

Extraction of coastal forest damage by the 2011 Tohoku Earthquake

Shimpei Inoue¹ and Chinatsu Yonezawa¹

¹*Graduate School of Agricultural Science, Tohoku University, Sendai, JAPAN
1-1 Amamiya-machi, Tsutsumidori, Aoba-ku, Sendai, Miyagi 981-8555, JAPAN,
b2am1111@s.tohoku.ac.jp*

Abstract: The coastal forest of the northeast region of Japan's Honshu island was seriously damaged by the tsunami caused by the 11 March 2011 Tohoku Earthquake. Fallen trees, washing away, and inundation caused by direct impact of the tsunami were confirmed immediately after the earthquake. Furthermore, additional tsunami impacts on the trees have emerged, over time, such as 'Akagare', a phenomenon where plant leaves turn reddish brown and wither away. In this study, we examined the possibility of identifying the damage level of the coastal forest using middle spatial resolution satellite data ALOS/AVNIR-2 and TERRA/ASTER. Two types of damage, direct damage immediately after the tsunami and 'Akagare' damage that progress after the tsunami, were investigated.

A coastal area of Sendai located in north eastern Japan, was selected as the investigation area. A coastal forest widely extended in the area before the disaster. The majority of the coastal forest trees were *Pinus*.

Unsupervised classification was applied to the dataset including original data of the AVNIR-2 4 bands and that of the computed NDVI band to extract direct tsunami damage immediately after the tsunami. Four categories of damaged coastal forest were identified from unsupervised classification: remaining undamaged trees; remaining but fallen trees; removed trees and inundated land; and removed trees with the land left bare. The overall accuracy was 79.50 %, with Kappa statistics of 0.6387.

To extract 'Akagare' damage, NDVI of the three ASTER/VNIR data obtained after the tsunami on 19 March 2011, 9 June 2011, and 23 November 2011 were analyzed. As a result, a relationship between the decrease in NDVI and the damage by 'Akagare' is revealed. 'Akagare' damage was found on 9 June and it has since expanded. The 'Akagare' damage was serious in the areas near the sea. But, it is difficult to detect the distribution of damage in detail at an independent tree scale because of the mixel problem. However, in the case of a large-scale disaster like the 2011 Tohoku Earthquake, it is necessary to estimate the damage of a wide area quickly. We also analyze

ASTER/VNIR data obtained on 2012 to extraction the recovery process from 'Akagare' damage. We conclude it is valuable to detect the damage distribution of coastal forest immediately after the disaster and the progressive damage after the disaster.

Keywords: ASTER, ALOS/AVNIR-2, tsunami, coastal forest, NDVI