Comprehensive comparison performances of Landsat-8 OLI atmospheric correction methods for inland and coastal waters

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Remote sensing is important for aquatic environment monitoring. The Operational Land Imager (OLI) sensor onboard Landsat-8 has been proved to be able to monitor water quality of inland and coastal waters. Atmospheric correction (AC) is a crucial step in the quantitative research of remote sensing, and its accuracy is the key to the quantitative analysis of inland and coastal waters. However, the optical complexity of inland and coastal waters remains a major challenge for AC of Landsat-8 imagery, which in turn affects the retrieval accuracy of optically active constituents (OACs). A variety of AC algorithms had developed specifically for water application. However, comprehensive comparative studies of AC methods for both inland and coastal waters with a gradient of turbidity levels are lacking. Meanwhile the comparation of different AC algorithms coupled with Landsat-8 Chlorophyll-a (Chl-a) retrieval algorithm are also limited. In this study, the performances of six water-based AC methods were evaluated by using multiple global datasets (\(N = 139\)). The AC methods include the default and Management Unit Mathematics Models (MUMM) algorithms integrated into Sea-Viewing Wide Field-of-View Sensor (SeaWiFS) Data Analysis System (SeaDAS), the Dark Spectrum Fitting (DSF) and Exponential Extrapolation (EXP) algorithms integrated into the Atmospheric Correction for OLI 'lite' (ACOLITE), image correction for atmospheric effects (iCOR), and the Case 2 Regional CoastColour processor (C2RCC). Four evaluation strategies were applied in this study including spectral similarity and Chl-a retrieval. The results showed that SeaDAS and DSF performed the best in term of analytical match, band ratio, Chl-a retrieval and spectral similarity for all matchups. SeaDAS had the lowest root-mean-square-error (RMSE) in the blue-green bands of 0.0036 sr\(^{-1}\) and 0.0043 sr\(^{-1}\) respectively. SeaDAS also showed good consistency across the spectra with the lowest median spectral angle of 7°. It should note that DSF performed best in high turbid waters, but was not as accurate as SeaDAS for remote sensing reflectance (\(R_{rs}\)) retrievals in most low-to-moderately turbid waters. For the retrieval of Chl-a using OC3 and Clark algorithm, all AC methods except iCOR and EXP gave similar performance compared to in-situ measurements. SeaDAS coupled with OC3 and Clark algorithms had the lowest RMSE of 1.3359 and 1.4250 mg m\(^{-3}\) respectively, which showed the advantage of SeaDAS in Chl-a retrieval. This study provides scientific basis for choosing AC methods of Landsat-8 OLI data for aquatic environment monitoring.