CT24B-1311: A new glider fluorescence sensor for monitoring dissolved aromatic hydrocarbons near offshore industrial installations

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RATIONALE

Monitoring hydrocarbons in proximity of industrial/offshore and urban/coastal installations is an important concern that poses several challenges, such as the rapid assessments of accidental releases in support to decision makers, or the comprehensive measurement of hydrocarbon concentrations as requested by environmental monitoring agencies. Such analyses are generally complex to put in place rapidly, or time consuming and expensive.

Recently, new techniques using the fluorescence properties of dissolved hydrocarbons have been employed to overcome difficulties associated with laboratory measurements and to increase the spatiotemporal coverage of the observations. Measurements presented in this study were carried out with a new miniaturized fluorescence sensor, the MiniFluo (Alseamar Cie, France), which is now fully operational on SeaExplorer underwater gliders. This sensor targets polycyclic aromatic hydrocarbons (PAHs), a specific class of hydrocarbons commonly found in crude oil. It is suggested that the package SeaExplorer glider/MiniFluo sensor is a powerful assessment tool to track dissolved hydrocarbons in natural waters.

• THE MINIFLUO SENSOR FOR HYDROCARBON DETECTION

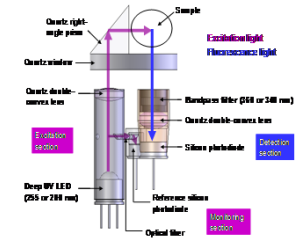

Fig.1. Principle of measurement of sensors MiniFluo: 2 optical channels (UV1 – Naphtalene & Phenanthrene), low energy consumption (500mW@12V), detection limits : (Naph 0,08 µg/L; Phe 0,10 µg/L).

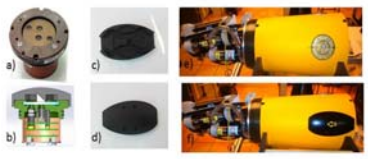

Fig. 2 Glider compatible MiniFluo (a) the complete MiniFluo : anodized aluminium for the upper part and copper cylinder for the bottom part; (b) diagram of the MiniFluo; (c) Optical cap with the quartz prisms at the center. The two channels for the through flow are also visible. (d) Optical cap (view from above); (e) MiniFluo installed on the SeaExplorer glider scientific payload; (f) MiniFluo with its optical cap.

• IN SITU VALIDATION IN MARSEILLE HARBOUR (MED SEA)

Fig.3. Glider track in Saumaty Harbor near Marseille city (glider towed behind a small boat). Surface water was sampled at S01-S05 wps for napthalene and phenanthrene laboratory GC/MS analysis. Photo credit: Jay Pearlman.

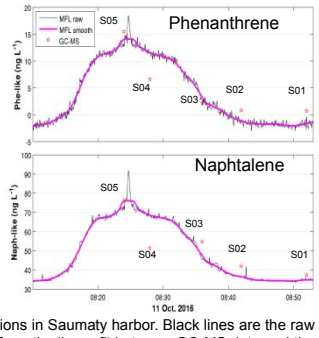

Fig. 4. Phenanthrene and Napthalene concentrations in Saumaty harbor. Black lines are the raw measurements using *in situ* calibration, calculated from the linear fit between GC-MS data and the mean relative-unit fluorescence returned by the MiniFluo (2mn period). Magenta line is the smoothed time series.

- Calibration with laboratory-prepared standard solutions is necessary for characterizing the sensor in terms of detection limit, performance compared to other sensors and ageing.
- For petroleum coumpounds detection at sea, calibration with crude oil water accomodated fraction (WAF) enables a better approach of true concentrations as it takes into account the presence of alkylated aromatics that have different fluorescent properties compared to parent compounds. When possible, it is preferable to use the oil expected to be found on the exploitation eld for the calibration.
- Finally, in situ calibration is preferable as it provides the best match with *in situ* concentrations measured by analytical chemistry method such as GC / MS.

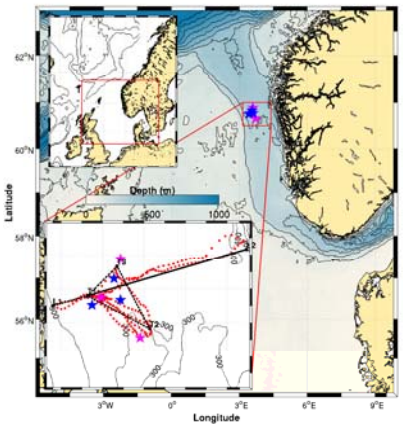

Fig. 5 SeaExplorer track glider deployment (nov 2016)

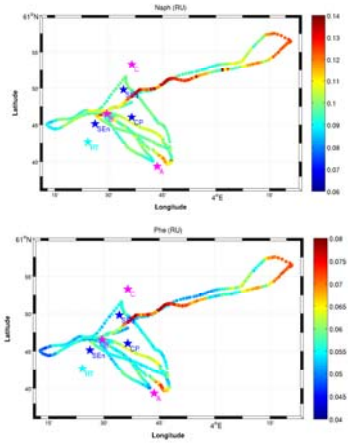

Fig. 6 Sub-surface distribution of Phe-like (upper) and Naph-like (lower). Maximum Phes concentration (WAF calibration) ≈ 20 ng L^{-1}, 2 orders of magnitude below the maximum admissible concentration of individual PAHs (2.4 µg L^{-1}, European DCE).

Chimney-like patterns

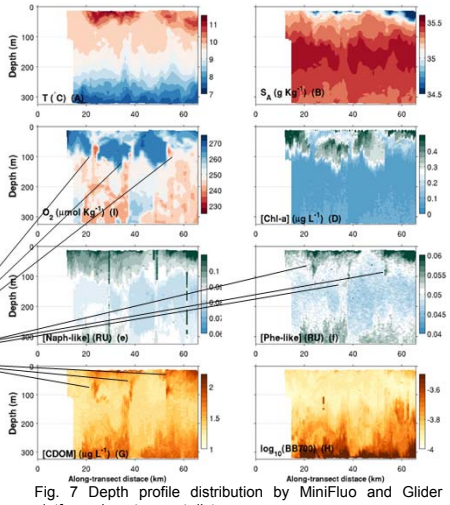

Fig. 7 Depth profile distribution by MiniFluo and Glider platform along transect distance.

- This campaign demonstrates the feasibility of using the MiniFluo/SeaExplorer package for an industrial offshore application.

▪ ACKNOWLEDGEMENTS

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