WITH THE CONTRIBUTION OF THE LIFE FINANCIAL INSTRUMENT OF THE EUROPEAN UNION
LIFE16ENV/IT/000488 - LIFE PHOENIX

Perfluorinated compounds
HOlistic ENvironmental
Interinstitutional eXperience

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Monitoring of PFAS in edible crops of an area impacted by a fluorochemical plant

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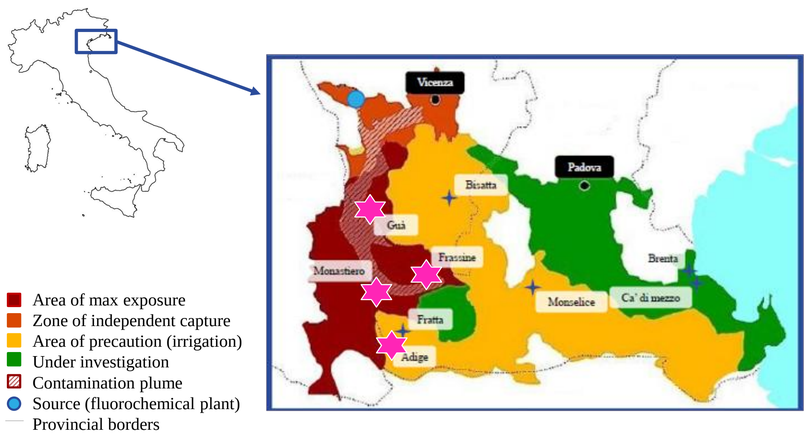
The Case Study

- A large-scale contamination with PFAAs was discovered in Veneto Region, Northern Italy, in 2013 as consequence of the emissions from a **fluorochemical plant** (Valsecchi et al., 2015; WHO, 2017)
- PFAS discharge started from '70 affecting a recharge area of groundwater in Veneto plain with impacts in both ground- and surface waters
- **Persistence** and **Mobility** characteristics of contaminants made possible that in **50 years** the pollution has spread over an area of about **540 km²**, involving three Provinces (Vicenza, Padova and Verona, **350,000 inhabitants**)
- Veneto Region authorities matched the biomonitoring study (Ingelido et al., 2018) to the drinking water chemical analyses to define 3 different health impacts area (**Red**, **Yellow** and **Green**)
- Even though elevated serum PFAAs concentrations were detected in the residents connected with contaminated water consumption, comprehensive health risk assessment considering the food consumption are still lacking, taking into consideration that mobile and water soluble molecules such as **short chain PFAS** are more prone to be **up-taken from vegetables**

Sampling Area

Veneto Region, Northern Italy



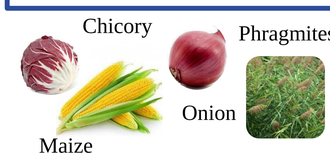
Sampling Activity

Abiotic matrices

Water: once a month → LC-MS/MS

Soil: once in July and once in October near the collected plant → *extraction with methanol and water (50:50) in alkaline conditions* → LC-MS/MS

Biotic matrices



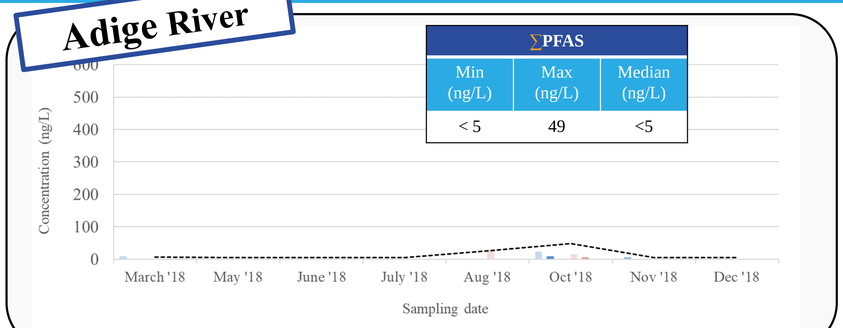
extraction with acetonitrile after drying of samples → LC-MS/MS

once in July and once in October

PFAS in irrigation Waters

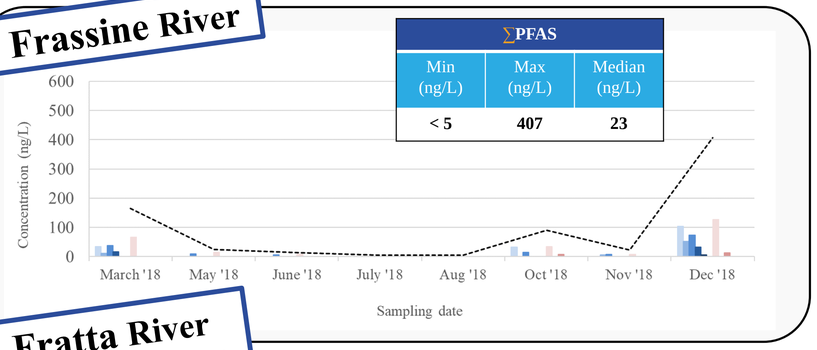
Adige River

∑PFAS		
Min (ng/L)	Max (ng/L)	Median (ng/L)
< 5	49	<5



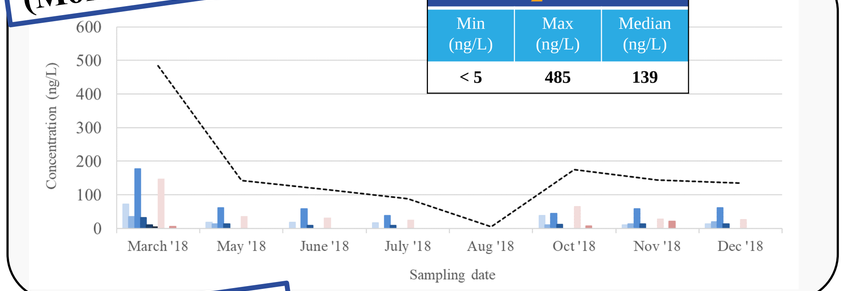
Frassine River

∑PFAS		
Min (ng/L)	Max (ng/L)	Median (ng/L)
< 5	407	23



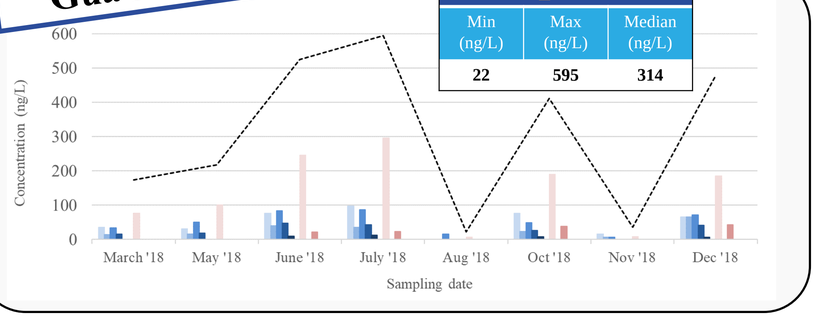
Fratta River (Monastero site)

∑PFAS		
Min (ng/L)	Max (ng/L)	Median (ng/L)
< 5	485	139



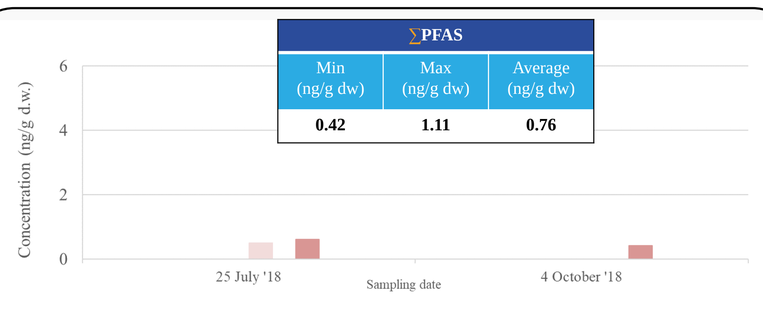
Guà River

∑PFAS		
Min (ng/L)	Max (ng/L)	Median (ng/L)
22	595	314

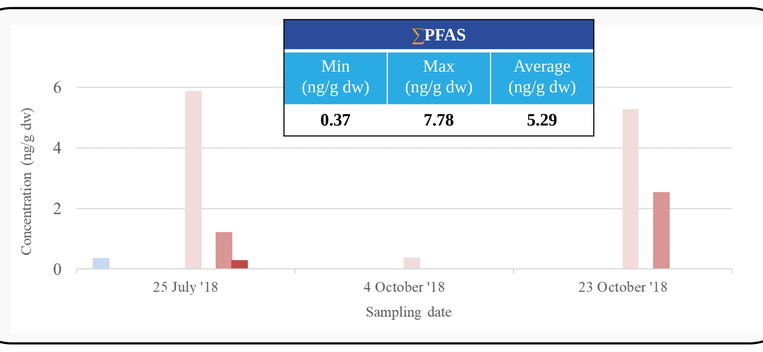


PFAS in agricultural Soil

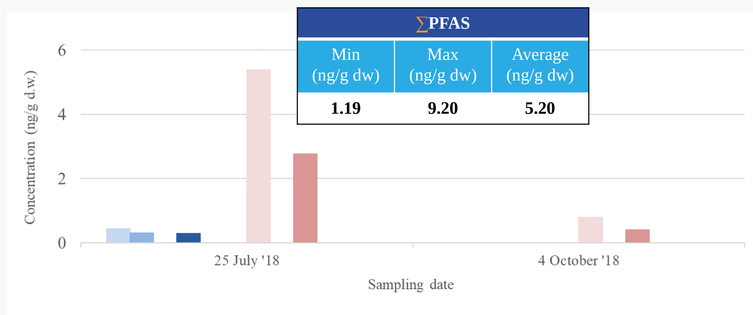
∑PFAS		
Min (ng/g dw)	Max (ng/g dw)	Average (ng/g dw)
0.42	1.11	0.76



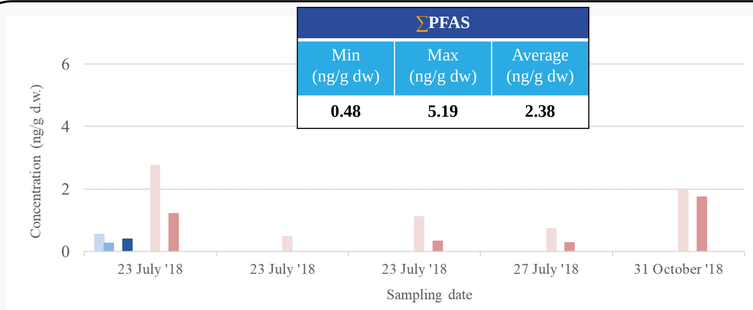
∑PFAS		
Min (ng/g dw)	Max (ng/g dw)	Average (ng/g dw)
0.37	7.78	5.29



∑PFAS		
Min (ng/g dw)	Max (ng/g dw)	Average (ng/g dw)
1.19	9.20	5.20

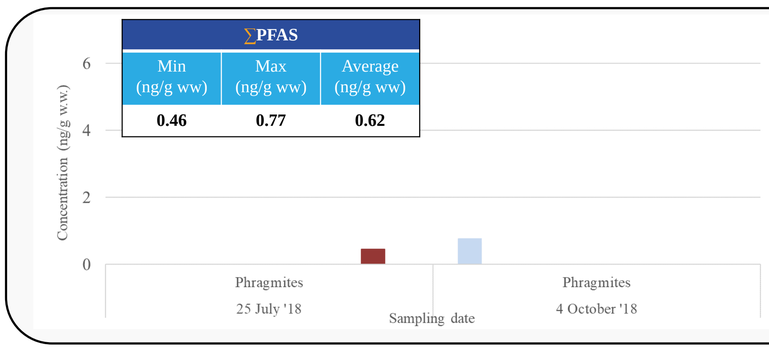


∑PFAS		
Min (ng/g dw)	Max (ng/g dw)	Average (ng/g dw)
0.48	5.19	2.38

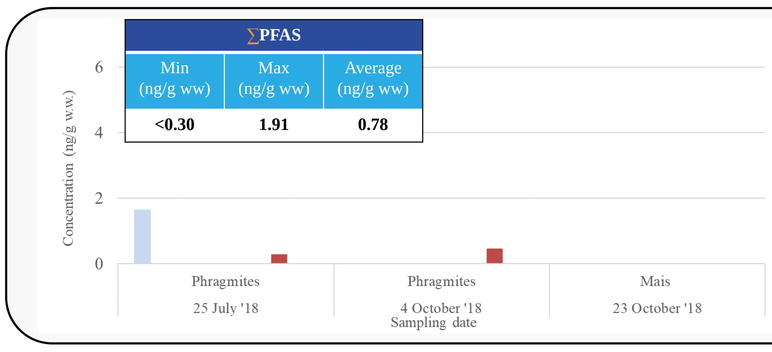


PFAS in aquatic and edible Plants

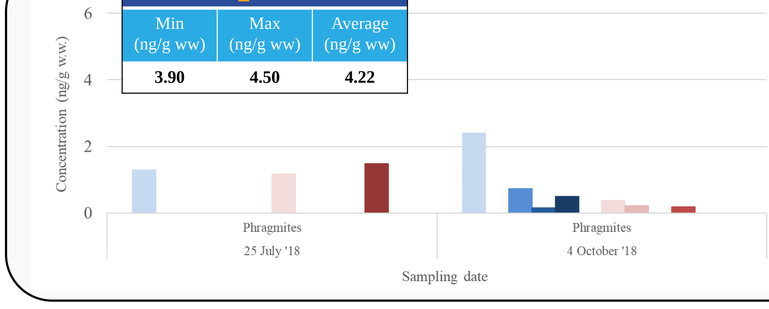
∑PFAS		
Min (ng/g ww)	Max (ng/g ww)	Average (ng/g ww)
0.46	0.77	0.62



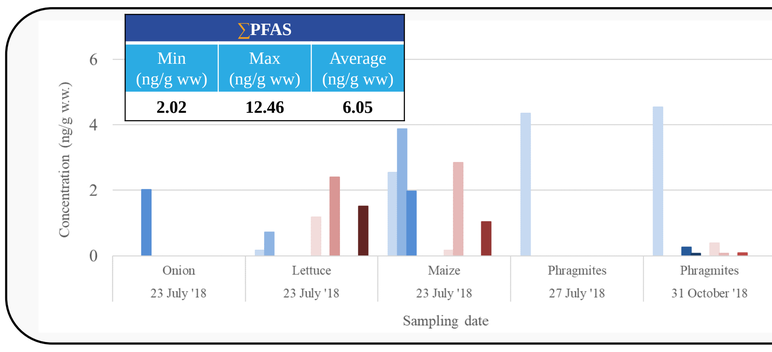
∑PFAS		
Min (ng/g ww)	Max (ng/g ww)	Average (ng/g ww)
<0.30	1.91	0.78



∑PFAS		
Min (ng/g ww)	Max (ng/g ww)	Average (ng/g ww)
3.90	4.50	4.22



∑PFAS		
Min (ng/g ww)	Max (ng/g ww)	Average (ng/g ww)
2.02	12.46	6.05



PFBA PFPeA PFBS PFHxA PFHpA PFHxS PFOA PFNA PFOS PFDA PFUnDA PFDoDA ------Σ Tot

LIFE PHOENIX Monitoring Plan

- LIFE PHOENIX project envisages an extensive monitoring program to assess the diffusion and impacts of PFAS in different environmental matrices (**water, soil, plants**) of agriculture land in the three areas
- The planned monitoring has been carrying out in 10 selected sampling stations, which are representative of the framed area with different levels of PFAS pressures
- Surface water is source of **irrigation waters** for all sites and in all the stations ubiquitous **aquatic vegetal species** (*Phragmites australis)* and **edible vegetables** (*Zea mais, Lactuca sativa, Cichorium intybus, Allium cepa)* were collected. Where terrestrial vegetal species are present, soil samples was collected during 3 different irrigation periods, at the max supply of river water On the selected sampling sites surface and ground-waters, vegetables (3 different periods of the irrigation season for 24 months), soil and animals (3 periods every 12 months) were analyzed.
- The monitoring activity started in Spring 2018 and will last in Spring 2020

Preliminary Results

- In the plots 4 sites are shown, representative of different water sources and levels of PFAS pollution
- **Irrigation waters**: total PFAS contamination ranges from <LOQ up to 600 ng/L, but the monthly variability is very high due to different contributions to the water sources along the year
- **Soil**: contamination is dominated by C8 PFAA (PFOA and PFOS), ranging from 0.37 to 10 ng/g dw. The most polluted soil sites (Frassine and Monastero) are different from the most polluted for both irrigation water and plants (Guà)
- **Plants**: concentrations ranged from <LOQ to 12.5 ng/g ww, with a general prevalence of short-chain PFAAs in the aerial part. Edible plant concentrations do not exceed 6 ng/g ww for each compounds, which represents a safe level for the consumers
- Concentrations measured in soil are much lower than the critical thresholds for agricultural soil stated by RIVM (92 and 86 ng/g dw for PFOS and PFOA) and close to NL soil background concentrations (0.9 and 0.8 ng/g dw for PFOS and PFOA)

Conclusions

- Soil contamination is only partially related with PFAS level in irrigation water
- Despite the significant PFAS contamination in irrigation waters, concentrations in edible vegetables are very low and connected risks for population are very limited
- Second year of monitoring is on-going and needs to be completed to confirm these preliminary results

References

Ingelido, A.M., et. al., 2018. Biomonitoring of perfluorinated compounds in adults exposed to contaminated drinking water in the Veneto Region, Italy. *Environ. Int.* 110, 149–159

Valsecchi, S., et al., 2015.Occurrence and sources of perfluoroalkyl acids in Italian river basins, *Chemosphere*, 129, 126-134

WHO Report, 2017. Keeping our water clean: the case of water contamination in the Veneto Region, Italy

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