Geophysical Research Abstracts, Vol. 9, 03376, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03376

Assessing Inland Surface Water Quality by means of Hyperspectral Remote Sensing – A Literature Review

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The acquisition of inland surface water quality data (SWQ) for scientific or governmental purposes is an important but tedious task due to the pronounced spatial and temporal variability of most water quality parameters. Hyperspectral Remote Sensing (HRS) provides data in the contiguous narrow bands which may assist in SWQ monitoring campaigns. This study was initiated to survey recent literature in order to assess the suitability of remote sensing techniques such as HRS in estimating SWQ especially of small inland water bodies (ponds, kettle-holes, etc.).

From the various classical water quality parameters (Total Suspended Sediment, Coloured Dissolved Organic Matter, Secchi Disk Transparency, etc.) chlorophyll-a – the central water quality parameter in this study - is an integrative measure indicating the trophic and nutrient status of surface waters. Remote sensing of chlorophyll-a in water is based on developing relationships between radiance/reflectance in narrow bands or band ratios and chlorophyll-a. Direct theoretical physical expressions linking the remote signal with the chlorophyll-a concentration can hardly be derived because of the missing correspondence between the band width at which most satellites operate and the diagnostic spectrum of chlorophyll-a. Most reviewed studies, therefore, concentrate on empirical or semi-empirical approaches in which the sub-surface irradiance reflectance (or volume reflectance) is correlated to chlorophyll-a concentration obtained from ground truth measurements.

This work presents the most widely used methods to identify chlorophyll-a: Simple Band Ratio, Continuum Interpolated Band Ratio, Area above a Baseline, Peak Magnitude above a Baseline, Position of the Peak near 700 nm, and Spectral Unmixing Model.

It appears from the review that the Spectral Unmixing Model is a feasible tool in remote sensing of water quality monitoring. In fact, the water surface-reflectance spectrum is a mixed spectrum because it is affected by several parameters of water quality. Spectral Unmixing Model is a quantitative analysis procedure used to recognize constituent cover materials (or end-members (EM)) and obtain their mixing from a mixed pixel. Thus, a proper selection of the end-members is vital to find the best model relating *in-situ* and HRS data. The most promising technique for identifying SWQ in small water bodies appears to be building a Non-Linear Model with end members of chlorophyll-a in different classes spanning a certain range of concentrations