

## Phase shift observed over a forest stand with PALSAR-2 SAR interferometry in Hakone

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Volcanic activity has increased in Owakudani Park, Hakone, Japan, since April 26, 2015, including a small eruption that occurred on May 29. Several Phased Array type L-band Synthetic Aperture Radar-2 (PALSAR-2) observations were conducted to detect crustal movement near the crater area. A phase shift of about  $90^\circ$  over a Japanese cedar forest stand located near Owakudani Park was clearly observed for the interferometric pair on March 1 and May 10, 2015. However, no clear phase shift was observed for the adjacent broadleaf forest stand. Except for the pair, no clear phase shift was observed over the forest stands.

Watanabe et al. [1] used L-band Synthetic Aperture Radar (SAR) to determine that the dielectric constant corresponding to moisture in a tree trunk often increases after rainfall and induces  $\sigma_0$  increase. Rainfall of 10.5 mm/h was observed 6 h prior to the observation on March 1, which may have affected the ground phase beneath the cedar forest stands.

A model describing the phase delay due to water vapor in the atmosphere [2] is introduced in the present study to describe the phase delay due to the moisture change in a forest layer. It is indicated that the estimated phase shift due to the moisture variation of trees is  $109^\circ$  assuming a 20% refractive index variation, which was actually observed in trees in Tsukuba and Tomakomai. This result implies that the possible cause of the phase shift observed over the Japanese cedar forest stand was caused by moisture change in the forest layer after the strong rainfall.

[1] M. Watanabe, T. Motohka, T. Shiraishi, R. B. Thapa, C. Yonezawa, K. Nakamura, and M. Shimada, "Multi-temporal Fluctuations in L-band Backscatter from a Japanese Forest", IEEE Trans. Geosci. Remote Sensing, 53(11), 5799-5813, 2015

[2] M. Shimada, "Correction of the satellite's state vector and the atmospheric excess path delay in the SAR Interferometry—An application to surface deformation detection," J. Geodetic Soc. Japan, 45(4), 327-346, 1999

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