Analyzing performances of different atmospheric correction techniques for Landsat data processing:
Applications for shallow water bathymetry

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ABSTRACT

Information on coastal bathymetry is becoming increasingly useful for a wide variety of purposes including coastal engineering and coastal science applications. Maps derived from bathymetric measurements are used for a range of activities such as pipeline laying, dredging, oil drilling and navigation, and are indispensable to marine spatial planning. Multispectral remote sensing has been used for many shallow water applications for which information about in-water optical properties, bottom features or bathymetry are needed. With the advent of new sensors, applications that require bathymetry information can now benefit from improved accuracy, made possible from the introduction of additional sensor bands. Nevertheless, obtaining accurate information about water depth still relies heavily on good estimates of remote sensing reflectance ($R_s$), defined as the ratio of water leaving radiance to the total downwelling irradiance just above the water. $R_s$ is derived from Top-of-Atmosphere Radiance data using atmospheric correction algorithms. This study seeks to evaluate performances of different atmospheric correction algorithms over bodies of water to determine which method produces the most robust $R_s$ in shallow coastal waters. To do so, Landsat-derived $R_s$ were compared to $R_s$ measured by in situ radiometers that are part of the ocean color component of the AErosol RObotic NETwork (AERONET-OC). Five different atmospheric correction methods were analyzed: a) the SeaWiFS Data Analysis System (SeaDAS), b) the Atmospheric Correction for OLI ‘lite’ (ACOLITE), c) the Matching of Underlying Spectra for In-scene Correction (MUSIC), d) Second Simulation of a Satellite Signal in the Solar Spectrum (6S), and e) the United States Geological Survey’s standard land-based atmospheric correction yielding Landsat Surface Reflectance (LSR) Climate Data Record (Landsat CDR). Based on preliminary analyses, SeaDAS is found to provide the most accurate $R_s$ estimates, as compared to in situ AERONET-OC observations. Our results indicate that Landsat-derived $R_s$ products obtained from SeaDAS can be utilized in bathymetric applications for improved depth estimation. Further research needs to be dedicated to global evaluations of SeaDAS $R_s$ products to fully understand its performance in optically shallow waters.