Multi-parametric observation for assessing activity of Nishinoshima volcano

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Nishinoshima started eruptive activity in November, 2013, and a new island is created. Few observation data are available to assess the eruptive activity at such a remote island. This study is intended to get more information of the volcanic activity at Nishinoshima and to develop methods for monitoring remote island volcanoes. We conducted continuous recordings of infrasound at the nearest accessible island and of seismic waves with OBSs around Nishinoshima. We also took movies and infrasonic data during the installation of the OBSs. Here we report the results.
Observation:
The continuous infrasonic observation is conducted at Chichijima island about 130 km east of Nishinoshima. An infrasonic array has been operated offline since April 26, 2014, and another online station was added on October 5, 2014. An automatic analysis is run once a day to detect infrasound from Nishinoshima using data from the online infrasonic station and a nearby seismic station operated by JMA. The offline array data is used for more detailed analyses. Ray-tracing for infrasound propagation from Nishinoshima to the stations is conducted using the atmospheric data measured at Chichijima observatory of JMA. The result is used to evaluate the atmospheric effect.
Five OBSs were installed around Nishinoshima on February 27-28, 2015, during the KR15-03 cruise of R/V KAIREI (JAMSTEC), and retrieved on October 3-4 during the KS15-07 cruise of R/V KEIFU (JMA). The first OBS station (NI11) was installed about 13 km to the south-east of Nishinoshima. Then in the afternoon of February 27, the boat stayed to the east of Nishinoshima in the distance about 6 km, and the movies and infrasonic data were recorded. The other 4 OBS stations (NI21-NI51) were installed afterward around Nishinoshima in the distance about 7 km.
Results:
The movies are compared with the infrasonic data recorded on the boat and the seismic data recorded at NI11. The times of the infrasonic and seismic data are shifted forward considering the propagation time. The signals associated with eruptions are clear in the 1-7 Hz band of the infrasound and in the 4-8 Hz band in the seismic data. The movies show that ash emission occurs intermittently with a cluster of successive small explosions. The individual explosions generate impulsive infrasound and a spindle-shape seismic wave packet is observed associated with the ash emission.
The continuous data of the five OBSs from February 28 to October 3, is used to analyze the spindle-shape wave packets. The epicenters are estimated using the travel time differences for 15 events that occurred on February 28, and are determined around Nishinoshima. Such events are automatically detected by the STA/LTA method, and 363367 events are counted in the period. The occurrence changes in the mid July: the daily number starts decreasing and the duration of an event starts increasing. The maximum amplitude in an hour is small in March, grows from April to May, and then decreases. It seems growing again after the mid July.
The ray-tracing calculation shows that the atmospheric structure is good for the infrasound propagation only until the beginning of April, 2015. Few rays reach the station after June, and the change in mid July is not detectable, if any. In the latter half of May, there are some days when the atmospheric conditions allow the infrasound propagation to the station, but no signal is

detected. According to the OBS observation, Nishinoshima is seismically active in the period, as mentioned above.
The remote infrasonic observation can provide us with some information of the volcanic activity, but the atmospheric conditions do not always allow infrasound to reach the station from the volcano. Observation with OBSs installed close to the volcano is important. If we can at least obtain the results of such event analyses as presented above, the OBS observation would make a useful monitoring method.

Keywords: Volcano, Monitoring, Infrasound, OBS

