Untargeted screening of marine sediments in offshore wind farms

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Offshore wind farms (OWFs) play a crucial role in reducing carbon emissions and the dependency on fossil fuels. The biological effects of OWFs on the marine ecosystem have systematically been monitored. However, chemical emissions have often been overlooked. As it is expected that current OWFs will further be expanded to comply with European energy and climate goals, it is paramount to understand and characterize the potential chemical emissions of these OWFs. This is not an easy task, as many activities are taking place in a limited area at sea, rendering it difficult to identify the specific emission sources.

Sediment samples were taken in and near two OWFs within the Belgian part of the North Sea to identify potential emissions. Three types of reference locations were considered: offshore reference samples at an area where low human impact is expected, aiming to capture background concentrations, ship reference samples, taken offshore near a shipping lane, aiming to correct for effects of ship traffic; and near-shore references, where a larger impact of multiple human activities taking place within 12 nm of the shoreline can be expected. Sample extracts were analyzed by GC-MS, resulting in the detection of more than 150 compounds. Most of these compounds were present in both impact and reference samples. To identify compounds that might be leaching from OWFs, the relative intensity was calculated between impact and reference samples, and peaks with an intensity of at least three times the measured intensity at all three reference locations were selected. Besides using the relative peak intensities, machine learning was also applied to identify potential peaks. Random forest, for example, allows the identification of peaks that are associated with impact, nearby, or reference areas. After building a forest with thousands of trees, the most important compounds that contributed to the impact or nearby areas were also selected. Further identification with MS libraries allowed us to identify, to the greatest extent possible, these compounds and characterize, for the first time, the potential chemical emission of OWFs.

Acknowledgement
The authors acknowledge the project Anemoi (Project number 41-2-13-22), an Interreg North Sea project co-funded by the European Union.

Keywords
Chemical Pollution; Offshore Wind Farms; Untargeted Screening