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Are sunscreen UV filters polluting our beaches? A case study from consumer habits to water analysis on the French Mediterranean Coast Coauthors

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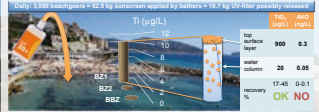
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Are sunscreen UV filters polluting our beaches?

A case study from consumer habits to water analysis on the French Mediterranean Coast

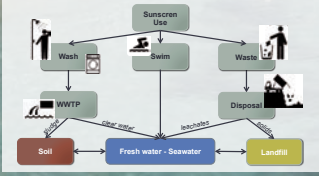
Abstract
Daily 3,000 beachgoers = 52.9 kg sunscreen applied by bathers = 16.7 kg UV filter possibly released



In order to assess the release of UV filters from the sunscreen used by beachgoers into seawater within the bathing zone, a field campaign was carried out during the summer of 2017 at three beaches in Marseille, along the French Mediterranean coast. A social survey analysed beachgoer attendance, the quantities and types of sunscreen products used and the bathing frequencies, while the bathing water was analyzed spatially and temporally so as to quantify both mineral and organic UV filters directly released and recovered. During the peak recreational time at the three beaches, both mineral and organic UV filters were detected in higher concentrations in the bathing area than offshore. In general, higher concentrations were recovered in the water top surface layer than in the water column, giving respectively 100-900 and 20-50 µg/L for TiO₂, 10-15 and 1-3 µg/L for ZnO, 40-420 and 30-150 ng/L for octocrylene, and 10-15 and 10-350 ng/L for avobenzone. More than 75% of the 471 interviewees reported bathing every time they go to the beach, with 68% using a sunscreen product 2-6 times on average. From these data we estimated that an average mass of 52 kg/day or 1.4 t/month of sunscreen products are possibly released into bathing water for a beach attended by 3,000 people daily. The mass ratio of UV filters in such products typically ranges from 0.03 to 0.1, allowing us to propose theoretical maximum concentrations in the beach water. Our recovery of measured UV filter concentrations in seawater compared to the theoretical concentrations revealed two distinct scenarios for the mineral and organic filters. While up to 45% of the mineral filters used by beachgoers may be released into the seawater, the organic filters were minimally recovered in the environment, most likely due to internalization through the skin barrier or partial photodegradation.

Aims of this work
-to estimate the daily flux of sunscreen and UV filters transferred from beachgoers into the bathing water on a standard summer day;
-to study the possible co-occurrence of organic and mineral UV filters in seawater, both in the water top surface layer and water column;
-to determine, for the first time, the patterns of UV filter occurrence in the bathing water at three French Mediterranean beaches.
This study is the first field campaign coupling chemical water analysis to quantify both organic and mineral UV filters in seawater, with a simultaneous social survey of consumer's habits on the beach.

Scenarios of UV filter release to the water usage cycle
Among the variety of scenarios of environmental release, this work deals the direct release via recreational activities.



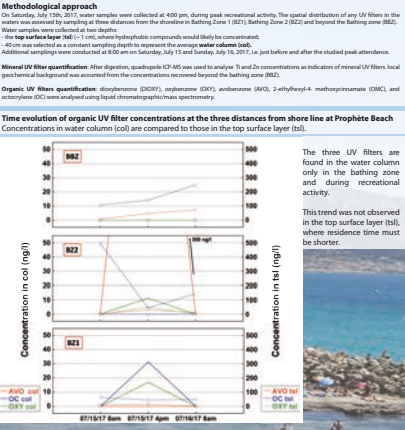
Field localisation, Marseille, Mediterranean coast, France



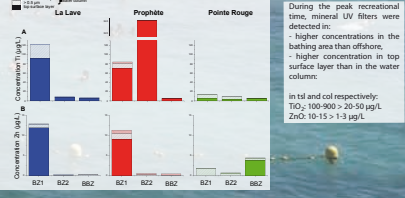
Sampling points on the three beaches studied



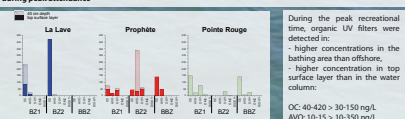
UV filter quantification in bathing water



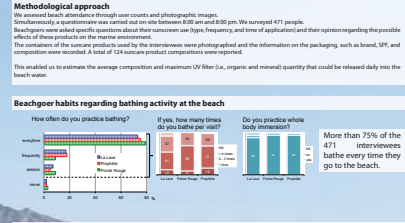
Concentrations of Ti and Zn found in different water fractions during peak attendance



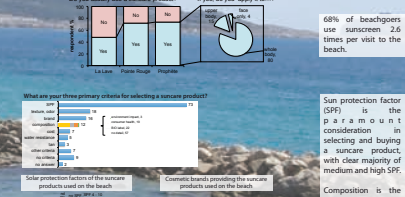
Concentrations of organic UV filters (ng/L) OC, AVO, OXY, OMC, and DIOXY found in different water fractions during peak attendance



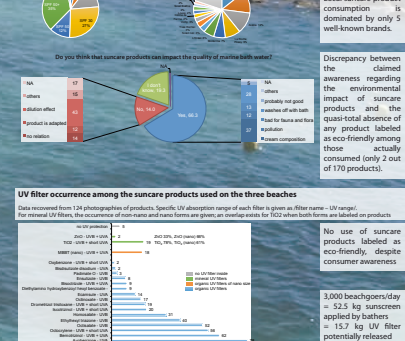
Social Survey



Sunscreen product consumption habits on the beach



UV filter occurrence among the sunscreen products used on the three beaches



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Predicted environmental concentrations of UV filters and actual recovery

