Submission date 2011/8/29

Cruise Summary

Cruise Information

- Cruise ID / Name of vessel: KY11-10 / R/V Kaiyo
- Title of the cruise: Field tests of a new buoyancy engine for a virtual mooring shuttle and a deep profiling float in Sagami-Bay
- Chief scientist: Taiyo KOBAYASHI / JAMSTEC
- Onboard scientists: Kenichi ASAKAWA / JAMSTEC
  Kenichi AMAIKE† / JAMSTEC
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- Representative of the Science Party: Taiyo KOBAYASHI / JAMSTEC
- Cruise period: 6 days (from August 9, 2011 to August 14, 2011)
- Ports of call: from JAMSTEC Yokosuka to JAMSTEC Yokosuka
- Research area: Sagami-Bay

Overview of the Observation

● Purpose of the cruise

In the cruise we indented to carry out field tests of a new buoyancy engine for autonomous devises for deep ocean observation such as virtual mooring (VM) shuttles and deep profiling floats, both of which have been developed at JAMSTEC. Basic functions of the devises, such as bidirectional communication with Iridium system, location fixing by Global Positioning System (GPS), and measurements with a Conductivity-Temperature-Depth (CTD) sensor, were also examined.

● Details of the field tests

(1) Location fixing by GPS
Examine the accuracy of position data fixed by GPS on a demonstrator of the buoyancy engine for VM shuttles at the sea surface.

(2) Communication with Iridium system
Verify the stable bidirectional communications (data transmissions) between the autonomous devises on the sea surface and the stations on land.

(3) Control of vertical movements in sallower depth for the demonstrator of the buoyancy engine for VM shuttles

Verify the stable control of the buoyancy engine in shallower depth by using the VM demonstrator. The demonstrator, which is tied to surface drifting GPS buoys by a 1000m-long fishing line, dives once to the depth of up to 500m in the test.

(4) Control of vertical movements in deeper depth for the demonstrator of the buoyancy engine for VM shuttles

Verify the stable control of the buoyancy engine in deeper depth by using the VM demonstrator. The demonstrator dives once to the depth of up to 1500m in the test. The test will be carried out only when the above experiment (3) is done well.

(5) Long-term control of vertical movements in sallower depth for a prototype of deep profiling floats

Examine the control sequence of vertical movements for the buoyancy engine by using a prototype of deep profiling floats. The prototype continues the observing cycles for as long a period as possible and the maximum descending depth is set at up to 500m. The prototype is tied to surface drifting GPS buoys by a 1000m-long fishing line.

● Results of the field tests

In the cruise we cancelled the above test (4). The test (5) was carried out three times for the periods of up to 22 hours and the whole drifting system was recovered next early morning. Because …

1. Surface drifting GPS buoy, which is necessary for the tests (3) and (5), did not work well on deck initially. Thus, we repaired the GPS buoy by replacement of its antenna and modem with those of the VM demonstrator.
2. The drifting system could not stay within the test field for longer time than about 1 day due to more rapid currents than expected.
3. It became difficult to continue the long-term test (5) and conduct deploy/recovery operations of the drifting system during daytime in the layer half of the cruise period, which fell on the Bon holiday period, due to appearance of many fishery's boats and yachts in the test field.

Test (1) and (2)

Both tests by using the VM demonstrator were carried out on 9th August. The performance was verified well. However, it was verified that the GPS function of the GPS buoy did not work well. After the test (3) for the VM demonstrator on 10th, its Iridium/GPS antenna and modem were moved into the GPS buoy and then the GPS function of the buoy was recovered.

Test (3)

The test was carried out in the daytime on 10th August under eye's monitoring the surface buoys. The VM demonstrator was waken up at 8:25 and deployed at 8:55. The deployment of the whole drifting system was completed at 9:35. The first profile data from the demonstrator was transmitted at 14:25. After the verification of the float operation change into surface drifting (or the success of the command transmission from land to the demonstrator), a recovery operation of the drifting system was started at 15:00 and completed at 16:10. The test results were as well as expected.

Test (5)

First deployment on 11-12th August: The prototype of deep float was waked up at 9:00 on 11th August and deployed at the sea surface at 9:10. The deployment of the whole drifting system was completed at 9:42. The profile data of the first and second ascends were received from the prototype at 15:46 and 23:30. The recovery of the drifting system was started at 5:55 and completed at 6:50 on 12th August. The period of the test was 21 hours 50 minutes and the test was ended when the prototype was operating in the third ascending. The results were well.

Second deployment on 12-13th August: The prototype was waked up at 11:59 on 12th August and deployed at the sea surface at 12:05. The deployment of the whole drifting system was completed at 12:26. The profile data of the first and second ascends were received from the prototype at 17:02 and at 00:13 on 13th. The recovery of the drifting system was started at 5:55 and completed at 6:40 on 13th August. The period of the test was 18 hours 41 minutes and the test was ended when the prototype was operating in the third ascending. The results were well.

Third deployment on 13-14th August: The prototype of deep float was waked up at 11:00 on 13th August and deployed at the sea surface at 11:05. The deployment of the whole drifting system was completed at 11:35. The profile data of the first and second ascends were received from the prototype at 17:30 and 23:30. The recovery of the drifting system was started at 5:55 and completed at 6:35 on 14th August. The period of the test was 19 hours 35 minutes and the test was ended when the prototype was operating in the third ascending. The results were well.

● Summary of the tests

At the test (5) the drifting system was extended very long and the prototype of deep floats was considered to be always pulled strongly by the line toward the buoys on the sea surface. It is probably derived from the fact(s) that the prototype in the sea was drifted faster due to (tidal) currents there and (/or) that the surface drifting buoys were blown strongly because of their large bodies. Thus, the prototype descended to shallower depths than the expected from the parameters set for the tests except for the first dive at the third trial. However, a self-learning function of its operating program seemed to work well since it dived deeper descend by descend to approach at the target depth.

By the field tests in the cruise we became sure that the operating program of the new buoyancy engine for the autonomous devices can work as well as it was expected. Thus, we are going to step to the next field test in the deep ocean confidently after some defects found here will be improved.