Day two – RRS *Sir David Attenborough* science capability

- Physics and IT – Dr Brian King and Jeremy Robst
- Geology and geophysics – Dr Rob Larter and Prof Colm Ó Cofaigh

Physics and IT capability

Dr Brian King
SDA physics representative, National Oceanography Centre

Jeremy Robst
IT Engineer, British Antarctic Survey

Why research in Polar physics is the coolest thing to do

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The Southern Ocean is the closure for the Atlantic Overturning Circulation that sets UK climate, and also sees the highest rates of ocean uptake of anthropogenic CO_2.

Observing and understanding these phenomena, and whether they will persist into the future, is at the forefront of understanding global climate and ecosystem changes.

Data gathered on expeditions that are now being conceived will be fundamental to creating new knowledge. Apart from the thrill of discovery, this knowledge will inform and transform assessments such as those by IPCC, and should be the basis for guiding the national response to the challenges posed by our changing planet.

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Where is the water coming from ?

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In physics terminology understanding the oceans is a giant advection-diffusion problem

To reach understanding we need to be able to measure or infer

Ocean currents

Ocean properties

Ocean processes, especially mixing and air-sea exchange

Our new ship gives us the ability to measure these things abundantly, and for a breathtaking array of ocean properties, each of which reveals a different facet of the puzzle.

If you're early in your career, say under 35, you may have at least 35 years before you get to draw a pension

In that time you will describe the oceans, and the Southern Ocean in particular, in detail and with techniques that until now we could barely dream about.

This new ship will take you to places with measurement capability on board that is unprecedented in ocean science, opening up unique opportunities.

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Unattended measurement platforms will enable us to be in multiple places at once, to go to places ships can't go, and to observe the ocean in ways that ships alone cannot, just as ships can deliver capability that will never be replicated on unattended platforms.

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Every 5 years or so I convince myself that now is the most exciting time there has ever been, to be an oceanographer. And the coming years will once again be more exciting than anything that has gone before.

What will you find on the ship ?

The expected array of physics and biogeochemistry observing equipment

- CTDs, conventional stainless steel and trace-metal friendly
- Underway surface measurements
- ADCPs 150 & **75 kHz**

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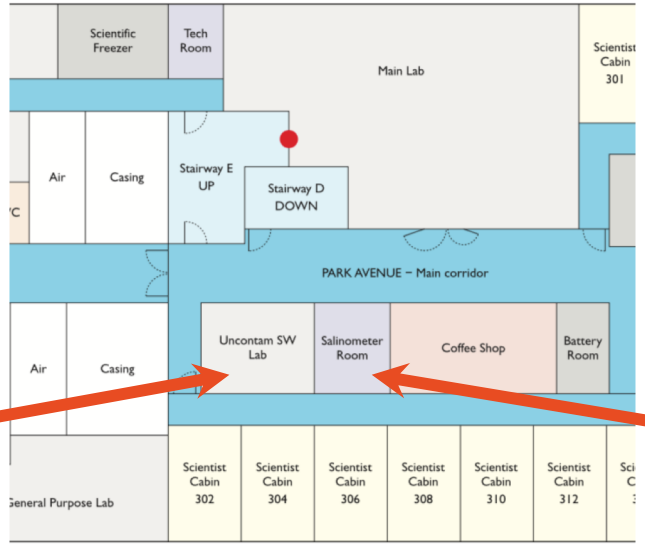

Underway seawater lab

Salinometer lab

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Deployment options

Two deployment options for overside vertical wires – a CTD boom and a conventional gantry – so it is possible to have two wires rigged at the same time. Familiar if you have sailed on DY recently

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The moonpool – many of the wires can be diverted to be deployed through the moonpool

CTD wire

Metal-free kevlar

Trawling/coring wire (16mm)

Electro-optical deep tow

Hydro wire

What will you find on the ship ?

Data logging and data distribution around the ship (Jeremy Robst will say more)

Nearly all the labs are on Deck 3, so samples land on deck and are easily and safely moved around for analysis

Up one deck to Deck 4, you find the **data suite**

Up one more deck to Deck 5, you find the winch control room, equivalent to the JCR UIC, where AME will set up to control things like CTD operations

The Chief Scientist's cabin is on Deck 6, and the Bridge is on Deck 9, so look forward to plenty of exercise if you ever visit those spaces

Hand over to Jeremy Robst who will talk about the data and IT provision

Physics and IT capability

Dr Brian King

SDA physics representative, National Oceanography Centre

Jeremy Robst

SDA IT Lead, British Antarctic Survey

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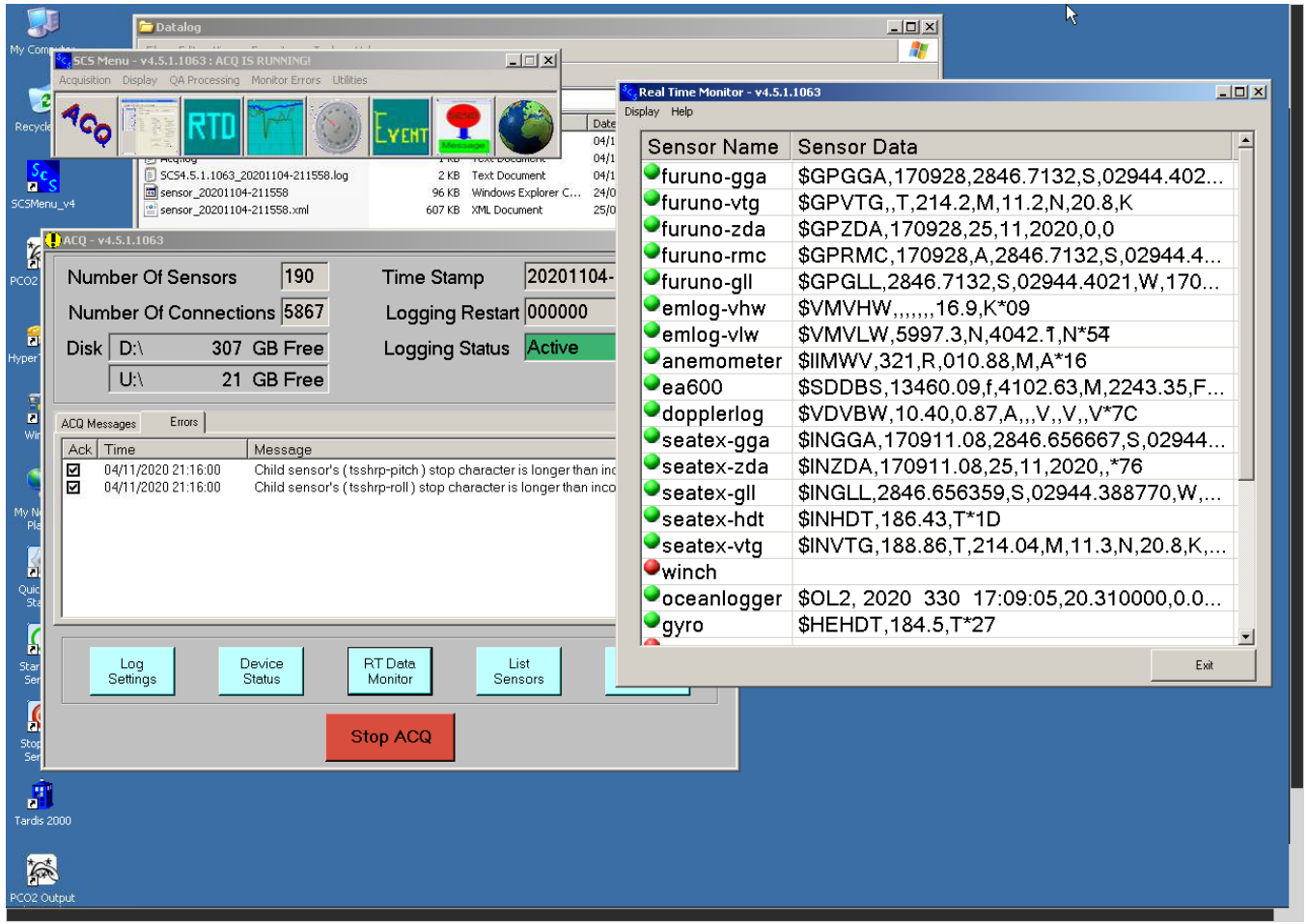
IT – Data Logging

- Data workshop held in November 2018 by SDA Data Manager (Alex Tate)

- Underway logging with 2 systems
  - **Primay:** NOAA SCS v5 (JCR using v4)
  - **Secondary**: NMF RVDAS
  - Sensors transmitting over network to both loggers
  - Data available in CSV format and BODC inspired NetCDF
  - SensorML based metadata

- Central location to store all other digital data – echo sounders, moorings, user data



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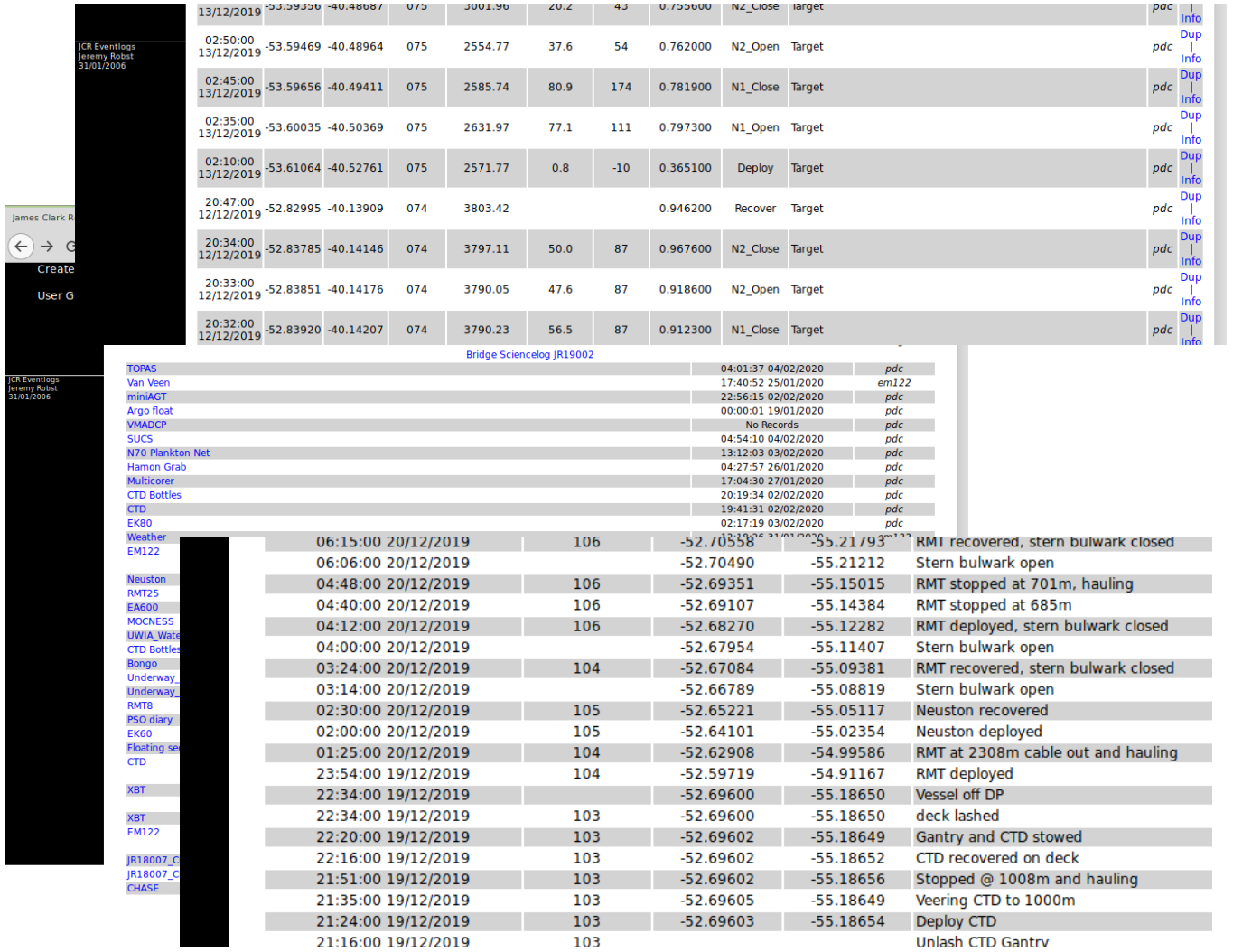
IT – Event Logging

- BAS IT developed system from the JCR transferred to the SDA
- Provides consistent view of cruise events recorded by the bridge
- User defined logs, saves paper recording and transcribing, securely backed up
- Integrated with data logging system to automatically populate underway data
- Data Workshop highlighted value and prioritized development (funding needed).



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02:50:00 13/12/2019	-53.59469	-40.48964	075	2554.77	37.6	54	0.762000	N2_Open	Target	pdc	Dup | Info
02:45:00 13/12/2019	-53.59656	-40.49411	075	2585.74	80.9	174	0.781900	N1_Close	Target	pdc	Dup | Info
02:35:00 13/12/2019	-53.60035	-40.50369	075	2631.97	77.1	111	0.797300	N1_Open	Target	pdc	Dup | Info
02:10:00 13/12/2019	-53.61064	-40.52761	075	2571.77	0.8	-10	0.365100	Deploy	Target	pdc	Dup | Info
20:47:00 12/12/2019	-52.82995	-40.13909	074	3803.42			0.946200	Recover	Target	pdc	Dup | Info
20:34:00 12/12/2019	-52.83785	-40.14146	074	3797.11	50.0	87	0.967600	N2_Close	Target	pdc	Dup | Info
20:33:00 12/12/2019	-52.83851	-40.14176	074	3790.05	47.6	87	0.918600	N2_Open	Target	pdc	Dup | Info
20:32:00 12/12/2019	-52.83920	-40.14207	074	3790.23	56.5	87	0.912300	N1_Close	Target	pdc	Dup | Info

Bridge Sciencelog JR19002

TOPAS	04:01:37 04/02/2020	pdc
Van Veen	17:40:52 25/01/2020	em122
miniAGT	22:56:15 02/02/2020	pdc
Argo float	00:00:01 19/01/2020	pdc
VMADCP	No Records	pdc
SUCS	04:54:10 04/02/2020	pdc
N70 Plankton Net	13:12:03 03/02/2020	pdc
Hamon Grab	04:27:57 26/01/2020	pdc
Multicorer	17:04:30 27/01/2020	pdc
CTD Bottles	20:19:34 02/02/2020	pdc
CTD	19:41:31 02/02/2020	pdc
EK80	02:17:19 03/02/2020	pdc
Weather	06:15:00 20/12/2019	106	-52.70558	-55.21793	RMT recovered, stern bulwark closed
EM122	06:06:00 20/12/2019		-52.70490	-55.21212	Stern bulwark open
Neuston	04:48:00 20/12/2019	106	-52.69351	-55.15015	RMT stopped at 701m, hauling
RMT25	04:40:00 20/12/2019	106	-52.69107	-55.14384	RMT stopped at 685m
EA600	04:12:00 20/12/2019	106	-52.68270	-55.12282	RMT deployed, stern bulwark closed
MOCNESS	04:00:00 20/12/2019		-52.67954	-55.11407	Stern bulwark open
UWIA_Wate	03:24:00 20/12/2019	104	-52.67084	-55.09381	RMT recovered, stern bulwark closed
CTD Bottles	03:14:00 20/12/2019		-52.66789	-55.08819	Stern bulwark open
Bongo	02:30:00 20/12/2019	105	-52.65221	-55.05117	Neuston recovered
Underway_	02:00:00 20/12/2019	105	-52.64101	-55.02354	Neuston deployed
Underway_	01:25:00 20/12/2019	104	-52.62908	-54.99586	RMT at 2308m cable out and hauling
RMT8	23:54:00 19/12/2019	104	-52.59719	-54.91167	RMT deployed
PSO diary	22:34:00 19/12/2019		-52.69600	-55.18650	Vessel off DP
EK60	22:34:00 19/12/2019	103	-52.69600	-55.18650	deck lashed
Floating se	22:20:00 19/12/2019	103	-52.69602	-55.18649	Gantry and CTD stowed
CTD	22:16:00 19/12/2019	103	-52.69602	-55.18652	CTD recovered on deck
XBT	21:51:00 19/12/2019	103	-52.69602	-55.18656	Stopped @ 1008m and hauling
XBT	21:35:00 19/12/2019	103	-52.69605	-55.18649	Veering CTD to 1000m
EM122	21:24:00 19/12/2019	103	-52.69603	-55.18654	Deploy CTD
JR18007_C	21:16:00 19/12/2019	103			Unlash CTD Gantry
JR18007_C					
CHASE					

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IT – Data Visualisation

- 12 screen video walls in main cruise hubs
- 2 to 4 screens in every laboratory and many living areas
- User selectable displays
  - Sensors and instruments
  - CCTV cameras
  - Cruise information screens
  - Ship Charts

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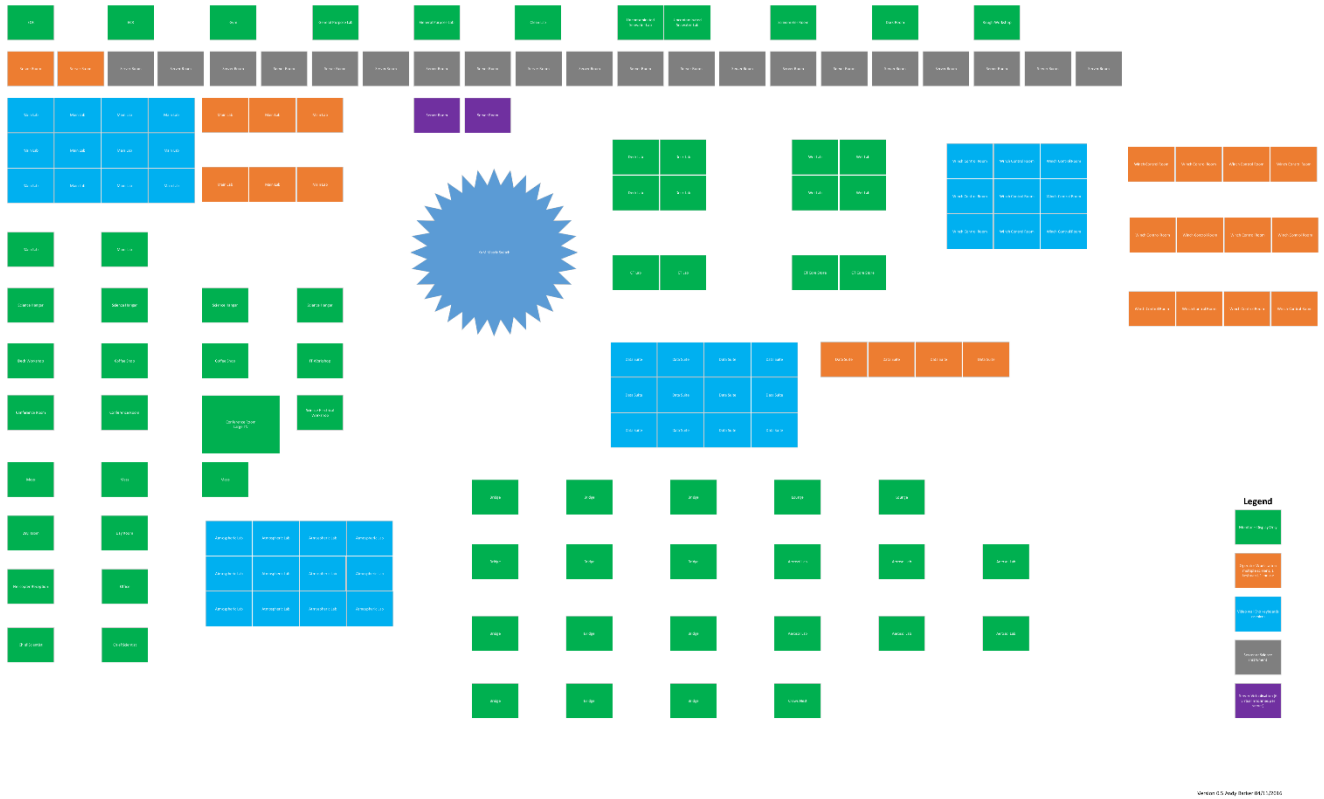
IT – Data Visualisation

- 4 screen operator stations in main hubs
- Allows control of multiple scientific systems from most convenient location
- 150+ screens across the vessel
- 85" touch screen in conference room



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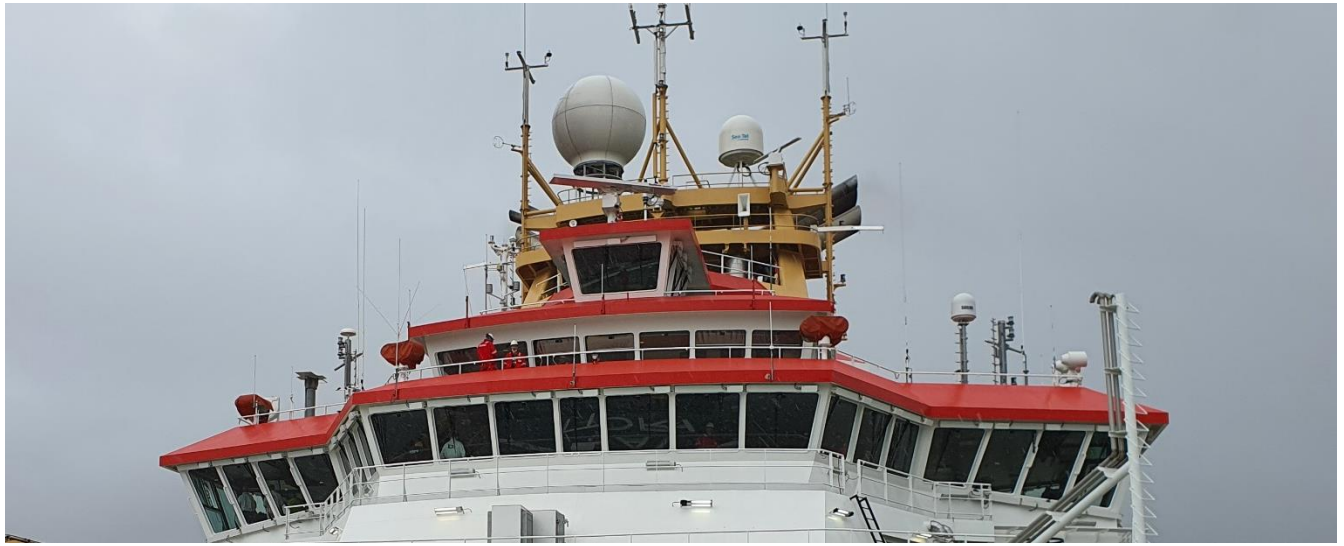
IT – Communications

- VSAT link ~ 2.5Mb/s
  (UK home average 64Mbps)
- Fleet broadband or Iridium backup links
- 900+ wired network ports
- 90 Wireless access points
- 240+ internal phones
- 4G or shore wired / wireless connections in some ports (mainly UK home port)
- WhatsApp text messaging
- Email, web access
- BFBS Satellite TV system



IT – Infrastructure Comparison

	SDA	JCR
Storage	420 TB	18 TB
CPU	80 cores	12 cores
Memory	1536 GB	96 GB
Internal network	Dual 10Gb/s backbone	Single 1Gb/s backbone
Wifi	Full access	Internal only
VSAT link	~2.5 Mb/s	~1 Mb/s

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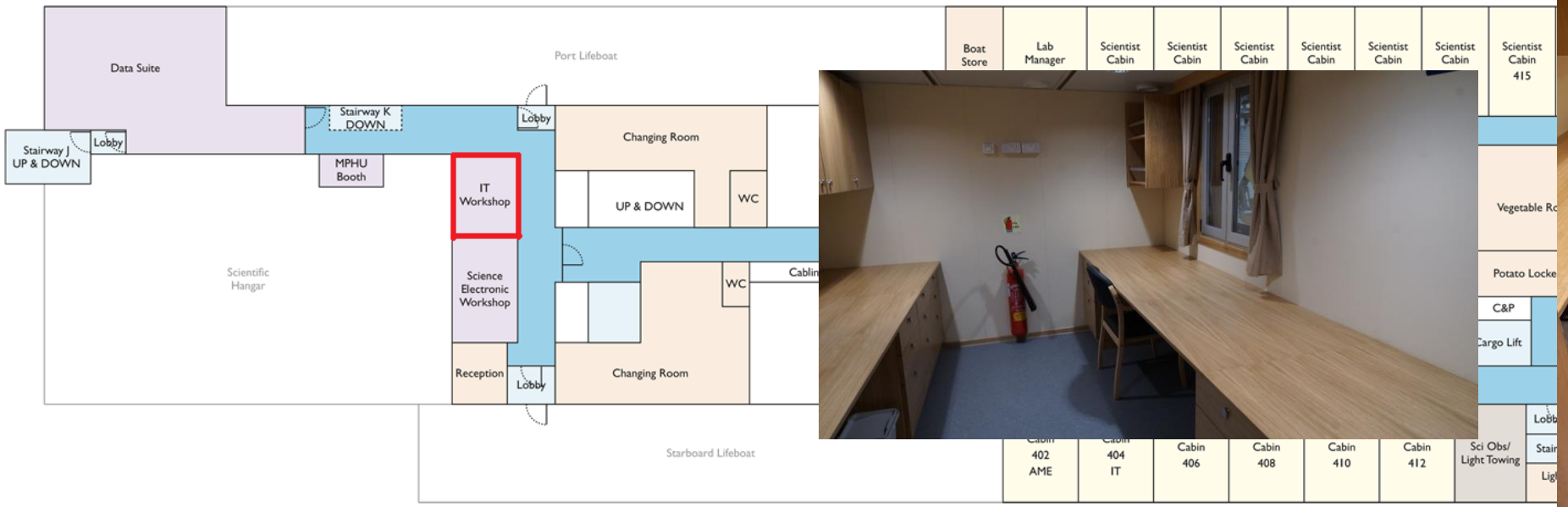
IT – and finally ….

A great office / workshop for the IT support on board, so you can always find us ☺



Thank you

Geology and geophysics capability

Dr Rob Larter

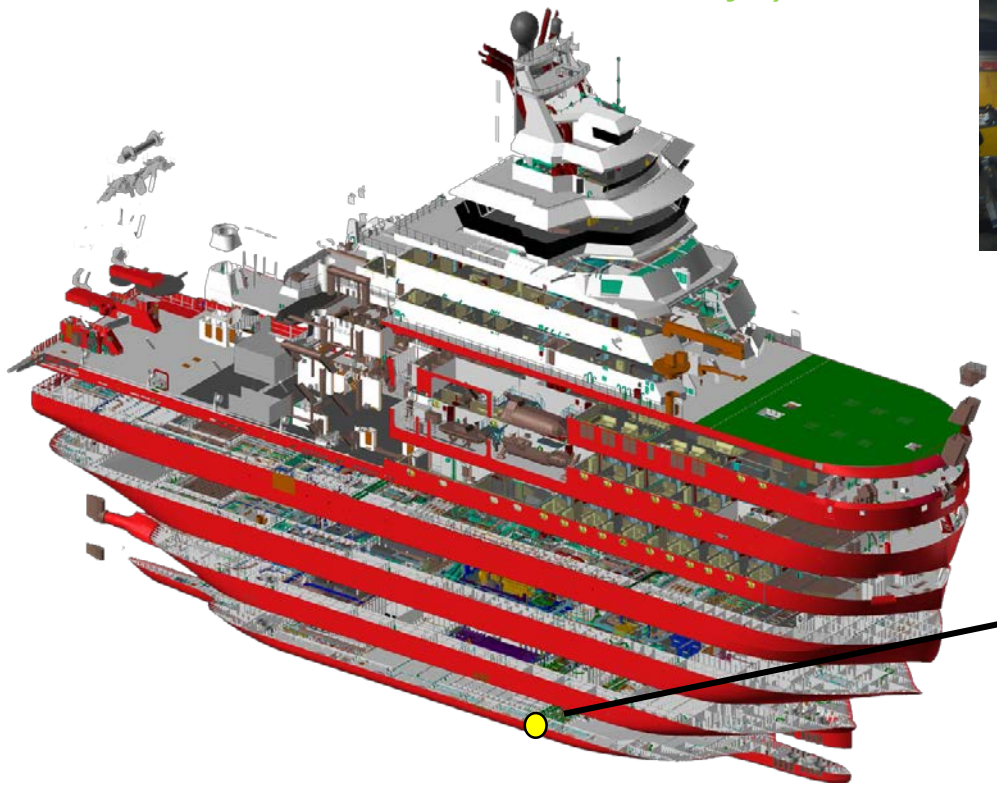
SDA Science User Consultation Panel geophysics representative, British Antarctic Survey

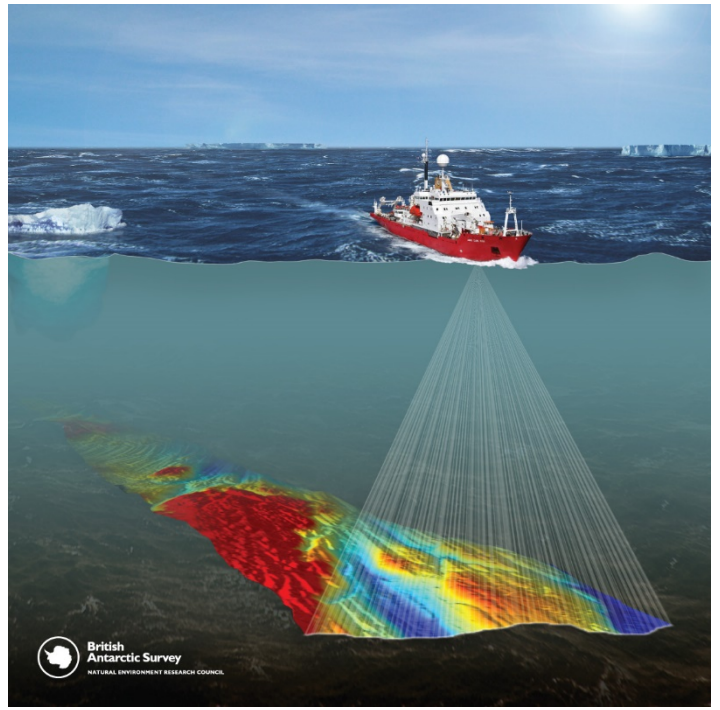
Professor Colm Ó Cofaigh

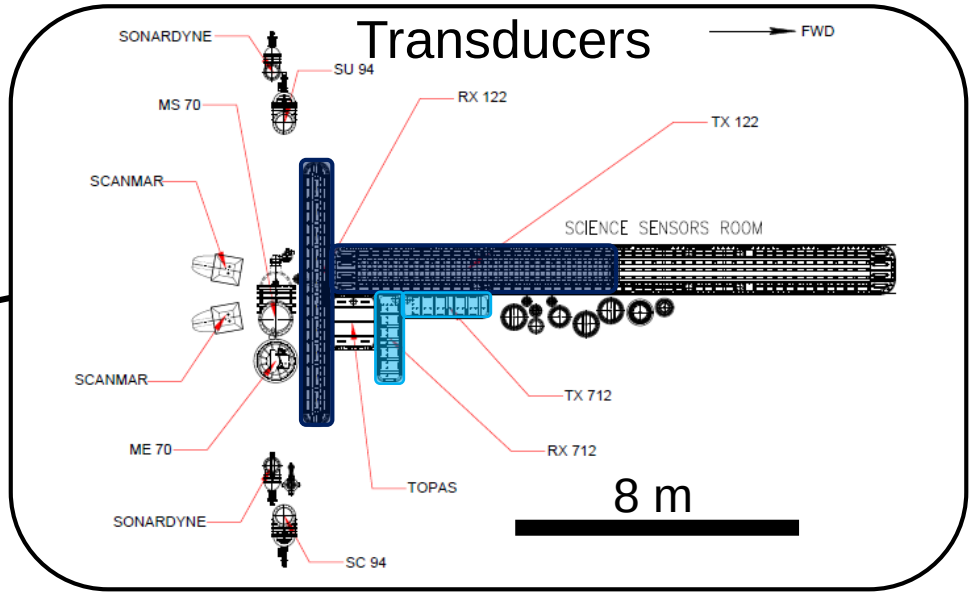
SDA Science User Consultation Panel geology representative, Durham University

Multibeam Echo Sounding Systems

Kongsberg EM122 – 12 kHz, full ocean depth
Kongsberg EM712 – 40-100 kHz, continental shelf and slope
(Also Kongsberg EM2040 – 200-200 kHz, on *Erebus* workboat for inshore surveys)

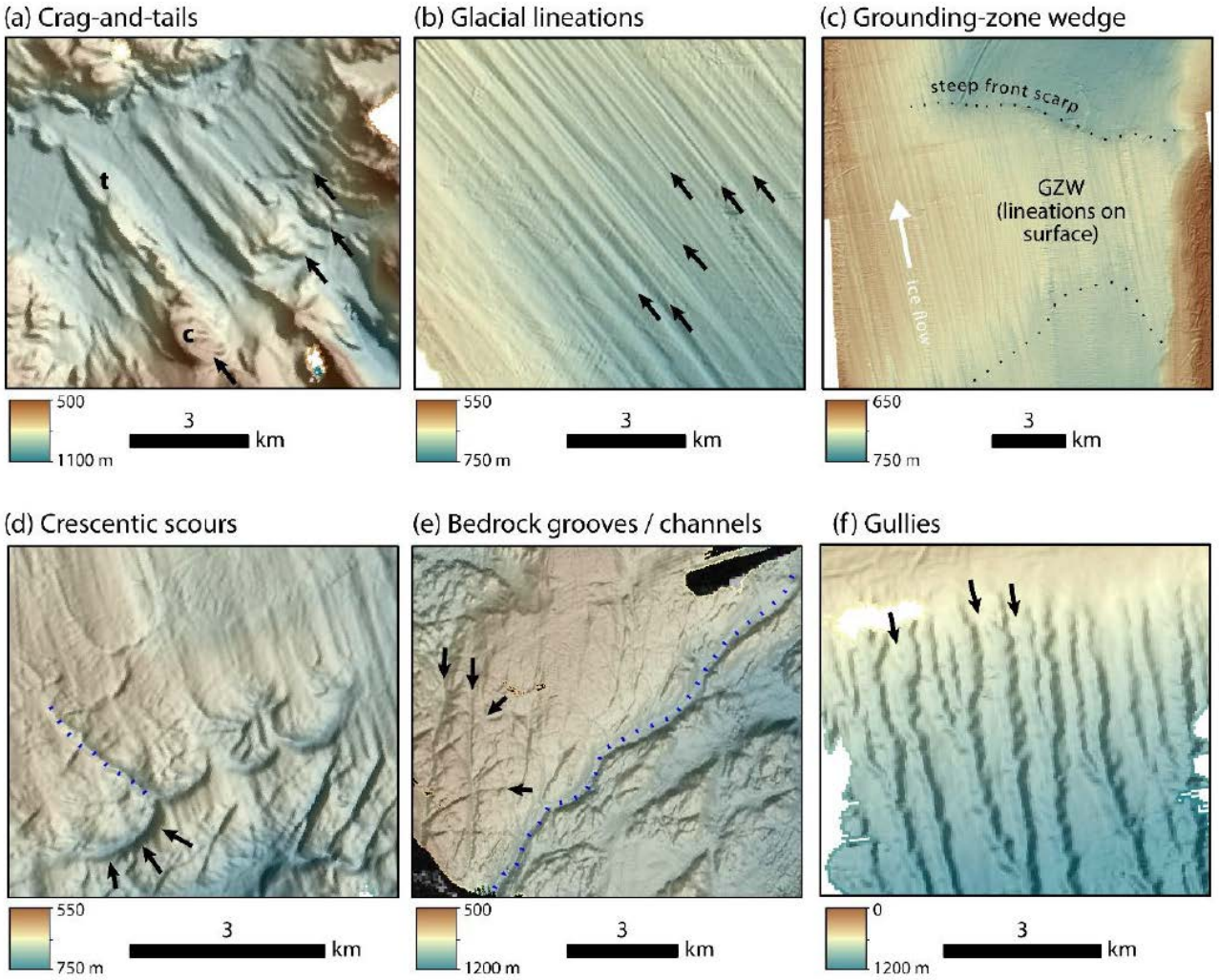






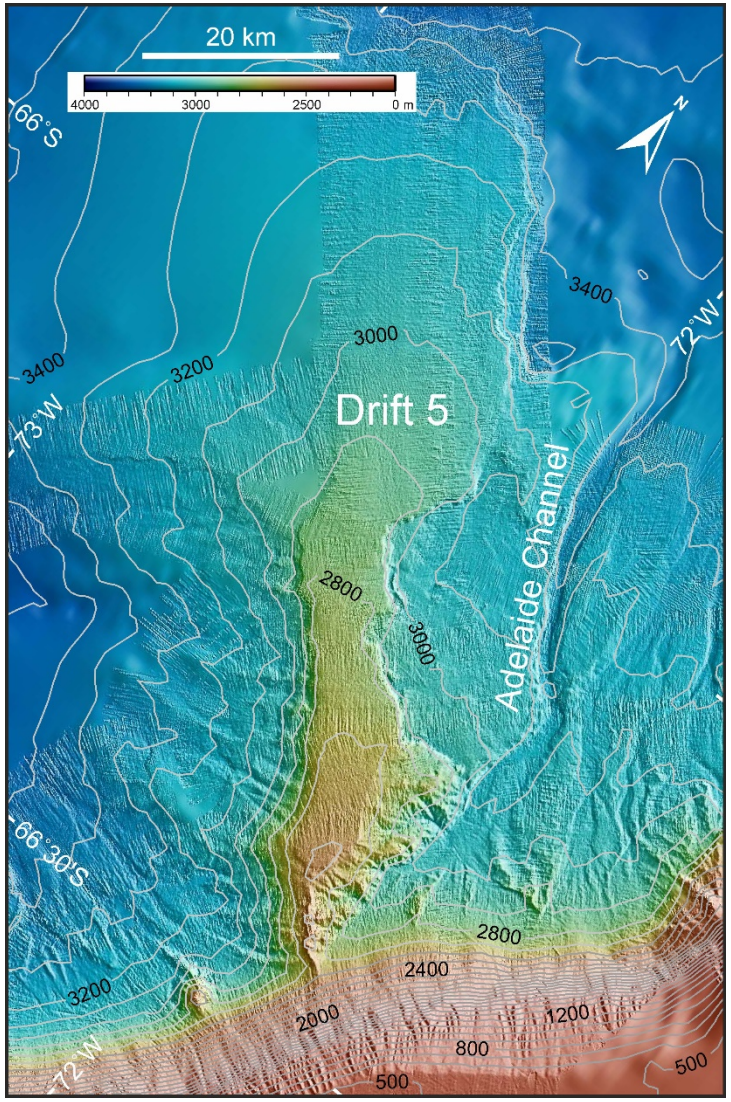
Multibeam Bathymetry Examples

Glacial/glacially-influenced continental shelf & slope



Hogan et al., *The Cryosphere*, 2020

Deep water sedimentary systems

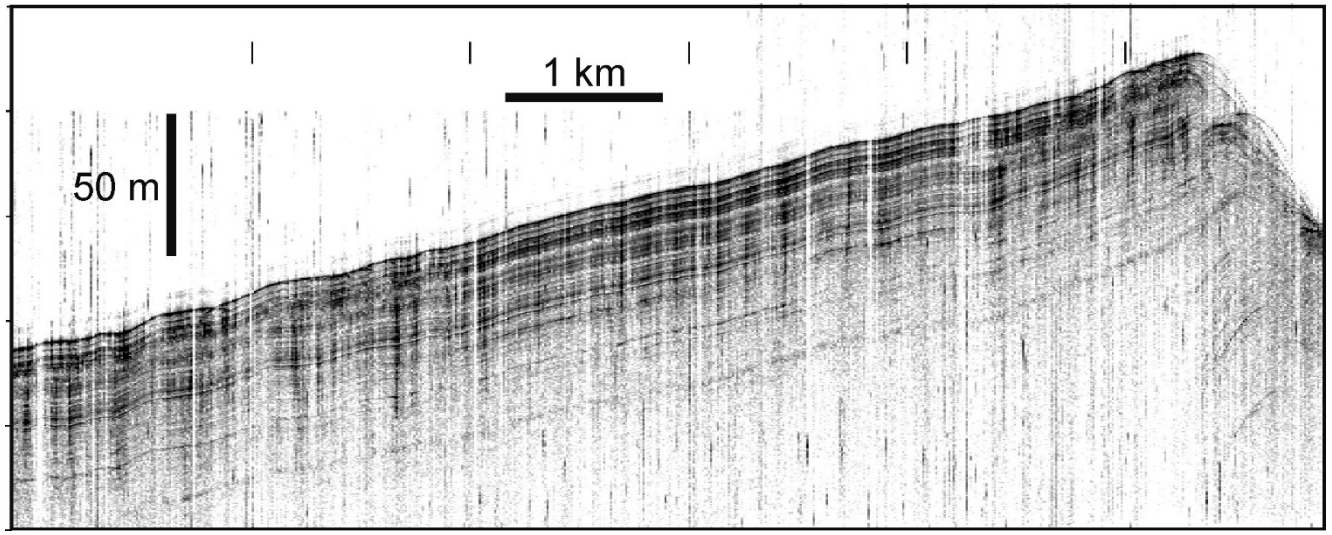


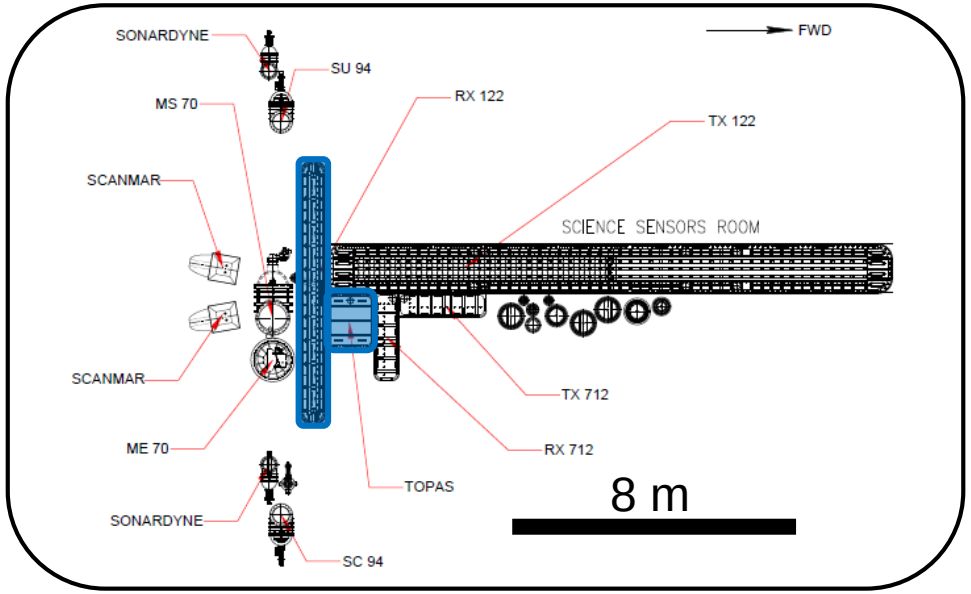
Larter et al., *Geol. Soc. Memoir* 46, 2016

Acoustic Sub-Bottom Profiling System

Kongsberg TOPAS PS 18

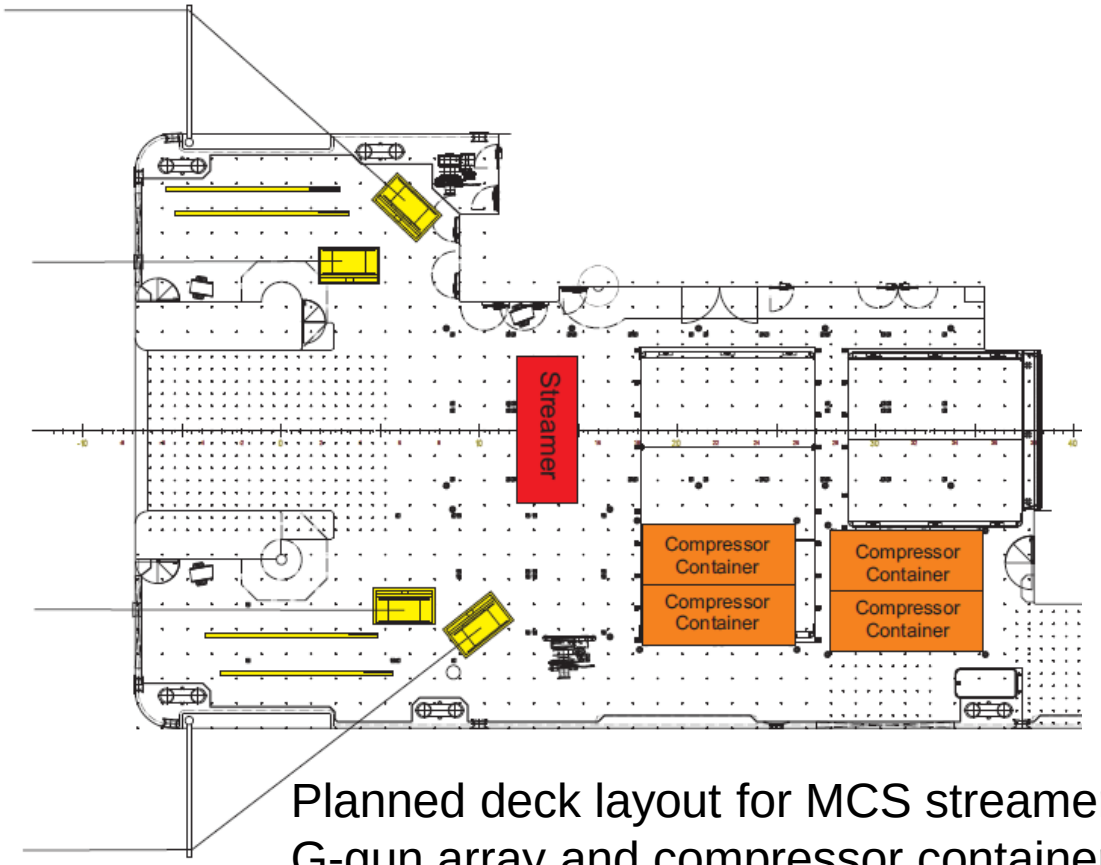
- 15-21 kHz primary frequencies
- 0.5-6.0 kHz secondary frequencies
- 4.5° beam width
- Uses EM122 receive array for detection of returns





Seismic Profiling Systems

- Capability to operate NMF multichannel streamer and full G-gun array
- New compact high-resolution seismic profiling system

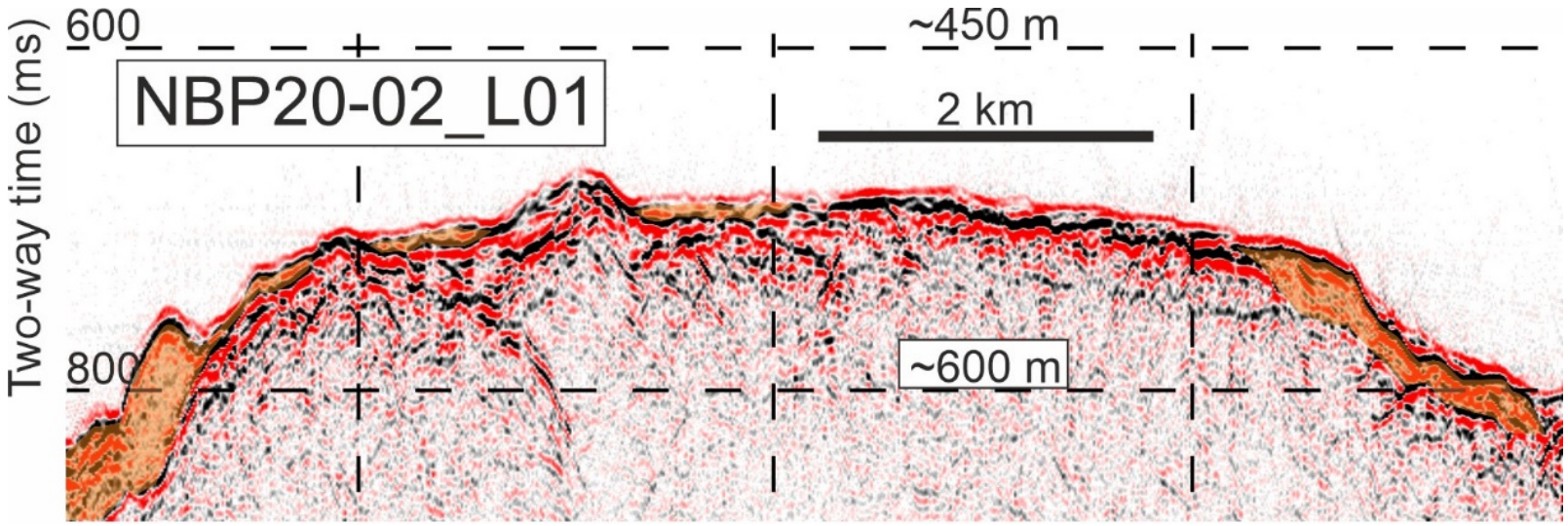


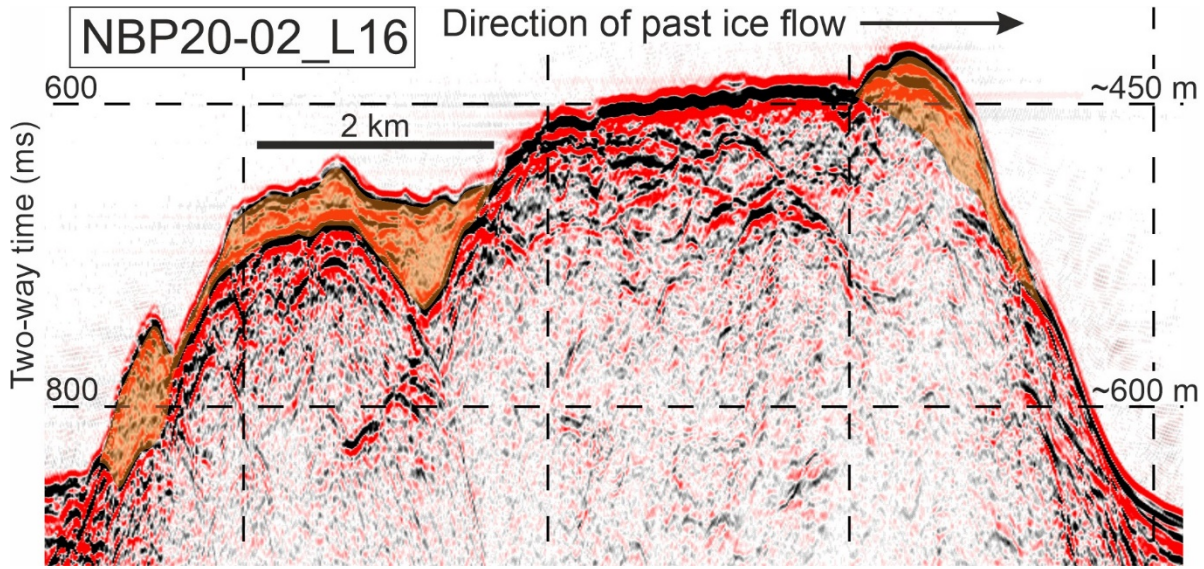
Planned deck layout for MCS streamer, G-gun array and compressor containers

Geometrics GeoEel solid hydrophone streamer with 40 x 6.25 m groups

2 x 3.44 l generator-injector airguns

High Resolution Seismic Profile Examples





Potential field sensors

Dynamic Gravity Systems AT1M gravity meter – on Deck 2

SeaSpy towed Overhauser magnetometer

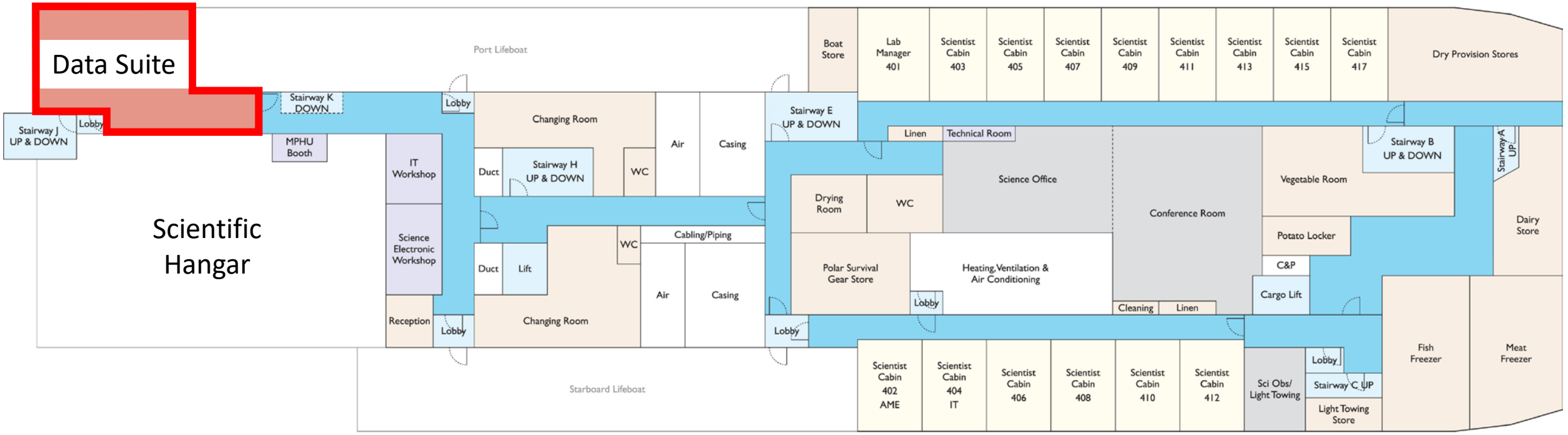
Shipboard three component magnetometer

KEY

- Laboratories/Offices
- Accommodation
- Corridors
- Scientific Support
- Facilities
- Stairway/Lift/Lobby
- Technical/Workshops
- Recreational
- Out of bounds
- Doors (only those linking corridors, lobbies, stairways and outside are shown)

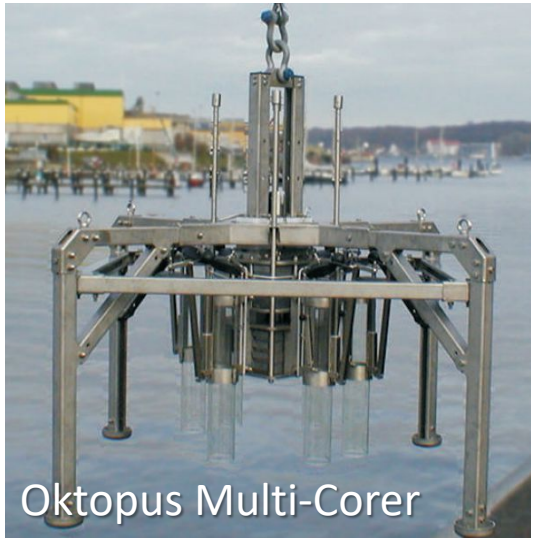
RRS *Sir David Attenborough*

Deck 4

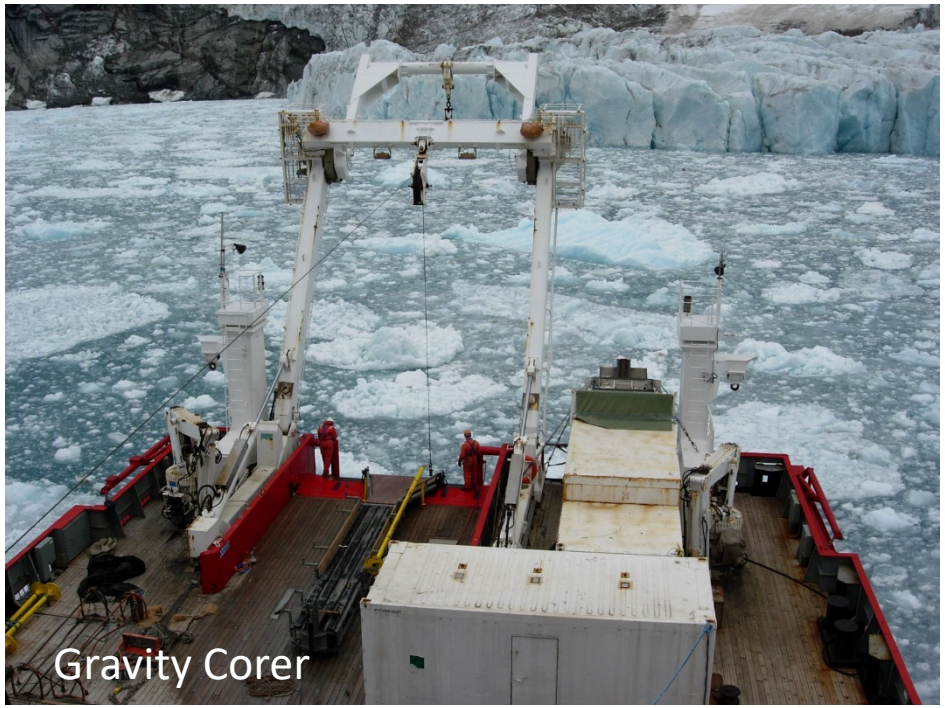


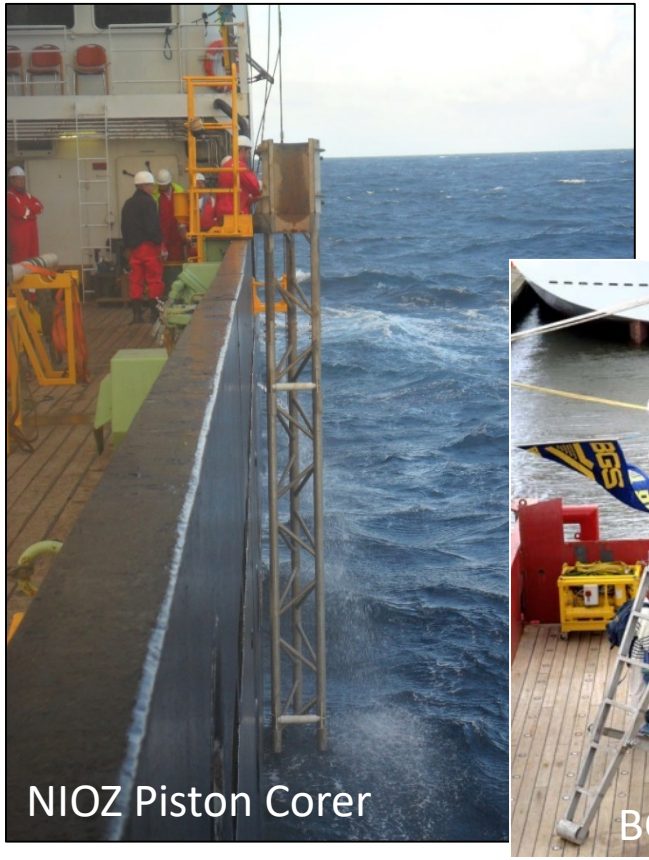
Sediment coring

- Over the side, stern & moonpool deployment of a range of sediment corers for seafloor sampling.
- Dedicated SDA multi- & box corers for recovery of seafloor sediment/water interface.
- Longer coring systems (gravity-, piston, BGS vibro-).
- Moonpool deployment in icy waters & rough seas.
- Potential for deployment of BGS RD2 seafloor drill over the side (and possibly via the moonpool).


Oktopus Multi-Corer

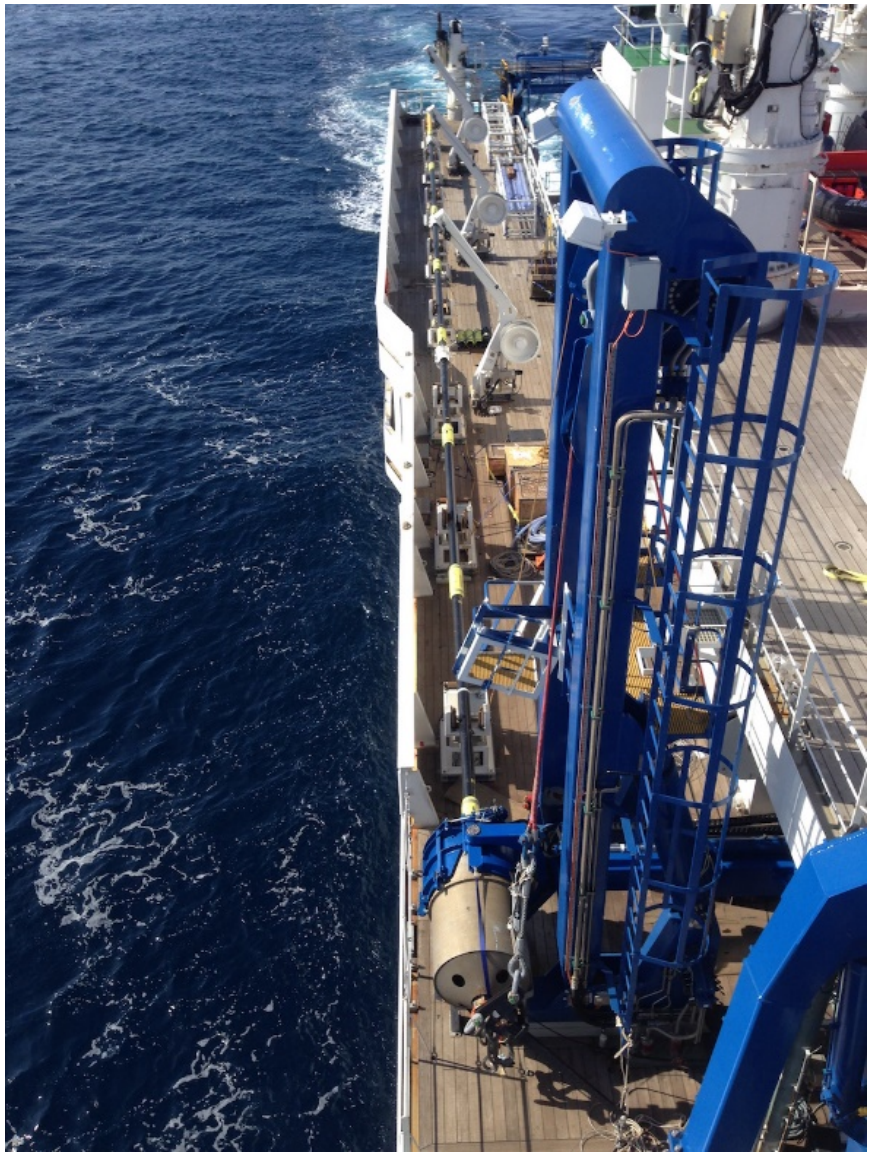

Giant Box Corer


Gravity Corer

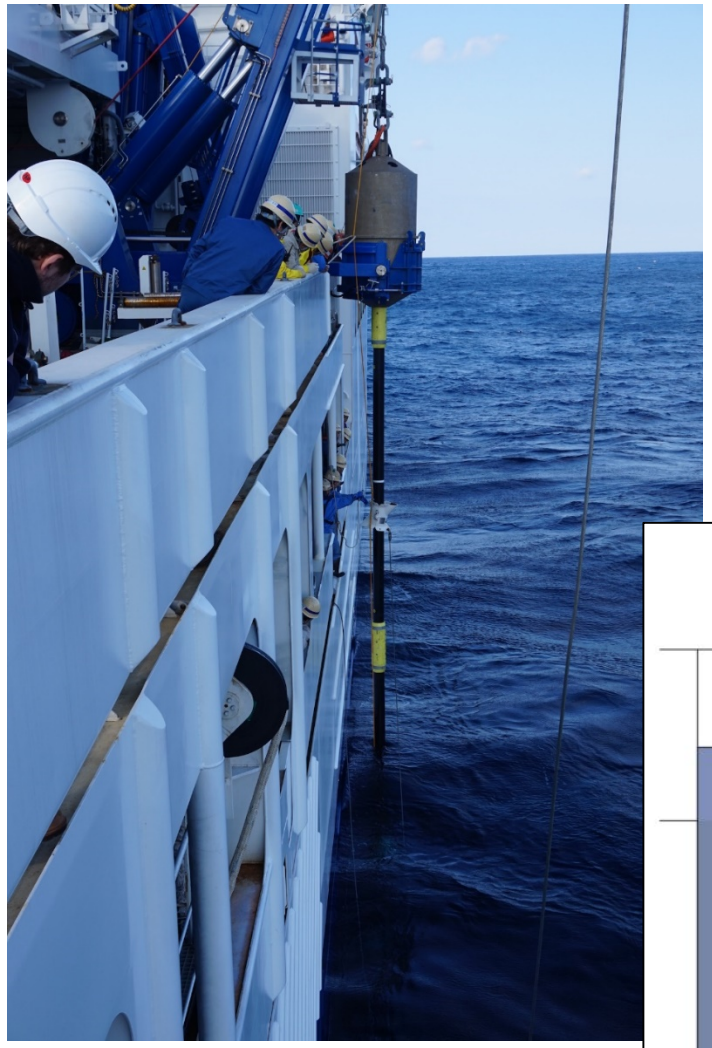

NIOZ Piston Corer


BGS RD2 rockdrill

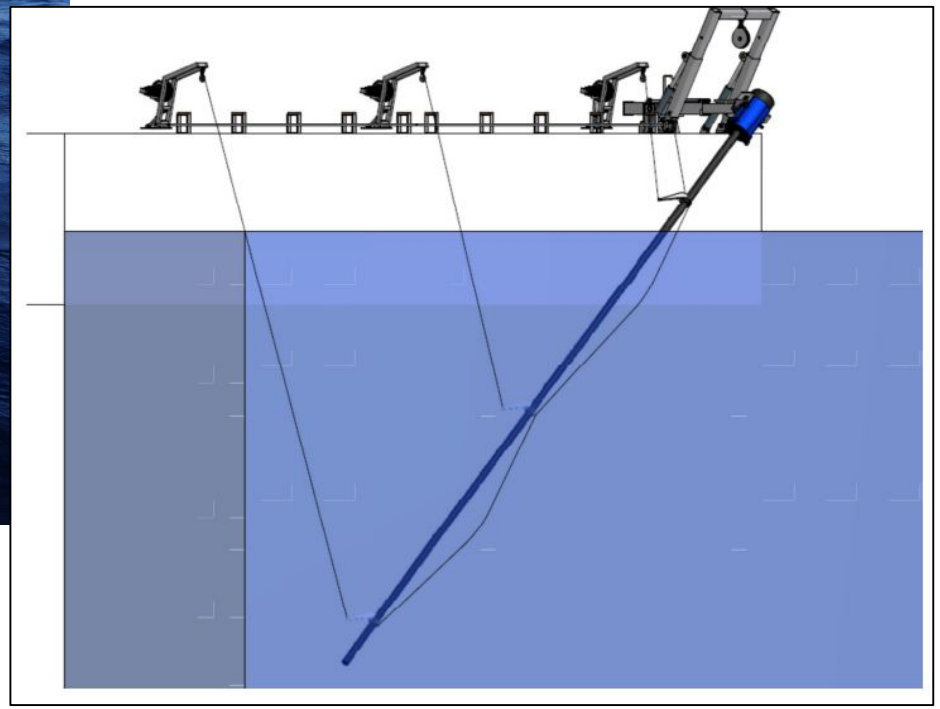
40 m Giant Piston Corer



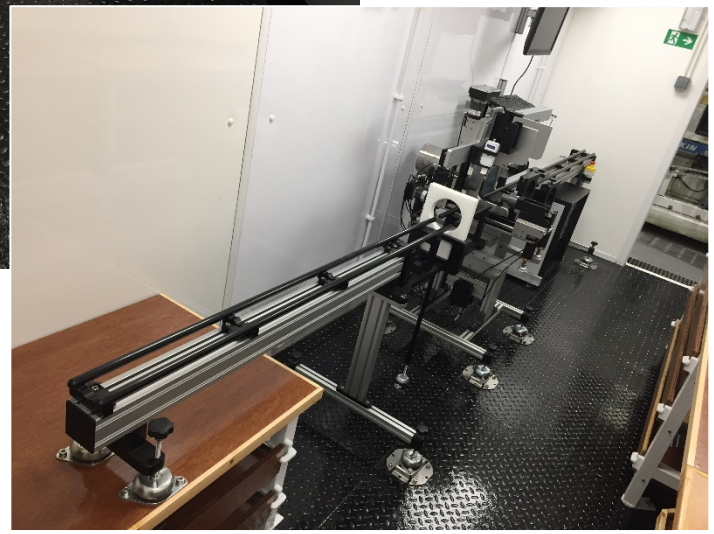
OSIL Giant Piston Corer aboard
R/V *Kaimei (JAMSTEC)*

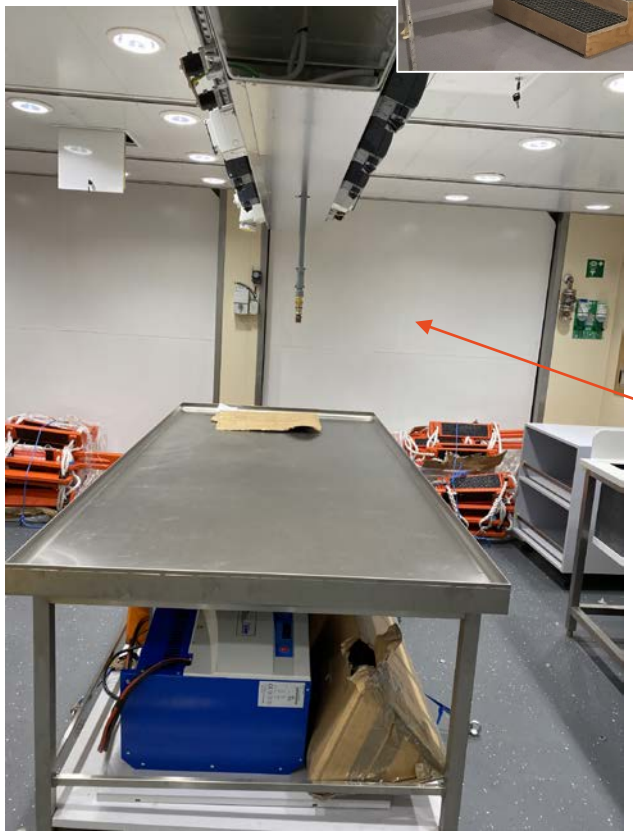


- Longest piston coring system on an ice-strengthened polar research ship.
- Recovery of long climate records potentially back through the entirety of the last c. 2 m+ years (depending on sedimentation rate)



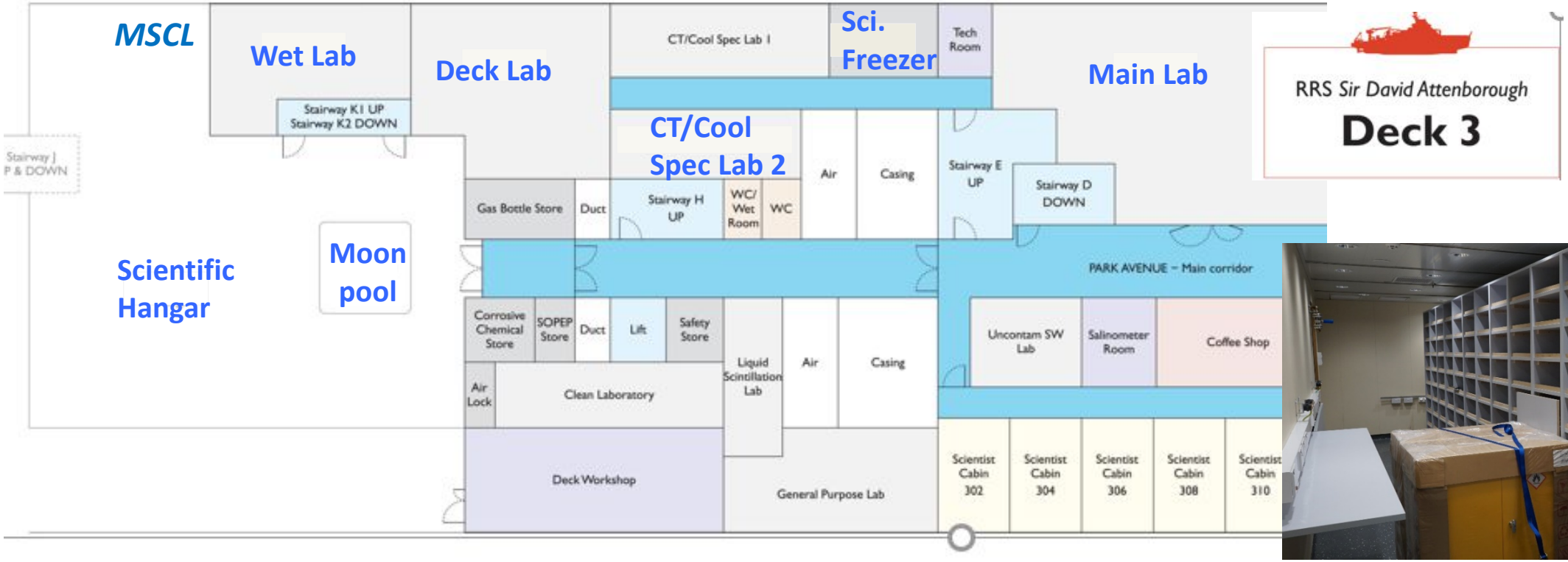
Containerised Multi-Sensor Core Logging System for analyzing physical properties of sediment cores





MSCL container to be placed on the port side of the hangar & connected directly to the aft end of the Wet Lab via removable bulkhead.

Laboratories & cold stores for sediment core processing and storage



Helicopter capability to support onshore geological sampling

Kangerdlussuaq Fjord System, SE Greenland

- Onshore deployment of geological field teams from the SDA
- Helis costed into grant & based out of the SDA as required to support individual grants.
- Capacity for 2 helis in the heli-hangar (Eurocopter AS365 N3 type)

e.g., KANG-GLAC (2023-2026) – using the SDA to investigate links between ice sheet change, ocean warming, carbon storage and biological productivity in Greenland fjords (partners - BAS, Durham SAMS, Leeds)