An Automatic Land Cover Updating Algorithm Based on NDVI Downscaling and Object-oriented Change Detection

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Land cover mapping and continuous updating are of great significance to climate change and land resource management. Recently, China released the first 30-m global land cover product GlobeLand30 with two years (2000/2010). GlobeLand30 was produced by a pixel-, object- and knowledge-based (POK) information extraction strategy, which guarantees high accuracy and consistency globally. However, the POK method cannot allow an automatic and quick updating for this product, and the existing land cover updating method has a lot of problems, e.g. the pixel-based classification method is not suitable for the high resolution image, and the pseudo-changes remove method based on the pixel NDVI time series results in ‘salt and pepper’ phenomenon. Thus an effective and efficient land cover product updating method is urgently needed. To address these problems, this research aimed to automatically update GlobeLand30 at object scale with downscaling NDVI time series data.
The automatic updating method involves two main algorithms. (1) Land cover updating algorithm by integrating downscaled NDVI time series. This algorithm requires the land cover map at time T_1, Landsat images at time T_1 and T_2, and MODIS yearly NDVI time series data at two years. The MODIS NDVI time series data at 250m resolution was downscaled at 30m by NDVI-LMGM model (Rao et al., 2015, doi:10.3390/rs70607865). All pixels in the T_1 and T_2 Landsat images are selected as training samples individually corresponding to the land cover map at T_1, and then we get the posterior probability of pixels belonging to every class. Then change pixels are detected by change vector analysis in posterior probability (CVAPS). Finally, the changed pixels are removed from both training samples, and classification and the change detection repeatedly until the changed/unchanged pixels between two iterations are 99% consistent. (2) Land cover updating method based on object-oriented analysis. The Landsat images are firstly segmented and an optimal scale factor is determined by the method proposed by Yang et al. (2016, doi:10.1109/JSTARS.2016.2615073). The training sample selection, classification and change detection methods are the same as above.
We choose Beijing/Tianjin/Tangshan region as the study area, and used Landsat OLI data and MODIS NDVI data in 2013 to update the GlobeLand30 2010 product. Result shows that the new method eliminates ‘salt and pepper’ phenomenon, and the land cover update accuracy is 86.71%. Besides, the optimal scale segmentation can help obtain the highest land cover update accuracy than any single scale segmentation. The object-based NDVI time-series data can help to remove more than 90% pseudo-change caused by phonological difference and spectral confusion. The automatic updating method can help to produce new global land cover maps at 30m spatial resolution.

Keywords: Land Cover Update, Object-based, NDVI downscaling

