

## **ANNEX: Opportunities to connect to ORCHESTRA activities**

This annex outlines fieldwork and modelling activities that the ORCHESTRA programme will undertake in the time window April 2016-March 2021. It is not intended to be exhaustive, but rather to highlight the major elements to which proposers into the RoSES scheme may wish to connect. This annex should be read in conjunction with the ORCHESTRA Case for Support, which provides the full background on ORCHESTRA science, in terms of its rationale, scope and delivery. See <https://www.bas.ac.uk/project/orchestra/> for the Case for Support, plus a schematic of the scheduled fieldwork locations.

Inevitably some of the activities tabulated below offer more scope for connection than others. For example, some of the cruises (e.g. A23, four of the SR1b occupations) are predominantly hydrography/physics cruises (CTD, LADCP, underway, etc.), and so offer great scope for inclusion of additional scientific parties, as well as potential for extension (i.e. addition of ship days) subject to the SME process. Other cruises (e.g. ANDREXII, 24S) are already extensively populated with scientific parties, and are already close to the durations for the vessels being used. Whilst addition of extra science on these latter cruises is certainly not impossible, there will be more logistical restrictions on what can be achieved. It should also be noted that, as with any marine/polar programme, the details of activity and delivery may subsequently change due to logistical/scheduling/etc considerations.

Primary contacts for different activities are detailed in the table below. It is also strongly suggested that proposers wishing to connect with ORCHESTRA interact with its management team, so as to enable the optimal links to be made.

### Key contacts:-

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Dr. Helene Hewitt (Met Office) [helene.hewitt@metoffice.gov.uk](mailto:helene.hewitt@metoffice.gov.uk) Met Office Centre Lead

Type of Activity	Designation	Primary contacts	Timing	Measurements	Platform(s)	ORCHESTRA datasets/deliverables
Hydrographic (carbon/tracer) cruise	SR1b	Yvonne Firing/Richard Sanders (NOC)	December 2016/17/18/19/20	<p>Every year:- CTD O18 LADCP VMADCP Underway SST Underway pCO2 Underway Met.</p> <p>2018/19 season only:- Dissolved Inorganic Nutrients TIC/TA 13C/14C</p> <p>In addition: bottle oxygen samples and calibrated oxygen sensor in years when floats with oxygen sensors are deployed (see Floats below)</p>	<p>RRS <i>James Clark Ross</i> (presumed up to 2019)</p> <p>RRS <i>Sir David Attenborough</i> (presumed after 2019)</p>	<p>Continuous profile CTD data and discrete bottle data analysed aboard ship delivered to BODC and GO-SHIP data centres within 6 months of the end of each cruise.</p> <p>Underway/ancillary data delivered to BODC on same timescale</p> <p>Some data delayed mode (isotope samples returned to UK and analysed in shore lab)</p>
Hydrographic	A23	Povl	Annually	CTD	RRS <i>James</i>	CTD and other

cruise		Abrahamsen (BAS)	(2015/16 through 2020/21)	O18 LADCP VMADCP Routine underway measurements	<i>Clark Ross</i> (presumed up to 2019)  <i>RRS Sir David Attenborough</i> (presumed after 2019)	shipboard data delivered to BODC following each cruise  Isotope data delivered to BODC after analysis in UK.
Hydrographic cruise	Orkney Passage cruises (for moorings turnaround)	Povl Abrahamsen (BAS)	March/April 2017, 2019, 2021	CTD LADCP VMADCP Routine underway measurements	<i>RRS James Clark Ross</i> (presumed up to 2019)  <i>RRS Sir David Attenborough</i> (presumed after 2019)	CTD and other shipboard data delivered to BODC following each cruise
Hydrographic (carbon/tracer) cruise	24S	Brian King/Richard Sanders (NOC)	Mar/Apr 2018	CTD Oxygen Inorganic Nutrients TIC/TA O18 13C/14C LADCP VMADCP Underway SST Underway pCO2 Underway Met	<i>RRS Discovery</i>	Continuous profile CTD data and discrete bottle data delivered to BODC and GO-SHIP data centres within 6 months of the end of the cruise.  Some data delayed mode (isotope samples returned to UK and analysed in shore lab).

Hydrographic (carbon/tracer) cruise	ANDREXII	Andrew Meijers (BAS), Malcolm Woodward, Vas Kitidis (PML)	18/19 Field season. Tip of Antarctic Peninsula to 30E, following South Scotia Ridge and northern Weddell Gyre.	Discrete samples for Inorganic nutrients, Discrete samples for Carbonate Chemistry, discrete O2 sampling, CTD O2 sensor. VMP5500 and VMP2000 microstructure CTD LADCP VMADCP 18O 13C/14C Underway SST Underway pCO2 Underway Met	RRS <i>James Clark Ross</i>	Continuous profile CTD data (including O2) and discrete bottle data delivered to BODC and GO-SHIP data centres within 6 months of the end of each cruise.  Some data delayed mode (isotope samples returned to UK and analysed in shore lab)
Deep-ocean moorings	Orkney Passage	Povl Abrahamsen (BAS)	2017 through 2021 (recovered on cruises every 2 years)	Continuous measurements of water current, temperature, conductivity at various points across the outflow of Weddell Sea Deep Water in Orkney Passage	RRS <i>James Clark Ross</i>  RRS <i>Sir David Attenborough</i>	Moorings data delivered to BODC following each recovery cruise
Underway		Vas Kitidis	Throughout	Measurements of	RRS <i>James</i>	Data from underway

measurements from research ships		(PML), Liz Kent (NOC)		routine surface meteorological and near surface observations from research vessel. Observations of ocean and atmospheric concentrations of pCO <sub>2</sub> .	<i>Clark Ross</i> , transitioning to <i>RRS Sir David Attenborough</i> presumed 2019	systems available from BODC.
Ship-based air-sea flux observations		Mags Yelland (NOC), Tom Bell (PML)	Years 3-5	Air/sea eddy covariance momentum, heat and CO <sub>2</sub> fluxes	<i>RRS James Clark Ross</i> <i>RRS Sir David Attenborough</i>	Direct estimates of air/sea CO <sub>2</sub> and heat fluxes in the Southern Ocean along cruise tracks and passage legs. Data and products made available via BODC after QC.
Meteorological aircraft flights	MASIN	Tom Lachlan-Cope; Alexandra Weiss (BAS)	2017/18 (Antarctic Peninsula; target area northern Weddell Sea; southern Scotia Sea)  2018/19 (Falklands; target area northern Drake Passage)	Air Temperature, Humidity, Wind, Aerosols, Cloud particle – habit, phase and size, Fluxes – momentum, sensible, latent and CO <sub>2</sub> , Surface-temperature,	Instrumented BAS Twin Otter (VPFAZ) MASIN	1)Turbulent atmospheric fluxes of heat, momentum and CO <sub>2</sub> 2)Mean values of temperature, pressure, humidity 3)Atmospheric stability 4)Sea/ice surface temperature 5)Radiative in- and outgoing fluxes of

			2019/20 (Halley; target area southern Weddell Sea)	Up and down welling long and short wave radiation,		longwave and short wave 6)Surface albedo 7)Mean wind speed and direction
Autonomous underwater gliders		Alex Brearley (BAS)	2017/18 and 2018/19 seasons	Temperature, salinity, depth-averaged currents, chlorophyll, turbidity, dissipation rate in NW Weddell Sea (in conjunction with MASIN flights) and over South Scotia Ridge	Teledyne Webb Slocum gliders, some equipped with Rockland microrider turbulence probes.	Decimated datasets delivered in realtime and made available via GTS. Full datasets available after glider recovery and QC (order of a few months).  Additionally, ORCHESTRA will combine with float data to produce 10-day maps of temperature and salinity at 1° resolution for the period since 2004.
Floats	Argo	Brian King (NOC)	To be deployed from appropriate cruises in 2016/17, 17/18, 18/19	6000m floats with oxygen, and 2000m floats with oxygen and pH	Argo (including Deep Argo)-type floats	Float data available within 24 hours through Argo data system.
Floats	EM-APEX	Alex Brearley (BAS)	To be deployed from appropriate cruises in	2000m profiles of temperature, salinity, ocean	Teledyne Webb EM-APEX	Data available after QC. Temperature and salinity will be

			2017/18, 2018/19	velocity. Spot measurements of ice thickness in winter.	floats	folded into ORCHESTRA activity to produce gridded products.
Marine mammal tagging	CTD-SRDL	Lars Boehme (SMRU)	Tags to be deployed in 2017/18, 2018/19, 2019/20 10 tags per season	Profiles of upper ocean temperature, salinity, fluorescence	SMRU CTD-SRDL marine mammal tag	Approx 2 profiles per tag per day, with data coverage extending from deployment into austral winter. Will be folded into ORCHESTRA effort for production of gridded data products.
Earth Observation (EO)	Radar altimetry	Andrew Ridout (CPOM)	Data will cover altimeter mission periods from ERS-1 up to present day (CryoSat-2 etc).	Satellite observations of sea ice freeboard and ocean lead height in the Southern Ocean	ERS-1, ERS-2, Envisat, CryoSat-2, Sentinel-3	Maps of sea surface height (SSH) and sea ice freeboard on a 5km polar stereographic grid smoothed using a circular operator of radius 25km
Earth Observation (EO)	Wind speed	Chris Banks (NOC)	Throughout	Wind speed estimates from Global Navigation Satellite Systems - Relectometry (GNSS-R).	Satellites with GNSS-R receivers.	Dataset and report/paper assessing wind speed from GNSS-R and wide-swath missions with a focus on high-wind events.
Earth Observation (EO)	Sea surface temperature	Dave Berry (NOC)	Throughout	Existing measurements of sea surface	Satellites contributing to	Dataset and report/paper on the stability and

				temperature (SST) from satellites, surface drifters and Argo.	the ESA SST CCI dataset <a href="http://www.esa-sst-cci.org/">http://www.esa-sst-cci.org/</a>	homogeneity of the ESA SST CCI product in the Southern Ocean.
Sector modelling	z-level model NAAS-12Z	George Nurser (NOC), David Munday (BAS)	throughout	5d-averages of physics + ventilation tracers.	Run on ARCHER, output on JASMIN	60 yr control simulation complete, year 2.  Perturbation experiments years 2-5.
Sector modelling	Hybrid terrain following/z-level model with tides NAAS-12Z	George Nurser (NOC), Maria Luneva (NOC)	throughout	5d-averages of physics + ventilation tracers	Run on ARCHER, output on JASMIN	60 yr control simulation complete, year 4
Adjoint model		Dan Jones (BAS)	All 5 years (ongoing)		Run on ARCHER, output on JASMIN	Diagnosed sensitivity of subduction and integrated metrics (e.g. mixed layer heat content) to surface forcing and ocean properties.
Climate Modelling	Air-sea fluxes	Joel Hirschi (NOC), Helene Hewitt (Met Office)	Years 1-2		GC2/GC3 resolutions of 1°, ¼° and 1/12°.  on MONSOON, JASMIN	Diagnostics of sensitivity of air-sea fluxes to model resolution.
Climate Modelling	Air-sea fluxes	Pat Hyder (Met O.)	throughout		UKESM, CMIP5/6	Assessment of air-sea fluxes in coupled models.



					on MONSOON, JASMIN	
Climate Modelling	Characterisation of heat and carbon subduction	Andrew Meijers (BAS).	throughout		UKESM CMIP5/6  on MONSOON, JASMIN	Intercomparison of surface ML properties and subduction in multiple models. Compare historical and RCP8.5 runs. Link to atmospheric modes of variability (SAM, ENSO etc.)
Climate Modelling	Heat and carbon budgets	Joël Hirschi (NOC).	Years 2-5		GC3, resolutions of 1°, ¼° and 1/12°; UKESM1, CMIP6; ORCHESTRA sector model	Transports and trends of heat and/or carbon in Southern Ocean. Link budgets to atmospheric modes of variability.