Geophysical Research Abstracts, Vol. 9, 00556, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-00556

Ultraviolet laser fluorometry of Gdansk Bay waters (Baltic sea)

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The research was performed in Gdansk Bay of Baltic sea during the cruise of r/v "Oceania" from 23.08.06 through 5.09.06 conducted by Institute of Oceanology, Polish Academy of Sciences. Laser probing was made by the ship-borne Ultraviolet Fluorescent automatic LIDAR UFL-8 with 2 laser wavelengths (355 and 532 nm). The instrument was developed in Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow. Concentrations of Dissolved Organic Matter (DOM), chlorophyll and suspended matter (seston) were estimated in optical relative units.

Very high spatial resolution profiles of laser-induced fluorescence were obtained along the ship's track at a route of over 100 miles. The measurements were carried out in automatic continuous mode, independently of weather conditions, with the sampling rate of 2 Hz. The spatial distributions of DOM, chlorophyll and seston concentration in the near-surface layer were obtained based on more than 15,000 laser soundings of each parameter.

Fluorescence of different organic matters, such as sewage waters, organic fertilizers, oil films, etc., is manifested in the spectral band of DOM fluorescence (380-600 nm in case of laser exciting pulse 355 nm). In particular, estimations of DOM concentration showed that waters near the Sopot seaport are relatively pure with no significant admixture of oil products in the near-surface layer. On the other hand, the main runoff of Vistula river at the eastern channel of the river mouth exhibited very high content of organic substances. In our opinion, the reason is that the main stream of the river is separated from the western channel of the delta and the seaport by a shipping lock, and, therefore, the major part of Vistula waters go straight to the sea through the eastern channel. Very low concentrations of seston were observed in the sea near the shore

and the seaport area adjacent to the western channel. The intensity and spectral shape of DOM fluorescence characteristic for Vistula runoff are rather similar to those previously reported for Weser river (Germany) and Kaliningrad channel (Russia) waters. This may point on anthropogenic impact on the Baltic sea.

The results of the observations served to identify the spatial dimensions of the river plume in the sea as 5x5 km approximately near the eastern river mouth channel. The river runoffs through the western and eastern channels of the Vistula mouth veer to the east because of the influence of Coriolis force. The small-scale vorticity features at the northern edge of the river plume may be indicative of shear instability between the river runoff and the general anticyclonic circulation in the northern part of the bay.

In addition, comparison between LIDAR and hydrological data obtained in the cruise by Polish researchers, are presented in this paper. Overall, DOM, chlorophyll, and seston concentrations in Gdansk bay area exhibited very strong spatial variability, with the LIDAR-derived values spanning within a range of 2 orders of magnitude.