Improving knowledge on atmospheric fate of currently-used pesticides: a case study in central Europe

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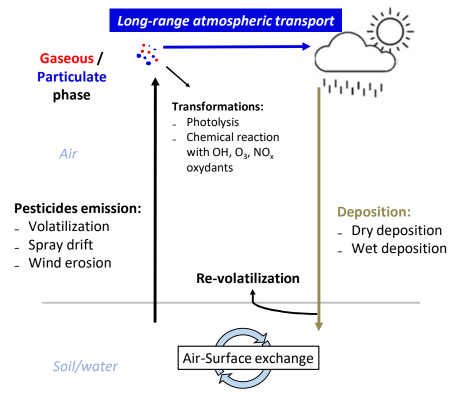
Introduction

Synthetic pesticides were introduced to the world of agricultural production in the 1940's (Li & Macdonald, 2005), The main goal at that time was to reduce the loss of production due to pests in order to maintain a sustainable food production. Organochlorine pesticides (OCPs) were the main pesticide groups used around the world. Their agricultural use was banned in 2001 by the Stockholm Convention on Persistent Organic Pollutants (POPs) (UNEP, 2001).

Currently-used pesticides (CUPs) replaced OCPs, as an alternative thought be more environmentally friendly due to their lower persistence and toxicity compared to OCPs. However, studies have shown that to be untrue, some CUPs are persistent, and/or toxic, and/or prone to long-range atmospheric transport (Chambers *et al.*, 2014). Given their increasing use at the global level over the last decades, and particularly the large diversity of active substances on the market, it is urgent to assess their potential harm to the environment and/or human health (FAO, 2018).

It is known that **CUPs can enter the atmosphere** via "spray-drift" during application, volatilization from surfaces and plants and wind erosion from soil particles (Van den Berg, 1999). Upon entering the atmosphere, CUPs are partitioning between the gaseous and the particulate phases depending on their physico-chemical properties as well as meteorological parameters, type and amounts of particles in the air (Scheyer *et al.*, 2008). This partitioning is crucial as it will influence their removal from the air via processes like wet or dry deposition affecting CUPs long range atmospheric transport potential. The current knowledge on that matter is rather scarce and is generally limited to only few CUPs (Schummer *et al.*, 2010). Further studies are therefore necessary to characterize the extent of several key processes affecting the atmospheric fate of many CUPs.



Objectives of the study

The main aims of this study are to:

Enhance knowledge on CUPs atmospheric fate by studying several relevant processes by looking at:

- **CUPs atmospheric levels** and **gas-particle partitioning** at an urban background site in proximity to agricultural fields in the Czech Republic in spring 2020
- **The first ever reporting** on **dry particulate deposition of CUPs** in addition to assessing wet particulate and total deposition of CUPs
- The identification for the **first time ever of the particle size distribution** of numerous CUPs
- **The first ever** use of soil fugacity sampler to **determine CUPs soil fugacity**

Methodology

(as the samples are currently being analyzed, no results will be shown on this poster)

Sampling setup

Total deposition sampler

Cascade impactor

High-volume air sampler

Low-volume air sampler

Automatic wet deposition sampler

Dry deposition sampler

Soil Fugacity sampler

Sampling site

The sampling took place in a central European mid-sized urban area, on the RECETOX Centre rooftop (50 meters agl.) located on the Masaryk University campus (Brno, CZ), in a residential area, around 2 km away from the closest agricultural field.

The sampling occurred during the main application season from May 12th to May 26th 2020. 7 different types of samplers were used.

Two samples were collected for each instrument.
Each with a sampling duration of one week.

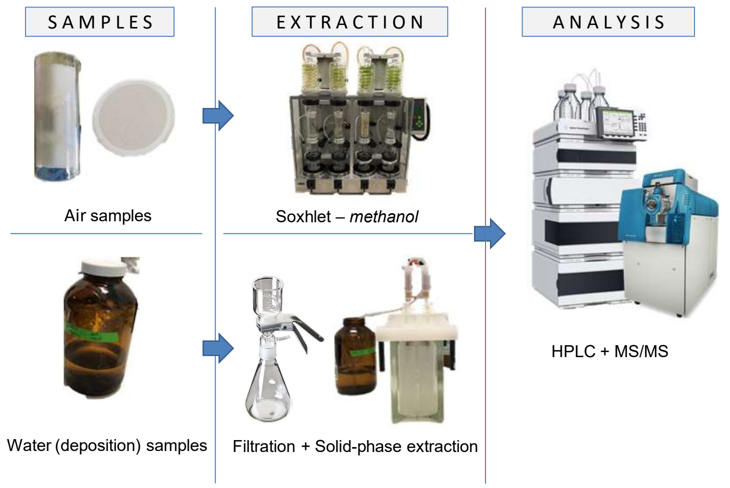
CUPs selection

The 78 CUPs studied were chosen based on their potential for long–range atmospheric transport, their chemical classes or to their previous occurrence in air, as well as potential harmful effects on human health.

List of analysed CUPs

2,4-D (2,4-dichlorophenoxyacetic acid)	Chlorothalonil	Dimethachlor	Folpet	Methoxychlor	Pymetrozine
Acetamiprid	Chlorpyrifos	Dimethoate	Fonofos	Metribuzin	Quizalofop ethyl
Acetochlor	Chlorpyrifos methyl	Disulfoton	Imidacloprid	Omethoate	Simazine
Alachlor	Chlorsulfuron	Diuron	Iprovalicarb	Parathion-methyl	S-Metolachlor
Aldicarb	Chlortoluron	Esfenvalerate	Isoproturon	Pendimethalin	Spiroxamine
Atrazine	Cyfluthrin	Ethalfluralin	Kresoxim-methyl	PCNB	Tebuconazole
Azinfos-methyl	Cypermethrin	Fenitrothion	Lambda-cyhalothrin	Permethrin	Tefluthrin
Bifenthrin	Cyprodinil	Fenoxaprop-p-ethyl	Malathion	Phosalone	Temefos
Boscalid	Dacthal	Fenpropathrin	Mancozeb	Phosmet	Terbufos
Carbaryl	Deltamethrin	Fenpropidin	MCPA	Pirimicarb	Terbuthylazine
Carbendazim	Diazinon	Fenpropimorph	Metalaxyl	Prochloraz	Thiacloprid
Carbofuran	Dichlorvos	Florasulam	Metamitron	Propiconazole	Triallate
Chloridazon	Dicofol	Fluroxypyr	Metazachlor	Prosulfocarb	Trifluralin
***Herbicides** (n=27)*		***Fungicides** (n=16)*		***Insecticides** (n=35)*	

Samples processing & analysing



Scientific impact

This study will be the first one reporting on several key processes affecting the atmospheric fate of many CUPs therefore adding understanding to an understudied research field. Such data will be beneficial in the long-term to understand the behavior of CUPs in the atmosphere and could be implemented in modelling of pesticide atmospheric fate on large spatial scales, used by the scientific community.

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Acknowledgements

This work was supported by RECETOX (LM2018121) and ACTRIS CZ (LM2018122) research infrastructures financed by the Czech Ministry of Education, Youth and Sports and by the European Commission, Structural and Investment Funds (CZ.02.1.01/0.0/0.0/16_013/0001761 and CZ.02.1.01/0.0/0.0/16_013/0001315) and H2020 (CETOCOEN EXCELLENCE Teaming 2, #857560).

We also would like to thank Brno Ph.D. Talent Scholarship Holder – Funded by the Brno City Municipality"