

Level Set Based Extraction and Update of Lake Contours Using Multi-Temporal Satellite Images

Authors : Yindi Zhao, Yun Zhang, Silu Xia, Lixin Wu

Abstract : The contours and areas of water surfaces, especially lakes, often change due to natural disasters and construction activities. It is an effective way to extract and update water contours from satellite images using image processing algorithms. However, to produce optimal water surface contours that are close to true boundaries is still a challenging task. This paper compares the performances of three different level set models, including the Chan-Vese (CV) model, the signed pressure force (SPF) model, and the region-scalable fitting (RSF) energy model for extracting lake contours. After experiment testing, it is indicated that the RSF model, in which a region-scalable fitting (RSF) energy functional is defined and incorporated into a variational level set formulation, is superior to CV and SPF, and it can get desirable contour lines when there are "holes" in the regions of waters, such as the islands in the lake. Therefore, the RSF model is applied to extracting lake contours from Landsat satellite images. Four temporal Landsat satellite images of the years of 2000, 2005, 2010, and 2014 are used in our study. All of them were acquired in May, with the same path/row (121/036) covering Xuzhou City, Jiangsu Province, China. Firstly, the near infrared (NIR) band is selected for water extraction. Image registration is conducted on NIR bands of different temporal images for information update, and linear stretching is also done in order to distinguish water from other land cover types. Then for the first temporal image acquired in 2000, lake contours are extracted via the RSF model with initialization of user-defined rectangles. Afterwards, using the lake contours extracted the previous temporal image as the initialized values, lake contours are updated for the current temporal image by means of the RSF model. Meanwhile, the changed and unchanged lakes are also detected. The results show that great changes have taken place in two lakes, i.e. Dalong Lake and Panan Lake, and RSF can actually extract and effectively update lake contours using multi-temporal satellite image.

Keywords : level set model, multi-temporal image, lake contour extraction, contour update

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