Institute for Chemistry and Biology of the Marine Environment

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ICBM

Approach for long-term observation of fluorescence in complex coastal waters by means of mobile phones

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MOTIVATION

Marine environments, in particular complex coastal waters like the Wadden Sea, are exposed to persistent alteration, fluctuation and anthropogenic as well as non-anthropogenic pressure on resources. Therefore it is required to observe status and changes of such fragile ecosystems by measuring optical properties of relevant indicators. One of them is chlorophyll *a* (Chl *a*) as proxy for algal biomass assessable via its fluorescence as an inherent optical property (IOP). Large-scale and long-term observations are necessary to track changes in the ecosystem and to determine their forcing functions. To achieve this goal we approach the measurement of key parameters of Wadden Sea processes, in particular Chl *a* fluorescence, by means of smart phones within the EU-project Citclops. This will enable the inclusion of citizens to Wadden Sea surveillance and thereby an increased spatio-temporal coverage of observations.

CHECKING OF APPLICABILITY

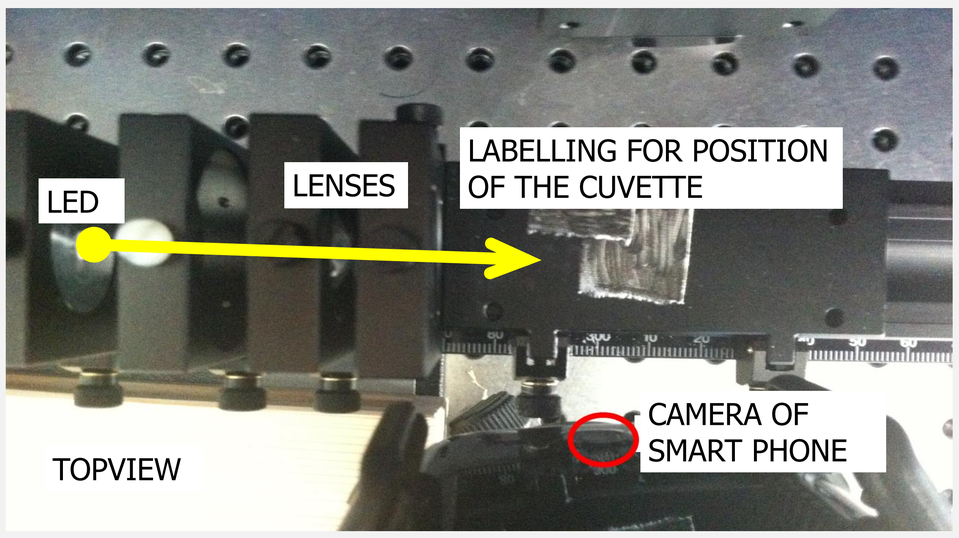


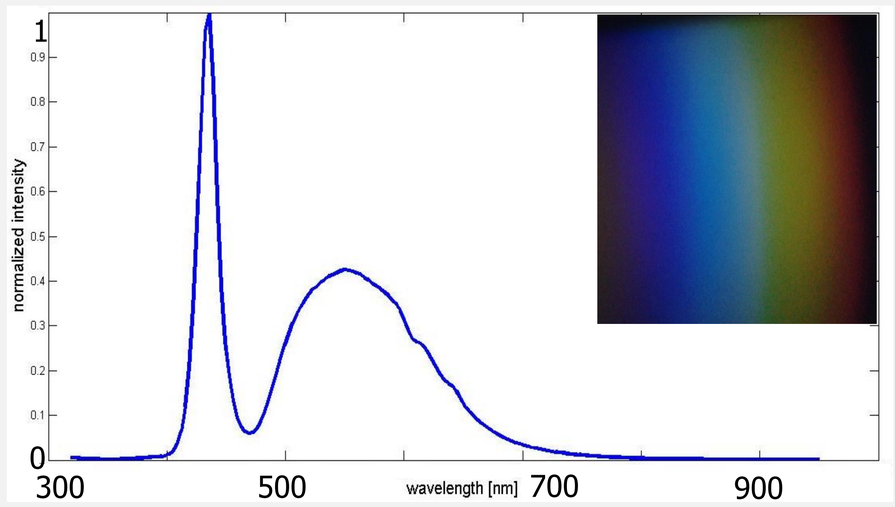
Fig 1: Top view of the measurement setup. LED as light beam source (light beam: yellow arrow), lenses to collimate the light and the camera to detected the signal. The 1 cm cuvette contains the sample. Measurements were conducted in darkness.

- Investigation of internal smartphone elements with a measurement setup (Fig. 1): Camera and light emitting diode (LED)
- And additional external elements: External blue and white LEDs, Collimating lenses
- Test samples: Water, purified water & acetone as reference and chlorophyll-standard, algal culture (*Tetraselmis* sp., see Fig. 2) as samples
- Testing method: Video record with smart phone including a dark measurement before and after illumination

Fig 2: Photo of the algal culture (*Tetraselmis* sp.)

FIRST RESULTS

Fig 3: Normalized intensity spectrum of the emitted light of the smart phone LED. Top right corner: the same spectrum but in spectral colours.



- Smart phone LED shows a large peak of the intensity in the blue at 430 nm (excitation wavelength of Chl *a* fluorescence is 470 nm) and low intensity in the red area around 685 nm (emission wavelength of Chl *a* fluorescence) (Fig. 3)

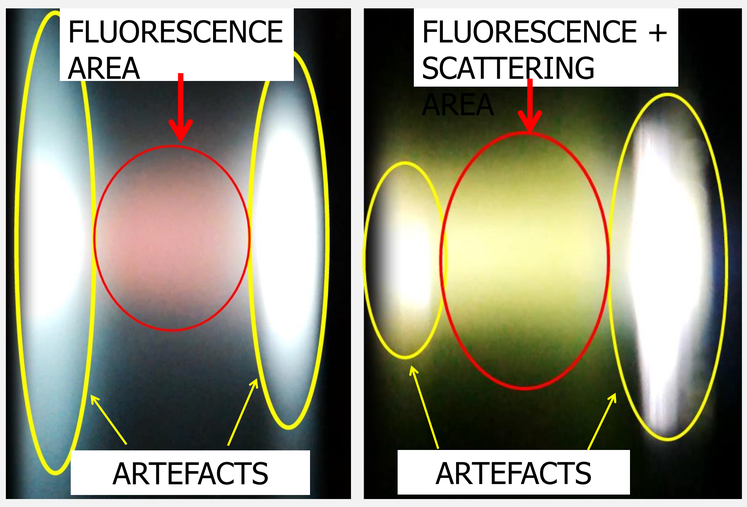


Fig 4: Snapshots taken from the videos: Left: Chl *a* –standard (5mg/l). Right: *Tetraselmis* sp. culture. Artefacts result from scattering at the cuvette sides.

- Chl *a* fluorescence visible in pigment standard due to the high concentration and without any scattering caused by particles (Fig. 4, left). For intact algal cells fluorescence emission wavelength is superimposed by scattering (Fig. 4, right)

OUTLOOK

- Verify the signal (high quality filters, blue at excitation side, red at detection side), remove artefacts from cuvettes and select the prominent image sections
- Evaluate RGB-colours of single frames and develop algorithm to calculate amount of fluorescence of the different samples
- Test of a dilution series of the Chl *a* standard additionally checking camera settings of the smart phone for example white balance and focus
- Apply the method to field campaign data (Netherlands, August 26th – 30th 2013)
- Design and manufacture an adaptor (external LED, holder for a cuvette) for smart phones

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