

**Plankton sampling by the training vessel *Umitaka-maru* in the Indian sector of
the Southern Ocean in the austral summer of 2015**

Hisae SAKURAI¹, Kazuo AMAKASU², Tetsuo IWAMI³, Kaori UCHIYAMA², Keishi SHIMADA²,
Naho MIYAZAKI², Masato MOTOKI^{1, 2}, Takahiro IIDA^{1, 4, 5}, Ryosuke MAKABE^{1, 4},
Atsushi TANIMURA^{1, 4}, Kunio T. TAKAHASHI^{1, 4*} and Tsuneo ODATE^{1, 4}

¹ National Institute of Polar Research, Research Organization of Information and Systems,
10-3 Midori-cho, Tachikawa, Tokyo 190-8518.

² Tokyo University of Marine Science and Technology, 4-5-7 Konan, Minato-ku, Tokyo 108-8477.

³ Tokyo Kasei Gakuin University, 2600 Aihara-machi, Machida, Tokyo 194-0292.

⁴ Department of Polar Science, School of Multidisciplinary Sciences, SOKENDAI (The Graduate
University for Advanced Studies), 10-3 Midori-cho, Tachikawa, Tokyo 190-8518.

⁵ Present address: Graduate School of Fisheries Sciences, Hokkaido University,
3-1-1 Minato-cho, Hakodate, Hokkaido 041-8611.

*Corresponding author. E-mail: takahashi.kunio@nipr.ac.jp

1. Introduction

The training vessel (T/V) *Umitaka-maru* II of the Tokyo University of Fisheries [currently Tokyo University of Marine Science and Technology (TUMSAT)] participated in the first Japanese Antarctic Research Expedition (JARE-1) as the ship associated with the icebreaker *Soya*. Research voyages for marine science in the Southern Ocean have been intermittently taken over by T/V *Umitaka-maru* III and IV (the present ship). After many years of a collaborative relationship, the National Institute of Polar Research (NIPR) and TUMSAT signed a comprehensive cooperation agreement on 9 February 2009.

With the second half of the six-year plan for JARE phase VIII (2010–2015) by NIPR, the new three-year (2013–2015) TUMSAT-NIPR joint program on “Studies on plankton community structure and environment parameters in the Southern Ocean.” was established. This program focused on the

spatio-temporal variation in plankton distribution in the Southern Ocean ecosystem as one of the JARE projects (Project no. AP-46; Associate Prof. Masato Moteki, TUMSAT, principal investigator).

The present report describes the data from the second year research cruise conducted by T/V *Umitaka-maru* IV under the mission of the AP-46 project. This report contains information about the samples collected using two kinds of plankton nets—an Intelligent Operative Net Sampling System (IONESS) and a Matsuda-Oozeki-Hu Trawl (MOHT)—along longitude 110°E off Wilkes Land, Antarctica, during the cruise period between 11 January 2015 and 5 February 2015.

2. Cruise number

Data covered in this report were obtained from the 18th *Kaiyodai* (abbreviated Japanese name for TUMSAT) Antarctic Research Expedition (*KARE-18*) cruise by T/V *Umitaka-maru*, which was conducted as a part of the 56th Japanese Antarctic Research Expedition (*JARE-56*) program. This cruise also served as a leg of the long-distance voyage of the Advanced Course of Marine Science and Technology of TUMSAT (voyage number UM-14-08).

3. Sampling protocol

(1) IONESS

The IONESS is a multiple-net opening and closing zooplankton sampler (Kitamura *et al.*, 2001). IONESS was equipped with nine nets with 335- μ m mesh for catching meso- to macro-zooplankton.

IONESS was deployed from the stern of vessel and towed obliquely over predetermined depth intervals. Each of the nets was opened and closed sequentially by commands from a deck transmitter through an armored cable to an underwater receiver. A deployment consisted of the oblique down-cast from the surface to the maximum depth; the opening and closing sequences through specific depth strata occurred during the up-cast.

Although there was a flow-meter (Tsurumi-Seiki Kosakusho Co., Ltd., Yokohama, Japan) mounted outside the opening of the net mouth to estimate towing distance, it was not used during this cruise because of a problem with the reliability of the flow-meter rotation due to rough sea conditions. In the present report, therefore, the volume of water filtered (V , m³) by each net was estimated with

the following equation, assuming filtration efficiencies of 100%:

$$V = D \times A, \quad (1)$$

where D and A are towing distance (m) and mean working filtration area (m²), respectively. D was calculated as:

$$D = \sqrt{D_h^2 + D_v^2}, \quad (2)$$

where D_h (m) and D_v (m) were the horizontal distance [towing time (s) multiplied by the ship speed (1.0 m s⁻¹)] and vertical distance, respectively. A was calculated as:

$$A = a \times \sin (\pi \times R/180), \quad (3)$$

where a was the mouth area of the net [1.44 m² (1.44 m high \times 1.0 m wide)] and R is the mean frame angle during each net tow, calculated using the frame angle recorded every 2 s.

Depth, temperature and salinity were also measured with a conductivity-temperature-depth (CTD) probe (SBE 37-SIP microCAT, Sea-Bird Electronics, Inc., Bellevue, WA, USA) mounted on the net frame. CTD data were recorded in real-time by an onboard computer.

Five stations were occupied along 110°E for IONESS samplings ([Fig. 1](#)). Detailed sampling information for the IONESS tows is given in [Table 1](#).

(2) MOHT

The MOHT is a quantitative frame trawl with a 5-m² mouth area that is used to sample pelagic fishes and macro- to mega-zooplankton (Oozeki *et al.*, 2004). The net was constructed of knotless ultra-high-strength polyethylene square mesh of 1.95-mm bar length and 0.36-mm twine diameter (1.59-mm square pores).

The MOHT was towed obliquely from a depth of either 200 m or 400 m to the surface. Four depth-stratified hauls were conducted at 0–50, 50–100, 100–200 and 200–400 m at five stations, and at 0–50, 50–100, 100–150 and 150–200 m at Stn. C02. The tow durations for the MOHT casts were approximately 2 h and 3 h, respectively. A calibrated digital flowmeter (Tsurumi-Seiki Kosakusho Co., Ltd., Yokohama, Japan) was attached on the upper frame to estimate the volume of water filtered.

Six stations were occupied along 110°E for MOHT samplings ([Fig. 2](#)). Detailed sampling information for the MOHT tows is given in [Table 2](#).

(3) Zooplankton sample processing

All zooplankton samples were immediately preserved in 5% borate-buffered formalin seawater on board and stored in a cool, dark place on the ship.

4. Data policy

The purpose of this data report is to provide information about the collection of zooplankton samples for scientists and students researching Antarctic ecosystems and zooplankton. This report should also make interested researchers aware of the opportunity to use these samples to quantitatively describe zooplankton distribution and biomass in the Southern Ocean. All underlying physical data collected with the CTD and the samples are available for scientific use. We expect the information in this report, in combination with the available samples and environmental data set, to be utilized in various future studies.

Permission to use the data and the preserved samples for publication or presentation should be obtained in writing. Inquiries about details of the data record should be addressed to one of the following:

Tsuneo Odate, Professor

National Institute of Polar Research

10–3 Midori-cho, Tachikawa,

Tokyo 190-8518, Japan

Phone: +81-42-512-0735

Masato Moteki, Associate Professor

Tokyo University of Marine Science and Technology

4–5–7 Konan, Minato-ku,

Tokyo 108-8477, Japan

Phone: +81-35-463-0527

Facsimile: +81-42-528-3492

Facsimile: +81-35-463-0523

E-mail: odate@nipr.ac.jp

E-mail: masato@kaiyodai.ac.jp

Acknowledgements

We acknowledge Captain Akira Noda and his crew of T/V *Umitaka-maru*, and all cadets on board participating in the Advanced Course for Marine Science and Technology of TUMSAT, for their invaluable assistance during oceanographic observations. We also thank our scientific colleagues and graduate students for their excellent support during the KARE-18 cruise.

References

- Kitamura, M., Tanaka, Y., Ishimaru, T., Mine, Y., Noda, A., Hamada, H. (2001): Sagami Bay Research Report: improvement of multiple opening/closing net, IONESS (Intelligent Operative Net Sampling System). Cruise Rep., **10**, 149–158 (in Japanese). Available at: <http://ci.nii.ac.jp/naid/110000481863/en/>.
- Oozeki, Y., Hu, F., Kubota, H., Sugisaki, H. and Kimura, R. (2004): Newly designed quantitative frame trawl for sampling larval and juvenile pelagic fish. Fish. Sci., **70**, 223–232, doi: 10.1111/j.1444-2906.2003.00795.x.

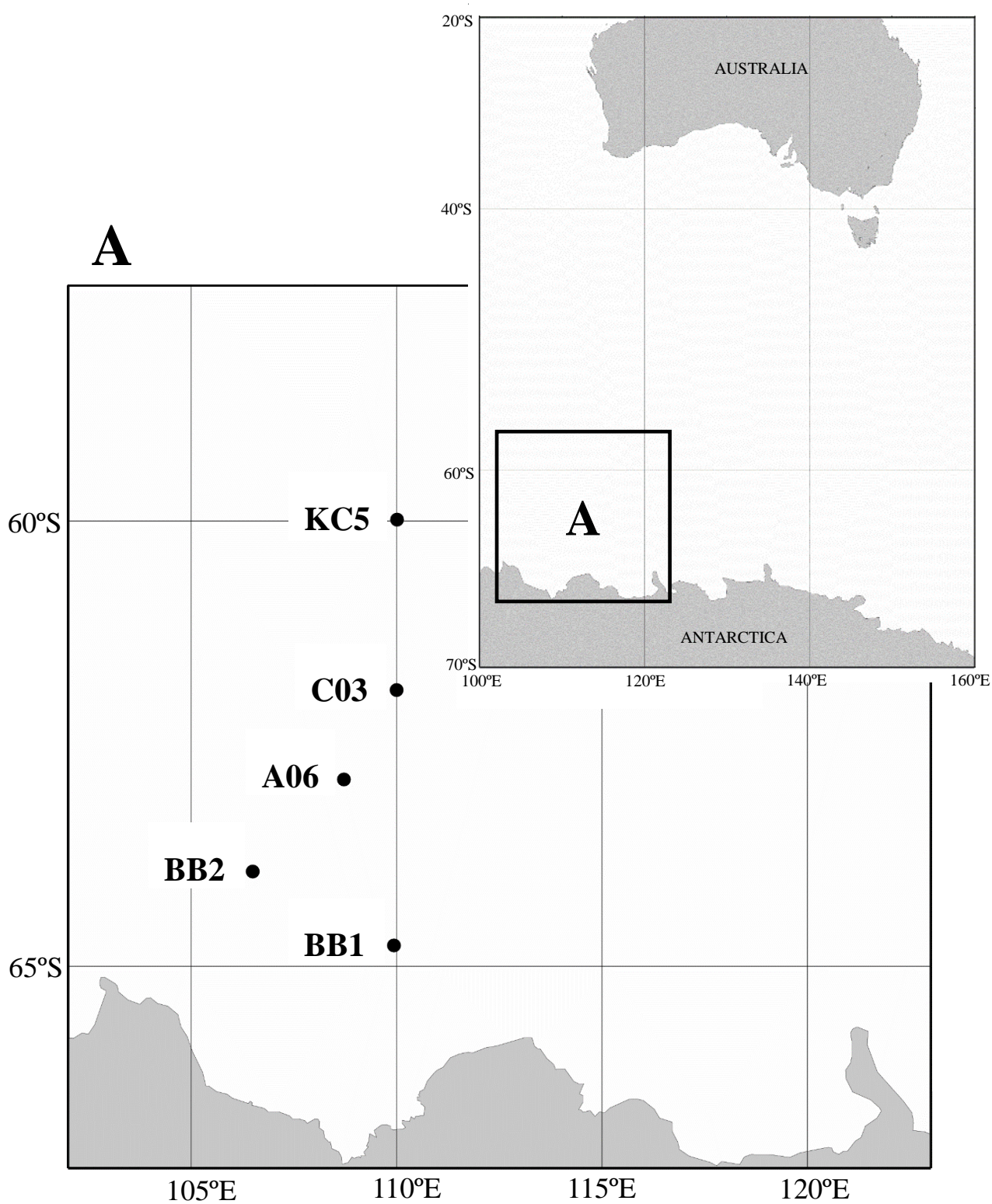


Fig. 1. Stations sampled with IONESS opening/closing multiple-net systems on board the training vessel *Umitaka-maru* in the Indian sector of the Southern Ocean, January 2015.

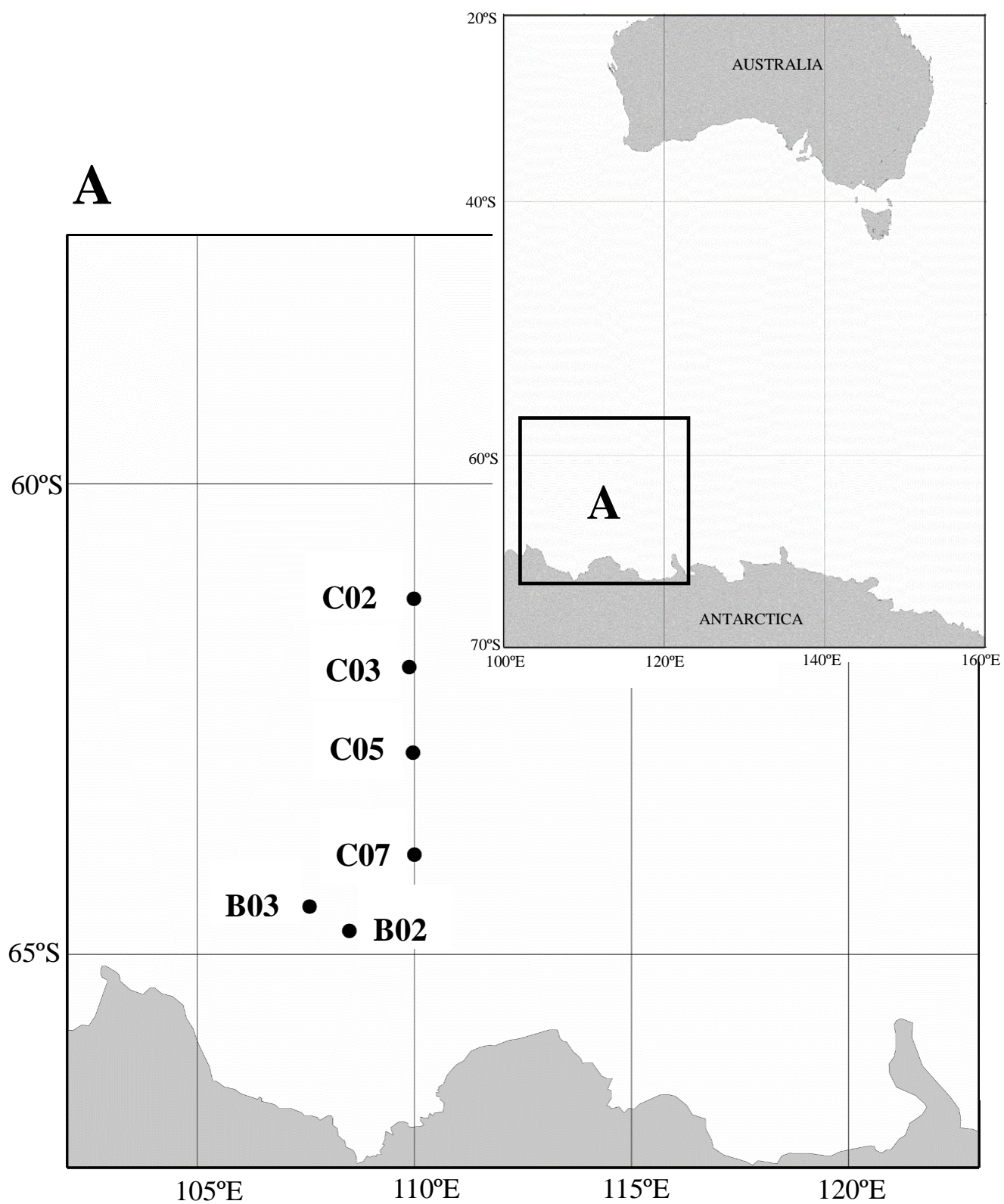


Fig. 2. Stations sampled with MOHT opening/closing multiple-net systems on board the training vessel *Umitaka-maru* in the Indian sector of the Southern Ocean, January 2015.

Table 1. Sampling data of an IONESS along the 110°E transect in the Southern Ocean in January 2015.

Stn.	Tow	Position				Date (yyyy/mm/dd) & Time (UTC) ^a		Bottom depth (m)	Net no. ^b	Sampling depth interval (m)	Volume filtered (m ³)
		Start		Finish		Start	Finish				
KC5	1	59 °	59.09	° S	60 °	1.85	° S	4363	1	25-50	438
		110 °	0.08	° E	110 °	0.02	° E		2	50-76	478
									3	76-101	487
									4	101-125	282
									5	125-152	298
									6	152-177	498
									7	177-201	444
									8	201-226	177
C03	2							3957	D	0-230	
		61 °	59.87	° S	61 °	59.95	° S		1	25-50	292
		109 °	59.99	° E	109 °	59.90	° E		2	50-77	295
									3	77-102	390
									4	102-125	485
									5	125-151	462
									6	151-175	467
									7	175-201	138
BB1	3							2570	8	201-225	126
									D	0-230	
		64 °	47.15	° S	64 °	47.58	° S		1	0-40	680
BB2	4	109 °	55.56	° E	110 °	0.85	° E		2	40-50	637
									D	0-51	
		64 °	0.45	° S	63 °	57.90	° S		1	0-40	2656
A06	5	106 °	29.73	° E	106 °	28.86	° E		2	40-46	182
									D	0-46	
		63 °	0.38	° S	62 °	58.54	° S		1	0-230-0	5658
		108 °	42.99	° E	108 °	48.07	° E				

^aShip mean time = UTC + 8 h^bMesh size, 335 µm; D, down-tow

Table 2. Sampling data of a MOHT along the 110°E transect in the Southern Ocean in January 2015.

Stn.	Tow	Position		Date(yyyy/mm/dd) & Time (UTC) ^a		Bottom depth (m)	Net No. ^b	Sampling depth interval (m)	Volume filtered (m ³)
		Start	Finish	Start	Finish				
C02	3	61 ° 18.20 ' S	61 ° 23.00 ' S	2015/01/19 08:09	2015/01/19 10:06	4233	1	0-50	9132
		109 ° 59.30 ' E	109 ° 58.40 ' E				2	50-100	9605
							3	100-150	8698
							4	150-200	6248
C07	4	64 ° 0.80 ' S	64 ° 9.30 ' S	2015/01/22 04:36	2015/01/22 07:45	3337	1	0-50	22257
		110 ° 0.00 ' E	110 ° 2.90 ' E				2	50-100	11394
							3	100-200	13528
							4	200-400	16494
B02	5	64 ° 46.20 ' S	64 ° 43.95 ' S	2015/01/23 20:02	2015/01/23 23:05	2739-3013	1	0-50	26258
		108 ° 29.80 ' E	108 ° 8.25 ' E				2	50-100	13055
							3	100-200	15341
							4	200-400	15736
B03	6	64 ° 32.00 ' S	64 ° 23.80 ' S	2015/01/24 06:40	2015/01/24 09:43	3160	1	0-50	23695
		107 ° 34.90 ' E	107 ° 22.20 ' E				2	50-100	19295
							3	100-200	17943
							4	200-400	19639
C05	8	62 ° 57.60 ' S	62 ° 49.30 ' S	2015/01/28 01:23	2015/01/28 04:33	3778-3850	1	0-50	14692
		109 ° 58.00 ' E	109 ° 53.60 ' E				2	50-100	9956
							3	100-200	14001
							4	200-400	15868
C03	9	62 ° 3.10 ' S	61 ° 57.70 ' S	2015/01/28 09:38	2015/01/28 12:50	3991-4008	1	0-50	15548
		109 ° 52.80 ' E	110 ° 7.40 ' E				2	50-100	13622
							3	100-200	12637
							4	200-400	13895

^aShip mean time = UTC + 8 h^bMesh size, 1.59 mm