GEOMAR REPORT

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Helmholtz-Zentrum für Ozeanforschung Kiel

RV SONNE
Fahrtbericht / Cruise Report
SO234-2

08.-20.07.2014
Durban, South Africa - Port Louis, Mauritius

Berichte aus dem GEOMAR
Helmholtz-Zentrum für Ozeanforschung Kiel

Nr. 20 (N. Ser.)

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RV Sonne cruise SO234-2: Durban-Port Louis, July 08-20, 2014

Introduction

Within the frame work of the BMBF-project OASIS ("**O**rganic very short lived substances and their **A**ir **S**ea Exchange from the **I**ndian Ocean to the **S**tratosphere") the research cruise SO234-2 of the German research vessel SONNE was organized and conducted by the University of Oslo, Norway (www.uio.no) together with the GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany (www.geomar.de) from 08 to 20 July, 2014 in the subtropical West Indian Ocean (Figure 1). The SO234-2 cruise was primarily planned as a training and capacity building cruise for students from southern Africa and Germany within the BMBF SPACES ("Science Partnerships for the Assessment of Complex Earth System Processes") program. Fifteen students from South Africa, Namibia and Germany participated, along with 9 scientists and one observer from Madagascar. The training and research covered air-sea gas exchange between the atmosphere and the ocean, and the transport of ocean trace gases from the Indian Ocean to the stratosphere during the southwest Monsoon as well as the determination of important biogeochemical parameters. This research project was funded within the national BMBF program SPACES within the project SO235-OASIS (Grant: 03G0235A).

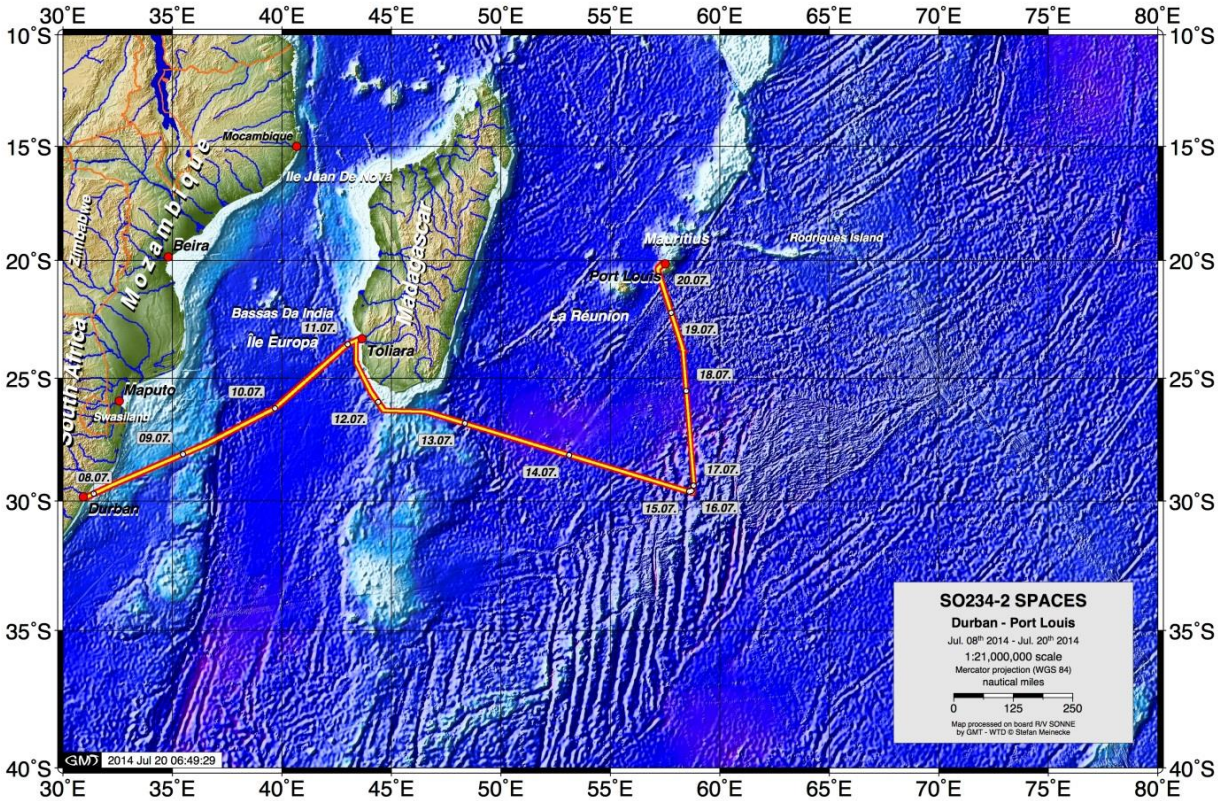

Figure 1: SO234-2 SPACES cruise track of RV Sonne: Durban – Port Louis (July 08-20, 2014).

Scientific background

Trace gases, containing halogens like chlorine and bromine are broken down by solar radiation in the stratosphere, where the halogens are highly efficient at destroying ozone. Increasing emissions from human activities have led to depletion of global stratospheric ozone over the last three decades. Whereas the chlorine supply is dominated by anthropogenic compounds, a major part of the bromine is supplied by natural, short-lived species, with oceanic sources. The importance of sulphur compounds emitted from the ocean for the middle atmosphere relates to their role as precursors to aerosols in the stratospheric aerosol layer. Recently, an increase of the stratospheric aerosol background level since 2000 has been observed. However, the origin of this elevated Junge layer, made either anthropogenically or naturally, is still under investigation. The tropical oceans are a known source of reactive halogen and sulfur compounds to the atmosphere in the form of short-lived brominated and iodinated methanes, as e.g. bromoform ($CHBr_3$), methyl iodide (CH_3I), dimethyl sulphide (DMS) and COS (carbonyl sulphide). Elevated atmospheric concentrations above the oceans are related to oceanic super saturations of the compounds, and to natural photochemical and biological production. Macro algae in coastal regions, as well as regionally enhanced phytoplankton, coral reefs, photochemical reactions and local anthropogenic sources all contribute to marine and atmospheric concentrations.

Trace gases enter the stratosphere principally in the tropics, where ascending warm air carries them rapidly from the ocean surface to the tropical tropopause layer. The intense vertical transport of the tropical atmosphere implies that the oceanic sources will supply significant amounts of halogens and sulfur to the upper troposphere/ lower stratosphere where they contribute to the observed halogen content and ozone changes. The subtropical and tropical Indian Ocean is a largely uncharacterized region for oceanic compounds and a projected hot spot, especially in coastal regions for their emissions and transport pathways into the stratosphere during southwest monsoon.

Spatial and temporal variability in production and sea-to-air flux of short-lived halogenated and sulfuric trace gases creates strongly varying oceanic distributions and thus also varying atmospheric contributions. The current impact of the natural ozone depleting substances is still uncertain and future changes in the mechanisms, that regulate their emissions to the atmosphere, their transport, and their chemical processing are largely unknown. Therefore the oceanic emissions have the potential to cause surprises in the evolution of the stratospheric ozone and aerosol layer in a changing climate, unless they are better understood. The measurements are thus needed to improve the understanding of future stratospheric halogen and sulphur loading and therewith on the ozone depletion and the radiative forcing of the future climate. The results of the SO234-2 campaign will contribute to new scientific insights of the United Nations Montreal Protocol on Substances that Deplete the Ozone Layer, to the United Nations Framework Convention on Climate Change, and to global climate change research.

Objectives and measurements

The SO234-2 cruise was primary planed as a training and capacity building cruise for students from southern Africa and Germany within the BMBF SPACES ("Science Partnerships for the Assessment of Complex Earth System Processes") program. The study program onboard the SPACES cruise SO234-2 was designed to teach the students mainly about "Air-Sea Interactions in the western Indian Ocean". The western tropical Indian Ocean experiences the Somali current, which reverses with the different monsoon systems, the Agulhas current, open ocean denitrification and high rates of nitrogen fixation in the Arabian Sea, and a large area in the western equatorial region of high carbon dioxide drawdown. All these phenomena make the tropical Indian Ocean an excellent laboratory and classroom, allowing special focus on anthropogenic effects, global climate change and on ocean biogeochemical and physical processes.

Of particular scientific relevance during SO234-2 were oceanic and atmospheric measurements of a suite of short-lived trace gases containing bromine, iodine and sulfur in various marine biogeochemical regimes like close to the coasts, in regions of high chlorophyll, close to coral reefs (as the Toliara reef south of Madagascar) and sea banks and in CO_2 sink regions, and open ocean conditions. From these measurements the climate-sensitive oceanic emission strengths and their contribution to stratospheric halogen and sulfur aerosol abundances will be deduced by high resolution transport modeling.

The atmospheric structure was determined by frequent radio and ozone soundings during the cruise. Other marine trace gases as e.g. nitrous oxide (N_2O), dimethyl sulphide (DMS), oxygen (O_2) and carbon dioxide (CO_2) were investigated as well. In situ and satellite measurements of phytoplankton groups, obtained by special retrieval methods from the SCIAMACHY and GOME-2 instruments gave further information about biogeochemical conditions during the cruise. Atmospheric concentrations of a variety of long-lived anthropogenic and natural trace gases were also determined. These measurements will help to identify transport pathways of the tropospheric trace gases to and away from the ship.

Quasi-continuous measurements of a set of halocarbons, DMS, COS and CO_2 in both seawater and air were carried out in order to determine actual sea to air fluxes. Additionally, we conducted direct flux measurements of CO_2, DMS, isoprene and acetone with the eddy covariance technique. Together with the main scientific objective of the cruise to characterize the oceanic emissions of natural halogenated and sulphuric gases in the subtropical West Indian Ocean, the participating groups followed additional research questions, which are further outlined below by the individual working groups themes (see also Table 1).

Working Groups

1.) HALOCARBONS: Atmospheric and oceanic concentrations of bromine, iodine and chlorine containing halocarbons, in order to calculate their air-sea fluxes.

2.) OCEANIC TRACE GASES: Oceanic concentrations of DMS, COS, CO_2, isoprene, CO, nitrous oxide and methane, in order to understand their distribution in the different biogeochemical regimes of the western Indian Ocean and to gain new insights into halocarbon sources.

3.) EDDY COVARIANCE FLUX: Direct measurements of DMS, CO_2, isoprene, and acetone air-sea exchange. When combined with bulk concentration measurements, the in-situ gas transfer coefficient is derived, which can be used for other gases measured onboard.

4.) OCEAN SENSORS: Identification of carbon dioxide and oxygen sources and sinks, separation of physical and biological factors for observed sources and sinks by CTD data temperature and salinity, joint evaluation with halocarbons, in order to understand more about their sources and sinks.

5.) RADIOSOUNDING: Identification of meteorological vertical profiles, ozone and water vapor in order to evaluate the mixing layer and tropopause height and calculate air mass back trajectories to identify origin of sampled air masses and to validate transport model results and the distribution of ozone above the tropical Indian Ocean atmosphere.

6.) AIR-SAMPLING: Determination of anthropogenic and natural trace gas concentrations by flask sampling, to identify regional and diurnal gradients of some compounds and for intercalibration of different instruments

7.) MAX-DOAS: Identification of reactive trace gases BrO and IO with Multi-Axis Differential Optical Absorption Spectroscopy in a three dimensional field and Cavity Ring Down Spectroscopy as possible decomposition products of organic trace gases and for validation of satellite-data.

8.) GHG: Continuous measurements of the atmospheric mixing ratios of a suite of pollution indicators and greenhouse gases (e.g. CO, CH_4, O_3, CO_2) in order to investigate their spatial and temporal variability in the lower tropical marine boundary layer.

9.) AEROSOL: Major ions and halogens in aerosol samples, in order to identify their sources and quantify the halogen budget in the western Pacific atmosphere.

Participants

Nr.	First / Sure Name	Institute/ Country	Position	Working Group
1.	Kirstin Krüger	UiO, Oslo, Norway	Chief Scientist / Teacher	5.), 6.)
2.	Birgit Quack	GEOMAR, Kiel, Germany	Project PI/ Teacher	1.), 6.), 9.)
3.	Christa Marandino	GEOMAR, Kiel, Germany	Co-Chief/ Teacher	3.), 7.)
4.	Tobias Steinhoff	GEOMAR, Kiel, Germany	Scientist/ Teacher	2.), 3.), 7.)
5.	Matthew Toohey	GEOMAR, Kiel, Germany	Scientist/ Teacher	5.), 6.), 9.)
6.	Matthias Krüger	GEOMAR, Kiel, Germany	Scientist/ Teacher	4.)
7.	Folkard Wittrock	IUP, Bremen, Germany	Scientist / Teacher	7.), 8.)
8.	Helmke Hepach	GEOMAR, Kiel, Germany	Scientist	1.)
9.	Gert Petrick	GEOMAR, Kiel, Germany	Technician	1.)
10.	Serge Kenny RAKOTONJANAHARY	Madagascar	Observer	
11.	Tobias Endjambi	University of Namibia, Namibia	Student	
12.	Eric Nchindo Kamwi	University of Namibia, Namibia	Student	
13.	Blessing Kamwi Kamwi	University of Cape Town, Namibia	Student	
14.	Michael Hemming	University Hamburg, Germany	Student	
15.	Kosmas Benjamin Hench	University of Oldenburg, Germany	Student	
16.	Jessica Holterhof	WMO, Geneva, Switzerland	Student	
17.	Iris Thurnherr	ETH Zürich, Switzerland	Student	
18.	Kelley Verentina Brown	Government of South Africa, South Africa	Student	
19.	Zoleka Filander	University of Cape Town, South Africa	Student	
20.	Robyn Granger	University of Cape Town, South Africa	Student	
21.	Gesa Eirund	GEOMAR, Kiel, Germany	Student	
22.	Alina Fiehn	GEOMAR, Kiel, Germany	PhD Student	
23.	Alex Zavarsky	GEOMAR, Kiel, Germany	PhD Student	
24.	Dennis Booge	GEOMAR, Kiel, Germany	PhD Student	
25.	Steffen Fuhlbrügge	GEOMAR, Kiel, Germany	PhD Student	

Table 1 Participants, institutions and working groups.

Teaching program during the SO234-2 cruise

The teaching program of SO234-2 included daily lectures in the morning, practical sessions using the > instruments on board, taking part in the day and night measurements shift of the > 40 hr station and ended in the preparation and presentation of the student work (Table 2). The studies onboard were carried out by pairs of students, one from a southern African country and one from Germany. The pairs rotated through different measurement stations: 1) meteorology, involving radiosonde launches, 2) atmospheric physics, including spectrophotometric determination of reactive trace gases in the atmosphere 3) physical oceanography, involving deep ocean profiles (CTD casts), 4) biological production including oxygen and nutrient sea water analyses, 5) biogeochemical cycling, involving gas chromatographic and mass spectrometric analysis of seawater samples, 6) atmospheric chemistry, involving air sampling of more than 50 trace gases, and 7) direct trace gas air-sea flux measurements. The student reports are given below.

Day/ Date in 2014	2/ 08.07.	3/ 09.07.	4/ 10.07.	5/11.07.	6/ 12.07.	7/ 13.07.	8/ 14.07.	9/ 15.07.	10/ 16.07.	11/ 17.07.	12/ 18.07.	13/ 19.07.
Notes	Departure					Bergfest						
08:30-10:00	Ship infos	Lecture 2-3	Station	Lecture 6-7	Lecture 8-9	Lect. 10-11	Lect. 12-13	Station	40 hr	40 hr	Present.	Present.
10:15-11:30			work 2					work 7	station	station	prep.	prep.
13:30-15:00		Station	Lecture 4-5	Station	Station	Station	Station	Station			Present.	Student
15:30-17:00	Lecture 1	work 1		work 3	work 4	work 5	work 6	work 8			prep.	present.
						Party						
Station work:		1	2	3	4	5	6	7				
Note		Station rotation							Choose station!			
Birgit		G1	G8	G7	G6	G5	G4	G3			All	All
B2		G2	G1	G8	G7	G6	G5	G4				
Matt		G3	G2	G1	G8	G7	G6	G5				
M2		G4	G3	G2	G1	G8	G7	G6				
Folkard		G5	G4	G3	G2	G1	G8	G7				
Matthias		G6	G5	G4	G3	G2	G1	G8				
Christa		G7	G6	G5	G4	G3	G2	G1				
C2		G8	G7	G6	G5	G4	G3	G2				
							Station:	8				

Groups:	Stations:	Birgit	G2	Lectures:
G1:	Birgit: GC-MS-halocarbons	B2	G3	1. Intro SO234-2 cruise KK (1 1/2 hours)
G2:	B2: Nutrients, O2 and biological parameters	Matt	G4	2. Intro Atmosphere MT (1 1/2 hours)
G3:	Matt: Radio-/ Ozonesondes	M2	G5	3. Intro Ocean MK (1 1/2 hours)
G4:	M2: Air sampling/ Aerosols	Folkard	G6	4. Intro Atmo Chemistry CM+TS (1 1/2 hours)
G5:	Folkard: MAX-DOAS	Matthias	G7	5. Intro Ocean Chemistry BQ (1 1/2 hours)
G6:	Matthias: CTD	Christa	G8	6. Intro Remote Sensing FW (1 1/2 hours)
G7:	Christa: Eddy-Covariance	C2	G1	7. Ocean Measurements MK (1 1/2 hours)
G8:	C2: Underway measurements			8. Reporting from students KK (1 hour, all?)
				9. Atmo Measurements MT/ SF (1 hour)
				10. Atmo Chemistry Measurements CM (1 hour)
				11. Ocean CH Measurements BQ (1 hour)
				12. RS Measurements FW (1 hour)
				13. Reporting from Students KK (1 hour all)

Table 2: Teaching program of SO234-2.

Work program during the SO234-2 cruise

During the SO234-2 cruise of 'RV Sonne' from 08 to 20 July 2014 in the subtropical West Indian Ocean from Durban, South Africa to Port Louis, Mauritius a variety of chemical, biological and physical parameters within the surface waters as well as between the atmospheric boundary layer and the stratosphere have been examined with different frequencies. Data and samples were obtained using a variety of analytical instruments and sampling devices (Tables 3 and 4). Regular water samples were collected from pumps submersed in the hydrographic shaft of the ship (Appendix A). Depth profiles (Appendix B) were undertaken at selected locations to investigate the vertical hydrographic structure of the water column and to obtain trace gas profiles as well as a Lagrangian drifter following the water masses at the surface was employed. Several trace gases from sea water and surface air were analyzed directly on board the ship.

The working schedule during transit included continuous sampling of seawater, a collection of discrete air samples, the installation of optical measuring techniques and the launch of weather balloons. During the cruise samples have been obtained with 44 instruments and sampling devices (Table 3). Routinely three hourly water and air samples were taken from pump supplies submersed in the hydrographic shaft, respectively installed on the monkey deck (Working Groups 1, 2, 6). Meteorologists sent weather balloons with trace gas instruments to the stratosphere (up to 30 km height) every six hours (Working Group 5).

The optical sensors and continuous instruments have been installed in the beginning of the cruise on the monkey deck, the bow and in a research container (Working Groups 3, 7, 9). Halogenated hydrocarbons have been analyzed directly on board using three different gas chromatography/ mass spectrometry systems (Working Group 1). Oxygenated trace gases and dimethyl sulfide were also analyzed directly with a gas chromatograph/mass spectrometric system from sea water (Working Group 3), while carbon dioxide and oxygen were measured immediately with sensors within the upper oceanic layer (Working group 4). More trace gases in sea water (N_2O, CH_4) will be analyzed by gas chromatography post-cruise in the laboratory. Oxygen was measured on board directly by the Winkler method and nutrient samples were frozen until analysis during SO235. Biological sampling included parameters of organic carbon and nitrogen as well as DNA, pigments, cell sizes, the amount of small cells and the composition and activity of the phytoplankton and zooplankton (Working Group 3).

Discrete air samples were taken for partners of the "Rosenstiel School of Marine and Atmospheric Sciences" in Miami and University of East Anglia (Working Groups 6 and 9). In the respective home laboratories more than 70 anthropogenic and natural trace gases, and elements in aerosols within the marine boundary layer shall be analyzed following the cruise. Atmospheric profiles of temperature, humidity and different kinds of trace gases (e.g. ozone, nitrous oxide, bromine oxide) were examined on the basis of optical measurements, and by rises of research balloons(Working Groups 5, 6, 7, 8).

Some samples taken during the cruise have been sent by air freight and are currently analyzed in the respective home laboratories, while the containers with equipment reach Kiel by beginning of October 2014. The analysis of the extensive dataset from the ocean and the atmosphere collected during SO234-2 will bring first results in summer 2015. The new

insights into the interaction of ocean and atmosphere from the subtropical West Indian Ocean will be published in peer reviewed scientific journals.

Instruments

Nr.	Group	Instrument/ Method	Parameter
1	Halocarbons	GC/MS1	Halocarbons
2		GC/ED1	Halocarbons
3		GC/ED2	Halocarbons
4	Oceanic Trace Gases	GC/MS2	DMS
5		Mini-CIMS	DMS/ Isoprene / Acetone
6		GC/ED	N2O
7	Oceansensors	Drifter with sensors	O2/CO2/fluorometer
9		ADCP	Currents
10		CTD	Salinity, Temperature, Depth
11		Auto-analyzer	nmolar-nutrients (uw)
12		Cell counter	Flow-Cytometrie
13		HPLC	Pigments
14		Sequencing	RNS
15		Auto-analyzer (Seal Quattro)	µmolar-nutrients (CTD)
16		TOC-Analyzer	DOC/TDN
20		Ion chromatograph	I-/IO3-
24		LWCC	CDOM
25		Winkler Titration	Oxygen
26	Eddy Covariance Flux	APCIMS	DMS, acetone, isoprene
27		Licor	CO2/ Water vapor
28		Campbell Sonic Anemometer	3D-wind speed and dir (2x)/ T-flux
29		IMU	Motion sensor (pitch and roll)
30	Radiosounding	GPS/ Kompass	Lat /long/ speed over ground
31		Radiosondes	T, Td, w
32		Ozonesondes	Ozone
33		Disdrometer	Precipitation/ Raindrop size
34		RAMSES	Radiation
35	Air sampling	weather-station	T, Td, rain, radiation
36	MAX-DOAS	canisters	long- and short lived trace gases
37		DOAS/ Cavity	BrO/ Nox/ Aldehyde
38	GHG	CES-DOAS	IO
39		Horiba ozone monitor	ozone
40		OA-ICOS	N2O/CO2/CO
41	Aerosols	GC	CH4
42		aeronet/ microtop	Aerosol
43		cascade impactor	Aerosol Ions
44	DSHIP	DSHIP	u,v, T, P, U

Table 3: Installed and operating instruments on board SO234-2 (Durban-Port Louis July, 08-20, 2014).

Measurement schedule

Group	Time of day in UTC																							
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	w			w			w			w			w			w			w			w		
2	w			w			w			w			w			w			w			w		
3	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
4																								
5	r			(r)			(r)			(r)			r/o			(r)			(r)			(r)		
6	a			a			a			a			a			a			a			a		
7						c	c	c	c	c	c	c	c	c	c	c	c	c	c	c				
8	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
9	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c

c: continuous	
w: water sample	
r: radiosonde	
a: air sample	
o: ozonesonde	

Table 4: Underway measurement plan and sampling strategy on board FS Sonne.

Student reports

1) **Oceanic trace gases - GC-MS measurements**
2) **Eddy Covariance measurements**
3) **CTD/rosette bottle sampling**
4) **DOC and DIC measurements**
5) **Dissolved oxygen profiles from titrated samples**
6) **Dissolved oxygen in surface waters – underway sampling**
7) **CDOM**
8) **Meteorological measurements**

1) Oceanic trace gases - GC-MS measurements

Gesa Eirund and Dennis Booge

In order to study gas producing material in the upper ocean, the contribution of phytoplankton and bacteria as well as eventually biogenic produced gases were investigated.

To identify certain groups of phytoplankton and bacteria, pigment filtration and flow cytometry analysis were performed (Figure 1). Results will be gained from lab analysis later on.

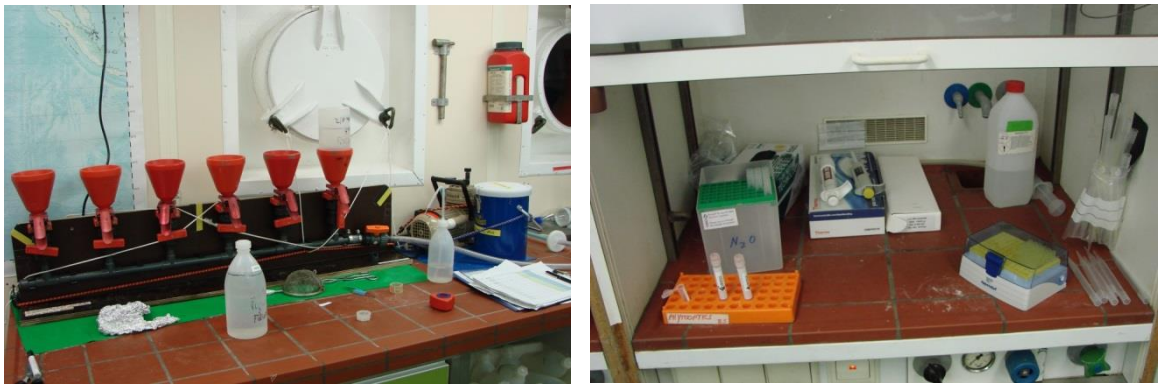

Figure 1 Filtration and flow cytometry.

We also improved a purge and trap technique coupled with a GC-MS (Figure 2) to measure different non-methane hydrocarbons (NMHCs) in seawater. In addition we developed a method to quantify different NMHCs (e.g. isoprene, dimethylsulfide (DMS)) in one measurement. With this analysis of volatile trace gases it is possible to study the surface ocean cycling and air-sea exchange in order to understand their impact on the chemistry of the atmosphere.

Figure 2 GC-MS coupled with a purge and trap technique.

During a 48h-station we performed 8 CTD-Stations. Samples were taken from 5 m to about 100 m depth in order to get information about a potential diurnal cycle in isoprene and DMS concentrations during 2 days in the euphotic zone.

The results show a slight correlation of isoprene-concentrations with chl-*a* (Figure 3). Even we were following with a drifter the same water mass in the upper 20 meters, the water mass below 30 m changed during the 48h-stations after noon of the first day, which could be seen in a different profile of DMS concentrations (Figure 4).

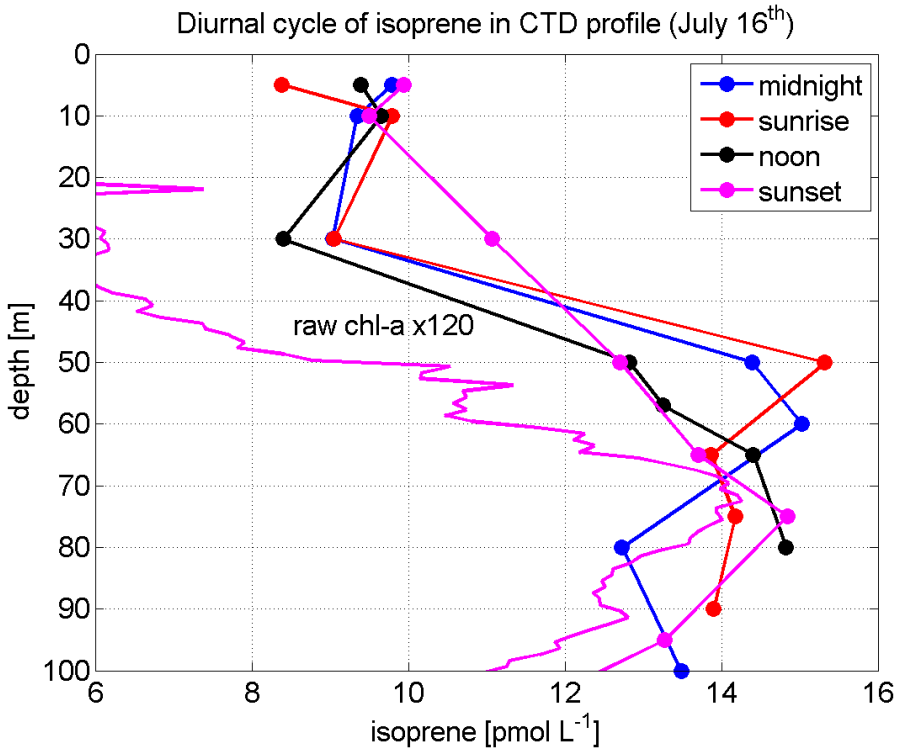

Figure 3 Ocean profiles from isoprene (pmol L^{-1}) and chl-a (x120) concentrations.

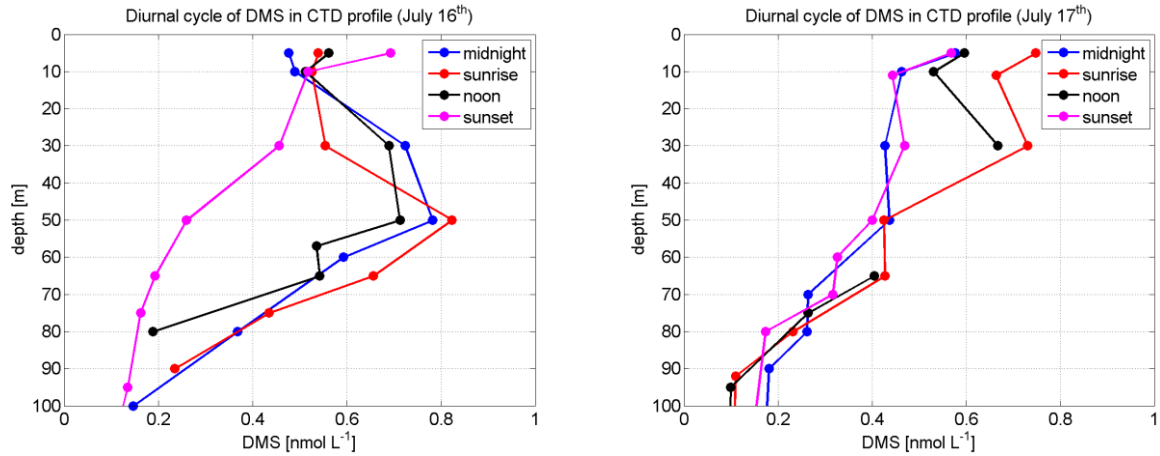

Figure 4 Ocean profiles from DMS (nmol L^{-1}) concentrations on two different days.

2) Eddy Covariance measurements

Alexander Zavarsky

Motivation

In order to investigate the ocean's role in the atmospheric budget of climate active trace gases, we deployed an eddy covariance (EC) direct flux measurement system onboard RV Sonne. EC can be used to perform biogeochemical cycling measurements without typical pitfalls associated with bulk flux calculations, as well as to constrain the main forcings on air-sea gas exchange. Using the direct flux (F), $F = \rho\langle w'c'\rangle$, from EC, we can attempt to improve the gas transfer parameterization (k) used in bulk formulas, $F = (HCw - Ca)$, where ρ is density, w' are the fast fluctuations in vertical wind speed, c' are the fast fluctuations in atmospheric gas concentrations (brackets denote time average), C_w and C_a are water and air concentrations, respectively, and H is the Henry's law solubility constant. My goal was to measure dimethylsulfide (DMS), isoprene and acetone flux. Measurements started at DOY 196 12:00 UTC (-29.62444288 LAT 58.58830401 LON) and continued until Port Louis.

Instrumentation

Atmospheric levels of DMS, isoprene and acetone were measured using an atmospheric pressure chemical ionization mass spectrometer (AP-CIMS). Air was sampled through a ½" tube from a mast welded to the bow (approximately 10 m above the sea surface) at a flow rate of 70 l min^{-1}.To obtain turbulent wind speed measurements and sensible heat flux, a sonic anemometer was placed at the bow mast. A GPS and inertial navigation system (INS) was used for motion correction (Figure 1).

Figure 1 Set-up of instruments onboard of SO234-2, Durban South Africa.

Preliminary results:

Bulk air concentrations

All three trace gases, isoprene, DMS and acetone, show relatively low bulk concentrations (Figure 2). This is in accordance to findings of the report by Gesa Eirund and Dennis Booge, which report very low water concentrations of respective gases. A daily cycle, due to photolysis (sunlight creates OH which oxidizes isoprene), of isoprene can be seen.

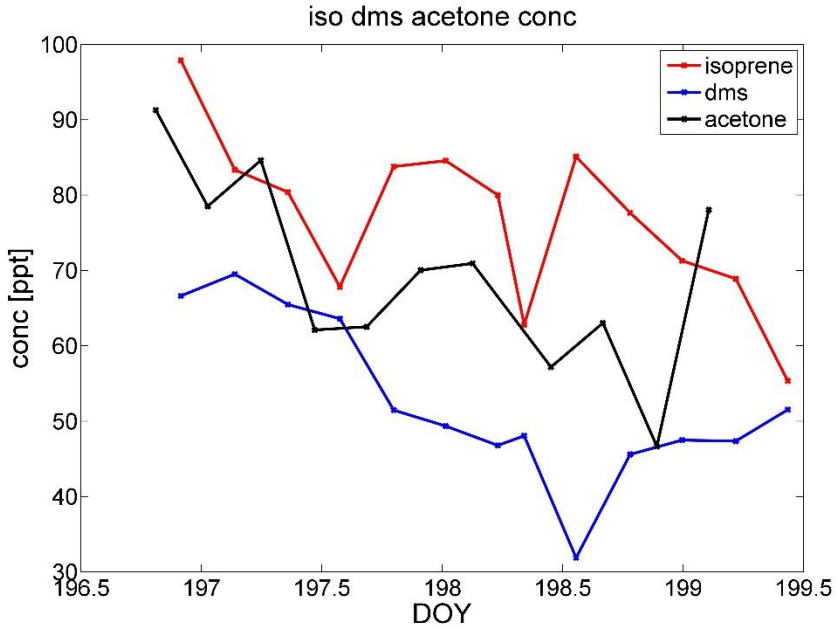

Figure 2 Bulk air concentrations of isoprene, DMS and acetone (in ppt).

Wind spectrum

Figure 3 shows a sample power spectrum of vertical wind speed. It reveals good agreement with the Kaimal turbulent wind spectrum. Still the motion peak at around 0.1 Hz has to be removed using data from the IMU.

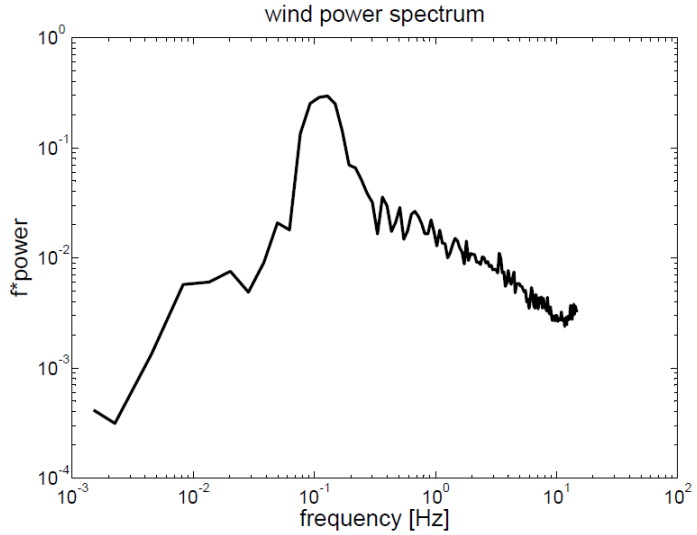

Figure 3 Power spectrum of vertical wind speed.

Trace gas spectrum

Figure 4 shows a sample spectrum of the fluctuations of acetone. However, this spectrum is promising; still an improvement of sensitivity of the mass spectrometer is needed to get good data to perform the correlation with wind data for flux calculations.

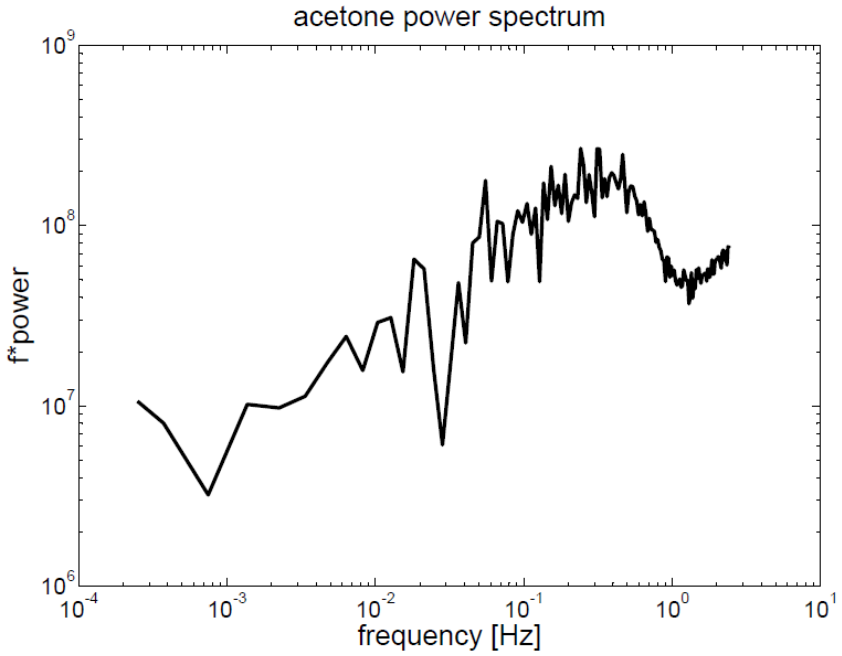

Figure 4 Power spectrum of acetone measurements.

3) CTD/rosette bottle sampling

Kelley Brown and Eric Kamwi Nchindo

Introduction

During the 48 hour station, the two of us took part in profiling the ocean using the CTD/Rosette sampler. We took turns through shift work, in which we were both able to be part of four deployments each.

The CTD instrument is an acronym for Conductivity, Temperature and Depth instrument. It measures these parameters throughout the water column, during casts. The CTD is situated below the Rosette bottles, which is triggered to close, using the software, to collect water samples at given depths. From the first CTD's conducted at the beginning of the cruise, graphs were drawn, using Microsoft Excel, to view what was being observed throughout the water column.

Preliminary results

Below is the graph (Figure 1) for temperature and the 4 casts displayed the same profile. An observation is made that surface temperature moderate for the Indian Ocean. The lowest and highest temperatures are approximately at 21 and 24 °C, respectively. The possible reason for Cast 1 having a slightly warmer temperature above 500m could be because of the Mozambican current.

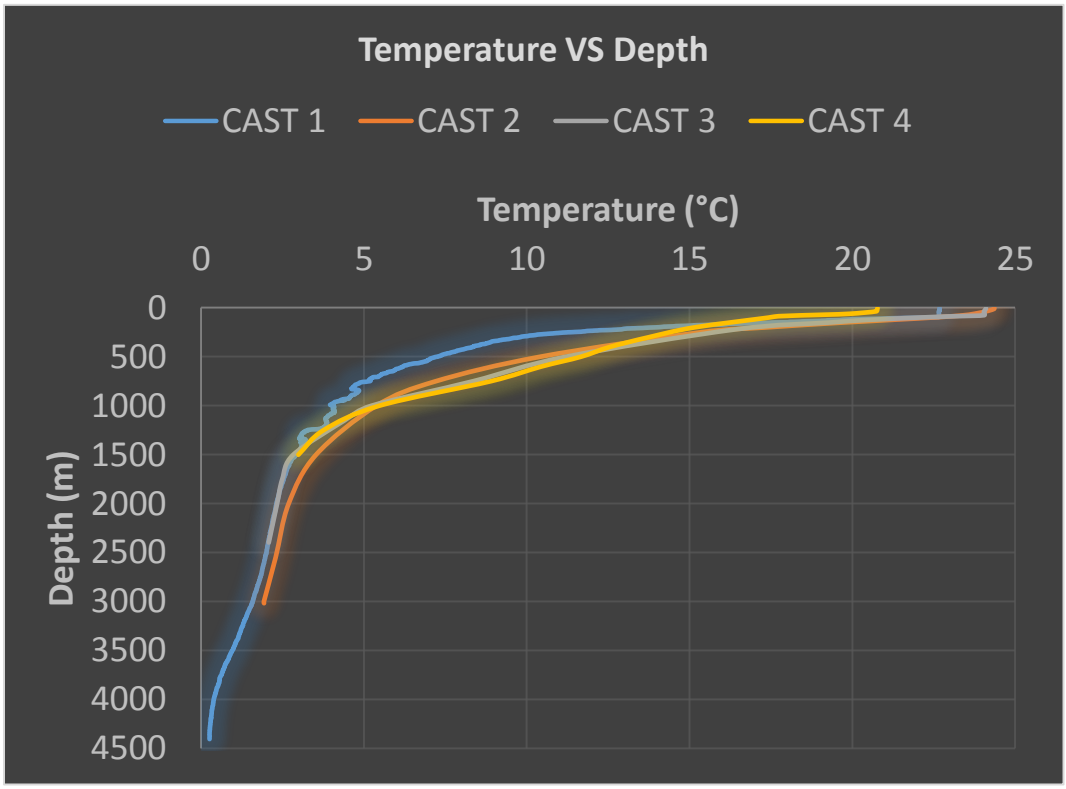

Figure 1 Water temperature (°C) versus ocean depth (m).

Figure 2 depicts temperature vs. salinity. It was observed that on the surface salinity was relatively high and this was due to high temperature. High temperature results in high

evaporation on the surface of course precipitation also played a role since we experienced just showers for some seconds, hence this did not alter the salt concentration on the surface. In addition to this, salinity decreased (observed) with increase in depth.

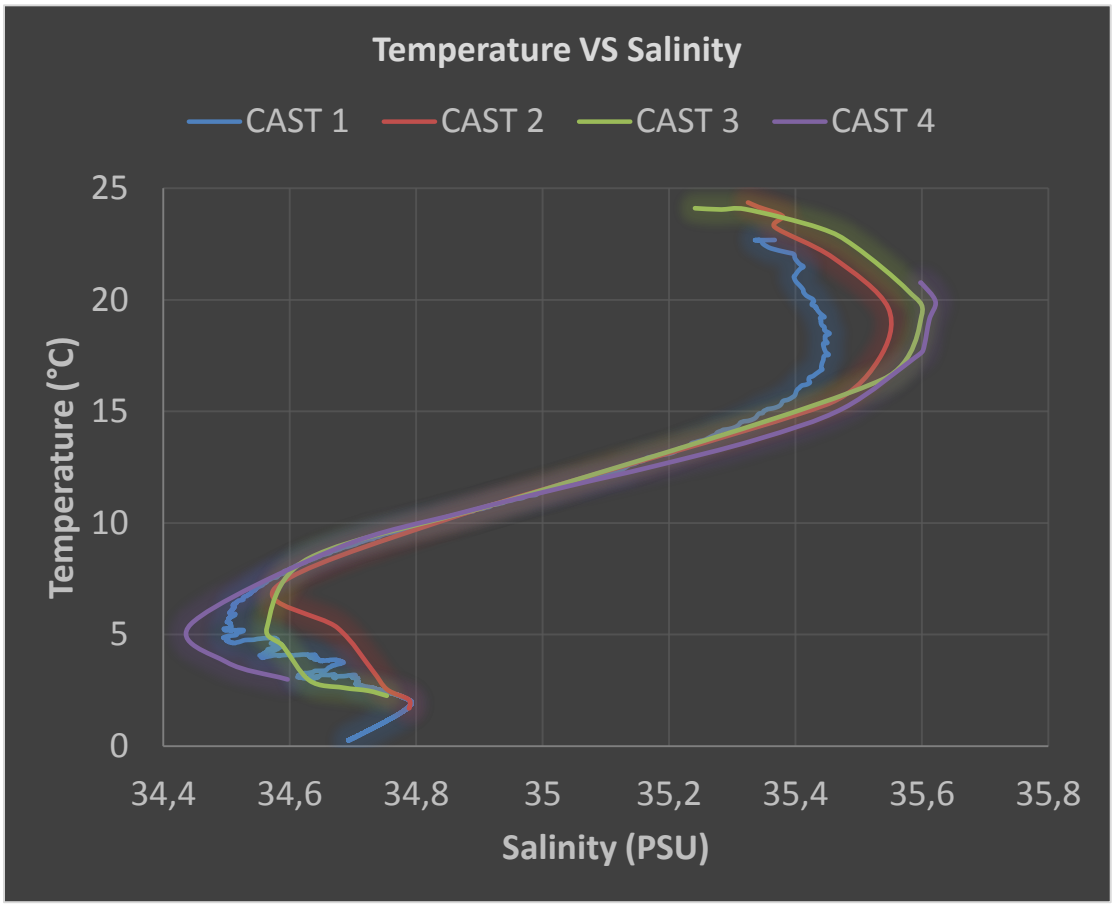

Figure 2 Water temperature (°C) versus salinity (psu).

Figure 3 is the graph that shows oxygen vs. depth (all the 4 casts displayed the same profile). We observed that oxygen concentration was high on the surface, why? This was due to primary production occurring tin the photic zone. So oxygen level decreased with increase in depth, hence a non-linear relationship was observed. However, oxygen concentration level was high again in deeper water because the deep layer is rich in oxygen due to water that is derived from the cold surface waters which sank (convection) to the bottom. Consumption is low because there are fewer organisms and less decay consuming oxygen.

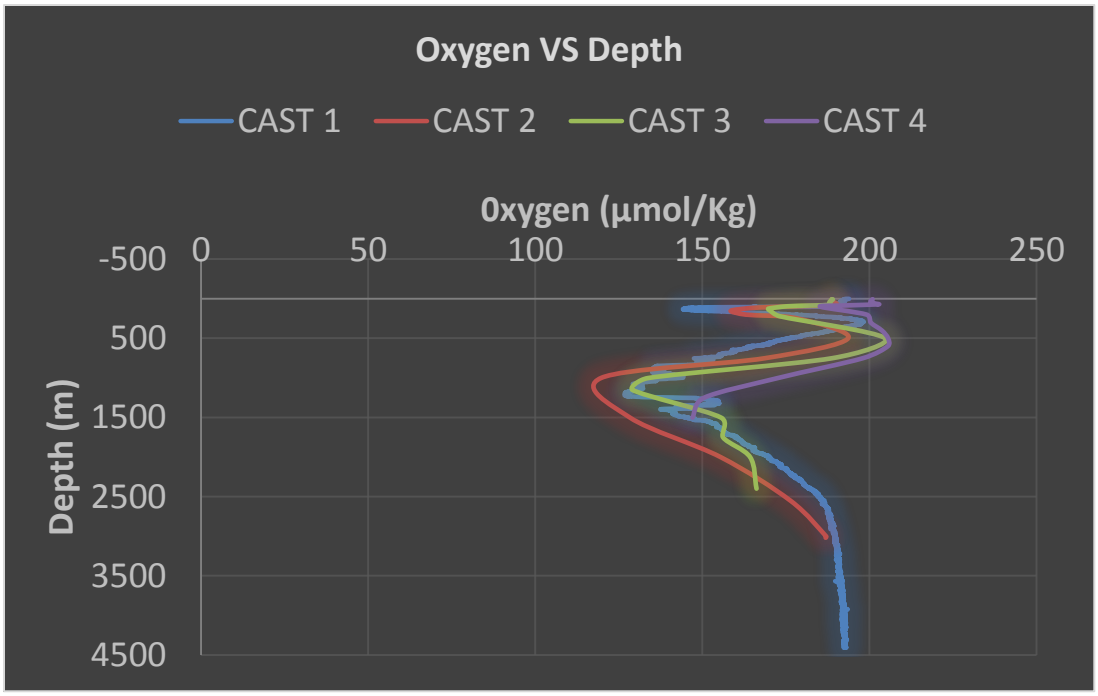

Figure 3 Oxygen (µmol/Kg) versus ocean depth (m).

Figure 4 shows fluorescence versus ocean depth. High Fluorescence concentration was observed on the surface due to primary production in the photic zone. Cast 2 and 4 displayed a high concentration level because we were close to the coast of Madagascar otherwise the other two displayed almost the same profile.

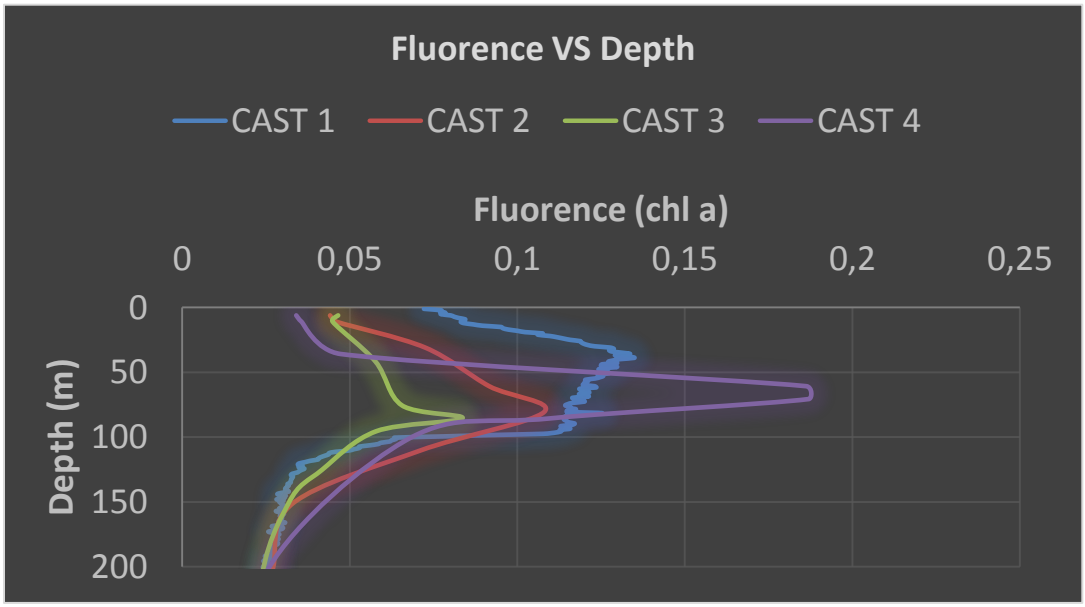

Figure 4 Fluorescence (chl-a indicator) versus ocean depth (m).

4) DOC and DIC measurements

Zoleka Filander and Iris Thurnherr

DOC and DIC measurements during the SO234-2 SPACES on FS Sonne in the Southern Indian Ocean.

By
Zoleka Filander
Offshore Benthic Ecologist at DEA, South Africa
and
Iris Thurnherr
MSC at ETH Zurich, Switzerland

Port Louis, Mauritius, July 19, 2014

Contents

1 Introduction

It is no secret that the climate is dramatically changing globally due to anthropogenic activities. With atmospheric carbon dioxide increasing at an exponential rate it is prominent to understand the distribution and pathways taken by such an influential gas. Sea-Air interactions of most oceans have been examined and datasets analyzed. However, the Indian Ocean has received little attention over the years; and paucity on how this mass is responding to climate change still exists; especially in the Southern Indian Ocean (SIBER, 2009).
This cruise thereby aimed to evaluate the biogeochemical and atmospheric statuses of various gases in the Southern Indian Ocean, and this report will emphasize on the carbon.
Carbon is transported through different mediums (land, oceans and atmosphere) by a phenomenon referred to as the carbon cycle. In marine environments carbon is extracted from the atmosphere in an inorganic form (Dissolved Inorganic Carbon - DIC) where photosynthesis converts it to a carbohydrate with assistance of sunlight and other gases, i.e. oxygen. There are various sources that affect the concentrations DIC in the ocean such as temperature or ocean circulation. This inorganic form is thereafter found in biomass as an organic form that can be classified as either dissolved Organic Carbon (DOC) or particulate organic carbon (POC). These classes are based on size i.e. POC $>= 0.45\mu m$ and DOC $<= 0.45\mu m$ (Dafner et al., 2002). As in DIC, there are some sources that influence DOC. They include freshwater input, rainfall input, sedimentation etc. Both phases find their way to greater depths of the ocean.

2 Data and Methods

2.1 DOC Analysis

. DOC samples were collected from a CTD that was casted at a 6-hour interval. All samples were from shallow depths (<100 m) due to the high abundance of species found. Samples were then taken to the lab where 20 ml was filtered into a glass bottle. Thereafter, 8 μl of phosphoric acid was added to stabilize the gas. Bottles were then flamed sealed, and refrigerated. Analyses to be undertaken in Germany (Kiel) using a high-temperature catalytic oxidative technique (HTC). Thus, no data was available to present on the cruise.

2.2 DIC (Dissolved Inorganic Carbon)

pCO_2 is a form of DIC , and this gas was measured from the under way system which ran at 3 hour intervals from the 10-18th July and a drifter that was operated for the 48-hrs station. The gas was measure using a CO_2 sensor which pumps the air till its dry and then passes the dry air through an infrared detector. No laboratory analysis was needed. No calibration of the data was done. Therefore preliminary results were presented on the cruise.

3 Preliminary Results

The partial pressure of CO_2 in the surface water (pCO_2^o) from the underway and drifter measurement, the equilibration temperature of the underway surface water (SST)and the partial pressure of CO_2 in the atmosphere (pCO_2^a) are shown in this section.
Figure 1 shows the time series from the 10.to 18.7.14 for the pCO_2^o, pCO_2^a and SST. pCO_2^a was

more or less constant during these days at a value of 386 ppm. pCO_2^a shows values from 350 to 378 ppm (the very high and low peaks show calibration measurements). From the 15.7. 17 pm to the end of the time series pCO_2^o is measured on the drifter.Around the 12.7.14, when the cruise was near the southern tip of Madagascar, the pCO_2^o highest. During the drifter measurement pCO_2^o is relatively constant. The atmospheric values of pCO_2 are higher the the oceanic values of pCO_2 during the whole time window. The SST decreased from around 25^oC in the beginning to around 19^oC at the end. The temperature seems to follow the decrease in oceanic pCO_2 from 12. -15.7.14 but shows more variability than pCO_2^o from the 14.to 18. of July.

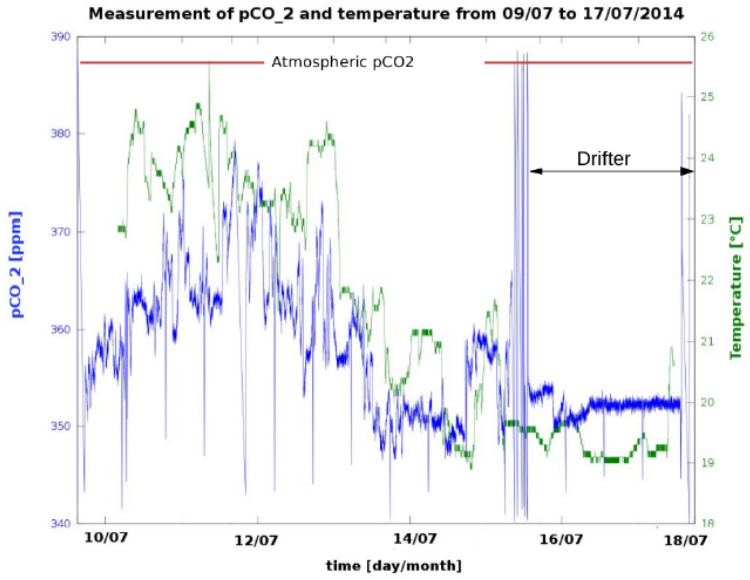

Figure 1: Time series of partial pressure of CO_2 of the surface water (pCO_2^o, dark blue) and atmosphere (pCO_2^a, bright blue) and sea surface temperature (SST, green). SST measured from underway water, pCO_2^o data from underway measurement apart from the section marked with D̈rifter:̈ The drifter data was measured on the drifter during the 48-hrs station.

As a rough estimate, the temperature dependence of pCO_2^o was calculated using the well known physical relationship between temperature and pCO_2 (see Appendix). Figure 2 and three show the analysis of this relationship. The cruise was divided into two part for this analysis. The part west of 45^oE where the water masses are within the Mozambique channel and the part east of 45^oE where the water masses are influenced by the circulation east of Madagascar. The "temperature dependent" pCO_2 corresponds to the partial pressure of CO_2 in the water if pCO_2^o was only dependent on temperature. This means that the measured pCO_2^o and the temperature dependent pCO_2^o overlay in cause measure pCO_2^o depends only on temperature.

Figure 2 shows the analysis for the first part of the cruise. The temperature dependent pCO_2^o

shows a different time line than the measured pCO_2^o. The temperature independent part which is the counterpart to the temperature dependent part should be the same as the temperature dependent part after it is mirrored on the measured pCO_2^o. This is not the case in figure 2. Figure 3 shows the second part of cruise. The temperature dependent pCO_2^o and measured pCO_2^o do not overlay. Contrary to figure 2 the temperature independent and dependent pCO_2^o are mirrored along measured pCO_2^o.

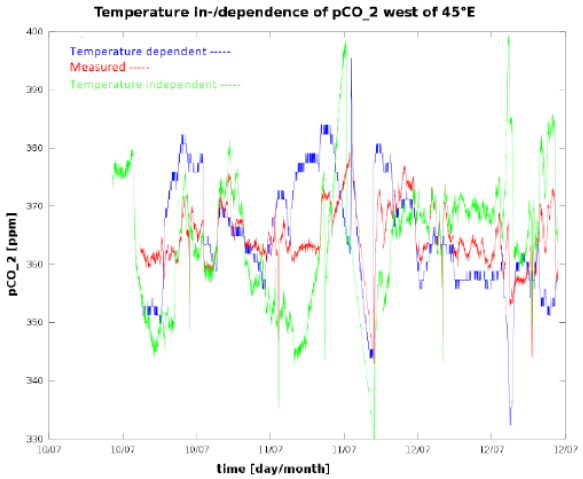

Figure 2: Time series of measured (red), temperature dependent(blue) and temperature independent(green) pCO_2^o west of 45^oE.

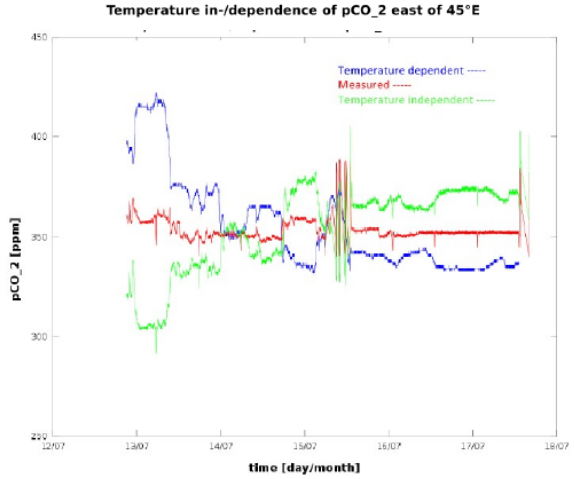

Figure 3: Time series of measured (red), temperature dependent(blue) and temperature independent(green) pCO_2^o east of 45^oE.

4 Discussion

Atmospheric pCO_2 versus oceanic pCO_2:
The pCO_2^a is larger than pCO_2^a over the whole time series. This indicates that the Indian Ocean on the cruise track is a CO_2 sink. Especially during the drifter measurement, the CO_2 sink is strong. The decrease of SST simultaneously with the decrease of pCO_2^o could indicate a temperature dependence of pCO_2^o . But the fluctuations of the SST from 14. - 15.7.14. do not agree support this hypothesis. The analysis of the temperature dependence in figure 2 and 3 show that temperature is not the only factor influencing pCO_2^o because the measured and temperature dependent pCO_2^o do not overlay each other. The mismatch of the temperature dependent and independent pCO_2^o during the first part of the cruise might be due to calculation errors or a mismatch of the time axis.

5 Further Studies

Temperature is not the only factor influencing pCO_2^o. Thus the investigation of other parameters might give some more insights into the processes behind the measured pCO_2^o. Possible parameters are biology (e.g. phytoplankton blooms), Circulation, DOC, pH of the seawater, Oxygen and Salinity.

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7 Appendix

Formula to calculate oceanic pCO_2 depending on temperature

$$pCO_2^{dep} = \overline{pCO_2} \cdot exp(0.0423 \cdot (T_{meas} - Tmean))$$

and the oceanic pCO_2 if temperature had no influence

$$pCO_2^{indep} = pCO_2 \cdot exp(0.0423 \cdot (T_{mean} - Tmeas))$$

. Where $\overline{pCO_2}$ is the mean pCO_2 over the calculation time, T_{meas} the measured temperature and T_{mean} the mean temperature over the calculation time.

5) Dissolved oxygen profiles from titrated samples

Tobias Endjambi and Blessing K. Kamwi

Introduction

The southern Indian Ocean is characterized by different water masses/current that influences the vertical mixing of water. However there little is published on the phenomena that are happening in this area. To understand this, more extensive studies need to be done.

This exertion of the project was aimed at determining the oxygen profile at predetermined sampling stations in the Southern Indian Ocean, between Durban – South Madagascar - Mauritius (Figure 1). Furthermore this work compared the CTD profile undertaken during the cruise to the titrated samples for calibration purpose. In addition to that, we compared the oxygen concentration during the day to the concentration of oxygen during the night

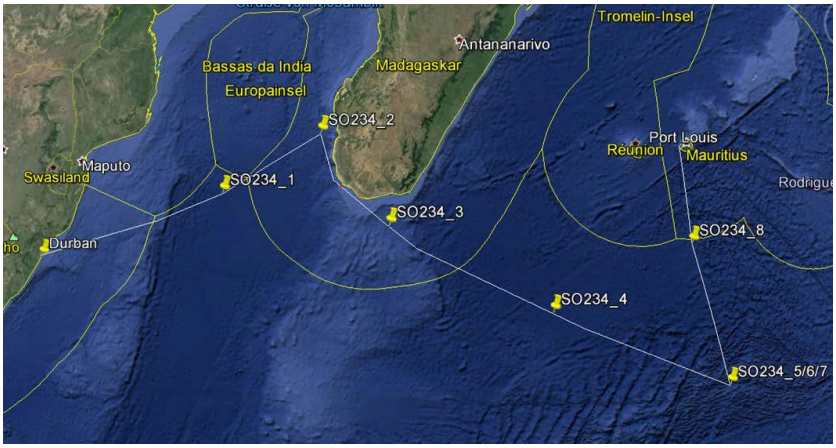

Figure 1 Proposed SO234-2 cruise track.

Materials and methods

Samples for oxygen where taken at predetermined CTD sampling stations along the cruise track. The oxygen samples were drawn into clear bottles (labelled with different "Bedford-No") from the *niskin* bottles and treated immediately with sodium hydroxide and magnesium chloride then mixed by shaking for about 30 seconds before they were taken to the laboratory for analysis. Samples were covered with a cloth to prevent further photosynthesis process by phytoplankton while allowing the solution to precipitate and settle at the bottom at least for 30 minutes.

Figure 2 A TITRONIC® *universal* Piston Burette used for titration.

A TITRONIC® *universal* Piston Burette set was used for sample analysis (titration) and the following procedures were followed as shown in Table 1 below.

Table 1 sample analysis procedures:

Standardization	**Sample (bottles) titration**
• 50 ml deionized H_20 into a glass beaker • Add 1 ml of 50%-H_2SO4 • Switch on the stirrer • Add NaOH • Add $MnCL_2$ • Add 10 ml iodate $KH(I03)_2$ • Titrate with Na-thiosulphate until it turn pale yellow • Add 1ml of starch • Titrate until it become clear • **NB:** note down the reading on the piston burette	• Open the sample bottle and add a magnet (make sure the stirrer is off) • Add 1ml of 50%-H_2SO4 • Turn the magnetic stirrer on • Titrate with Na-thiosulphate until the color turn pale yellow • Add starch and titrate until the solution become clear • **NB:** note down the reading on the piston burette

Determination of oxygen concentration

Calculation of oxygen concentration was done following Winkler (1988)

O_2 (µmol/L) = $a \cdot f \cdot 500/ (b\text{-}2)$

$f = \frac{5}{v\ (mL)}$

f- is the …factor

a- is the volume of the titrated Na-thiosulphate *(bottle sample)*

b- is the volume of the bottle sample

v- is the volume of the titrated Na-thiosulphate *(standard)*

The units (µmol/ L) of oxygen concentration were changed to (µmol/ Kg) as follow:

$$\mu\text{mol/ Kg} = \frac{(\mu\text{mol/ L})}{\text{Density (Kg/L)}}$$

Results and Discussion

The dissolved oxygen concentration from the six stations along the SO234-2 cruise track was determined. The CTD oxygen data from the sensor was compared to the oxygen titrated using the Winkler method. The dissolved oxygen determined from the Winkler method was converted to µmol/kg for better comparison with the CDT data. The dissolved oxygen from both the CDT and the Winkler method show similar oxygen profile patterns (Figure 3 and 4).

Station one was in the Mozambique Channel and shows an oxygen maximum of CDT (192.05 µmol/kg) and Winkler (217.09 µmol/kg) between the depth of 10-500 m (Figure 3). This oxygen maximum is also depicted in stations 2 at the depth of approximately 500 m. It is also important to note that station 2 was close to the continental shelf of Madagascar where there is primary productivity. This oxygen maximum was also evident at station 3 at the same depth of 500 m. Station 4 is along the southwest Indian ridge, at this station the oxygen maxima was deeper (600 m) compared to the other stations (Figure 4). This oxygen maximum along these four stations may be due to the Antarctic Intermediate Water which is reach in oxygen travelling northwards (Tomczak and Godfrey, 1994). The oxygen maxima are also observed to be sinking to deeper depth as you follow the cruise track eastward.

All four stations depict an oxygen minima zone at the depth between 1000-1300m conversely as you move south east along the cruise track, the oxygen minima zone get deeper (Figure 3 and 4). These oxygen minima may be due to aged water mass which is isolated and becomes warmer. According to Rogers (2000), the Indian Ocean has an intense intermediate-depth oxygen minima zone. The oxygen concentration tend to be higher at the bottom, this may be due to the influence of Antarctic Bottom Water (AABW) water mass which flows from the Weddell Bay into the Indian Ocean at through the gap of the southwest Indian ridge and the Madagascar basin (Thomas et al., 1998).

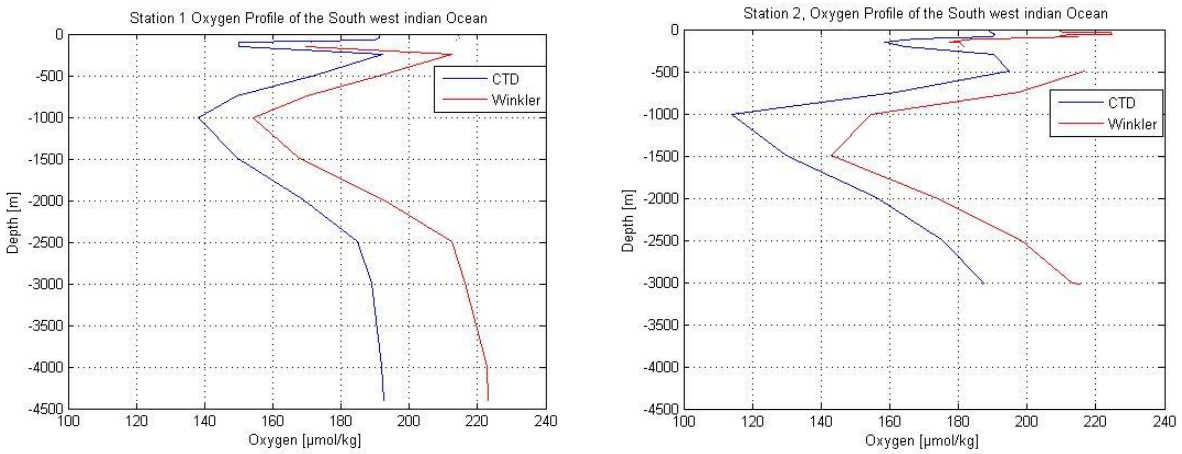

Figure 3 Oxygen profiles from station 1 and 2 along the SO234-2.

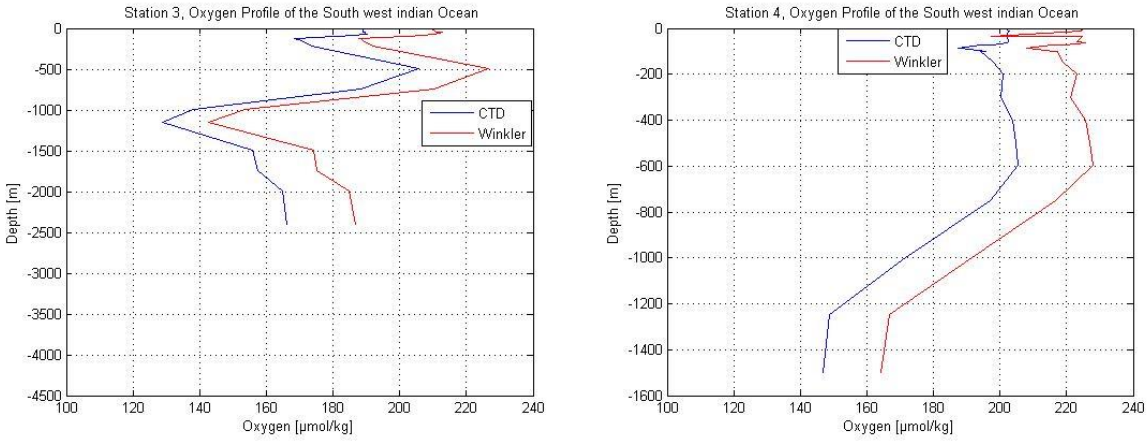

Figure 4 Oxygen profiles from station 3 and 4 along the SO234-2.

The 48 hours station

Along the 48 hours station eight different casts were taken with the CDT following the drifter deployed on the 16th of July 2014. Two casts were made at midnight and two were made at mid-noon. The oxygen levels were measured at all the casts. Figure 5 shows the midnight and mid-noon oxygen profile from the Winkler method. This depicts higher oxygen levels during midnight then during mid-noon. This may be due to errors during the titration of oxygen as the levels were expected to be higher during noon due to photosynthesis.

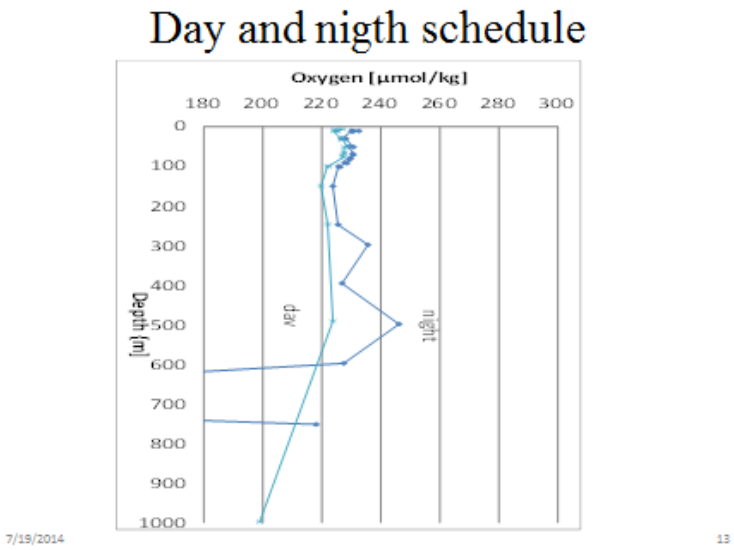

Figure 5 Day and night oxygen profile along two stations 5 and 7.

The CTD and Winkler offset

The offset between the CTD and Winkler were determined by subtracting the CTD data from the Winkler data and then expressed in percentage as shown in figure 6. The offset increased with increasing depth. The offset is approximately 15%, this is due to the calibration of the CTD or due to pressure.

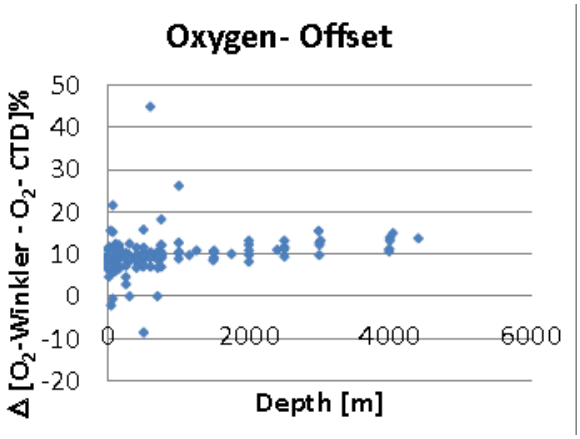

Figure 6 Offset between Oxygen –sensor on CTD and direct oxygen-determination by Winkler.

Conclusion

There appear to be a low oxygen minima zone along the cruise tracks whereas the oxygen maximum is between the depths of 100-1000m. This is influenced by different water masses. The oxygen levels tend to be deeper from station to station and follows a water mass. Therefore further studies should investigate the spatial and temporal variation. Comparison with other parameters such chlorophyll a and salinity and the physical dynamics of the South West Indian Ocean.

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6) Dissolved oxygen in surface waters – underway sampling

Robyn Granger and Jessica Holterhof

O_2 is pivotal in the biogeochemical cycling of carbon, nitrogen, and others (P, Fe, Mn, etc.), and fundamental for all aerobic life. Oxygen concentrations in seawater are mainly controlled by fluxes through the air-sea interface, by biological assimilation and dissimilation, and the dynamical motion and mixing of water (Hansen, 2007).

At present, dynamics of the Indian Ocean are sparsely documented. The SO234-2 cruise therefore presents new dissolved O_2 data in this seasonally variable region.

SETTING

The Southwest Indian Ocean circulation is affected by multiple water masses, including the Southeast Madagascar Current (SEMC) and the Antarctic Circumpolar Current (ACC) waters, the former of which plays a large role in the region explored during the cruise. The wind-driven, anticyclonic circulation of the Southern Indian Ocean shows two persistent features – a large basin-wide circulation and a well-developed subgyre west of the Madagascar Ridge.

The ACC transports cold O_2-rich bottom water in the thermohaline circulation northwards into the northern Indian Ocean. The water circulates in the Northern Hemisphere, and returns as intermediate/surface water to the southern Indian Ocean. The South Indian gyre then recirculates the water masses in the western and central parts of the basin (Stramma and Lutjeharms, 1997).

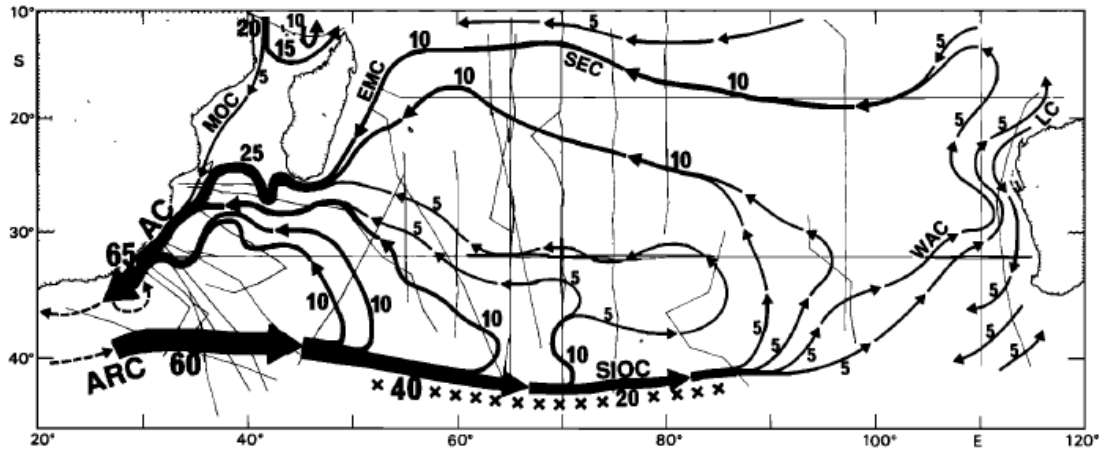

Figure 1 Schematic overview of the flow field in the South Indian Ocean (Stramma and Lutjeharms, 1997).

METHODOLOGY

Measurements were mainly taken with an O_2 optode that was installed on board of the ship. During the 40h station, the optode was deployed onto the drifter. For the in situ detection of oxygen, the optode provides a good method for measurement, as it is based on the ability of oxygen to act as a luminescence quencher (Tengberg et al., 2006). The higher the

concentration of oxygen in the water, the lower the luminescence reaction detected within the optode.

Additionally, underway samples and the uppermost 5-10 m samples of the CTD from the first four stations of cruise SO234-2 were taken into account. O_2 concentrations for those samples were measured with the Winkler Titration method. The Winkler Titration is a multi-step oxidation-reduction process that enables the calculation of actual oxygen concentration values within the water samples (Hansen, 2007). Through the use of multiple detectors such as the Winkler Titration of underway and CTD samples and the O_2 optode, higher accuracy could be established of the dissolved oxygen using the following formula: y=0.615*x+76.498. The calibration enabled the correction of the O_2 optode data.

RESULTS/MEASUREMENTS

The data taken represent the dissolved oxygen values in surface waters of the southern Indian Ocean, and a focus was set on the sampling of underway measurements in the top few meters of the ocean. In general, surface layers may often become saturated and sometimes slightly over-saturated due to air-sea exchange of oxygen, photosynthesis, respiration and oxidation of organic matters (Miyake and Saruhashi, 1966).

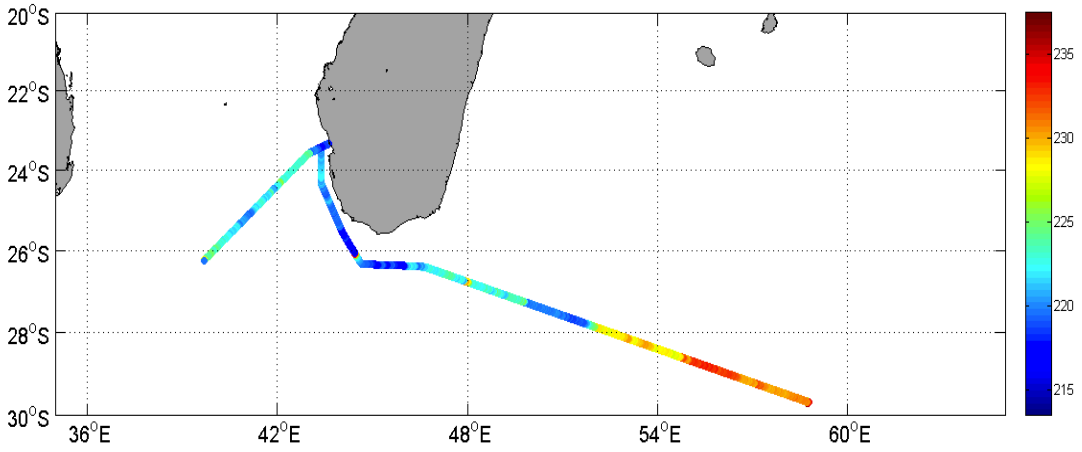

Figure 2 Dissolved O_2 measurements using the Optode from 9-15 July 2014. The scale on the right side shows amounts of O_2 concentrations in µmol/L.

Figure 2 displays the calibrated dissolved O_2 concentration, which is shown to be increasing towards the southeast of the research area. Lower values can be detected in the coastal regions surrounding the southernmost tip of Madagascar. This is consistent with the underway titration O_2 measurements taken within the region of the 40 hr station (at approximately 30° S and 60° E), as they show amounts well above 230 µmol/L as well. The O_2 values were then used to calculate the oxygen saturation (see Figure 3), where results indicate a similar trend. The data suggest a slight over-saturation in the overall sampling area.

Variations in surface temperature, taken from approximately 6 m water depth using the equilibrator on board, seem to correlate with the O_2 saturation data. As one moves further southeast into the gyre, temperatures decrease with a sharp gradient occurring at about 48° E.

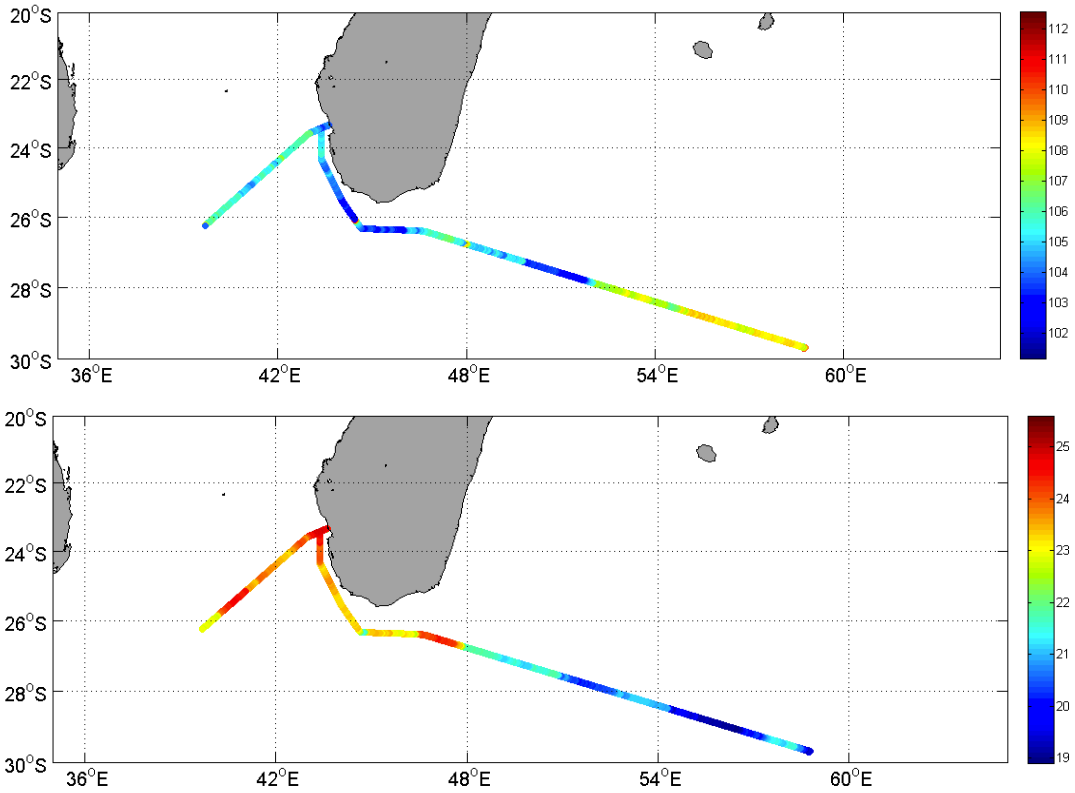

Figure 3 The uppermost figure displays the O_2 saturation in %, and the lower image shows the surface temperatures in °C.

REMARKS

The complex current circulation within the region gives rise to interesting physical surface properties. Changes in absolute dissolved O_2 and O_2 saturation could be due to the influence of the SEMC, which is in turn effected by the bathymetric profile to the south of Madagascar. Biological activity is generally considered to be an important forcing mechanism with regard to changes in dissolved O_2. Whether this is the case in the southwest Indian Ocean remains to be seen, and would make for further studies.

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7) CDOM

Alina Fiehn and Kosmas Hench

What is CDOM?

Chromophoric dissolved organic matter (CDOM) is the fraction of DOM that interacts with solar radiation (280-700 nm). A fraction of it is fluorescent.

Sources of oceanic CDOM include Terrestrial humic materials from rivers and runoff as well as autochthonous production from microbial Metabolism in the open ocean. The CDOM from terrestrial sources is mostly removed in the coastal zone. CDOM production in the open ocean is a byproduct of the metabolism of zooplankton, dinoflaggelates, and macroalgae. The main sink of CDOM is in the ocean is solar bleaching. CDOM is degraded by photolysis and therefore influences the underwater radiation budget. This also means that the ocean color is greatly influenced by its CDOM content.

The absorption of light by CDOM also has implications for photochemistry and –biology in the ocean. On the one hand it limits the amount of accessible light in the visible spectral range; on the other hand it functions as a protection against UV radiation for plankton.

Why do we measure CDOM?

Ocean color based satellite remote sensing of chlorophyll and primary productivity is biased by the CDOM fingerprint of the water color. For calibration reference measurements are necessary.

The degradation of CDOM by UV light results in the formation of trace gases. These include COS, CS_2, OVOCs, formaldehyde, acetone, acetaldehyde, alkanes and alkenes (e.g. isoprene). Therefore CDOM plays a vital role in the air-sea exchange of trace gases.

Measurement

CDOM can be optically quantified by spectrometry. A mass quantification is not possible yet, but the absorption coefficient correlates with the quantity. Still, the absorption is relative to exact composition of CDOM.

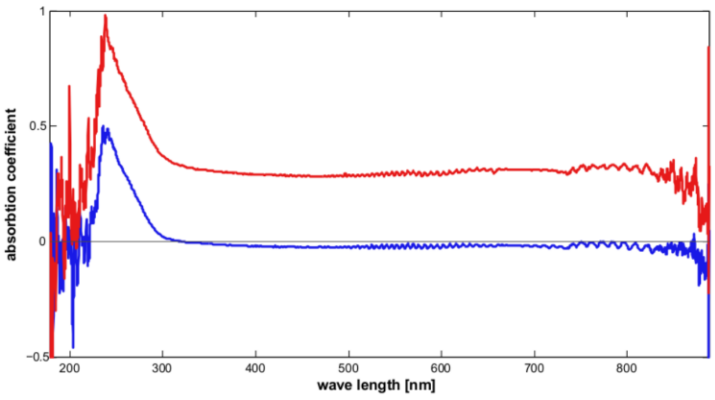

Figure 1 Absorption spectra of CDOM.

Figure 1 shows two measured absorption spectra of CDOM of this cruise. A typical spectrum has a maximum between 230 and 250 nm and then falls exponentially to a base value. In order to compare the different spectra this base value at about 700 nm and the absorption coefficient close to the maximum value are determined. The abundance of CDOM is then relative to the difference between those two values.

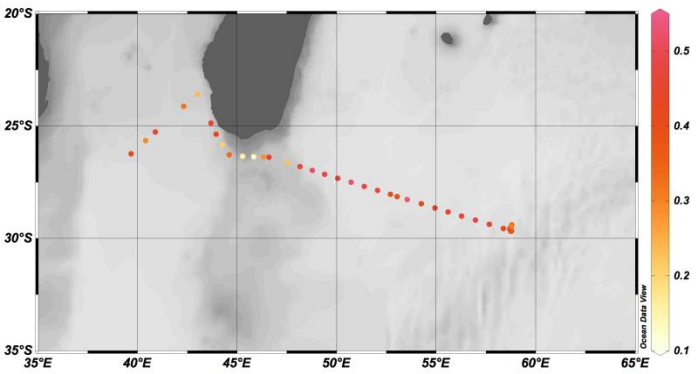

Figure 2 Abundance of CDOM from underway measurements.

The abundance of CDOM in terms of absorption has been determined for all underway samples from SO234-2 so far. The results are depicted in Figure 2. Normally the amount of CDOM in the surface waters is high close to the coast and decreases towards the open ocean. Figure 2 shows the lowest values close to the reef south of Madagascar and higher values in the open ocean.

CDOM abundances have also been determined for the CTD casts during SO234-2. Figure 3 shows the profiles of CDOM and isoprene from the 7 CTD casts of the 48h station. The abundance of CDOM declined slightly with depth in the first 500m. In greater depths the abundance remained constant. This goes in accordance with the expectations as major depletion of CDOM by photolysis can only take place in surface water masses. As CDOM presents a precursor to isoprene, a relationship of the abundance of CDOM and isoprene would be plausible – yet after preliminary analysis of the CTD casts no such relation could be detected.

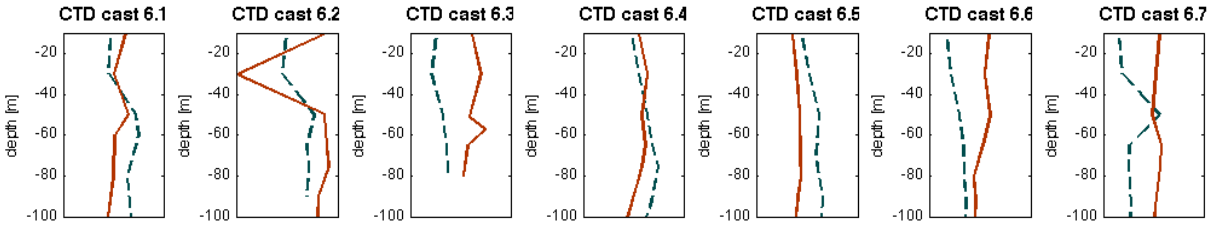

Figure 3 CTD profiles of CDOM (red) and isoprene (dashed) for the seven casts from the 48h station.

Classification of CDOM

A classification of the type of CDOM and its source is possible by analyzing the spectra as well. The absorption spectra can be approximated using the following formula, where a_{CDOM} is the absorption coefficient, S is the exponential slope parameter and λ_0 is a reference wavelength:

$$a_{CDOM}(\lambda) = a_{CDOM}(\lambda_0)e^{-S(\lambda-\lambda_0)}$$

The slope parameter can be calculated by a linear fit through the logarithmic spectrum and is used to classify the CDOM. Figure 4 shows CDOM absorption spectra from different regions. Lower slope values correspond to coastal waters with high amounts of terrestrial sourced CDOM and open ocean waters show higher slope parameter values (Nelson & Siegel, 2013).

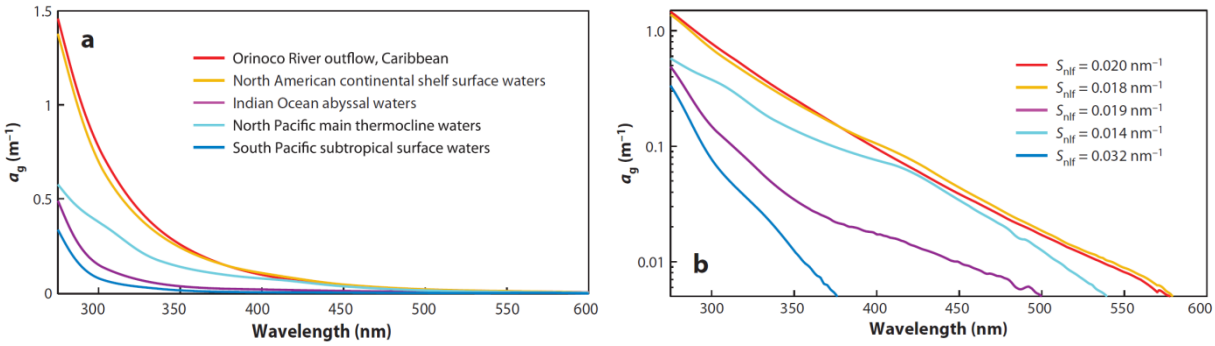

Figure 4 CDOM spectra from different locations on the globe with normal (left) and logarithmic (right) y-axes. The slope of the spectrum helps classifying the type of CDOM (Nelson & Siegel, 2013).

This method of classification has been applied to some of the CDOM spectra obtained during SO234-2. Figure 5 shows two spectra from underway measurements (black and grey) and two spectra from CTD casts (blue and red). The underway probes have been taken close to the coast of Madagascar, the CTD probes are from the 48h station in the open ocean. The slope parameters for all spectra have been determined and are noted in the legend of the right figure. We find that the coastal spectra have higher slope values than the underway spectra from coastal waters. This corresponds to the results from Nelson and Siegel (2013).

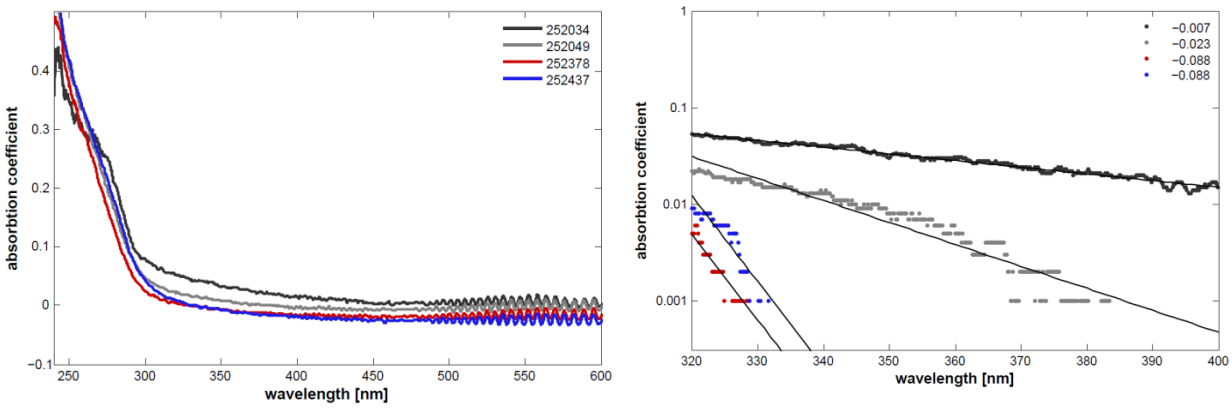

Figure 5 Absorption spectra of CDOM from four SO234-2 CDOM measurements in linear (left) and logarithmic (right) scale. The values of the slope parameter have been determined with a linear fit.

References

Nelson, NB, and DA, Siegel: The global distribution and dynamics of chromophoric dissolved organic matter; Annual review of marine science, Vol. 5: 447-476, 2013.

8) Meteorological measurements

Steffen Fuhlbrügge, and Michael Hemming

Introduction

34 radiosondes have been launched to date (19.07.2014, 15:00 UTC). Launch locations and horizontal flight tracks are shown in Figure 1.

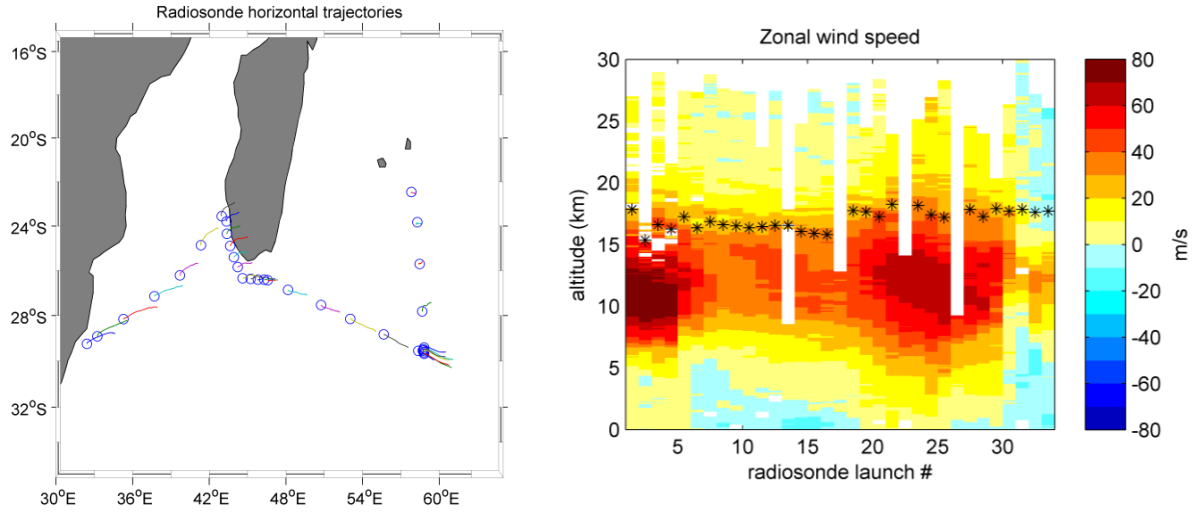

Figure 1 (left) Radiosonde launch locations (circles) and horizontal trajectories for launches from 8-18 July. (right) Zonal wind speed (m/s) derived from the radiosonde launches as a function of height. Cold-point tropopause heights (km) shown by markers.

Data from the radiosondes shows a high tropical cold-point tropopause at around 17km (stars in Figure 1, right). Maximum zonal wind speeds are found a few km below the tropopause, and show a strong gradient with respect to the latitude of launch. At southernmost launch latitude, south of ~28°S, we find strong zonal winds of ~80m/s. Northward of this threshold, we find weaker maximum zonal wind speeds of 30-50 m/s.

During the portion of the cruise track closest to the Madagascarian coast, radiosondes were launched at a 3-hourly frequency. Winds measured by these sondes show a strong wind shear in the lower troposphere, with north-easterly winds at the surface and south-westerly winds beginning at 2-5 km height. Figure 1 (right), which shows the zonal wind as a function of height, shows this feature for sonde launches 7-18.

A sharp gradient in the relative humidity profiles is found between 2-4 km height (not shown). Here the relative humidity decreases from > 80% to 15 - 30%. However this gradient does not mark the upper limit of the atmospheric boundary layer per se. The moist layers up to 4 km are air masses that have been advected and do not interact with the surface by turbulent mixing processes. The mean atmospheric boundary layer height determined from the radiosonde profiles of temperature, humidity and wind is ~ 0.8 km during the cruise.

Two ozonesonde launches have been performed. Due to a failure of the GPS on the first launch, altitude and position (therefore winds) are missing from the data of the first flight. Approximate heights have been estimated by comparing the measured temperature profile to the profile measured via radiosonde 6 hours earlier.

Preliminary profiles of ozone vs. height for the two ozonesonde launches are shown in Figure 2.

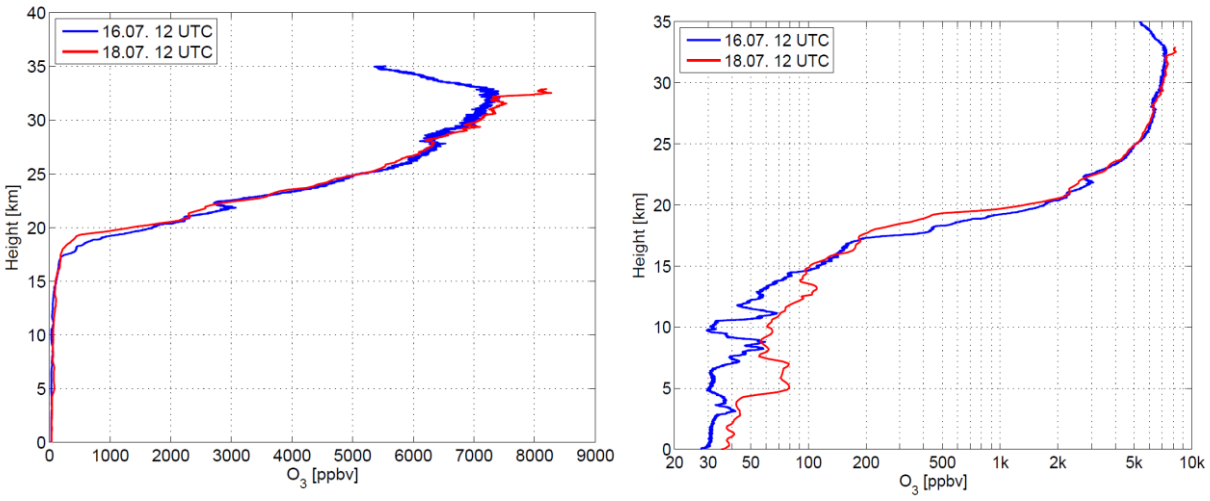

Figure 2 Preliminary ozone profiles (ppbv) from ozonesonde launches on 16.07.2014 and 18.07.2014. Ozone values shown in (right) linear and (left) log scales to highlight stratospheric and tropospheric values, respectively.

Surface meteorological fields measured by the ship's instruments are being collected and archived. Surface pressure, temperature, humidity and wind speed for a portion of the cruise are shown in Figure 3.

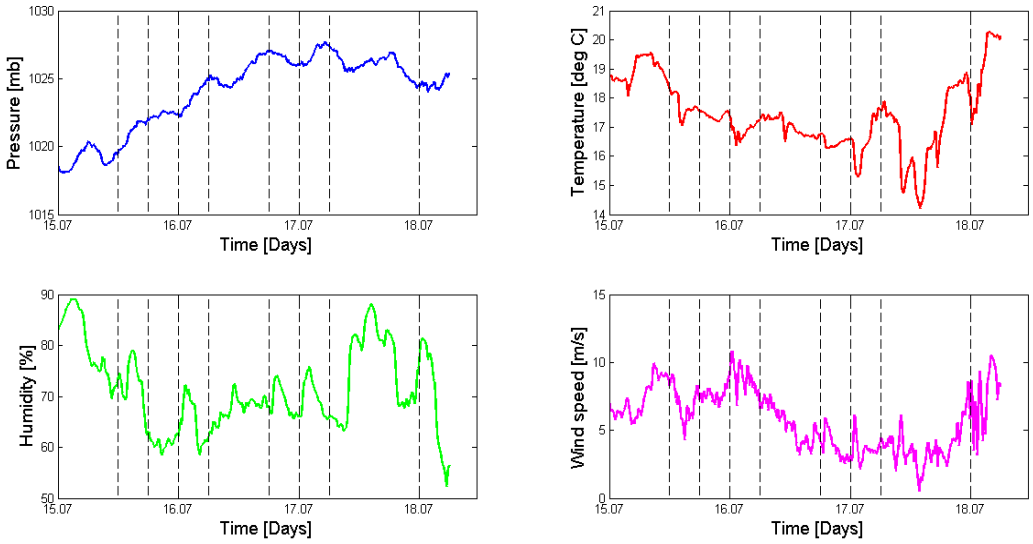

Figure 3 Surface meteorological fields as measured and archived by the Sonne systems.

Working groups reports

1.) HALOCARBONS

2.) OCEANIC TRACE GASES

3.) EDDY COVARIANCE - TRACE GASES

4.) OCEANSENSORS

5.) RADIOSOUNDING

6.) AIR-SAMPLING

7.) MAX-DOAS

8.) GHG

9.) AEROSOL

1) Halocarbons in surface and deep water

Helmke Hepach, Gert Petrick, Birgit Quack (PI) (GEOMAR, Kiel, Germany)

Background

Halocarbons are hydrocarbons in which one or more hydrogen atoms are replaced by one or more halogens. Some halocarbons are produced naturally in the oceans. Although it is commonly acknowledged that many of these compounds have a biological origin with distinct maxima in the chlorophyll a (Chl a) maximum, their cycling within the water column is still poorly understood. Other production pathways such as photochemical formation might play a significant role. Once the halocarbons are transported into the troposphere from the sea surface by air-sea gas exchange, they have very short lifetimes of less than 120 days. Bromoform ($CHBr_3$) and dibromomethane (CH_2Br_2) are together the biggest carriers of organic bromine into the atmosphere, while CH_3I is the most abundant organoiodine. The tropical ocean is a key region with respect to atmospheric transport processes: tropical deep convection can carry these compounds despite their short lifetimes into the stratosphere where they can deplete ozone much more effectively than chlorine. Additionally, diiodomethane (CH_2I_2) and chloroiodomethane (CH_2ClI) have recently been suggested to be similarly important for the organic iodine loading of the troposphere as CH3I. These compounds are involved in numerous chemical cycles within the atmosphere with iodinated compounds even participating in aerosol formation.

So far, large data gaps with respect to halocarbons exist in the Indian Ocean. Very few studies have focused on this region, although it might be of large importance for convective transport processes. The measurements of halocarbons during the SO234-2 cruise are the first measurements of these compounds in this region. They will help to characterize this area with respect to the global oceanic distribution of these compounds, and the contribution of the Indian Ocean to the stratospheric organic halogen loading.

Material and methods

Halocarbons onboard the RV Sonne were measured directly after sampling. Discrete samples were collected both from the continuously working pump located in the ship's moon pool (underway) every three hours, and from the Niskin bottles attached to the CTD. Each CTD was sampled for five to eight different depths. The water was analyzed for ten brominated, chlorinated and iodinated compounds including CH_3I, dichloromethane (CH_2Cl_2), chloroform ($CHCl_3$), tetrachloromethane (CCl_4), CH_2Br_2, CH_2ClI, bromoiodomethane (CH_2BrI), dibromochloromethane ($CHBr_2Cl$), $CHBr_3$, and CH_2I_2. 50 mL of the sampled water was introduced into a purge chamber. The water was purged with a stream of helium of 30 mL min-1 while it was concurrently heated up to 70 °C. The purged gas was trapped in stainless steel tubing hanging in liquid nitrogen for 50 min. The trap was desorbed at 100 °C and the sample was injected into a gas chromatograph attached with a detector. CTD samples were measured using combined gas chromatography and mass spectrometry (GC-MS), while underway samples were analyzed using a gas chromatograph equipped with an electron capture detector (ECD). Calibration was conducted using volumetrically prepared standards in methanol. In total, 13 CTD casts were measured, rounding up to a total of 76 samples that

were measured from the CTD, while 70 samples were taken from the underway pump system, making a total of 146 halocarbon water samples during SO234-2. Additionally, 30 air samples were measured. For these measurements, 500 mL of air was sucked from a sampling line located at the ship's main deck into a cooled trap, and then injected into a third GC-ECD for quantification.

Preliminary results

First evaluation of the underway and CTD data reveal low concentrations of the bromocarbons $CHBr_3$ and CH_2Br_2. Concentrations were in the range of typical open ocean concentrations during the greater part of the cruise. Higher concentrations of both compounds were measured close to the Banc de l'Etoile, a coral reef with also rich microalgal abundances close to Southern Madagascar. This was also the only region where atmospheric measurements showed elevated $CHBr_3$ mixing ratios. Mean $CHBr_3$ in all CTD profiles of 3.2 pmol L-1 ranging only between 0 and 7.4 pmol L-1 were measured with the higher values in the deeper water close to the chlorophyll a (Chl a) maximum, which is in agreement to biogenic formation of this compound. In contrast, CH_2Br_2 showed higher values with a slightly higher mean of 3.8 pmol L-1 and up to 19.5 pmol L-1 in the deeper water. An example for a depth profile measured during the cruise is given in Figure 1 for the first day of the 48-h-station. $CHBr_3$ displays low variability within the water column, but shows generally higher values in the deeper water. The variability within the CH_2Br_2 profiles is larger, showing more distinct maxima. Both show similar distributions during all day times, which is in agreement to previous studies hypothesizing similar sources for both compounds.

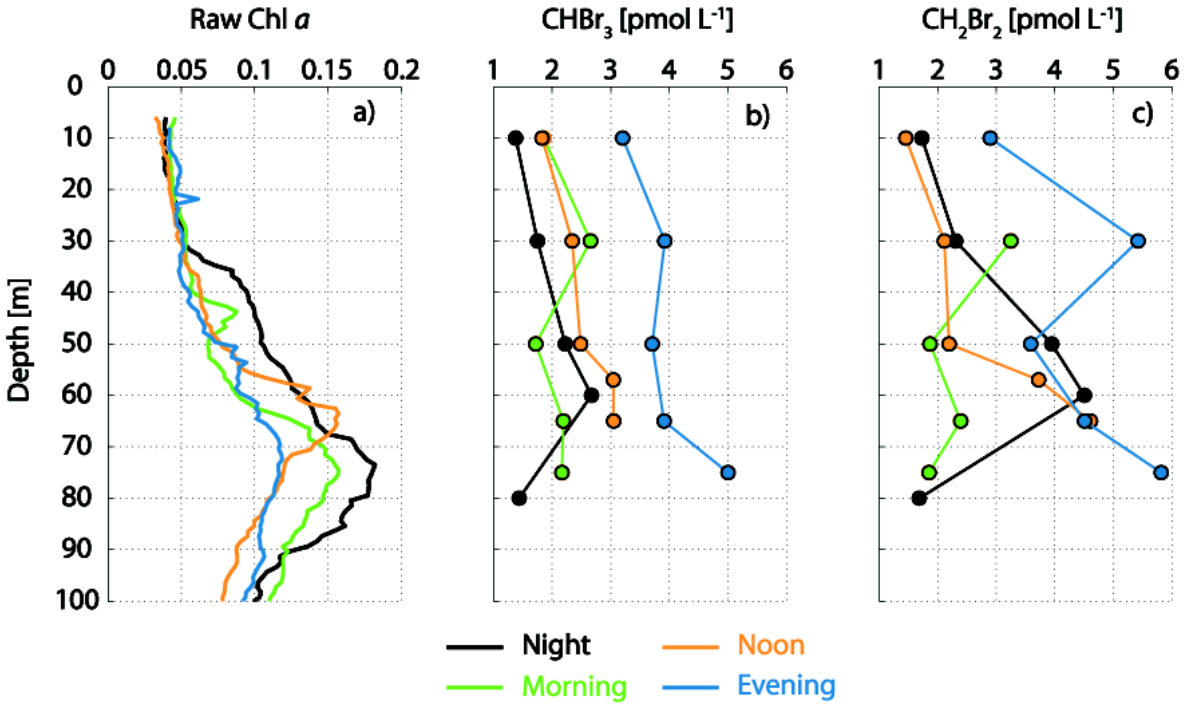

Figure 1 Raw Chlorophyll a (a), $CHBr_3$ (b) and CH_2Br_2 (c) depth profiles during the 48-h-station (day 1).

Surprisingly, highest concentrations of both compounds were measured in the evening where the lowest Chl a signal was detected. $CHBr_3$ is generally assumed to be emitted in higher concentrations than CH_2Br_2. However, the higher CH_2Br_2 in comparison to $CHBr_3$ has previously been observed in the open ocean, further away from fresh sources. The ratio of $CHBr_3$ and CH_2Br_2 leaning towards CH_2Br_2, as is here the case, has been hypothesized to be caused by different lifetimes of these compounds (Carpenter et al., 2009), assuming that CH_2Br_2 has a longer lifetime in water than $CHBr_3$ similarly to the atmosphere. However, Quack et al. (2007), supported by Hughes et al. (2013), suggested an additional explanation for the elevated CH_2Br_2 in the open ocean: biologically mediated conversion from $CHBr_3$ to CH_2Br_2, possibly through heterotrophic processes. The depth profiles with largely elevated CH_2Br_2 in comparison to $CHBr_3$ observed during 234-2 could therefore be an indicator for the latter hypothesis, which will be investigated more thoroughly during the second leg.

Outlook

Further analysis of the data will be performed in Kiel. Once the data is fully analyzed, it will be compared to biological and physical parameters. Emissions will be calculated using discrete atmospheric samples that were taken at the same time as the water samples, and using several parameters from the DSHIP data and the continuously measuring thermosalinograph (e.g. wind speed, air pressure, water temperature, density). Furthermore, the data will be compared to pigment data, nutrients, CDOM, and iodide and iodate, which were all sampled in parallel to evaluate sources of halocarbons in the Indian Ocean and learn more about their biogeochemical cycling. The final evaluation of the 48h-station will reveal possible diurnal variability of these compounds within the water column. Sea-to-air fluxes from the Indian Ocean will be used to calculate the entrainment of halocarbons into the stratosphere.

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Hughes, C., Johnson, M., Utting, R., Turner, S., Malin, G., Clarke, A., and Liss, P. S.: Microbial control of bromocarbon concentrations in coastal waters of the western Antarctic peninsula, Mar. Chem., 151, 35-46, http://dx.doi.org/10.1016/j.marchem.2013.01.007, 2013.

Quack, B., Peeken, I., Petrick, G., and Nachtigall, K.: Oceanic distribution and sources of bromoform and dibromomethane in the Mauritanian upwelling, J. Geophys. Res.-Oceans, 112, C1000610.1029/2006jc003803, 2007b.

2) OCEANIC TRACE GASES - Underway measurements of CO_2, O_2, CO, and N_2O

Tobias Steinhoff, Gesa Eirund and Damian Arevalo-Martinez (GEOMAR, Kiel, Germany)

Oceanic and atmospheric measurements of CO_2, CO and N2O were carried out by means of a continuous system based upon the off-axis integrated cavity output spectroscopy technique (RMT-200 N2O/CO Analyzer, Los Gatos research Inc.) coupled to a CO_2 detector based upon non-dispersive infrared detection (LICOR, USA; LI-6252). Water was drawn on board by using a submersible pump installed in the ship's moonpool at 6 m depth and was subsequently conducted at a rate of about 5 L min^{-1} through the equilibrator. Sample air from the headspace of the equilibrator was continuously pumped through the instruments and then back to the equilibration chamber forming a closed loop. The air stream was dried before being injected into the analyzers in order to diminish interferences due to the water vapor content of the sample. In order to correct for potential warming of the seawater between intake and equilibrator the water temperature at the equilibrator was constantly monitored by means of a digital thermometer and at the intake by a Seabird SBE37 termosalinograph. Ambient air measurements were accomplished by drawing air into the system from a suction point located at the ships mast at about 30 m high. Control measurements and calibration procedures were performed every ~6 and 24 h respectively, by means of 3 standard gas mixtures. Fig. 1 shows the over- or undersaturation of N_2O and CO_2 with respect to the atmosphere. During most of the cruise both gases were near the equilibrium, while strong supersaturation was observed when entering the coastal upwelling region along the African coast.

Underway measurements of surface water O_2 and gas tension were carried out in a flow-through box. Gas tension data are only available until 15. July due to a broken connector at the instrument. The box was connected to the same water supply and the water flow was adjusted to approximately 20 L min^{-1}. The following instruments were implemented: Aanderaa Oxygen Optode (model 4330), Pro Oceanus Gas tension device. The gas tension device physically measures the total pressure of all dissolved gases, i.e, pN_2, pO_2, pH_2O, and pAr as well as minor trace gases below the instrument's accuracy. As water vapour pH_2O is a function of temperature and salinity, Argon pAr is constant, and Oxygen pO_2 is measured by the oxygen optode, it effectively gives the pN2, which is a prime indicator of physical processes of gas exchange, like e.g., bubble processes, and unaffected by biology. It thus helps to separate biological and physical contributions to air-sea gas exchange of O_2. This is complemented by the biology-dominated pCO_2 measurements in water and air. In combination with information about the mixed layer from the CTD, the continuous underway measurement thus yield insight into major physical and biological processes at play in the surface ocean. Occasionally, discrete oxygen and salinity samples were taken from the bypass to compare these underway measurements.

Discrete comparison samples for N_2O and CO_2 were carried out in 8-12 h intervals by sampling from the same water stream that fed the underway setup. N_2O and DIC/TA samples were collected and stored to be measured at the Chemical Oceanography Department of the GEOMAR in Kiel.

Preliminary results

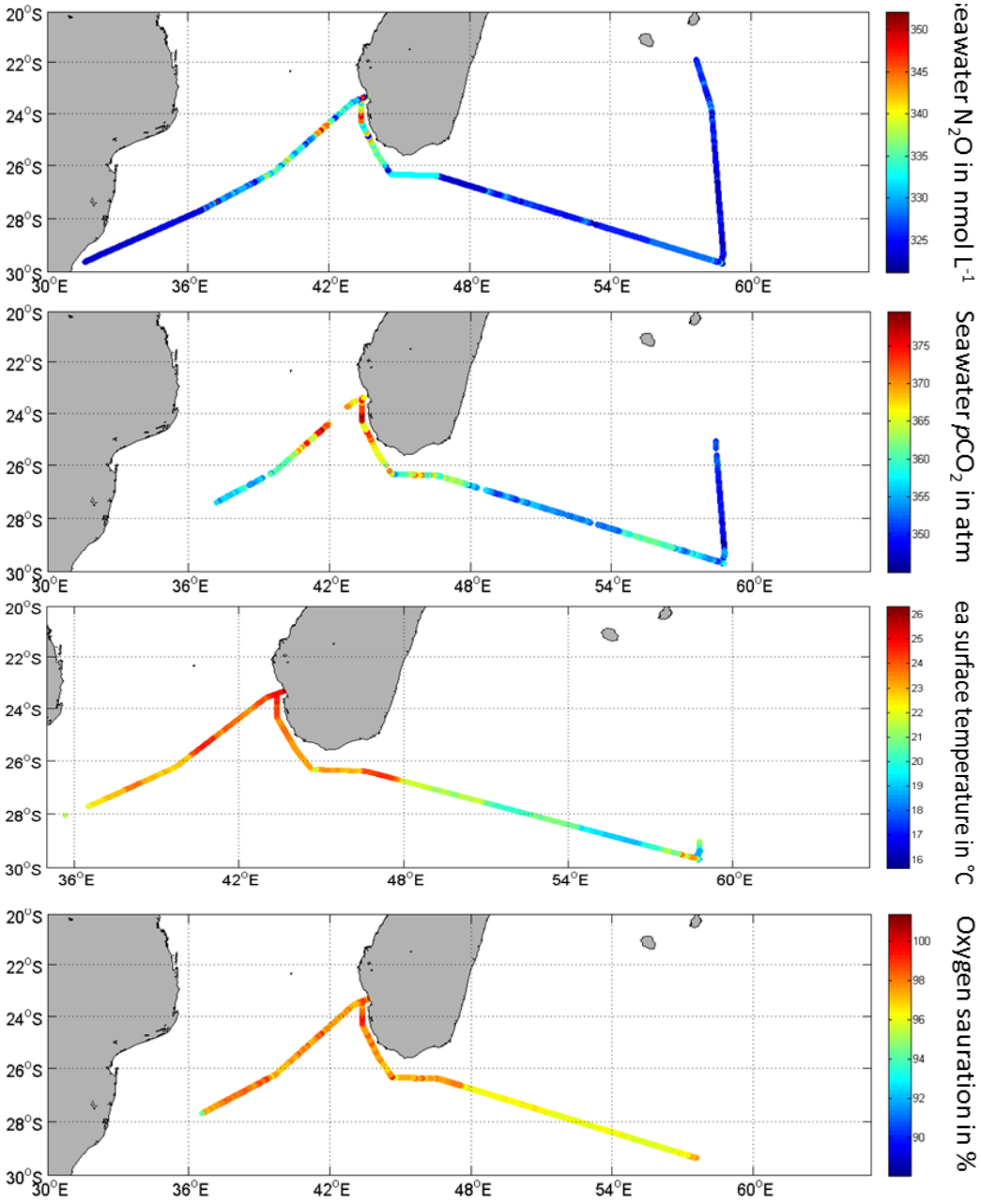

Figure 1 Surface water distribution of pCO_2, N_2O, oxygen saturation and sea surface temperature (SST) during SO234-2.

Figure 1 shows preliminary data of surface distributions of pCO_2, N_2O, oxygen and SST along the cruise track. Under the influence of the Mozambique Channel higher SST up to 25°C was observed. East of 48°W SST dropped and lowest temperature around 19°C was observed in the most easterly part of the cruise track. This differentiation between the part west and east of Madagascar can be also found in the different gases. CO_2 was undersaturated with respect to the atmosphere during the whole cruise with lowest values in the eastern part. N_2O surface water concentrations were around equilibrium with the atmosphere during most of the time. Only in the Mozambique Channel slight supersaturation was observed. The oxygen data are not calibrated yet and the shown saturation values seem to be too low. But the observed pattern in the oxygen saturation can also be found in the SST data. Warmer waters have a slightly higher saturation than colder waters.

3) EDDY COVARIANCE – trace gases

Christa Marandino (PI), Alex Zavarsky, Dennis Booge, Alina Fiehn (GEOMAR, Kiel, Germany), and Kosmas Hench (University of Oldenburg, Germany)

Motivation

Despite their low abundances, short-lived trace gases produced in the oceans play an important role in biogeochemical cycling and atmospheric processes. Some examples of such climate active gases that are measured on board the SO234-2 cruise are dimethylsulfide (DMS), isoprene, acetone, and carbonyl sulfide (OCS). These gases react rapidly when emitted to the atmosphere, with lifetimes between 1 hour and 1 month. They participate in ozone and hydroxyl radical cycles and in the formation of aerosols and cloud condensation nuclei. The biogeochemical and physical factors influencing the production and destruction of these compounds in the surface ocean are only marginally constrained for gases such as DMS, OCS, and acetone, while very little information about isoprene cycling is known. In addition, quantifying the air-sea exchange of these compounds is further hindered by the lack of direct flux measurements and poor constraints on the factors controlling their fluxes (e.g. the gas transfer coefficients, presence of vertical gradients, etc.). The goal of this cruise is to understand what controls the biogeochemical cycling of these gases in the surface ocean, in depth profiles, and their exchange with the atmosphere.

In order to investigate the ocean's role in the atmospheric budget of these trace gases, bulk atmospheric and oceanic concentration measurements and ancillary data (such as colored dissolved organic matter, cell counts, and DNA), as well as direct air-sea exchange, have been measured. We deployed three different instruments to measure underway and CTD seawater samples for trace gas concentrations and three instruments to measure air concentrations. An eddy covariance (EC) direct flux measurement system has also been deployed, which can be used to perform biogeochemical cycling measurements without typical pitfalls associated with bulk flux calculations, as well as to constrain the main forcings on air-sea gas exchange. Measurements of the precursors and sinks of these trace gases were measured in order to better understand and quantify surface ocean cycling. The main factor thought to influence these gases is biological activity. Therefore, samples for DNA and cell counts (i.e. flow cytometry) were taken for later analysis. Because the degradation of CDOM by UV light results in the formation of trace gases, such as OCS, acetone, and isoprene, CDOM quantities were also measured.

Methods

This working group is responsible for the following measurements:

1. Continuous eddy covariance fluxes of DMS, isoprene, acetone using atmospheric pressure chemical ionization mass spectrometry (AP-CIMS)
2. Continuous eddy covariance fluxes of CO_2 using infrared absorption (LICOR 7200)
3. Three hourly underway and CTD water concentrations of DMS (and related compounds such as DMSP, DMSO), and isoprene with purge and trap gas chromatography-mass spectrometry (GC-MS)
4. Continuous underway water concentrations of DMS, isoprene, and acetone using an equilibrator coupled to AP-CIMS

5. Continuous underway water levels of OCS using an equilibrator coupled to a cavity ring down spectrophotometer (MICA), with hourly valve switches to measure air mixing ratios for 15 minutes
6. Quantification of CDOM (both underway and at depth with the CTD) using UV-visible absorption (qualification may be attempted with a fluorescence spectrophotometer, but this has not yet been accomplished)
7. Sampling and preparation of DNA and flow cytometry samples for identifying types and amount of biological activity

Eddy covariance

The eddy covariance direct flux (F) is computing with the following equation,

$F = \rho \langle w'c' \rangle$

where ρ is the density, w' are the vertical wind fluctuations, and c' are the concentration fluctuations (brackets denote time average). Using this technique, we can attempt to improve the gas transfer parameterization (k) used in the commonly employed bulk formula,

$F = k(HC_w - C_a)$,

where C_w and C_a are water and air concentrations, respectively, and H is the Henry's law solubility constant. The goal was to measure dimethylsulfide (DMS), isoprene and acetone flux with the AP-CIMS and CO_2 flux with the LICOR 7200. Measurements started at DOY 196 12:00 UTC (-29.62444288 LAT 58.58830401 LON) and continued until Port Louis.

Air was sampled through a ½" tube from a mast welded to the bow (approximately 10 m above the sea surface) at a flow rate of 70 l min^{-1} to the AP-CIMS and approximately 25 l min^{-1} to the LICOR. To obtain turbulent wind speed measurements and sensible heat flux, a sonic anemometer was placed at the bow mast, which measured three dimensional wind speed and the speed of sound. A GPS and inertial navigation system (INS) was used for motion correction (Figure 1). The AP-CIMS can discriminate gases using a single quadrupole mass spectrometer. The gases are ionized at atmospheric pressure using H_3O^+ as the reagent gas and electrostatically steered to the quadrupole. The ions are detected using a counting electron multiplier. The LICOR measures CO_2 and H_2O using infrared absorption.

Figure 1 Eddy covariance setup on the R/V Sonne.

Purge and trap GC-MS

We improved a purge and trap technique coupled with a GC-MS (Figure 2) to measure different non-methane hydrocarbons (NMHCs) in seawater. In addition, we developed a method to quantify different NMHCs (e.g. isoprene, dimethylsulfide (DMS)) in one measurement using isotopically labeled internal standards. A 40 ml discrete water sample was taken, bubble free, and purged with approximately 30 ml min^{-1} of helium for 15 minutes and trapped with liquid nitrogen on an empty u-shaped trap. The frozen gas was then injected with boiling water into the GC. Each analysis took approximately 13 minutes.

Figure 2 Purge and trap GC-MS aboard R/V Sonne.

Instruments coupled to equilibrators

A miniature AP-CIMS and a cavity ring down spectrophotometer (MICA) were each coupled to a membrane equilibrator to measure trace gases. The AP-CIMS measured DMS and isoprene, while the MICA measured OCS (there were also hourly valve switches to measure air mixing ratios with the MICA). Each equilibrator had approximately 5 l min^{-1} water flow and a counterflow of purified air of ~300 ml min^{-1}. The AP-CIMS air stream was dried with a Nafion dryer and diluted with dry purified air with a flow of 1100 ml min^{-1}. All gas flows were controlled with mass flow controllers and all liquid flows were measured and recorded.

Ancillary measurements

Samples for DNA, cell counts, and CDOM were also taken from both the underway system and the CTD and preserved for later analysis. 2 l of water for DNA were filtered through 0.2 micron filters and mixed with 0.5 ml of RNA later before shock freezing and final storage in the -80C freezer. The samples will be shipped to Hong Kong for analysis. 4.5 ml of water were taken for phytoplankton and bacteria cell counts, each, and were preserved with GDA (20 and 200 microliters, respectively) before final storage in the -80C freezer. The samples will be shipped by to Kiel for flow cytometry analysis. 50 ml of water was filtered through 0.2

micron filters for CDOM quantification. The samples were stored in the refrigerator until shipboard analysis, between 1 and 48 hours. Measurements were made using a UV-visible spectrophotometer. Milliq water was used as a reference. The CDOM value was computed by subtracting the absorbance at approximately 700 nm from that at 350 nm. All values are reported in absorbance units and reflect relative amounts.

Preliminary results

Bulk air values – Eddy covariance system

Figure 3 shows the bulk air concentrations of isoprene, DMS, and acetone measured with the AP-CIMS during the 48 hour station. All three trace gases show relatively low bulk concentrations. This is in accordance with the results from the surface seawater measurements of the same gases, which were also low. A daily cycle, due to photolysis (sunlight creates OH which oxidizes isoprene), of isoprene can be clearly seen, especially because the lifetime of isoprene in the atmosphere is on the order of 1 hour. The DMS lifetime is on the order of 1 day, and a less clear diurnal pattern is evident.

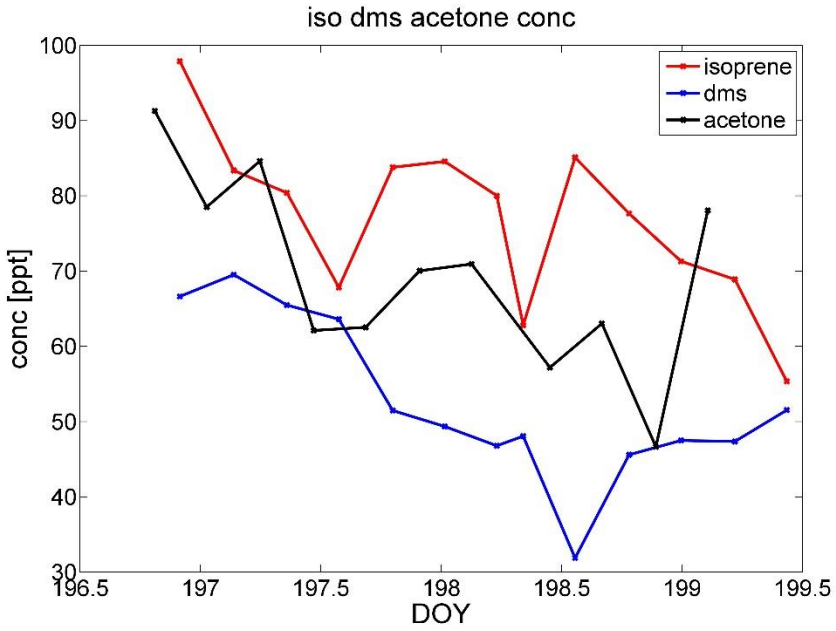

Figure 3 Trace gas measurements in the atmosphere during the 48 hour station using the AP-CIMS and the inlet on the eddy covariance mast.

Eddy covariance wind measurements

Vertical wind speed power spectra are in good agreement with the empirically determined Kaimal turbulent wind spectrum (Kaimal et al., 1972; Figure 4), which is used as the standard for all turbulence measurements. The high frequency portion of the spectrum exhibits the appropriate slope, but the peak at around 0.1 Hz is due to the motion of the ship. This must be removed from the wind data in post processing, using the data from the IMU situated on the mast.

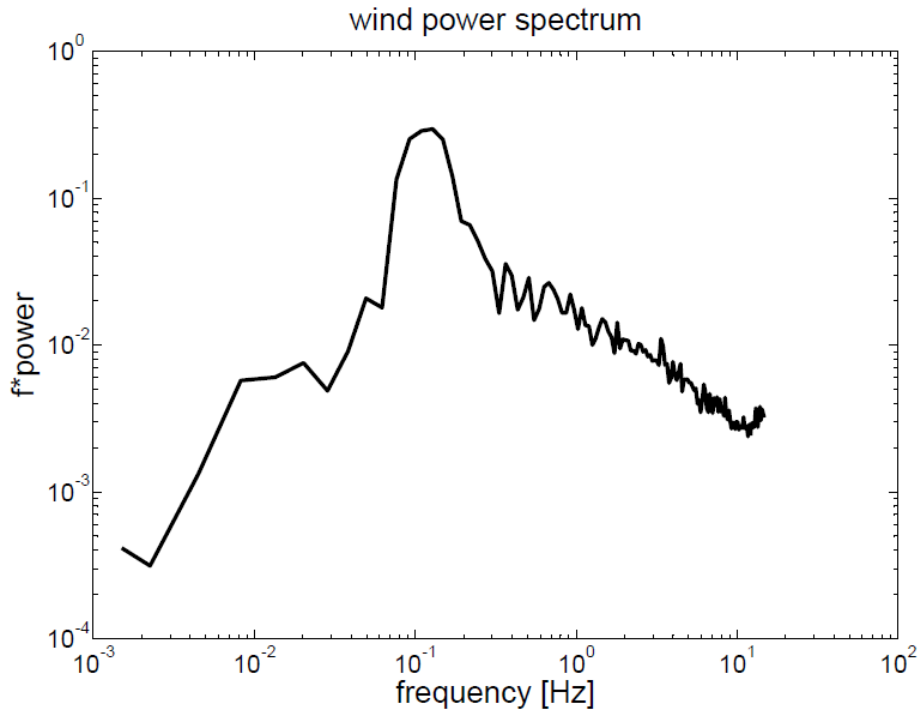

Figure 4 Sample power spectrum of vertical wind speed.

Eddy covariance trace gas measurements

It is clear that trace gas spectra show the same features as the wind spectrum, in accordance with the Kaimal curve (Figure 5). Therefore, the trace gas measurements can be correlated with the vertical wind speed measurements to obtain the eddy covariance flux. However, this data must be post processed to correct for high and low frequency interferences and the possibility of flow distortion.

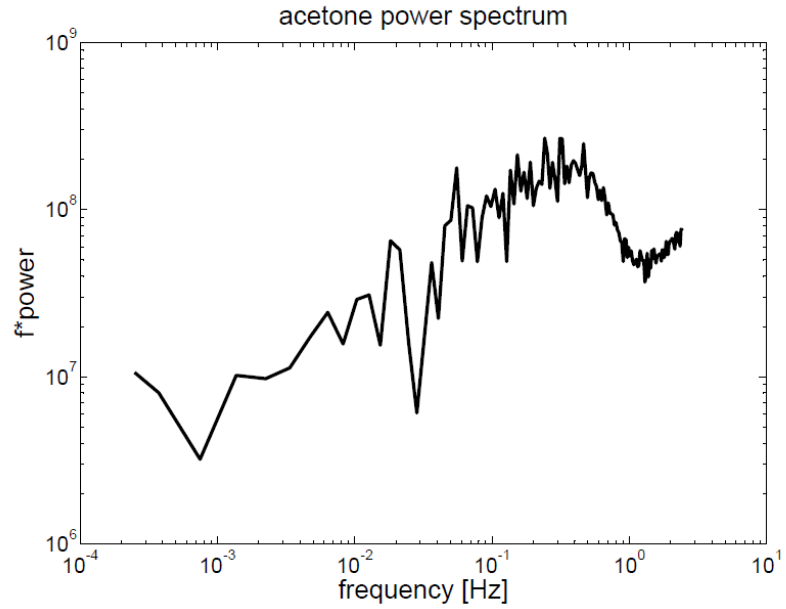

Figure 5 Sample power spectrum of the turbulent fluctuations of acetone.

GC-MS measurements

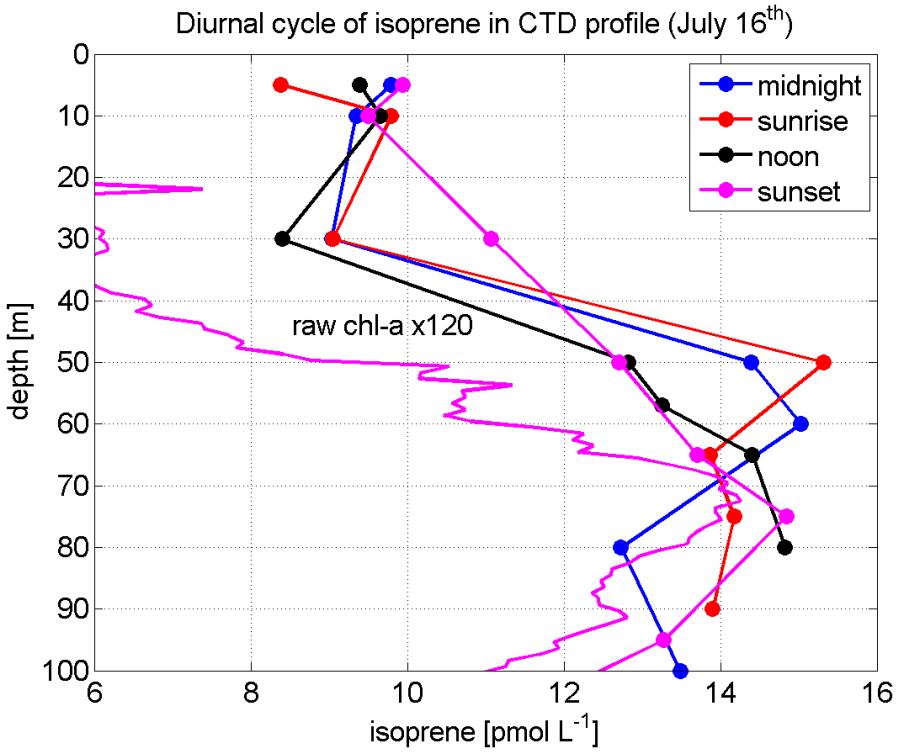

Figure 6 Diurnal isoprene cycle plotted with fluorescence values from the CTD.

During a 48h-station we sampled from 8 CTD-Stations. Samples were taken from 5m to about 100m depth in order to get information about a potential diurnal cycle in isoprene and DMS concentrations during 2 days in the euphotic zone (Figures 6, 7). The results show a slight correlation of isoprene-concentrations with chl-*a*. It appears however, that despite following the same water mass with a drifter in the upper 20 meters, the water mass below 30m changed during the 48h-stations after noon of the first day. This could also be detected in the evening profile of DMS concentrations from the first day (Figure 7, left). Values for both DMS and isoprene were below the global annual average.

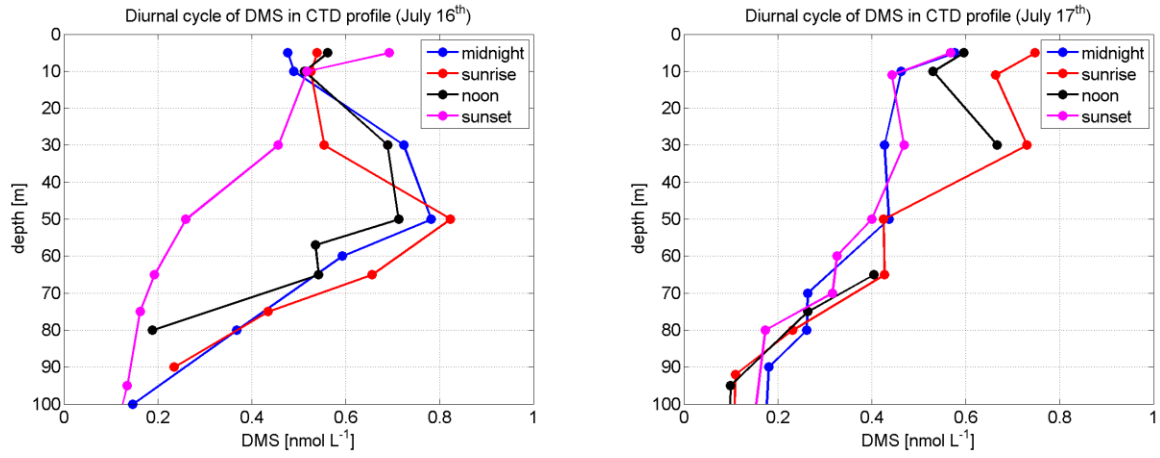

Figure 7 Diurnal DMS from CTDs during the 48 hour station, left) first day, right) second day.

OCS measurements

Preliminary mixing ratios of OCS in air and water are shown in Figure 8. The values appear to be below the expected levels by approximately 40%. We believe this is due to dirty mirrors inside the cavity and can be corrected during post processing. The water values exhibit the expected diurnal cycle, which is related to the CDOM photolysis source of OCS. It appears that OCS was undersaturated in the water during most of the cruise, which is unusual and may have to do with the low SSTs.

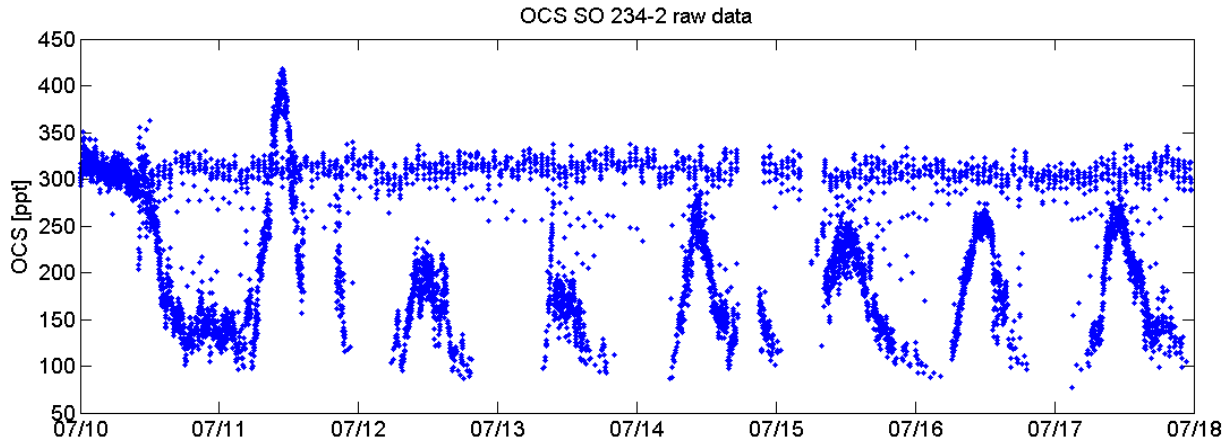

Figure 8 OCS mixing ratios (ppt). Top constant value is the air mixing ratio, while the cycling lower values are in the water.

CDOM measurements

Figure 9 shows two measured absorption spectra of CDOM from this cruise. A typical spectrum has a maximum between 230 and 250 nm and then falls exponentially to a base value. The abundance of CDOM in terms of absorption has been determined for most underway samples from SO234-2 (Figure 10). Normally the amount of CDOM in the surface

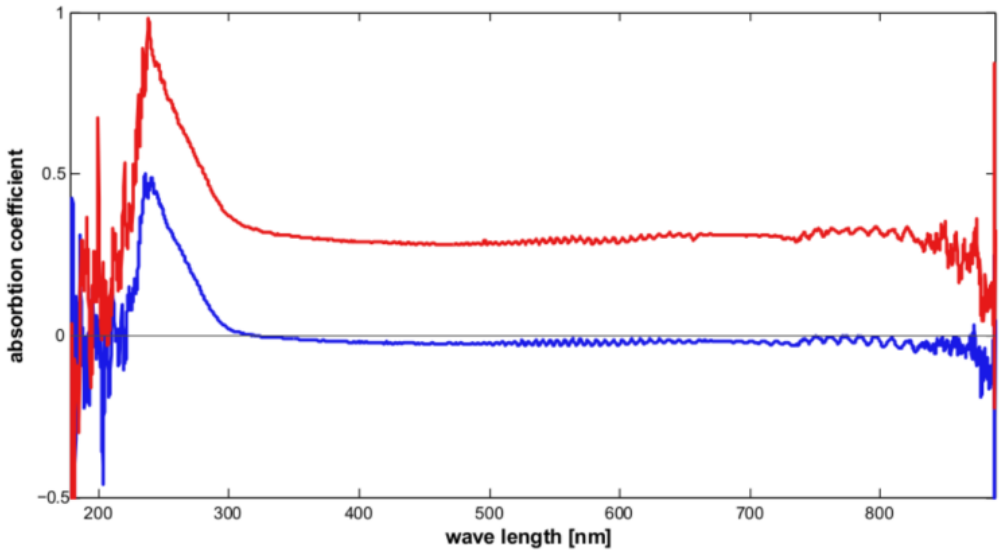

Figure 9 Absorption spectra of CDOM from two underway samples.

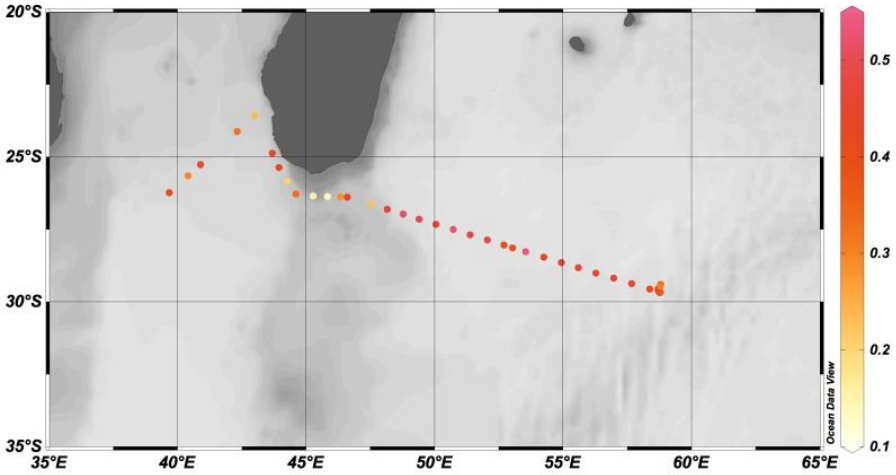

Figure 10 CDOM underway samples.

waters is high close to the coast and decreases towards the open ocean. However, we observed the lowest values close to the reef south of Madagascar and higher values in the open ocean.

CDOM abundances have also been determined for the CTD casts during SO234-2. Figure 11 shows the profiles of CDOM and isoprene from the 7 CTD casts of the 48h station. The abundance of CDOM declined slightly with depth in the first 500m. In greater depths the abundance remained constant. This goes in accordance with the expectations as major depletion of CDOM by photolysis can only take place in surface water masses. As CDOM could be a precursor to isoprene, a relationship of the abundance of CDOM and isoprene would be plausible – yet after preliminary analysis of the CTD casts no such relation could be Figure 10. Relative abundances of surface seawater CDOM.

A classification of the type of CDOM and its source is possible by analyzing the spectra as well. The absorption spectra can be approximated using the following formula, where a_{CDOM} is the absorption coefficient, S is the exponential slope parameter and λ_0 is a reference wavelength:

$$a_{CDOM}(\lambda) = a_{CDOM}(\lambda_0)e^{-S(\lambda-\lambda_0)}$$

The slope parameter can be calculated by a linear fit through the logarithmic spectrum and is used to classify the CDOM. Figure 12 shows CDOM absorption spectra from different regions. Lower slope values correspond to coastal waters with high amounts of terrestrial sourced CDOM and open ocean waters show higher slope parameter values (Nelson & Siegel, 2013).

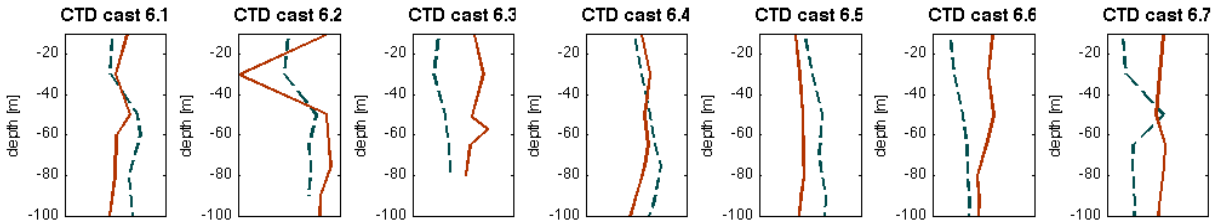

Figure 11 CTD profiles of CDOM (red) and isoprene (dashed) for the seven casts from the 48h station.

This method of classification has been applied to some of the CDOM spectra obtained during SO234-2. Figure 13 shows two spectra from underway measurements (black and grey) and two spectra from CTD casts (blue and red). The underway samples have been taken close to the coast of Madagascar, the CTD samples are from the 48h station in the open ocean. The slope parameters for all spectra have been determined and we find that the coastal spectra have higher slope values than the underway spectra from coastal waters. This corresponds to the results from Nelson and Siegel (2013).

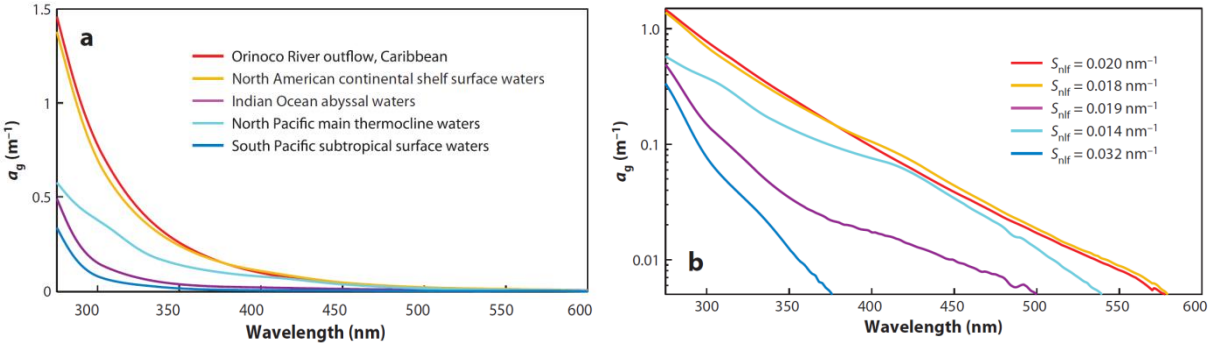

Figure 12 Examples of CDOM spectra from various source regions, where the right side is the log of the left side. The slopes of the different curves is given in the legend of the right panel and can be used to determine the source regions of CDOM (Nelson and Siegel, 2013).

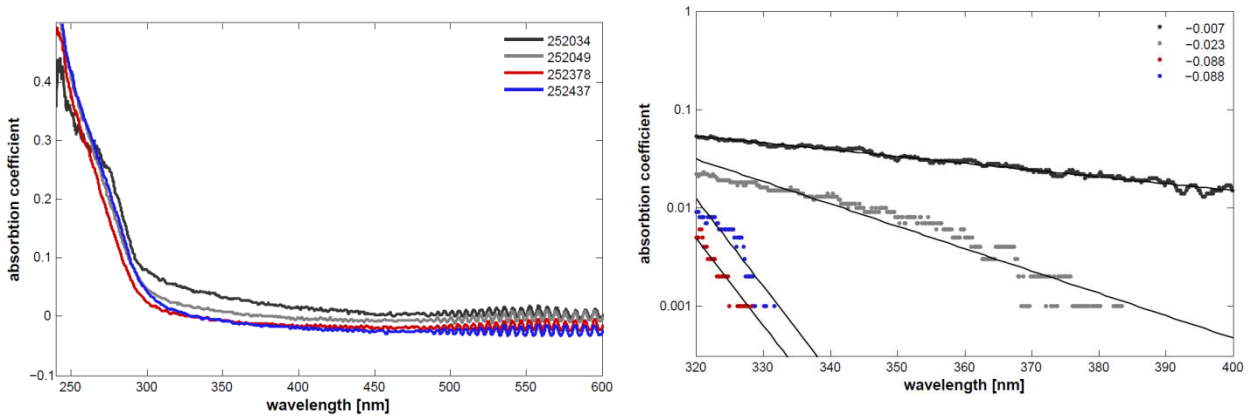

Figure 13 Analysis of SO234-2 CDOM samples in the method of Nelson and Siegel (2013). See Figure 12 above.

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4) OCEANSENSORS

4A) Conductivity Temperature Density (CTD)

Matthias Krüger (GEOMAR, Kiel, Germany)

During SO234-2, 13 profiles of pressure (P), temperature (T) and conductivity (C) were recorded. These CTD profiles usually ranged to the bottom, on the 48 h station to the bottom and some to 750m. We used a Seabird Electronics (SBE) 9plus system, attached to the water sampler rosette, and the latest Seabird Seasave software. The system had the following sensors: p #64860, T #2135, c #1854, Oxygen (O) #1902 and a Dr. Haardt Fluorometer. Conductivity will be calibrated using a linear relation in p, T and c. This relation will be obtained by fitting the according CTD salinity to 37 water samples, which will be analyzed with a salinometer later on. Oxygen will be calibrated using a linear relation in p, T and O. Winkler titration of 312 bottle samples gives the accurate value of absolute oxygen in the water.

A potential temperature – salinity diagram of the first four CTD stations is shown in Figure 1, with such a diagram the water masses can be easily detected.

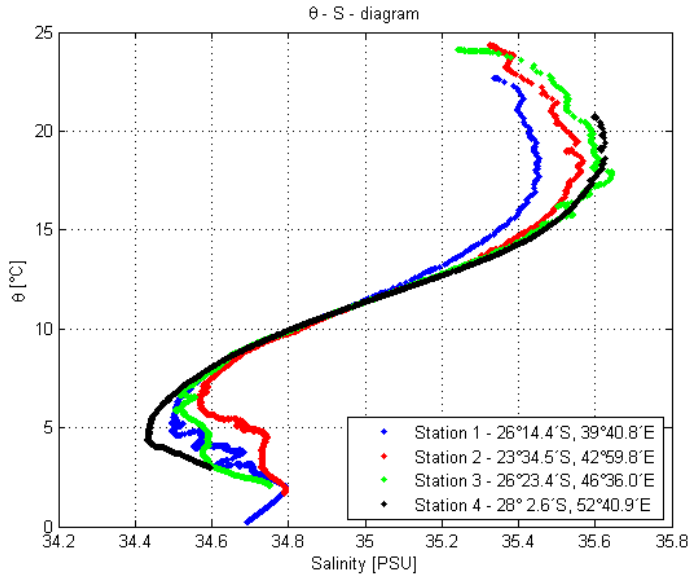

Figure 1 Temperature - salinity diagram of the first four stations.

Preliminary results

A vessel mounted Acoustic Doppler Current Profiler (ADCP) continuously recorded current velocities. We used a RD Instrument Ocean Surveyor 38kHz (OS38) mounted in the ship's hull. The instrument was run in two configurations: one configuration in broadband mode (BB) and one configuration in narrowband mode (NB). Usually NB is for the deeper regions of the ocean. The main reason to choose the less robust BB mode was the higher possible resolution in space and time. The two configurations of OS38 were: a) NB mode, 55 bins of 32m, range 1000m; b) BB mode, 80 bins of 16m, range 800m.

Due to the extremely low abundance of acoustic scatters in parts of the cruise area, there are sometimes lacks of interpretable acoustic backscatter signals, even when using the more robust NB mode.

A time series showing the velocity structure in the upper 1000 meters of the water column is shown in Figure 2, where enhanced internal wave activity is evident.

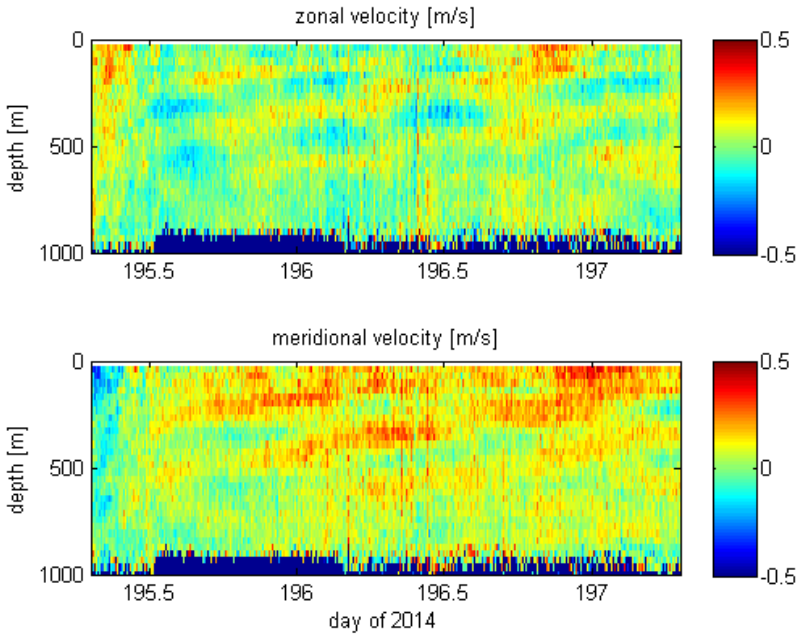

Figure 2 Velocity time series (m/s) at the beginning of the 48 h station, data from 38kHz ADCP. Enhanced internal wave activity is apparent in the upper 800m.

4B) Surface drifter

Tobias Steinhoff (GEOMAR, Kiel, Germany)

During one station a 48h (Lagrangian) drift experiment was conducted. In order to follow a water parcel in a quasi-Lagrangian approach a surface drifter was used to mark a water patch and follow it with the ship for 48 h (Figure 1). The drifter was further equipped with autonomous instrumentation at approx. 15 m water depth for in situ measurements of Salinity and Temperature (Seabird MicroCat), pCO2 (Contros HydroC), O2 (Aanderaa Oxygen Optode, Model 4330), Chlorophyll (Trios Micro flu) and Nitrate (Trios Props). The continuously recorded data need to be processed and will be available after the cruise. During the drift experiment the ship approached the drifter every 6 hours in order to conduct a CTD hydrocast (750 m max. depth) next to it. Samples were taken and analyzed for various parameters. Most of sampling and measurement procedures are described in the cruise report of other groups.

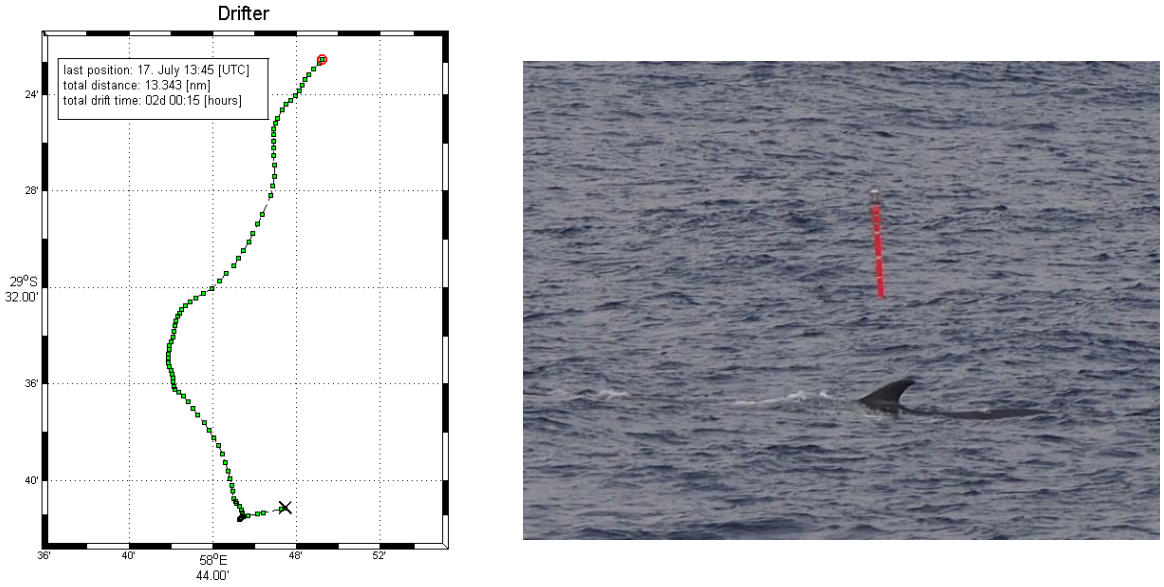

Figure 1 Track of the surface drifter during the deployment of 48 h; photo of the drifter on 17.07.2014 @Folkard Wittrock).

5) RADIOSOUNDING - meteorology measurements

Matthew Toohey, Steffen Fuhlbrügge (GEOMAR, Kiel, Germany), Michael Hemming (University Hamburg, Germany), and Kirstin Krüger (PI - UiO, Oslo, Norway)

Introduction

34 radiosondes were launched until 19.07.2014, 15:00 UTC. Launch locations and horizontal flight tracks are shown in Figure 1.

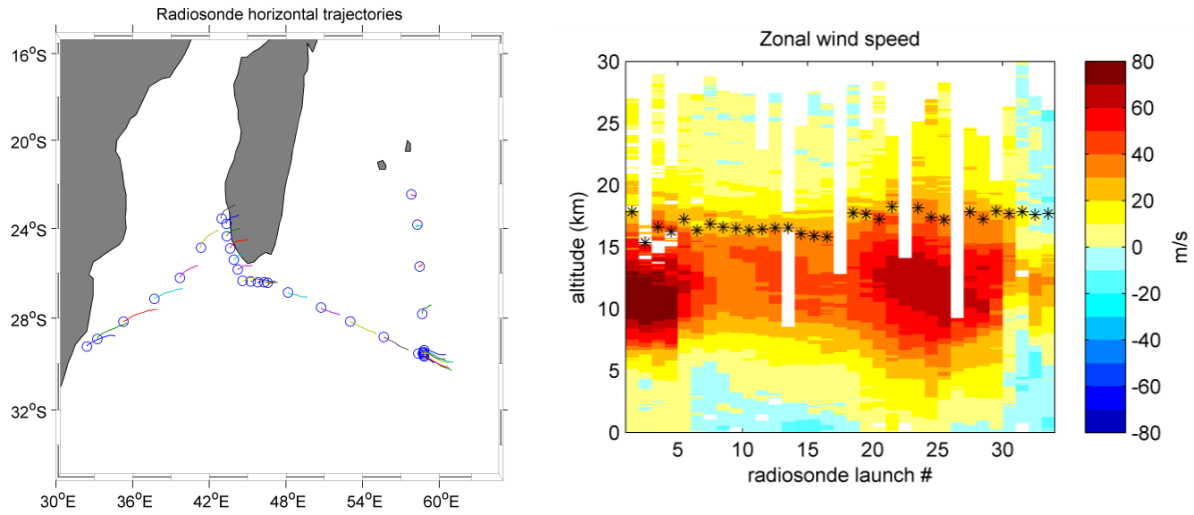

Figure 1 (left) Radiosonde launch locations (circles) and horizontal trajectories for launches from 8-18 July. (right) Zonal wind speed derived from the radiosonde launches as a function of height. Cold-point tropopause heights shown by markers.

Preliminary results

Data from the radiosondes shows a high tropical cold-point tropopause at around 17km (stars in Figure 1, right). Maximum zonal wind speeds are found a few km below the tropopause, and show a strong gradient with respect to the latitude of launch. At southernmost launch latitude, south of ~28S, we find strong zonal winds of ~80m/s. Northward of this threshold, we find weaker maximum zonal wind speeds of 30-50 m/s.

During the portion of the cruise track closest to the Madagascarian coast, radiosondes were launched at a 3-hourly frequency. Winds measured by these sondes show a strong wind shear in the lower troposphere, with north-easterly winds at the surface and south-westerly winds beginning at 2-5 km height. Figure 1 (right), which shows the zonal wind as a function of height, shows this feature for sonde launches 7-18.

A sharp gradient in the relative humidity profiles is found between 2-4 km height (not shown). Here the relative humidity decreases from > 80% to 15 - 30%. However this gradient does not mark the upper limit of the atmospheric boundary layer per se. The moist layers up to 4 km are air masses that have been advected and do not interact with the surface by

turbulent mixing processes. The mean atmospheric boundary layer height determined from the radiosonde profiles of temperature, humidity and wind is ~ 0.8 km during the cruise.

Two ozonesonde launches have been performed. Due to a failure of the GPS on the first launch, altitude and position (therefore winds) are missing from the data of the first flight. Approximate heights have been estimated by comparing the measured temperature profile to the profile measured via radiosonde 6 hours earlier.

Preliminary profiles of ozone vs. height for the two ozonesonde launches are shown in Figure 2.

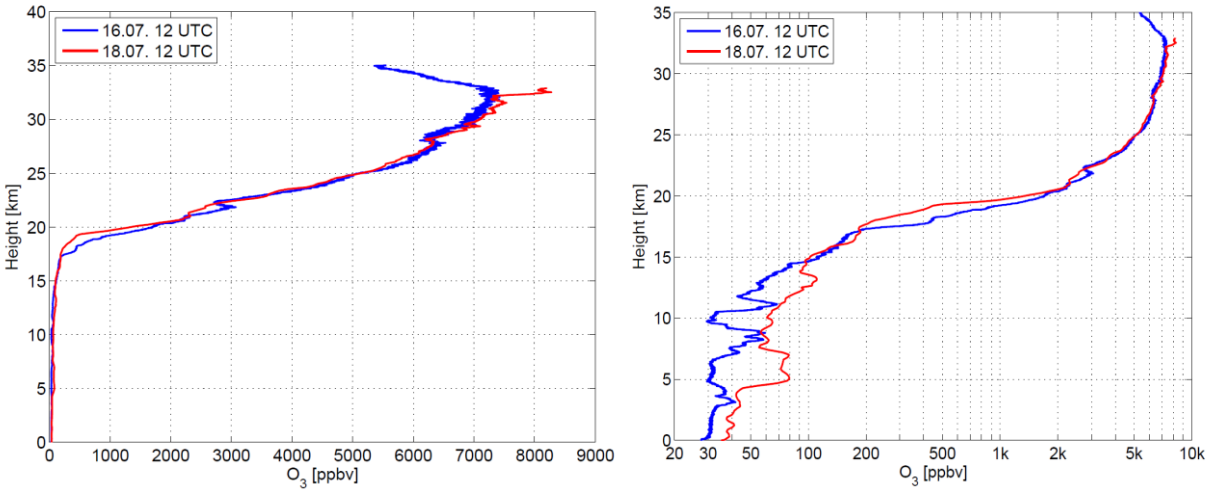

Figure 2 Preliminary ozone profiles from ozonesonde launches on 16.07.2014 and 18.07.2014. Ozone values shown in (right) linear and (left) log scales to highlight stratospheric and tropospheric values, respectively.

Surface meteorological fields measured by the ship's instruments are being collected and archived. Surface pressure, temperature, humidity and wind speed for a portion of the cruise are shown in Figure 3.

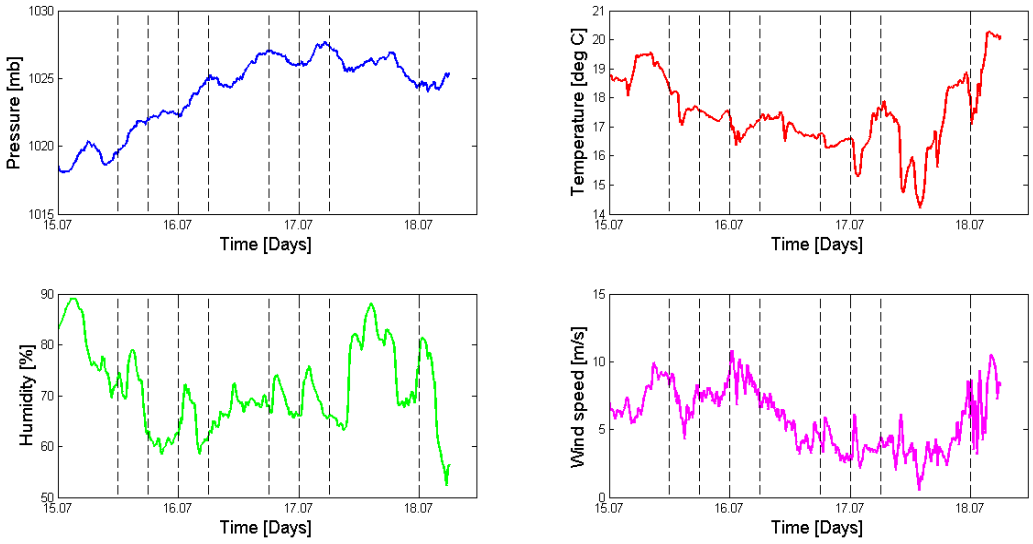

Figure 3 Surface meteorological fields as measured and archived by the Sonne systems.

The pyrgeometer and pyranometer, measuring atmospheric emission longwave (LW) and solar shortwave (SW) radiation, respectively, and precipitation measuring disdrometer were working fine and collecting data continuously. Figure 4 shows a preliminary version of data collected to date.

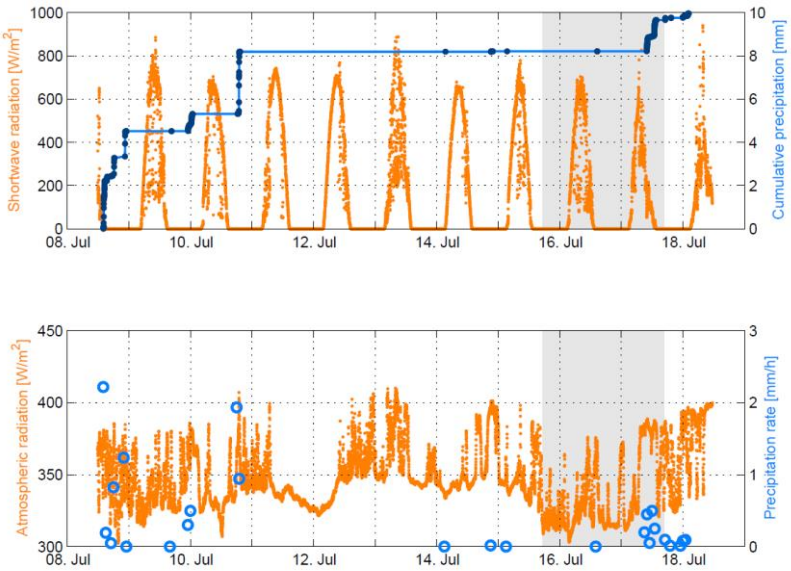

Figure 4 Radiative and precipitation quantities measured by the radiometers and disdrometer, respectively.

6) AIR-SAMPLING - for atmospheric trace gases

Elliot Atlas (RSMAS, Miami, USA), and Birgit Quack (GEOMAR, Kiel, Germany)

94 canister samples of air have been collected in 2 L stainless steel tanks, being pressurized to 2 bar for RSMAS with a metal bellows pump and will be analyzed for a variety of trace gases as natural and anthropogenic hydrocarbons and halocarbons, DMS, N_2O, alkyl nitrates, CO and other long-lived anthropogenic and natural trace gases on different instruments at the Rosenstiel School of Marine and Atmospheric Sciences in Miami.

Long lived anthropogenic gases producing halogen radicals can account for about 3400 ppt of chlorine and about 15-16 ppt of bromine in the stratosphere, depleting ozone.

Other gases with shorter lifetimes, the so-called very short-lived substances (chemical lifetimes shorter than 6 months) like bromoform ($CHBr_3$) or dibromomethane (CH_2Br_2) as well as iodinated methanes with the ocean as their main source also may have a significant impact on the stratospheric bromine loading. Deep convection within the tropics could provide a fast pathway for these substances to be transported in significant abundances into the stratosphere. The quantification of this input to the budget of stratospheric bromine and iodine from the Indian Ocean during southwest monsoon was a major objective of the cruise. It will give information about natural background halogen loading of the stratosphere and improve the projections of future stratospheric ozone concentrations.

With the help of the anthropogenic and terrestrial trace gases and calculated trajectories oceanic, land-based and anthropogenic sources and possibly source strengths can be determined.

7) MAX-DOAS

Folkard Wittrock (IUP, University of Bremen, Germany)

During the SO234-2 cruise in the Indic from July 8 to July 20, 2014, measurements of different reactive trace gases were carried out using the Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) technique (Wittrock et al., 2004 and Wittrock, 2006). The Bremian MAX-DOAS setup was running almost continuously for the whole cruise without having any serious problems (starting already early in the morning on July 7 in the port of Durban). Since the MAX-DOAS technique is based on solar stray light, measurements were only possible during daytime short before sunrise until sunset (96° SZA). In addition some complementary parameters were obtained: surface ozone with an in situ ozone monitor (Horiba), meteorological parameters (wind speed and direction, total solar radiation, UV radiation, precipitation, humidity, pressure and temperature). Starting July 18 denuder tube sampling was carried out to quantify the amount of molecular iodine. Furthermore the MAX-DOAS is also collecting AIS data from passing ships which might help to explain measured pollution levels.

The MAX-DOAS setup used on the ship was covering a wavelength range of approximately 300 to 470 nm with a medium resolution (FWHM 0.8 nm). This enables us to retrieve the following trace gases: IO, BrO, CHOCHO, HCHO, H_2O, O_3, NO_2, and SO_2. From O4 measurements the aerosol extinction profile and the AOD can be derived. The telescope was installed on the starboard side of the ship and was collecting spectra toward three different azimuth angles possibly identifying horizontal gradients of trace gases. In addition the water-leaving radiance was measured once per measurement cycle (Peters et al., 2014).

During the cruise a first analysis was carried out. For the halogen oxides BrO and IO no clear indications of levels above the detection limit (~0.5 ppt) was found. For the tropospheric pollutants NO_2 and SO_2 elevated levels up to several ppb were measured in Durban and when passing the main shipping routes close to Madagascar. In case of HCHO similar values (~ 0.6 to 0.8 ppb) as published in Peters et al. have been retrieved. AOD levels were in general very low with values around 0.06. A detailed analysis of the whole data set taking into account detailed radiative transfer calculations will be done at the IUP Bremen as soon as possible. Preliminary and raw data have been uploaded to the cruise data base.

Figure 1 MAX-DOAS telescope on RV Sonne heading to starboard. During SO234-2 the telescope was scanning different azimuth angles to identify spatial inhomogeneities in trace gas distributions.

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8) GHG (see work group reports 2 and 3)

9) AEROSOLS

9A) Alex Baker (UEA, Norwich, UK)

Aerosols play a key role in halogen cycling in the marine atmosphere, with Cl being transferred to the gas phase by acid displacement reactions, Br release being induced by reaction of ozone on sea salt particles and iodine chemistry promoting transfer of Cl, Br and I to the gas phase via halogen activation reactions. Ultimately aerosols appear to be net sources for Cl and supermicron Br and net sinks for I and submicron Br.

During the SO234-2 cruise two day aerosol samples were collected for determination of Cl-, Br- and iodine speciation, as well as a number of other aerosol ionic components which will provide us with useful information on aerosol background chemistry. 6 fourtyeight hour aerosol samples of about 600 L of air have been collected with a multistage aerosol impactor.

The data obtained will allow us to examine the potential strength of the aerosol Br source along the transect and investigate the role of iodine chemistry in halogen activation, as well as providing a unique opportunity to compare atmospheric iodine source (trace gas) and sink (aerosol) strengths in the Indian Ocean for the first time.

9B) Matthew Toohey (GEOMAR, Kiel, Germany)

The microtops sun photometer (Figure 1 left) is being used to measure aerosol optical thickness in cloud-free conditions. Based on satellite AOT retrievals, we expect weak aerosol levels in this region at this time of year, with values below 0.2 and often below 0.1. Microtops measurements are in line with this expectation (Figure 1 right). Larger AOT values are expected in the later portion of the cruise as the ship gets in closer proximity to India.

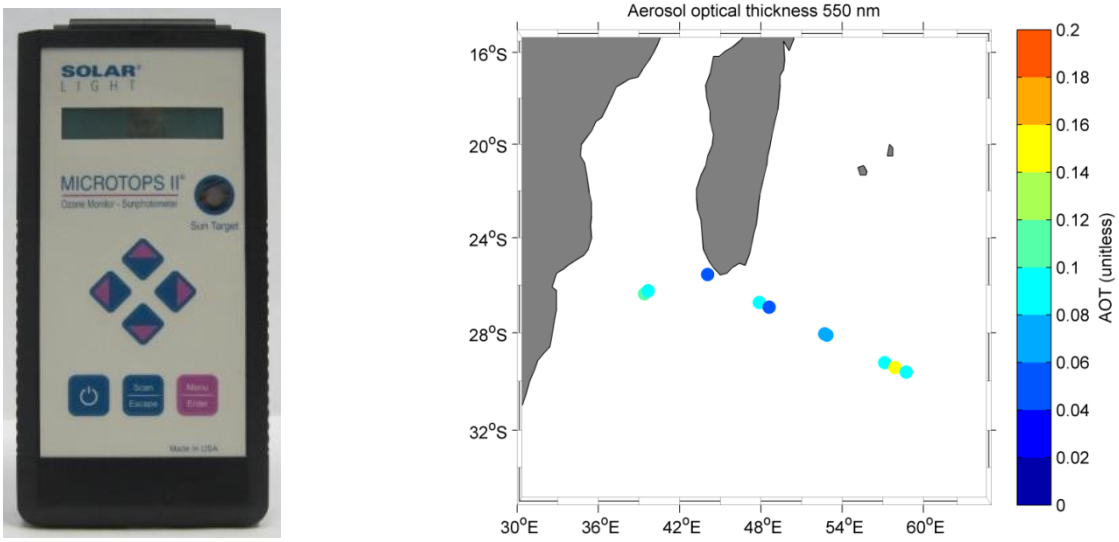

Figure 1 (Left) Microtops sun photometer; (right) aerosol optical thickness (AOT) as measured by the Microtops handheld sun photometer during the cruise.

Acknowledgements

I would like to thank the scientific team on board for their extra-ordinary hard work to set-up and operate the instruments additional to their teaching duties during the 12 days of SO234-2. Thanks in particular to all of you who have looked after several measurement and sampling devices and that you have worked day and night to get samples every 3 hours. During the 48 hour station, this was only possible with the help of our wonderful students, who did a great job carrying out the measurements at day and night and who also survived the turbulent classes during strong storm and wave events. Despite these tough times, all of you together managed to create a pleasant and professional working environment. Next to an inspiring and fruitful exchange with our SPACES students we were also able to gain a great and unique data set of the subtropical West Indian Ocean. The analysis and evaluation of the data are still ongoing for the next months and I am very much looking forward to see the final scientific results.

During our SO234-2 cruise we managed to set up our instruments quickly, supported also by the expertise of the professional ship's crew, who was always there, when we faced technical problems. The ships' crew was very helpful and we had the best cooking team on board. Special thanks go to the WTD and the electrician, who rapidly repaired our breakdowns with insight and care. Thanks also to the decks crew for all helping hands and friendly support of our activities and the machinery for the smooth maintenance of all technical details of this fine ship. SO234-2 succeeded not last due to the professional cooperation between the captain, the crew and the scientists, so we were able to carry out all of our work together during SO234-2 to the best results. I would also like to especially thank the captain of RV Sonne for his careful and considerate navigation through the rough subtropical West Indian Ocean.

Finally, I would like to thank my colleagues Birgit Quack and Christa Marandino for their collaboration and support with the SO234-2 SPACES SONNE project and ship cruise.

Last but not least, I am very grateful to the BMBF for funding the SO235 OASIS/ SO234-2 SPACES project (BMBF grant 03G0235A) and the SO234-2 SPACES SONNE cruise, Barbara Tanner, Susanne Korich and the PTJ for taking care of the student, project and the ship cruise administration and the Geoscience Department at University of Oslo and GEOMAR Kiel for supporting our SO234-2 activities.

All together you were a wonderful, hard-working and very successful SO234-2 team!

Yours Kirstin Krüger (Chief Scientist, UiO)

Appendix A: Sample lists for underway samples

SPACES (SO234-2) Samples from Underway system (approx. 5m) (preliminary)

Campaign	Event label	Label Optional	TimeUTC	Time Local	Time UTC	System	System	System	System	System	System	System	System	Thermo Salinograph	Thermo Salinograph	Thermo Salinograph	Weather-station	Weather-station	Weather-station	Weather-station	Weather-station	Weather-station	O2	N2O	CH4	DMS + Isoprene	Hal	CO2	CDOM	I-/IO3-	DOC / TDN	Flow Cytometry	Nano-nuts	µ-nuts	PABS	DNA	Pig-ments	Air
						Course	Depth	Heading	Position lat (degrees)	Position lon (degrees)	Speed	True wind direction	True wind speed	Conductivity	Salinity	Tempe-rature	Air pressure	Air temperature	Humidity	(relative) Wind direction	Wind gust	Wind speed	[Wink-ler]	[Xiao]	[Xiao]	[Booge]	[Hepach]	[Sein-hoff]	[Maran-dino]	[Quack]	[Endres]	[Endres]	[Quack]	[Quack]	[Wieg-mann]	[Cheah]	[Wieg-mann]	
SO234_2	SO234_2/UW_1_252001	252001	08.07.2014 11:00:00	13:00	11:00	60.12	9999.9	73.4	-29.80010	31.18390	13.38	217.28	17.66	9999.999	9999.999	9999.999	1028.0	15.30	55.00	131.70	14.30	12.40																x
SO234_2	SO234_2/UW_2_252002	252002	08.07.2014 14:00:00	16:00	14:00	68.46	326.9	66.4	-29.54000	31.81610	11.69	227.20	6.85	9999.999	9999.999	9999.999	1027.0	15.40	70.00	92.60	3.10	1.90																x
SO234_2	SO234_2/UW_3_252003	252003	08.07.2014 17:00:00	19:00	17:00	76.40	1399.8	59.8	-29.32990	32.32710	8.73	184.50	14.48	9999.999	9999.999	9999.999	1027.2	15.80	66.00	107.90	18.30	12.40																x
SO234_2	SO234_2/UW_4_252004	252004	08.07.2014 20:00:00	22:00	20:00	61.48	1681.8	63.6	-29.14230	32.82070	8.79	194.01	11.03	9999.999	9999.999	9999.999	1027.0	18.10	46.00	99.20	13.40	8.90																x
SO234_2	SO234_2/UW_5_252005	252005	08.07.2014 23:00:00	01:00	23:00	65.60	2140.2	68.3	-28.96250	33.28780	9.13	187.55	9.82	9999.999	9999.999	9999.999	1026.6	18.30	58.00	94.00	12.10	8.30																x
SO234_2	SO234_2/UW_6_252006	252006	09.07.2014 02:00:00	04:00	02:00	72.37	1887.2	66.7	-28.77410	33.77950	11.00	168.15	11.05	9999.999	9999.999	9999.999	1025.2	18.20	51.00	76.50	14.00	11.20																x
SO234_2	SO234_2/UW_7_252007	252007	09.07.2014 05:00:00	07:00	05:00	68.97	1786.3	69.8	-28.56030	34.33400	10.38	172.64	8.33	9999.999	9999.999	9999.999	1026.2	18.20	55.00	68.50	10.90	8.60																x
SO234_2	SO234_2/UW_8_252008	252008	09.07.2014 08:00:00	10:00	08:00	74.17	1898.9	67.8	-28.36410	34.84250	9.40	207.83	6.87	9999.999	9999.999	9999.999	1027.4	19.10	57.00	92.90	6.50	4.30																x
SO234_2	SO234_2/UW_9_252009	252009	09.07.2014 11:00:00	13:00	11:00	63.96	2154.6	70.1	-28.19230	35.28700	11.56	202.27	6.41	9999.999	9999.999	9999.999	1025.0	19.50	54.00	77.90	6.80	5.10																x
SO234_2	SO234_2/UW_10_252010	252010	09.07.2014 14:00:00	16:00	14:00	67.94	1792.0	70.4	-27.96030	35.88720	12.38	198.60	9.11	9999.999	9999.999	9999.999	1024.6	18.90	58.00	83.20	10.60	7.50																x
SO234_2	SO234_2/UW_11_252011	252011	09.07.2014 17:00:00	19:00	17:00	69.62	1612.4	69.4	-27.72350	36.49930	11.35	190.29	3.88	9999.999	9999.999	9999.999	1025.6	18.90	58.00	40.20	6.50	5.10																x
SO234_2	SO234_2/UW_12_252012	252012	09.07.2014 20:00:00	22:00	20:00	60.98	2709.4	60.8	-27.45420	37.08400	11.51	201.04	4.26	9999.999	9999.999	9999.999	1026.4	19.20	54.00	46.50	5.30	4.00																x
SO234_2	SO234_2/UW_13_252013	252013	09.07.2014 23:00:00	01:00	23:00	60.86	4569.3	64.1	-27.16770	37.70250	12.15	183.48	11.38	9999.999	9999.999	9999.999	1025.0	17.20	61.00	81.80	13.10	10.50																x
SO234_2	SO234_2/UW_14_252014	252014	10.07.2014 02:00:00	04:00	02:00	67.56	4561.4	72.5	-26.88580	38.30030	12.69	204.38	4.80	9999.999	9999.999	9999.999	1024.0	18.30	57.00	54.50	5.90	4.40																x
SO234_2	SO234_2/UW_15_252015	252015	10.07.2014 05:00:00	07:00	05:00	59.74	4507.6	70.9	-26.60470	38.90250	12.19	217.55	8.67	9999.999	9999.999	9999.999	1025.2	20.00	55.00	102.70	6.80	4.90																x
SO234_2	SO234_2/UW_16_252016	252016	10.07.2014 08:00:00	11:00	08:00	68.69	4402.3	70.0	-26.32640	39.49960	12.75	149.23	4.14	9999.999	9999.999	9999.999	1026.0	19.10	61.00	30.10	9.30	8.20																x
SO234_2	SO234_2/UW_17_252017	252017	10.07.2014 11:00:00	14:00	11:00	170.77	4414.8	212.0	-26.24010	39.67950	0.71	224.10	4.38	9999.999	9999.999	9999.999	1024.6	20.30	56.00	10.90	6.20	4.70																x
SO234_2	SO234_2/UW_18_252018	252018	10.07.2014 14:00:00	17:00	14:00	51.56	4286.9	46.8	-26.06250	39.90410	11.91	216.55	7.53	9999.999	9999.999	9999.999	1024.6	20.80	51.00	139.40	2.50	1.60																x
SO234_2	SO234_2/UW_19_252019	252019	10.07.2014 17:00:00	20:00	17:00	49.10	4236.7	41.9	-25.66220	40.40510	11.46	199.77	6.66	9999.999	9999.999	9999.999	1026.0	20.80	50.00	82.80	4.00	2.80	x				x			x			x				x	x
SO234_2	SO234_2/UW_20_252020	252020	10.07.2014 20:00:00	23:00	20:00	54.86	4065.6	46.5	-25.27200	40.89100	11.53	195.65	6.46	9999.999	9999.999	9999.999	1026.2	20.20	69.00	78.60	4.70	3.40					x											x
SO234_2	SO234_2/UW_21_252021	252021	10.07.2014 23:00:00	02:00	23:00	47.61	3958.8	48.6	-24.88590	41.37450	11.63	186.35	6.18	9999.999	9999.999	9999.999	1025.0	20.80	61.00	71.00	6.50	4.50																x
SO234_2	SO234_2/UW_22_252022	252022	11.07.2014 02:00:00	05:00	02:00	53.95	4124.0	52.7	-24.51120	41.83800	11.07	149.40	8.55	9999.999	9999.999	9999.999	1024.2	20.90	63.00	65.00	11.20	9.20					x										x	x
SO234_2	SO234_2/UW_23_252023	252023	11.07.2014 05:00:00	08:00	05:00	51.17	3493.6	46.8	-24.11930	42.32330	12.61	135.39	7.86	9999.999	9999.999	9999.999	1024.8	21.10	66.00	49.70	11.80	10.30					x										x	x
SO234_2	SO234_2/UW_24_252024	252024	11.07.2014 08:00:00	11:00	08:00	53.18	3216.3	52.1	-23.73750	42.79370	11.77	117.75	8.19	9999.999	9999.999	9999.999	1026.0	20.50	64.00	40.60	13.70	11.80																x
SO234_2	SO234_2/UW_25_252025	252025	11.07.2014 11:00:00	14:00	11:00	129.07	3023.1	182.7	-23.57520	43.00140	0.99	170.93	5.96	9999.999	9999.999	9999.999	1024.4	21.10	54.00	348.40	6.80	6.10																x
SO234_2	SO234_2/UW_26_252026	252026	11.07.2014 14:00:00	17:00	14:00	70.21	1321.7	69.2	-23.40650	43.42410	13.53	183.46	11.79	9999.999	9999.999	9999.999	1022.6	21.90	65.00	80.40	12.70	10.60																x
SO234_2	SO234_2/UW_27_252027	252027	11.07.2014 17:00:00	20:00	17:00	90.61	42.0	185.1	-23.34350	43.60860	1.51	182.06	9.80	9999.999	9999.999	9999.999	1023.4	21.80	66.00	4.30	12.10	10.40					x										x	x
SO234_2	SO234_2/UW_28_252028	252028	11.07.2014 20:00:00	23:00	20:00	248.54	748.9	242.7	-23.37380	43.50410	11.34	119.91	13.15	9999.999	9999.999	9999.999	1024.4	20.10	70.00	268.50	13.40	11.10					x						x				x	x
SO234_2	SO234_2/UW_29_252029	252029	11.07.2014 23:00:00	02:00	23:00	179.93	2758.3	174.4	-23.83510	43.38190	10.50	102.97	10.86	9999.999	9999.999	9999.999	1024.0	18.80	76.00	312.10	14.90	13.80					x			x			x				x	x
SO234_2	SO234_2/UW_30_252030	252030	12.07.2014 02:00:00	05:00	02:00	152.30	3758.7	151.3	-24.36000	43.39770	10.86	116.39	9.79	9999.999	9999.999	9999.999	1023.0	18.10	81.00	336.90	16.80	14.50				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_31_252031	252031	12.07.2014 05:00:00	08:00	05:00	150.97	2732.6	152.3	-24.86850	43.67520	10.72	106.66	10.51	9999.999	9999.999	9999.999	1024.0	19.50	79.00	329.90	15.50	14.80				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_32_252032	252032	12.07.2014 08:00:00	11:00	08:00	153.15	3075.4	153.9	-25.37050	43.95050	11.88	69.14	9.28	9999.999	9999.999	9999.999	1024.6	21.10	64.00	306.50	12.70	11.50				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_33_252033	252033	12.07.2014 11:00:00	14:00	11:00	146.68	2042.3	144.1	-25.84130	44.27090	9.65	107.19	9.61	9999.999	9999.999	9999.999	1023.0	21.10	77.00	336.50	16.50	14.40		x		x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_34_252034	252034	12.07.2014 14:00:00	17:00	14:00	143.92	1478.1	146.8	-26.28270	44.61150	12.15	89.44	9.57	9999.999	9999.999	9999.999	1022.0	21.20	77.00	324.30	15.50	13.80				x	x	x	x	x		x	x			x	x	x
SO234_2	SO234_2/UW_35_252035	252035	12.07.2014 17:00:00	20:00	17:00	91.68	712.4	92.4	-26.35050	45.27090	12.35	78.21	11.69	9999.999	9999.999	9999.999	1022.4	21.80	70.00	350.80	20.80	18.30				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_36_252036	252036	12.07.2014 20:00:00	23:00	20:00	99.28	1723.5	90.3	-26.36700	45.84380	7.75	61.19	11.41	9999.999	9999.999	9999.999	1022.8	21.90	69.00	339.30	17.40	16.10				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_37_252037	252037	12.07.2014 23:00:00	02:00	23:00	101.43	2182.6	84.1	-26.38060	46.32770	8.20	50.35	11.62	9999.999	9999.999	9999.999	1022.4	21.70	68.00	333.40	16.80	15.20				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_38_252038	252038	13.07.2014 02:00:00	05:00	02:00	268.24	2400.4	45.3	-26.39840	46.58200	2.01	48.57	8.98	9999.999	9999.999	9999.999	1022.0	21.70	66.00	3.90	10.90	9.60	xx			x	x	x	x			x	x			x	x	x
SO234_2	SO234_2/UW_39_252039	252039	13.07.2014 05:00:00	08:00	05:00	106.01	2622.4	99.3	-26.47620	46.92670	11.17	19.75	12.97	9999.999	9999.999	9999.999	1022.6	21.90	70.00	303.00	17.10	15.20				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_40_252040	252040	13.07.2014 08:00:00	11:00	08:00	114.43	2523.0	109.6	-26.64310	47.54030	11.81	52.84	9.79	9999.999	9999.999	9999.999	1023.0	21.30	75.00	324.70	16.50	14.10	xxx			x	x		x			x	x	xxx		x	x	x
SO234_2	SO234_2/UW_41_252041	252041	13.07.2014 11:00:00	14:00	11:00	103.98	4118.5	103.9	-26.81100	48.15140	11.01	31.30	10.82	9999.999	9999.999	9999.999	1021.4	20.80	76.00	312.50	16.20	14.00		xxx		x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_42_252042	252042	13.07.2014 14:00:00	17:00	14:00	110.78	4571.6	106.5	-26.98130	48.77510	11.98	21.36	10.50	9999.999	9999.999	9999.999	1021.2	21.10	71.00	302.30	14.30	12.40				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_43_252043	252043	13.07.2014 17:00:00	20:00	17:00	106.66	4945.6	108.5	-27.15200	49.40020	11.87	11.66	9.33	9999.999	9999.999	9999.999	1022.0	20.50	76.00	299.90	11.80	10.70				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_44_252044	252044	13.07.2014 20:00:00	23:00	20:00	102.72	14.7	103.8	-27.33160	50.05900	11.93	13.13	8.95	9999.999	9999.999	9999.999	1022.4	20.60	76.00	307.60	12.70	11.30					x		x			x	x			x	x	x
SO234_2	SO234_2/UW_45_252045	252045	13.07.2014 23:00:00	02:00	23:00	107.19	5236.6	109.6	-27.51120	50.72560	12.87	344.15	10.72	9999.999	9999.999	9999.999	1021.0	21.10	72.00	270.20	10.90	8.80					x		x			x	x			x	x	x
SO234_2	SO234_2/UW_46_252046	252046	14.07.2014 02:00:00	05:00	02:00	108.55	14.7	106.1	-27.69170	51.38830	11.77	351.64	9.98	9999.999	9999.999	9999.999	1020.0	20.20	77.00	282.80	10.30	9.30				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_47_252047	252047	14.07.2014 05:00:00	08:00	05:00	107.75	5150.4	106.6	-27.87150	52.04980	12.49	347.30	10.53	9999.999	9999.999	9999.999	1020.0	20.60	77.00	280.40	10.90	9.40				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_48_252048	252048	14.07.2014 08:00:00	11:00	08:00	327.69	5293.6	353.7	-28.04330	52.69830	0.79	341.89	9.70	9999.999	9999.999	9999.999	1019.8	20.40	79.00	350.20	11.80	10.20				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_49_252049	252049	14.07.2014 11:00:00	15:00	11:00	106.45	3844.8	103.3	-28.13760	53.03680	12.92	321.39	9.77	9999.999	9999.999	9999.999	1017.9	20.70	80.00	259.40	8.70	6.20		xxx		x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_50_252050	252050	14.07.2014 14:00:00	18:00	14:00	104.04	5090.5	106.6	-28.27600	53.55150	13.33	319.75	10.20	9999.999	9999.999	9999.999	1018.7	20.30	80.00	255.20	8.10	6.00				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_51_252051	252051	14.07.2014 17:00:00	21:00	17:00	102.90	4976.4	109.7	-28.46400	54.25290	12.94	319.56	9.39	9999.999	9999.999	9999.999	1019.6	20.20	83.00	253.80	6.80	5.00				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_52_252052	252052	14.07.2014 20:00:00	00:00	20:00	102.48	4914.1	109.6	-28.64880	54.93500	12.04	326.36	8.70	9999.999	9999.999	9999.999	1019.1	19.30	87.00	267.10	6.50	5.30				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_53_252053	252053	14.07.2014 23:00:00	03:00	23:00	103.23	4729.3	108.8	-28.82780	55.60280	12.22	291.45	8.28	9999.999	9999.999	9999.999	1018.9	19.50	83.00	190.30	3.40	1.90				x	x		x			x				x	x	x
SO234_2	SO234_2/UW_54_252054	252054	15.07.2014 02:00:00	06:00	02:00	104.31	4852.0	108.3	-29.01000	56.28360	11.84	274.03	6.01	9999.999	9999.999	9999.999	1018.1	18.60	88.00	74.40	2.80	1.60				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_55_252055	252055	15.07.2014 05:00:00	09:00	05:00	105.71	14.7	107.2	-29.19380	56.96810	12.41	245.87	5.33	9999.999	9999.999	9999.999	1019.8	18.90	86.00	59.40	5.30	4.10				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_56_252056	252056	15.07.2014 08:00:00	12:00	08:00	105.87	4375.7	106.7	-29.38080	57.67500	12.41	241.77	8.15	9999.999	9999.999	9999.999	1019.6	19.50	75.00	79.30	6.80	5.90				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_57_252057	252057	15.07.2014 11:00:00	15:00	11:00	112.04	4301.5	110.0	-29.56690	58.36720	11.37	208.49	8.97	9999.999	9999.999	9999.999	1018.9	18.80	71.00	62.60	11.80	10.00		xxx		x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_58_252058	252058	15.07.2014 14:00:00	18:00	14:00	300.46	4012.8	161.8	-29.68350	58.78110	1.92	197.80	7.19	9999.999	9999.999	9999.999	1020.6	16.90	76.00	30.50	8.10	7.30		xxx		x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_59_252059	252059	15.07.2014 17:00:00	21:00	17:00	10.15	4068.8	235.9	-29.69300	58.77030	0.16	228.16	7.24	9999.999	9999.999	9999.999	1022.2	17.70	68.00	357.10	8.70	7.60		xxx		x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_60_252060	252060	15.07.2014 20:00:00	00:00	20:00	134.61	4053.8	212.8	-29.69410	58.77170	0.11	223.56	7.53	9999.999	9999.999	9999.999	1022.2	17.30	62.00	7.10	9.00	7.80		xxx		x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_61_252061	252061	15.07.2014 23:00:00	03:00	23:00	6.55	4207.1	272.6	-29.68560	58.75430	2.02	232.54	6.74	9999.999	9999.999	9999.999	1022.6	17.50	62.00	322.60	9.00	7.20	xxx			x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_62_252062	252062	16.07.2014 02:00:00	06:00	02:00	227.00	4302.3	222.2	-29.66250	58.73920	3.47	195.87	10.56	9999.999	9999.999	9999.999	1022.8	16.30	71.00	331.30	12.40	11.20	xxx			x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_63_252063	252063	16.07.2014 05:00:00	09:00	05:00	67.00	4239.4	186.6	-29.64980	58.74140	1.21	226.99	7.64	9999.999	9999.999	9999.999	1024.8	17.10	60.00	39.50	10.30	8.40	xxx			x	x	x	x			x	x			x	x	x
SO234_2	SO234_2/UW_64_252064	252064	16.07.2014 08:00:00	12:00	08:00	72.93	4508.6	189.3	-29.62300	58.72040	0.94	212.86	8.09	9999.999	9999.999	9999.999	1024.8	17.20	63.00	19.30	9.90	8.60				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_65_252065	252065	16.07.2014 11:00:00	15:00	11:00	83.78	4367.8	210.8	-29.60870	58.71030	1.29	247.97	5.89	9999.999	9999.999	9999.999	1025.0	16.80	71.00	34.00	7.10	6.10		xxx		x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_66_252066	252066	16.07.2014 14:00:00	18:00	14:00	315.98	4597.6	221.0	-29.58480	58.69940	0.67	169.08	3.87	9999.999	9999.999	9999.999	1025.6	16.80	68.00	309.30	5.00	4.00				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_67_252067	252067	16.07.2014 17:00:00	21:00	17:00	215.07	4577.1	239.9	-29.55800	58.69930	0.39	145.24	6.10	9999.999	9999.999	9999.999	1026.8	16.50	70.00	271.30	7.80	6.10				x	x	x	x			x	x			x	x	x
SO234_2	SO234_2/UW_68_252068	252068	16.07.2014 20:00:00	00:00	20:00	131.48	4637.2	194.6	-29.54760	58.70680	0.57	140.20	4.27	9999.999	9999.999	9999.999	1026.8	16.30	73.00	306.50	5.60	4.40				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_69_252069	252069	16.07.2014 23:00:00	03:00	23:00	104.13	4485.6	145.8	-29.53310	58.73490	0.39	79.18	2.66	9999.999	9999.999	9999.999	1026.0	16.50	65.00	306.90	5.00	3.10				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_70_252070	252070	17.07.2014 02:00:00	06:00	02:00	21.81	4215.5	88.8	-29.49700	58.76580	0.98	108.25	1.91	9999.999	9999.999	9999.999	1026.4	15.30	76.00	16.90	2.80	2.10				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_71_252071	252071	17.07.2014 05:00:00	09:00	05:00	48.34	4039.9	166.4	-29.48270	58.76960	2.10	65.45	3.72	9999.999	9999.999	9999.999	1027.8	17.30	66.00	276.90	6.20	3.60				x	x	x	x			x	x			x	x	x
SO234_2	SO234_2/UW_72_252072	252072	17.07.2014 08:00:00	12:00	08:00	300.31	3997.4	177.2	-29.48450	58.76320	0.71	51.45	4.42	9999.999	9999.999	9999.999	1026.2	17.40	64.00	233.90	7.10	4.30				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_73_252073	252073	17.07.2014 11:00:00	15:00	11:00	56.46	4602.0	52.4	-29.39590	58.79740	0.84	137.06	2.12	9999.999	9999.999	9999.999	1025.6	15.10	82.00	66.40	3.40	2.30		xxx		x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_74_252074	252074	17.07.2014 14:00:00	18:00	14:00	316.72	4389.7	184.9	-29.37460	58.82120	0.59	92.09	1.56	9999.999	9999.999	9999.999	1026.2	14.20	87.00	283.10	2.80	1.60				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_75_252075	252075	17.07.2014 17:00:00	21:00	17:00	354.16	5138.0	353.5	-28.95190	58.78140	12.92	90.42	2.31	9999.999	9999.999	9999.999	1026.8	17.30	79.00	20.70	8.10	6.50				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_76_252076	252076	17.07.2014 20:00:00	00:00	20:00	355.06	14.7	359.3	-28.35370	58.72540	10.83	60.88	4.06	9999.999	9999.999	9999.999	1025.6	18.30	68.00	24.90	9.90	8.50				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_77_252077	252077	17.07.2014 23:00:00	03:00	23:00	357.19	14.7	351.8	-27.77440	58.67270	11.10	70.72	6.17	9999.999	9999.999	9999.999	1024.4	18.80	69.00	41.30	10.60	9.20				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_78_252078	252078	18.07.2014 02:00:00	06:00	02:00	359.68	4863.6	357.4	-27.19700	58.61760	11.74	115.17	6.60	9999.999	9999.999	9999.999	1024.2	18.20	79.00	63.30	8.10	6.40	xxx			x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_79_252079	252079	18.07.2014 05:00:00	09:00	05:00	351.63	5144.6	356.3	-26.64880	58.56730	9.69	48.26	8.18	9999.999	9999.999	9999.999	1025.4	20.00	55.00	32.90	13.70	11.80				x	x	x	x	x		x	x			x	x	x
SO234_2	SO234_2/UW_80_252080	252080	18.07.2014 08:00:00	12:00	08:00	352.73	5217.6	358.3	-26.17070	58.52380	9.50	65.50	6.45	9999.999	9999.999	9999.999	1025.0	20.20	52.00	36.40	11.50	9.90				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_81_252081	252081	18.07.2014 11:00:00	15:00	11:00	351.56	5343.2	354.0	-25.68830	58.47960	9.98	81.80	8.40	9999.999	9999.999	9999.999	1023.0	20.50	57.00	58.00	11.20	9.90				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_82_252082	252082	18.07.2014 14:00:00	18:00	14:00	351.06	5185.5	353.3	-25.20580	58.43660	8.51	84.62	6.71	9999.999	9999.999	9999.999	1023.8	20.80	60.00	52.10	9.90	8.50				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_83_252083	252083	18.07.2014 17:00:00	21:00	17:00	356.95	5214.5	354.8	-24.73710	58.39410	9.68	96.02	9.41	9999.999	9999.999	9999.999	1023.8	21.00	59.00	70.60	11.20	9.80				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_84_252084	252084	18.07.2014 20:00:00	00:00	20:00	356.75	4977.6	355.8	-24.27930	58.35180	9.98	64.06	9.11	9999.999	9999.999	9999.999	1023.0	21.20	58.00	46.50	13.10	11.70				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_85_252085	252085	18.07.2014 23:00:00	03:00	23:00	333.81	4972.3	82.2	-23.81800	58.31160	0.56	89.08	5.81	9999.999	9999.999	9999.999	1022.0	21.50	58.00	3.60	7.10	6.10				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_86_252086	252086	19.07.2014 02:00:00	06:00	02:00	118.46	4914.7	73.0	-23.81800	58.31160	1.07	99.14	8.55	9999.999	9999.999	9999.999	1022.2	21.30	64.00	24.20	9.60	8.70				x	x		x			x	x			x	x	x
SO234_2	SO234_2/UW_87_252087	252087	19.07.2014 05:00:00	09:00	05:00	347.09	4862.3	344.6	-23.49500	58.20920	10.62	73.25	9.38	9999.999	9999.999	9999.999	1023.0	21.90	71.00	59.40	13.10	10.90				x	x	x	x	x		x	x			x	x	x
SO234_2	SO234_2/UW_88_252088	252088	19.07.2014 08:00:00	12:00	08:00	337.38	4576.9	344.1	-22.95270	58.02140	11.00	82.61	8.81	9999.999	9999.999	9999.999	1022.0	22.60	74.00	62.60	10.90	9.80				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_89_252089	252089	19.07.2014 11:00:00	15:00	11:00	337.81	4317.2	340.1	-22.42190	57.84060	11.36	87.96	9.61	9999.999	9999.999	9999.999	1020.4	23.00	78.00	73.00	11.20	9.60		xxx		x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_90_252090	252090	19.07.2014 14:00:00	18:00	14:00	336.19	4705.0	345.6	-21.89490	57.66120	11.41	88.38	9.18	9999.999	9999.999	9999.999	1021.0	23.00	81.00	69.20	11.20	9.50				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_91_252091	252091	19.07.2014 17:00:00	21:00	17:00	343.65	4340.9	345.3	-21.38480	57.48950	10.46	93.38	9.32	9999.999	9999.999	9999.999	1021.8	23.10	81.00	75.50	11.50	9.20				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_92_252092	252092	19.07.2014 20:00:00	00:00	20:00	336.71	3968.9	347.2	-20.90750	57.32750	9.45	107.88	6.79	9999.999	9999.999	9999.999	1021.6	22.90	84.00	77.20	7.80	6.00				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_93_252093	252093	19.07.2014 23:00:00	03:00	23:00	342.43	2283.4	343.7	-20.46540	57.17890	9.89	116.29	6.88	9999.999	9999.999	9999.999	1019.8	23.10	81.00	88.40	8.40	5.10				x	x		x	x		x	x			x	x	x
SO234_2	SO234_2/UW_94_252094	252094	20.07.2014 02:00:00	06:00	02:00	58.30	1827.4	78.3	-20.12660	57.39780	0.87	91.83	5.75	9999.999	9999.999	9999.999	1019.8	23.10	76.00	12.00	7.80	6.80																x

Appendix B: Sample lists for CTD samples

SPACES (SO234-2) Samples taken from CTD casts (preliminary)

Event label	Station	Cast	Bottle No.	Bedford-Nr.	Device abbreviation	planned Depth	True Depth	Date and time	Salinity [S]	Density [g/L]	Lat Latitude	Lon Longitude	Pressure [dbar] PrDM	Depth [m] DepSM	Temp [°C] T090C Po	Pot. temp [°C] temp090C	Oxygen [µmol/kg] x0Mm/Kg	Oxygen Sat [%] Sbeox0PS	Fluorescence [mv] HaardtC	O_2 [Winkler]	N_2O + CH_4 [Xiao]	DMS + Isoprene [Booge]	Hal [Hepach]	CO_2 [Steinhoff]	DOC/TDN [Endres]	Flow cytometry [Endres]	TEP/CSP [Endres]	Composition [Endres]	measurements [Endres]	DNA [Endres] (C. Stolle)	CDOM [Marandino]	Iodi/Ioda [Quack]	Nano-nuts [Quack]	µicro-nuts [Quack]	15N [Quack]	PAB [Wiegmann]	DNA [Cheah]	Pigments [Wiegmann]	Salt [Krueger]	PFOs [Petrick]	Hal-DOC [Quack]
SO234_2/CTD_1_1_1_252251	1	1	1	252251	CTD	bottom+5	4403	10.07.2014 10:33:30	34.6927	1027.8442	-26.24008	39.67948	4479.336	4403.814	0.5988	0.2542	192.497	56.05365	0.0326	x														x					x	x	
SO234_2/CTD_1_1_2_252252	1	1	2	252252	CTD	4000	4000	10.07.2014 10:43:28	34.7020	1027.8447	-26.23948	39.67978	4062.988	3998.239	0.6793	0.3770	192.032	56.03802	0.0328	x		x				x					x	x		x			x	x			
SO234_2/CTD_1_1_3_252253	1	1	3	252253	CTD	3000	3000	10.07.2014 11:07:37	34.7799	1027.8289	-26.23992	39.67967	3038.549	2997.130	1.7906	1.5632	188.903	56.73805	0.0333	x														x							
SO234_2/CTD_1_1_4_252254	1	1	4	252254	CTD	2500	2500	10.07.2014 11:18:06	34.7929	1027.8063	-26.24020	39.67980	2531.494	2499.919	2.1805	1.9933	184.677	56.01859	0.0327	x														x						x	
SO234_2/CTD_1_1_5_252255	1	1	5	252255	CTD	2000	2000	10.07.2014 11:29:43	34.7672	1027.7588	-26.23920	39.68009	2018.673	1995.882	2.4682	2.3225	169.102	51.65215	0.0350	x														x							
SO234_2/CTD_1_1_6_252256	1	1	6	252256	CTD	1500	1500	10.07.2014 11:41:47	34.7038	1027.6625	-26.23962	39.67982	1514.286	1498.968	2.9576	2.8487	149.722	46.26637	0.0348	x														x					x		
SO234_2/CTD_1_1_7_252257	1	1	7	252257	CTD	1000	1000	10.07.2014 11:51:40	34.5859	1027.4495	-26.23946	39.67994	1010.208	1001.187	4.1471	4.0693	138.215	43.92423	0.0350	x														x							
SO234_2/CTD_1_1_8_252258	1	1	8	252258	CTD	750	750	10.07.2014 11:59:10	34.5129	1027.2652	-26.24002	39.68060	753.693	747.421	5.2680	5.2050	149.395	48.73335	0.0333	x														x							
SO234_2/CTD_1_1_9_252259	1	1	9	252259	CTD	500	500	10.07.2014 12:04:12	34.5498	1027.0325	-26.23990	39.68024	502.161	498.283	7.2757	7.2269	172.509	58.95967	0.0307	x														x						x	
SO234_2/CTD_1_1_10_252260	1	1	10	252260	CTD	250	250	10.07.2014 12:12:10	35.0081	1026.6731	-26.24032	39.68000	251.103	249.315	11.6217	11.5895	192.049	72.38294	0.0296	x		x	x			x					x	x		x			x	x			
SO234_2/CTD_1_1_11_252261	1	1	11	252261	CTD	150	150	10.07.2014 12:16:27	35.4381	1025.6954	-26.24024	39.67982	152.435	151.385	17.6691	17.6433	150.335	64.05104	0.0338	x														x							
SO234_2/CTD_1_1_12_252262	1	1	12	252262	CTD	150	150	10.07.2014 12:16:33	35.4383	1025.6932	-26.24024	39.67982	152.144	151.097	17.6784	17.6526	150.037	63.93558	0.0335						x																
SO234_2/CTD_1_1_13_252263	1	1	13	252263	CTD	Chl.a Grad.	100	10.07.2014 12:21:19	35.4134	1024.8193	-26.23998	39.67954	102.506	101.812	20.9805	20.9609	150.191	67.96209	0.0524	x		x			x	x					x	x	x				x	x			
SO234_2/CTD_1_1_14_252264	1	1	14	252264	CTD	Chl.a Grad.	100	10.07.2014 12:21:24	35.4130	1024.8094	-26.23998	39.67952	101.702	101.014	21.0158	20.9963	150.221	68.01840	0.0522				x											x							
SO234_2/CTD_1_1_15_252265	1	1	15	252265	CTD	70	70	10.07.2014 12:23:30	35.3548	1024.3007	-26.24015	39.67942	73.015	72.526	22.6738	22.6590	189.748	88.41290	0.1106	x		x				x					x	x	x				x	x			
SO234_2/CTD_1_1_16_252266	1	1	16	252266	CTD	70	70	10.07.2014 12:23:35	35.3548	1024.3017	-26.24016	39.67942	71.790	71.310	22.6701	22.6556	189.869	88.46391	0.1092				x		x									x							
SO234_2/CTD_1_1_17_252267	1	1	17	252267	CTD	Chl.a Max	40	10.07.2014 12:26:26	35.3550	1024.2972	-26.24044	39.67952	40.514	40.246	22.6799	22.6717	190.994	89.00280	0.1426	x		x				x											x	x			
SO234_2/CTD_1_1_18_252268	1	1	18	252268	CTD	Chl.a Max	40	10.07.2014 12:26:31	35.3549	1024.2967	-26.24044	39.67952	40.912	40.641	22.6815	22.6732	191.194	89.09837	0.1456				x		x						x	x	x	x							
SO234_2/CTD_1_1_19_252269	1	1	19	252269	CTD	Chl.a Grad.	25	10.07.2014 12:27:53	35.3551	1024.2962	-26.24056	39.67954	25.462	25.295	22.6808	22.6756	191.394	89.19070	0.1562	x		x				x											x	x			
SO234_2/CTD_1_1_20_252270	1	1	20	252270	CTD	Chl.a Grad.	25	10.07.2014 12:27:57	35.3551	1024.2961	-26.24056	39.67953	25.444	25.276	22.6813	22.6762	191.258	89.12818	0.1596				x		x						x	x	x	x					x	x	
SO234_2/CTD_1_1_21_252271	1	1	21	252271	CTD	10	10	10.07.2014 12:29:25	35.3569	1024.2897	-26.24064	39.67952	10.402	10.334	22.7050	22.7029	191.763	89.40117	0.1471	xxx														x							
SO234_2/CTD_1_1_22_252272	1	1	22	252272	CTD	10	10	10.07.2014 12:29:30	35.3572	1024.2879	-26.24064	39.67952	10.984	10.912	22.7123	22.7101	191.602	89.33729	0.1444						x																
SO234_2/CTD_1_1_23_252273	1	1	23	252273	CTD	5	5	10.07.2014 12:30:24	35.3580	1024.2864	-26.24066	39.67950	5.847	5.809	22.7187	22.7175	191.624	89.35811	0.1171	x		x				x					x	x	x				x	x			
SO234_2/CTD_1_1_24_252274	1	1	24	252274	CTD	5	5	10.07.2014 12:30:27	35.3581	1024.2857	-26.24066	39.67950	5.830	5.792	22.7213	22.7201	191.624	89.36210	0.1195				x		x									x							
SO234_2/CTD_2_1_1_252275	2	1	1	252275	CTD	Bottom + 5	3015	11.07.2014 10:31:25	34.7886	1027.8263	-23.57492	43.00098	3056.195	3014.979	1.9233	1.6911	187.086	56.38350	0.0334	x														x					x	x	
SO234_2/CTD_2_1_2_252276	2	1	2	252276	CTD	3000	3000	11.07.2014 10:32:50	34.7886	1027.8263	-23.57482	43.00094	3041.129	3000.221	1.9228	1.6921	187.223	56.42425	0.0338	x		x	x			x					x	x	x	x			x	x			
SO234_2/CTD_2_1_3_252277	2	1	3	252277	CTD	2500	2500	11.07.2014 10:44:27	34.7849	1027.7890	-23.57532	43.00132	2530.890	2499.794	2.3178	2.1282	175.000	53.26168	0.0362	x														x							
SO234_2/CTD_2_1_4_252278	2	1	4	252278	CTD	2000	2000	11.07.2014 10:56:24	34.7523	1027.7282	-23.57492	43.00124	2019.136	1996.711	2.6914	2.5424	156.180	47.96428	0.0360	x														x							
SO234_2/CTD_2_1_5_252279	2	1	5	252279	CTD	1500	1500	11.07.2014 11:09:19	34.7291	1027.6299	-23.57518	43.00172	1514.294	1499.256	3.5272	3.4117	129.865	40.70072	0.0369	x														x					x	x	
SO234_2/CTD_2_1_6_252280	2	1	6	252280	CTD	1000	1000	11.07.2014 11:19:05	34.6836	1027.3771	-23.57468	43.00166	1009.704	1000.876	5.4882	5.4000	114.132	37.47108	0.0381	x														x							
SO234_2/CTD_2_1_7_252281	2	1	7	252281	CTD	750	750	11.07.2014 11:26:48	34.5819	1027.0896	-23.57526	43.00196	755.468	749.318	7.0721	6.9986	161.882	55.08539	0.0313	x														x					x		
SO234_2/CTD_2_1_8_252282	2	1	8	252282	CTD	500	500	11.07.2014 11:32:09	34.8442	1026.7853	-23.57556	43.00210	501.549	497.770	10.3209	10.2608	194.676	71.30098	0.0288	x														x						x	
SO234_2/CTD_2_1_9_252283	2	1	9	252283	CTD	250	300	11.07.2014 11:39:09	35.3157	1026.4644	-23.57536	43.00196	301.914	299.783	13.8857	13.8420	190.215	75.25146	0.0305	x		x	x		x	x					x	x	x	x			x	x			
SO234_2/CTD_2_1_10_252284	2	1	10	252284	CTD	200	200	11.07.2014 11:41:05	35.5166	1025.8737	-23.57540	43.00186	199.287	197.930	17.1888	17.1555	164.680	69.56857	0.0323	x														x							
SO234_2/CTD_2_1_11_252285	2	1	11	252285	CTD	150	150	11.07.2014 11:42:18	35.5275	1025.1928	-23.57542	43.00179	152.671	151.648	19.9198	19.8916	158.581	70.46268	0.0457	x			x											x							
SO234_2/CTD_2_1_12_252286	2	1	12	252286	CTD	150	150	11.07.2014 11:42:28	35.5297	1025.1967	-23.57544	43.00180	151.488	150.473	19.9112	19.8832	158.330	70.34116	0.0411	x														x				x			
SO234_2/CTD_2_1_13_252287	2	1	13	252287	CTD	Chl.a Grad.	110	11.07.2014 11:49:38	35.4436	1024.5267	-23.57570	43.00156	110.126	109.400	22.1221	22.1002	167.511	77.35295	0.0713	x		x	x		x	x					x	x	x	x							
SO234_2/CTD_2_1_14_252288	2	1	14	252288	CTD	Chl.a Grad.	110	11.07.2014 11:49:45	35.4412	1024.5140	-23.57572	43.00156	111.225	110.490	22.1615	22.1393	166.968	77.15394	0.0787	x														x			x	x			
SO234_2/CTD_2_1_15_252289	2	1	15	252289	CTD	Chl.a Max	80	11.07.2014 11:52:05	35.3768	1024.0518	-23.57579	43.00150	80.703	80.176	23.5926	23.5758	189.653	89.78655	0.0998	x		x	x		x	x					x	x	x	x							
SO234_2/CTD_2_1_16_252290	2	1	16	252290	CTD	Chl.a Max	80	11.07.2014 11:52:12	35.3791	1024.0539	-23.57578	43.00150	80.786	80.258	23.5916	23.5748	189.970	89.93648	0.0935	x														x			x	x			
SO234_2/CTD_2_1_17_252291	2	1	17	252291	CTD	Chl.a Grad.	60	11.07.2014 11:53:34	35.3820	1024.0157	-23.57580	43.00146	60.410	60.019	23.7247	23.7121	190.175	90.23927	0.0957	x		x	x		x	x					x	x	x	x							
SO234_2/CTD_2_1_18_252292	2	1	18	252292	CTD	Chl.a Grad.	60	11.07.2014 11:53:39	35.3822	1024.0153	-23.57580	43.00144	61.042	60.646	23.7268	23.7140	190.586	90.43772	0.0968	x														x			x	x	x		
SO234_2/CTD_2_1_19_252293	2	1	19	252293	CTD	30	30	11.07.2014 11:55:26	35.3431	1023.8546	-23.57578	43.00138	30.925	30.726	24.1629	24.1563	189.579	90.60474	0.0757	x		x	x		x	x					x	x	x	x							
SO234_2/CTD_2_1_20_252294	2	1	20	252294	CTD	30	30	11.07.2014 11:55:30	35.3433	1023.8546	-23.57578	43.00138	30.776	30.579	24.1637	24.1572	189.249	90.44817	0.0716	x														x			x	x		x	
SO234_2/CTD_2_1_21_252295	2	1	21	252295	CTD	10	11	11.07.2014 11:56:57	35.3254	1023.7706	-23.57574	43.00136	11.103	11.033	24.3953	24.3929	189.070	90.70585	0.0516	x			x		x							x	x	x							
SO234_2/CTD_2_1_22_252296	2	1	22	252296	CTD	10	11	11.07.2014 11:57:05	35.3264	1023.7720	-23.57572	43.00136	11.126	11.056	24.3931	24.3907	188.728	90.53898	0.0512	x														x				x			
SO234_2/CTD_2_1_23_252297	2	1	23	252297	CTD	5	5	11.07.2014 11:57:43	35.3263	1023.7720	-23.57570	43.00136	5.041	5.009	24.3917	24.3906	188.351	90.35628	0.0456	x		x	x		x	x					x	x	x	x							
SO234_2/CTD_2_1_24_252298	2	1	24	252298	CTD	5	5	11.07.2014 11:57:48	35.3260	1023.7711	-23.57570	43.00134	5.626	5.591	24.3939	24.3927	188.841	90.59439	0.0464	x														x			x	x			
SO234_2/CTD_3_1_1_252299	3	1	1	252299	CTD	bottom+5	2397	13.07.2014 01:48:28	34.7535	1027.7684	-26.39698	46.58532	2427.477	2397.751	2.2512	2.0726	166.209	50.49027	0.0324	x														x							
SO234_2/CTD_3_1_2_252300	3	1	2	252300	CTD	2000	2000	13.07.2014 01:57:58	34.7258	1027.7259	-26.39814	46.58260	2020.316	1997.474	2.4657	2.3202	164.915	50.35434	0.0332	x														x					x		
SO234_2/CTD_3_1_3_252301	3	1	3	252301	CTD	1750	1750	13.07.2014 02:03:08	34.6871	1027.6816	-26.39882	46.58115	1767.624	1748.677	2.6039	2.4782	157.551	48.25645	0.0343	x														x					x		
SO234_2/CTD_3_1_4_252302	3	1	4	252302	CTD	1500	1500	13.07.2014 02:09:22	34.6272	1027.6022	-26.39970	46.57935	1513.445	1498.120	2.9470	2.8385	155.899	48.13454	0.0328	x														x							
SO234_2/CTD_3_1_5_252303	3	1	5	252303	CTD	1250	1150	13.07.2014 02:16:27	34.5840	1027.4060	-26.40044	46.57741	1157.774	1147.018	4.5561	4.4621	128.674	41.29414	0.0341	x														x					x		
SO234_2/CTD_3_1_6_252304	3	1	6	252304	CTD	1000	1000	13.07.2014 02:19:06	34.5396	1027.2569	-26.40070	46.57670	1006.038	997.052	5.5387	5.4507	138.042	45.32620	0.0330	x														x							
SO234_2/CTD_3_1_7_252305	3	1	7	252305	CTD	750	750	13.07.2014 02:25:37	34.6364	1026.9111	-26.40120	46.57488	753.300	747.022	8.5890	8.5072	188.236	66.29526	0.0287	x														x							
SO234_2/CTD_3_1_8_252306	3	1	8	252306	CTD	500	500	13.07.2014 02:30:45	34.9603	1026.7191	-26.40164	46.57345	501.418	497.540	11.2035	11.1401	205.621	76.79642	0.0267	x														x							
SO234_2/CTD_3_1_9_252307	3	1	9	252307	CTD	250	220	13.07.2014 02:37:12	35.5809	1025.9781	-26.40192	46.57174	218.646	217.103	16.9616	16.9254	173.550	73.03328	0.0300	x		x	x			x					x	x		x			x	x			
SO234_2/CTD_3_1_10_252308	3	1	10	252308	CTD	150	150	13.07.2014 02:38:21	35.5843	1025.3657	-26.40202	46.57136	148.874	147.848	19.4235	19.3964	170.694	75.19397	0.0372	x														x							
SO234_2/CTD_3_1_11_252309	3	1	11	252309	CTD	125	125	13.07.2014 02:38:55	35.5233	1024.8651	-26.40211	46.57114	125.822	124.962	21.1241	21.0999	168.409	76.45593	0.0419	x			x											x							
SO234_2/CTD_3_1_12_252310	3	1	12	252310	CTD	125	125	13.07.2014 02:39:05	35.5253	1024.8624	-26.40214	46.57109	126.739	125.873	21.1396	21.1152	168.980	76.73729	0.0443	x					x									x				x			
SO234_2/CTD_3_1_13_252311	3	1	13	252311	CTD	Chl.a Grad.	95	13.07.2014 02:40:41	35.4399	1024.2169	-26.40245	46.57035	95.742	95.094	23.1936	23.1739	180.629	84.96783	0.0928	x		x	x			x					x	x		x							
SO234_2/CTD_3_1_14_252312	3	1	14	252312	CTD	Chl.a Grad.	95	13.07.2014 02:40:48	35.4418	1024.2196	-26.40248	46.57030	96.113	95.464	23.1895	23.1697	181.730	85.48072	0.0859	x					x									x			x	x			
SO234_2/CTD_3_1_15_252313	3	1	15	252313	CTD	Chl. a Max	85	13.07.2014 02:41:39	35.3179	1023.9244	-26.40268	46.56987	87.380	86.791	23.8753	23.8570	185.648	88.28072	0.0739	x		x	x			x					x	x		x							
SO234_2/CTD_3_1_16_252314	3	1	16	252314	CTD	Chl. a Max	85	13.07.2014 02:41:48	35.3126	1023.9039	-26.40272	46.56979	87.110	86.523	23.9311	23.9128	185.699	88.38533	0.0676	x					x									x			x	x			
SO234_2/CTD_3_1_17_252315	3	1	17	252315	CTD	Chl.a Grad.	75	13.07.2014 02:42:42	35.3132	1023.8840	-26.40296	46.56932	78.132	77.606	23.9977	23.9813	190.143	90.60299	0.0599	x		x	x			x					x	x		x							
SO234_2/CTD_3_1_18_252316	3	1	18	252316	CTD	Chl.a Grad.	75	13.07.2014 02:42:49	35.3132	1023.8826	-26.40300	46.56925	75.555	75.048	24.0019	23.9860	189.222	90.17060	0.0601	x					x									x			x	x			
SO234_2/CTD_3_1_19_252317	3	1	19	252317	CTD	40	41	13.07.2014 02:45:18	35.3139	1023.8759	-26.40372	46.56788	40.788	40.518	24.0189	24.0103	189.572	90.36358	0.0528	x		x	x			x					x	x	x	x							
SO234_2/CTD_3_1_20_252318	3	1	20	252318	CTD	40	41	13.07.2014 02:45:23	35.3129	1023.8747	-26.40375	46.56783	41.772	41.495	24.0208	24.0120	189.002	90.09404	0.0541	x					x									x			x	x	x		
SO234_2/CTD_3_1_21_252319	3	1	21	252319	CTD	10	10	13.07.2014 02:47:15	35.2190	1023.7789	-26.40434	46.56673	10.559	10.490	24.0977	24.0955	188.917	90.11601	0.0558	x		x	x			x					x	x	x	x							
SO234_2/CTD_3_1_22_252320	3	1	22	252320	CTD	10	10	13.07.2014 02:47:25	35.2195	1023.7794	-26.40440	46.56663	10.566	10.497	24.0972	24.0950	189.996	90.63046	0.0524	xxx					x									x			x	x			
SO234_2/CTD_3_1_23_252321	3	1	23	252321	CTD	5	5	13.07.2014 02:48:04	35.2188	1023.7792	-26.40462	46.56625	6.419	6.377	24.0949	24.0936	189.288	90.28861	0.0528	x		x	x			x					x	x	x	x							
SO234_2/CTD_3_1_24_252322	3	1	24	252322	CTD	5	5	13.07.2014 02:48:17	35.2188	1023.7796	-26.40468	46.56612	6.001	5.961	24.0935	24.0922	189.201	90.24475	0.0527	x					x									x			x	x			
SO234_2/CTD_4_1_1_252323	4	1	1	252323	CTD	1500	1500	14.07.2014 08:36:56	34.5958	1027.5636	-28.04242	52.69778	1516.305	1500.757	3.0975	2.9871	146.980	45.53794	0.0315	x														x					x		
SO234_2/CTD_4_1_2_252324	4	1	2	252324	CTD	1250	1250	14.07.2014 08:43:29	34.4997	1027.4140	-28.04218	52.69804	1261.239	1249.061	3.8428	3.7465	148.639	46.86147	0.0313	x														x							
SO234_2/CTD_4_1_3_252325	4	1	3	252325	CTD	1000	1000	14.07.2014 08:48:29	34.4395	1027.1782	-28.04220	52.69830	1009.887	1000.734	5.5351	5.4469	171.735	56.34258	0.0296	x														x					x		
SO234_2/CTD_4_1_4_252326	4	1	4	252326	CTD	750	750	14.07.2014 08:55:12	34.6765	1026.8739	-28.04226	52.69854	756.422	750.021	9.0279	8.9432	196.919	70.04702	0.0266	x														x							
SO234_2/CTD_4_1_5_252327	4	1	5	252327	CTD	600	600	14.07.2014 08:59:13	34.8696	1026.7646	-28.04220	52.69876	603.352	598.466	10.5669	10.4931	205.427	75.64836	0.0254	x														x							
SO234_2/CTD_4_1_6_252328	4	1	6	252328	CTD	500	500	14.07.2014 09:00:49	35.0448	1026.6791	-28.04216	52.69884	502.415	498.466	11.7750	11.7094	204.820	77.46425	0.0255	x														x							
SO234_2/CTD_4_1_7_252329	4	1	7	252329	CTD	400	400	14.07.2014 09:02:27	35.1749	1026.6156	-28.04210	52.69892	400.769	397.717	12.6174	12.5628	203.906	78.54395	0.0260	x														x							
SO234_2/CTD_4_1_8_252330	4	1	8	252330	CTD	300	300	14.07.2014 09:07:18	35.3378	1026.4993	-28.04200	52.69918	301.875	299.647	13.8006	13.7571	200.284	79.11178	0.0280	x														x							
SO234_2/CTD_4_1_9_252331	4	1	9	252331	CTD	200	200	14.07.2014 09:09:23	35.4570	1026.3301	-28.04193	52.69925	200.173	198.745	15.0046	14.9742	201.011	81.38576	0.0295	x			x		x									x				x			
SO234_2/CTD_4_1_10_252332	4	1	10	252332	CTD	150	150	14.07.2014 09:10:16	35.5187	1026.1638	-28.04192	52.69928	148.505	147.464	15.9489	15.9254	197.986	81.68235	0.0421	x														x							
SO234_2/CTD_4_1_11_252333	4	1	11	252333	CTD	100	100	14.07.2014 09:11:57	35.5777	1025.9322	-28.04188	52.69938	102.178	101.473	17.1241	17.1072	194.048	81.90862	0.0705	x		x	x			x					x	x	x	x							
SO234_2/CTD_4_1_12_252334	4	1	12	252334	CTD	100	100	14.07.2014 09:12:05	35.5745	1025.9289	-28.04186	52.69938	100.935	100.239	17.1270	17.1103	195.812	82.65582	0.0718	x					x									x			x	x			
SO234_2/CTD_4_1_13_252335	4	1	13	252335	CTD	Chl.a Grad.	85	14.07.2014 09:13:12	35.5921	1025.8115	-28.04185	52.69945	87.620	87.018	17.6659	17.6510	188.050	80.19818	0.1040	x		x	x			x					x	x	x	x							
SO234_2/CTD_4_1_14_252336	4	1	14	252336	CTD	Chl.a Grad.	85	14.07.2014 09:13:18	35.5847	1025.8065	-28.04186	52.69946	86.276	85.684	17.6630	17.6484	187.352	79.89193	0.0917	x					x									x			x	x			
SO234_2/CTD_4_1_15_252337	4	1	15	252337	CTD	Chl.a Max	70	14.07.2014 09:14:39	35.6001	1025.6856	-28.04182	52.69954	71.465	70.977	18.1985	18.1861	194.220	83.66097	0.2046	x		x	x			x					x	x	x	x							
SO234_2/CTD_4_1_16_252338	4	1	16	252338	CTD	Chl.a Max	70	14.07.2014 09:15:00	35.6024	1025.6397	-28.04182	52.69954	72.005	71.513	18.3893	18.3768	197.782	85.49874	0.2123	x					x									x			x	x			
SO234_2/CTD_4_1_17_252339	4	1	17	252339	CTD	Chl.a Grad.	60	14.07.2014 09:15:58	35.6012	1025.3821	-28.04180	52.69960	61.472	61.054	19.3942	19.3830	202.163	89.01907	0.1990	x		x	x			x					x	x	x	x							
SO234_2/CTD_4_1_18_252340	4	1	18	252340	CTD	Chl.a Grad.	60	14.07.2014 09:16:09	35.6057	1025.3851	-28.04180	52.69959	61.137	60.722	19.3955	19.3844	202.359	89.11025	0.2004	x					x									x			x	x			
SO234_2/CTD_4_1_19_252341	4	1	19	252341	CTD	35	36	14.07.2014 09:17:40	35.6059	1025.0293	-28.04176	52.69966	36.768	36.520	20.7347	20.7277	202.292	91.25515	0.0494	x		x	x			x					x	x	x	x							
SO234_2/CTD_4_1_20_252342	4	1	20	252342	CTD	35	36	14.07.2014 09:17:50	35.6062	1025.0299	-28.04176	52.69964	36.452	36.206	20.7334	20.7264	201.553	90.91959	0.0493	xxx					x									x			x	x	x		
SO234_2/CTD_4_1_21_252343	4	1	21	252343	CTD	10	10	14.07.2014 09:19:40	35.6033	1025.0183	-28.04174	52.69971	9.952	9.885	20.7629	20.7610	202.695	91.48086	0.0416	x		x	x			x					x	x	x	x							
SO234_2/CTD_4_1_22_252344	4	1	22	252344	CTD	10	10	14.07.2014 09:19:46	35.6036	1025.0188	-28.04174	52.69972	10.137	10.070	20.7617	20.7598	202.386	91.34001	0.0418	x					x									x			x	x			
SO234_2/CTD_4_1_23_252345	4	1	23	252345	CTD	5	5	14.07.2014 09:20:53	35.6035	1025.0173	-28.04174	52.69976	4.809	4.777	20.7659	20.7650	202.151	91.24084	0.0374	x		x	x			x					x	x	x	x							
SO234_2/CTD_4_1_24_252346	4	1	24	252346	CTD	5	5	14.07.2014 09:20:59	35.6034	1025.0158	-28.04174	52.69978	5.047	5.013	20.7716	20.7707	202.277	91.30676	0.0384	x					x									x			x	x			
SO234_2/CTD_6_1_1_252347	6	1	1	252347	CTD	bottom + 5	4043	15.07.2014 18:23:33	34.7158	1027.8249	-29.69438	58.77042	4109.637	4042.653	1.2032	0.8807	173.872	51.42815	0.0333	x											x	x		x					x		
SO234_2/CTD_6_1_2_252348	6	1	2	252348	CTD	4000	4000	15.07.2014 18:25:37	34.7164	1027.8238	-29.69416	58.77026	4065.802	3999.929	1.2225	0.9041	172.932	51.17559	0.0334	x														x							
SO234_2/CTD_6_1_3_252349	6	1	3	252349	CTD	3000	3000	15.07.2014 18:45:22	34.7343	1027.7926	-29.69171	58.76952	3029.062	2987.051	1.7865	1.5603	154.602	46.41438	0.0359	x														x							
SO234_2/CTD_6_1_4_252350	6	1	4	252350	CTD	2500	2500	15.07.2014 18:54:47	34.7336	1027.7742	-29.69256	58.76984	2532.493	2500.240	1.9785	1.7953	155.114	46.79263	0.0342	x														x					x		
SO234_2/CTD_6_1_5_252351	6	1	5	252351	CTD	2000	2000	15.07.2014 19:07:09	34.7048	1027.7214	-29.69334	58.77032	2019.970	1996.631	2.3143	2.1711	157.351	47.85667	0.0337	x														x							
SO234_2/CTD_6_1_6_252352	6	1	6	252352	CTD	1500	1500	15.07.2014 19:23:19	34.5663	1027.5471	-29.69319	58.77004	1514.123	1498.412	3.0191	2.9099	154.462	47.75354	0.0335	x														x							
SO234_2/CTD_6_1_7_252353	6	1	7	252353	CTD	1000	1000	15.07.2014 19:40:51	34.4337	1027.1192	-29.69320	58.77036	1008.059	998.798	5.9805	5.8891	181.094	60.03072	0.0305	xxx														x					x		
SO234_2/CTD_6_1_8_252354	6	1	8	252354	CTD	500	500	15.07.2014 20:01:57	35.0800	1026.6650	-29.69392	58.77198	503.589	499.566	11.9951	11.9285	207.785	78.96563	0.0269	x														x							
SO234_2/CTD_6_1_9_252355	6	1	9	252355	CTD	250	250	15.07.2014 20:14:33	35.3419	1026.4924	-29.69454	58.77121	249.675	247.832	13.8411	13.8052	204.607	80.88753	0.0293	x											x	x		x							
SO234_2/CTD_6_1_10_252356	6	1	10	252356	CTD	150	150	15.07.2014 20:18:02	35.4574	1026.3168	-29.69432	58.77156	151.066	149.986	15.0592	15.0363	200.178	81.13543	0.0343	x					x									x							
SO234_2/CTD_6_1_11_252357	6	1	11	252357	CTD	Chl.a Grad.	100	15.07.2014 20:20:08	35.5341	1025.9740	-29.69436	58.77180	101.578	100.865	16.8078	16.7911	206.710	86.70579	0.0934	x		x				x					x	x		x				x			
SO234_2/CTD_6_1_12_252358	6	1	12	252358	CTD	Chl.a Grad.	100	15.07.2014 20:20:22	35.5376	1025.9522	-29.69438	58.77180	102.099	101.382	16.9108	16.8940	207.000	86.99969	0.0925	x					x									x			x				
SO234_2/CTD_6_1_13_252359	6	1	13	252359	CTD	Chl.a Max	80	15.07.2014 20:21:46	35.6340	1025.7094	-29.69452	58.77186	82.189	81.615	18.2092	18.1949	210.414	90.67554	0.1604	x		x	x			x					x	x		x				x			
SO234_2/CTD_6_1_14_252360	6	1	14	252360	CTD	Chl.a Max	80	15.07.2014 20:22:04	35.6351	1025.7101	-29.69452	58.77186	81.765	81.195	18.2096	18.1954	210.436	90.68642	0.1610	x					x									x			x				
SO234_2/CTD_6_1_15_252361	6	1	15	252361	CTD	Chl.a Grad.	60	15.07.2014 20:23:45	35.6419	1025.6902	-29.69460	58.77192	60.211	59.794	18.3063	18.2958	211.797	91.44085	0.1672	x		x	x			x					x	x	x	x				x			
SO234_2/CTD_6_1_16_252362	6	1	16	252362	CTD	Chl.a Grad.	60	15.07.2014 20:23:50	35.6425	1025.6903	-29.69460	58.77190	61.418	60.993	18.3079	18.2973	212.079	91.56591	0.1635	x					x									x			x				
SO234_2/CTD_6_1_17_252363	6	1	17	252363	CTD	50	50	15.07.2014 20:24:49	35.6583	1025.6639	-29.69469	58.77185	50.236	49.890	18.4597	18.4509	212.063	91.82615	0.0750	x		x	x			x					x	x	x	x				x			
SO234_2/CTD_6_1_18_252364	6	1	18	252364	CTD	50	50	15.07.2014 20:25:02	35.6587	1025.6642	-29.69470	58.77182	50.485	50.136	18.4597	18.4509	212.111	91.84724	0.0697	x					x									x			x				
SO234_2/CTD_6_1_19_252365	6	1	19	252365	CTD	30	30	15.07.2014 20:26:25	35.6864	1025.5760	-29.69484	58.77156	30.721	30.510	18.8876	18.8822	210.494	91.88576	0.0487	x		x	x			x					x	x	x	x				x			
SO234_2/CTD_6_1_20_252366	6	1	20	252366	CTD	30	30	15.07.2014 20:26:30	35.6859	1025.5942	-29.69482	58.77152	32.318	32.096	18.8152	18.8095	210.170	91.62178	0.0504	x					x									x			x				
SO234_2/CTD_6_1_21_252367	6	1	21	252367	CTD	10	10	15.07.2014 20:27:59	35.7340	1025.4866	-29.69494	58.77120	11.081	11.006	19.3733	19.3713	207.938	91.60827	0.0423	x		x	x			x					x	x	x	x				x			
SO234_2/CTD_6_1_22_252368	6	1	22	252368	CTD	10	10	15.07.2014 20:28:10	35.7342	1025.4873	-29.69494	58.77116	11.119	11.044	19.3710	19.3690	208.147	91.69663	0.0437	x					x									x			x		x		
SO234_2/CTD_6_1_23_252369	6	1	23	252369	CTD	5	5	15.07.2014 20:28:53	35.7345	1025.4875	-29.69500	58.77104	5.574	5.536	19.3701	19.3691	208.052	91.65366	0.0417	x		x				x					x	x	x	x				x			
SO234_2/CTD_6_1_24_252370	6	1	24	252370	CTD	5	5	15.07.2014 20:28:56	35.7345	1025.4875	-29.69499	58.77103	6.024	5.983	19.3702	19.3691	207.775	91.53173	0.0421	x					x									x							

SPACES (SO234-2) Samples taken from CTD casts (preliminary)

Event label	Station	Cast	Bottle No.	Bedford-Nr.	Device abbreviation	planned Depth	True Depth	Date and time	Salinity [S]	Density [g/L]	Lat Latitude	Lon Longitude	Pressure [dbar] PrDM	Depth [m] DepSM	Temp [°C] T090C Po	Pot. temp [°C] temp090C	Oxygen [µmol/kg] x0Mm/Kg	Oxygen Sat [%] Sbeox0PS	Fluorescence [mv] HaardtC	O_2 [Winkler]	N_2O + CH_4 [Xiao]	DMS + Isoprene [Booge]	Hal [Hepach]	CO_2 [Steinhoff]	DOC/TDN [Endres]	Flow cytometry [Endres]	TEP/CSP [Endres]	Composition [Endres]	measurements [Endres]	DNA [Endres] (C. Stolle)	CDOM [Marandino]	Iodi/Ioda [Quack]	Nano-nuts [Quack]	µicro-nuts [Quack]	15N [Quack]	PAB [Wiegmann]	DNA [Cheah]	Pigments [Wiegmann]	Salt [Krueger]	PFOs [Petrick]	Hal-DOC [Quack]
SO234_2/CTD_6_2_1_252371	6	2	1	252371	CTD	750	750	16.07.2014 02:37:45	34.6830	1026.8744	-29.66192	58.73840	757.344	750.839	9.0568	8.9719	197.537	70.31455	0.0238	x														x					x		
SO234_2/CTD_6_2_2_252372	6	2	2	252372	CTD	700	700	16.07.2014 02:40:53	34.7457	1026.8318	-29.66176	58.73858	701.631	695.697	9.6157	9.5344	196.503	70.83590	0.0263	x														x							
SO234_2/CTD_6_2_3_252373	6	2	3	252373	CTD	600	600	16.07.2014 02:42:38	34.8966	1026.7449	-29.66166	58.73868	603.933	598.965	10.7979	10.7230	204.996	75.87598	0.0245	x														x							
SO234_2/CTD_6_2_4_252374	6	2	4	252374	CTD	500	500	16.07.2014 02:44:20	35.0382	1026.6788	-29.66162	58.73866	500.896	496.899	11.7496	11.6843	206.837	78.18198	0.0258	x														x							
SO234_2/CTD_6_2_5_252375	6	2	5	252375	CTD	400	400	16.07.2014 02:47:40	35.1523	1026.6323	-29.66140	58.73872	403.303	400.178	12.4429	12.3885	207.763	79.73092	0.0256	x														x					x		
SO234_2/CTD_6_2_6_252376	6	2	6	252376	CTD	300	300	16.07.2014 02:52:27	35.2583	1026.5665	-29.66074	58.73922	298.360	296.124	13.1732	13.1316	206.133	80.35389	0.0255	x														x							
SO234_2/CTD_6_2_7_252377	6	2	7	252377	CTD	250	250	16.07.2014 02:53:14	35.3327	1026.4978	-29.66078	58.73926	247.033	245.212	13.7807	13.7452	204.356	80.68527	0.0286	x														x							
SO234_2/CTD_6_2_8_252378	6	2	8	252378	CTD	150	150	16.07.2014 02:54:50	35.4744	1026.2462	-29.66086	58.73918	149.421	148.354	15.4349	15.4118	202.401	82.65084	0.0451	xxx											x	x		x							
SO234_2/CTD_6_2_9_252379	6	2	9	252379	CTD	100	100	16.07.2014 02:58:34	35.5645	1025.8684	-29.66045	58.73930	99.903	99.202	17.3466	17.3298	207.163	87.80479	0.1078	x														x							
SO234_2/CTD_6_2_10_252380	6	2	10	252380	CTD	100	100	16.07.2014 02:58:45	35.5775	1025.8314	-29.66044	58.73930	100.542	99.837	17.5405	17.5235	207.838	88.42040	0.1099	x					x									x							
SO234_2/CTD_6_2_11_252381	6	2	11	252381	CTD	Chl.a Grad.	90	16.07.2014 02:59:54	35.6038	1025.7603	-29.66038	58.73935	90.738	90.103	17.9116	17.8960	209.337	89.69515	0.1223	x		x				x					x	x		x							
SO234_2/CTD_6_2_12_252382	6	2	12	252382	CTD	Chl.a Grad.	90	16.07.2014 03:00:04	35.6043	1025.7561	-29.66036	58.73934	90.577	89.943	17.9302	17.9147	209.076	89.61476	0.1256	x					x									x			x	x			
SO234_2/CTD_6_2_13_252383	6	2	13	252383	CTD	Chl.a Max	75	16.07.2014 03:01:52	35.6310	1025.7025	-29.66018	58.73948	76.471	75.938	18.2265	18.2133	210.831	90.88279	0.1556	x		x	x			x					x	x		x							
SO234_2/CTD_6_2_14_252384	6	2	14	252384	CTD	Chl.a Max	75	16.07.2014 03:02:00	35.6311	1025.7026	-29.66016	58.73946	75.330	74.806	18.2259	18.2129	211.238	91.05751	0.1538	x					x									x			x	x			
SO234_2/CTD_6_2_15_252385	6	2	15	252385	CTD	Chl.a Grad.	65	16.07.2014 03:03:06	35.6393	1025.6911	-29.66006	58.73956	68.481	68.005	18.2960	18.2841	211.501	91.29436	0.1476	x		x	x			x					x	x		x							
SO234_2/CTD_6_2_16_252386	6	2	16	252386	CTD	Chl.a Grad.	65	16.07.2014 03:03:20	35.6421	1025.6885	-29.66004	58.73958	67.306	66.839	18.3149	18.3032	211.719	91.42198	0.1403	x					x									x			x	x			
SO234_2/CTD_6_2_17_252387	6	2	17	252387	CTD	50	50	16.07.2014 03:04:56	35.6463	1025.6779	-29.65988	58.73960	51.125	50.772	18.3676	18.3586	212.115	91.68498	0.0827	x		x	x			x					x	x	x	x							
SO234_2/CTD_6_2_18_252388	6	2	18	252388	CTD	50	50	16.07.2014 03:05:10	35.6493	1025.6735	-29.65988	58.73960	50.909	50.558	18.3939	18.3850	211.724	91.56222	0.0731	x					x									x			x	x			
SO234_2/CTD_6_2_19_252389	6	2	19	252389	CTD	30	30	16.07.2014 03:06:56	35.7099	1025.5665	-29.65986	58.73944	31.739	31.522	18.9955	18.9898	208.439	91.18316	0.0439	x		x	x			x					x	x	x	x							
SO234_2/CTD_6_2_20_252390	6	2	20	252390	CTD	30	30	16.07.2014 03:07:09	35.7174	1025.5482	-29.65986	58.73942	31.123	30.910	19.0889	19.0834	208.670	91.44502	0.0444	x					x									x			x	x			
SO234_2/CTD_6_2_21_252391	6	2	21	252391	CTD	10	10	16.07.2014 03:08:56	35.7252	1025.5342	-29.65986	58.73928	10.891	10.817	19.1632	19.1612	208.485	91.49280	0.0413	x		x	x			x					x	x	x	x							
SO234_2/CTD_6_2_22_252392	6	2	22	252392	CTD	10	10	16.07.2014 03:09:08	35.7256	1025.5342	-29.65986	58.73926	10.790	10.716	19.1641	19.1621	208.237	91.38556	0.0414	x					x									x			x	x			
SO234_2/CTD_6_2_23_252393	6	2	23	252393	CTD	5	9	16.07.2014 03:10:31	35.7274	1025.5334	-29.65980	58.73917	9.096	9.035	19.1722	19.1705	208.070	91.32681	0.0417	x		x				x					x	x	x	x					x		
SO234_2/CTD_6_2_24_252394	6	2	24	252394	CTD	5	9	16.07.2014 03:10:39	35.7279	1025.5335	-29.65980	58.73914	10.208	10.139	19.1735	19.1717	208.109	91.34667	0.0418	x					x									x			x	x			
SO234_2/CTD_6_3_1_252395	6	3	1	252395	CTD	750	749	16.07.2014 08:14:43	34.7318	1026.8429	-29.62270	58.72103	755.483	748.999	9.4883	9.4013	196.431	70.60740	0.0261	x														x					x		
SO234_2/CTD_6_3_2_252396	6	3	2	252396	CTD	700	700	16.07.2014 08:18:02	34.7863	1026.8071	-29.62266	58.72119	703.121	697.174	9.9541	9.8709	199.491	72.46181	0.0264	x											x			x							
SO234_2/CTD_6_3_3_252397	6	3	3	252397	CTD	600	600	16.07.2014 08:19:53	34.9451	1026.7237	-29.62261	58.72132	603.623	598.660	11.1268	11.0505	206.179	76.87249	0.0247	xxx														x							
SO234_2/CTD_6_3_4_252398	6	3	4	252398	CTD	500	500	16.07.2014 08:21:30	35.0590	1026.6746	-29.62254	58.72145	500.257	496.267	11.8575	11.7918	207.425	78.59203	0.0242	x														x							
SO234_2/CTD_6_3_5_252399	6	3	5	252399	CTD	400	400	16.07.2014 08:24:05	35.1777	1026.6199	-29.62256	58.72156	402.360	399.245	12.6067	12.5519	207.385	79.86838	0.0260	x														x							
SO234_2/CTD_6_3_6_252400	6	3	6	252400	CTD	300	300	16.07.2014 08:29:48	35.2952	1026.5403	-29.62296	58.72124	300.318	298.066	13.4425	13.4000	205.849	80.70233	0.0279	x														x							
SO234_2/CTD_6_3_7_252401	6	3	7	252401	CTD	250	250	16.07.2014 08:30:40	35.3561	1026.4847	-29.62296	58.72120	249.444	247.604	13.9301	13.8940	205.237	81.28900	0.0281	x					x									x							
SO234_2/CTD_6_3_8_252402	6	3	8	252402	CTD	150	150	16.07.2014 08:32:27	35.4717	1026.2640	-29.62292	58.72123	146.579	145.534	15.3455	15.3230	204.228	83.24978	0.0477	x														x							
SO234_2/CTD_6_3_9_252403	6	3	9	252403	CTD	100	100	16.07.2014 08:34:18	35.5611	1025.9841	-29.62288	58.72126	100.981	100.272	16.8528	16.8362	204.771	85.98150	0.0791	x														x							
SO234_2/CTD_6_3_10_252404	6	3	10	252404	CTD	100	100	16.07.2014 08:34:27	35.5593	1025.9461	-29.62288	58.72126	101.374	100.663	17.0066	16.9899	205.510	86.54297	0.0790	x														x							
SO234_2/CTD_6_3_11_252405	6	3	11	252405	CTD	Chl.a Grad.	80	16.07.2014 08:35:48	35.5957	1025.7753	-29.62278	58.72137	78.415	77.869	17.8234	17.8100	208.683	89.26250	0.1292	x		x				x					x	x		x							
SO234_2/CTD_6_3_12_252406	6	3	12	252406	CTD	Chl.a Grad.	80	16.07.2014 08:35:53	35.5895	1025.8076	-29.62276	58.72140	82.444	81.869	17.6726	17.6586	207.928	88.68539	0.1180	x					x									x			x	x			
SO234_2/CTD_6_3_13_252407	6	3	13	252407	CTD	Chl.a Max	65	16.07.2014 08:37:00	35.6403	1025.7030	-29.62270	58.72148	65.735	65.279	18.2511	18.2397	212.022	91.44354	0.1485	x		x	x			x					x	x		x							
SO234_2/CTD_6_3_14_252408	6	3	14	252408	CTD	Chl.a Max	65	16.07.2014 08:37:13	35.6421	1025.6952	-29.62270	58.72150	64.888	64.439	18.2875	18.2762	211.646	91.34421	0.1481	x					x									x			x	x			
SO234_2/CTD_6_3_15_252409	6	3	15	252409	CTD	Chl.a Grad.	57	16.07.2014 08:37:56	35.6501	1025.6859	-29.62266	58.72156	58.654	58.248	18.3484	18.3381	211.999	91.60483	0.0969	x		x	x			x					x	x		x							
SO234_2/CTD_6_3_16_252410	6	3	16	252410	CTD	Chl.a Grad.	57	16.07.2014 08:38:05	35.6510	1025.6829	-29.62266	58.72156	57.742	57.342	18.3629	18.3528	211.913	91.59286	0.0956	x					x									x			x	x			
SO234_2/CTD_6_3_17_252411	6	3	17	252411	CTD	50	51	16.07.2014 08:38:56	35.6533	1025.6727	-29.62264	58.72166	51.031	50.679	18.4095	18.4006	210.587	91.09966	0.0797	x		x	x			x					x	x	x	x							
SO234_2/CTD_6_3_18_252412	6	3	18	252412	CTD	50	50	16.07.2014 08:38:59	35.6531	1025.6722	-29.62264	58.72167	51.043	50.691	18.4108	18.4019	212.003	91.71445	0.0753	x					x									x			x	x			
SO234_2/CTD_6_3_19_252413	6	3	19	252413	CTD	30	30	16.07.2014 08:40:28	35.7088	1025.5555	-29.62277	58.72181	30.012	29.807	19.0349	19.0295	209.426	91.68017	0.0431	x		x	x			x					x	x	x	x							
SO234_2/CTD_6_3_20_252414	6	3	20	252414	CTD	30	30	16.07.2014 08:40:34	35.7054	1025.5749	-29.62278	58.72180	31.840	31.621	18.9494	18.9437	209.453	91.54659	0.0434	x					x									x			x	x			
SO234_2/CTD_6_3_21_252415	6	3	21	252415	CTD	10	10	16.07.2014 08:41:50	35.7401	1025.5023	-29.62292	58.72188	10.067	9.999	19.3304	19.3285	207.438	91.32061	0.0334	x		x	x			x					x	x	x	x							
SO234_2/CTD_6_3_22_252416	6	3	22	252416	CTD	10	10	16.07.2014 08:41:54	35.7402	1025.5017	-29.62292	58.72185	10.931	10.857	19.3332	19.3313	207.679	91.43118	0.0328	x					x									x			x	x			
SO234_2/CTD_6_3_23_252417	6	3	23	252417	CTD	5	10	16.07.2014 08:42:19	35.7404	1025.5019	-29.62297	58.72186	10.295	10.225	19.3331	19.3312	207.689	91.43549	0.0325	x		x				x					x	x		x					x		
SO234_2/CTD_6_3_24_252418	6	3	24	252418	CTD	5	10	16.07.2014 08:42:24	35.7403	1025.5021	-29.62298	58.72184	11.309	11.232	19.3323	19.3302	208.349	91.72466	0.0332	x					x									x			x	x			
SO234_2/CTD_6_4_1_252419	6	4	1	252419	CTD	750	749	16.07.2014 13:33:31	34.6583	1026.8974	-29.58624	58.70016	755.020	748.543	8.7881	8.7050	192.911	68.25160	0.0254	x														x					x		
SO234_2/CTD_6_4_2_252420	6	4	2	252420	CTD	700	697	16.07.2014 13:36:17	34.7104	1026.8573	-29.58589	58.70046	704.627	698.666	9.2909	9.2110	195.913	70.10817	0.0253	x											x	x		x							
SO234_2/CTD_6_4_3_252421	6	4	3	252421	CTD	600	595	16.07.2014 13:37:57	34.9123	1026.7380	-29.58572	58.70058	597.223	592.324	10.9040	10.8295	204.938	76.03354	0.0243	x														x							
SO234_2/CTD_6_4_4_252422	6	4	4	252422	CTD	500	500	16.07.2014 13:39:29	35.0567	1026.6733	-29.58568	58.70057	501.664	497.663	11.8550	11.7892	206.924	78.39701	0.0247	x														x							
SO234_2/CTD_6_4_5_252423	6	4	5	252423	CTD	400	400	16.07.2014 13:42:32	35.1884	1026.6144	-29.58578	58.70005	403.872	400.745	12.6769	12.6218	207.234	79.93111	0.0265	x														x							
SO234_2/CTD_6_4_6_252424	6	4	6	252424	CTD	300	300	16.07.2014 13:47:15	35.2836	1026.5517	-29.58548	58.69978	300.925	298.670	13.3428	13.3004	206.503	80.78944	0.0265	x														x					x		
SO234_2/CTD_6_4_7_252425	6	4	7	252425	CTD	250	250	16.07.2014 13:48:06	35.3497	1026.4961	-29.58534	58.69978	248.288	246.458	13.8520	13.8162	206.205	81.54113	0.0285	xxx														x							
SO234_2/CTD_6_4_8_252426	6	4	8	252426	CTD	150	150	16.07.2014 13:49:39	35.4523	1026.3282	-29.58500	58.69995	150.144	149.073	14.9890	14.9663	203.331	82.29673	0.0397	x		x			x	x					x	x		x			x	x			
SO234_2/CTD_6_4_9_252427	6	4	9	252427	CTD	100	101	16.07.2014 13:50:49	35.5598	1025.9729	-29.58484	58.70002	102.694	101.973	16.8958	16.8789	204.674	86.01045	0.0811	x														x							
SO234_2/CTD_6_4_10_252428	6	4	10	252428	CTD	100	101	16.07.2014 13:50:57	35.5650	1025.9828	-29.58482	58.70002	103.298	102.572	16.8709	16.8539	204.303	85.81676	0.0835	x														x							
SO234_2/CTD_6_4_11_252429	6	4	11	252429	CTD	Chl.a Grad.	85	16.07.2014 13:52:12	35.5944	1025.8386	-29.58485	58.69996	86.376	85.773	17.5620	17.5474	206.924	88.07740	0.1008	x		x			x	x					x	x		x							
SO234_2/CTD_6_4_12_252430	6	4	12	252430	CTD	Chl.a Grad.	85	16.07.2014 13:52:14	35.5954	1025.8394	-29.58486	58.69996	86.683	86.078	17.5619	17.5472	206.225	87.78000	0.1010	x														x			x	x			
SO234_2/CTD_6_4_13_252431	6	4	13	252431	CTD	Chl.a Max	75	16.07.2014 13:53:08	35.6248	1025.7689	-29.58494	58.69979	77.138	76.601	17.9399	17.9267	207.956	89.16271	0.1069	x		x	x		x	x					x	x		x							
SO234_2/CTD_6_4_14_252432	6	4	14	252432	CTD	Chl.a Max	75	16.07.2014 13:53:14	35.6248	1025.7677	-29.58494	58.69976	76.382	75.850	17.9447	17.9315	208.245	89.29474	0.1072	x														x			x	x			
SO234_2/CTD_6_4_15_252433	6	4	15	252433	CTD	Chl.a Grad.	65	16.07.2014 13:54:06	35.6470	1025.6934	-29.58497	58.69963	67.048	66.583	18.3102	18.2986	210.515	90.89748	0.1255	x		x	x		x	x					x	x	x	x							
SO234_2/CTD_6_4_16_252434	6	4	16	252434	CTD	Chl.a Grad.	65	16.07.2014 13:54:14	35.6541	1025.6769	-29.58498	58.69962	65.729	65.274	18.3977	18.3862	209.829	90.75214	0.1208	x														x			x	x			
SO234_2/CTD_6_4_17_252435	6	4	17	252435	CTD	50	50	16.07.2014 13:55:29	35.6785	1025.6417	-29.58500	58.69952	50.340	49.993	18.6091	18.6003	210.808	91.54761	0.0890	x		x	x		x	x					x	x	x	x							
SO234_2/CTD_6_4_18_252436	6	4	18	252436	CTD	50	50	16.07.2014 13:55:32	35.6788	1025.6417	-29.58500	58.69952	51.405	51.050	18.6101	18.6011	209.663	91.05240	0.0899	x														x			x	x			
SO234_2/CTD_6_4_19_252437	6	4	19	252437	CTD	30	30	16.07.2014 13:56:59	35.6944	1025.6044	-29.58492	58.69948	30.318	30.111	18.8004	18.7950	210.378	91.69293	0.0510	x		x	x		x	x					x	x	x	x					x		
SO234_2/CTD_6_4_20_252438	6	4	20	252438	CTD	30	30	16.07.2014 13:57:01	35.6944	1025.6046	-29.58492	58.69948	31.343	31.129	18.7996	18.7940	210.421	91.71036	0.0493	x														x			x	x			
SO234_2/CTD_6_4_21_252439	6	4	21	252439	CTD	10	10	16.07.2014 13:58:14	35.7028	1025.5885	-29.58486	58.69948	10.049	9.980	18.8842	18.8824	210.296	91.80320	0.0452	x		x	x		x	x					x	x	x	x							
SO234_2/CTD_6_4_22_252440	6	4	22	252440	CTD	10	10	16.07.2014 13:58:16	35.7027	1025.5884	-29.58485	58.69948	10.052	9.984	18.8846	18.8828	210.210	91.76636	0.0461	x														x			x	x			
SO234_2/CTD_6_4_23_252441	6	4	23	252441	CTD	5	9	16.07.2014 13:58:28	35.7055	1025.5867	-29.58484	58.69946	9.893	9.826	18.8994	18.8976	209.453	91.46272	0.0445	x														x							
SO234_2/CTD_6_4_24_252442	6	4	24	252442	CTD	5	9	16.07.2014 13:58:30	35.7057	1025.5862	-29.58484	58.69946	10.054	9.986	18.9024	18.9006	210.336	91.85328	0.0443	x														x							
SO234_2/CTD_6_5_1_252443	6	5	1	252443	CTD	750	750	16.07.2014 20:07:08	34.7351	1026.8424	-29.54826	58.70720	758.730	752.216	9.5079	9.4203	197.160	70.90133	0.0257	x											x			x					x		
SO234_2/CTD_6_5_2_252444	6	5	2	252444	CTD	700	700	16.07.2014 20:11:29	34.8084	1026.7956	-29.54848	58.70748	702.789	696.849	10.1236	10.0395	200.287	73.02819	0.0251	x														x							
SO234_2/CTD_6_5_3_252445	6	5	3	252445	CTD	600	600	16.07.2014 20:13:16	34.9332	1026.7287	-29.54850	58.70766	602.859	597.907	11.0473	10.9714	206.113	76.71284	0.0234	x														x							
SO234_2/CTD_6_5_4_252446	6	5	4	252446	CTD	500	500	16.07.2014 20:14:55	35.0447	1026.6801	-29.54850	58.70784	502.741	498.731	11.7699	11.7043	207.462	78.45505	0.0249	x		x				x					x			x			x	x			
SO234_2/CTD_6_5_5_252447	6	5	5	252447	CTD	400	395	16.07.2014 20:23:29	35.1996	1026.6091	-29.54830	58.70872	398.879	395.796	12.7473	12.6926	207.645	80.21118	0.0247	x														x							
SO234_2/CTD_6_5_6_252448	6	5	6	252448	CTD	300	300	16.07.2014 20:28:31	35.3008	1026.5403	-29.54815	58.70915	300.710	298.457	13.4637	13.4211	206.388	80.95130	0.0280	x														x							
SO234_2/CTD_6_5_7_252449	6	5	7	252449	CTD	250	250	16.07.2014 20:29:57	35.3640	1026.4831	-29.54814	58.70926	249.205	247.369	13.9674	13.9312	205.464	81.44404	0.0283	x														x					x		
SO234_2/CTD_6_5_8_252450	6	5	8	252450	CTD	150	150	16.07.2014 20:32:32	35.4790	1026.2657	-29.54812	58.70952	151.217	150.138	15.3640	15.3407	203.963	83.17612	0.0456	x														x							
SO234_2/CTD_6_5_9_252451	6	5	9	252451	CTD	100	100	16.07.2014 20:35:14	35.5698	1025.9190	-29.54800	58.70975	100.856	100.149	17.1537	17.1369	206.197	87.08096	0.0977	x														x							
SO234_2/CTD_6_5_10_252452	6	5	10	252452	CTD	100	100	16.07.2014 20:35:18	35.5775	1025.9005	-29.54799	58.70976	102.081	101.364	17.2551	17.2381	205.955	87.15008	0.0989	x					x									x							
SO234_2/CTD_6_5_11_252453	6	5	11	252453	CTD	Chl.a Grad.	90	16.07.2014 20:36:23	35.6176	1025.7792	-29.54794	58.70984	90.628	89.995	17.8781	17.8626	208.108	89.12082	0.1109	x		x				x					x			x							
SO234_2/CTD_6_5_12_252454	6	5	12	252454	CTD	Chl.a Grad.	90	16.07.2014 20:36:26	35.6204	1025.7737	-29.54794	58.70984	92.688	92.040	17.9093	17.8934	208.479	89.33363	0.1119	x					x									x			x	x			
SO234_2/CTD_6_5_13_252455	6	5	13	252455	CTD	Chl.a Max	80	16.07.2014 20:37:35	35.6422	1025.7113	-29.54788	58.70994	81.159	80.594	18.2263	18.2122	209.683	90.39429	0.1297	x		x	x			x					x			x							
SO234_2/CTD_6_5_14_252456	6	5	14	252456	CTD	Chl.a Max	80	16.07.2014 20:37:38	35.6415	1025.7112	-29.54788	58.70995	82.046	81.475	18.2249	18.2107	209.931	90.49841	0.1322	x					x									x			x	x			
SO234_2/CTD_6_5_15_252457	6	5	15	252457	CTD	Chl.a Grad.	70	16.07.2014 20:38:36	35.6814	1025.6558	-29.54778	58.71008	71.731	71.233	18.5656	18.5530	209.557	90.93311	0.1215	x		x	x			x					x			x							
SO234_2/CTD_6_5_16_252458	6	5	16	252458	CTD	Chl.a Grad.	70	16.07.2014 20:38:45	35.6845	1025.6606	-29.54776	58.71007	69.222	68.741	18.5555	18.5434	209.725	90.99118	0.1119	x					x									x			x	x			
SO234_2/CTD_6_5_17_252459	6	5	17	252459	CTD	50	50	16.07.2014 20:40:00	35.6961	1025.6292	-29.54762	58.71021	50.276	49.929	18.7114	18.7025	210.440	91.57073	0.0611	x		x	x			x					x		x	x							
SO234_2/CTD_6_5_18_252460	6	5	18	252460	CTD	50	50	16.07.2014 20:40:04	35.6957	1025.6294	-29.54760	58.71020	51.475	51.120	18.7098	18.7007	210.906	91.77071	0.0603	x					x									x			x	x			
SO234_2/CTD_6_5_19_252461	6	5	19	252461	CTD	30	30	16.07.2014 20:41:24	35.7007	1025.6075	-29.54744	58.71032	30.679	30.469	18.8074	18.8020	210.614	91.81135	0.0517	x		x	x			x					x		x	x					x		
SO234_2/CTD_6_5_20_252462	6	5	20	252462	CTD	30	30	16.07.2014 20:41:30	35.7011	1025.6071	-29.54742	58.71032	30.312	30.105	18.8099	18.8045	210.636	91.82547	0.0506	x					x									x			x	x			
SO234_2/CTD_6_5_21_252463	6	5	21	252463	CTD	10	10	16.07.2014 20:42:44	35.7029	1025.6044	-29.54726	58.71042	10.678	10.605	18.8224	18.8205	210.462	91.77153	0.0453	x		x	x			x					x		x	x							
SO234_2/CTD_6_5_22_252464	6	5	22	252464	CTD	10	10	16.07.2014 20:42:50	35.7032	1025.6052	-29.54724	58.71042	11.415	11.337	18.8203	18.8182	209.924	91.53354	0.0475	x					x									x			x	x			
SO234_2/CTD_6_5_23_252465	6	5	23	252465	CTD	5	10	16.07.2014 20:43:13	35.7032	1025.6047	-29.54720	58.71046	10.618	10.546	18.8222	18.8203	210.456	91.76892	0.0482	x													x	x							
SO234_2/CTD_6_5_24_252466	6	5	24	252466	CTD	5	10	16.07.2014 20:43:16	35.7029	1025.6044	-29.54720	58.71046	10.553	10.481	18.8224	18.8205	210.371	91.73183	0.0464	x					x									x							
SO234_2/CTD_6_6_1_252467	6	6	1	252467	CTD	750	750	17.07.2014 02:41:16	34.6622	1026.8951	-29.48614	58.77216	757.190	750.696	8.8227	8.7391	195.218	69.12264	0.0283	x											x			x							
SO234_2/CTD_6_6_2_252468	6	6	2	252468	CTD	700	700	17.07.2014 03:29:17	34.7446	1026.8354	-29.48352	58.77325	705.712	699.746	9.5888	9.5072	198.863	71.64399	0.0271	x														x							
SO234_2/CTD_6_6_3_252469	6	6	3	252469	CTD	600	595	17.07.2014 03:32:10	34.8932	1026.7496	-29.48334	58.77321	598.137	593.234	10.7555	10.6815	204.659	75.68094	0.0267	x														x							
SO234_2/CTD_6_6_4_252470	6	6	4	252470	CTD	500	500	17.07.2014 03:33:44	35.0638	1026.6738	-29.48326	58.77319	501.554	497.558	11.8817	11.8158	207.672	78.72813	0.0252	x		x				x					x			x			x	x			
SO234_2/CTD_6_6_5_252471	6	6	5	252471	CTD	400	400	17.07.2014 03:36:35	35.1707	1026.6253	-29.48320	58.77325	401.885	398.779	12.5515	12.4969	207.990	80.00670	0.0282	x														x							
SO234_2/CTD_6_6_6_252472	6	6	6	252472	CTD	300	300	17.07.2014 03:42:29	35.2823	1026.5535	-29.48296	58.77320	299.519	297.277	13.3288	13.2866	206.647	80.82185	0.0258	x														x							
SO234_2/CTD_6_6_7_252473	6	6	7	252473	CTD	250	250	17.07.2014 03:43:20	35.3570	1026.4853	-29.48294	58.77321	249.081	247.247	13.9308	13.8947	206.011	81.59724	0.0292	x														x							
SO234_2/CTD_6_6_8_252474	6	6	8	252474	CTD	150	150	17.07.2014 03:45:00	35.4721	1026.2611	-29.48292	58.77324	146.719	145.674	15.3603	15.3377	204.199	83.26233	0.0459	xxx														x							
SO234_2/CTD_6_6_9_252475	6	6	9	252475	CTD	100	105	17.07.2014 03:46:10	35.5708	1025.9830	-29.48294	58.77324	105.664	104.923	16.8894	16.8720	204.929	86.11358	0.0823	x														x							
SO234_2/CTD_6_6_10_252476	6	6	10	252476	CTD	100	105	17.07.2014 03:46:16	35.5719	1025.9832	-29.48294	58.77324	105.233	104.494	16.8921	16.8748	205.267	86.26068	0.0811	x					x									x							
SO234_2/CTD_6_6_11_252477	6	6	11	252477	CTD	92	92	17.07.2014 03:47:24	35.5809	1025.8804	-29.48298	58.77324	93.361	92.709	17.3479	17.3323	207.946	88.14848	0.0920	x		x				x					x			x							
SO234_2/CTD_6_6_12_252478	6	6	12	252478	CTD	92	92	17.07.2014 03:47:27	35.5801	1025.8492	-29.48298	58.77322	93.906	93.249	17.4746	17.4588	207.659	88.23642	0.0928	x					x									x			x	x			
SO234_2/CTD_6_6_13_252479	6	6	13	252479	CTD	Chl.a Grad.	80	17.07.2014 03:48:59	35.6049	1025.7645	-29.48300	58.77324	79.959	79.403	17.8962	17.8825	209.798	89.86746	0.1218	x		x	x			x					x			x							
SO234_2/CTD_6_6_14_252480	6	6	14	252480	CTD	Chl.a Grad.	80	17.07.2014 03:49:03	35.6039	1025.7751	-29.48302	58.77322	82.932	82.355	17.8505	17.8364	210.158	89.94410	0.1199	x					x									x			x	x			
SO234_2/CTD_6_6_15_252481	6	6	15	252481	CTD	Chl.a Max	65	17.07.2014 03:50:38	35.6317	1025.6911	-29.48296	58.77328	65.646	65.192	18.2724	18.2610	212.016	91.47163	0.1469	x		x	x			x					x			x							
SO234_2/CTD_6_6_16_252482	6	6	16	252482	CTD	Chl.a Max	65	17.07.2014 03:50:41	35.6312	1025.6900	-29.48294	58.77328	65.073	64.622	18.2751	18.2638	211.036	91.05321	0.1417	x					x									x			x	x			
SO234_2/CTD_6_6_17_252483	6	6	17	252483	CTD	Chl.a Grad.	50	17.07.2014 03:52:00	35.6503	1025.6507	-29.48290	58.77332	51.593	51.238	18.4881	18.4790	211.701	91.71276	0.0688	x		x	x			x					x		x	x							
SO234_2/CTD_6_6_18_252484	6	6	18	252484	CTD	Chl.a Grad.	50	17.07.2014 03:52:04	35.6533	1025.6436	-29.48290	58.77332	51.549	51.194	18.5252	18.5162	212.178	91.98448	0.0646	x					x									x			x	x			
SO234_2/CTD_6_6_19_252485	6	6	19	252485	CTD	30	30	17.07.2014 03:53:30	35.6939	1025.6116	-29.48286	58.77332	31.255	31.041	18.7708	18.7652	210.847	91.84672	0.0456	x		x	x			x					x		x	x							
SO234_2/CTD_6_6_20_252486	6	6	20	252486	CTD	30	30	17.07.2014 03:53:39	35.6984	1025.6144	-29.48286	58.77333	31.253	31.039	18.7732	18.7677	211.271	92.03817	0.0439	x					x									x			x	x			
SO234_2/CTD_6_6_21_252487	6	6	21	252487	CTD	10	11	17.07.2014 03:55:23	35.7152	1025.6000	-29.48290	58.77333	11.356	11.279	18.8765	18.8745	210.146	91.73254	0.0424	x		x	x			x					x		x	x							
SO234_2/CTD_6_6_22_252488	6	6	22	252488	CTD	10	11	17.07.2014 03:55:25	35.7152	1025.6003	-29.48290	58.77332	11.445	11.367	18.8756	18.8735	210.380	91.83317	0.0418	x					x									x			x	x			
SO234_2/CTD_6_6_23_252489	6	6	23	252489	CTD	5	5	17.07.2014 03:56:32	35.7156	1025.6007	-29.48296	58.77330	4.596	4.564	18.8741	18.8732	210.487	91.87742	0.0416	x													x	x							
SO234_2/CTD_6_6_24_252490	6	6	24	252490	CTD	5	5	17.07.2014 03:56:34	35.7153	1025.5994	-29.48297	58.77331	4.229	4.200	18.8781	18.8774	210.361	91.82904	0.0419	x					x									x							

SPACES (SO234-2) Samples taken from CTD casts (preliminary)

Event label	Station	Cast	Bottle No.	Bedford-Nr.	Device abbreviation	planned Depth	True Depth	Date and time	Salinity [S]	Density [g/L]	Lat Latitude	Lon Longitude	Pressure PrDM [dbar]	Depth DepSM [m]	Temp T090C Po [°C]	Pot. temp temp090C [°C]	Oxygen x0Mm/Kg [µmol/kg]	Oxygen Sat Sbeox0PS [%]	Fluores-cence HaardtC [mv]	O_2 [Winkler]	N_2O + CH_4 [Xiao]	DMS + Isoprene [Booge]	Hal [Hep-ach]	CO_2 [Stein-hoff]	DOC/TDN [End-res]	Flow cytometry [Endres]	TEP/CSP [End-res]	Compo-sition [Endres]	measure-ments [Endres]	DNA [End-res] (C. Stolle)	CDOM [Maran-dino]	Iodide/oda [Quack]	Nano-nuts [Quack]	µicro-nuts [Quack]	15N [Quack]	PAB [Wieg-mann]	DNA [Cheah]	Pig-ments [Wieg-mann]	Salt [Krueger]	PFOs [Petrick]	Hal-DOC [Quack]
SO234_2/CTD_6_7_1_252491	6	7	1	252491	CTD	bottom + 5	3988	17.07.2014 06:28:07	34.7193	1027.8266	-29.48286	58.76449	4057.468	3991.872	1.2136	0.8964	173.861	51.44010	0.0332	x													x				x	x		
SO234_2/CTD_6_7_2_252492	6	7	2	252492	CTD	4000	3988	17.07.2014 06:28:12	34.7194	1027.8267	-29.48288	58.76450	4055.019	3989.485	1.2141	0.8972	173.777	51.41586	0.0341	x	x	x				x					x			x						
SO234_2/CTD_6_7_3_252493	6	7	3	252493	CTD	3000	3000	17.07.2014 07:09:32	34.7375	1027.7964	-29.48400	58.76336	3038.295	2986.142	1.7689	1.5422	155.276	46.59731	0.0363	x	x													x						
SO234_2/CTD_6_7_4_252494	6	7	4	252494	CTD	2500	2500	17.07.2014 07:18:47	34.7353	1027.7732	-29.48372	58.76314	2531.980	2499.778	2.0107	1.8269	155.452	46.93314	0.0350	x													x					x		
SO234_2/CTD_6_7_5_252495	6	7	5	252495	CTD	2000	2000	17.07.2014 07:28:46	34.7049	1027.7197	-29.48416	58.76308	2019.009	1995.719	2.3364	2.1930	157.707	47.99152	0.0347	x	x													x				x			
SO234_2/CTD_6_7_6_252496	6	7	6	252496	CTD	1500	1490	17.07.2014 07:39:02	34.5565	1027.5328	-29.48381	58.76307	1502.144	1486.623	3.0895	2.9805	154.157	47.73803	0.0331	x	x													x					x		
SO234_2/CTD_6_7_7_252497	6	7	7	252497	CTD	1000	1000	17.07.2014 07:47:31	34.4359	1027.1275	-29.48472	58.76312	1007.960	998.717	5.9274	5.8364	181.274	60.01733	0.0309	x													x					x		
SO234_2/CTD_6_7_8_252498	6	7	8	252498	CTD	500	496	17.07.2014 07:57:46	35.0690	1026.6709	-29.48460	58.76317	495.191	491.253	11.9172	11.8521	208.195	78.98728	0.0283	x	x	x				x					x			x			x	x			
SO234_2/CTD_6_7_9_252499	6	7	9	252499	CTD	250	250	17.07.2014 08:04:00	35.3693	1026.4733	-29.48448	58.76326	248.520	246.690	14.0330	13.9968	206.043	81.78379	0.0299	x	x				x									x							
SO234_2/CTD_6_7_10_252500	6	7	10	252500	CTD	150	150	17.07.2014 08:05:52	35.4732	1026.2715	-29.48440	58.76324	150.438	149.365	15.3180	15.2948	205.444	83.70171	0.0478	x						x									x					x		
SO234_2/CTD_6_7_11_252501	6	7	11	252501	CTD	Chl.a Grad.	100	17.07.2014 08:07:29	35.5819	1025.9019	-29.48426	58.76322	101.388	100.677	17.2634	17.2465	208.602	88.28626	0.0985	x		x			x	x									x							
SO234_2/CTD_6_7_12_252502	6	7	12	252502	CTD	Chl.a Grad.	100	17.07.2014 08:07:32	35.5786	1025.9138	-29.48426	58.76322	100.189	99.486	17.2032	17.1865	207.541	87.73575	0.0980	x													x	x			x	x		
SO234_2/CTD_6_7_13_252503	6	7	13	252503	CTD	Chl.a Max	75	17.07.2014 08:09:11	35.6310	1025.7257	-29.48410	58.76316	77.691	77.150	18.1334	18.1199	212.168	91.30101	0.1604	xxx		x	x		x	x									x							
SO234_2/CTD_6_7_14_252504	6	7	14	252504	CTD	Chl.a Max	75	17.07.2014 08:09:18	35.6335	1025.7211	-29.48410	58.76315	75.257	74.734	18.1592	18.1462	212.118	91.32490	0.1651	x						x	x									x		x	x			
SO234_2/CTD_6_7_15_252505	6	7	15	252505	CTD	Chl.a Grad.	65	17.07.2014 08:10:12	35.6446	1025.6969	-29.48400	58.76314	65.741	65.286	18.2857	18.2772	213.240	92.03571	0.1263	x		x	x		x	x									x							
SO234_2/CTD_6_7_16_252506	6	7	16	252506	CTD	Chl.a Grad.	65	17.07.2014 08:10:15	35.6469	1025.6913	-29.48400	58.76313	67.267	66.801	18.3186	18.3069	213.075	92.01669	0.1365	x						x	x	x								x		x				
SO234_2/CTD_6_7_17_252507	6	7	17	252507	CTD	50	50	17.07.2014 08:11:19	35.6535	1025.6780	-29.48386	58.76310	52.343	51.982	18.3889	18.3798	212.975	92.09767	0.0780	x		x	x		x	x									x							
SO234_2/CTD_6_7_18_252508	6	7	18	252508	CTD	50	50	17.07.2014 08:11:30	35.6527	1025.6765	-29.48384	58.76308	49.561	49.220	18.3930	18.3834	213.470	92.31650	0.0759	x						x	x	x								x		x				
SO234_2/CTD_6_7_19_252509	6	7	19	252509	CTD	30	30	17.07.2014 08:12:41	35.6800	1025.6225	-29.48370	58.76304	30.886	30.674	18.6859	18.6804	212.798	92.54343	0.0553	x		x	x		x	x									x					x		
SO234_2/CTD_6_7_20_252510	6	7	20	252510	CTD	30	30	17.07.2014 08:12:45	35.6818	1025.6243	-29.48371	58.76301	32.828	32.603	18.6844	18.6786	212.280	92.31666	0.0528	x						x	x	x								x		x	x			
SO234_2/CTD_6_7_21_252511	6	7	21	252511	CTD	10	10	17.07.2014 08:14:18	35.7314	1025.5597	-29.48350	58.76294	11.373	11.296	19.0828	19.0807	210.500	92.24518	0.0403	x		x	x		x	x									x							
SO234_2/CTD_6_7_22_252512	6	7	22	252512	CTD	10	10	17.07.2014 08:14:25	35.7329	1025.5579	-29.48348	58.76292	11.956	11.875	19.0943	19.0922	210.321	92.18710	0.0398	x						x	x	x								x		x	x			
SO234_2/CTD_6_7_23_252513	6	7	23	252513	CTD	5	5	17.07.2014 08:15:07	35.7344	1025.5559	-29.48338	58.76291	5.806	5.766	19.1051	19.1040	209.624	91.90048	0.0375	x						x									x				x			
SO234_2/CTD_6_7_24_252514	6	7	24	252514	CTD	5	6	17.07.2014 08:15:17	35.7346	1025.5560	-29.48338	58.76288	6.748	6.703	19.1054	19.1042	209.808	91.98177	0.0382	x															x							
SO234_2/CTD_8_1_1_252515	8	1	1	252515	CTD	750	750	17.07.2014 14:10:24	34.7045	1026.8670	-29.37354	58.82188	756.586	750.105	9.2082	9.1225	196.957	70.35170	0.0245	x						x									x							
SO234_2/CTD_8_1_2_252516	8	1	2	252516	CTD	700	700	17.07.2014 14:12:23	34.7069	1026.8213	-29.37332	58.82205	707.328	701.352	9.7796	9.6968	198.435	71.79740	0.0237	x															x							
SO234_2/CTD_8_1_3_252517	8	1	3	252517	CTD	600	600	17.07.2014 14:15:05	34.9073	1026.7432	-29.37302	58.82215	602.749	597.806	10.8539	10.7789	205.693	76.22985	0.0232	x															x							
SO234_2/CTD_8_1_4_252518	8	1	4	252518	CTD	500	500	17.07.2014 14:16:49	35.0591	1026.6733	-29.37284	58.82220	500.572	496.589	11.8650	11.7993	206.784	78.36152	0.0242	x															x							
SO234_2/CTD_8_1_5_252519	8	1	5	252519	CTD	400	400	17.07.2014 14:18:28	35.1913	1026.6141	-29.37268	58.82230	401.839	398.737	12.6898	12.6349	207.636	80.10876	0.0238	x															x							
SO234_2/CTD_8_1_6_252520	8	1	6	252520	CTD	300	300	17.07.2014 14:21:08	35.3029	1025.5347	-29.37264	58.82238	298.564	296.333	13.4983	13.4559	206.044	80.87404	0.0246	x															x							
SO234_2/CTD_8_1_7_252521	8	1	7	252521	CTD	250	250	17.07.2014 14:21:57	35.3510	1026.4974	-29.37264	58.82244	250.856	249.010	13.8510	13.8148	207.122	81.99296	0.0262	x		x	x			x										x		x	x			
SO234_2/CTD_8_1_8_252522	8	1	8	252522	CTD	150	150	17.07.2014 14:23:37	35.4654	1026.3131	-29.37272	58.82254	149.722	148.657	15.1037	15.0808	201.919	81.91689	0.0386	x			x													x							
SO234_2/CTD_8_1_9_252523	8	1	9	252523	CTD	100	100	17.07.2014 14:25:12	35.5763	1025.8940	-29.37280	58.82262	102.017	101.302	17.2786	17.2615	206.353	87.35609	0.0936	x																						
SO234_2/CTD_8_1_10_252524	8	1	10	252524	CTD	100	100	17.07.2014 14:25:19	35.5818	1025.8861	-29.37282	58.82264	101.415	100.705	17.3285	17.3115	206.851	87.65293	0.0907	x						x									x							
SO234_2/CTD_8_1_11_252525	8	1	11	252525	CTD	Chl.a Grad.	80	17.07.2014 14:26:39	35.6241	1025.7416	-29.37294	58.82270	80.992	80.429	18.0486	18.0346	209.011	89.79631	0.1097	x		x	x			x										x							
SO234_2/CTD_8_1_12_252526	8	1	12	252526	CTD	Chl.a Grad.	80	17.07.2014 14:26:42	35.6275	1025.7531	-29.37294	58.82270	81.505	80.939	18.0127	17.9987	209.813	90.08291	0.1163	x						x									x		x					
SO234_2/CTD_8_1_13_252527	8	1	13	252527	CTD	Chl.a Max	70	17.07.2014 14:27:34	35.6776	1025.6708	-29.37304	58.82276	71.898	71.400	18.4946	18.4820	210.098	91.04589	0.1410	x		x	x			x										x							
SO234_2/CTD_8_1_14_252528	8	1	14	252528	CTD	Chl.a Max	70	17.07.2014 14:27:45	35.6779	1025.6711	-29.37306	58.82276	70.518	70.030	18.4943	18.4820	210.583	91.25608	0.1329	x						x									x		x					
SO234_2/CTD_8_1_15_252529	8	1	15	252529	CTD	Chl.a Grad.	60	17.07.2014 14:28:37	35.6959	1025.6449	-29.37316	58.82281	61.128	60.706	18.6511	18.6403	211.516	91.93669	0.0727	x		x	x			x										x							
SO234_2/CTD_8_1_16_252530	8	1	16	252530	CTD	Chl.a Grad.	60	17.07.2014 14:28:40	35.6948	1025.6482	-29.37316	58.82280	61.840	61.413	18.6348	18.6239	211.159	91.75331	0.0731	x						x									x		x					
SO234_2/CTD_8_1_17_252531	8	1	17	252531	CTD	50	50	17.07.2014 14:29:36	35.6917	1025.6353	-29.37326	58.82284	50.846	50.497	18.6742	18.6653	211.550	91.98837	0.0591	x						x									x		x					
SO234_2/CTD_8_1_18_252532	8	1	18	252532	CTD	50	50	17.07.2014 14:29:40	35.6919	1025.6357	-29.37326	58.82284	51.343	50.990	18.6732	18.6642	211.141	91.80873	0.0594	x						x									x							
SO234_2/CTD_8_1_19_252533	8	1	19	252533	CTD	30	30	17.07.2014 14:31:06	35.7005	1025.6229	-29.37341	58.82295	30.707	30.497	18.7460	18.7406	210.536	91.67375	0.0465	x						x									x							
SO234_2/CTD_8_1_20_252534	8	1	20	252534	CTD	30	30	17.07.2014 14:31:10	35.7006	1025.6231	-29.37342	58.82297	31.780	31.563	18.7456	18.7399	211.484	92.08563	0.0462	x						x									x							
SO234_2/CTD_8_1_21_252535	8	1	21	252535	CTD	10	11	17.07.2014 14:32:38	35.7049	1025.6012	-29.37355	58.82304	11.801	11.721	18.8413	18.8391	211.217	92.13387	0.0431	x						x									x							
SO234_2/CTD_8_1_22_252536	8	1	22	252536	CTD	10	11	17.07.2014 14:32:48	35.7049	1025.6013	-29.37356	58.82304	11.641	11.562	18.8407	18.8386	210.726	91.91901	0.0438	x						x									x							
SO234_2/CTD_8_1_23_252537	8	1	23	252537	CTD	5	5	17.07.2014 14:33:22	35.7051	1025.6011	-29.37356	58.82310	5.746	5.707	18.8413	18.8402	211.038	92.05588	0.0450	x																						
SO234_2/CTD_8_1_24_252538	8	1	24	252538	CTD	5	5	17.07.2014 14:33:25	35.7041	1025.6006	-29.37356	58.82306	6.338	6.296	18.8401	18.8389	211.575	92.28755	0.0430	x																						
SO234_2/CTD_9_1_1_252539	9	1	1	252539	CTD	no bottom	4653	19.07.2014 00:51:20	34.7050	1027.8382	-23.81817	58.31166	4736.070	4654.334	0.9118	0.5283	184.430	54.14293	0.0321	x	x													x					x	x	
SO234_2/CTD_9_1_2_252540	9	1	2	252540	CTD	4000	4000	19.07.2014 01:08:44	34.7195	1027.8249	-23.81794	58.31146	4062.530	3998.477	1.2439	0.9253	171.784	50.86477	0.0329	x						x	x							x							
SO234_2/CTD_9_1_3_252541	9	1	3	252541	CTD	3000	2995	19.07.2014 01:28:33	34.7416	1027.7922	-23.81768	58.31188	3033.457	2982.655	1.8723	1.6437	146.590	44.10672	0.0371	x	x													x					x	x	
SO234_2/CTD_9_1_4_252542	9	1	4	252542	CTD	2500	2500	19.07.2014 01:37:31	34.7404	1027.7711	-23.81768	58.31208	2532.661	2501.492	2.0910	1.9057	145.663	44.06795	0.0351	x															x							
SO234_2/CTD_9_1_5_252543	9	1	5	252543	CTD	2000	2000	19.07.2014 01:50:28	34.7172	1027.7212	-23.81784	58.31164	2022.953	2000.435	2.4389	2.2935	148.752	45.38604	0.0346	x															x							
SO234_2/CTD_9_1_6_252544	9	1	6	252544	CTD	1500	1500	19.07.2014 02:03:34	34.6572	1027.5892	-23.81812	58.31160	1513.248	1498.200	3.3513	3.2381	133.979	41.78783	0.0350	xxx	x		x			x									x					x		
SO234_2/CTD_9_1_7_252545	9	1	7	252545	CTD	1000	1000	19.07.2014 02:16:07	34.4994	1027.2308	-23.81820	58.31164	1008.351	999.423	5.4922	5.4043	145.007	47.54726	0.0336	x	x															x					x		
SO234_2/CTD_9_1_8_252546	9	1	8	252546	CTD	500	500	19.07.2014 02:33:50	35.0327	1026.6874	-23.81778	58.31126	502.854	499.055	11.6806	11.6153	207.895	78.90690	0.0264	x															x							
SO234_2/CTD_9_1_9_252547	9	1	9	252547	CTD	250	250	19.07.2014 02:42:44	35.5093	1026.2066	-23.81774	58.31149	249.870	248.133	15.7456	15.7062	192.162	78.96379	0.0311	x	x	x	x			x									x							
SO234_2/CTD_9_1_10_252548	9	1	10	252548	CTD	150	150	19.07.2014 02:46:07	35.5949	1025.3699	-23.81786	58.31118	150.819	149.806	19.4388	19.4114	170.982	75.34732	0.0344	x															x							
SO234_2/CTD_9_1_11_252549	9	1	11	252549	CTD	Chl.a Max	95	19.07.2014 02:48:12	35.4559	1024.3129	-23.81782	58.31140	96.733	96.097	22.9036	22.9039	192.809	90.25597	0.0822	x		x	x			x	x									x							
SO234_2/CTD_9_1_12_252550	9	1	12	252550	CTD	Chl.a Max	95	19.07.2014 02:48:28	35.4565	1024.3133	-23.81782	58.31140	96.802	96.165	22.9038	22.8841	193.028	90.35918	0.0819	x															x							
SO234_2/CTD_9_1_13_252551	9	1	13	252551	CTD	Chl.a Grad.	80	19.07.2014 02:50:08	35.4092	1024.2388	-23.81784	58.31142	80.252	79.727	23.0346	23.0182	194.342	91.15120	0.0675	x	x					x	x									x							
SO234_2/CTD_9_1_14_252552	9	1	14	252552	CTD	Chl.a Grad.	80	19.07.2014 02:50:13	35.4078	1024.2372	-23.81786	58.31142	80.899	80.370	23.0361	23.0196	194.723	91.33125	0.0644	x	x		x			x										x		x					
SO234_2/CTD_9_1_15_252553	9	1	15	252553	CTD	60	60	19.07.2014 02:51:44	35.3156	1024.0603	-23.81788	58.31138	60.447	60.054	23.4009	23.3884	192.682	90.88627	0.0676	x		x				x	x	x								x							
SO234_2/CTD_9_1_16_252554	9	1	16	252554	CTD	60	60	19.07.2014 02:51:46	35.3156	1024.0600	-23.81788	58.31136	60.408	60.016	23.4017	23.3892	192.745	90.91721	0.0632	x	x		x			x										x		x					
SO234_2/CTD_9_1_17_252555	9	1	17	252555	CTD	50	50	19.07.2014 02:52:34	35.3155	1024.0599	-23.81790	58.31136	50.822	50.493	23.3998	23.3893	192.966	91.01818	0.0628	x		x				x										x	x	x					
SO234_2/CTD_9_1_18_252556	9	1	18	252556	CTD	50	50	19.07.2014 02:52:38	35.3154	1024.0598	-23.81790	58.31136	50.731	50.403	23.4001	23.3896	192.764	90.92324	0.0653	x			x			x										x		x					
SO234_2/CTD_9_1_19_252557	9	1	19	252557	CTD	30	30	19.07.2014 02:54:01	35.3150	1024.0581	-23.81788	58.31132	31.065	30.866	23.4006	23.3942	192.774	90.93861	0.0632	x			x			x	x	x											x				
SO234_2/CTD_9_1_20_252558	9	1	20	252558	CTD	30	30	19.07.2014 02:54:03	35.3151	1024.0576	-23.81789	58.31132	31.240	31.039	23.4030	23.3965	193.011	91.04403	0.0625	x			x			x										x		x					
SO234_2/CTD_9_1_21_252559	9	1	21	252559	CTD	10	10	19.07.2014 02:55:35	35.3154	1024.0592	-23.81786	58.31132	10.788	10.719	23.3939	23.3917	193.403	91.21516	0.0627	x		x				x	x	x															
SO234_2/CTD_9_1_22_252560	9	1	22	252560	CTD	10	10	19.07.2014 02:55:37	35.3154	1024.0593	-23.81786	58.31132	10.686	10.618	23.3935	23.3913	193.305	91.17201	0.0620	x			x			x										x		x					
SO234_2/CTD_9_1_23_252561	9	1	23	252561	CTD	5	5	19.07.2014 02:56:16	35.3158	1024.0603	-23.81786	58.31134	6.207	6.168	23.3899	23.3886	193.502	91.25541	0.0622	x						x	x	x															
SO234_2/CTD_9_1_24_252562	9	1	24	252562	CTD	5	5	19.07.2014 02:56:23	35.3157	1024.0605	-23.81786	58.31136	6.303	6.262	23.3891	23.3878	193.010	91.02228	0.0623	x					x																	

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