Estimation of co-seismic surface displacement and ground deformation associated with the 2018 Hokkaido Eastern Iburi Earthquake, based on differential InSAR and differential LiDAR DEM analysis.

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It is important to detect the damage situation of the building quickly when an earthquake occurs for the initial response. Satellite remote sensing can measure a wide area, and is expected to obtain the damage at the time of a disaster. However, the observation frequency of the satellite, the analysis processing time, selection of information required at the beginning are suggested as problems for practical use.
This paper introduces information which can be provided by Coherence Change Detection and differential LiDAR DEM analysis when an earthquake occurs. Especially, it will introduce the earthquakes which occurred in 2018, the 2018 Hokkaido Eastern Iburi Earthquake.
On 6 September 2018, an earthquake of magnitude 6.7 hit southern Hokkaido, which is the largest and northernmost prefecture of Japan. Interferometric analysis was carried out using images of Sentinel-1 before (August 25) and after (September 6) the earthquake to estimate the damage of the building due to the ground deformation and the deterioration of the coherence. In addition, the same analysis was carried out using the image of ALOS-2.
Figure shows an example of Kiyota Ward in Sapporo City where liquefaction occurred. In the interferometry image using Sentinel-1, deviation was discontinuous or shown as noise, so extraction of the deviation was difficult. However, the area which buildings were damaged could be extracted from the coherence change detection.
On the other hand, the degradation of coherence when using ALOS-2 is Low, so the damage area can be extracted from the deviation of the interferometry image as a ground deformation. This difference is thought to be due to the difference in the sensitivity of the observation wavelength band.
For comparison, the particle image velocimetry method was applied to calculate 3-D vectors of co-seismic deformation. The result shows deformation of the housing area, which was developed over the valley that was filled up with soil, agrees with SAR analysis result.
In this case, since Sentinel-1 observed the disaster area about 3 hours after the earthquake, the image was analyzed on the day and the results were provided to local staff. Field confirmation was carried out the day after the earthquake, and the results were provided to the affected local governments. Except for the day of the earthquake, the weather was bad for the disaster area for several days, so it was not possible to take aerial photos using the aircraft. 2018 Hokkaido Eastern Iburi Earthquake is a case where utilization of the satellite SAR, which can quickly extracts damaged area, became advantageous.
Obtaining disaster damage by satellite remote sensing is effective. However, field survey and aircraft surveillance are carried out as soon as the disaster occurred in Japan, and satellite remote sensing has not be practically used in many situations. However, similar to the 2018 Hokkaido Eastern Iburi Earthquake, if acquiring the satellite data and providing analysis results could be carried out quickly, satellite remote sensing can be an option for understanding the damage at early disaster response stage. Furthermore, estimation the light damaged area is difficult by aerial photographs, therefore estimation by SAR coherence change detection are considered importance.
Finally, I wish to express my deepest condolences to those who lost loved ones in these disasters, and also to express my sympathy to all who were affected.

Keywords: Earthquake, SAR, LiDAR