Remote Sensing of Environment

Application of Sentinel 3 OLCI for chl-a retrieval over small inland water targets: Successes and challenges

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Abstract

Eutrophication and increasing prevalence of potentially toxic cyanobacterial blooms among global inland water bodies is becoming a major concern and requires direct attention. The European Space Agency recently launched the Ocean and Land Color Instrument (OLCI) aboard the Sentinel 3 satellite. The success of the mission will depend on extensive validation efforts for the development of accurate and robust in-water algorithms. In this study, four full atmospheric correction methods are assessed over four inland water reservoirs in South Africa, along with a suite of red/NIR based semi-analytic and band difference models for chl-a estimation which were applied to both full and partial atmospherically corrected data. In addition, we tested a novel duplicate pixel correction method to account for duplicate pixels induced by high observation zenith angles. Radiometric errors associated with OLCI Top of Atmosphere (TOA) radiances over small water targets were also investigated by modeling in situ reflectance measurements to at-sensor radiances using MODTRAN. Of the four atmospheric corrections, the 6SV1 radiative transfer code showed the most promise for producing reasonable reflectances when compared to in-situ measurements. Empirically derived band difference models outperformed all other chl-a retrieval methods on both partially and fully corrected reflectances. The Maximum Peak Height (MPH) algorithm applied to Bottom of Rayleigh Reflectance (BRR) performed best overall (R2= 0.55, RMSE(%) =99), while the Maximum Chlorophyll Index (MCI) performed best on atmospherically corrected data using 6SV1 (R2 = 0.35, RMSE(%) = 107). Semi-analytic chl-a retrieval methods proved very successful when applied to in situ Rrs, however, are not reliable when applied to low quality reflectance data. The SIMilarity Environment Correction (SIMEC), an adjacency correction applied in conjunction with the image correction for atmospheric effects (iCOR) processor, did not improve retrieval results for these small water targets.