promptly. Confidentiality was maintained,

and communications with RPSC medical staff seemed clear and prompt. Notification of missing tests was quick. Some cruise participants did not mind having such a complete medical work-up at employer/NSF expense. There were, however, cases where treatments (e.g., dental extractions) were required by the USAP which caused some participants significant personal expense. (NSF policy as explained to the Chief Scientist by NSF is that USAP-required exams and tests are reimbursable via the grant but treatments required as conditions of participation are not reimbursable.) The Colorado office lost some papers that were easily re-faxed.

Services/amenities provided by ECO

The Palmer is one of the cleanest, best maintained, smoothest functioning research ships in the world. This impression remained at all times during the cruise. ECO does a great job with this ship. The engineering staff is as good as it gets. Chief Engineer JP was instrumental (along with RPSC tech Tony D'Aoust) in repairing the trace metal van when it was damaged in a storm. For that matter the entire crew and officers - every department - is staffed by experienced, helpful, friendly, very hard working people who do a great job. All three of the winch operators are excellent, and should be singled out for special commendation.

The ship is extremely well run by enthusiastic people (both ECO and RPSC) who want to make sure the science mission is accomplished. ECO was clearly dedicated to supporting science missions. Ship handing on station was excellent. The bridge was always observant, polite, responsive, and helpful. The bridge officers were very easy to work with in terms of station locations and science planning. The Captain and ECO group responded quickly and helpfully to any reasonable procedure that would improve science operations. For example, they agreed to avoid using standard surface cleaners in the labs and corridors in order to reduce spread of organic compounds which potentially could contaminate DOC samples. They readily agreed to pay attention to the ship's orientation while on station (bow into the wind) and to avoid incinerator operation while on station (to minimize soot emission), which allow the team to collect aerosol samples as frequently as possible. Science was obviously their mission. All of the ECO team had great attentiveness to science and seemed genuinely pleased to be supporting science.

Staterooms and heads were found in excellent condition, linens and towels were good quality, laundry rooms ample and well supplied. Maintenance (e.g., toilet or shower problem) response time, personnel attitude, and efficiency/knowledge were excellent.

The gym is adequate but the treadmill needs upgrading to a more robust model and the universal gym needs a little TLC. The bike and the stepper are both good quality. The Bowmaster weight set was broken - I have not yet seen one of these that is not broken. (A good idea marred by poor manufacture?) The two mats are marginal quality but adequate. The sauna was used daily and was appreciated. Ping-pong (makeshift) and foosball tables were used and appreciated.

The quantity and quality of the food served on the Palmer is very good. Everyone expected a long cruise which started in McMurdo to be short of fresh produce, but the galley did better than expected in that regard. After the fresh items were consumed the galley continued to come up with vegetables - canned and frozen - every day. Spicy and ethnic food were especially

appreciated (e.g., there were some great vegetarian curries), though for unknown reasons the spicier dishes seemed to diminish somewhat as the cruise got along. Ethnic foods were always popular. So-called Mexican food was very popular. (We would have loved trying some of the Filipino food that the galley doubtlessly could have made.) There was a bit of tendency at times for some of the main dishes to be fairly plain slabs of meat (e.g., "sweet and sour pork" was slabs of pork with a small amount of sweet and sour sauce on top, not the dish one associates with the name), but there was usually an appealing alternative. Vegetarian fare varied from great (e.g., said curries) to a bit scrappy, but there was an effort to accommodate the vegetarians. Here is a comment from one of the vegetarians, "We understand that food can be an issue on a long cruise and especially for vegetarians. In comparison with previous cruises they did a great job but there were still some meals that were very limited for us." Fresh breads were baked daily and savored as the treat they were. Whole grain breads started making an appearance later in the cruise to acclaim. Occasionally some delicious pastries showed up. (Some were made by one of the scientists, but others were made by the galley staff.) This was the first cruise I was on in 37 years with adequate and varied supplies of whole-grain cereals. (Many ships seem to have mostly sugared cereals.) This is important because except for the beans at every meal, and the whole-grain breads that showed up later in the cruise, there was little other source of fiber. Desserts were over the top in terms of quantity, and the quality was usually very good, too. The Palmer's near-endless supply of fresh cookies is legendary. This is a great ship for a sweet tooth! Special note should be made of mid-rats: No other research ship in my experience does such a good job with food for the night watch. There were always breakfast-type items, maybe some leftovers from dinner, and often a special item, such as pizza, or fresh bagels, or freshly-made sloppy joes on fresh buns, or a special baked treat - on and on. The night watch was treated well indeed; the only improvement would have been access during the off-meal times to the refrigerator with the dinner leftovers in it, as on some UNOLS ships - it’s a long time until breakfast. There was a great supply of juices, milk, carbonated beverages, water, coffee, etc. etc. The supply of frozen berries was wonderful. Never before had any of us sailed on a ship with berries available nearly every meal. What a wonderful idea! The galley staff deserves many, many thanks. These are people we genuinely enjoy sailing with, and who take pride and joy in their work. They made a huge difference on this cruise.

The science party appreciated being allowed to use the ECO crew phone (also called the "morale phone") though it could be challenging at times to find it available to make a phone call. This was only a minor issue, because for general calls one could eventually get to the phone, and also because RPSC let science team members use the RPSC phone in the MPC office for urgent calls when the crew phone was busy.

One nuisance aspect of working with ECO had to do with repeatedly filling out safety forms for a science operation that stayed the same throughout the cruise. Everyone expects a joint science-RPSC-ECO safety review of each work procedure, and also requiring each person involved to sign off on the training/review. But as one participant noted, "The need to continually sign forms acknowledging training every single time the same operation is carried out seems to be a total waste of time. OK to do this once at the beginning of the cruise for each individual, but to repeat this day in day out contributes nothing to safety." It should be pointed out, however, that RPSC and ECO made this basically transparent to the science team for over-the-side work with the large 36-place rosette, probably because RPSC did the handling.

Comments about CTD operations on the Nathaniel B. Palmer

In very rough terms, if we can get the rosette safely into the water and down 10-20+ meters, we might be able to do a cast with the big rosette in a slightly higher sea state on a UNOLS global-class ship (e.g., Roger Revelle or Melville) than on the Palmer. The good news is that on the Palmer we never kinked the main rosette's 0.322 cable, as we often do (not on purpose of course) in heavier seas on our cruises on the UNOLS global-class ships. Did we (the MTs) shut down Palmer CTD operations in heavier seas sooner? Was avoiding the risk of taking seas in the Baltic Room a factor? Was the Palmer's excellent stability in seas a positive factor? Was the ship's well-exercised cable a positive factor? Were the MTs' efforts to stabilize the cable with heavy bungee cord a positive factor? On the open deck on a UNOLS ship we need to use tag lines to help stabilize the rosette when the ship is moving around in seas. It is not feasible to obtain that kind of control on the Palmer, so "wilder" situations cannot be attempted on the Palmer. On a UNOLS ship the winch operator sits above the fray, and the winch control station is in no risk of being swamped when the deck is awash. On the Palmer, with its main deck a little closer to the water than on the Revelle, the rosette is a crucial couple of feet closer to the seas when it is extended out from the ship (also, the extending boom is atop the 02 on the Revelle), giving more opportunity for destructive wave slap - another reason to exercise caution. On an open deck on a UNOLS ship the deck leader might be able to judge the waves, looking for a low packet during which to launch or recover the rosette. That said, there is still the issue of slack wire and shock loading, a major enemy in seas on any ship, and this was less of a problem on this Palmer cruise than during Southern Ocean cruises for the program on UNOLS ships. Is that due to a half-notch more caution on this cruise? Or luck/skill plus the Palmer's sea kindliness? This is very hard to say with any certainty.

Services provided in New Zealand

The start of the expedition for most participants was travel to New Zealand and the stay and pre-flight services in Christchurch. Although this has nothing to do with RPSC, it was not at all clear how one got from the international terminal in Auckland to the domestic terminal there until one was already on the (then) well-marked path. (Perhaps RPSC could include a route diagram and description in the pre-flight mailing.) It was also quite a long haul between terminals with an Antarctic-sized load of luggage, and would have been difficult in bad weather. The check-in at the domestic terminal in Auckland - on a beautiful day with no flight cancellations - was one of the worst, most ineptly managed, longest check-ins many of the travelers had ever experienced.

At the Christchurch airport, the Super Shuttles, once located (not all travelers found them), were a great convenience, and transportation to the hotels was at a very attractive price. When it came time for the shuttles to the pre-flight briefing - to which we had been asked to bring our check-in luggage - the Super Shuttles were not prepared for the number of travelers or the amount of luggage. But eventually sufficient vans were sent to hotels so that everyone did arrive at the Antarctic flight center.

The Antarctic pre-flight briefing was well done. The person who provided this was expert at that task. Every member of our team was surprised to learn, however, that the "boomerang bag" was

simply a selected piece of checked luggage. This was a great relief because everyone had been agonizing over how to get an under-seat boomerang bag with enough supplies for a day or two, plus "must hand carry" items such as laptops, plus their cold weather gear bag under one seat.

> *Recommendation: Please state prominently in the materials given to south-bound travelers that the "boomerang bag" is simply one piece of the traveler's checked luggage which is labeled and returned to the traveler in the event of a "boomerang".*

Check-in for the flight to McMurdo was well managed. There was a long line, but it moved along. The crew working at the center in Christchurch were well organized and professional, and never officious. The preflight briefing was fine. It was appreciated that there was a cafeteria nearby for a quick meal.

The flight to McMurdo was a gas. The USAF flight crew was friendly, helpful, and had a good sense of humor. The bag lunch was very generous. The landing at McMurdo was one of the softest landings anyone had ever experienced. To say that disembarking at the McMurdo ice runway was awesome is a serious understatement.

At the end of the cruise, RPSC and AGUNSA helped provide hotel reservations and transportation to hotels and to the airport. This was very much appreciated by the science team.

IT Participant Exit Survey

Comment: The IT exit survey asks plain vanilla questions and avoids the issues that really annoyed people. It is geared toward the status quo as opposed to, say, comparison of IT support on the ship vis-à-vis the home institution/laboratory or on UNOLS ships.

1. Were any IT support issues from your RSP not provided? Not that we are aware of.

2. Was any additional IT equipment or service provided beyond your RSP? Not that we know of, unless one is talking about the project's web site, which was part of our SIP and our pre-cruise teleconference but somehow overlooked or misunderstood by RPSC. But it worked out OK.

3. Were basic IT services satisfactory? (user accounts, e-mail, printers, etc.) Yes.

4. Was all IT equipment (computers & peripherals) properly maintained? Yes.

5. Can you suggest any IT service, software, or equipment which you feel should be provided in the future? **Internet connectivity** at least occasionally, wireless network on board, simpler email addresses on board, simpler & longer-lasting passwords aboard, ability to transfer larger files off/on the ship

6. Please rate the following attributes of your IT staff on a scale from 1 (poor) to 10 (excellent).:
Expertise 9
Knowledge 9
Courtesy 10

Response 8
Attitude 10

Please explain in detail, all staff ratings lower than 6.

7. Rate your IT service on a scale of 1 to 10, as promised from the RSP. Probably would rate it a 7-8 for personal email, and a couple of points lower for accomplishing research support (professional email, web access including FastLane) on/off the ship. Personnel would rate 8-9.

8. On a scale of 1 to 10, how important was IT service to your research? Importance of maintaining ship-shore research support *for this project*: 2-5, because we are self-contained. Importance of maintaining ship-shore research support *for other ongoing projects off the ship*: 4-8+, because the PIs aboard need to manage their other research while at sea. Personal ship-shore email service rates 8-9 on a long cruise.

Comments from LDEO mooring PI Dr. Xiaojun Yuan

Here is my summary of Raytheon's support to our ADP mooring project.

1. Pre-cruise preparation – The ADP mooring is a complicated and technically challenged mooring operation. Deploying such a mooring during a long and complex cruise that involves many PIs needs a lots of pre-cruise coordination. Raytheon had done fine jobs on coordinating teleconferences. Those teleconferences sorted out many technical issues and were effective. The multi-beam technician on board is a critical support for the success of the deployment. The multi-beam data provided us with accurate information of the bathymetry in the region of the mooring and helped us to choose a relatively flat spot of the correct depth for our mooring line.

2. Equipment shipping – Shipping for our equipments went smoothly. Particularly, the staff at Pt Hueneme captured our labeling errors upon the arrival of our cargo and corrected in a day or two, which avoided the confusion at McMurdo station. One disappointment is the damage of ARGO floats in McMurdo. ARGO floats data become increasingly important to us because we missed the first two years of sampling and because these floats were proved successful in our research area from the last season's operation.

3. Support during the cruise – The ADP mooring was deployed successfully. Our mooring specialist on the cruise, Jim Ryder (WHOI) received excellent support from the Palmer MT and ET, as well as the Chief Scientists and other cruise participants. We are sure that their combined efforts led to the successful deployment of our challenging deep-water [mooring].

Comments from LDEO mooring PI Stan Jacobs

Question: Were the scientific goals of your project achieved? If not, why not?

Stan's reply: No. Reported ice concentrations were too heavy, snow cover too thick/wet. Ship time was limited and scheduled for the wrong time of year. Time will tell whether snowflakes have been counted.