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Short Cruise Report RV SONNE SO305-2

Singapore – Port Louis

16.07.2024 – 05.08.2024

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Captain: Oliver Meyer

Objectives

The expedition SO305-2 along the route between Singapore and Port Louis combines the scientific work of two projects E-POLIO and M2ARGO. The E-POLIO project used this obligatory transit to measure a range of pollutants in the air, surface waters, and water column of the Indian Ocean to 1) quantify anthropogenic stress, to 2) provide a preliminary risk assessment in the region, and 3) to identify the water masses and their sources. The study area represents an ideal model system, as it encompasses almost the entire Indian Ocean basin, extending from the highly populated regions of Indonesia, Malaysia, and Singapore into the open Indian Ocean. The expedition allows a better understanding of the impact of megacities on the land-coast-ocean interactions and beyond, in a very sensitive and understudied marine ecosystem.

In particular, our objectives are (1) to map the concentrations of pollutants (e.g., estrogens, polycyclic aromatic hydrocarbons) and the abundance of microplastics in relation to hydrographic conditions in the air and the surface waters of the Indian Ocean, as well as vertically in water masses at selected positions. Our second objective is (2) to identify the transport pathways of anthropogenic pollutants horizontally, from land to the open ocean, and vertically, from the water surface to deeper water layers, their sources and possible sinks in the Indian Ocean. Furthermore, we aim to (3) assess and quantify the anthropogenic contamination with emerging pollutants (microplastic, estrogens) by using environmental descriptors, e.g. the risk quotient (RQ) or estradiol equivalent concentration (EEQ). Additionally, we seek (4) to understand water mass distribution and nitrogen cycling in the central equatorial and southern Indian Ocean, a region that has been understudied in the global context.

The SO305-2 expedition contributes to the first goal of the UN Decade “Ocean Science for Sustainable Development” (a clean ocean (1); a healthy and resilient ocean (2); a productive ocean (3); a predictable ocean (4)), which are identical to the visions of the Ocean Decade (7 Ocean Outcomes describe the Ocean we want). Therefore, SO305-2 was an endorsed Ocean Decade activity.

The M2ARGO project focuses on fracture zones, which are an integral part of the seabed long before the concept of plate tectonics was established. Later, the theory of plate tectonics linked the fracture zones to oceanic transform faults, suggesting that they are the inactive and hence fossil trace of transformations. Yet, scientists dedicate minimal time for conducting comprehensive surveys of these structures. Recent evidence suggests that the traditional concept of transform faults as being conservative (non-accretionary) plate boundary faults might be incorrect. Instead, ridge-transform intersections seem to be

settings of magmatic activity, modifying the lithosphere initially produced in the transform before it passes into the fracture zone region. Evidence for this process is found by imaging the seafloor relief along transform-fault-fracture-zone-systems, revealing a highly dynamic system. However, due to the paucity of transform studies in the past decades, the quality and range of such basic data on transforms is limited. During this research cruise, we use the transit of RV SONNE from Singapore to Port Louis to map a transform fault and the transition into its fracture zones of the Argo transform fault at 14°S at the Central Indian Ridge to improve the current situation. Mapping the inactive fracture zones and the active transform system will yield evidence of lithospheric accretion at a ridge crest discontinuity as a function of time, enabling us to understand the dynamics of crustal accretion over ~20 Mio. years along a flowline on two conjugated ridge flanks. Furthermore, magnetic field measurements will be used to obtain the magnetization of the basement of both the transform fault and fracture zones, testing the newly proposed model of crustal accretion at transform faults.

Narrative

In the morning of July 16th 2024, around 09:00 (Singapore Time, ST), the scientific party and the observer from Mauritius commenced the SO305-2 cruise aboard the research vessel SONNE. Just after, the scientific crew started setting up the laboratories and preparation of the measuring equipment for the cruise. The RV SONNE departed from Singapore with a 1.5 day delay because of late arrival of two food containers and one container containing scientific equipment for the SO306 cruise at 21:30 ST on July 17th. As we had not received either the permission to conduct research in the Economic Zone of Malaysia nor any explanation, the RV SONNE proceeded through the Strait of Malacca without sampling. RV SONNE reached international waters of Indian Ocean at night of July 20th and we started our measuring campaign. We collected samples from the surface water every 30 N.M. using the ship's seawater intake pump system for the analysis of inorganic nutrients (nitrite, nitrate, silicate, and phosphate), suspended particulate matter, dissolved and particulate carbon, dissolved organic matter, chlorophyll a, polycyclic aromatic hydrocarbons (PAH), per- and polyfluoroalkylated substances (PFAS) and trace metals, as well as UV filters, estrogens, and nitrogen isotopes. Microplastics in the water surface was continuously collected over the entire transect via the pump-filtration system directly coupled to the seawater intake pump of the ship. The overlying air was continuously sampled as well for microplastics, PFAS and PAH using two different air filtration systems.

Between July 20th and 28th, sampling of the surface waters (every 30 N.M. and continuously for microplastics), air masses (continuously), and at selected positions, roughly every 2.5°, hydrographic stations using the CTD rosette were conducted. Additionally, on July 28th, a test of the magnetometer was conducted just after the completion of the CTD measurements, to guarantee the success of magnetometer survey scheduled for following day. One day later, on July 29th, RV SONNE reached the working area of the M2Argo project and started the seafloor mapping using the ship own Multibeam and the magnetometer. The mapping survey, which spanned roughly 40 h, culminated in a successful dredge at 4000 m depth in the afternoon of July 31st.

RV SONNE entered national waters of Mauritius on August 1st, 2024 and we continued with sampling of surface waters and air masses every until RV SONNE reached the territorial waters of Mauritius. The sampling and station work for EPOLIO and M2Argo projects was stopped on August 2nd. The speed limit of 10 knots was not applicable during our cruise because of the late departure, allowing us to conduct in total 12 hydrographic stations (Fig. 1) with a remarkable vertical resolution in terms of discrete sampling (up to

48 depth levels).

On August 3rd and 4th, tests of the echo sounders of RV SONNE were conducted, and a SONADYNE technician arrived by boat on board. After the tests were completed, the ship proceeded on a course towards Port Louis. In the meantime, the scientific party finished the remaining filtrations and extractions and started to dismantle the laboratories and pack the equipment into the containers just prior to arrival at Port Louis (Mauritius) on August 5th. During the entire transit time, currents in the upper water column, were registered using a 38 and 75 kHz Acoustic Doppler Current Profilers (ADCP). Registrations of the sea surface temperature, salinity, chlorophyll a fluorescence, and turbidity by the ship's thermosalinograph system, as well as the prevailing weather conditions, such as wind, humidity, air temperature, air pressure, and irradiance completed the collected data set. The cruise terminated in Port Louis, Mauritius at 08:00 local time on August 5th. In the morning, the containers were packed and prepared for shipping home to Germany. After cleaning the laboratories, the scientific party disembarked at noon local time on August 6th, transferred to the hotel before heading home on August 7th.

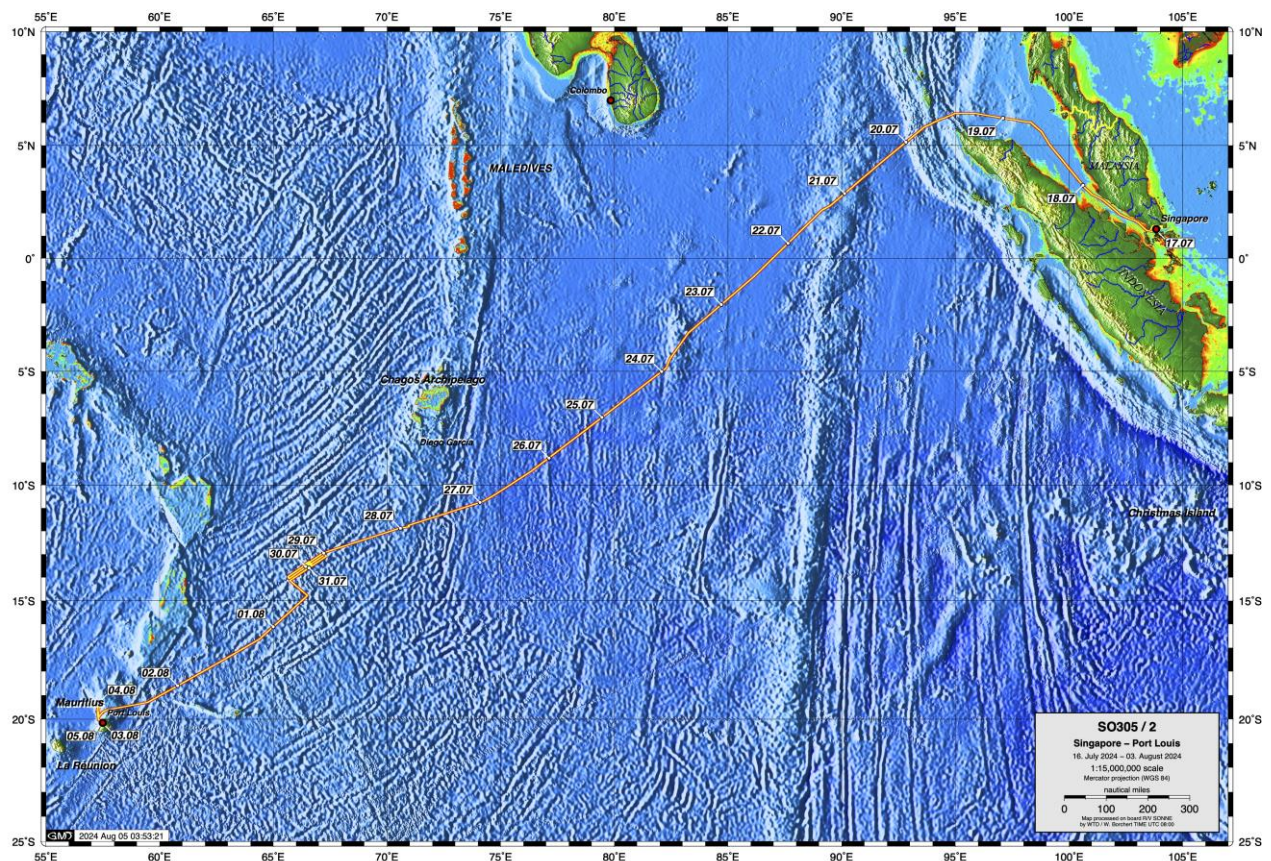


Fig. 1 Cruise track of the SO305-2 expedition from Singapore to Port Louis (Mauritius).

Acknowledgements

We kindly acknowledge the financial support for the involved project at the German site. The chief scientist received funding for the cruise SO305-2 (E-POLIO: Emerging Pollutants and Microplastic Abundance in Surface Waters of Indian Ocean) from the BMBF under contract number 03G0305TA/B/C as well as 03G0305TD.

We owe our thanks as well to the authorities of Mauritius, which supported our activities by giving us work permission for studies within their territorial waters. Finally, we thank the captain and the crew of RV SONNE for their continuous support during the cruise.

Teilnehmerliste / List of Participants

Name / Name	Tätigkeit / Task	Institut/Institute
1. Waniek , Joanna	Fahrtleiter / <i>Chief Scientist</i>	IOW
2. Prien, Ralf	Phys. Ozeanographie / <i>Phys. Oceanography</i>	IOW
3. Reineccius, Janika	Mikroplastik / <i>Microplastic</i>	IOW
4. Dierken, Madleen	Nährstoffe / <i>Nutrients</i>	IOW
5. Fensky, Ute	Filtration / <i>Filtration</i>	IOW
6. Jeschek, Jenny	DOC/POC / <i>DOC/POC</i>	IOW
7. Kolbe, Martin	CTD / <i>CTD</i>	IOW
8. Fechtel, Christin	Filtration / <i>Filtration</i>	IOW
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24. Ziolkowski, Tobias	Geophysik / <i>Geophysics</i>	Geomar
25. Xie, Zhiyong	Org. Schadstoffe / <i>Organic pollutants</i>	Hereon
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Abbreviation:

ADCP	Acoustic Doppler Current Profiler
Chla	Chlorophyll a
CTD	Conductivity
DO	dissolved oxygen
DOC	Dissolved Organic Carbon
DOM	Dissolved Organic Matter
DRG	dredge
H	Hormones
MAG	Magnetometer
MP	Microplastic
NI	nitrogen isotopes
Nut	Nutrients
Org	Organic Pollutants
PAH	polycyclic aromatic hydrocarbons
PFAS	polyfluoroalkylated substances
POC	Particulate Organic Carbon
S	Salinity
SPM	Suspended Particulate Matter
T	Temperature
TM	trace metals
TR	turbidity
UWS	underway sampling
UV	UV-filters

Station log SO305-2

Abbreviations: Nutrients (Nut), Chlorophyll a (Chla), Particulate Organic Carbon (POC), Suspended Particulate Matter (SPM), Dissolved Organic Carbon (DOC), Dissolved Organic Matter (DOM), UV-filters (UV), Hormones (H), Organic Pollutants (Org), Microplastic (MP), Temperature (T), Salinity (S), nitrogen isotopes (NI), trace metals (TM), dissolved oxygen (DO), turbidity (TR)

Device Operation	Device	Event Time	Action	Latitude	Longitude	Depth (m)	Speed (kn)	Wind Dir	Wind Speed (m/s)	Course (Deg)	Parameter sampled
SO305/2_0_Underway-4	EM122	2024/07/20 16:35:30	station start	04° 10,547' N	091° 39,258' E	0.0	11.0	180.0	8.0	229.9	
SO305/2_0_Underway-1	WISS-DATA	2024/07/20 16:35:30	station start	04° 10,547' N	091° 39,258' E	0.0	11.0	180.0	8.0	229.9	
SO305/2_0_Underway-6	CT	2024/07/20 16:35:30	station start	04° 10,547' N	091° 39,258' E	0.0	11.0	180.0	8.0	229.9	T, S
SO305/2_0_Underway-2	VMADCP _38kHz	2024/07/20 16:35:30	station start	04° 10,547' N	091° 39,258' E	0.0	11.0	180.0	8.0	229.9	currents
SO305/2_0_Underway-5	UWS	2024/07/20 16:35:30	station start	04° 10,547' N	091° 39,258' E	0.0	11.0	180.0	8.0	229.9	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-3	VMADCP _75kHz	2024/07/20 16:35:30	station start	04° 10,547' N	091° 39,258' E	0.0	11.0	180.0	8.0	229.9	currents
SO305/2_0_Underway-5	UWS	2024/07/20 16:35:30	information	04° 10,547' N	091° 39,258' E	0.0	11.0	180.0	8.0	229.9	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/20 19:22:08	information	03° 50,932' N	091° 16,217' E	3812.9	11.1	174.9	6.9	229.1	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/20 22:06:01	information	03° 31,381' N	090° 53,303' E	2992.0	10.7	173.2	7.8	230.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/21 00:53:50	information	03° 11,681' N	090° 30,410' E	2696.9	4.9	171.1	7.4	229.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_1-1	CTD	2024/07/21 01:00:12	station start	03° 11,614' N	090° 30,334' E	2711.2	0.2	169.2	6.7	76.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_1-2	CTD	2024/07/21 04:21:16	station start	03° 11,608' N	090° 30,333' E	2698.0	0.1	158.5	5.2	172.1	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_0_U	UWS	2024/07/21	information	02° 52,150' N	090° 07,471' E	2315.4	10.2	173.7	7.4	231.0	Nut, chla, POC, SPM, DOC, TM,

nderway-5		08:01:38									DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/21 10:58:33	information	02° 32,823' N	089° 44,848' E	2738.1	10.1	169.9	6.2	228.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/21 15:25:07	information	02° 08,073' N	089° 07,803' E	2690.8	10.1	154.2	10.5	242.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/21 18:31:18	information	01° 45,986' N	088° 45,314' E	3775.1	10.1	164.0	6.9	226.2	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/21 21:31:57	information	01° 24,007' N	088° 23,008' E	4345.0	10.6	156.1	8.3	224.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/22 00:30:46	information	01° 02,005' N	088° 00,675' E	4414.5	10.2	152.2	9.9	226.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_2-1	CTD	2024/07/22 03:46:37	station start	00° 40,184' N	087° 38,412' E	4453.5	0.3	139.0	5.7	256.9	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_2-2	CTD	2024/07/22 06:59:42	station start	00° 40,108' N	087° 38,431' E	4452.1	0.1	137.1	8.0	136.7	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_0_U nderway-5	UWS	2024/07/22 11:22:36	information	00° 18,005' N	087° 16,002' E	4517.9	13.1	137.6	10.0	226.2	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/22 13:46:09	information	00° 03,963' S	086° 53,701' E	4559.3	13.2	134.4	10.6	226.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/22 16:06:39	information	00° 25,955' S	086° 31,377' E	4561.9	13.6	132.6	9.8	226.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/22 18:26:26	information	00° 47,931' S	086° 09,079' E	4604.6	10.2	138.7	10.6	225.8	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/22 20:33:19	information	01° 06,794' S	085° 47,274' E	4622.0	13.8	139.9	9.7	228.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/22 22:35:50	information	01° 25,515' S	085° 25,632' E	4663.1	14.0	118.5	9.7	230.3	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/23 00:39:45	information	01° 44,251' S	085° 03,982' E	4665.0	11.8	118.4	11.4	228.0	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_3-1	CTD	2024/07/23 03:07:36	station start	02° 02,944' S	084° 42,378' E	4746.9	0.2	119.0	9.1	301.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_3-2	CTD	2024/07/23 06:35:08	station start	02° 02,940' S	084° 42,366' E	4743.7	0.1	127.5	10.1	284.2	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_0_U	UWS	2024/07/23	information	02° 21,747' S	084° 20,626' E	4755.2	12.0	128.9	10.9	229.0	Nut, chla, POC, SPM, DOC, TM,

nderway-5		10:53:47									DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/23 13:17:07	information	02° 40,515' S	083° 58,930' E	4773.4	11.9	132.6	13.8	229.3	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/23 15:42:12	information	02° 59,261' S	083° 37,259' E	4814.8	11.8	133.5	13.2	230.0	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/23 18:12:12	information	03° 18,045' S	083° 15,565' E	2130.6	11.4	135.4	13.0	219.0	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/23 21:47:30	information	03° 52,789' S	082° 51,003' E	3405.0	11.9	115.3	11.4	213.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/24 01:29:10	information	04° 27,600' S	082° 26,408' E	3527.4	4.1	99.7	11.0	205.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_4-1	CTD	2024/07/24 01:35:15	station start	04° 27,716' S	082° 26,321' E	3584.2	0.2	102.3	10.8	266.3	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_4-2	CTD	2024/07/24 04:33:10	station start	04° 27,715' S	082° 26,322' E	3549.6	0.0	118.2	9.5	349.2	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_0_U nderway-5	UWS	2024/07/24 07:37:42	information	04° 50,789' S	082° 17,168' E	5082.3	11.6	122.3	13.3	201.8	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/24 10:13:05	information	05° 09,223' S	081° 53,556' E	5162.8	11.4	110.6	11.5	233.3	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/24 12:51:31	information	05° 27,518' S	081° 29,965' E	5191.6	11.2	106.8	10.8	232.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/24 15:32:23	information	05° 45,774' S	081° 06,385' E	5200.7	11.0	118.1	11.2	231.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/24 18:17:20	information	06° 04,108' S	080° 42,654' E	5219.8	11.1	126.7	10.4	232.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/24 20:57:26	information	06° 22,303' S	080° 19,041' E	5208.8	11.2	122.9	11.0	231.8	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/24 23:51:06	information	06° 40,527' S	079° 55,354' E	5040.6	1.0	108.6	9.3	214.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_5-1	CTD	2024/07/24 23:57:01	station start	06° 40,573' S	079° 55,324' E	5279.1	0.2	141.1	9.4	128.7	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_5-2	CTD	2024/07/25 04:08:36	station start	06° 40,569' S	079° 55,341' E	5049.2	0.5	124.3	12.9	109.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_0_U	UWS	2024/07/25	information	06° 58,947' S	079° 31,362' E	5198.0	10.2	113.1	14.3	229.8	Nut, chla, POC, SPM, DOC, TM,

nderway-5		08:31:01									DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/25 11:24:59	information	07° 16,940' S	079° 07,869' E	5381.5	10.4	123.2	16.4	233.9	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/25 14:20:43	information	07° 35,075' S	078° 44,121' E	4887.6	10.4	117.3	13.6	232.7	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/25 17:10:27	information	07° 53,221' S	078° 20,294' E	5406.8	10.6	128.6	19.5	237.0	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/25 19:56:59	information	08° 11,484' S	077° 56,251' E	5389.3	10.7	116.1	15.5	233.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/25 22:42:21	information	08° 29,473' S	077° 32,515' E	5428.7	11.2	124.6	15.1	232.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/26 01:23:06	information	08° 47,525' S	077° 08,548' E	5448.8	5.1	108.6	12.2	233.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_6-1	CTD	2024/07/26 01:28:02	station start	08° 47,681' S	077° 08,455' E	5696.3	0.6	122.5	11.6	173.2	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_6-2	CTD	2024/07/26 05:20:41	station start	08° 47,688' S	077° 08,447' E	5447.7	0.3	125.2	13.3	11.1	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_6-3	CTD	2024/07/26 07:39:44	station start	08° 47,687' S	077° 08,451' E	5448.3	0.4	124.9	11.7	150.0	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_0_U nderway-5	UWS	2024/07/26 11:26:57	information	09° 05,606' S	076° 44,612' E	5367.9	11.6	138.9	11.7	233.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/26 14:01:24	information	09° 23,636' S	076° 20,610' E	5380.7	11.4	122.1	13.1	234.9	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/26 16:36:04	information	09° 39,629' S	075° 55,701' E	5324.4	11.3	116.3	11.3	237.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/26 19:19:01	information	09° 55,714' S	075° 30,587' E	5343.8	10.5	111.4	11.6	238.1	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/26 21:58:36	information	10° 11,591' S	075° 05,694' E	5300.1	11.1	130.0	10.9	236.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/07/27 00:45:34	information	10° 27,593' S	074° 40,525' E	5152.5	10.7	120.2	10.1	238.7	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_7-1	CTD	2024/07/27 04:09:23	station start	10° 43,409' S	074° 12,020' E	5068.5	0.0	108.1	9.9	120.7	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_0_U	UWS	2024/07/27	information	10° 52,073' S	073° 44,006' E	4772.0	11.7	123.9	11.9	252.3	Nut, chla, POC, SPM, DOC, TM,

nderway-5		10:58:20									DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/27 13:24:54	information	11° 00,928' S	073° 16,080' E	5273.6	11.6	125.3	14.2	252.0	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/27 15:55:19	information	11° 09,798' S	072° 48,093' E	5474.8	11.8	117.8	11.1	251.0	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/27 18:25:49	information	11° 18,669' S	072° 20,107' E	4249.5	11.8	112.6	10.4	251.4	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/27 20:52:38	information	11° 27,551' S	071° 52,111' E	4024.0	11.6	126.4	12.1	252.3	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/27 23:23:48	information	11° 36,406' S	071° 24,170' E	3499.5	11.6	128.0	14.4	252.7	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/28 01:57:20	information	11° 45,218' S	070° 56,141' E	3380.1	2.9	127.2	13.7	220.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_8-1	CTD	2024/07/28 02:04:04	station start	11° 45,324' S	070° 56,108' E	3383.4	0.1	131.6	11.7	192.3	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_8-2	CTD	2024/07/28 04:55:54	in the water	11° 45,320' S	070° 56,114' E	3381.7	0.1	106.4	10.5	244.2	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_8-3	MAG	2024/07/28 05:44:00	information	11° 45,343' S	070° 56,112' E	3385.2	1.4	105.4	9.0	160.0	
SO305/2_8-3	MAG	2024/07/28 05:45:04	information	11° 45,382' S	070° 56,121' E	3383.6	2.5	105.9	8.1	155.9	
SO305/2_8-3	MAG	2024/07/28 05:47:44	information	11° 45,490' S	070° 56,161' E	3382.2	2.4	111.5	9.3	167.0	
SO305/2_8-3	MAG	2024/07/28 06:13:34	information	11° 46,705' S	070° 57,417' E	3297.7	4.4	107.5	8.0	126.4	
SO305/2_8-3	MAG	2024/07/28 09:22:36	information	11° 53,455' S	070° 31,860' E	3349.5	9.5	118.2	9.3	260.7	
SO305/2_8-3	MAG	2024/07/28 09:32:09	information	11° 53,407' S	070° 30,730' E	3384.1	4.9	112.3	7.4	282.2	
SO305/2_8-3	MAG	2024/07/28 09:52:44	on deck	11° 53,051' S	070° 29,146' E	3372.4	4.5	116.5	6.5	284.2	
SO305/2_8-3	MAG	2024/07/28 09:54:37	on deck	11° 53,022' S	070° 29,002' E	3368.2	4.6	116.0	6.8	281.8	
SO305/2_8-3	MAG	2024/07/28 09:54:56	on deck	11° 53,018' S	070° 28,978' E	3369.0	4.7	117.0	7.4	278.5	
SO305/2_8-3	MAG	2024/07/28	station end	11° 53,013' S	070° 28,954' E	3367.3	4.7	122.3	6.9	281.2	

		09:55:14									
SO305/2_0_Underway-5	UWS	2024/07/28 12:45:00	information	12° 03,003' S	070° 00,262' E	3693.3	11.4	125.1	11.2	251.8	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/28 15:17:20	information	12° 11,871' S	069° 32,292' E	3779.0	11.3	116.5	11.6	252.8	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/28 17:51:17	information	12° 20,743' S	069° 04,321' E	3514.9	10.9	130.2	11.1	252.2	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/28 20:27:11	information	12° 29,616' S	068° 36,319' E	3757.3	11.3	123.1	10.4	251.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/28 23:02:02	information	12° 38,474' S	068° 08,393' E	4250.4	11.2	126.2	9.9	252.0	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/29 01:34:31	information	12° 47,345' S	067° 40,416' E	4229.8	11.2	143.6	8.5	252.0	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_Underway-5	UWS	2024/07/29 04:20:08	information	12° 56,290' S	067° 12,438' E	3085.8	0.4	131.5	8.6	47.8	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_9-1	CTD	2024/07/29 04:23:34	station start	12° 56,300' S	067° 12,419' E	3102.9	0.3	132.5	8.4	313.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_9-2	CTD	2024/07/29 07:08:36	in the water	12° 56,307' S	067° 12,409' E	3121.8	0.1	146.0	7.7	42.7	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_9-3	MAG	2024/07/29 07:53:15	station start	12° 56,309' S	067° 12,412' E	3114.6	0.1	138.5	7.6	142.0	
SO305/2_9-3	MAG	2024/07/29 08:00:45	information	12° 56,415' S	067° 12,517' E	3126.9	2.0	135.5	8.4	139.5	
SO305/2_9-3	MAG	2024/07/29 09:00:51	information	12° 57,202' S	067° 13,337' E	3517.3	2.2	138.5	8.7	129.7	
SO305/2_9-3	MAG	2024/07/29 09:01:23	in the water	12° 57,214' S	067° 13,353' E	3513.1	2.2	139.1	8.4	129.0	
SO305/2_9-3	MAG	2024/07/29 09:04:11	in the water	12° 57,268' S	067° 13,432' E	3500.8	1.8	142.1	7.3	120.3	
SO305/2_9-3	MAG	2024/07/29 09:27:53	information	12° 58,314' S	067° 14,823' E	3828.1	5.0	142.3	8.7	121.6	
SO305/2_9-3	MAG	2024/07/29 10:15:35	profile start	12° 56,234' S	067° 12,403' E	3082.6	9.0	134.5	13.6	241.4	
SO305/2_9-3	MAG	2024/07/29 21:53:20	alter course	13° 57,954' S	065° 38,426' E	2829.3	8.8	130.1	13.0	213.4	
SO305/2_9-3	MAG	2024/07/29	alter course	14° 02,844' S	065° 41,334' E	3563.5	8.9	135.2	10.0	134.1	

		22:30:49									
SO305/2_9-3	MAG	2024/07/30 03:46:55	alter course	13° 34,426' S	066° 23,758' E	4704.3	9.3	133.7	10.4	11.0	
SO305/2_9-3	MAG	2024/07/30 04:31:24	alter course	13° 28,372' S	066° 20,018' E	2266.2	8.3	137.1	12.6	38.1	
SO305/2_9-3	MAG	2024/07/30 06:18:19	alter course	13° 18,859' S	066° 34,112' E	3147.0	9.5	144.5	14.2	63.3	
SO305/2_9-3	MAG	2024/07/30 06:44:23	alter course	13° 21,802' S	066° 36,582' E	3207.2	9.4	127.9	12.8	178.2	
SO305/2_9-3	MAG	2024/07/30 08:29:15	alter course	13° 31,598' S	066° 22,251' E	3409.8	9.5	122.5	12.7	236.4	
SO305/2_9-3	MAG	2024/07/30 08:41:53	alter course	13° 33,122' S	066° 22,803' E	4587.7	9.0	127.9	9.0	137.8	
SO305/2_9-3	MAG	2024/07/30 10:41:48	alter course	13° 23,380' S	066° 38,086' E	3819.3	9.2	141.4	11.3	58.4	
SO305/2_9-3	MAG	2024/07/30 11:12:19	alter course	13° 26,946' S	066° 40,838' E	3366.8	9.8	133.7	11.1	200.9	
SO305/2_9-3	MAG	2024/07/30 12:57:55	alter course	13° 37,100' S	066° 25,655' E	3009.7	10.0	135.0	11.3	266.2	
SO305/2_9-3	MAG	2024/07/30 13:15:45	alter course	13° 34,730' S	066° 24,113' E	4696.9	9.3	136.8	11.1	20.5	
SO305/2_9-3	MAG	2024/07/30 19:48:49	alter course	13° 00,775' S	067° 16,343' E	3879.9	8.5	126.5	12.1	73.7	
SO305/2_9-3	MAG	2024/07/30 20:27:41	alter course	13° 04,999' S	067° 20,035' E	3209.9	9.5	120.5	10.1	150.3	
SO305/2_9-3	MAG	2024/07/31 02:10:36	profile end	13° 35,533' S	066° 33,582' E	2512.3	8.4	126.0	13.4	238.7	
SO305/2_9-3	MAG	2024/07/31 02:18:48	hoisting	13° 36,115' S	066° 33,244' E	2610.8	1.9	131.9	10.6	138.7	
SO305/2_9-3	MAG	2024/07/31 02:37:52	on deck	13° 36,627' S	066° 33,597' E	2506.9	2.4	132.2	11.7	137.6	
SO305/2_9-3	MAG	2024/07/31 02:40:44	recovered	13° 36,716' S	066° 33,673' E	2564.0	2.4	120.1	12.1	138.6	
SO305/2_9-3	MAG	2024/07/31 02:42:10	station end	13° 36,763' S	066° 33,705' E	2594.1	2.3	122.0	12.8	147.9	
SO305/2_10-1	DRG	2024/07/31 03:40:50	station start	13° 30,590' S	066° 29,922' E	3518.7	0.7	121.8	12.2	243.3	
SO305/2_10-1	DRG	2024/07/31	in the water	13° 30,580' S	066° 29,924' E	3509.2	0.1	124.2	9.8	332.6	

		03:49:35									
SO305/2_10-1	DRG	2024/07/31 04:52:47	max depth/on ground	13° 30,547' S	066° 30,004' E	3494.8	0.1	129.5	11.0	311.3	
SO305/2_10-1	DRG	2024/07/31 04:53:16	information	13° 30,545' S	066° 30,006' E	3491.0	0.2	127.4	10.8	88.9	
SO305/2_10-1	DRG	2024/07/31 05:37:18	information	13° 30,841' S	066° 30,617' E	3321.2	0.2	122.8	9.6	91.3	
SO305/2_10-1	DRG	2024/07/31 06:16:08	information	13° 30,833' S	066° 30,616' E	3323.5	0.1	132.9	12.3	117.0	
SO305/2_10-1	DRG	2024/07/31 07:11:10	on deck	13° 30,840' S	066° 30,612' E	3319.5	0.2	133.1	10.5	142.7	
SO305/2_10-1	DRG	2024/07/31 07:27:45	station end	13° 30,838' S	066° 30,619' E	3342.2	0.2	137.4	11.0	334.5	
SO305/2_11-1	MAG	2024/07/31 08:36:35	station start	13° 34,749' S	066° 33,856' E	2828.5	1.6	139.2	9.9	144.8	
SO305/2_11-1	MAG	2024/07/31 08:40:45	in the water	13° 34,860' S	066° 33,929' E	2954.1	1.7	143.5	11.0	160.4	
SO305/2_11-1	MAG	2024/07/31 08:44:31	in the water	13° 34,954' S	066° 33,970' E	2786.3	1.7	141.4	11.5	158.1	
SO305/2_11-1	MAG	2024/07/31 09:05:59	in the water	13° 35,659' S	066° 34,363' E	2889.2	3.9	141.4	12.3	142.8	
SO305/2_11-1	MAG	2024/07/31 09:35:51	profile start	13° 35,555' S	066° 33,520' E	2494.7	10.2	124.5	15.2	242.2	
SO305/2_11-1	MAG	2024/07/31 15:23:17	profile end	14° 07,765' S	065° 44,297' E	2786.7	9.3	107.0	13.6	231.5	
SO305/2_11-1	MAG	2024/07/31 15:30:49	hoisting	14° 08,327' S	065° 44,443' E	2722.6	3.6	107.6	10.8	142.1	
SO305/2_11-1	MAG	2024/07/31 15:51:59	on deck	14° 09,450' S	065° 45,739' E	3160.6	5.2	109.1	10.4	131.8	
SO305/2_11-1	MAG	2024/07/31 15:52:07	station end	14° 09,458' S	065° 45,748' E	3160.6	5.2	108.7	10.8	130.3	
SO305/2_0_U nderway-5	UWS	2024/07/31 18:05:38	information	14° 27,337' S	066° 06,956' E	2862.8	12.9	112.2	10.5	131.7	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_12-1	CTD	2024/07/31 20:34:28	station start	14° 46,746' S	066° 30,038' E	3089.1	0.5	116.0	8.0	32.3	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_12-2	CTD	2024/07/31	station start	14° 46,242' S	066° 29,993' E	3084.9	0.2	129.2	8.8	124.5	Nut, chla, POC, SPM, DOC, TM,

		23:38:34									DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_0_U nderway-5	UWS	2024/08/01 02:34:05	information	15° 06,938' S	066° 07,127' E	3304.7	14.2	131.9	11.8	228.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/01 04:44:31	information	15° 27,280' S	065° 45,001' E	2830.9	14.1	132.1	11.4	226.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/01 06:56:49	information	15° 47,546' S	065° 21,666' E	3239.6	13.9	134.0	11.3	228.1	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/01 09:06:56	information	16° 07,632' S	064° 58,433' E	3251.5	12.2	132.8	10.6	228.3	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_13-1	CTD	2024/08/01 11:24:06	station start	16° 27,815' S	064° 35,260' E	3603.1	0.4	127.4	8.2	168.9	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI, DO, TU
SO305/2_0_U nderway-5	UWS	2024/08/01 15:03:57	information	16° 38,248' S	064° 23,153' E	4183.4	13.7	115.6	10.3	231.7	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/01 17:13:43	information	16° 53,105' S	063° 56,648' E	3728.4	13.7	109.1	8.4	239.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/01 19:27:04	information	17° 07,852' S	063° 30,178' E	3571.2	13.1	126.2	9.3	240.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/01 21:38:26	information	17° 22,594' S	063° 03,533' E	3578.8	13.7	129.9	8.0	239.5	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/01 23:49:58	information	17° 37,263' S	062° 36,833' E	3517.6	12.8	144.9	7.1	241.9	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/02 02:00:52	information	17° 51,878' S	062° 10,058' E	3557.1	13.7	131.1	8.5	240.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/02 04:12:58	information	18° 06,424' S	061° 43,240' E	3856.0	12.9	136.6	8.2	241.2	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/02 06:32:36	information	18° 20,902' S	061° 16,344' E	4377.2	12.7	155.0	9.1	241.2	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/02 08:51:33	information	18° 35,334' S	060° 49,332' E	4108.9	13.1	169.1	11.5	240.1	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/02 11:14:56	information	18° 49,775' S	060° 22,102' E	2977.4	11.8	163.0	11.2	240.1	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/02 13:43:35	information	19° 03,985' S	059° 55,127' E	3533.9	12.2	150.7	7.4	241.6	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U nderway-5	UWS	2024/08/02 16:07:22	information	19° 18,202' S	059° 27,919' E	3175.2	12.4	161.1	9.0	248.0	Nut, chla, POC, SPM, DOC, TM, DOM, UV, H, Org, MP, T, S, NI
SO305/2_0_U	WISS-	2024/08/03	station end	19° 58,609' S	057° 18,129' E	0.0	0.1	156.7	8.0	339.3	

nderway-1	DATA	04:00:00									
SO305/2_0_U nderway-5	UWS	2024/08/03 04:00:00	station end	19° 58,609' S	057° 18,129' E	0.0	0.1	156.7	8.0	339.3	
SO305/2_0_U nderway-4	EM122	2024/08/03 04:00:00	station end	19° 58,609' S	057° 18,129' E	0.0	0.1	156.7	8.0	339.3	
SO305/2_0_U nderway-3	VMADCP _75kHz	2024/08/03 04:00:00	station end	19° 58,609' S	057° 18,129' E	0.0	0.1	156.7	8.0	339.3	
SO305/2_0_U nderway-6	CT	2024/08/03 04:00:00	station end	19° 58,609' S	057° 18,129' E	0.0	0.1	156.7	8.0	339.3	
SO305/2_0_U nderway-2	VMADCP _38kHz	2024/08/03 04:00:00	station end	19° 58,609' S	057° 18,129' E	0.0	0.1	156.7	8.0	339.3	