EVALUATION OF LAND COVER CHANGES USING DCP VALIDATION DATA

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Abstract: Various research institutes have produced global land cover maps. The accuracy of the existing global land cover maps ranges from about 60% to over 80%. In addition, time-series global land cover maps such as CCI-LC and MCD12 have been developed. There is a possibility to extract information on land cover change from such time-series global land cover maps by taking the differences. The information on land cover change is important for environmental assessment and future prediction. However, since each land cover map contains errors and sub-pixel misregistrations from year to year, which leads error propagations, it is difficult to detect the true land cover change by taking the difference between two periods, and the frequency of land cover change becomes over or underestimated. Thus, although information on land cover change is important, a method to extract it over a wide area using remote sensing technology has not been established. There are several possible factors for this, one of which is the inadequate maintenance of land cover validation data at the global level. Therefore, it is necessary to create validation data that can evaluate the accuracy of land cover change. If validation data for time series are developed, it can be evaluated the accuracy of land cover maps, and in the future, highly accurate time series land cover maps will be possible to produce. However, such data sets are currently not sufficiently developed. The Degree Confluence Project (DCP) is a volunteered validation project started in 1994, which publishes ground photographs and related descriptions for integer latitudes and longitudes on the web. The total number of integer latitudes and longitudes visited so far is 7,186. Of these, 2,905 have been visited multiple times. These sites that have been visited multiple times may be able to see land cover change. DCP validation data has been used to evaluate the accuracy of global land cover maps, but has never been used to validate land cover change. Therefore, the objective of this study is to investigate the possibility of using DCP data to validate land cover change.

In this study, we used DCP points that existed for both the five years centered on 2005 and the five years centered on 2015. The land cover class of these points were visually interpreted by two people. We used only for points where the interpretation results of the two people matched. Eight land cover classes were defined: Forest, Grass/Shrub, Wetland, Cropland, Urban, Mosaic

of natural vegetation and cropland, Barren, and Water. During the visual interpretation, we used not only photographs and texts from the DCP, but also aerial photographs from Google Earth. In addition, if there was a change in land cover during each of the five years, those DCP sites were excluded. As a result, the number of DCP sites covered in this study was 600. We also created a transition matrix for the 600 DCPs to see which class they changed into which class. For the points that had changed, we again checked the photographs of DCPs and Google Earth to examine whether they had really changed.

Of the 600 DCPs for which land cover classes were visually interpreted independently, 37 points of land cover classes were changed. The most frequent pattern of change was from Cropland to Grass/Shrub (18 points). The second frequent change was from "Forest" to "Grassland/Shrub" (seven points). When we reconfirmed the DCP points using Google Earth and ground photographs, we found that there were points where the class had not actually changed due to visual blurring caused by misalignment, ambiguity in the definition of the class, and differences in the survey season. Only 15 points which is about 40% of the 37 points, were found to have actually changed. In terms of the pattern of change, the change from "Cropland" to "Grass/Shrub" had the highest rate of decrease, decreasing from 18 points to two points.

The DCP sites that were identified as having changes in the time series were examined in detail. In terms of countries, Brazil and Russia had four and three points, respectively, which are relatively high. In Brazil, the patterns were deforestation, afforestation, and change from bare land to natural vegetation, while in Russia, the patterns were deforestation, growth of natural vegetation, and conversion of agricultural land to abandoned land. Deforestation was also observed in Malaysia and Sweden. Urbanization were observed in Mongolia, Georgia, and China. In Italy, a change from sandy beaches to natural vegetation was observed. These results indicate that most of the land cover changes observed in the past 10 years are anthropogenic factors. Conversely, the time scale of land cover change as a natural phenomenon is probably larger than about 10 years.

From the results of this study, it is clear that the amount of land cover change differs between the cases where visual interpretations of land cover classes are conducted independently and the cases where visual interpretations are conducted as a set of time series for DCPs at the same latitude and longitude. In other words, in order to correctly extract land cover change in DCP validation data, it is necessary to also perform visual interpretation as a time series. The results of this study also indicate that it is difficult to determine Cropland and Grass/Shrub classes from only DCP photos. Therefore, to use DCP validation data for accuracy assessment of land cover change, it is necessary to ensure the quality of the validation data in combination with other information. In addition, in order to establish a validation database for land cover change, it is necessary to collect information on land cover change by conducting surveys preferentially, especially for sites that have been surveyed less than twice.

Keywords : Degree Confluence Project, time series change, validation dataset, global land cover map