

Improving Bohai Sea Ice Detectability of MODIS Data Using Gray Level Co-occurrence Matrix Texture Analysis Method

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Abstract: The Bohai Sea is the most southern area in the northern hemisphere with sea ice in winter. Sea ice as a natural disaster in the Bohai Sea must be considered in offshore operations, ports, shipping, and marine fisheries. The monitoring of sea ice distribution and its spatiotemporal evolution plays an important role in maritime activities on the sea ice edge region. An effective methodology for Bohai sea ice detection based on gray level co-occurrence matrix (GLCM) texture analysis is proposed using MODIS 250m imagery. The method determines texture measures for sea ice extraction by analyzing the discrepancy of textural features between sea ice and sea water. Sea ice extent and outer edge are recognized accurately by texture segmentation owing to significant differences in texture statistical features between ice and water. The texture analysis method can properly eliminate perturbations on sea ice extraction due to suspended sediment. It effectively solves the problem of spectral confusion and sea ice misassignment in the conventional gray-threshold segmentation and ratio-threshold segmentation methods. The method eliminates the need for threshold range setting for sea ice segmentation. Taking the Bohai Sea as an example, the results of the proposed method are validated using co-temporal HJ1B-CCD 30m imagery by visual interpretation as well as accuracy evaluation based on confusion matrix. The MODIS sea ice detection results (including the ice extent and its outer edge) are in general spatially consistent with the sea ice distribution shown in HJ1B-CCD imagery. The results show that the proposed method is superior and more reliable for sea ice detection compared to conventional classification methods according to the accuracy with higher overall accuracy and Kappa coefficient, providing an ideal tool for precise sea ice extraction. The method provides technical support and a theoretical basis for further study of sea ice classification.

Keywords: Sea ice detection; Texture analysis; GLCM; MODIS 250m imagery; Bohai Sea