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Analysis, quantification and identification of in situ bioluminescence signals by an innovative sensor (CEMSOR2)

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Bioluminescence, the light emitted naturally by marine organisms, is the main light source in the mesopelagic zone. Nearly 75% of marine organisms, from the surface to the deep sea, use this capability for communication with diverse ecological goals (predation, repulsion...). Bioluminescence detection thus offers an indirect way of tracking the presence, distribution and migrations of organisms. Such detection can lead for example to a better understanding of vertical migrations of organisms and consequently of a better quantification of the active carbon export in the mesopelagic ocean. However, current technologies still limit large deployments, and high frequency observations of in situ bioluminescence.

To overcome these limitations, the CEMSOR2 project, led by several institutions (including LIRMM, MIO and IFREMER), aims to develop an innovative, low cost, compact, multi-instrumented sensor capable of measuring bioluminescence in situ. The CEMSOR2 is designed to be easily deployable on a wide range of vectors (such as underwater gliders, CTDs, buoys, trawls, living organisms). The sensor being easy to deploy will enable us to collect a wide range of bioluminescent data with high spatiotemporal resolution, while recording environmental and behavioral variables related to the organisms.

Validation of this sensor relies on a series of tests in a controlled environment to verify its robustness under marine conditions (pressure, water), and to calibrate and characterize it. Field testing of the CEMSOR2 is an essential part of the project. Controlled experiments have been performed on several luminous species (*Pennatula Rubra*, *Pteroides Griseum*, and *Veretillum Cynomorium*). By hypothesizing that each species or individual emits distinct bioluminescent flashes, we mechanically stimulated these organisms with a water current in a dark room, detected their light signals with the sensor, and then analyzed their light emissions. These results are essential for calibrating the sensor and refining detection algorithms. This research highlights distinct light signatures for these species of cnidarians.

Once deployed, a template script allows to analyse bioluminescence signals according to their

spatio-temporal distribution in the water column. By classifying light peaks according to their characteristics (shape, intensity, duration), we aim to link these events to species behavior and environmental variables. The aim is to develop on-board algorithms to detect and process these signals within the sensor.