

## Comparison between Liquefaction Area Associated with the 2011 Tohoku earthquake and Interferometric SAR Coherence Change

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**Preface:** In this study, we demonstrate that reductions of coherence values, which obtained from interferometric analyses using SAR data acquired before and after the occurrence of liquefaction, have good spatial correlations with the liquefaction area investigated from field surveys. Associated with the 2011 Tohoku earthquake, liquefaction occurred in Kanto District, mainly in Chiba and Ibaraki prefectures. After liquefaction occurred, serious ground surface changes due to sand boiling etc. are expected to culminate in significant coherence reduction. So far, there have been some reports in which incoherent phase areas in an interferogram have been regarded as liquefaction area. However, it is not necessarily appropriate that the incoherence in an interferogram is used as an indicator of liquefaction area, because the incoherent area does not necessarily reflect the liquefaction in the case that the scattering condition easily varies owing to inherent bad ground condition (e.g., arable land). Thus, in this study, we attempt to make use of a reduction of coherence value as an indicator of identification of liquefaction area. This is why it is presumably expected that coherence values largely decrease associated with serious ground condition changes due to liquefaction and for inherent bad ground condition area there is no significant coherence change.

**Analysis procedure:** To identify the liquefaction area, we generate a differential image of two coherence images. One coherence image is obtained from an interferometric analysis using SAR data acquired before the 2011 Tohoku earthquake, and the other is from SAR data before and after the earthquake. We here subtract the coherence values of the former image from those of the latter one. We compare the liquefaction areas to the areas where the coherence values decrease. Our studied areas are around the lower Tonegawa River and along Tokyo Bay, where serious liquefaction occurred associated with the 2011 Tohoku earthquake. For the analysis, we use ALOS/PALSAR data acquired on December 28, 2010, February 2, 2011 and March 20, 2011 for the lower Tonegawa River (path 404) and January 4, 2011, February 19, 2011 and April 6, 2011 for Tokyo Bay (path 405).

**Result:** We find good spatial correlations between the area showing decrease of coherence values and the liquefaction area for both the studied areas. For the lower Tonegawa River, in particular, significant reduction in coherence values can be recognized in Hinode District in Itako City, Sawara District in Katori City, and Nishishiro District in Inashiki City. Especially, we can recognize a high spatial correlation between the two in Hinode District where serious liquefaction in residential area has occurred. For Tokyo Bay, reduction of coherence values distributes along the coastal zone from the city of Urayasu to Narashino. In and around Urayasu City, the reduction of coherence values can be recognized in the coastal zone from metropolitan express way. However, in Tokyo Disney Land and in seaside zones of Minato, Takasu, Akemi, and Hinode Districts, there is no remarkable reduction on coherence. These features observed from the differential coherence image are consistent with the field survey results.

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