LAKE VICTORIA WATER BIO-OPTICAL COMPOUNDS ASSESSMENT THROUGH HIGH SPATIAL AND SPECTRAL RESOLUTION SATELLITE IMAGERY

Rosa Maria Cavalli[a], Lorenzo Fusilli[a], Giovanni Laneve[b], Stefano Pignatti[c], Federico Santini[a]

(a) Institute for Atmospheric Pollution, LARA Section, CNR,
Via del Fosso del Cavaliere 100, 00133 Rome, Italy,
cavalli@lara.rm.cnr.it, fusilli@lara.rm.cnr.it, federico.santini@lara.rm.cnr.it

(b) Centro di Ricerca Progetto San Marco (CRPSM), University of Rome ''La Sapienza'',
Salaria 851, 00138 Rome, Italy, laneve@psm.uniroma1.it

(c) Institute of Methodologies for Environmental Analysis, CNR,
C.da S. Loja, 85050 Tito Scalo (Pz), Italy, pignatti@imaa.cnr.it

Abstract.
In the mainframe of the well-established Italian Foreign Affair Ministry (through the University of Rome) and Kenyan Authorities cooperation in place since the early '90, the study described in the paper aims to develop and apply new methods, based on up-to-date technology, to the water resource management. Within this framework, an European Space Agency Category 01 (ESA-CAT-01, titled "water quality assessment in connection to floating macrophites growing of the Winam gulf by means of physical based models for the case 2 waters bio-optical properties and spectral classification techniques for mapping purpose") project aiming to apply high resolution spectral data to monitor the ecosystem of the Kenyan part of the Victoria lake (i.e. the Winam Gulf), was submitted by the authors.
In particular, this paper is devoted to assess the capability of satellite-based remotely sensed high spatial and spectral resolution imagery to provide information suitable for enhancing the effectiveness and efficacy of the monitoring and management of the Lake Victoria resources. In fact, Kenya, as well the other countries surrounding the lake, are facing a number of serious challenges related to water resource management which include growing population, water scarcity, climate variability and water resource degradation, invasive species, rivers water pollution (agricultural and agrochemical residuals, discharge of industrial/urban waste).
In particular, the Winam Gulf was interested by the highest infestation of water hyacinth in 1998 that caused significant socio-economic impact on riparian populations. The many problems caused by aquatic weeds drove our interest in analyzing the possibility of exploiting satellite images to retrieve optical parameters suitable to develop an early warning strategy. For this purpose a preliminary field sampling campaign has been carried out in 2004.
The spectral data collected during the field campaign served two purposes: to discriminate water hyacinth from associated macrophytes and to estimate the bio-optical compounds related to water quality. The first objective was obtained by means of a spectral characterization of weed species and compiling an ad hoc spectral library while the second one was achieved through surface radiance measurements and water samples laboratory analysis.
By using "in situ" measurements and high spatial and spectral resolution satellite images (i.e. 2007-2009 temporal series of CHRIS/PROBA) the following indicators have been retrieved: (a) the distribution of water hyacinth and associated macrophytes; (b) the estimation of parameters related to water quality and composition, like concentrations of chlorophyll a (Chl a) colored dissolved organic matter (CDOM) and total suspended solid (TSS). The water compounds were estimated by applying an opportunely developed bio-optical model, suitable for the optically complex water of the Gulf.

Results show that a correlation between these quantities can be established. In principle, such a correlation can help determining the main causes of the growing of floating weeds that have infested the area over the last few years.