SOLAS Air-Sea Gas Experiment (SAGE) RESEARCH VOYAGE PLAN
17 March to 15 April 2004
Version: 2 MAR 2004
Mike Harvey

NAME OF VOYAGE: SOLAS/SAGE
MOBILISE: Wednesday 17 March 2004
RETURN: Thursday 15 April 2004

VOYAGE DURATION: 30 days

STUDY AREA: South-East of New Zealand in the vicinity of the S.W. Bounty Trough 48°S, 173E

VESSEL: R.V. Tangaroa (VTD0410)

PERSONNEL (NIWA staff unless indicated):
30 Scientists

Voyage leader Mike Harvey

Safety officers: Bill Main (Deckboard)
Andrew Marriner (Chemicals)

Home base science contact: Mark Hadfield (m.hadfield@niwa.co.nz)

Participants (All NIWA unless indicated)

GROUP	NAME AND AFFILIATION	MEASUREMENT
Gas transfer co-ordinator (6)	**Murray Smith** m.smith@niwa.co.nz	REA, EC fluxes (CO_2,H_2O), micromet (wind stress, heat flux)
	Kim Currie k.currie@niwa.co.nz	pCO_2
Voyage leader	**Mike Harvey** m.harvey@niwa.co.nz	REA/DMS CN, Aerosol
	Dave Katz, Uni of Rhode Island drkatz@gso.uri.edu	pN_2/pO_2 surface mapping, Winkler titrations
	Burns Macaskill b.macaskill@niwa.co.nz	pH, total alk
	Rona Thompson r.thompson@niwa.co.nz	Atmos CO_2/O_2
Tracer /dissolved gases co-ordinator (5)	**Cliff Law** c.law@niwa.co.nz	SF_6, bio-gases, vertical profiling sampling/CTD
	Edward Abraham e.abraham@niwa.co.nz	Upper ocean physics, CTD, ADCP, DAS , SF_6, FRRF
Electronics	**Peter Hill** p.hill@niwa.co.nz	SF_6, CTD (electronics support)
	David Ho, LDEO, Columbia david@ldeo.columbia.edu	^{3}He & Ne vertical profiles in water O2/Ar sample collection

Chemical safety	**Andrew Marriner** a.mariner@niwa.co.nz	SF_6 and dissolved gases, GC support
Surface physics co-ordinator (4)	**Craig Stevens** c.stevens@niwa.co.nz	Upper ocean physics, TRAMP Temperature µstructure, Vector
	John McGregor j.mcgregor@niwa.co.nz	Radar sea state and wave-breaking, REA/DMS
	Peter Minnett, RSMAS pminnett@rsmas.miami.edu	Radiometric skin temperature
	Brian Ward, WHOI bward@whoi.edu	Radiometers, SkinDeep (autonomous high-res temperature and salinity)
Biology/DMS co-ordinator (7)	**Julie Hall** j.hall@niwa.co.nz	Microbial, flow cyt, Bacteria and micro- and meso-grazers, Size frac Chla
	Stephen Archer, PML, UK stda@mail.pml.ac.uk	DMS(P)/ecosystem interactions, bact Sulf
	Graham Jones, **Southern Cross Uni, Australia** gjones@scu.edu.au	DMS/DMSP/DMSO, HPLC pigments
	Jorma Kuparinen, (Postdoc) j.kuparinen@niwa.co.nz	Flow cytometry, µzoo, bacteria (stocks/productivity)
	Jill Peloquin, VIMS jillp@vims.edu	1° productivity, Size frac Chla
	Stu Pickmere s.pickmere@niwa.co.nz	Nutrients
	Karl Safi k.safi@niwa.co.nz	Het grazing, taxon phyto samples DMSP productn/utilisation
Phytoplankton processes/iron (2) (Philip Boyd)	**Michael Ellwood** m.ellwood@niwa.co.nz	Fe speciation, other metals algal iron stress, dissolved iron, sedimentation total ligands
	Doug Mackie dmackie@alkali.otago.ac.nz	Fe: dissolved and algal + atmospheric iron
Photochemistry (1) (Cliff Law)	**Lori Ziolkowski, Dalhousie University, Canada** lori.ziolkowski@dal.ca	CO, CDOM
Atmos Chem (2) (Mike Harvey)	**Jill Cainey, CGBAPS, Australia** j.cainey@bom.gov.au	SO2,UCN
	Dawn DeVries, Univ of Colorado ddevries@carbon.cudenver.edu	Berner aerosol + assisting sulfur gas and aerosol
Export (2)	**Scott Nodder** s.nodder@niwa.co.nz	Export Sediment traps, - marine particulates & Chl a , mooring turnaround)
Scientific Safety Officer	**Bill Main** w.main@niwa.co.nz	Mooring turnaround, Iron release deck operations
CTD operations(1)	**Matt Walkington** m.walkington@niwa.co.nz	CTD

On-board planning group: Mike Harvey, Ed Abraham, Julie Hall, Cliff Law, Scott Nodder, Murray Smith, Craig Stevens

Meals / Diets
Note meals are not available on board until 17th March. Overseas collaborators can stay on board overnight on 16th March

(NB Lori Ziokowski has wheat intolerance: no bread, muffins, cookies – flour in sauce is OK)
David Ho, Jill Peloquin and Rona Thompson are vegetarian.

BACKGROUND:

A separate science plan ("SOLAS-ANZ Dual Tracer Gas Exchange Experiment") has been produced for this voyage and contains details of the rationale, voyage objective and scientific methods. A brief summary is given here:

Phytoplankton blooms, either natural or stimulated, provide effective natural laboratories in which to study the pronounced biogeochemical fluxes and gradients associated with their evolution and decline. These phytoplankton-mediated signals are mainly expressed in the ocean, but also result in enhanced fluxes of CO_2, DMS and other biogenic gases across the air-sea interface. The Southern Ocean is a net sink region for atmospheric CO_2, yet uncertainties remain in the strength of this sink because of there are few measurements of the efficiency of ocean-atmosphere gas exchange have been made under turbulent windy open-ocean conditions.

In this experiment, in a similar fashion to SOIREE in 1999, we propose to stimulate a phytoplankton bloom through addition of iron fertiliser to iron-limited Sub-Antarctic waters. The fertilisation will be marked with the addition of two inert dissolved gas tracers, SF_6 and ^3He. The enhanced gas fluxes associated with a phytoplankton bloom provide optimal conditions for measuring the rate of gas exchange and the physical factors governing it. During the experiment the SF_6 tracer will serve not only to track the patch but, in conjunction with the second ^3He tracer of higher ocean-atmosphere diffusion rate, will allow gas transfer rates between the atmosphere and ocean to be determined. At the same time, key physical processes governing the exchange will be measured. These include near-surface turbulence (typically generated by breaking waves), temperature microstructure, stratification, wave field, wave breaking and wind speed. In conjunction with these patch scale and surface physics measurements, the micrometeorological relaxed eddy accumulation technique (REA) will be deployed to make direct atmospheric measurements of gas fluxes. A combination of gas concentration measurement and REA flux allows the efficiency of gas exchange to be calculated at the local scale. These local scale measurements can be compared with exchange rates derived from the dual tracer technique for the larger labelled patch.

EXPERIMENTAL GOALS

Determine drivers and controls of ocean-atmosphere gas exchange quantifying:

- *biological production and utilisation of climatic relevant gases in particular CO_2 and DMS) in the surface ocean*
- *physical control of exchange across the interfaces of the surface mixed layer*
- *production of aerosols resulting from interaction of biological and physical processes*

OBJECTIVES:

This experiment combines seven main research objectives considering:

1. quantification of gas transfer fluxes and velocities for a variety of gases
2. physical processes affecting gas transfer
3. ecosystem interactions controlling dissolved DMS concentration and CO_2 removal
4. the impact of iron availability upon phytoplankton productivity and its influence upon dissolved gas concentration
5. the impact of photochemistry in the surface ocean on dissolved gas concentration and air-sea exchange
6. the fate of DMS in the atmosphere and aerosol condensation nuclei production from chemical transformation in the atmospheric boundary-layer.
7. Role of aggregation in the timing and magnitude of export processes

Additional objectives are the:

- servicing of NIWA biophysical moorings: 41º11.28'S 178º28.62'E (NBM) and approximately 46º38.202'S 178º33.486'E (SBM)
- final release of 2 Carioca Buoys at SBM

BACKGROUND TO SCIENTIFIC METHODS
See Science Plan

Timetable
Over page, for basic daily work plan, see additional spreadsheet

Voyage Timetable

Mon 15-March-04	Day no	Crew Changeover: **ship not available**	**Comments**
Tue 16-March-04		Science meeting Greta am, Ship available from noon with loading main deck thru hatch	Ship maintenance Day, Load gear down hatch (pm)
Wed 17-March-04	0	Loading	
Thu 18-March-04		Earliest departure from Wellington 20:00	Departure to be reviewed in morning
Fri 19-March-04	0	Transit to SOLAS site (~35hrs)	
Sat 20-March-04	0	08:00 Pre-release survey at SW Bounty - Pre-release Day 1	
Sun 21-March-04	0	Pre-release Day 2 20:00 1st deploy Carioca 22:00 Start Release	
Mon 22-March-04	0	11:00 End Release 1	
Tue 23-March-04	1	SAGE experiment 20 days Vert Fe profile1	
Wed 24-March-04	2		48 hr deploy of traps: in 1,2, out 3
Thu 25-March-04	3		1st Reinfusion?
Fri 26-March-04	4		Recover traps
Sat 27-March-04	5	Vert Fe profile 2	
Sun 28-March-04	6		
Mon 29-March-04	7		Deploy traps: in 1,2
Tue 30-March-04	8		
Wed 31-March-04	9		Recover traps
Thu 1-April-04	10	Vert Fe profile 3	
Fri 2-April-04	11		Deploy traps: in 1,2, out 3
Sat 3-April-04	12		
Sun 4-April-04	13		Recover traps
Mon 5-April-04	14	Vert Fe profile 4	
Tue 6-April-04	15		Deploy traps: in 1,2
Wed 7-April-04	16		
Thu 8-April-04	17		Recover traps
Fri 9-April-04	18		Good Friday Deploy traps: in 1,2, out 3
Sat 10-April-04	19	Vert Fe profile 5	
Sun 11-April-04	20	12:00 Recover Carioca 14:00 End SAGE Transit to SBM (20 hrs)	Morning: Recover traps
Mon 12-April-04	BM	10:00 Arrive SBM, Deploy Carioca SBM Mooring service 21-23:00? Transit to NBM	Easter Monday
Tue 13-April-04	BM	SBM to NBM (30 hrs)	
Wed 14-April-04	BM	05:00 Arrive NBM NBM Mooring Service 17:00 Transit WGTN (16.5 hrs)	
Thu 15-April-04	BM	09:00 Arrive WGTN DEMOB	
Fri 16-April-04		Crew Changeover Post voyage meeting	

VOYAGE ACTIVITIES

Summary
A suitable location with low current velocity and shear will be selected in an initial site selection survey centred on 48°S, 173°E, taking into account current remote sensing data SSH SST & Ocean Colour . Site selection will commence with a larger scale survey around the proposed site (ca. 24 h duration, CTD, XBT and underway seawater sampling, nutrients, ADCP) of these waters. On the second day, finer scale survey work will be carried out around the proposed site. Once a site is located, fertilisation and tracer labelling – over a 50 km^2 area will commence with the addition of approx 1.4 tonnes of Iron Sulfate fertiliser in 9 m^3 of seawater dispensed over about 15 hours. With the fertiliser, the chemically inert tracers Sulfur hexafluoride (SF_6) and 3-Helium will be added. A similar technique with iron and SF_6 was used in the SOIREE voyage on Tangaroa in February 1999 captained by Roger Goodison, and his officers and crew. The overall aim this time, is to create elevated gas fluxes and measure the physical and biological factors governing gas exchange through a combination of oceanographic and atmospheric techniques. The labelled patch of water will then be mapped daily for SF_6 (10-12 h required at 8-10 knots, underway seawater sampling) by the Tangaroa. The remaining 12-14 h each day will be spent sampling ocean and atmosphere in and out of the SF_6 labelled waters (0-200 m depth), with the aim of studying gas exchange during a phytoplankton bloom.

Research groups:

1. Labelled patch tracking, advection and diffusion of patch
This group is responsible for labelling and mapping the 10 km length-scale fertilised SF_6 patch. Vertical profiling and mapping of SF_6 will provide estimates of vertical and horizontal diffusivity. Alongside the mapping, continuous underway measurements will be made of T,S, nutrients fluorescence, FRRF, ADCP currents. Vertical information on SF_6 will be provided from CTD casts including collection of samples for subsequent 3-Helium analysis.

Cliff Law, Peter Hill, David Ho, Andrew Marriner, Ed Abraham

2. Iron chemistry
This team will be responsible for mapping patch dissolved iron, iron speciation, ligands and particulate iron, A key role is keeping track of iron availability in the early stages of the experiment following fertilisation in order to provide information for planning possible re-infusions. Iron mapping will be conducted at night at the same time as SF_6 mapping with the fish deployed whilst steaming. Iron mapping is likely to be done every second night to monitor patch evolution. For determining whether iron reinfusion is required, a sample will be collected every day from the centre of the patch, during or just after SF_6 mapping has been completed.

In addition to oceanographic measurements, aerosol samples will be collected on the transit legs for quantifying atmospheric iron input. A high-volume sampler will be used with an inlet on the tower mounted in the bow.

Michael Ellwood, Doug Mackie

3. Ocean atmosphere gases
This team will combine point sampling atmospheric and oceanographic and atmospheric measurements of CO_2, and DMS to estimate air-sea exchange fluxes. For DMS, in addition to underway dissolved gas measurements, measurements of the flux into the atmosphere will be made using the relaxed eddy accumulation technique with a sonic anemometer mounted on-top of the foredeck mast. This technique partitions gas samples into the concentrations associated with updraft and downdraft eddies in air arriving at the mast and in combination with the sea-water concentration, allows the gas exchange coefficient to be calculated. For CO_2, a combination of

pCO_2 and atmospheric measurements will be made to allow exchange coefficient estimates of CO_2 fluxes. Additional measurements include, pH, alkalinity, atmospheric and dissolved oxygen and d18O.

Murray Smith, Kim Currie, Mike Harvey, Burns Macaskill, Graham Jones, David Katz, Rona Thompson

4. Surface Physics

This group will measure the state of the sea-surface interface to examine the role of waves, skin temperature and near surface ocean stability in governing gas exchange. Measurements include radiometric and radar measurements from sea-surface viewing instrumentation on the vessel and over side and from Zodiac deployments of microturbulence profilers. On suitable days, the physics deployments will be combined with floating flux chamber measurements for gases.

Gear	**Owner**	**IS**	**GIVES**
Skindeep	Brian W.	autonomous T profiler with Iridium beacon – 24 hr deployments	microT
SCAMP	Craig S.	T microstructure from Tang/Wboat profiles to 50m	turbulence
TRAMP	Craig S.	T/Shear profiler sim to SKINDEEP w/- GPS/VHF beacon	turbulence
SparBuoy	Murray S.	Floating mini-spar, deployed over Tangaroa side for 2 hours.	Velocity/wave
Beacons	Edward A/Craig S.	VHF/GPS beacons with drogues	Lagrangian
ADCP	Edward A.	inboard operation, integrated with DAS/SF6 etc	currents
M-AERI radiometer	Peter M.	Port railing in front of bridge throughout voyage. 10 min update to (nwork) PC	Real-time skin SST
Sband Radar	John McGregor	stbd railing just below bridge. Op. from bridge, mainly during CTDs	surface VV/HH

Craig Stevens, John McGregor, Peter Minnett, Brian Ward

5. Biological processes and DMS

This group will investigate the role of the ecosystem in governing the production of dissolved DMS. In addition to a comprehensive suite of biological measurements, on-board experiments are planned to look at the biological production and utilisation of DMSP and DMS.

Water column measurements include measurement of: chlorophyll a , size fractionated chlorophyll (0.2-2, <20, Total), HPLC samples, bacteria –microzooplankton –(flagellates & ciliates), mesozooplankton – phytoplankton biomass. Daily primary production will be estimated from simulated in-situ measurements. Accompanying column measurement of nutrients and DMS(P) will be made.

Production DMSPp will be measured using a dilution grazing experiments. The role of microzooplankton and mesozooplankton grazing will be investigated. Bacterial production will be measured using tritiated thymidine. Experiments will be conducted to estimate bacterial turnover of DMSP/DMS.

Julie Hall, Stephen Archer, Jorma Kuparinen, Jill Peloquin, Karl Safi, Stu Pickmere, Graham Jones

6. Aquatic Photochemistry / greenhouse gases

This module will look at the photochemical production of carbon monoxide in surface waters with a combination of in-situ chamber and incubation techniques. Measurements of light absorption by dissolved organic matter and UV_R profiles in the water column will be obtained, along with water column sampling for CDOM and CO.

Nitrous oxide production will be studied from concentration profile measurements from CTD samples within the mixed layer and below the pycnocline.

Cliff Law, Lori Ziolkowski, Andrew Marriner

7. Atmospheric Chemistry

This group will examine the atmospheric gas and aerosol products resulting from DMS oxidation. SO_2 will be measured using an HPLC fluorescence technique, size resolved aerosol chemistry will be measured by collecting samples on Tedlar film using a Berner impactor with four stages of size segregation: 4-10 um, 1.1-4 um, 0.55-1.1 and less than 0.55 µm with analysis by IC. Particle sizing will be done on occasion using a ASASP-100X laser optical sampler, which bins particles into 15 channels between 0.1 and 3 µm diameter, used to give an estimate of the concentration of mechanically generated sea salt aerosol. Condensation nuclei (>10 nm) and ultrafine nuclei (>3 nm) will be measured using TSI 3010 and 3025A nuclei counters, used to give an indication of any events of new aerosol particle formation.

Mike Harvey, Jill Cainey, Dawn Devries

8. Export Processes and Biophysical Moorings

Floating sediment trap deployments will be carried out both in (5 deployments) and out (3 deployments) of the patch. Measurement from the traps will be used to determine the time-scales of aggregation and export processes and linkages to temporal changes in physical, chemical and biological processes within a bloom. The size, composition and flux magnitude of exported organic matter will be calculated with chemical fluxes of (POC, PP, PN, PSi) in and out of the SF_6-defined patch including profiles from CTD casts.

At the end of the voyage, the two NIWA biophysical moorings will be serviced, the northern mooring at 41º11.28'S 178º28.62'E and southern mooring at approximately 46º38.202'S 178º33.486'E.

Scott Nodder, Bill Main

Daily planning

Following overnight mapping, the core planning group will meet and the timetable for the day will be posted. Activities will depend on the state of patch evolution, iron concentrations, biological response, and weather.

1/ Pre-site oceanographic survey:. (2 days duration)

The experimental site will be selected based on:

pre-experiment site selection survey, local remote-sensing data (SeaWiFS, SSH, SST) and underway mapping (FRRF, Fe, T/Salinity, nutrients, chlorophyll etc), interspersed with CTD's and XBT's. Drogued drifters and ADCP data will also be used?

2/ 1st Iron Release (15 hours)
During the transit and survey, the fertiliser and tracer SF_6 tanks will be prepared. Preparation of the fertiliser will be co-ordinated by Bill Main. Although the process will be mechanised, there is an amount of manual labour required to dose the tanks with iron fertiliser supplied in 25 kg sacks. Assistance in shifts will be requested from teams of voyage personnel in order to prepare the fertiliser and SF_6.

Approximately 1.4 tonnes of Iron Sulfate fertiliser in 9 m^3 of seawater acidified to pH 2 will be dispensed over about 15 hours with $SF_6/^3He$ tracers over a 50 km^2 area in a spiralling grid about a marker buoy. A 2nd iron infusion likely after 2-4 days. A watch system of volunteers will be needed to oversee the pumping process.

3/ Mapping: the labelled patch of water is mapped over night using SF_6 (10-12 h required at 8-10 knots, underway seawater sampling) by the Tangaroa.

4/ Continuous underway measurement includes: oceanographic, T,S fluorometry, FRRF, met, DMSw, pCO_2, dissolved O_2 ,atmos CO_2, O_2, DMS, aerosol.

5/Basic SAGE Sampling programme: The remaining 12-14 h each day will be spent in the sampling programme with a nominal plan for 1 in and 1 (upwind) out CTD station per day.

5a/ CTD water column studies: to include one in and one out patch station with 24 bottle rosette and CTD incorporating 1° production cast close to dawn; 1 deployment to 10 m, main cast to 100 m. Go-flo samplers on Kevlar line, Zooplankton vertical net hauls on Kevlar line, Vertical profiling (metal-clean) hosing sampler unit with surface-mounted all-Teflon pumps

Water column studies
CTD casts will be used to collect vertical water column information on dissolved gases, particle particulate carbon, nitrogen and silica, nutrient distributions and the biomass of bacteria, phytoplankton, microzooplankton. Gases will be sampled in priority sequence - ^3He, SF_6, O_2, CO_2, DMS, CO, N_2O. Water samples for particulate and dissolved parameters will be collected on each of the CTD casts at 6 to 8 depths, in the upper 200 m. CTD casts will measure T°C, S, σ_t, pressure (depth), fluorometry, transmissiometry, dissolved oxygen and PAR. Water column particulate analyses will include: POC/PON (size-fractionated), chlorophyll *a* biomass (size-fractionated), particulate C, N, P, Si. Dissolved analyses will include: nitrate + nitrite, dissolved reactive phosphorus and silica, ammonia and urea. These nutrient samples will be analysed on board where possible – or stored frozen and analysed onshore at a latter date.

Underway T/S, nutrient and fluorescence data will be collected using the existing non-toxic, surface seawater pump system diverted through a thermosalinograph, nutrient auto-analyser and in-line fluorometer, respectively. Calibration samples will be collected periodically.

Vertical resolved iron sampling (pump and Go flo's) will be done 3-4 times during the voyage, requiring approximately 4-5 hours.

5b/ Atmospheric flux stations
Where possible the vessel will be oriented with wind onto the starboard bow during CTD work to provide optimum orientation for atmospheric gas flux measurement.

5c/ Free drifting samplers: Periodically, free-drifting surface tethered equipment will be deployed then recovered from the vessel including:

(Drifter buoys – one possibly 2 will be used as patch markers).

2 Sediment traps (48 hour deployment each)
In situ productivity rigs (24 h deployments)
2 pCO2 Carioca buoys deployed at outset together before iron release. If they drift too far from the patch they will need to be recovered and redeployed. They will be picked up at the end of the patch experiment and taken to final release point at SBM.

5d/ Zodiac deployments of 2-3 hours in suitable weather following CTD cast (2hrs 2 scientists plus skipper):

Free-fall optical profiler (SPMR)
Free-fall turbulence profilers (SCAMP) SkinDeEP
Gas flux chamber
High resolution surface profiler

5e/ Special topic experimental days to be conducted at appropriate time

Special D1: Transect of CTD casts to sample vertical section across the patch
Special D2: Diurnal cycle study within the patch (photochemistry study)
Special D3: Atmospheric product days sampling gas and aerosol upwind and downwind (1 hr max) of patch during later stages of the experiment.

Each day the ship will leave the patch for 1-2 h to dispose of waste, while the ship is sampling the patch we request that no waste is disposed of (galley, deck-washing, grey or black waste).

Other activities planned for the voyage include:

Servicing of Southern biophysical mooring 46º38.202'S 178º33.486'E. towards the end of the voyage and release of Carioca buoys at this point.
Servicing of Northern Biophysical Mooring 41º11.28'S 178º28.62'E at end of voyage

PRE-VOYAGE SCIENCE
The Ground Floor meeting room in Brodie Building, Greta Point has been booked from 8 to 14 March for use of collaborators.

A pre-voyage science **briefing** will be held on Tuesday **morning 16 March 10:00** at NIWA-Greta Point in the Brodie Building 2nd Floor Board Room.

Vans have been booked for ferrying light gear to vessel. All drivers must be registered with NIWA. A truck is operated by Vessels Management for heavy goods.

COLLABORATOR COMPUTER CONFIGURATION
NIWA IT staff (Chris Edsall, Geoff Blair and colleagues) will be available at the ship to assist with computer networking configuration. Please advise asap on arrival of machines that require networking. [Networking is configured using DHCP.] Networking jacks are available in laboratories and all cabins.

All networked machines must have:
1/ reputable antivirus software [Norton or McAfee] installed with up-to-date virus definitions
2/ all relevant security/service patches/updates applied to the operating system and internet software.
We advise visitors to check with their own IT department or ISP if unsure of what protection you have. Access to the network will be refused if the above conditions are not met.

Email is available on the vessel and the up/down load link occurs 3 times a day at 10:05, 15:05, 03:05 local time (either NZDT or NZST switching 21 Mar). Contact addresses are listed below and are active from a day or so before sailing until end of voyage. [Server names are smtp for smtp server, pop3 for pop3 server] Please keep message sizes small, especially if digital image files are attached, these should be in a compressed format. No transmissions >1MB are allowed, preferably be considerate and an order of magnitude or two smaller. Email costs will be charged back to users. The approximate cost is around $7 per MB. Note for sending and receiving zip file attachments that the name must starts with niwa, e.g.: *niwaAnythingHere.zip*.

Kim Currie	kimc@tangaroa.niwa.co.nz	Jill Peloquin	peloquin@tangaroa.niwa.co.nz
David Ho	ho@tangaroa.niwa.co.nz	Jorma Kuparinen	kuparinen@tangaroa.niwa.co.nz
Mike Harvey	harvey@tangaroa.niwa.co.nz	Julie Hall	hall@tangaroa.niwa.co.nz
Cliff Law	law@tangaroa.niwa.co.nz	Graham Jones	jonesg@tangaroa.niwa.co.nz
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Craig Stevens	stevensc@tangaroa.niwa.co.nz	Peter Hill	hill@tangaroa.niwa.co.nz
Brian Ward	ward@tangraoa.niwa.co.nz	Matt Walkington	mattw@tangaroa.niwa.co.nz
Stephen Archer	archer@tangaroa.niwa.co.nz	Stu Pickmere	stup@tangaroa.niwa.co.nz

For those requiring a basic text output for Nav, met, underway ocean variables from the ships Data Acquisition System (DAS), help can be given to set this up using telnet on your client PC. If you want to keep a record of this info handy on your local disk, please provide a telnet with the ability to write to disk. A master record of the DAS data will be available to all post-voyage.

MOBILISATION

Safety note: No loading is allowed through the CTD cut-away. All gear other than gangway hand-carry must be loaded by crane. Loading cages available.

1/ 3 days are required to mobilise

2/ If possible, the relocation of large gear from the previous voyage will be done at the time of that demob. This includes

- move container from foredeck and either leave on quayside or move to shelter deck, leaving hatch clear. This container (Mk 2) will be trace metal lab on main deck
- when Pelorus is lifted off, place 2nd 20 ft container (Mk 1) in position on Forecastle deck – end doors aft.

3/ Earliest loading of gear will be on afternoon of 16 March. Overseas collaborators may sleep on board on the night of the 16th Mar. Meals will not be available until 17 Mar.

4/ Early construction/provision of plywood benches especially in main deck factory

5/ Science loading order

16/3/04 afternoon

Hatch off, crane all GC's destined for main deck down below (SF6 Cliff Law, Steve Archer Graham Jones, carbonate gear, oxygen?) 2 pallets of compressed gases (32 cylinders).

17/3/04 onwards

Hatch on, 20' trace metal container, 2 10' containers on container flat rack.
Load iron tanks in frames and fix in position on deck
Load SF6 tanks and fix on deck
Load 10 tonne iron to rear container on or from pallets
Load Forecastle Deck container
Load Forecastle Deck gas bottle rack (1 pallet of compressed gases 16 bottles)
Load spare hydrogen (2 bottles into deck gas store.
Load remaining heavy gear to deck, Traps, Carioca buoys, moorings gear

Foredeck loading at earliest opportunity:

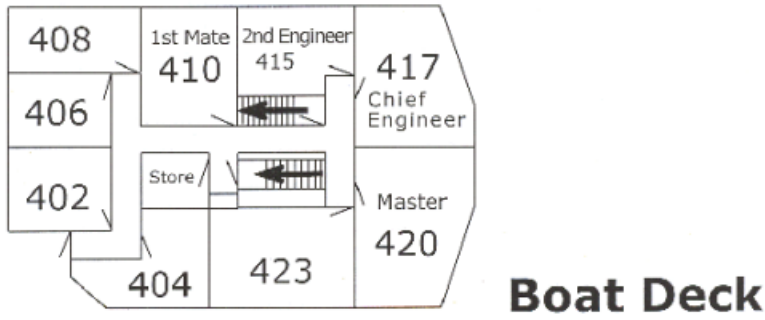
Discuss loading foredeck mast at earliest opportunity - not to interfere with provisions loading

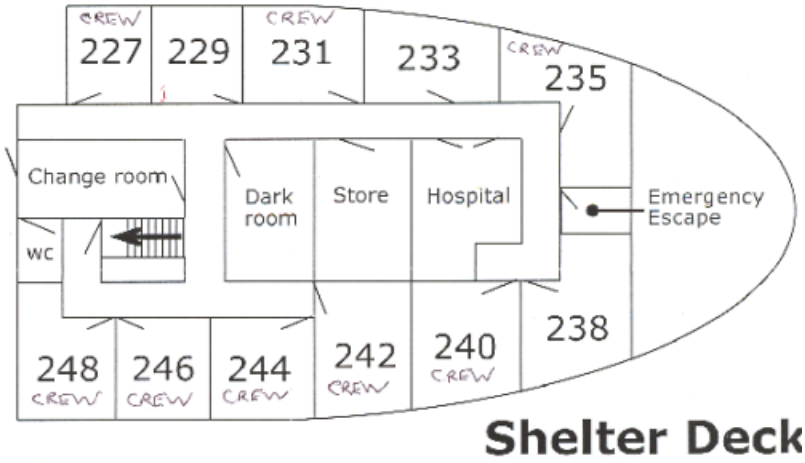
M-AERI to portside of deck in front of bridge, Radar to starboard walkway by bridge

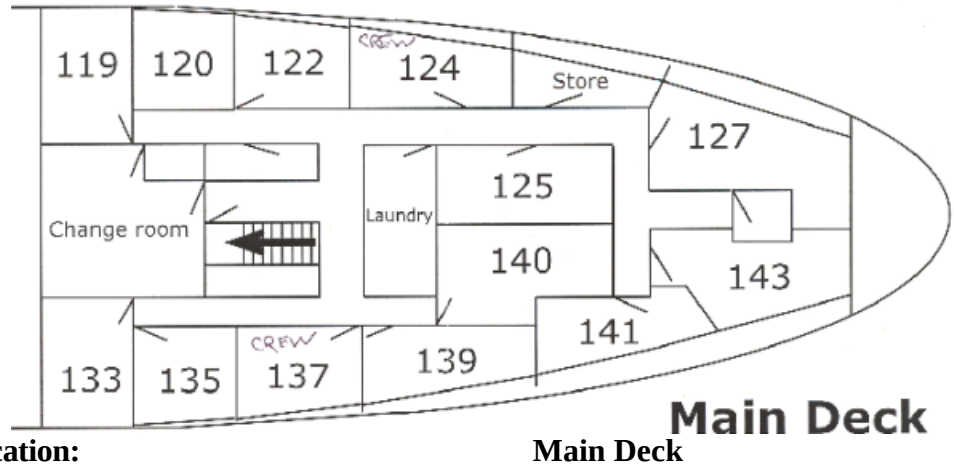
6/ Departure time will be reviewed on the morning of the 18th March. The earliest departure time will be 20:00 on 18th March. It is quite likely that an additional half day will be required in port with departure afternoon on the 19th March and the initial programme will be set back a day. A readiness meeting to be held 6 hours? prior to planned departure to review final departure time (Master, Engineering, IT, Science...)

7/ At end of voyage, demob will be on 15 & 16 Apr.

RV Tangaroa Cabin Plan







Cabin Allocation:

Boat Deck

402	Julie Hall
404	Cliff Law
406	Murray Smith
408	Peter Minnett
423	Mike Harvey

Shelter Deck

229	Bill Main
233	Steve Archer
238	Graham Jones

Main Deck

119	Edward Abraham / Scott Nodder
120	Matt Walkington / John McGregor
122	Jill Cainey / Dawn Devries
125	Michael Ellwood / Doug Mackie
127	Andrew Marriner / Jorma Kuparinen
133	Craig Stevens / Brian Ward
135	Kim Currie / Rona Thompson
139	Burns Macaskill / Karl Safi
140	Stu Pickmere / Peter Hill
141	David Ho / Dave Katz
143	Jill Peloquin / Lori Ziolkowski

DECK LAYOUT

(See attached diagram) plus:

Deckspace to tie down large gear:
SF_6 release system
3 SF_6 tanks
2 off Carioca buoys Boxes: (2.74 x 0.76 x 0.82m, 200 kg) 2 off + 5 smaller 25 kg boxes with ancillary gear.
Moorings equipment (including 3 wagon wheel anchors)
Sediment trap prep area (3m2)
1.5m^3 for cages for sediment traps
Large incubators (in full sun position)
Fantail – 4 off 3m trough incubators

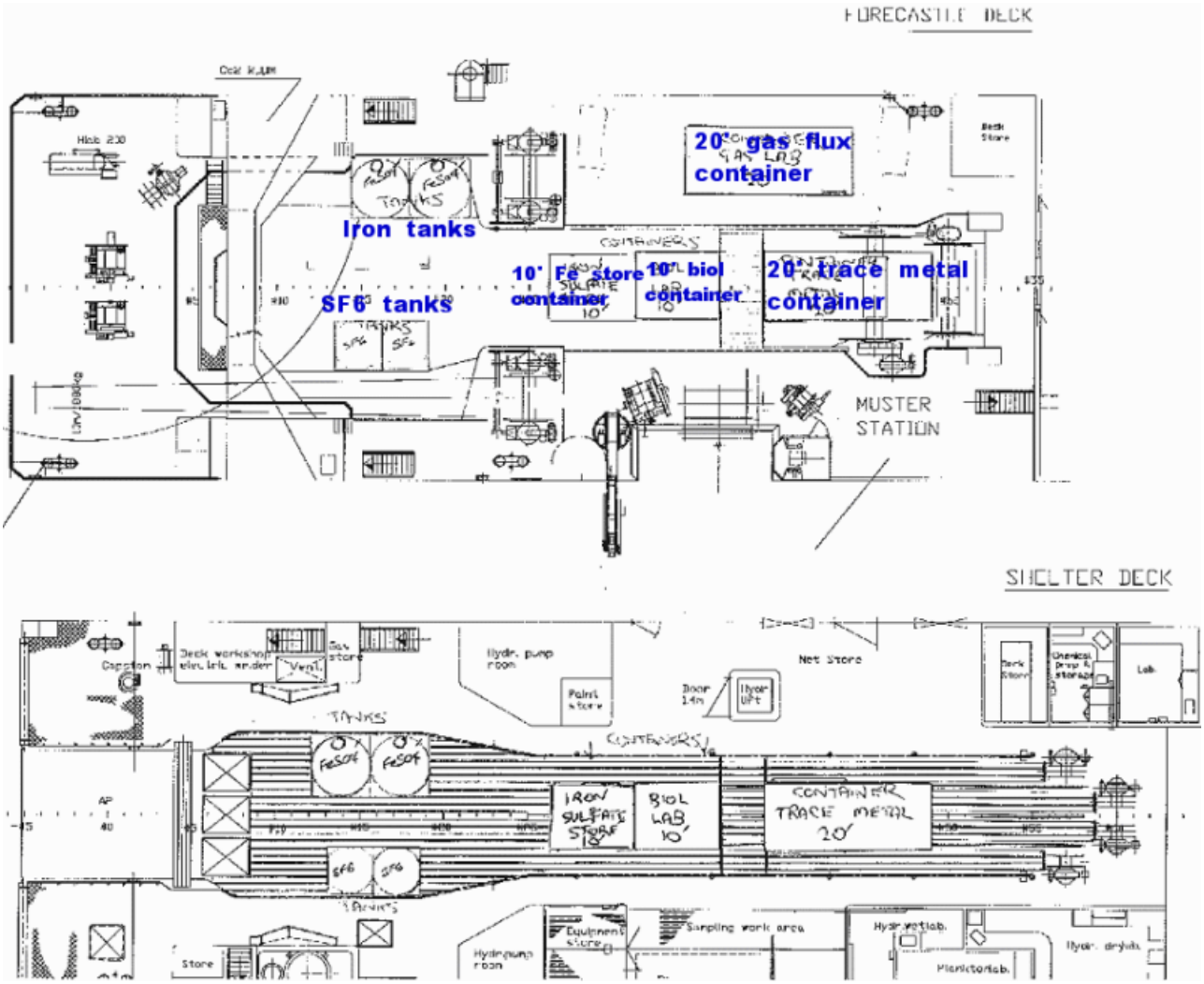


Figure 1: Container labs and tank placement on decks <stern -- bow>

SHIP-BOARD EQUIPMENT:

MAJOR REQUIREMENTS FROM VESSEL:

(1) Non-toxic, non-filtered surface sea-water supply to Dry Lab and Fish Factory: Poison and Flush inlet at outset. Replace filters on shelter deck lab outlet.

(2) Milli-Q water system operational with new plus spare cartridges essential for many experiments. During voyage, the system will be maintained by the biology group.

(3) Containers:

1 x 10 ft container with benching both sides and end

1 x 10 ft container store for Iron ???

2 x 20 foot NIWA Containers - 220/260 V 60 Hz & UPS electrical supply + computer networking Fore Shelter deck and Forecastle deck

(4) 2 off $9m^3$ iron tanks and 2 off SF_6 tanks aft on main deck

(5) Winches – CTD, port and starboard sweep winches on trawl deck (moorings), winch for zooplankton net.

(6) Laboratory space - all lab space required

- Plankton Lab, Hydro Dry Lab, Hydro Wet Lab, Chemistry lab, port side, Dark Room, Fish factory 2 x port side labs, Fish Factory deck Fish Weighing Room/Wet Lab, Electronics lab

(7) New bench installation

- Install new wall mounted bench (5 m length?) forward of the aft staircase in the factory area tables.

(8) Install plywood benchtops

- Fish Weighing Room/Wet Lab bench tops covered including bridge between 2 weighing tables on stern side only (ie creating a U-shaped bench.
- Middle lab in factory L shaped bench
- Temperature controlled lab over floor mounted incubator – benches around all walls
- CTD lab for Flow Cytometer (Julie)
- End wall of 10' container
- End wall of plankton lab (Scott)
- Over conveyer area in forward fish factory (Rona) plus provide lino/mat over small floor area near computer for operator

(9) Sound-proofing in fish weighing area.

(10) Remove washer drum from factory area forward of fish weighing room

(11) 2 off Gas cylinder cage and 34+ cylinders located in Fish Factory 1 off gas bottle rack and 16 cylinders on Forecastle Deck, 3 SF6 cylinders on main deck.

(12) Sampling tower on foredeck

(13) Large M-AERI radiometer (100 kg) port rail in front of bridge

(14) ASASP particle spectrometer on lightmast on roof of bridge. Power/data cables thru bridge roof to instrument box in bridge.

(15) Zodiac on starboard side of deck in front of bridge

(16) Accommodation for scientific staff – complement of 30

SHIPBOARD EQUIPMENT DETAILS

Surface seawater pump supply (unfiltered, non-toxic, 2 outlets, one in Dry Lab and one in fish factory) **Poison and Flush seawater inlet at outset.**

Seawater filtration (20 & 5 μm) system in Constant Temperature laboratory

On deck hoses (to fill the SF6 tanks (aft, trawl deck), to clean mooring floats, to supply on deck incubators on the trawl deck and on the fantail (for 10-12 days)) tapped from aft port and midships starboard deck hydrants (with std Nylex/Gardenia snap-lock fittings to hose manifold)

Milli-Q distilled water system in Chemical Prep & Storage Lab on trawl deck operational with water to reagent grade specification (spares cartridges also)

2 gas racks for 34 tanks (GC analysis) – to be mounted in the fish factory on hatch (adjacent to the aft Fish Factory Lab, 2nd Deck)

20 foot NIWA container laboratory (Mark 1) mounted on forecastle deck port side (240VAC60Hz and UPS)

20-foot NIWA container laboratory (Mark 2) (installed & equipped with 220/240 V 60 Hz and UPS electrical supply, freshwater and seawater, in a similar fashion to TAN0010, October 2000) Ethernet link to both 20 foot containers.

2 off 10' containers on Shelter deck (NIWA lab plus hire container for iron storage)

Walkway (between container labs??) and steps (mounted to provide the shortest run to the starboard midships cut-away)

Winches
- CTD (Camera winch with warp read-out; max. depth 3 km)
- Kevlar winch and plastic blocks for go-flo samplers
- Clean pumped seawater profiler – deployed from the boom aft of the midships cut-away
- all wires (except acoustic cable) to be deployed through starboard side gantry using existing A-frame with separate blocks for each operation
- port and starboard sweep winches on trawl deck (moorings) and free-drifting sediment trap deployments
- The free-fall SPMR will be deployed (and recovered) over the stern (as previously on the vessel)
- Boom just aft of cut-away (CN22 net monitor boom) for trace metal fish

Trawl deck needs to be cleared of trawl gear for storage of equipment, mooring floats, drifting sediment traps, Carioca buoys, and for placement of containers

Port side net bay area needs to be cleared for storage of scientific supplies and as an area for fixing samples with formalin/preservative

Refrigerator and freezer for non-toxic samples (in Dark Room, plus galley and walk-in scientific freezer in fish factory) Additional portable NIWA upright freezer installed in corner behind mess

Refrigerators and freezer for toxic samples (small fridge in Chemical Prep & Storage Lab and small, brown, portable chest freezer)

Space on starboard stern upper deck for installation of deck incubators

DAS up and running

Area beside cut-away available for trace metal pump

ADCP / 12, 38, 120 and 150 kHz kHz hull-mounted acoustic systems

POS/MV motion sensing

Access to meteorological data package, access to the crows nest to secure irradiance sensors and loggers

Zodiac boat launched from foredeck to recover TRAMP free-fall profiler (and other free-drifting buoyed equipment) and for fairweather surface physics and gas chamber experiments

Access to gas sampling tower on bow – mounted as in the Nov 03 Mooring voyage, logging equipment in foredeck winch-house using Ethernet port.

LAB ALLOCATION

WHERE	WHAT	WHO
Bridge: Scientific area	Buoys, Wave radar terminal, ASASP logger	Ed, John, Mike
Bridge: Scientific area	M-AERI electronics rack (1m2 floor) + 1m bench PC	Peter Minnett
Foredeck winch-house	Micromet interface to foredeck mast, Berner pump, Hi-Vol pump	Murray, Dawn, Doug
Forecastle Deck, 20' container	DMS/REA (4m), SO2 (2m), balloon receiver (1m) TSI particle counters (2m)	Mike, Murray, John, Jill C, Dawn, Peter
Shelter Deck: Chemical prep room and port side lab.	Biology: Bacterial production, mesozooplankton grazing, microzooplankton grazing, set-up for Steve's Biology samples	Julie, Karl and Jorma
Shelter deck, Hydro-dry lab	Biology: Flow cytometer (starboard wall – ply bench)	Julie
Shelter deck, Hydro-dry lab	Nutrient analyzer	Stu
Shelter deck, Hydro-dry lab	CTD, acoustics, ADCP physics	Matt, …
Shelter deck Hydro-wet lab	General scientific filtering, sediment traps	Scott, Jill P
Shelter deck, plankton lab (starboard)	Biology: 1° production, ^{14}C	Jill Peloquin
Shelter deck, Dark Room	Fridges and freezers (non-toxic) SCAMP, SkindeEP servicing	Craig Stevens, Brian Ward
Shelter deck forward 20 foot container	Trace metal clean lab 12m bench? Aerosol filter loading	Michael Ellwood, Doug Mackie, Dawn DeVries
Shelter deck, 10' container, back corner	Discrete pH, alkalinity (1.5m)	Burns Macaskill
Shelter deck, 10' container	Pigments filters + LN2 (2m)	Graham Jones?
Shelter deck, 10' container	Solar simulator (1.2m) + 0.5 m PC	Lori Z
Shelter deck, 10' container	Helium sampling equipment	David Ho
Shelter deck, Net bay area	Sample fixing	Biology group
Shelter deck, misc	Space for David Ho sampling, Matt's trunks, Scott's trap work	
Fantail	4 off 3m Deck incubators	
TBA – on deck	1° prod incubator	
Main deck, Fish weighing Room	SF6, dissolved gas sampling and analysis	Cliff, Andrew, David Ho, Peter
Main deck, Fish weighing Room (or new bench – Factory processing area)	Underway fluorometer, Underway GTD-DO sensor	David Katz
Main deck, Fish weighing Room	DMS(P) analysis (2m + 1m filtering)	Steve Archer
Main Deck, Scientific Freezer		
Main Deck, Temperature controlled lab	On line pCO_2 pH, Alkalinity (+ ply bench)	Kim, Burns
Main Deck, Middle Lab	DMSw (3m bench)	Graham
(Main Deck, - new bench in – Factory processing area)	Winkler titrations (2m+ 2m floor)	David Katz

Fall back is – 10ft container		
Main Deck, Factory processing area	Atmos Oxygen (1.5m2 floor)	Rona
Below Main Deck, Electronics Lab	Biology: microscopes	Jill Peloquin

COLLABORATOR EQUIPMENT

Scientist	Equipment	Power	Location
External gear			
Dawn DeVries	Berner Impactor (Aerosol chem.)	110VAC 6A?	Foredeck mast & winch-house
Mike Harvey	ASASP-100X (particles) (20 kg) Aerosol phys)	110VAC 8A	Lightmast on top of bridge cables through to bridge.
Doug Mackie	Hi Volume sampler (Aerosol chem.)	240 VAC 6A	Foredeck mast and winch-house
Peter Minnett	M-AERI (IR emission) (100 kg)	110VAC/1kW	Starboard bridge rail
Peter Minnett	All-sky camera	110VAC 100W	
Internal Gear			
Steve Archer	GC (Varian 3800)	240 VAC 10A	
Jill Cainey	HPLC/Fluorescence	120 VAC 6A?	
Harvey/Cainey	TSI 3025/3010	240 VAC 3A?	Gas flux lab
Harvey	GC (HP 5890)	240 VAC 10A peak	Gas Flux lab
Graham Jones	GC (Varian 3400)	240 VAC 10A	
Cliff Law	SF6 GC's	240 VAC	
Brian Ward	SkinDeEP	110 VAC	
Lori Ziolkowski	Solar simulator	220 VAC 14A	
Lori Ziolkowski	Optronic Spectroradiometer	110 VAC 7A	

SHIPS POWER

Main ship power is provided 240VAC 60Hz and is usually reliable and clean. UPS outlets are also available at 240VAC 50Hz but UPS duration is not long. UPS loading should be kept small (electronics items, not motors).

CTD WATER BUDGET

Currently being compiled.

Electronic copies sent to:

Shipboard scientific & technical staff (as above)
Mark Gall, Pete Gerring, Matt Walkington, DAS people (NIWA),
NIWA Publicity (Geoff Baird)
NIWA GIS/Voyage Archive (Kevin MacKay)
Vessel Management (John Hadfield, Greg Foothead, Fred Smits)
Regional Manager (Andrew Laing)
Research Director (Rob Murdoch)
Neil Andrew (GM Marine) Murray Poulter (GM Atmosphere)

Hard copies sent to

Master (2) (NIWA Vessel Management)
Bosun (2) (NIWA Vessel Management)