Coupled correction and classification of hyperspectral imagery for mapping coral reefs of Agatti and Flat Islands, India

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Abstract

Among the various remote-sensing options available today to map ecomorphological classes of corals, hyperspectral remote sensing is one of the best options by virtue of its spectral capabilities, while high spatial resolution is a necessary condition to resolve finer morphological features spatially. Given high-spatial resolution data of equal to or better than 30 m, the discrimination capability of end-members of multy-/hyperspectral satellite data is dependent on the efficacy of the correction for atmospheric effects and the intervening water column. In this study, a coupled approach to account for oceanic and atmospheric radiative contributions, called the Coupled Ocean Atmosphere Radiative Transfer (COART), was applied to Earth Observing 1 (EO-1) mission Hyperion image data acquired over the coral reefs of Agatti Island in the Lakshadeep Islands, Arabian Sea and Flat Island in the Andaman Islands, Bay of Bengal, India. The paper presents an open-source approach to correct and perform unsupervised classification of Hyperion imagery using a custom-built software toolkit called HyperCorals. The study finds that Hyperion has sufficient capabilities for discrimination of a few ecomorphological classes and can be improved further by using coupled radiactive transfer models. Correcting for the intervening water column helps in classifying submerged features. The k-means classification offers a simpler classification method to classify an image of a subset with 42 selected spectral channels of Hyperion in the visible and near infrared (VNIR) region than the traditional iterative self-Organizing Data Analysis Technique (ISODATA). The classification results using the cosine distance metric over 42 selected spectral channels of Hyperion in the VNIR region offer the potential to differentiate between various ecomorphological zones. The study also presents results from sensitivity analysis experiments and discusses the relative importance of three parameters: water column depth, bottom albedo, and chlorophyll concentration on the overall correction and classification of the imagery.