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High resolution remote sensing of inland and marginal seas by shipborne fluorescent lidars

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As it is well known, the continental discharges, encompassing the river runoffs, submarine groundwater seepage, and anthropogenic sewage from populated and industrial areas, represent a major pathway through which various anthropogenic pollutants and terrigenic nutrients are emitted into the inland water bodies or oceanic shelves. Understanding the mechanisms governing re-distribution of terrigenic agents over the lake or sea shelves is a task of obvious scientific and practical importance. Spatial and temporal variability of dissolved organic matter (DOM), chlorophyll, and total suspended matter (TSM) in lakes and inland seas is often instructive of circulation patterns and the state of shelf or lake ecosystems, in particular, those in estuarine areas and regions exposed to anthropogenic impacts.

High spatial resolution (up to 2 meters) measurements of chlorophyll, DOM and TSM were conducted in 2007-2009 in the Black Sea and South China Sea (Taiwan Strait), and the Lake Balaton with the help of ultra-violet lidars UFL-8 and UFL-9. The latter is a newly developed one, allowing obtaining data of chlorophyll, DOM and TSM concentrations simultaneously, with the sampling rate of 2 Hz from a moving vessel. Such a high spatial resolution over broad areas is not commonly achieved by conventional sampling techniques.

In this paper, we show some results of the lidar high resolution data processed with the help of wavelet analysis. These results indicate that the scales of spatial variability of the parameters mentioned above in a lake or coastal sea are significantly different near the shore and in the offshore part. In particular, the typical scales of the chlorophyll variability appear to be almost always smaller than those of DOM and TSM. Furthermore, the patterns are highly variable, and their scales depend on atmospheric forcing and local hydrological circulation. We also observed that the spatial patterns of all the parameters were subject to strong diurnal cycling. We conclude that the lidar remote sensing method provides rare chance to get insight into the fine structure of the surface layer of the inland water bodies or marginal seas.