A new method for landslide extraction using optical and SAR images

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Number of hazards dramatically increases in the world with global warming effects. For a decade from 1993 to 2002, 17% of fatality with various hazards is caused by landslides.
In recent years, some space agencies have released satellite data through their web pages in order to promote private use. With these datasets, we could understand surveillance of land surface motion risks. These supplies associated with satellite technology can open to study various hazards in any regions as developing countries, mountain regions, deserts and so on without a bunch of infrastructures.
Two acquisition systems by satellite technology can be used for the land surface motion analyses. One has an optical sensor detecting the sun light reflected from a ground surface. A NDVI value is one of the most useful tools that using optical satellite data to survey roughly a landslide activity. It is calculated with near infrared and visible red-light bands, and it can find vegetation area. If landslides occur in a research area, NDVI will decrease. Thus, we can see landslide activities using the NDVI values.
The other is a Synthetic Aperture Radar (SAR) system using a microwave. The microwave is transmitted from the satellite and the reflected wave from a ground surface is detected. SAR images are not affected by clouds because microwave passes through them.

In this paper, we discuss a new method to extract landslides efficiently using a combination of two acquisition systems; optical and SAR systems. Because of heavy rains and mountain region, there are many rain hazards and flush floods, and landslides in this district. We can use optical datasets at there, but most of them are widely covered with clouds, so that we need to confirm a new methodology.

We selected fifteen optical datasets without cloud covers from November 2016 to November 2019.
First, we examined the analyzed conditions using the optical datasets. The optical datasets should be generally controlled with shooting conditions as a sunlight direction, a sunlight intensity, a satellite direction and so on, so we chose three different conditions in the optical datasets. Therefore, we analyzed a small area being 2 km^2 or smaller in optical studies.
Second, we collected the SAR datasets in August 1^{st}, 4^{th}, 13^{th} and 16^{th} 2017 on the ESA website. We analyzed surface characteristics and topographical change using these datasets. Datasets of Augusts 1^{st} –13^{th} and August 4^{th} –16^{th} have descending and ascending orbit data, respectively. Land Cover Change Detection method and interferometric analysis were used to reveal the surface characteristics and topographical change, respectively.

As a result of calculation with the NDVI value (Expression; (NIR-R)/(NIR+R)), a vegetation field has higher number. With this value, we confirmed landslides that occurred in August 2017 using drone system from ground survey. As we follow the transition, we found a tendency of vegetation field/bare field percentage transition in the research area through years. The percentage rises in February to May, then it gradually decreases until next February. However, there are some rapid increases in the gradual decreasing period (from May to February). It might be affected by acquisition conditions because there is no apparent sign in an actual image. As a conclusion, it is hard to extract the change based on the effect of landslides.
As a result of SAR data analyzing, we found some surface characteristics and topography changes that occurred in the period. Some of them are on slopes and the others are between mountains. We can detect landslides within approximately 300 m diameter when they are assembled in a small region, but a

single landslide is not detected with the method. Most of landslides on slopes show both topography and surface characteristics changes but some of them demonstrate only topography change. There is an area that shows topography and surface characteristics changes even though it has no apparent change in the optical images through the period. These results need to be confirmed with ground survey. The result of Land Cover Change Detection shows the changes of landslides and artificial activities as same results. It is also necessary to confirm this result with ground survey or optical images.

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