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A physically-based model for Total Suspended Matter retrieval via hyperspectral reflectance inversion in turbid waters

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We present an approach to estimate the vertical distribution of total suspended matter (TSM) from above-surface radiometric measurements in inland waters. To obtain the needed ground-truth data, a field campaign was carried out in Lake Constance on May 25, 2012. In spring, Lake Constance receives massive input of suspended particles due to a discharge peak from the Alpine Rhine caused by intensive snow melting. Due to density differences between lake's and river's waters, and also to lake currents, TSM shows with complicated horizontal and vertical variation.

We made a transect consisting of 26 points, covering the east part of the lake. We measured light transmissivity along a 10 cm path at the wavelength 650 nm, which was converted to beam attenuation c(z) (1/m). Additionally, we made gravimetric measurements of TSM from surface water TSM(0), which ranged between 0 and 14 mg/l. The regression line c(0)-TSM(0) (r2=0.96) was used as a calibration curve to build TSM(z).Chlorophyll-a was measured with a Trilux fluorometer, from Chelsea Technologies Group. Absorption by CDOM was supposed known, having exponential decay with depth and wavelength. We also took above-surface radiometric measurements with a hand-held spectrometer.

Using optical theory, we modelled the water inherent optical properties (IOPs) as formed by four components: pure water, dissolved coloured organic matter (CDOM), chlorophyll-bearing particles and mineral particles. Radiative transfer code (Hydrolight) was used to model the light field. As a derived quantity, the simulated remote sensing reflectance was matched to the measured one.

The possibilities of this technique are evaluated and discussed. In particular, how much vertical information can be retrieved from above-surface measurements, having also the physical limitation of light penetration.

This work is part of the validation activities for the FP-7 project 263.287 FreshMon (High Resolution Freshwater Monitoring: FreshMon GMES Downstream Services) (www.freshmon.eu), which develops a new service line for the continuous provision of Earth Observation based products, integrated with in situ and hydrodynamic modelling components, for water quality monitoring.