Extraction of topographic changes associated with the 2018 eruption and tsunami of Krakatau volcano using time-series SAR

*Daiki Inano[1], Hodaka Okazaki[1], Masanobu Shimada[1]

1. Tokyo Denki University

Synthetic aperture radar (SAR) has the advantage of being able to observe over a wide area without being affected by the weather or day and night. Because SAR passes through clouds and smoke, changes in the island immediately after the eruption can be clearly seen even if the eruptions and volcanic ash erupt from the crater. Then, in order to classify land and sea from the images observed by SAR, consider the definition of land and sea. The land area is a place where the altitude is 0 m or more, and the scattered signal is generally larger than that of the sea area. On the other hand, the sea area is a zone where the altitude is 0 meters, and the reflected signal is generally small. Since the signal in the land area is larger than that in the sea area, it appears bright in the amplitude image.

In this study, we used the time-series SAR data to extract changes in island area for topographic changes associated with the eruption of Anak Krakatau Island in 2018. We analyzed the image data from January 22, 2018 to May 21, 2019, and calculated the area change by two methods for three scenes in which the terrain changed significantly.

The first is a histogram method. From the amplitude image, histograms of the land area and the sea area are created, and an optimum threshold at which both distribution functions intersect is determined. Then, the area where the backscattering coefficient was larger than the sea was defined as land, and the area was calculated by multiplying the number of pixels in the land area by the image cell size. This method works with high accuracy when the island is clearly brighter than the sea. However, when the sea surface is rough and the scattering coefficient is high as in this study, it may be difficult to make clear identification.

The second is a shoreline extraction method. The pixel value of the amplitude image is forcibly set to 0 based on the threshold value obtained by the histogram method. Then, the coastline displayed brightly is extracted (manual operation), and the inside of the extracted closed curve is included in the land area. Similar to the histogram method, the number of land pixels was multiplied by the image cell size. The shoreline extraction method is considered to be a method that can calculate the area with higher accuracy than the histogram method without being affected by backscatter on the sea.

As a result, the area of Anak Krakatau Island was 2.88 square kilometer before the eruption, 3.07 square kilometer after the eruption, and 3.06 square kilometer several months after the eruption. As for the amount of change, the island area increased by 0.18 square kilometer before and several months after the eruption. It is said that it is difficult to analyze an island surrounded by the sea on all sides using the interferometric SAR method. The method in this study is considered to be very effective in the area where the coastline is clear even in the analysis of such islands.

