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Cruise report of R / V Kaiyo KYl0-03 cruise.

Research Theme: Construction and improvement of Seafloor observation Network for Earthquakes and Tsunamis

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Research area: Kumano-nada

Cruise period: Feb. 20/2010 (Yokosuka JAMSTEC) - Feb 26 (Mikawa-bay) - Mar. 4 (Yokosuka JAMSTEC)

1. Background and Objectives

Research project of earthquake and tsunami, disaster prevention, JAMSTEC has been conducting development of monitoring system for earthquake and tsunamis since 2006 under a contracted research program from MEXT, "Development of monitoring system of earthquake and tsunami". The development consists from development of network system that can deploy seismometers and tsunami sensors densely in offshore Kii Peninsula (Figure 1), where large earthquake occurs in an interval of 100-150 years. We developed a network system consisting from a backbone cable, nodes, sensors, and extension cables. The backbone cable is a loop of approximately 250 km fiber optic cable both ends landed at land station in Furue-cho, Owase-city of Mie prefecture. The backbone cable has five termination units where we can connect a node that distributes power and data communication to sensors Searfloor sensors, 20 of which are distributed in and around the rupture zone of Tonankai Earthquake offshore Kii Peninsula, are connected to the backbone cable via a node, which distributes power and data to each seafloor sensors. The sensors, consists from a set of seismometers, pressure gauges, and a thermometer. Seismometers are buried in the seabed to improve its coupling to the ground motion and escape from influences caused by seafloor water motion.

The backbone cable was laid out by a commercial cable laying ship in January to March, 2010. Installation of nodes and sensors are conducted by JAMSTEC's RIV Natsushima with remotely operated vehicle (ROV) Hyper Dolphin. Seismic sensors are buried into the seabed. We need to have a shallow hole in the seafloor to bury the seismic sensor by ROV. Perforating seafloor shallow hole is planned by two steps, installing a caisson with a root using gravity corer, and sweeping mud which is enclosed in the caisson using a hydraulic pump with ROV Hyper Dolphin. The purpose of this cruise is to conduct the former half operations to perforate seafloor hole; installation of caissons using gravity corer.

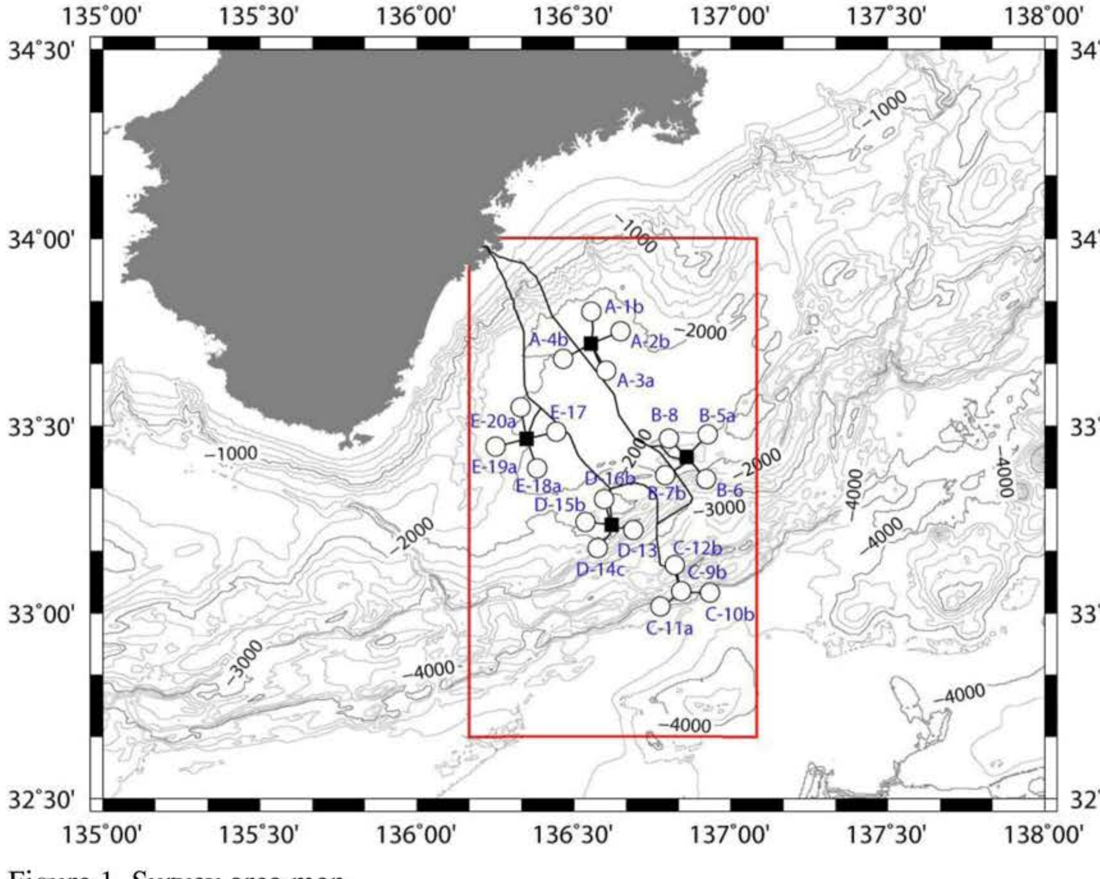

Figure 1. Survey area map.

2. Methods

2.1 Seafloor casing installation by gravity corer.

Perforation of seafloor and installation of seafloor casing for seismometer installation was performed by a gravity corer which can release a caisson attached to the end of corer. Figure 2 illustrates the gravity corer we used. The corer is lowered to the seafloor using #5 winch of R/V Kaiyo. When approached near the seafloor, after checking location using SSBL of the position of the corer from acoustic transponder located 50 m above the corer, the corer is further lowered to the seafloor until the pilot corer touch the seafloor and the corer weight and caisson free fall to penetrate seafloor. Penetration status of seafloor casing is confirmed by seafloor sensor and tiltmeter. Status of these sensors can be monitored by the response of the acoustic release transponder when called. Acoustic command to the acoustic release from R/V Kaiyo releases the casing while the inner pipe and core sample is recovered with the corer.

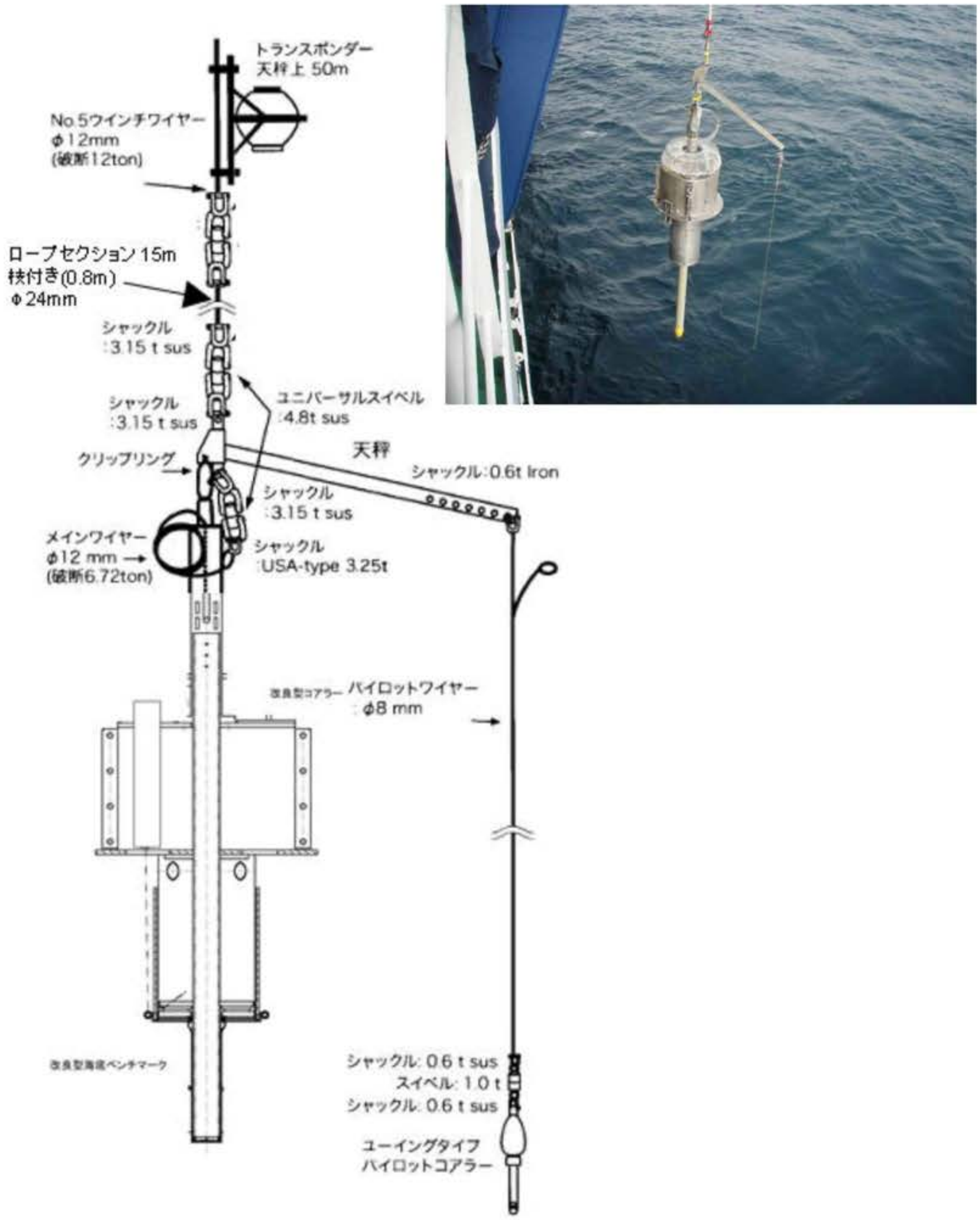

Figure 2. Casing installing piston corer.

2,2 Seafloor survey and route clearance by “Deep Tow”

Based on the past seafloor survey results, detailed seafloor visual survey along the extension cable route between observation nodes and observatories was planned. The seafloor cable route survey was planned to use “Deep Tow” with a cutter attached near the bottom of the towing cable (Figure 3) in case obstacles such as a floating ropes was in the course of the extension cable route. It was planned to try to recover obstacles in such a case in order to improve safety along the cable route. The procedure of recovery of obstacle is according to that in YK07-E02 R/V Yokosuka JAMSTEC cruise.

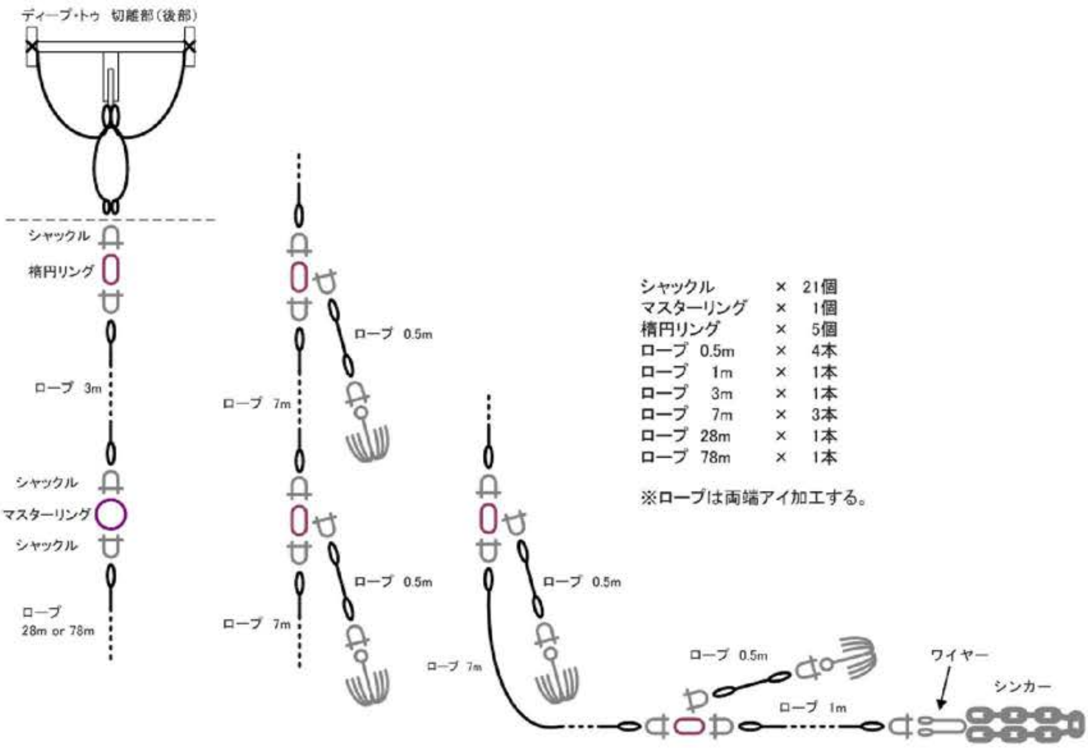

Figure 3. Towing system plan

3. Operation and results

3.1 Seafloor casing installations

Seafloor casing installation using gravity corer in areas of Node A and E were attempted from Feb. 21 to Feb. 24. Three coring run were conducted each day except for Feb. 24. In the earlier run in Feb. 21, weight balance of the gravity corer when the end of casing reached to the seafloor, were not very good. This resulted in tilt of the installed casing over 10 degrees. In such run, we didn’t release casing from the corer and recovered the casing with gravity corer on deck. There were also runs such that the gravity corer weight didn’t reach to the seafloor. These indicate that casing is not completely buried in the seafloor, or seafloor is tilted so that seafloor sensor didn't turn on at the point of the sensor. In these cases, we recovered corer without releasing the casing. There were two cases (at A1 and E20) that casing was installed in the seabed due to break of wire connecting release and casing, although we tried to recover the casing.

Operation of casing installation is summarized in Table 1, showing location of the corer by transponder location from SSBL acoustic navigation, and tilt of installed casing.

location	target depth	Homer ID	deployment time (JST)	release	location by acoustic		corer tilt		coring		remarks
					latitude	longitude	X(°)	Y(°)	sample#	penetration	
near A-3a	2,063m	65	2010/02/21 08:29	No	33-38.9005'N	136-36.2227'E	-7.3	-21.1	GC01	2.650m	
near A-3a	2,063m	65	2010/02/21 12:43	No	33-38.9037'N	136-36.2291'E	-5.1	-18.1	GC02	2.500m	
near A-3a	2,063m	65	2010/02/21 16:40	Yes	33-38.9044'N	136-36.2274'E	1.2	-7.4	GC03	2.300m	
A-2b	2,009m	92	2010/02/22 08:04	Yes	33-45.1605'N	136-38.9348'E	-1.2	-2.7	GC04	2.500m	
A-1b	2,036m	10	2010/02/22 11:26	No	33-48.2974'N	136-33.4334'E	-3.5	3.4	GC05	-	casing deployed in the seafloor during recovery.
A-4b	1,991m	24	2010/02/22 15:12	Yes	33-40.6773'N	136-28.0368'E	-9.4	-4.9	GC06	2.000m	
E-20a	1,961m	69	2010/02/23 07:57	No	33-33.0249'N	136-19.8626'E	1.2	-3.6	GC07	-	casing deployed in the seafloor during recovery.
E-17	2,053m	98	2010/02/23 11:49	No	33-29.0913'N	136-26.6996'E	-23.5	-11.6	GC08	2.200m	
E-17	2,053m	98	2010/02/23 15:13	No	33-29.0957'N	136-26.7181'E	-13.7	4.2	GC09	2.050m	
E-17	2,053m	98	2010/02/24 08:00	Yes	33-29.0791'N	136-26.6983'E	-5.6	-1.5	GC10	-	

Table 1. Casing installation operation summary.

3.2 Seafloor survey and route clearance by "Deep Tow".

During the second period of KY10-03 cruise, we carried out only the free fall of the optical cable due to the bad weather. We considered that 4500 meters water depth was a free fall location initially, but we could not approach there. This is why 2000 meters free fall was carried out. The track of Kaiyo and the transponder are simultaneously represented in Fig. 4. Figure 5 and Figure 6 show chain block and transponder using for optical cable free fall.

Throughout the cruise, because stormy weather continued, e.g., forecasting of wave and wind on 4 March in Fig.7, Kumano-nada area was no good condition to do "Deep Tow" survey. Hence we could do no "Deep Tow" survey for DONET construction during KY10-03 cruise.

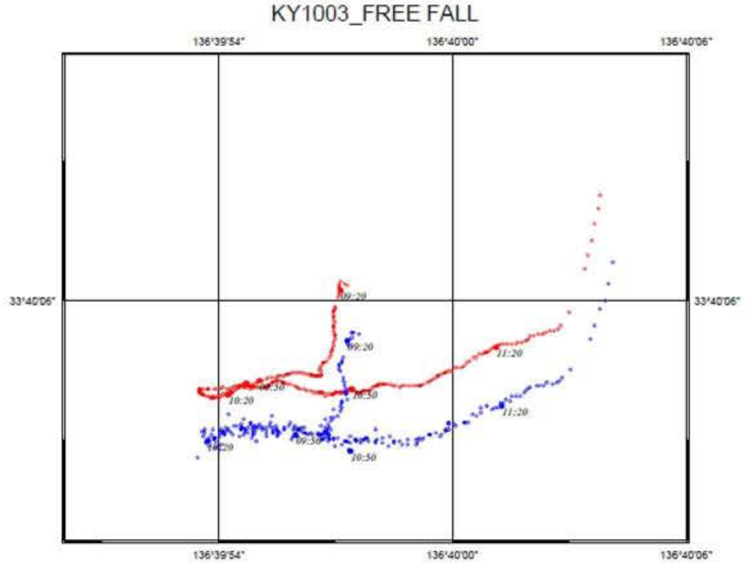

Fig. 4 Track of Kaiyo (red dots) and tranponder (Blue dots) during the optical cable free fall.

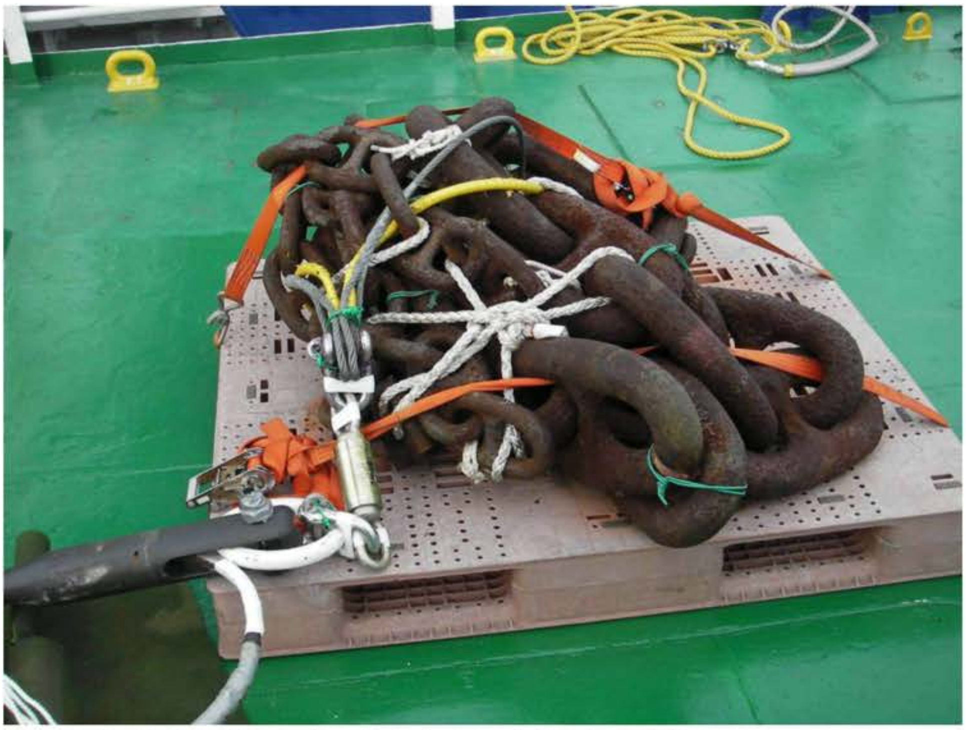

Fig. 5. Optical cable end and chain block for free fall

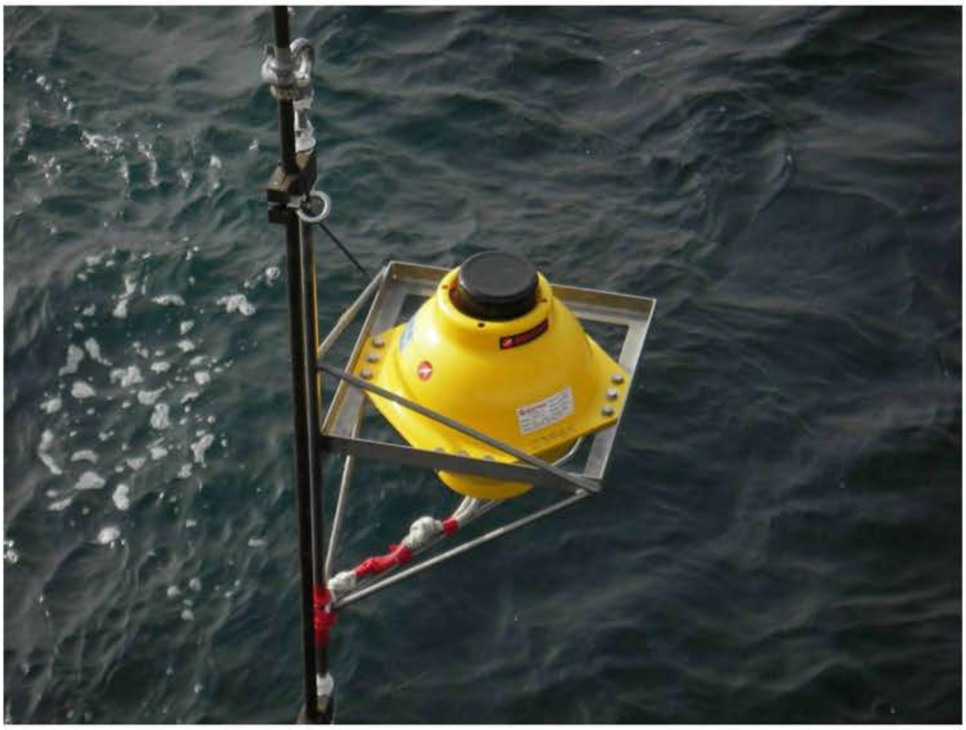

Fig. 6. Transponder attached with the optical cable

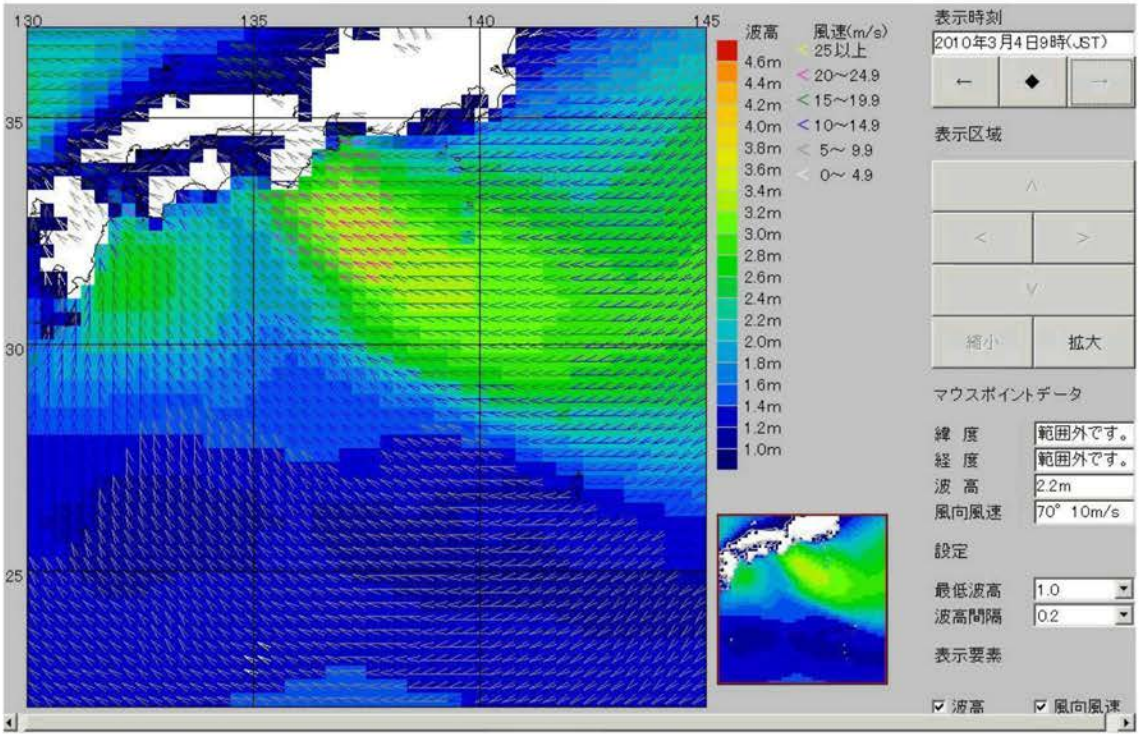

Fig. 7. Forecast of wave and wind on 4 March

4. Conclusions

During KY10-03 cruise, we conducted 10 gravity coring operation to install seafloor casing for seismic sensor installation in the Kumano area of the Nankai Trough. Among these coring shots, we successfully installed seafloor casing in 4 shots. We also installed two seafloor casings unintended due to excess stress applied on the connecting wire between the casing and the corer. These installed seafloor casings will be utilized to house buried ocean bottom seismic sensor for DONET.

Latter half leg of KY10-03 cruise suffered from rough sea condition. There were no seafloor survey operation conducted as planned, but free fall cable of "Deep Tow" was conducted for keeping condition of the "Deep Tow".