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# Heterogeneous atmospheric ozonolysis of currently used pesticides in Viticulture

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## Context

Currently used pesticides are semi-volatile organic compounds often found in the particulate phase.

European regulations solely consider pesticides' reactivity with OH radicals in the gaseous phase. This approximation may significantly underestimate their lifetimes, as research has shown that degradation kinetics in the heterogeneous phase can be up to 100 times slower than in the homogeneous gaseous phase.

## List of pesticides

	Dinitroaniline	Pendimethalin
	Pyrimidine	Cyprodinil
	Triazole	Tebuconazole
	Dicarboximide	Folpet
	Carboxamide	Boscalid
	Strobilurin	Trifloxystrobin
	Spiroketalamine	Spiroxamine
	Pyrethroid	Deltamethrin Cypermethrin

## Instrumentation

Gas phase degradation products are identified by PTR-ToF-MS ( $H_3O^+$  and  $O_2^+$ )

Particulate phase degradation products are identified by GC-MS/MS (EI) and LC-Orbitrap-MS (ESI)



## Conclusions

Currently used pesticides present in the particulate phase can be considered POPs towards ozone.

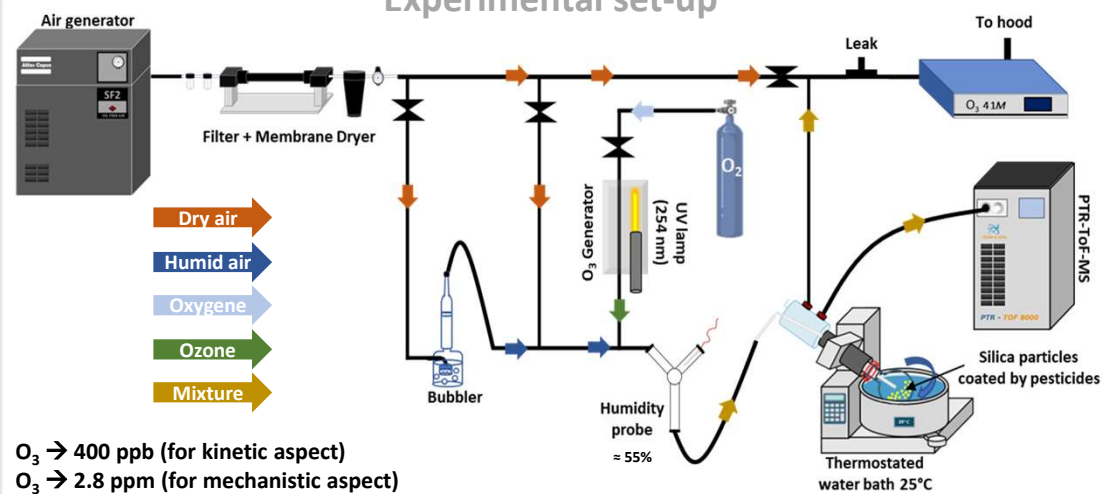
Cypermethrin degrades to 10 molecules when exposed to ozone. One of these products is phosgene ( $Cl_2CO$ ), a toxic chemical warfare gas even at low concentrations.

The results of our study will contribute to a better understanding of the atmospheric fate of pesticides in the particulate phase.

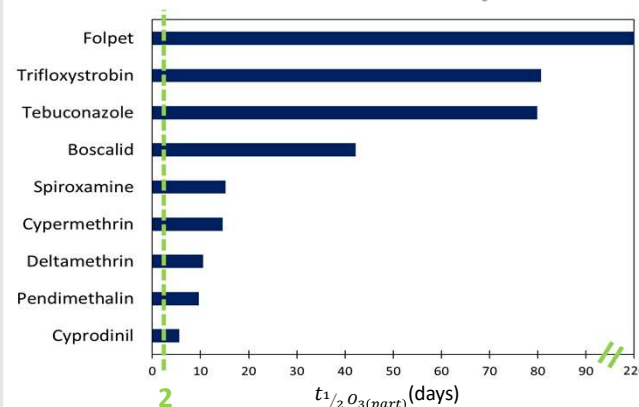
## Objectives

- 1) Determine the atmospheric half-lives for nine pesticides commonly found in viticulture regions, the largest consumer of pesticides.
- 2) Understand the degradation mechanisms of these pesticides, as degradation products may be more toxic than the parent molecules and challenging to analyze due to their chemical reactivity.

## Experimental set-up



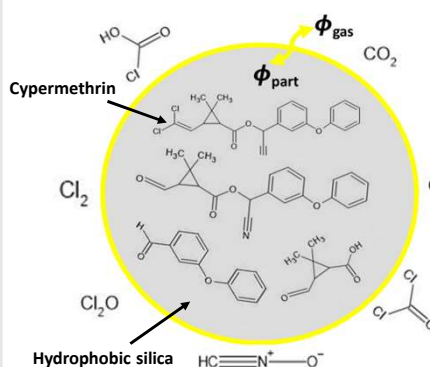
## Atmospheric half-lives



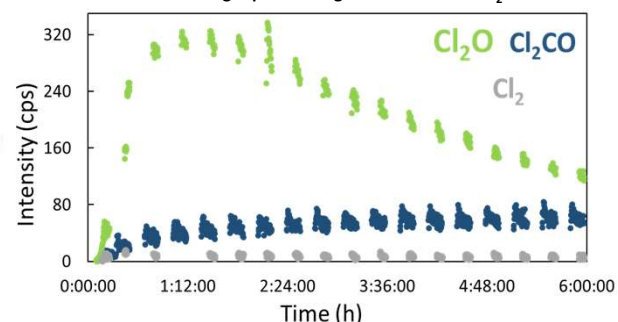
## Stockholm Convention, 2001

A pesticide is considered a Persistent Organic Pollutant (POP) when its atmospheric half-life in the gas phase exceeds 2 days

## Example of degradation products of Cypermethrin



Temporal monitoring of some degradation products of Cypermethrin identified in the gas phase using PTR-ToF-MS with  $O_2^+$  mode.



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