Preliminary report :

Methodology and results concerning the evaluation of surface micro- and mesoplastics pollution in Norwegian waters

Sampling performed by the ship “The Mauritius” during the summer 2020

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1. Introduction

Oceaneye is a Swiss scientific non-profit organization specialized in the analysis of plastic pollution in marine waters. Since 2015, Oceaneye is leading a global citizen science project with the aim to monitor micro- and mesoplastic pollution in surface waters around the world with the help of volunteer sailors. Thus, Oceaneye has equipped various sailing vessels, and in particular the sailing ship “the Mauritius” with scientific equipment to collect surface samples. Sampling is performed opportunistically (no pre-defined sampling program) when circumstances and weather conditions are fulfilled. The collected samples are analyzed by the Oceaneye association to produce data concerning this pollution. These data are then shared with scientists [1] and international organization and more specifically with the Grid/UN-environment [2] and soon to the monitoring program of G20 [3] and the MSFD of the European Commission [4]. For more details concerning the use of the data, please refer to our own scientific publications [5], [6], and [7].

The sailing yacht “the Mauritius” collected 11 samples between the 22.06.2020 and 30.07.2020 in Norwegian waters. The goal of this report is to present preliminary results as the analysis of the samples is still in progress (Oceaneye received more than 100 samples after the sailing season 2020). Thus, we propose to provide the final report and the raw data to the Norvegian authorities the 28th February 2021. Oceaneye's activities being of public interest and the data produced being opensource, Oceaneye remains at the full disposal of the Norwegian authorities to provide any data or information.

2. Methodology

2.1 Sampling

The samples have been collected by the ship “The Mauritius” using a "Manta Trawl" surface net tow. The Manta Trawl was placed on the windward side of the ship at a distance of 2.0 m off the hull to avoid any wake effect of the ship. The net has a mesh size of 0.33 mm, and the size of the inlet flow rectangular opening is 0.6 m×0.15 m. The samples were collected at a target speed of 3 kn in wind conditions between 0 and 20 kn. The duration of the trawl was of 30 min. The filtered volume of water was measured with a mechanical flowmeter (Hydrobios 438 110). The wind speed has been recorded every 5 min, and the sea conditions were classified in three categories following the Douglass scale : slight (wave height <0.5 m), smooth (0.5 m<wave height<1.25 m) and moderate (1.25<wave height<2.5 m). Samples were stored in plastic pockets with salt and under vacuum at room temperature and protected from exposure to light.

2.2 Sample analysis

Samples were first sieved through 5.0 mm and 1.0 mm square mesh sieves (VWR) to separate mesoparticles from microparticles, and rinsed with water. The resulting filtrate was placed in Petri dishes, and observed through a stereo microscope (Leica EZ4W). All particles were visually identified, separated from the plankton and sorted into six form categories based on that of Shaw and Day 1994 [8] —fragments from larger pieces, pellets (including preproduction pellets as well as smaller cosmetics microbeads), lines (fishing lines and synthetic fibres), thin films, foams and other particles (tar, glass, etc.). Once dried for 1 week at room temperature, the particles of each category were counted and weighted (Mettler Toledo AT261, accuracy 0.1 mg).

2.3 Correction due to the effect of wind mixing

Kukulka et al. 2012 demonstrated that plastic debris is vertically distributed within the upper water column due to wind-driven mixing and that surface net tows cannot account for the total amount of plastic pieces in the upper ocean mix layer, except in low wind conditions (u_{10}<4 m/s). An estimation model [9] based on wind speed measurement can be used to improve the estimation of the total amount of plastic in the wind-mixed surface layer.

3. Results

The final results will be provided on February 28, 2021, in the form of a map and a summary table in this report and as raw data in an attached excel file.

The variables in the table below are as follows:

Id = name of the sample
Date = date of sampling in mm/dd/yyyy
Lat = latitude of net launching in degrees, minutes and decimals of minutes
Long = longitude of net launching in degrees, minutes and decimals of minutes
U_{10} = wind speed at 10 meters in knots
C_{micro_num} = number concentration of microplastics (1.0 <= siewing diameter < 5.0 mm) in items/km^2
C_{micro_mg} = mass concentration of microplastics (1.0 <= siewing diameter < 5.0 mm) in mg/km^2
C_{meso_num} = number concentration of mesoplastics (siewing diameter >= 5.0 mm) in items/km^2
C_{meso_mg} = mass concentration of mesoplastics (siewing diameter >= 5.0 mm) in mg/km^2
C_{tot_num} = number concentration of total plastics (siewing diameter >= 1.0 mm) in items/km^2
C_{tot_mg} = mass concentration of total plastics (siewing diameter >= 1.0 mm) in mg/km^2

Id	Date	Lat	Long	U_{10}	C_{micro_num}	C_{micro_mg}	C_{meso_num}	C_{meso_mg}	C_{tot_num}	C_{tot_mg}
MAU_2020_4	6/22/2020	N 60°55.70'	E 004°23.62'	11.5						
MAU_2020_5	6/24/2020	N 64°02.67'	E 009°34.99'	11.5						
MAU_2020_6	6/27/2020	N 66°23.77'	E 012°58.88'	10.8						
MAU_2020_7	6/28/2020	N 68°09.24'	E 014°45.52'	15.1						
MAU_2020_8	6/30/2020	N 69°08.42'	E 017°41.88'	11.8						
MAU_2020_9	7/17/2020	N 70°59.66'	E 020°36.54'	8.6						
MAU_2020_10	7/18/2020	N 73°16.07'	E 019°44.07'	6.6						
MAU_2020_11	7/20/2020	N 75°49.02'	E 017°32.74'	3.8						
MAU_2020_12	7/21/2020	N 77°37.96'	E 013°32.92'	5.3						
MAU_2020_13	7/26/2020	N 78°30.66'	E 016°05.40'	4.0						
MAU_2020_14	7/30/2020	N 78°58.39'	E 011°14.42'	3.1						

4. Conclusions

We wish to thank all the crew of the Mauritius for their contribution to this project. The data will be shared with several scientists and the results used and interpreted in future scientific publications. We also would like to thank the Norwegian authorities for their permission to carry out this project in their territorial waters. Oceaneye remains at the disposal of national authorities for further information.

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References

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https://app.mapx.org/static.html?views=MX-MKEVU-V3UVX-UMQEX&zoomToViews=true&language=en&

[3] https://g20mpl.org/

[4] https://emodnet.eu/en

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