

**Chlorophyll *a* concentration of phytoplankton during *Umitaka-maru* cruises of the
55–57th Japanese Antarctic Research Expedition in 2014–2016**

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1. Introduction

This report documents the phytoplankton chlorophyll *a* concentration in seawater at depths less than 200 m measured during a cruise by the training vessel *Umitaka-maru* of the Tokyo University of Marine Science and Technology (UM13-09, UM14-08, UM15-08) as part of the 55–57th Japanese Antarctic Research Expedition (JARE-55–57) in the austral summer of 2014–2016. The chlorophyll *a* concentration was measured in two series: (1) spatial variations in chlorophyll *a* within the surface water along the cruise track, and (2) vertical profiles of chlorophyll *a* in the Indian sector of the Southern Ocean.

2. Materials and methods

Surface seawater was collected basically twice a day during the cruise from water that was continuously pumped through the vessel from an intake in the hull (Tables [2](#), [4](#), [6](#)). At stations where water-column water sampling was performed, surface seawater was collected in a plastic bucket.

Water samples were collected over the upper 200 m of water column by using Niskin bottles, attached to CTD/Carousel Water Sampling System, which is 24-position Carousel water sampler with CTD (SBE9plus, Sea-Bird Electronics, Inc.). Seawater samples (280 mL) were filtered onto glass-fiber filters (Whatman, GF/F). The filters were immediately soaked in N,N-dimethylformamide (Suzuki and Ishimaru, 1990) and pigments were extracted. The samples were stored in a freezer (−18 °C) until analysis on board. Concentrations of chlorophyll *a* were determined fluorometrically (Welschmeyer, 1994) with an on-board fluorometer (10-AU; Turner Design, Sunnyvale, California, USA). The fluorometer was calibrated against a chlorophyll *a* standard (Wako Chemical Co.) at a laboratory on land prior to the cruise, using a spectrophotometer and the specific absorption coefficient of chlorophyll *a* (Porra *et al.*, 1989).

3. Data

Figures [1](#), [2](#) and [3](#) are maps showing the sampling stations for the UM13-09, UM14-08 and UM15-08 cruises. Tables [1](#), [3](#) and [5](#) lists the sampling locations and chlorophyll *a* concentrations at the sea surface and in subsurface water during three cruises. Underway water-sampling information and results of the three cruises are shown in Table [2](#), [4](#) and [6](#).

4. Data archive

The data presented in this report are archived and available from the online Science Database of the National Institute of Polar Research (http://scidbase.nipr.ac.jp/?ml_lang=en). Permission to use these data for publication or presentation should be obtained in writing. Inquiries about details of the data record should be addressed to:

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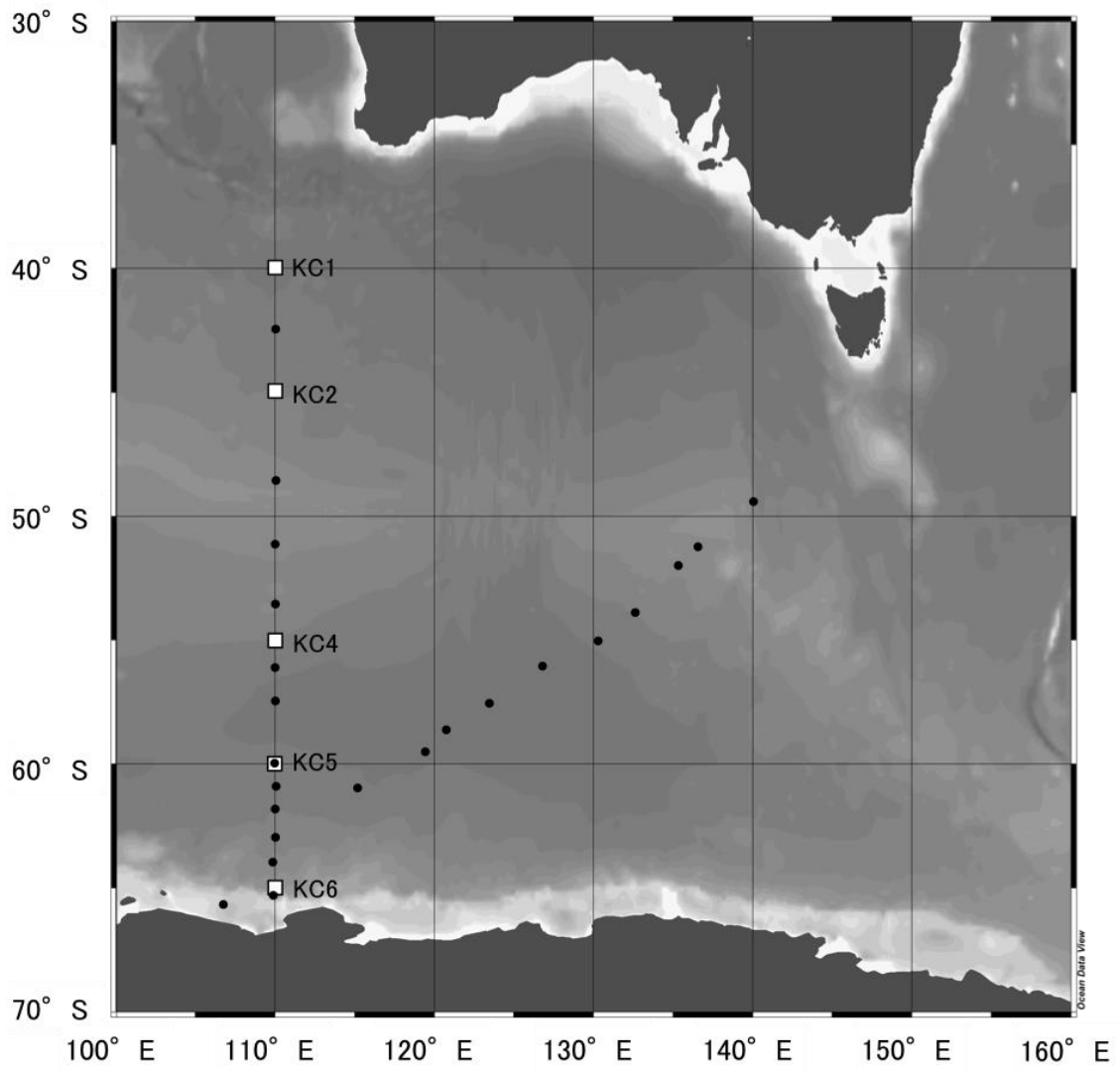


Fig. 1. Locations of sampling stations during the UM13-09 cruise. Solid circles indicate underway surface water sampling points. Open squares indicate vertical sampling stations.

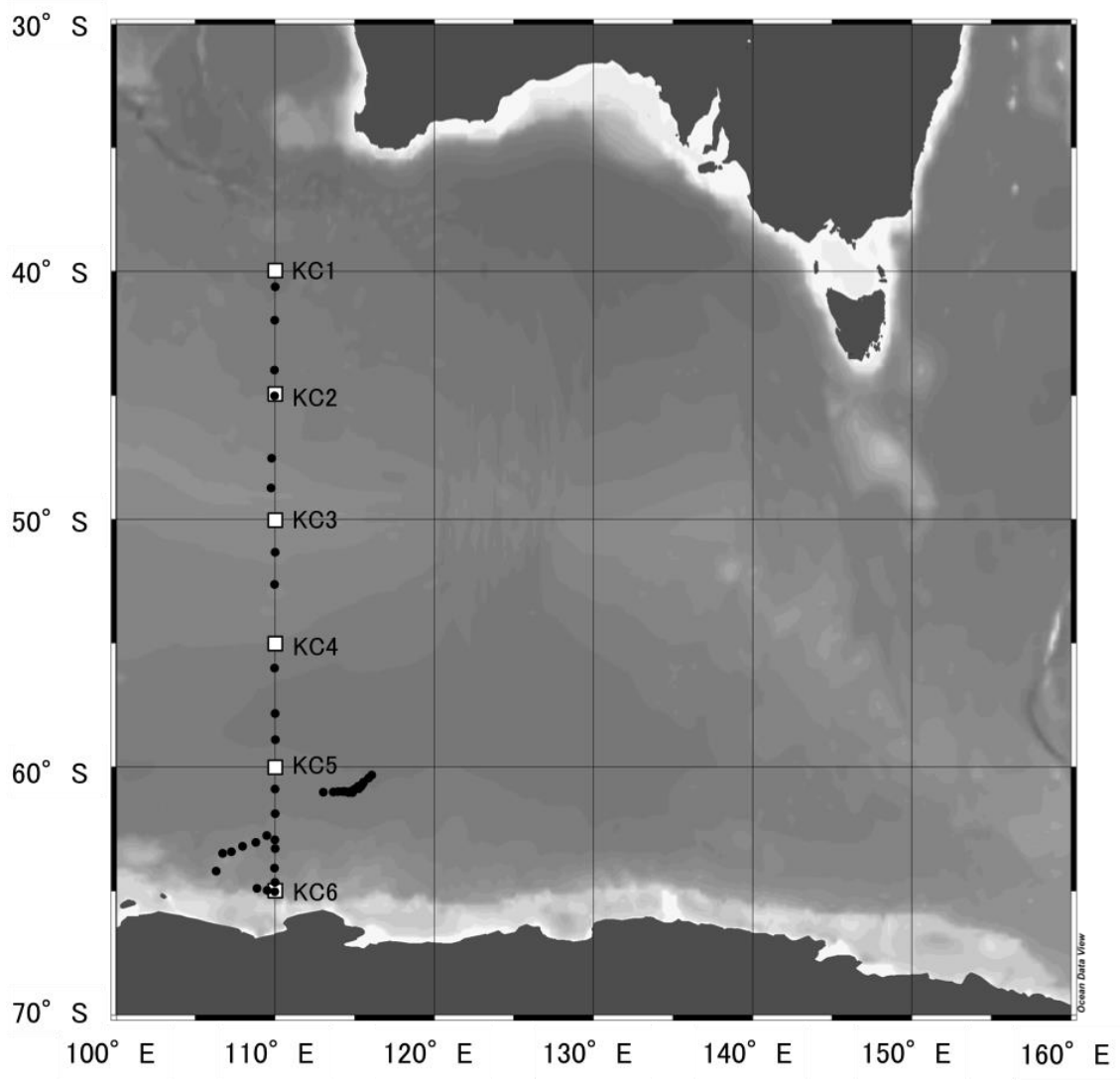


Fig. 2. Locations of sampling stations during the UM14-8 cruise. Solid circles indicate underway surface water sampling points. Open squares indicate vertical sampling stations.

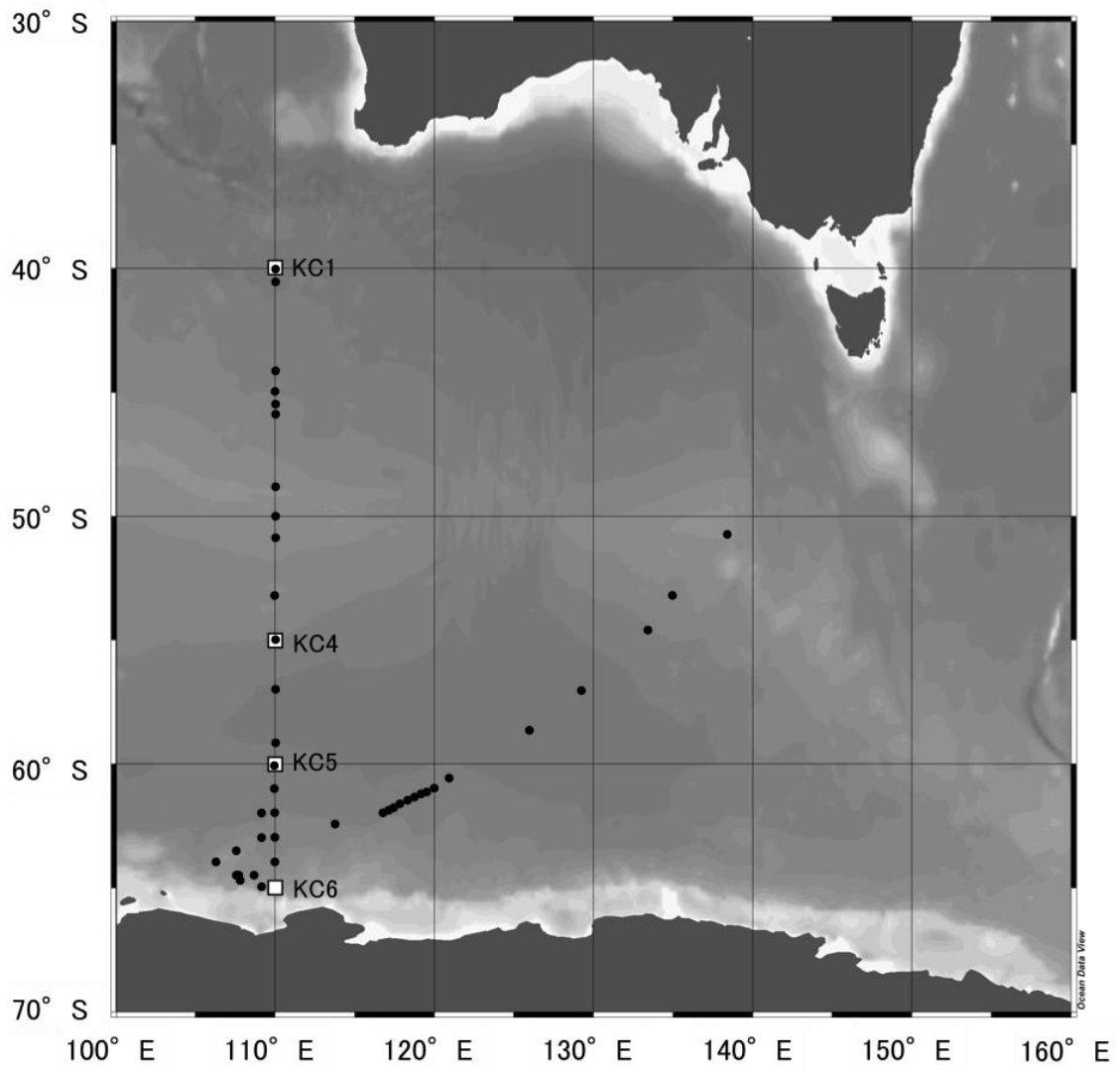


Fig. 3. Locations of sampling stations during the UM15-08 cruise. Solid circles indicate underway surface water sampling points. Open squares indicate vertical sampling stations.

Table 1. Sampling date, time, position, and chlorophyll *a* concentrations for stations KC1-6 during UM13-09 cruise.

Station	KC1		KC2		KC3		KC4	
Data (UTC)	2014/1/13		2014/1/14		—		2014/1/16	
Latitude (°S)	39°59.97'		44°59.98'		—		54°59.98'	
Longitude (°E)	110°00.05'		110°00.01'		—		110°00.07'	
	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>
	(m)	(µg/L)	(dbar)	(µg/L)	(dbar)	(µg/L)	(dbar)	(µg/L)
	0	0.272	0	0.322	0	—	0	0.328
	25	0.284	25	0.306	25	—	25	0.318
	50	0.406	50	0.409	50	—	50	0.450
	75	0.356	75	0.514	75	—	75	0.439
	100	0.140	100	0.421	100	—	100	0.200
	150	0.030	150	0.022	150	—	150	0.026
	200	0.021	200	0.010	200	—	200	0.012

Station	KC5		KC6	
Data (UTC)	2014/1/19		2014/1/24	
Latitude (°S)	60°00.01'		65°00.05'	
Longitude (°E)	109°59.98'		110°00.00'	
	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>
	(dbar)	(µg/L)	(dbar)	(µg/L)
	0	0.424	0	0.860
	25	0.583	25	1.246
	50	1.022	50	0.480
	75	0.916	75	0.138
	100	0.414	100	0.099
	150	0.058	150	0.078
	200	0.011	200	0.130

*Water sampling at KC3 was canceled due to bad weather.

Table 2. Sampling date, time, position, and chlorophyll *a* concentrations for underway surface-water samplings during UM13-09 cruise.

Station	Date (UTC)	Time (UTC)	Lat. (°S)	Long. (°E)	Chl <i>a</i> (µg/L)
S01	2014/1/14	11:06	45°00.00'	109°59.99'	N.D.
S02	2014/1/15	5:03	48°29.63'	110°00.30'	0.171
S03	2014/1/15	23:31	51°00.92'	110°00.43'	0.304
S04	2014/1/16	12:38	53°36.35'	109°59.88'	0.421
S05	2014/1/17	7:22	56°04.84'	109°59.56'	0.313
S06	2014/1/17	15:10	57°29.92'	110°00.18'	0.389
S07	2014/1/19	14:06	59°59.98'	109°59.97'	N.D.
S08	2014/1/20	4:27	60°59.98'	109°59.98'	0.321
S09	2014/1/22	21:08	61°59.98'	109°59.97'	0.237
S10	2014/1/23	6:35	62°54.98'	109°59.95'	0.212
S11	2014/1/24	4:12	64°04.88'	109°51.24'	0.271
S12	2014/1/25	4:14	65°16.44'	109°51.06'	1.571
S13	2014/1/25	22:19	65°25.46'	107°38.17'	0.348
S14	2014/1/30	0:45	60°52.58'	115°23.49'	0.464
S15	2014/1/30	10:10	59°31.13'	119°05.24'	0.199
S16	2014/1/30	16:15	58°44.56'	121°09.88'	0.153
S17	2014/1/31	0:00	57°43.65'	123°59.43'	0.129
S18	2014/1/31	10:33	56°19.61'	127°44.71'	0.141
S19	2014/1/31	21:52	55°15.26'	130°29.83'	0.274
S20	2014/2/1	8:16	53°58.48'	132°40.56'	0.226
S21	2014/2/1	22:26	52°14.50'	135°32.80'	0.370
S22	2014/2/2	4:09	51°33.53'	136°39.86'	0.279
S23	2014/2/2	21:33	49°16.43'	140°03.36'	0.685

Table 3. Sampling date, time, position, and chlorophyll *a* concentrations for stations KC1-6 during UM14-08 cruise.

Station	KC1		KC2		KC3		KC4	
Data (UTC)	2015/1/13		2015/1/14		2015/1/15		2015/1/16	
Latitude (°S)	39°59.98'		45°00.03'		49°59.94'		54°59.97'	
Longitude (°E)	110°00.06'		110°00.11'		110°00.23'		110°00.08'	
	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>
	(m)	(µg/L)	(dbar)	(µg/L)	(dbar)	(µg/L)	(dbar)	(µg/L)
	0	0.250	0	0.240	0	0.247	0	0.276
	10	0.264	10	0.237	10	0.246	10	0.247
	25	0.267	25	0.241	25	0.247	25	0.269
	50	0.301	50	0.342	50	0.269	50	0.316
	75	0.257	75	0.366	75	0.284	75	0.313
	100	0.196	100	0.288	100	0.241	100	0.342
	125	0.098	125	0.199	125	0.092	125	0.216
	150	0.034	150	0.100	150	0.044	150	0.069
	200	0.024	200	0.025	200	0.021	200	0.025

Station	KC5		KC6	
Data (UTC)	2015/1/18		2015/1/22	
Latitude (°S)	60°00.02'		64°59.97'	
Longitude (°E)	110°00.06'		110°00.05'	
	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>
	(dbar)	(µg/L)	(dbar)	(µg/L)
	0	0.161	0	0.472
	10	0.182	10	0.462
	25	0.246	25	0.486
	50	0.353	50	0.882
	75	0.207	75	0.174
	100	0.163	100	0.100
	125	0.074	125	0.102
	150	0.037	150	0.083
	200	0.013	200	0.017

Table 4. Sampling date, time, position, and chlorophyll *a* concentrations for underway surface-water samplings during UM14-08 cruise.

Station	Date (UTC)	Time (UTC)	Lat. (°S)	Long. (°E)	Chl <i>a</i> (µg/L)	Station	Date (UTC)	Time (UTC)	Lat. (°S)	Long. (°E)	Chl <i>a</i> (µg/L)
S1	2015/1/12	11:21	41°12.30'	110°00.20'	0.23	S23	2015/1/25	23:20	63°18.01'	107°59.71'	0.58
S2	2015/1/12	15:59	42°17.20'	110°00.70'	0.23	S24	2015/1/26	6:18	63°01.99'	108°39.92'	0.44
S3	2015/1/12	22:50	43°54.60'	109°59.90'	0.45	S25	2015/1/26	15:26	62°46.00'	109°20.09'	0.39
S4	2015/1/13	11:28	45°09.20'	110°00.41'	0.35	S26	2015/1/27	0:27	63°00.00'	109°59.90'	0.56
S5	2015/1/13	23:58	47°20.47'	109°46.55'	0.39	S27	2015/1/28	6:58	60°55.40'	112°48.20'	0.36
S6	2015/1/14	8:56	48°37.90'	109°33.80'	0.23	S28	2015/1/28	11:52	60°50.40'	113°34.60'	0.44
S7	2015/1/15	4:22	51°30.31'	110°00.46'	0.28	S29	2015/1/28	12:36	60°50.30'	113°43.50'	0.38
S8	2015/1/15	10:10	52°50.37'	109°59.80'	0.30	S30	2015/1/28	13:18	60°50.30'	113°50.70'	0.38
S9	2015/1/16	7:28	56°23.90'	109°59.80'	0.26	S31	2015/1/28	13:53	60°50.28'	113°57.01'	0.45
S10	2015/1/16	15:56	58°03.29'	110°00.17'	0.22	S32	2015/1/28	14:25	60°50.26'	114°00.22'	0.44
S11	2015/1/17	0:42	59°01.10'	110°00.00'	0.16	S33	2015/1/28	17:29	60°50.40'	114°14.70'	0.38
S12	2015/1/18	1:39	60°59.90'	110°00.53'	0.20	S34	2015/1/28	17:56	60°50.30'	114°20.30'	0.37
S13	2015/1/19	9:08	61°59.90'	109°59.80'	0.31	S35	2015/1/28	20:39	60°50.30'	114°31.60'	0.32
S14	2015/1/20	13:45	63°30.00'	109°59.98'	0.35	S36	2015/1/28	21:15	60°50.30'	114°38.50'	0.35
S15	2015/1/20	21:21	63°59.90'	109°59.90'	N.D.	S37	2015/1/28	21:57	60°50.20'	114°49.10'	0.36
S16	2015/1/21	11:59	64°30.05'	110°00.41'	0.37	S38	2015/1/28	23:10	60°49.45'	115°08.20'	0.38
S17	2015/1/22	10:57	64°53.90'	109°32.10'	0.46	S39	2015/1/29	5:17	60°43.90'	115°25.80'	0.35
S18	2015/1/22	15:45	64°46.61'	108°32.10'	0.44	S40	2015/1/29	6:14	60°38.70'	115°33.90'	0.32
S19	2015/1/22	17:35	64°59.90'	110°00.47'	0.31	S41	2015/1/29	7:08	60°34.20'	115°41.00'	0.31
S20	2015/1/24	22:42	64°00.00'	106°29.64'	0.25	S42	2015/1/29	7:58	60°30.30'	115°47.90'	0.31
S21	2015/1/25	11:26	63°41.30'	107°00.00'	0.27	S43	2015/1/29	9:03	60°24.70'	115°55.60'	0.30
S22	2015/1/25	16:21	63°30.00'	107°29.90'	N.D.	S44	2015/1/29	9:59	60°19.20'	116°03.10'	0.22

Table 5. Sampling date, time, position, and chlorophyll *a* concentrations for stations KC1-6 during UM15-08 cruise.

Station	KC1		KC2		KC3		KC4	
Data (UTC)	2016/1/17		-		-		2016/1/21	
Latitude (°S)	40°09.58'		-		-		54°59.86'	
Longitude (°E)	109°53.45'		-		-		110°00.13'	
	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>
	(m)	(µg/L)	(dbar)	(µg/L)	(dbar)	(µg/L)	(dbar)	(µg/L)
	0	0.424	0	-	0	-	0	0.356
	25	0.417	25	-	25	-	25	0.358
	50	0.447	50	-	50	-	50	0.428
	75	0.473	75	-	75	-	75	0.447
	100	0.198	100	-	100	-	100	0.365
	125	0.112	125	-	125	-	125	0.109
	150	0.074	150	-	150	-	150	0.053
	200	0.035	200	-	200	-	200	0.017

Station	KC5		KC6	
Data (UTC)	2016/1/23		2016/1/27	
Latitude (°S)	60°00.01'		64°58.50'	
Longitude (°E)	110°00.11'		109°01.04'	
	Depth	Chl <i>a</i>	Depth	Chl <i>a</i>
	(dbar)	(µg/L)	(dbar)	(µg/L)
	0	0.891	0	1.847
	25	0.644	25	0.838
	50	0.602	50	0.238
	75	0.256	75	0.098
	100	0.101	100	0.071
	125	0.062	125	0.117
	150	0.027	150	0.028
	200	0.016	200	0.034

*Water sampling at KC2 and KC3 were canceled due to bad weather.

Table 6. Sampling date, time, position, and chlorophyll *a* concentrations for underway surface-water samplings during UM15-08 cruise.

Station	Date (UTC)	Time (UTC)	Lat. (°S)	Long. (°E)	Chl <i>a</i> (µg/L)	Station	Date (UTC)	Time (UTC)	Lat. (°S)	Long. (°E)	Chl <i>a</i> (µg/L)
S01	2016/1/17	1:28	40°9.55'	109°53.45'	0.51	S23	2016/1/28	4:47	64°47.97'	107°42.87'	1.19
S02	2016/1/17	12:48	40°31.93'	109°56.4'	0.45	S24	2016/1/28	16:01	64°30.03'	107°30.2'	2.30
S03	2016/1/18	4:07	43°54.21'	110°0.23'	0.94	S25	2016/1/29	6:41	64°32.9'	107°40.13'	1.92
S04	2016/1/18	13:17	44°59.91'	110°0.11'	0.57	S26	2016/1/29	15:00	63°59.99'	106°29.49'	1.38
S05	2016/1/19	4:15	45°29.82'	110°1.88'	0.41	S27	2016/1/30	1:47	63°29.58'	107°28.84'	1.57
S06	2016/1/19	13:43	45°58.4'	110°0.73'	0.65	S28	2016/1/30	16:46	62°32.18'	113°42.33'	0.79
S07	2016/1/20	4:10	48°31.72'	110°0.04'	0.38	S29	2016/1/31	1:42	61°57.88'	117°17.24'	0.98
S08	2016/1/20	14:36	49°59.97'	110°0.04'	0.44	S30	2016/1/31	2:58	61°48.58'	117°38.67'	0.60
S09	2016/1/21	2:50	51°11.17'	110°3.48'	0.35	S31	2016/1/31	4:02	61°40.21'	117°55.46'	0.80
S10	2016/1/21	15:14	53°31.66'	109°59.33'	0.71	S32	2016/1/31	5:10	61°33.01'	118°19.2'	0.89
S11	2016/1/22	3:51	54°59.66'	110°0.46'	0.42	S33	2016/1/31	6:19	61°24.34'	118°41.1'	0.87
S12	2016/1/22	14:04	57°8.79'	110°0.03'	0.56	S34	2016/1/31	7:24	61°16.49'	119°2.31'	0.88
S13	2016/1/23	4:33	59°0.75'	109°57.66'	1.17	S35	2016/1/31	8:33	61°8.43'	119°23.03'	0.80
S14	2016/1/23	17:40	60°13.3'	109°55.87'	1.06	S36	2016/1/31	9:38	61°0.73'	119°42.75'	0.88
S15	2016/1/24	4:30	60°58.92'	109°55.6'	1.26	S37	2016/1/31	10:29	60°55.96'	120°0.2'	0.98
S16	2016/1/24	18:43	62°0.01'	109°0.09'	0.97	S38	2016/1/31	13:45	60°29.98'	121°6.21'	0.84
S17	2016/1/25	5:07	62°0.02'	110°0.13'	1.41	S39	2016/2/1	3:15	58°27.21'	126°4.25'	0.37
S18	2016/1/25	17:48	62°59.98'	110°0.03'	0.88	S40	2016/2/1	13:31	57°0.67'	129°8.11'	0.15
S19	2016/1/26	5:11	63°1.63'	109°6.48'	1.18	S41	2016/2/2	2:53	54°38.56'	133°17.62'	0.24
S20	2016/1/26	16:17	63°59.99'	109°59.89'	2.18	S42	2016/2/2	13:56	53°37.38'	135°0.49'	0.15
S21	2016/1/27	4:00	64°58.55'	109°1.13'	1.96	S43	2016/2/3	3:17	51°12.02'	138°13.42'	0.46
S22	2016/1/27	15:25	64°30.36'	108°41.13'	2.25						