Gelbstoff in the East Frisian Wadden Sea

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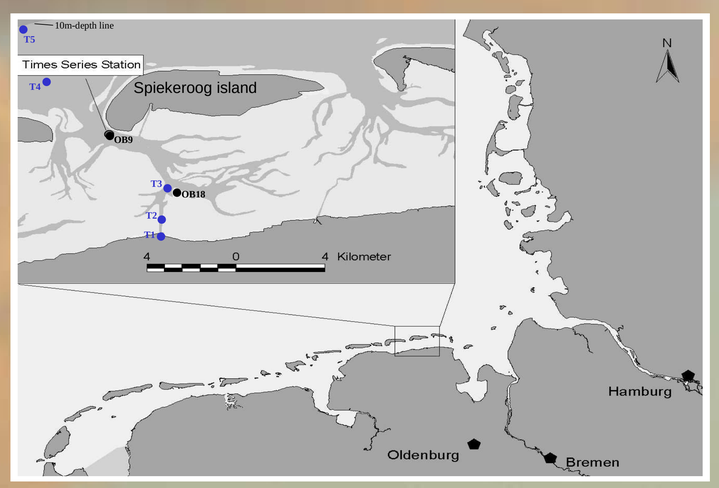

Fig. 1. German Bight with enlargement of the tidal flat area.

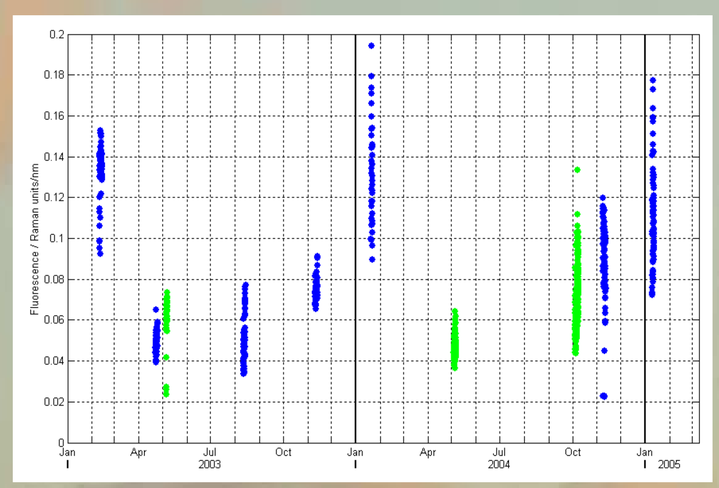

Fig. 2. Variation of fluorescence north (green) and south (blue) of the Spiekeroog inlet since 2003.

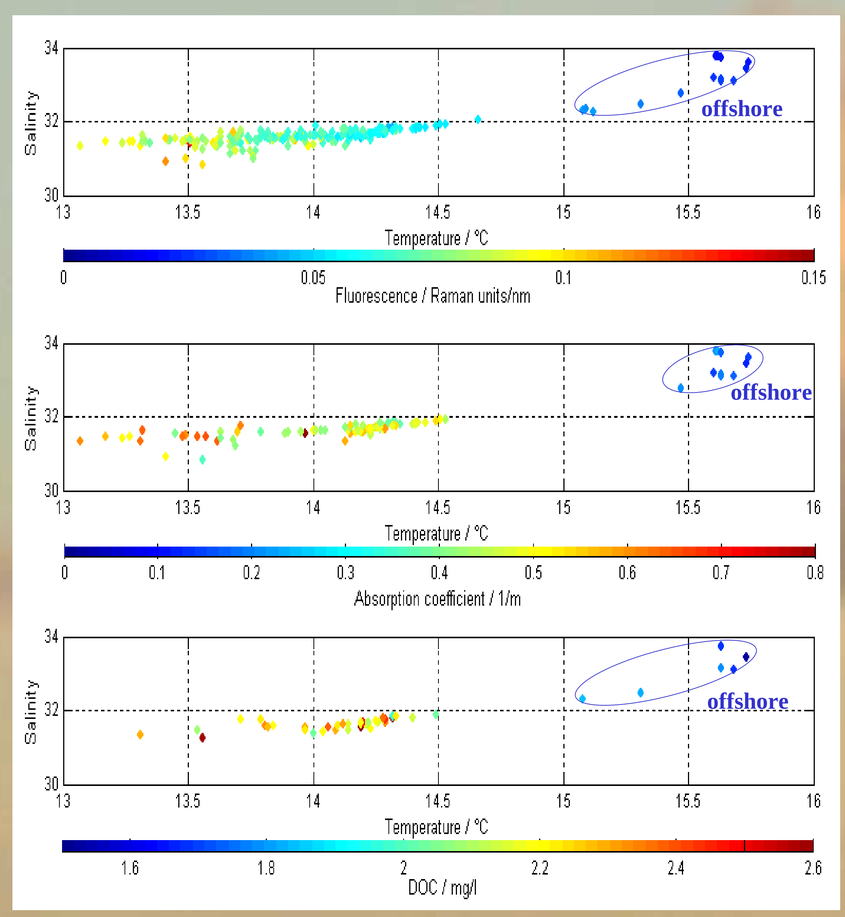

Fig 3. Data taken at the 10m-depth line north of Spiekeroog island, and in the open German Bight (offshore). T-S diagrams with coloured values of fluorescence (at 420nm), absorption (at 450nm) and DOC.

Gelbstoff is the light absorbing and fluorescent fraction of dissolved organic matter (DOM). Its near-conservative behaviour makes it an optical tracer for circulation and mixing studies in coastal zones.

Investigations of Gelbstoff have been performed during ship cruises in the East Frisian Wadden Sea (Fig. 1) since 2003. Gelbstoff fluorescence and absorption data were measured along with temperature and salinity, and dissolved organic carbon (DOC) taken from water samples. The relations of these parameters are shown in Figure 3. Approximately 80% of the dissolved organic carbon in water consists of humic substances. When excited in the ultraviolet, it emits a spectrally broad fluorescence band with a maximum at 400 nm to 450 nm, depending on the composition and origin of the material.

Distributions of fluorescence over two years have shown highest and most variable values during winter time, when higher inputs through the flood gates implicate a higher amount of refractory fluorescent organic matter. Lowest values occur during spring and summer time when precipitation is low (Fig. 2).

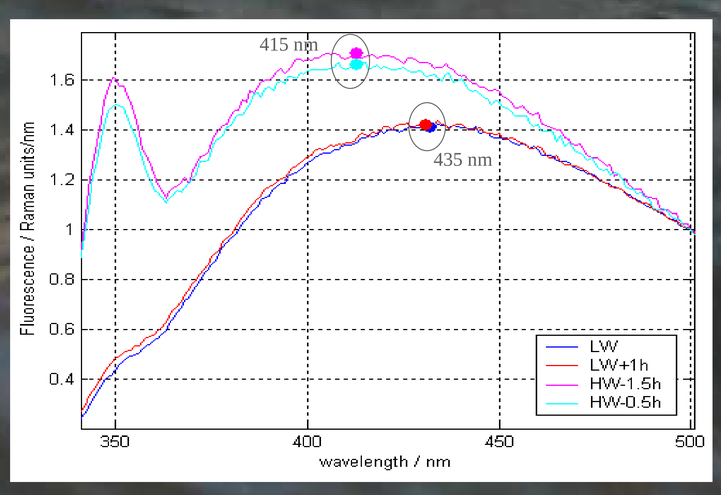

Fig. 4. Emission spectra of January 2004, tidal cycle at OB 9 (see Fig. 1), excited at 308 nm, normalized at 500 nm.

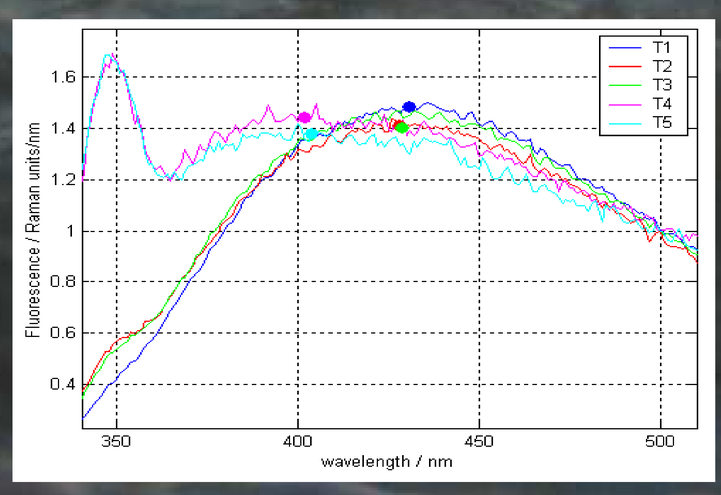

Fig. 5. Emission spectra from a transect at low tide in the tidal flat, between harbour and 10m-depth line, excited at 308 nm, normalized at 500 nm. February 27th, 2005.

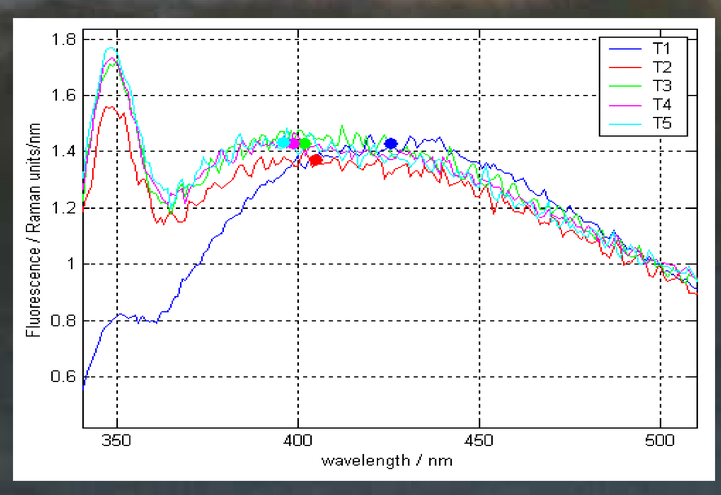

Fig. 6. Emission spectra from a transect at high tide in the tidal flat, between harbour and 10m-depth line, excited at 308 nm, normalized at 500 nm. February 27th,2005.

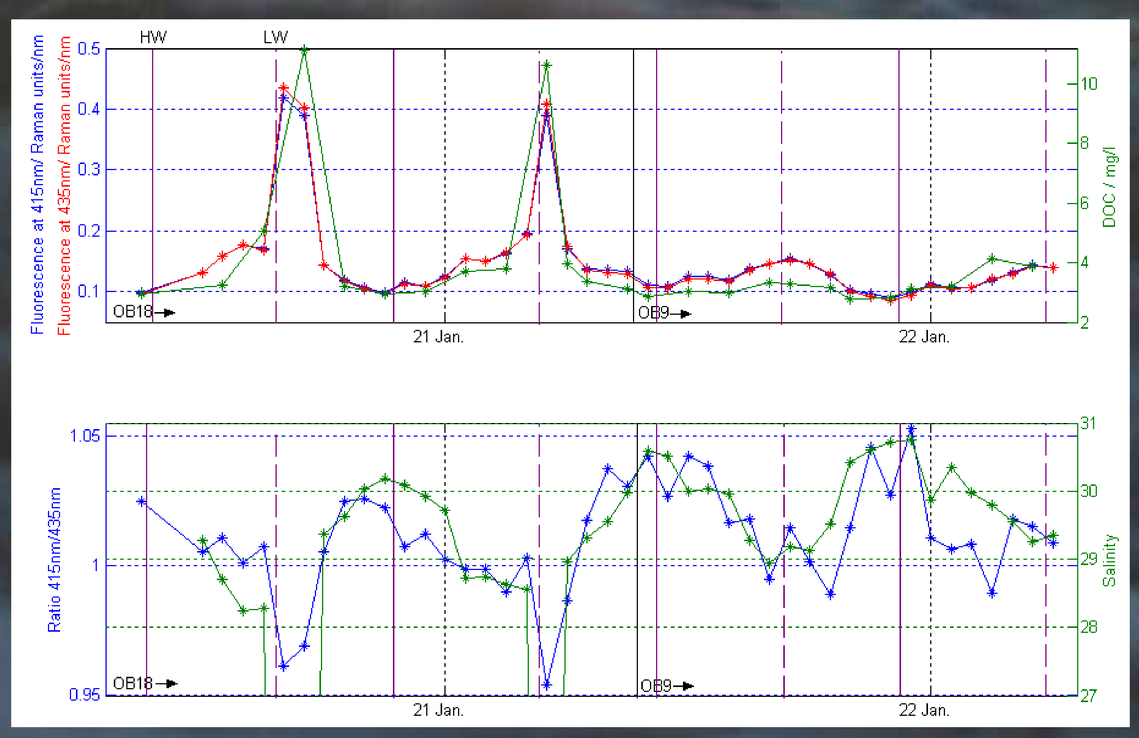

Fig. 7. Fluorescence emission at 415 and 435 nm, 308 nm excitation (upper), and ratio of these values compared with salinity (lower). January 2004.

Spectra from samples taken at different tidal phases are characterized by an emission maximum depending on the presence of freshwater and porewater which mixes with water from the open sea (Fig. 4). Fluorophores from terrestrial sources have larger molecules than marine ones. This leads to a blue shift of the Gelbstoff fluorescence maximum of marine substances. Two maxima were found within the spectra: 415 nm indicating the marine water mass expanding in the tidal flat area during flood tide, and 435 nm representing terrestrial water mass flowing through the outlet during ebb tide. The ratio of these two values point at the influence of these water masses due to the tidal phase (Fig. 7 upper). According to the low salinity (Fig. 7 lower), which indicates terrestrial run off, water samples represent an extremely high Gelbstoff fluorescence. Salinity correlates with the 415 nm/435 nm fluorescence ratio. The blue shift of the Gelbstoff fluorescence maximum is also observed along transects from the harbour to the 10m-depth line north of Spiekeroog island at low and high tide (Fig. 5 and 6), where the terrestrial influence variates (for positions see blue points in Fig. 1).

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