



## PLASTILAC



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# The plastic contamination: key Numbers



## Global plastic pollution

- Nearly 400 million tons of plastic produced each year
- A significant part ends 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  $\mu\text{m}$  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.

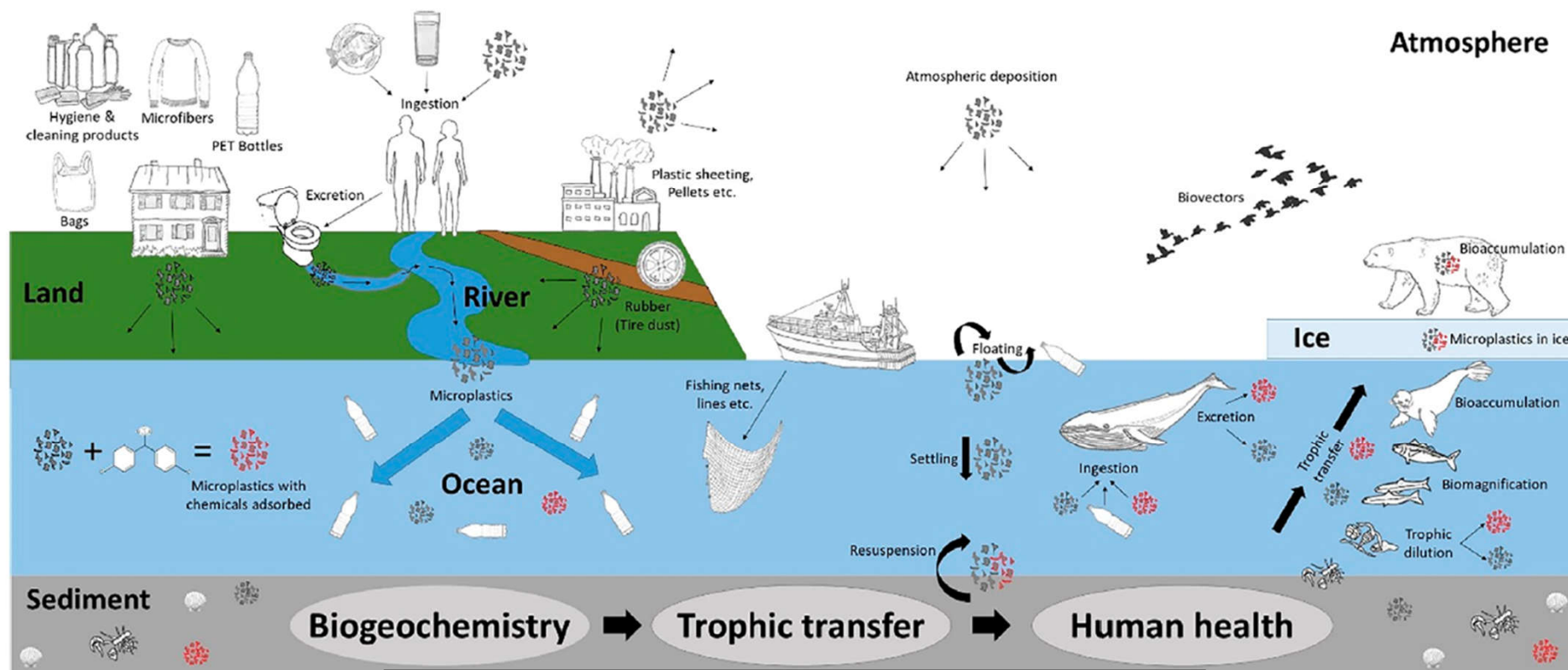


# Environmental transfers of microplastics



Environmental Science & Technology

Viewpoint



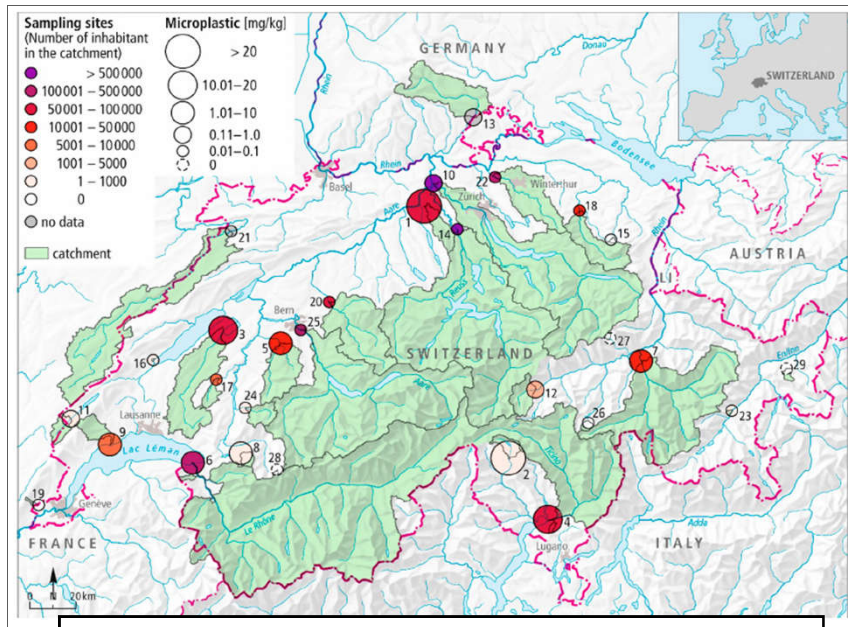
## The Plastic Cycle: A Novel and Holistic Paradigm for the Anthropocene

Michael S. Bank and Sophia V. Hansson

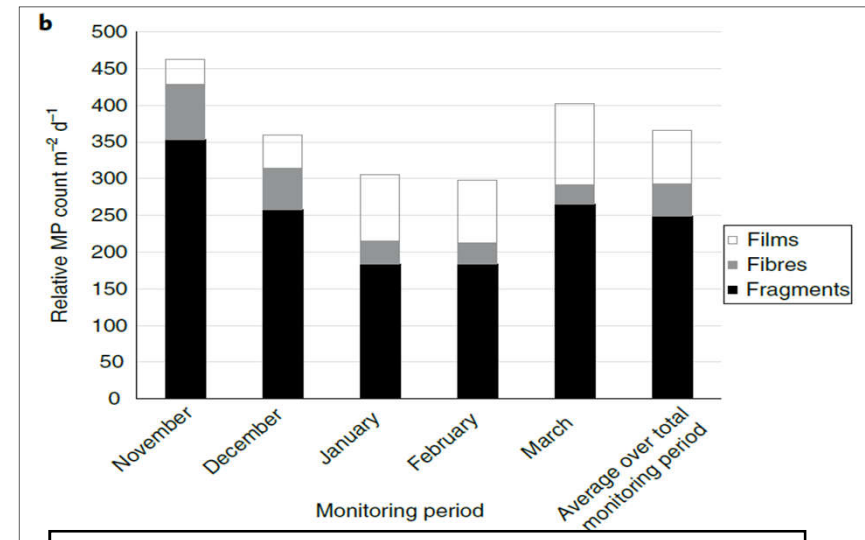
*Environmental Science & Technology* **2019** 53 (13), 7177-7179

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>

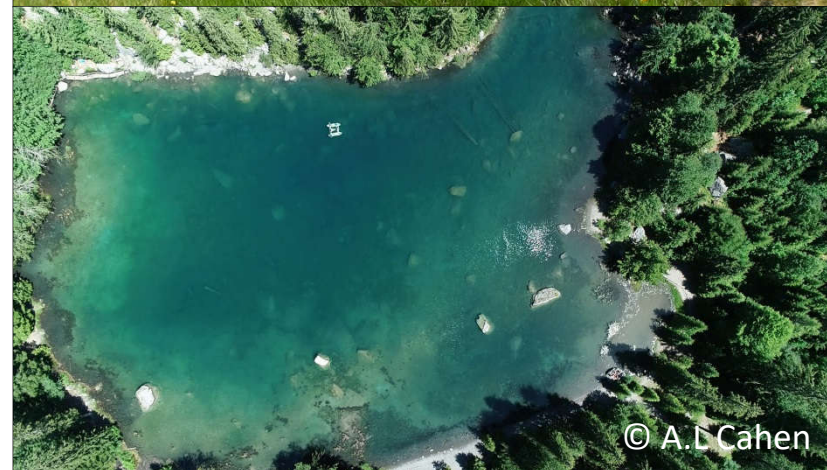
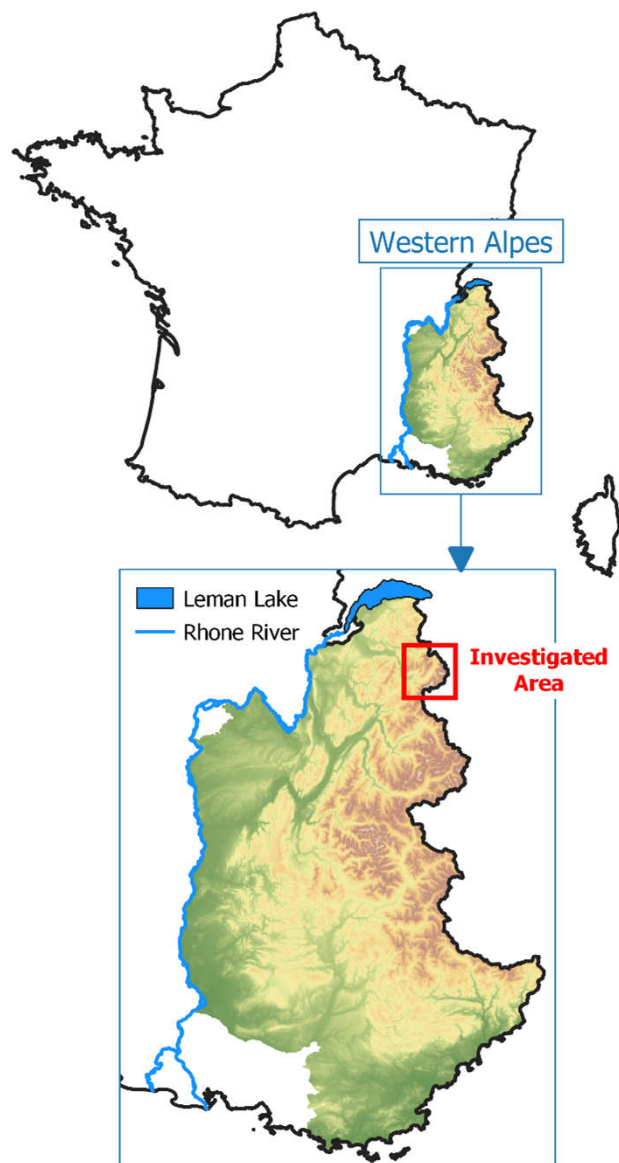
According to literature:

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

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

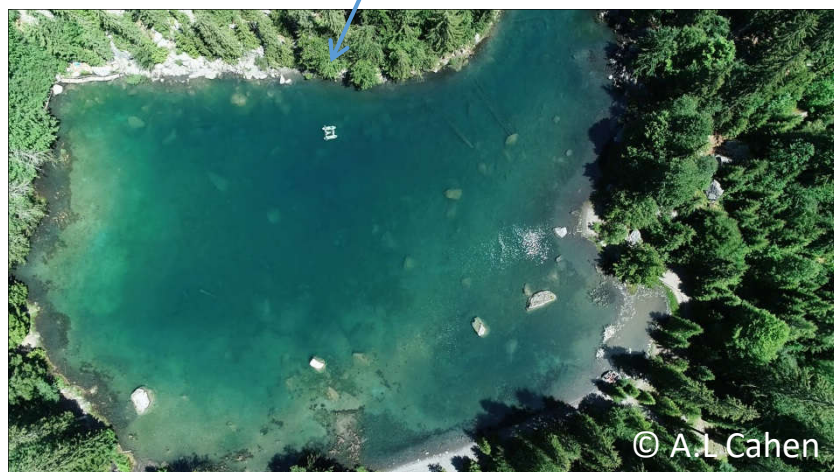
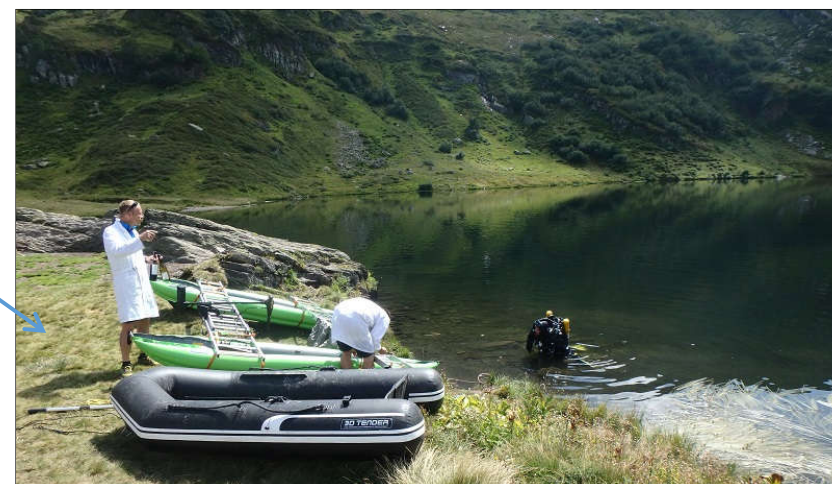
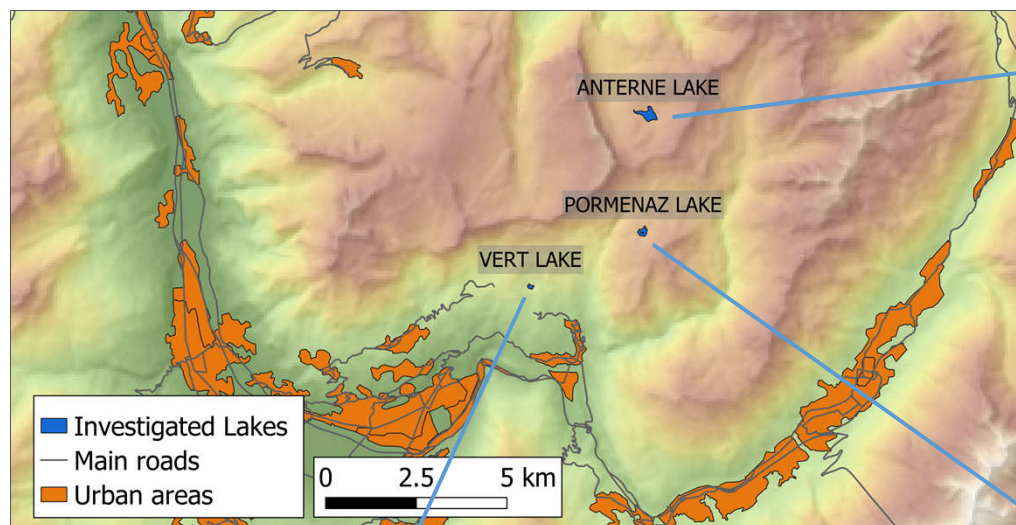
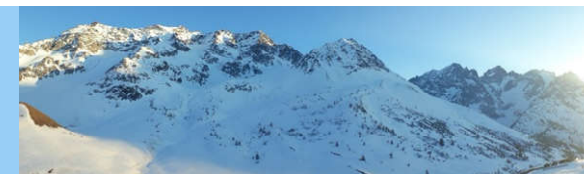


# PLASTILAC: Microplastics in elevated lakes?



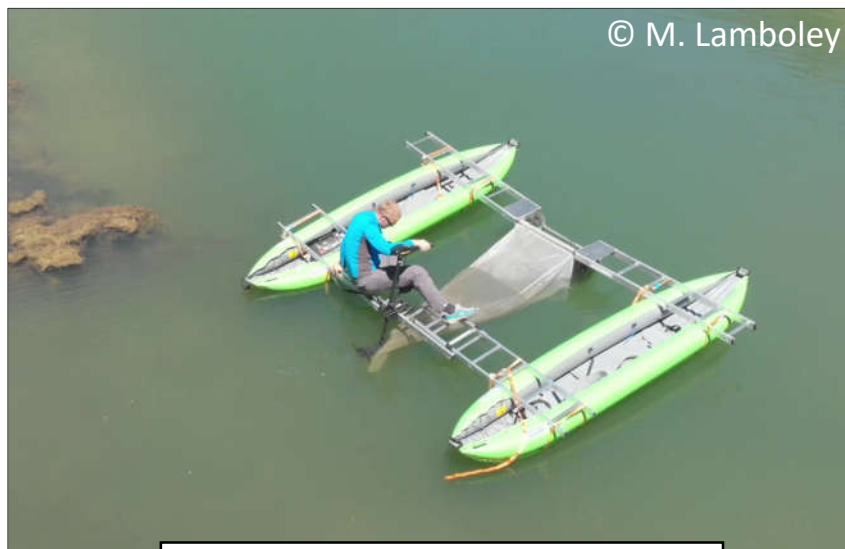


### 3 investigated lakes



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 MP contamination in remote lakes



Mantamaran



Continuous monitoring of the filtration speed

## Mantamaran

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

## Filtration

- 50  $\mu\text{m}$  inox mesh
- Samples last for  $\sim 30$  minutes to filter 100 to 200  $\text{m}^3$
- 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



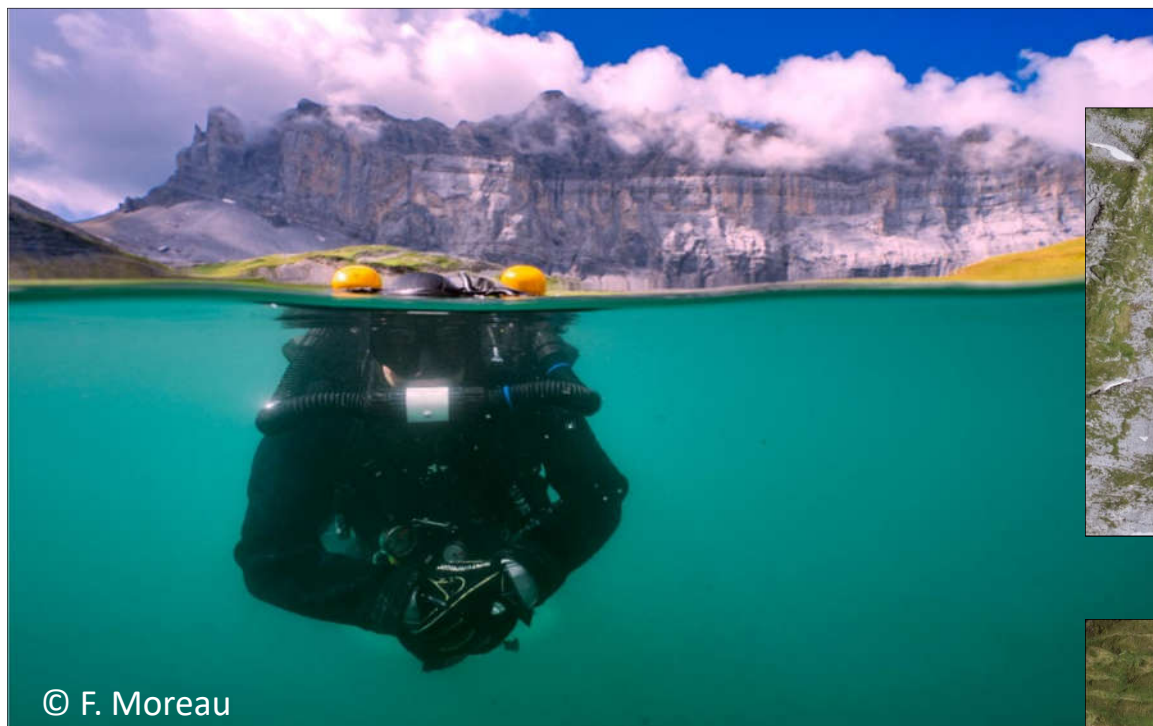
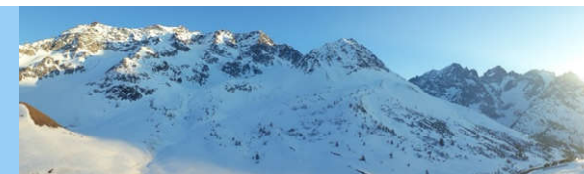
**Tributaries and outlet:** device similar to the net used for the water column. Flow velocity is also monitored through the experiment.

**Atmospheric deposition:** 0.6 m<sup>2</sup> collector combined to a 50 µm inox mesh. Sampling for 1 to 2 months.

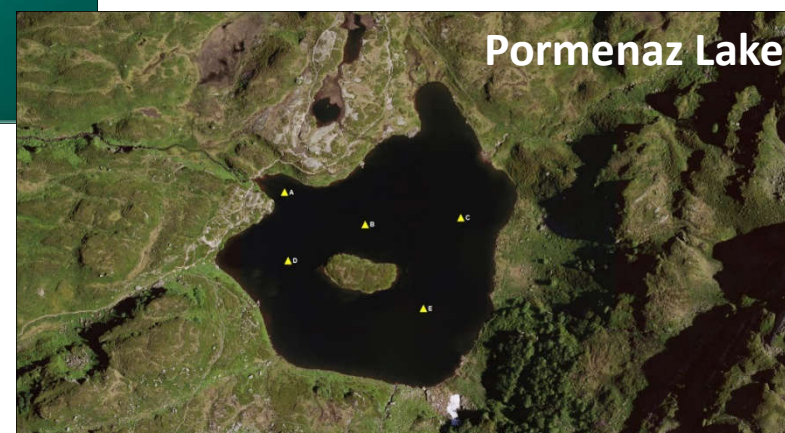




## Monitoring the MP contamination in sediment



*Sediment sampling locations*

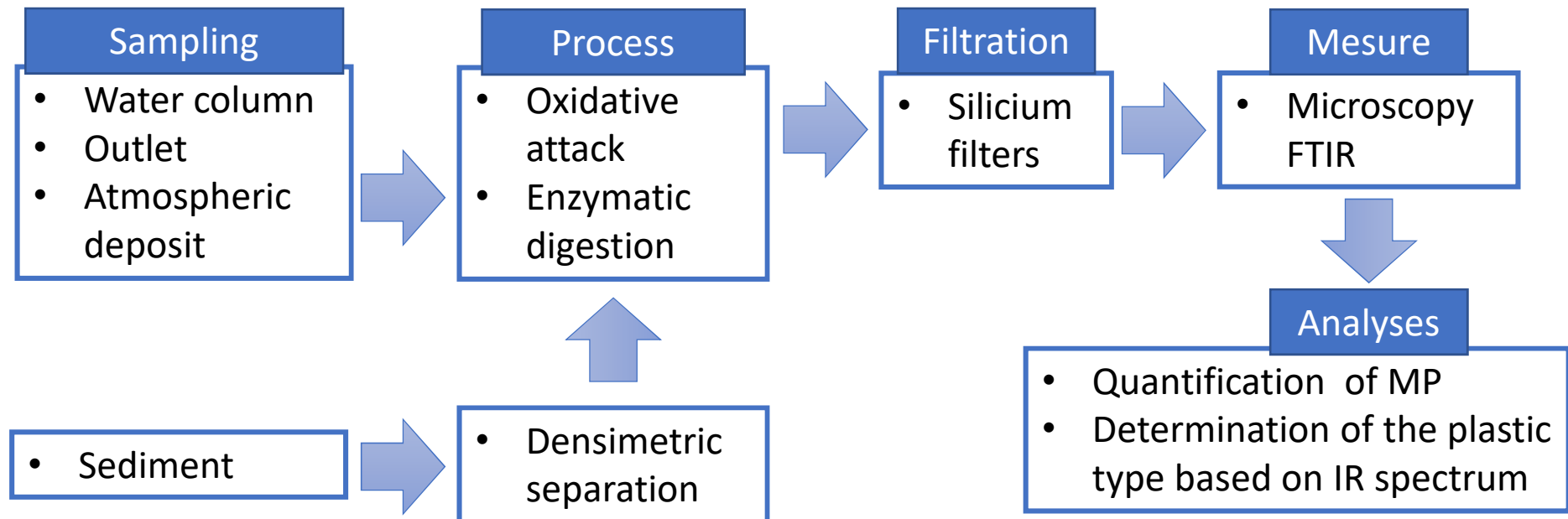


*Sediment sampling locations*

### **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 MP analyses



## 2019 field campaign

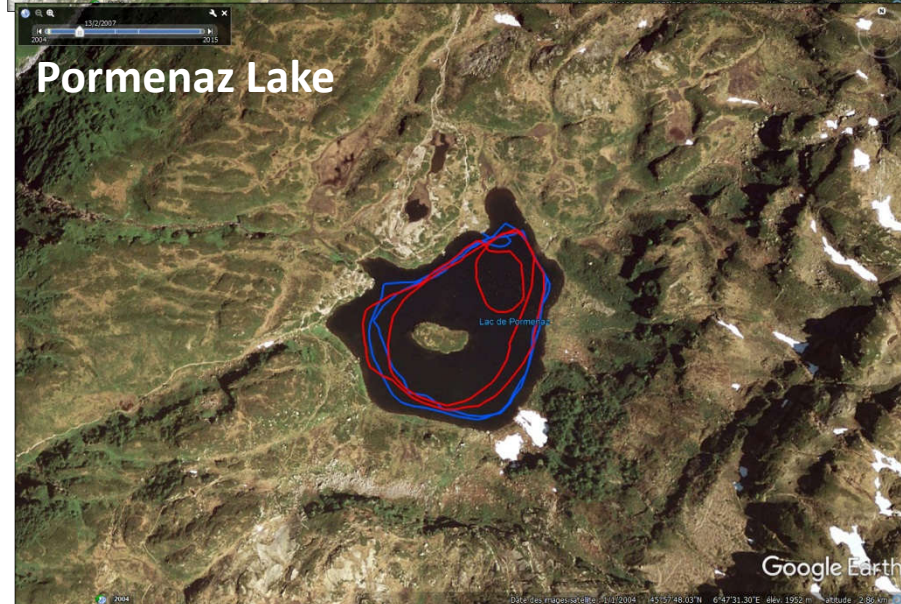
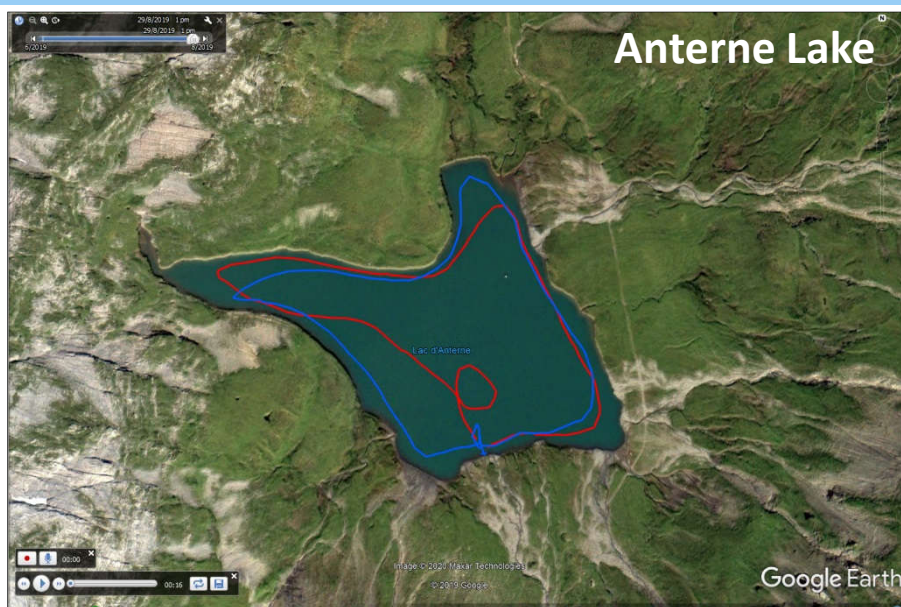
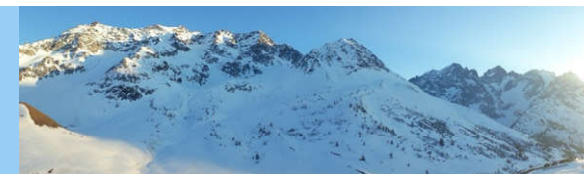


Sampling	Vert Lake	Anterne Lake	Pormenaz Lake
Water column	1	2	2
Outlet	0	1	1
Sediment	8	9	5
Atmospheric deposit	-	2	-



→ 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<sup>3</sup>
  - Methodological issues related to rock flour
  - Microplastics : 2 fibres
- **No significant contamination**

### Pormenaz Lake (water column #2) :

- Filtered volume: 130 m<sup>3</sup>
  - Microplastics: 156 fibres
- **1,2 microfibers per m<sup>3</sup>**



## Discussion



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

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

→ Ongoing analysis of the 2<sup>nd</sup> sample

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

→ Ongoing qualitative analysis of the sample and analysis of the 2<sup>nd</sup> sample

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

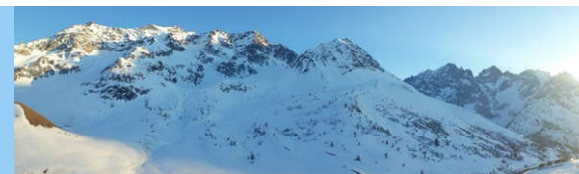
→ Analysis of meteorological data and of the sediment samples

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

→ Analysis of sediment samples



## Conclusions

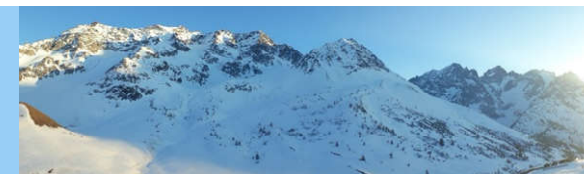


1. Presence of microplastics in certain altitude lakes
2. Great spatial variability of the MP contamination
3. Limited contamination in comparison to urban water bodies
4. Contamination mainly due to fibres
5. Methodological issues specific to altitude lakes
6. Influence of the contamination mode on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





## Acknowledgement



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