

PSICAM - A novel probe for continuous absorption determination in water

Jochen Wollschläger & Maik Grunwald, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research
Kontakt: Jochen.Wollschlaeger@hzg.de, Maik.Grunwald@hzg.de

Introduction

The amount of light which is absorbed in natural seawater is of interest for different questions in marine science. Various components in the seawater influence the absorption coefficients, mainly the chromophoric dissolved organic matter ('gelbstoff'), detritus, and planktonic microalgae due to their photosynthetic and accessory pigments. The amount and composition of these pigments can provide information about the structure of the phytoplanktonic community. Thus, determination of absorption values is of great interest for marine biologists.

Absorption measurements of natural water samples with traditional photometric methods can be difficult because of light scattering on particles (like detritus and phytoplankton) and low concentration of absorbing material. Furthermore, most methods allow only discrete measurements and provide no continuous *in situ*-data. The device we present here is a point-source integrating-cavity absorption meter (PSICAM) designed for the named measurements. It consists of a cavity with reflective walls and a central light source. The absorbing medium (seawater) provided by a FerryBox is pumped continuously through the cavity. This system provides the opportunity to measure the absorption over the whole spectrum of visible light by a detector located in the cavity wall. Light which is irradiated into the cavity is reflected by the walls multiple times until it reaches the detector, so measurements are very sensitive due to the long optical path length, while scattering by particles is negligible. Hence, the PSICAM facilitates to determine absorption even in waters with a high turbidity, e.g. along high productive coastal zones.

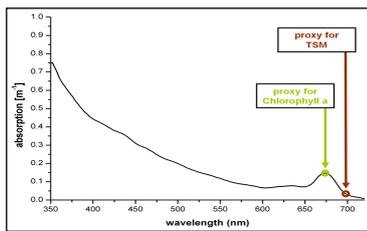


Fig. 3: Absorption spectrum from 350 – 720 nm of seawater near the Research platform FINO3 in the German Bight in April 2011

Results

Figure 3 shows a typical absorption spectrum measured with the PSICAM. This spectrum is composed of gelbstoff absorption, phytoplankton pigment and particle absorption. The wavelengths which are giving information about the TSM-content or the amount of chlorophyll-a in the water sample are highlighted.

Examples of the online measurements at these wavelengths are shown in Figure 4a and 5a, respectively. Data were collected in April 2011 during a research cruise with the FS Heincke on the North Sea. Owing to maintenance, some gaps occur during the usually continuous measurements along a predefined track.

The absorption of TSM at a wavelength of 696 nm obeys the same pattern than the turbidity measurements of the FerryBox (Fig. 4b). TSM values increase towards shore due to resuspension of sediments as well as sediment transport via freshwater discharge by rivers.

For estimating chlorophyll-a content in the water, the absorption at 696 nm is subtracted from the one at 674 nm to exclude influence of detritus, sediments and phytoplankton shells. Online PSICAM Chl-a data show a similar pattern like the fluorescence-based chlorophyll measurements of the FerryBox (Fig. 5b).

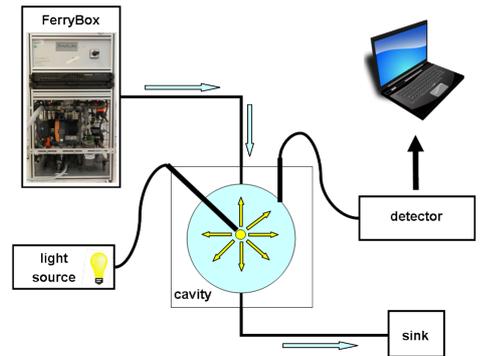


Fig. 1: Configuration of the *in situ* PSICAM

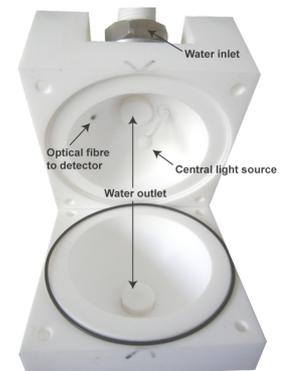


Fig. 2: Design of the cavity

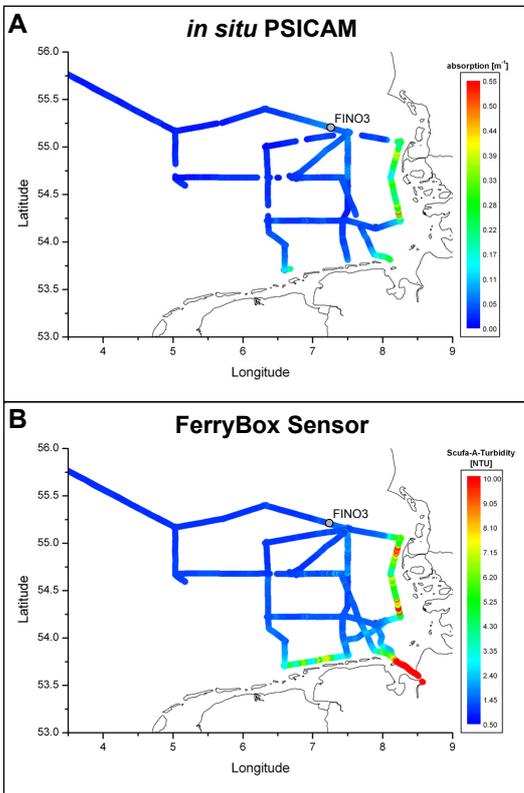


Fig. 4: Absorption values at 696 nm determined with the PSICAM (A) in comparison with turbidity data obtained with the Scufa FerryBox Sensor (B)

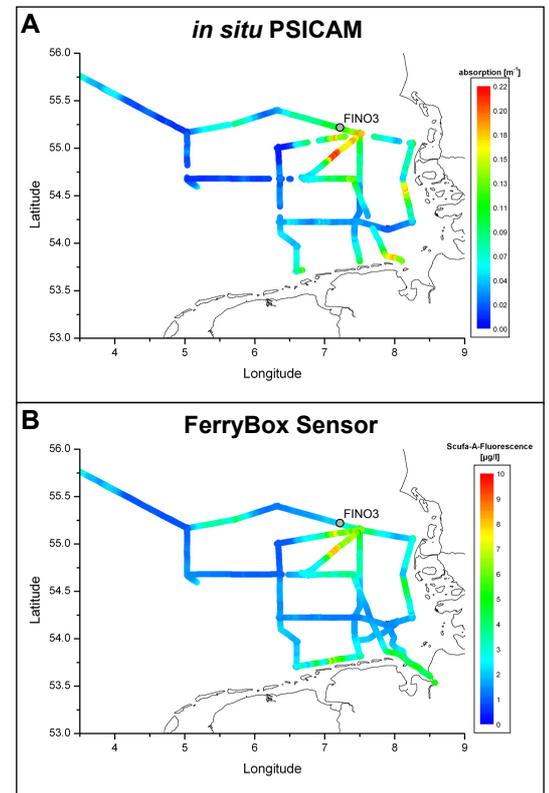


Fig. 5: Absorption values at 674 nm (chlorophyll-a) corrected with the values at 696 nm (particles) determined with the PSICAM (A) in comparison with turbidity data obtained with the Scufa FerryBox Sensor (B)