Selection of best atmospheric correction method and estimation of Chlorophyll-a in coastal waters of Hong Kong using Landsat and HJ-1 imagery.

Majid Nazeer and Janet E. Nichol

Abstract: **-** Precise atmospheric correction is important for applications where small differences in Surface Reflectance (SR) are significant, such as biomass estimation, crop phenology and retrieval of water quality parameters. It also enables direct comparison between different image dates and different sensors. As a precursor to monitoring different parameters of water quality around the coastline of Hong Kong using medium resolution sensors Landsat TM/ETM and HJ-1 A/B, this study evaluated the performance of five atmospheric correction methods. The estimated SR of the first four reflective bands of Landsat 7 ETM+ and of the identical bands of the HJ-1 A/B satellites were compared with in situ Multispectral Radiometer (MSR) SR measurements over sand, artificial turf, grass and water surfaces for the five atmospheric correction methods 6S (Second Simulation of the Satellite Signal in the Solar Spectrum), FLAASH (Fast Line-of-sight Atmospheric Analysis of Spectral Hypercubes), ATCOR (ATmospheric CORection), DOS (Dark Object Subtraction) and ELM (Empirical Line Method). Among the five methods 6S was observed to be consistently more precise for SR estimation, with significantly less difference from the in situ measured SR, especially over lower reflective surfaces of artificial turf, grass and water, while FLAASH and ELM were best for SR estimation over bright sand areas. Of the two image-based methods DOS and ELM, DOS performed well over the darker surfaces of water and artificial turf, although still inferior to 6S, while ELM worked well for grass sites and equaled the good performance of FLAASH over the high reflective sand surfaces.

Coastal waters are productive and sensitive marine ecosystems and their physical, chemical and biological conditions are subjected to change with tidal variations, fresh water input, temperature, salinity, seasonal variations and human activities such as industrial, agricultural and household drainage. In coastal productive waters Chl-a concentration is a widely used measure of phytoplankton and suspended algal mass which provides primary food to the aquatic life. Because of an important role of Chl-a in

marine habitats, it can be used as marine system's health indicator. The estimation of Chl-a concentration as an indicator of algal biomass using space borne data helps to assess coastal water quality, spatially and temporally. Monitoring the spatially complex near-shore environment of coastal and inland waters such as Hong Kong needs the retrieval of Chl-a at high spatial resolution. Therefore Landsat TM/ETM+ and HJ-1 A/B along with in situ Chl-a concentration (0.8 to 13.0 ug/l) data for Hong Kong's coastal waters were used to develop a regression model. The algorithm takes the band ratio of red and blue bands [B3/(B1)2] as independent variable for Chl-a estimation. Validation of the algorithm using an independent Chl-a dataset (N=13) of 2009 and near-concurrent Landsat TM/ETM+ measurements showed good performance with a correlation coefficient (R) of 0.91, Root Mean Square Error (RMSE) of 0.10 and Mean Absolute Error (MAE) of 0.68. The algorithm was implemented to develop the synoptic maps of Chl-a concentration for 2 January, 2009 and 10 March, 2013, TM and ETM+ images, respectively.