Inverse modeling for retrieval of the optical properties of sea water and atmospheric aerosols from remote sensing reflectance

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Abstract:

In this study algorithms were developed to retrieve the optical properties of the atmosphere and water in the region of Singapore. They were developed for various satellite imageries. An algorithm was developed to correct for atmospheric effects in satellite imagery using cloud and shadow image features without the assumption of atmospheric optical properties as input for the visible bands. The method was able to retrieve optical properties of the atmosphere from hyperspectral satellite imagery. The atmospheric correction scheme was also able to perform atmospheric correction on high spatial resolution satellite (IKONOS) and high spectral resolution satellite (HYPERION).

Optical properties of aerosols such as optical thickness and scattering transmittance were retrieved from a hyperspectral sensor (HYPERION). An atmospheric correction scheme was used to correct the atmospheric effects caused by aerosol and gaseous absorption. This correction scheme makes use of cloud and shadow features in the image and was applied to a high spatial resolution satellite IKONOS and Hyperion. The method used radiance detected over these features to derive the path radiance with minimal inputs. These inputs are the sensor radiance calibration and atmospheric transmittance in the Near-infrared region. Models and types of aerosols are not needed as inputs. The atmospheric correction on Ikonos was validated by field measurements of water reflectance. The results from Hyperion were compared with the reflectance corrected by a well-known atmospheric correction scheme (TAFKAA).

An inversion algorithm was also developed to retrieve optical properties of both shallow and deep turbid waters in Singapore. The inversion algorithm uses spectral windows where light has the least transmittance in water to minimize the influence from the sea bottom. This algorithm was validated by in-situ measurements of absorption and scattering coefficients performed in several sampling locations in the coastal waters of Singapore. It was also applied to retrieve optical properties from a dataset of simulated reflectance, which covers a wide range of optical properties and remote sensing reflectance of water. This dataset was compiled by an international working group to be used as a benchmark for evaluating algorithms for water optical properties retrieval.