European Geosciences Union

PLASTILAC

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The plastic contamination: key Numbers

Global plastic pollution

- Nearly 400 million tons of plastic produced each year
- 1/3 end up in the environment
- 80% of the plastic found in the oceans come from terrestrial ecosystems *(A. L. Andrady, « Microplastics in the marine environment », Marine Pollution Bulletin, vol. 62, n° 8, p. 1596-1605, 2011)*

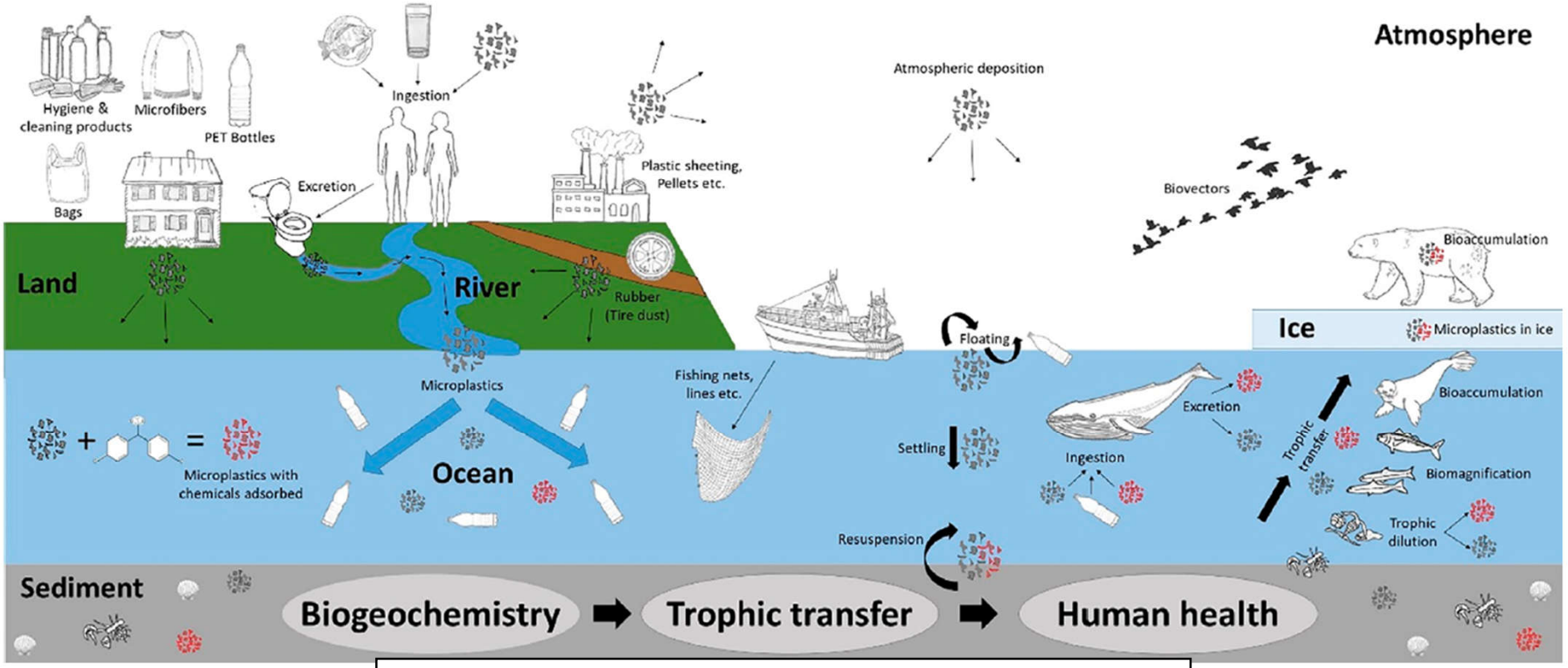
Microplastic pollution

- Particle sizes ranging from 1 µm to 5 mm
- Microplastics can undergo long range transportation (> 1000 km) over the ocean *(X. Wang, C. Li, K. Liu, L. Zhu, Z. Song, et D. Li, « Atmospheric microplastic over the South China Sea and East Indian Ocean: abundance, distribution and source », Journal of Hazardous Materials, vol. 389, p. 121846, 2020)*
- Multiple sources: wastewater discharge, fragmentation of macro/mesoplastics, tyre abrasion, atmospheric deposition, etc.

Environmental transfers of microplastics

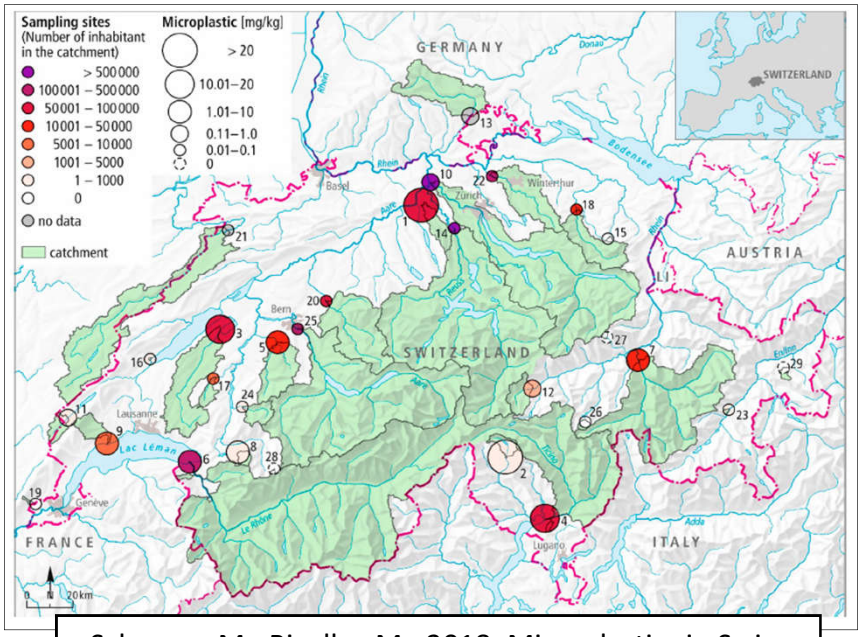
Environmental Science & Technology

Viewpoint

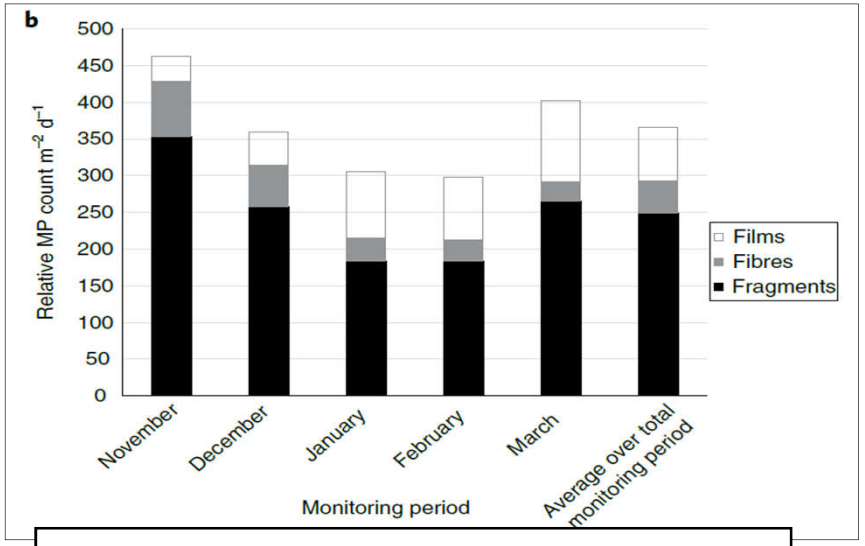


The Plastic Cycle: A Novel and Holistic Paradigm for the Anthropocene
Michael S. Bank and Sophia V. Hansson
Environmental Science & Technology **2019** *53* (13), 7177-7179
DOI: 10.1021/acs.est.9b02942

Microplastics in mountainous ecosystems?



Scheurer, M., Bigalke, M., 2018. Microplastics in Swiss Floodplain Soils. Environ. Sci. Technol. 52, 3591–3598. https://doi.org/10.1021/acs.est.7b06003



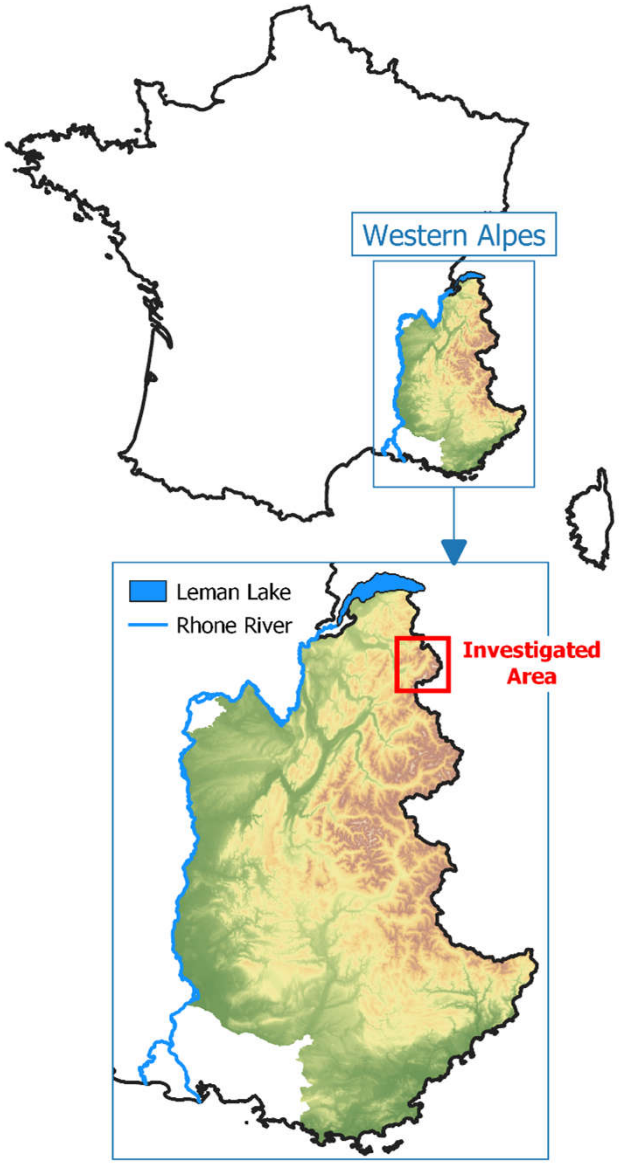
Allen et al., 2019. Atmospheric transport and deposition of microplastics in a remote mountain catchment. Nat. Geosci. 12, 339–344. https://doi.org/10.1038/s41561-019-0335-5

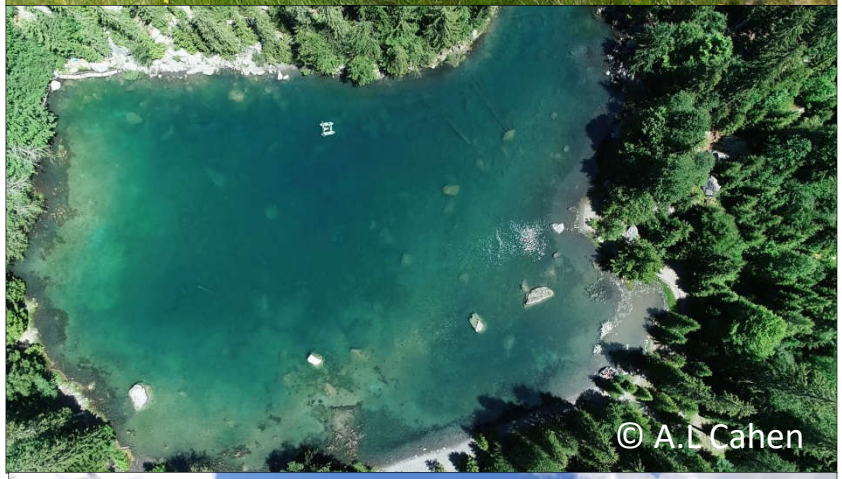
According to literature:

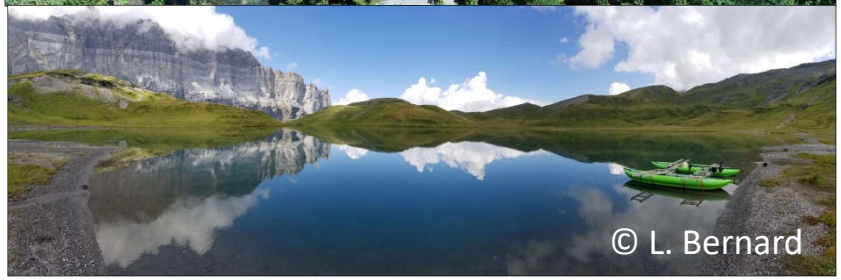
- Plastic microparticles can be found in large amount in alpine soils
- Atmospheric deposition is an input pathway of µP to remote ecosystems

As integrators of atmospheric deposition, **remote elevated lakes** are great study sites to **understand the µP contamination of aquatic ecosystems** from the start

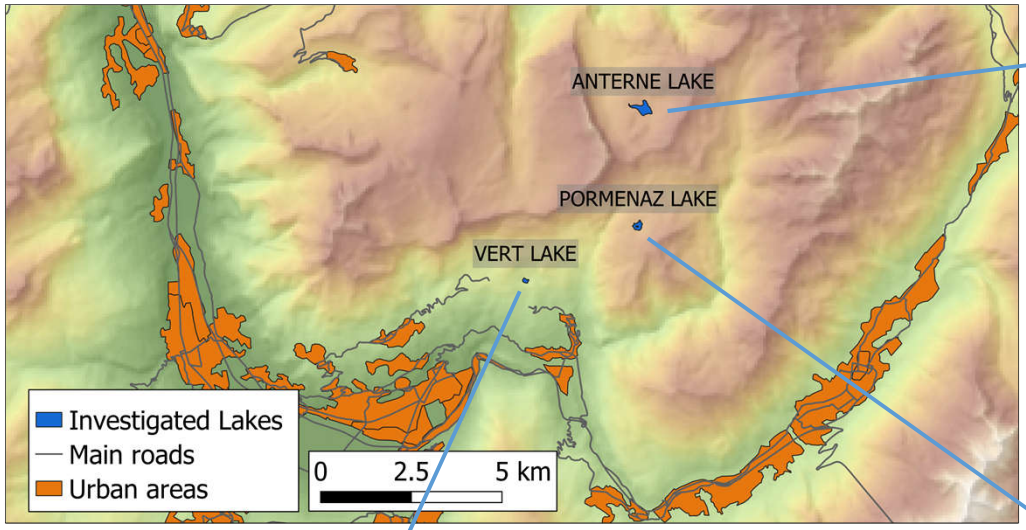
PLASTILAC: Microplastics in elevated lakes?

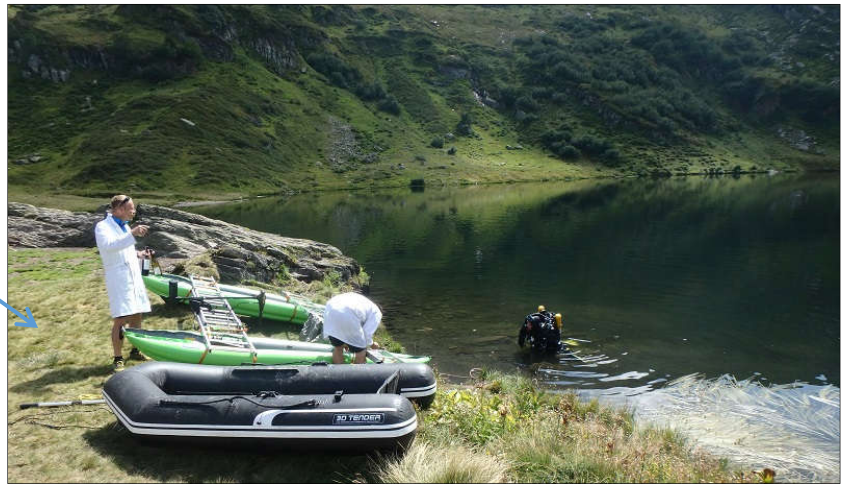


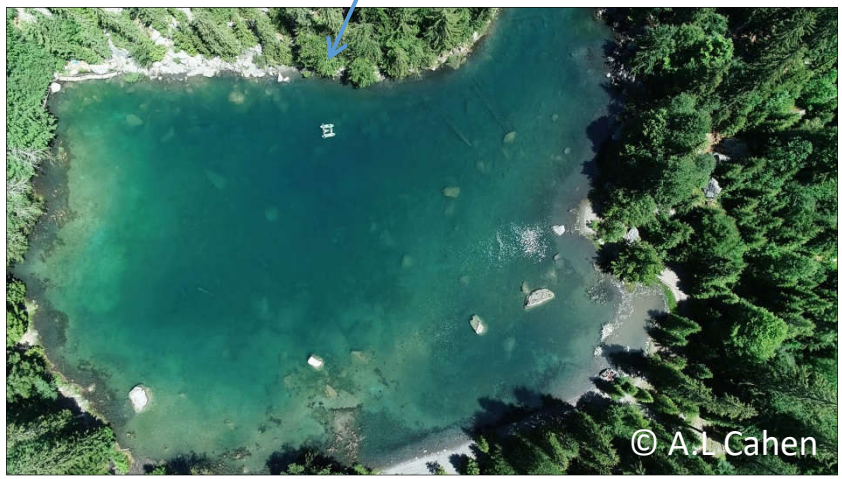




3 investigated lakes







Lacs	Area [ha]	Depth [m]	Alti. [m]
Vert	1,5	9,3	1267
Pormenaz	4,4	9,5	1945
Anterne	11,1	13,2	2060

Monitoring the µP contamination in remote lakes

Mantamaran

Continuous monitoring of the filtration speed

Mantamaran

- Specifically designed to collect µP in remote lakes
- Man portable
- Powered by electric engine

Filtration

- 50 µm inox mesh
- Samples last for ~ 30 minutes to filter 100 to 200 m^3
- Velocity flow within the net is monitored though the sampling to insure there is no clogging

Monitoring of incoming and outgoing fluxes

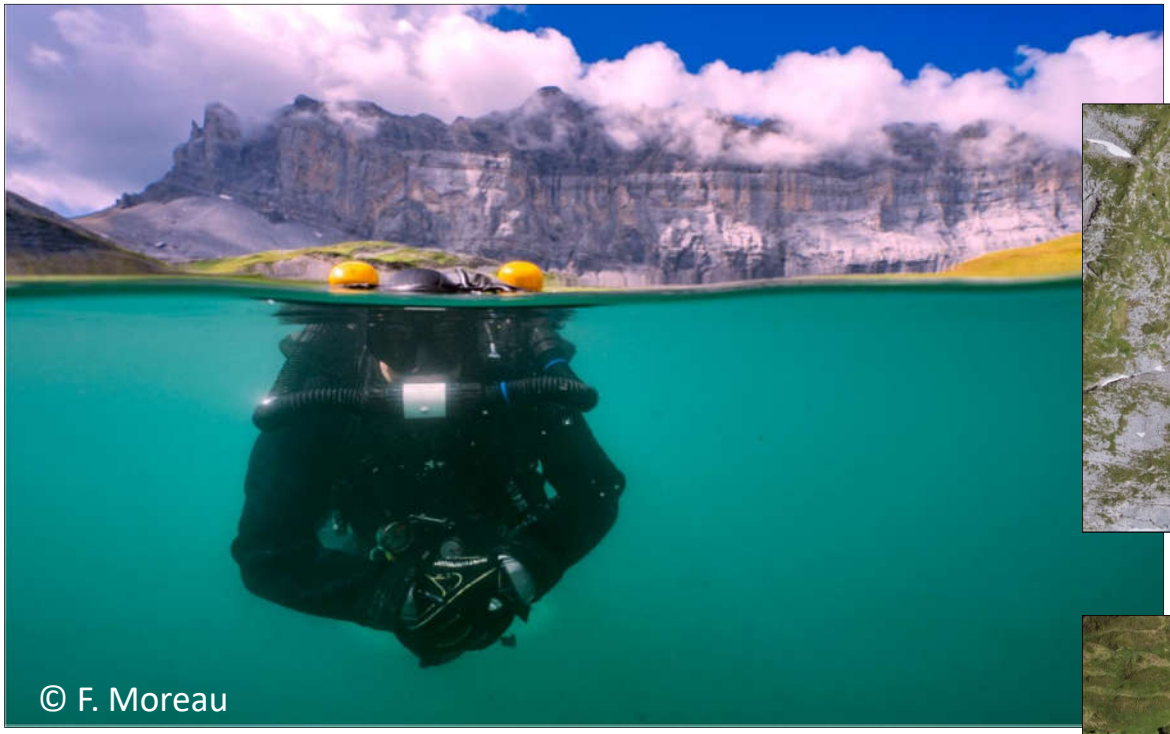
Tributaries and outlets

Atmospheric deposit

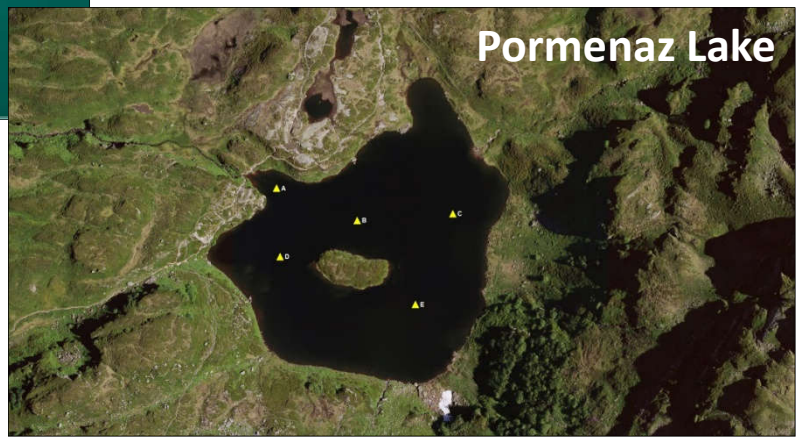
Tributaries and outlet: device similar to the net used for the water column. Flow velocity is also monitored through the experiment.

Atmospheric deposition: 0.6 m² collector combined to a 50 µm inox mesh. Sampling for 1 to 2 months.

Monitoring the µP contamination in sediment



Sediment sampling locations

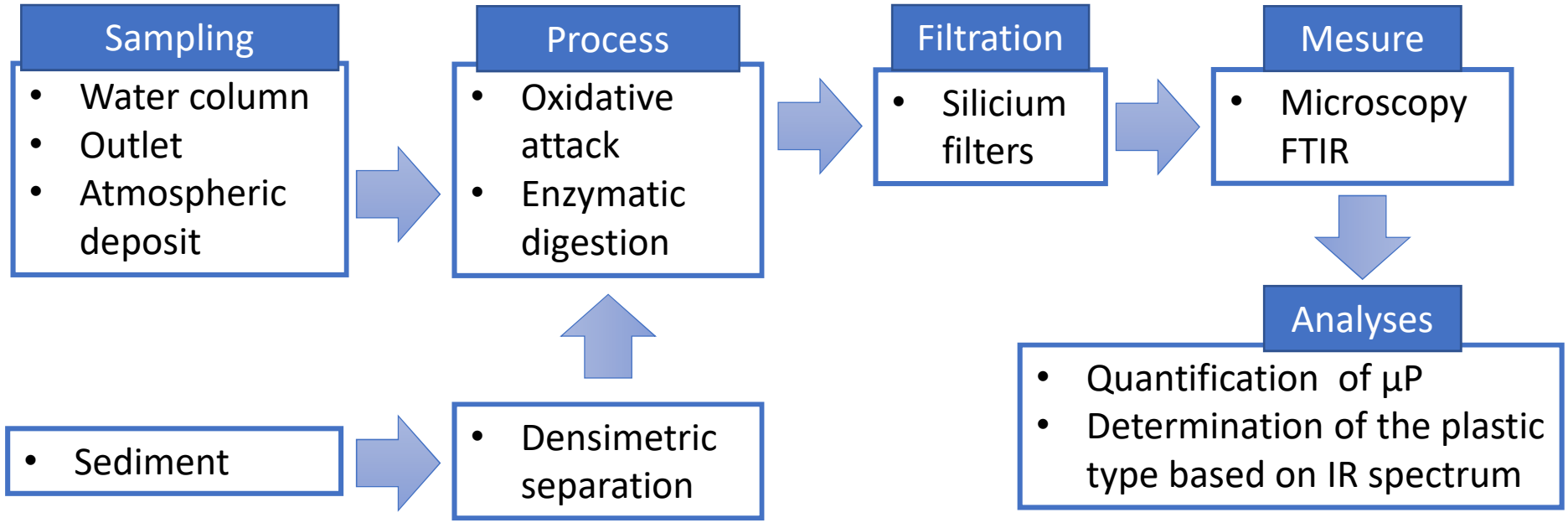


Sediment sampling locations

Sediment:

- samples collected by scuba divers
- Bulk sampling of the 5 top centimetres
- Direct observation of the lake bottom by divers helps choose the best sampling strategy

Analyses workflow



To prevent contamination:

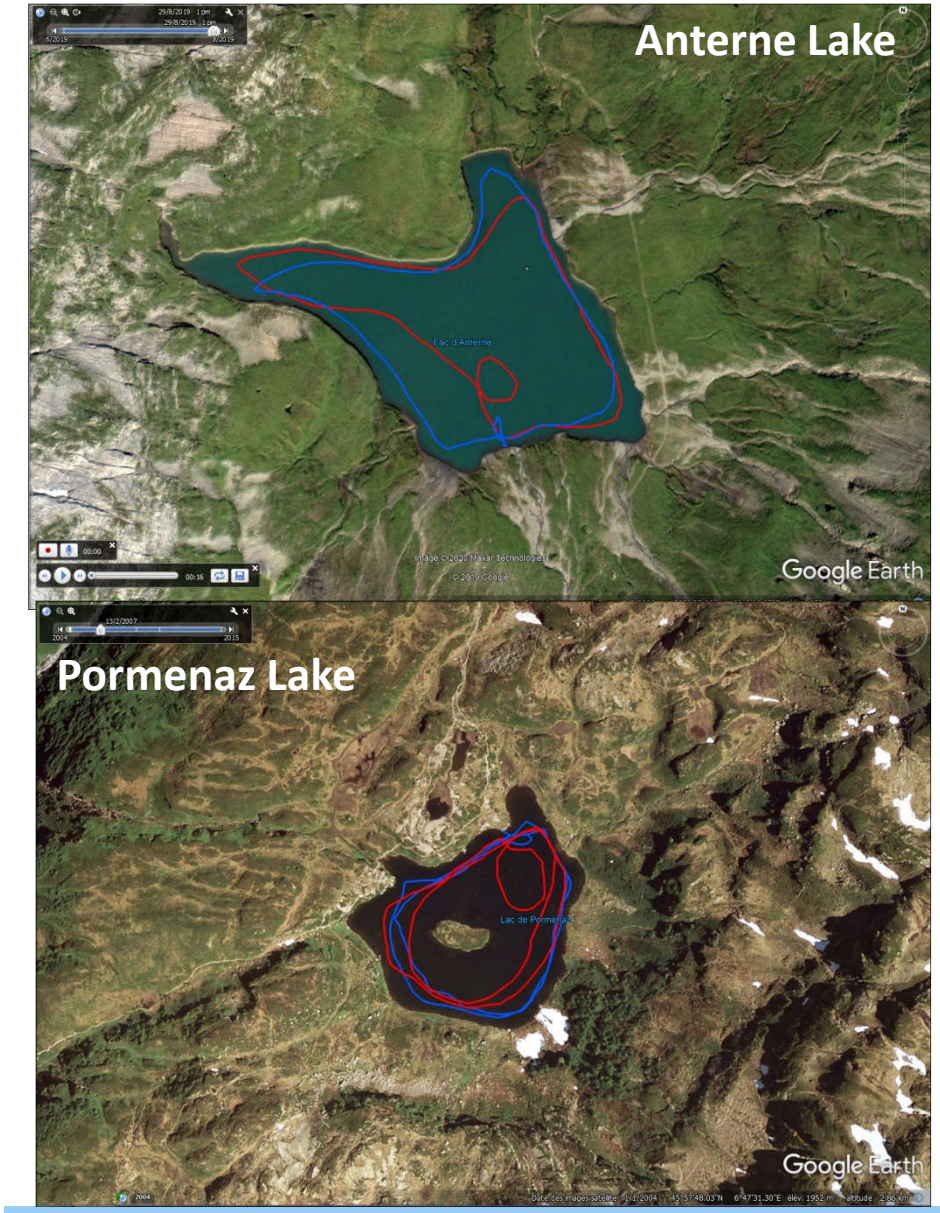
- Field blanks
- Lab blanks
- The IR spectra of plastic tools used during the field campaign were added to the spectrum library used for the µP analyses

2019 field campaign

Sampling	Vert Lake	Anterne Lake	Pormenaz Lake
Water column	1	2	2
Outlet	0	1	1
Sediment	8	9	5
Atmospheric deposit	-	2	-

→ Analyses of the water column samples at LEESU (University Paris Est Creteil)
→ Analyses of sediment, atmospheric deposit and outlet at USMB (University Savoie Mont Blanc) postponed due to Covid-19 outbreak

First results



Due to the **corona outbreak** and the resulting lab closure, **95% of the samples have not been analysed yet** and the following **results must be cautiously considered**

Anterne Lake (water column #2):

- Filtered volume: 118 m^3
- Methodological issues related to rock flour
- Microplastics : 2 fibres
  - ➢ **No significant contamination**

Pormenaz Lake (water column #2) :

- Filtered volume: 130 m^3
- Microplastics: 156 fibres
  - ➢ **1,2 microfibers per m^3**

Discussion

The two lakes are 3km apart and
there is a significant difference in the µP contamination

Hypothesis 1: Anterne Lake sample poorly processed due to rock flour (underestimated contamination)

→ Ongoing analysis of the 2nd sample

Hypothesis 2: Temporary contamination of Pormenaz Lake (overestimated contamination)

→ Ongoing qualitative analysis of the sample and analysis of the 2nd sample

Hypothesis 3: The contamination difference is related to contrasting atmospheric deposit

→ Analysis of meteorological data and of the sediment samples

Hypothesis 4: The contamination difference is related to contrasting sediment dynamics (scavenging)

→ Analysis of sediment samples

Conclusions

1. Presence of microplastics in certain altitude lakes
2. Great spatial variability of the µP contamination
3. Limited contamination in comparison to urban water bodies
4. Contamination mainly due to fibres
5. Methodological issues specific to altitude lakes
6. Influence of the contamination mode on the type of PM to be studied
7. Duration of contamination is a crucial parameter to consider for future studies

Acknowledgement

FINANCIAL SPONSORS

NGO & ACADEMIC COLLABORATORS