Landsat 8 Remote Sensing Reflectance (Rrs) Products: Evaluations, Intercomparisons, and Enhancements

Abstract:
The Operational Land Imager (OLI) onboard Landsat 8 is generating high-quality aquatic science products, the most critical of which is the remote sensing reflectance (Rrs); defined as the ratio of water-leaving radiance to the total downwelling irradiance just above water. The quality of the Rrs products has not, however, been extensively assessed. This manuscript provides a comprehensive evaluation of Level 1B, i.e., top of atmosphere reflectance, and Rrs products available from OLI imagery under near-ideal atmospheric conditions in moderately turbid waters. Furthermore, the across-track spatial non-uniformity of the OLI data across its observing swath is characterized and corrected in order to enhance the quality of Rrs products. The procedure includes a) evaluations of the Rrs products at sites included in the Ocean Color component of the Aerosol Robotic Network (AERONET-OC), b) intercomparisons and cross-calibrations against other ocean color products, and c) optimizations of vicarious calibration gains across the entire OLI observing swath. Results indicate that the near-infrared and shortwave infrared (NIR-SWIR) band combinations yield the most robust and stable Rrs retrievals in moderately turbid waters. Intercomparisons against products derived from the Visible Infrared Imaging Radiometer Suite (VIIRS) and Moderate Resolution Imaging Spectroradiometer onboard the Aqua platform (MODISA) indicate slight across-track (spatial) non-uniformities (< 1%) across OLI scenes in the blue bands. In both product domains (TOA and Rrs), on average, the OLI products were found larger in radiometric responses in the blue. As a result of application of updated vicarious calibration gains, matchup analysis using independent in-situ validation data confirmed improvements in Rrs products. These findings further support high-fidelity OLI-derived aquatic science products in terms of both demonstrating a robust atmospheric correction method and providing consistent products across its imaging swath.


Authors:
PAHLEVAN Nima
SCHOTT John
FRANZ Bryan
ZIBORDI Giuseppe
MARKHAM Brian
BAILEY Sean
SCHAAF Crystal