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## Assessment of deep learning based landslide detection and mapping performances with backscatter SAR data

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Multiple landslide events are one of the most critical natural hazards. Landslide occurrences have become more frequent in recent decades because of rapid urbanization and climate change, causing widespread failures throughout the world. Extreme landslide events can cause severe damages to both human lives and infrastructures. Hence, there is a growing need to intervene quickly in the impacted areas. Although a vast quantity of research have been carried out to address rapid mapping of landslides by employing optical Earth Observation (EO) data, various gaps and uncertainties are still present when dealing with optical images, since they present limitations due to weather-related issues such as cloud cover.

To address this issue, various combinations of composites of SAR backscatter data and state-of-art Deep Learning (DL) models are evaluated by analyzing and comparing object detection and image segmentation approaches. The study area lies in the eastern Iburi sub-prefecture in Hokkaido. At 03.08 local time (JST) on September 6, 2018, the area was hit by an Mw 6.6 earthquake that triggered about 8000 co-seismic landslides. The models' predictions are compared against an accurate landslide inventory obtained by manual mapping on pre- and post-event PlanetScope imagery, by using evaluation metrics. When dealing with object detection, a tri-temporal combination of SAR backscatter data yielded the best results (88% F1-score). Similarly, for the landslide segmentation, the best result was given by the augmented ascending tri-temporal SAR composite image and slope angle (61% F1-score). Results show that the landslide location is usually predicted correctly, while the landslide boundaries are often wrongly detected or may present dimension overestimation. Our findings demonstrate that the combination of SAR data and Deep Learning algorithms may help detect landslides quickly, even during storms and under deep cloud cover. For the chosen study area, the first suitable Sentinel-2 optical image was acquired more than a month after the earthquake event of September 6, 2018, while SAR data were readily available right after and before. However, further investigations and improvements are still needed, this being the first attempt in which the combination of SAR data and DL algorithms are employed for landslide detection and mapping purposes.

