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Deep dive into the Surface MicroLayer (SML) of Brest harbour

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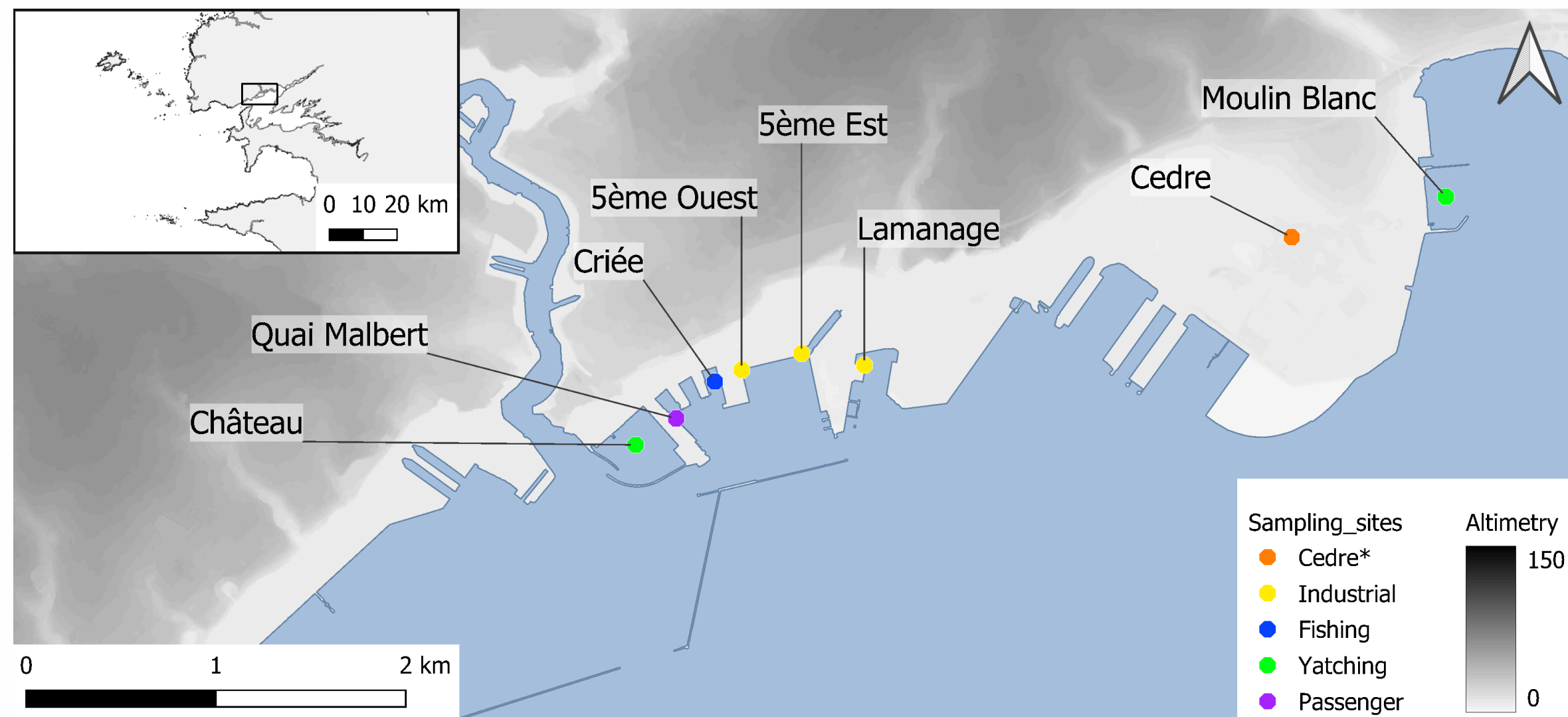
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The **surface microlayer (SML)** is an exchange interface between the atmosphere and the hydrosphere, about 1mm thick, with chemical, physical and biological processes that differ from the **Sub Surface Water (SSW)** layer (1). It is also defined as a short-term bioaccumulator. Well-studied in the open ocean and costal areas, this microenvironment is less regarded in closed basins such as harbours (2). Brest harbour is home to a wide range of activities and therefore has multiple impacts. The aim of this study is to investigate the SML in a multipurpose harbour (Brest) in terms of microbiological biodiversity, physicochemical and polycyclic aromatic hydrocarbons (PAH's) composition.

1 Study sites and techniques

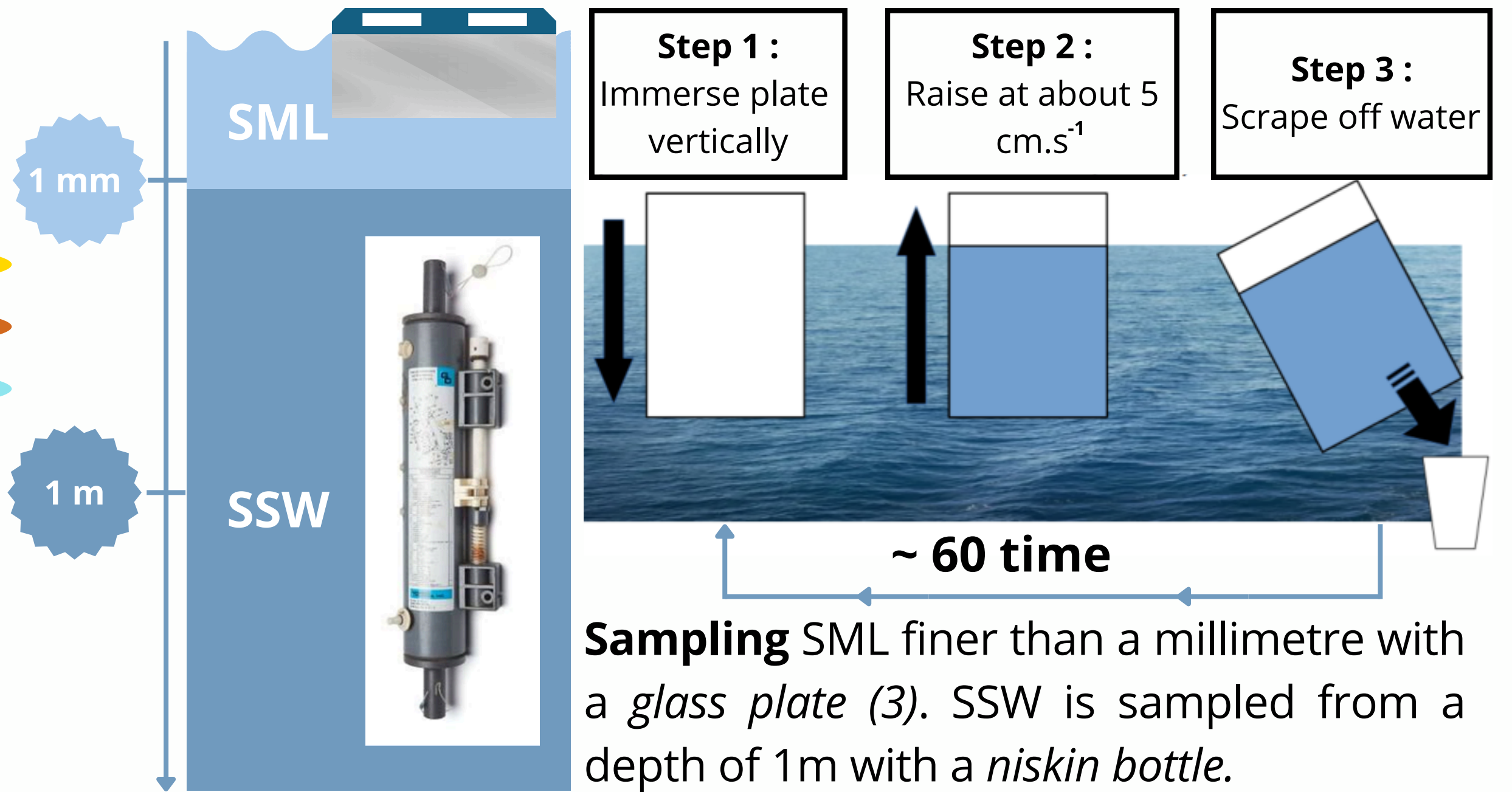


Map of sampling sites in the port of Brest. Altimetric data from RGE ALTI®. *Sampling results from Cedre's basins are not shown here.

7 sampling sites repeated at 3 different periods of 2024:

- A: August 9 - 18
- B: August 26 - September 15
- C: October 9 - 23

5 different port uses: military, industrial, fishing, yatching, passenger.



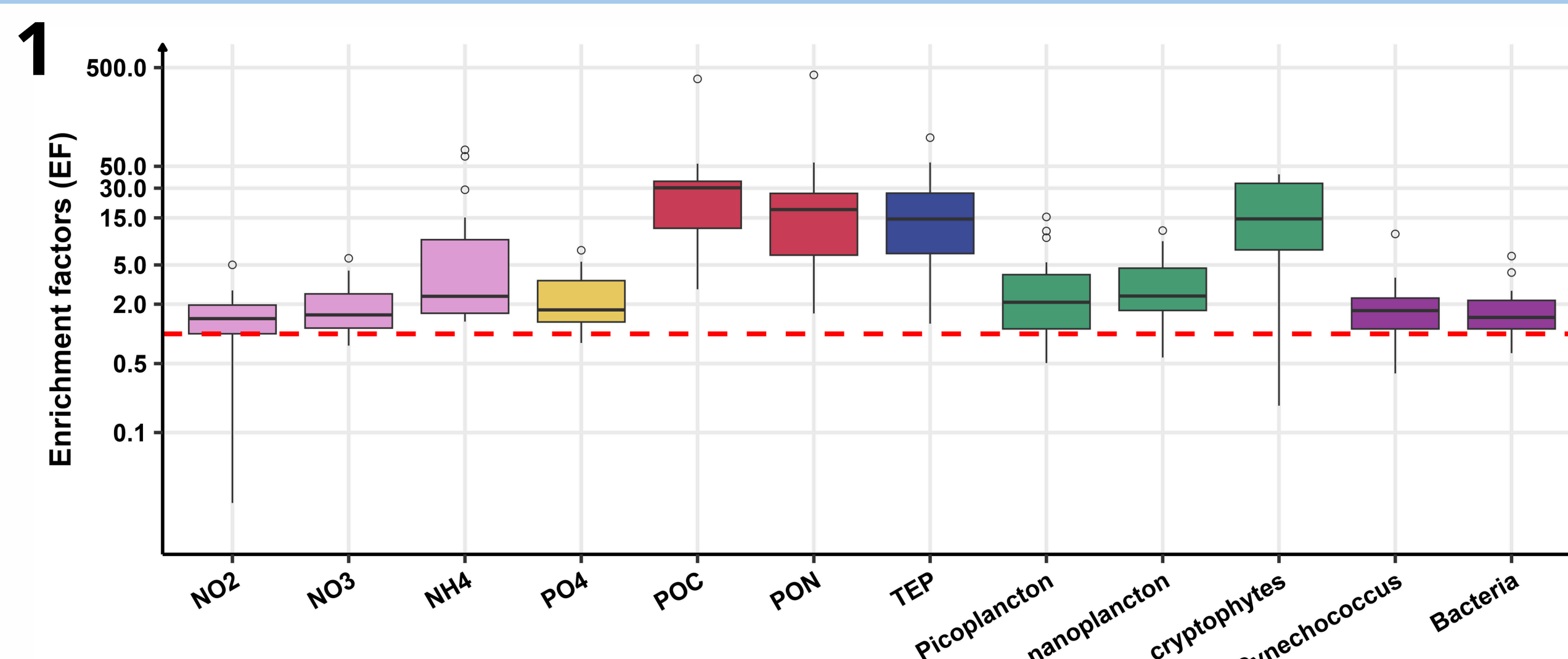
Sampling SML finer than a millimetre with a glass plate (3). SSW is sampled from a depth of 1m with a niskin bottle.

2 Methods

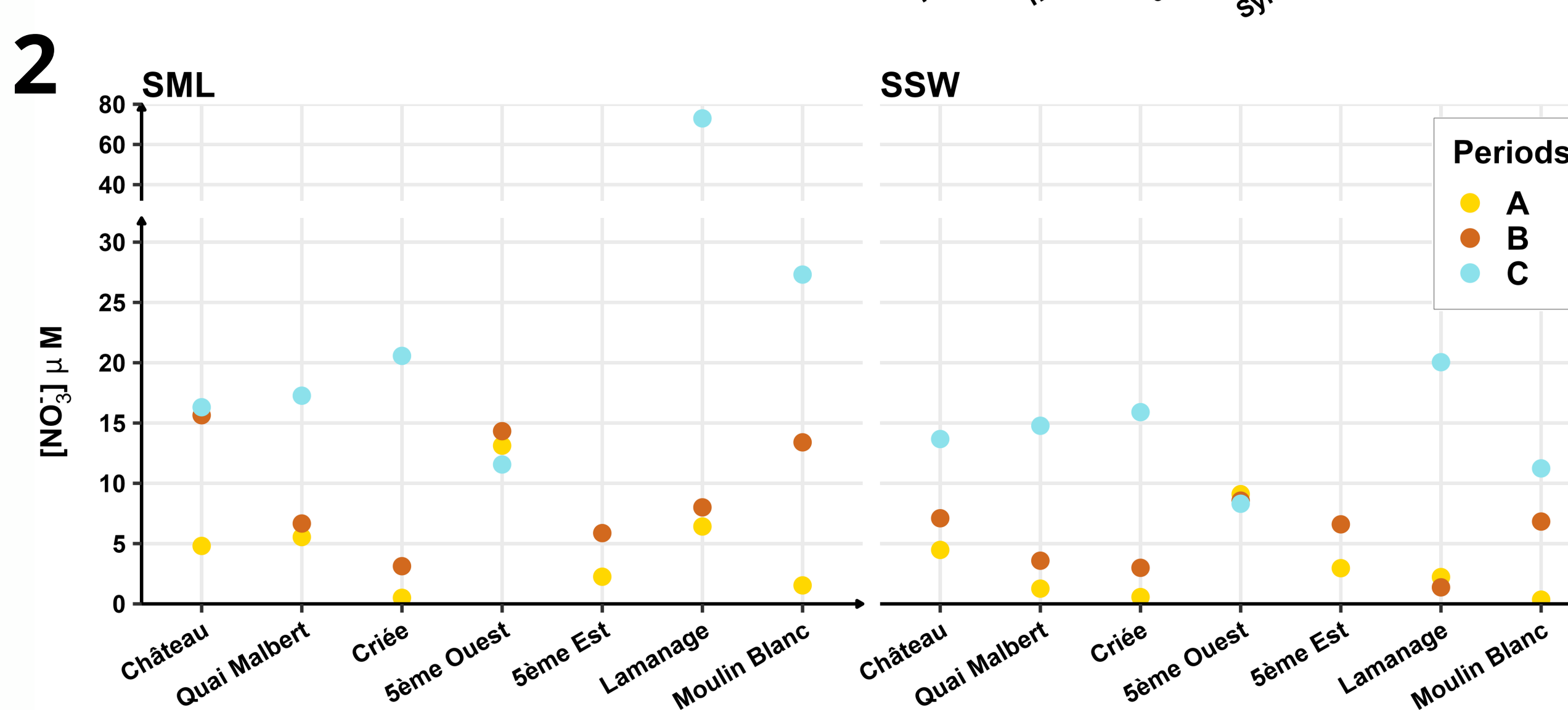
- Determination of **nutrient salts** (nitrites, nitrates, ammonium, phosphates) and **particulate matter** (particulate organic carbon and nitrogen (POC, PON)) in SML and SSW. **Physico-chemical** parameters (T°, salinity, oxygen, turbidity, chlorophyll) are measured for SSW only.
- TEP's**: As the surface microlayer is a gel-like polysaccharidic hydrated elastic biofilm that is composed mainly of transparent exopolymer particles (TEP), we quantitatively measured them with a *spectrophotometer*.
- Cells count**: The concentration of bacterial and phytoplankton cells is measured by an *automated flow cytometer*.
- 16S sequencing for **prokaryotic diversity** identification by *metabarcoding* (In progress)
- PAH's, PCB's, Pesticides**: Compound identification with the *Stir bar sorptive* extraction method (4) (In progress).

3 First results

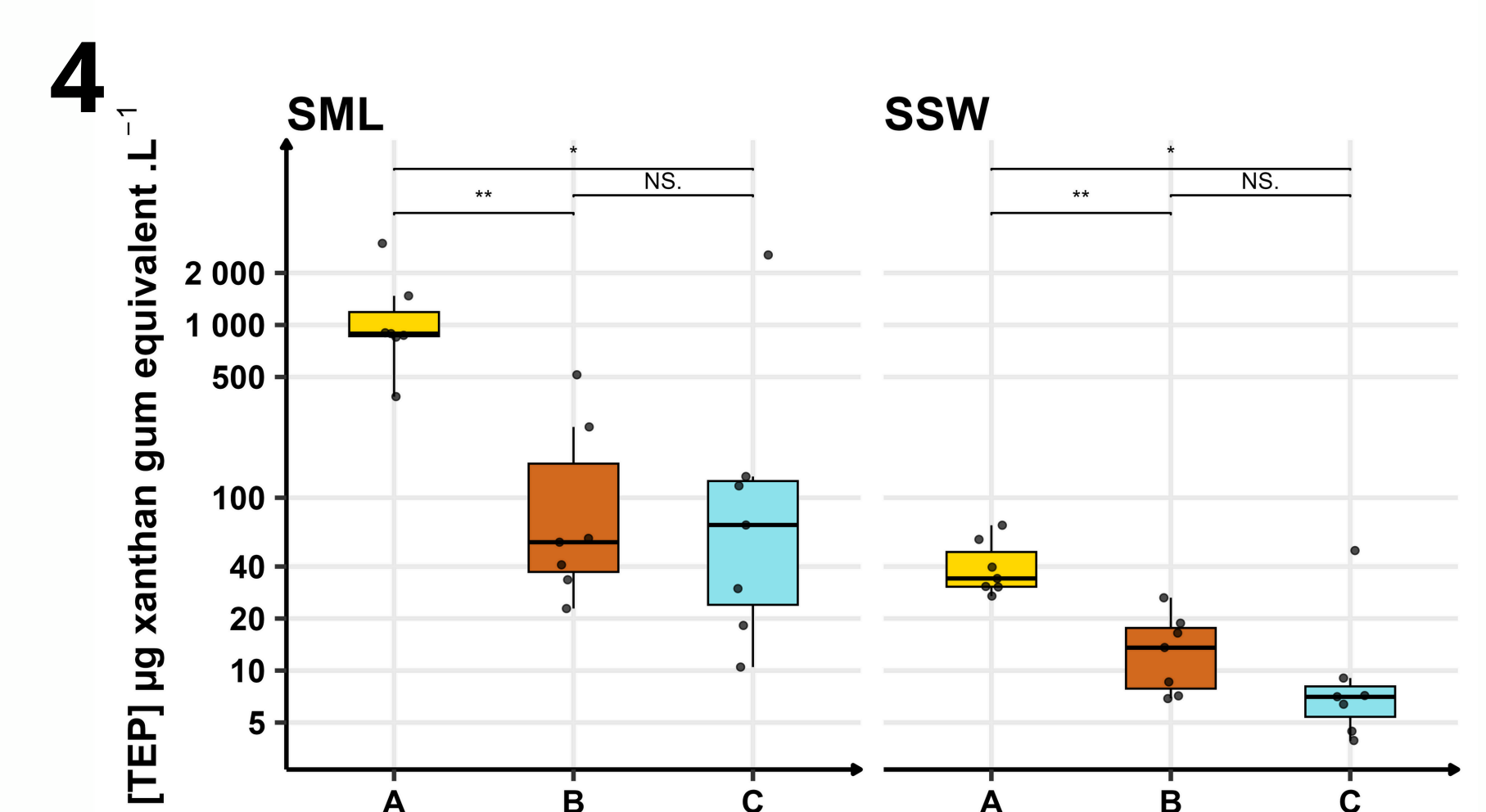
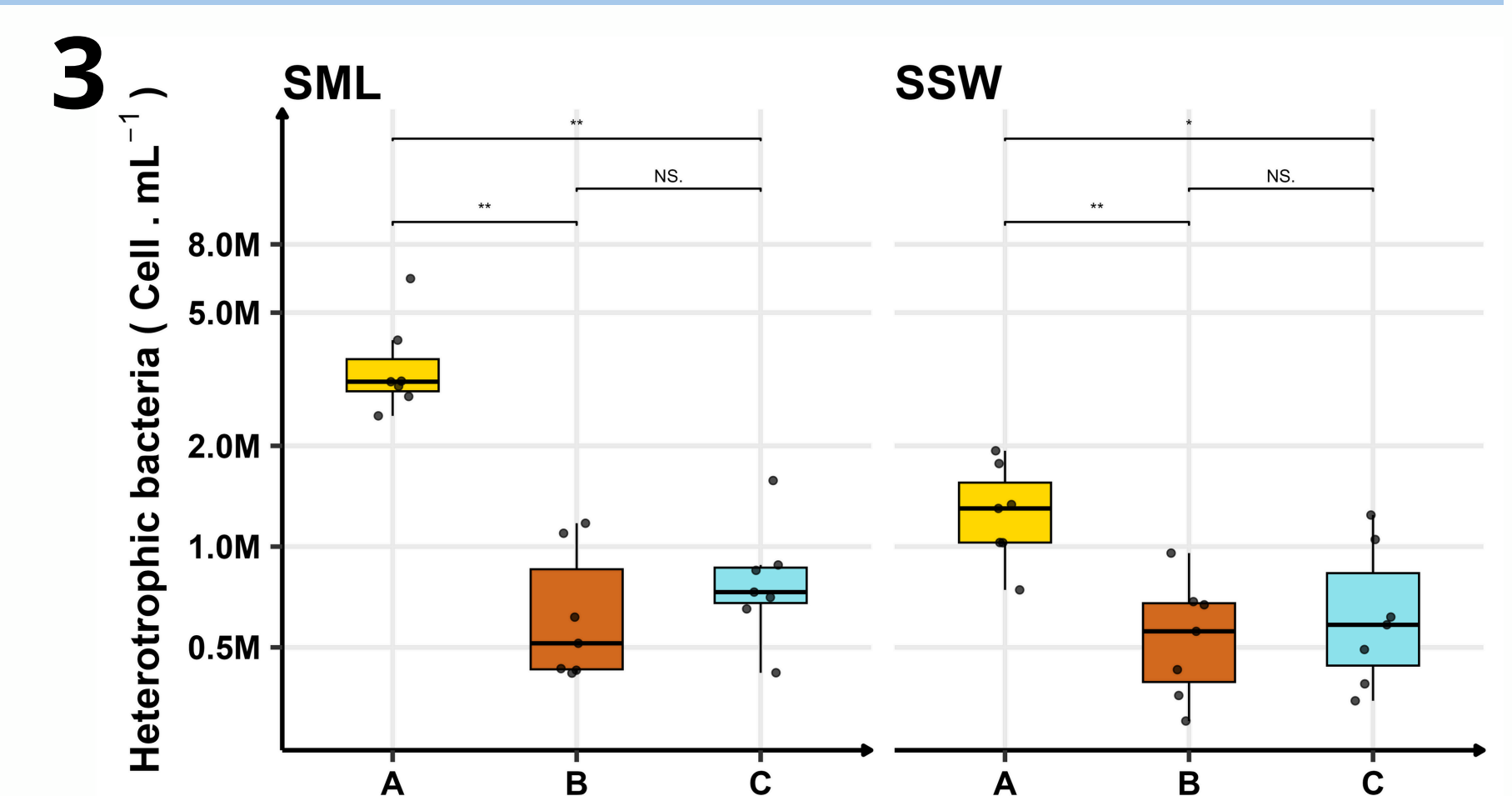
(1) The **Enrichment Factor (EF)** is the ratio of the value measured in the SML to the SSW. A concentration greater than 1 (red dotted line) indicates an enrichment of the parameter measured in the SML. Here it is enriched throughout the sampling period.



(2) **Nitrate variation** in SML and SSW between sites for the 3 periods. Sème Ouest shows no variability, while A and B period sites seem to be opposed to C. In the SML, the Lamanage site shows a nitrate peak at the surface during period C.



(3, 4) **Temporal evolution** over the 3 sampling periods (A,B,C) of bacterial cell numbers (3) and TEP concentration (4). The temporal signal is similar for all parameters and more or less pronounced.



kruskal wallis test (* = 0.05, ** = 0.01, *** = 0.001, NS = not significant).

4 Conclusions and perspectives

- All compounds measured in the SML are enriched compared to the SSW. The enrichment is massive for large particles such as POC, PON as well as TEP and cryptophytes. To a lesser extent, SML is also enriched with dissolved matter such as nutrient salts and very small particles like bacteria.
- Nutrients concentration follow seasonal trends (higher in October) and show slight differences between port sites. Possible explanations are the natural freshwater inflows to the Château and Moulin Blanc sites. Peak in Lamanage can be explained by rainwater outlet associated with wetter weather in October.
- SML does not show a different mechanism but rather a temporal evolution that mirrors what happens in SSW.
- Further analysis will reveal the bacterial and PAH's diversity along the Brest harbour.

References

(1) Engel et al., 2017. Front. Mar. Sci. doi: 10.3389/fmars.2017.00165; (2) Zäncker et al., 2017. Frontiers in Microbiology. doi : 10.3389/fmicb.2017.02369; (3) Harvey and Burzell, 1972. Limnology and Oceanography; (4) David and Sandra, 2007. Journal of Chromatography. doi : 10.1016/j.chroma.2007.01.032

