GNSS-R time series on the D/V Chikyu

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(1) Objectives

The sea surface height (SSH) variations are one of the most fundamental variables for physical oceanography, but their measurements in open ocean are limited to sparse points along subsatellite tracks of satellite altimeters. In this measurements, the SSH variations at the drilling site C002 and C0024 during the IODP Expedition 358 were designed to be measured by combination of Global Navigation Satellite System (GNSS) and GNSS Reflectometry (GNSS-R) methods.

(2) Instruments and methods

The heights of the antennas on D/V Chikyu (Figure 1) are obtained by post-processed kinematic GNSS. The vertical distance between the antenna and the sea surface can be geometrically estimated from the excess path length of the GNSS signal reflected at the sea surface with respect to the direct GNSS path (GNSS-R method). By subtracting the latter from the former, SSH is determined.

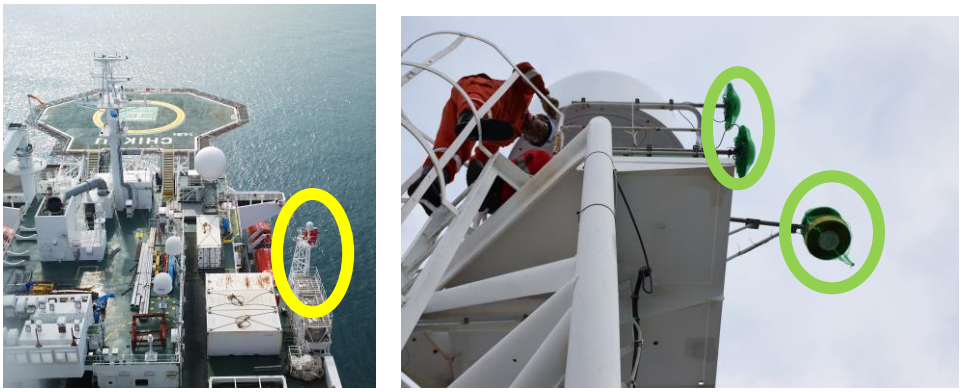

Figure 1 The Irridium antenna tower on D/V Chikyu (yellow circle; left panel) and two pairs of GNSS antennas on the tower (left).

In the present measurements, two different GNSS-R methods are examined. One is to measure the temporal delay of the reflected GNSS signals with respect to the direct signals. This method requires a set of an upward right-handed circular polarization (RHCP) antenna (Hemisphere A45)

and a downward left-handed circular polarization antenna (Leica AR20 LHCP), each of which receives the direct and reflected GNSS signals, respectively. These signals are recorded by geodetic receivers (Hitz NetSurv RE) and recorded using ublox M8T receivers.

Figure 2 The upward RHCP antenna and Downward LHCP antenna (left). Two horizontally-settled RHCP antennas (right).

(3) Resutls

All data were recorded at 1 Hz rate since 2018/10/05. Unfortunately, the data loggers for the upward and downward antennas were accidentally stopped on 2018/10/19. In addition, received power level of the downward antenna was generally so low that only a few satellites per epoch were recorded.

Data of the side-looking antennas were recorded until 2019/04/05, but their quality is quite low since the antenna gains were low. Especially, accuired data from the lower antenna were too noisy to obtain significant signals.

(4) Data archive

These obtained data will be submitted to JAMSTEC Data Manager Group (DMG), although their data quality is not good except the upward RHCP GNSS data during a period from 2018/10/05 to 2018/10/19. The data files for the upward and downward antennas (Upward.zip, Downward.zip, respectively) are in RINEX 3.02 format. The data files for the side-looking antennas (SideTop.zip and SideBottom.zip) are in the ublox binary format which can be read by a program called u-center (https://www.u-blox.com/ja/product/u-center).

(5) References

Ichikawa, K., T. Ebinuma, M. Konda and K. Yufu (2019); Low-Cost GNSS-R Altimetry on a UAV for Water-Level Measurements at Arbitrary Times and Locations, *Sensors*, 19, 998, doi:10.3390/s19050998.