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Time series analysis of satellite multi-sensors imagery to study the recursive abnormal grow of floating macrophyte in the lake victoria (central Africa)

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Remote sensing allows multi-temporal mapping and monitoring of large water bodies. The importance of remote sensing for wetland and inland water inventory and monitoring at all scales was emphasized several times by the Ramsar Convention on Wetlands and from EU projects like SALMON and ROSALMA, e.g. by (Finlayson et al., 1999) and (Lowry and Finlayson, 2004).
This paper aims at assessing the capability of time series of satellite imagery to provide information suitable for enhancing the understanding of the temporal cycles shown by the macrophytes growing in order to support the monitor and management of the lake Victoria water resources.
The lake Victoria coastal areas are facing a number of challenges related to water resource management which include growing population, water scarcity, climate variability and water resource degradation, invasive species, water pollution. The proliferation of invasive plants and aquatic weeds, is of growing concern. In particular, let us recall some of the problems caused by the aquatic weeds growing:
Ø interference with human activities such as fishing, and boating;
Ø inhibition or interference with a balanced fish population;
Ø fish killing due to removal of too much oxygen from the water;
Ø production of quiet water areas that are ideal for mosquito breeding.

In this context, an integrated use of medium/high resolution images from sensors like MODIS, ASTER, LANDSAT/TM and whenever available CHRIS offers the possibility of creating a congruent time series allowing the analysis of the floating vegetation dynamic on an extended temporal basis. Although MODIS imagery is acquired daily, cloudiness and other sources of noise can greatly reduce the effective temporal resolution, further its spatial resolution can results not always adequate to map the extension of floating plants. Therefore, the integrated use of sensors with different spatial resolution, were used to map across seasons the evolution of the phenomena. The integrated use of satellite resources allowed the estimate of the temporal variability of physical parameters that were used to i) sample the spatio-temporal distribution of the whole floating vegetation (i.e. native vegetation and weed) and ii) assess the seasonal recurrence of the abnormal weeds grow, as well as, their possible relation with the hydrological regimes of the rivers.
The paper describes how the 2000 - 2009 MODIS images time series, were analysed (navigated and processed) to derive i) the map the floating vegetation on the test area and ii) identify the areas more interested by the growing iii) to discriminate, whenever possible, according to the spectral and spatial resolution of the sensor applied (i.e. LANDSAT, ASTER, CHRIS), the different vegetation species in order to discriminate the weeds from the floating vegetation. The spectral identification of the different species was performed by exploiting the results of a field campaign performed in the past along the Kenyan coastal areas devoted to define a data base of spectral signatures of the main species. Spectral information was treated to define indexes and spectral analysis procedure customized to multispectral high resolution satellite data.
Moreover, the results of the images time series has been analysed to identify a possible definition of the temporal

occurrence of the floating vegetation growing considering both the natural phenomenological cycles and the conditions related to the abnormal growing. These results, whenever related to ancillary hydrological information (e.g. the amount of rain), they have shown that the synergy of MODIS images time series with lower temporal frequency time series imagery is a powerful tool to monitor the lake Victoria ecosystem and to follow the floating vegetation extension and even to foresee the possibility to set up a model for the abnormal vegetation growing.