

# Monitoring of airborne pesticide transport and deposition in selected sampling sites in Germany between March and September 2025

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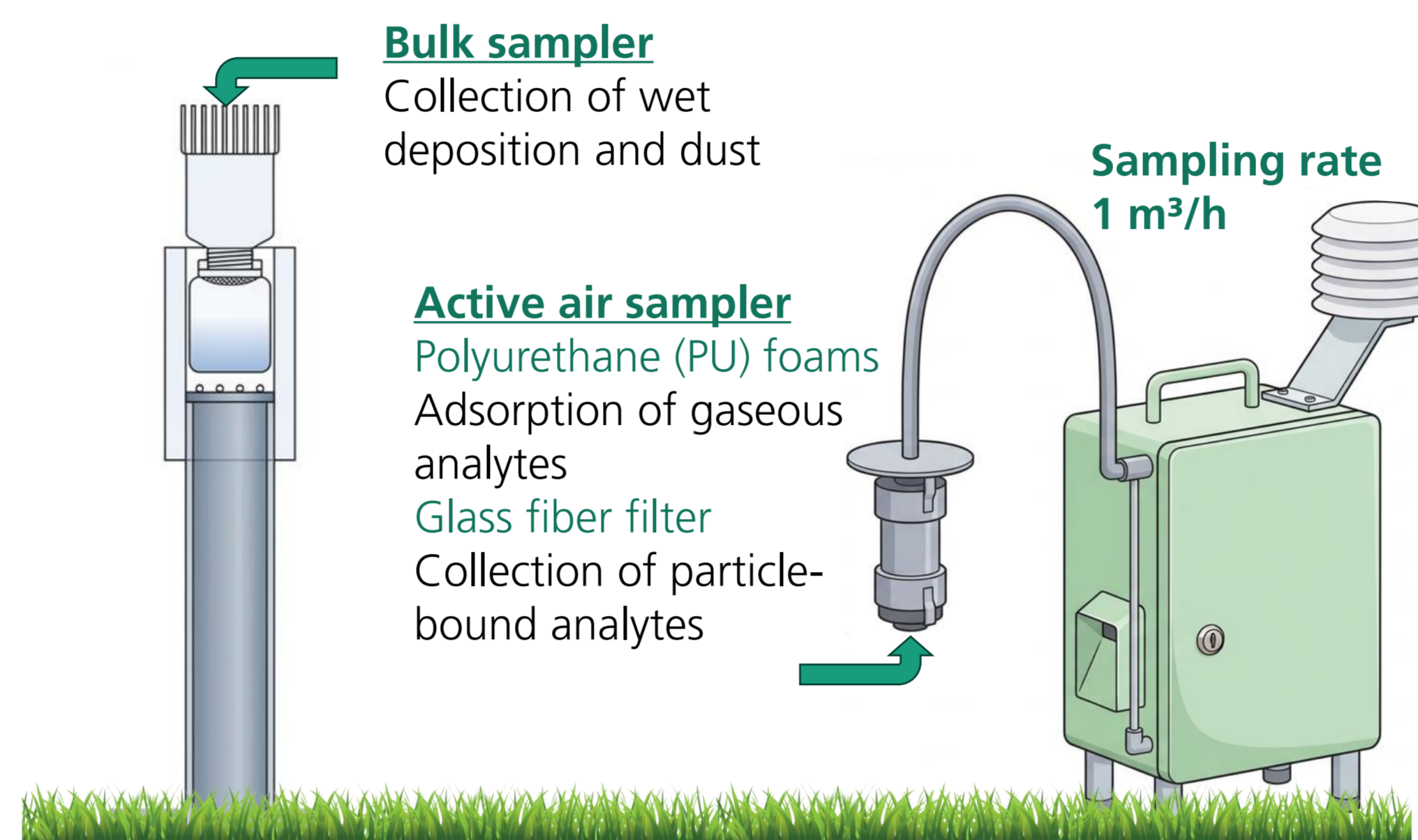
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## Introduction and aim of the study

A pilot monitoring campaign was performed in 2025 in Germany to investigate the entry of airborne pesticides into the environment. Pesticide residues in the air, as well as deposition were determined at three sites in different regions in Germany, representing each one area with a high, medium, and low percentage of agricultural land close by.

Methodological experiments were performed to determine stability of pesticides under field and storage conditions, the breakthrough behavior in the active air sampler, as well as a method comparison of two analytical laboratories to verify the results of the pilot monitoring campaign.

## Experimental setup



## Study performance

- Six sampling intervals of 27 days each
- Study performance March – September 2025 to capture the major time of pesticide application
- Three sampling sites: high, medium, and low percentage of agricultural land close by

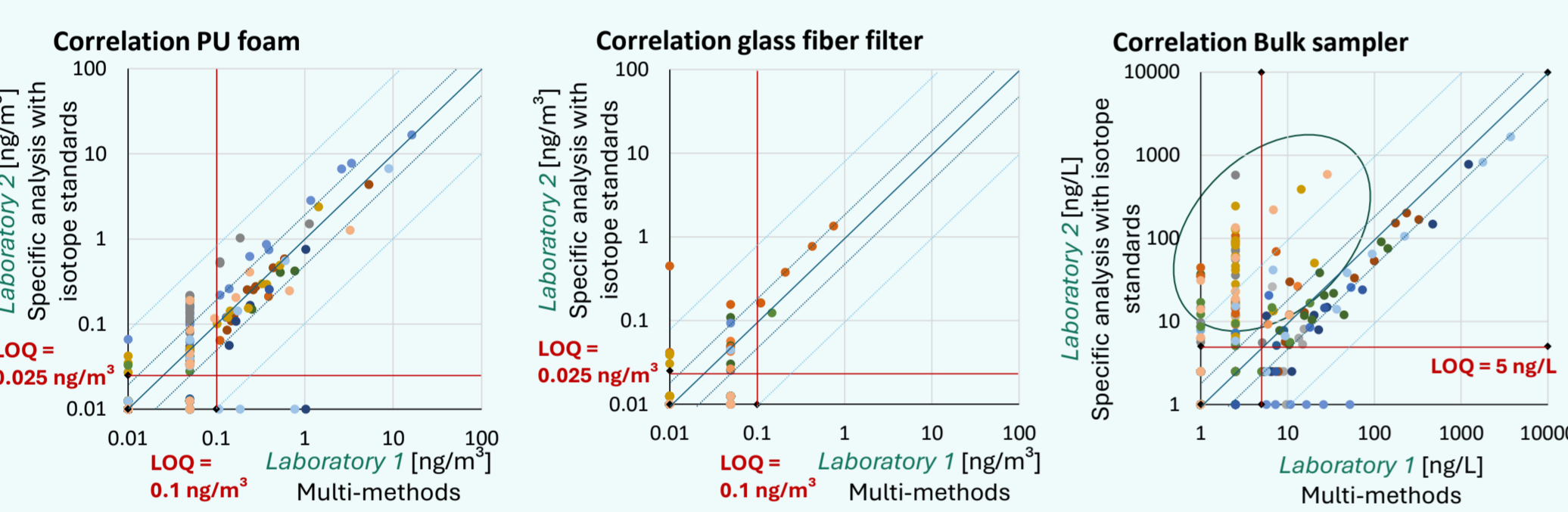
## Analytical methods

- *Laboratory 1*: 124 analytes (Multi-methods)
- *Laboratory 2*: 26 selected analytes confirmed using isotope-dilution analysis
- Methods validated: LOQ of 5 ng/L (bulk sampler) and 0.025-0.1 ng/m<sup>3</sup> (PU-foam and glass fiber filter)

## Methodological experiments

### Method comparison of analytical approaches

Monitoring samples were evaluated in two laboratories independently, analyzing bulk sampler, PU foam and glass fiber filters:



- ▶ **Polyurethane foam & Glass fiber filter**  
Good correlation between both laboratories for all analytes
- ▶ **Bulk sampler**  
Good correlation between both laboratories for many analytes, losses during sample preparation using multi-methods without use of isotope standards (marked in above graph by an ellipse)

Highly comparable results for different analytical approaches – Limitations for aqueous samples using multi-methods

### Recovery under field conditions

Blank matrices water (bulk sampler), PU foam and glass fiber filter were spiked for 26 selected analytes. Samples were tightly sealed and placed in the field next to the samplers for 27 days during each sampling period individually. Recoveries were determined and following conclusions can be drawn:

Analyte	Bulk sampler			PU foam			Glass fiber filter		
	Water	PU foam	Glass fiber filter	Water	PU foam	Glass fiber filter	Water	PU foam	Glass fiber filter
Acetamiprid	Green	Green	Green	Green	Green	Green	Green	Green	Green
Azoxystrobin	Green	Green	Green	Green	Green	Green	Green	Green	Green
Boscalid	Green	Green	Green	Green	Green	Green	Green	Green	Green
Chlorotoluron	Green	Green	Green	Green	Green	Green	Green	Green	Green
Clomazone	Green	Green	Green	Green	Green	Green	Green	Green	Green
Cyantraniliprol	Green	Green	Green	Green	Green	Green	Green	Green	Green
Difenoconazol	Green	Green	Green	Green	Green	Green	Green	Green	Green
Dimethenamid-P	Green	Green	Green	Green	Green	Green	Green	Green	Green
Dimethomorph	Green	Green	Green	Green	Green	Green	Green	Green	Green
Florasulam	Green	Green	Green	Green	Green	Green	Green	Green	Green
Flufenacet	Green	Green	Green	Green	Green	Green	Green	Green	Green
Fluopyram	Green	Green	Green	Green	Green	Green	Green	Green	Green
Fluxapyroxad	Green	Green	Green	Green	Green	Green	Green	Green	Green
Mandipropamid	Green	Green	Green	Green	Green	Green	Green	Green	Green
Metazachlor	Green	Green	Green	Green	Green	Green	Green	Green	Green
Metsulfuron-methyl	Green	Green	Green	Green	Green	Green	Green	Green	Green
Pendimethalin	Green	Green	Green	Green	Green	Green	Green	Green	Green
Pinoxaden	Green	Green	Green	Green	Green	Green	Green	Green	Green
Pirimicarb	Green	Green	Green	Green	Green	Green	Green	Green	Green
Propamocarb	Green	Green	Green	Green	Green	Green	Green	Green	Green
Prothioconazol-desthio	Green	Green	Green	Green	Green	Green	Green	Green	Green
S-Metolachlor	Green	Green	Green	Green	Green	Green	Green	Green	Green
Tebuconazol	Green	Green	Green	Green	Green	Green	Green	Green	Green
Terbutylazin	Green	Green	Green	Green	Green	Green	Green	Green	Green
Terbutylazin-desethyl	Green	Green	Green	Green	Green	Green	Green	Green	Green

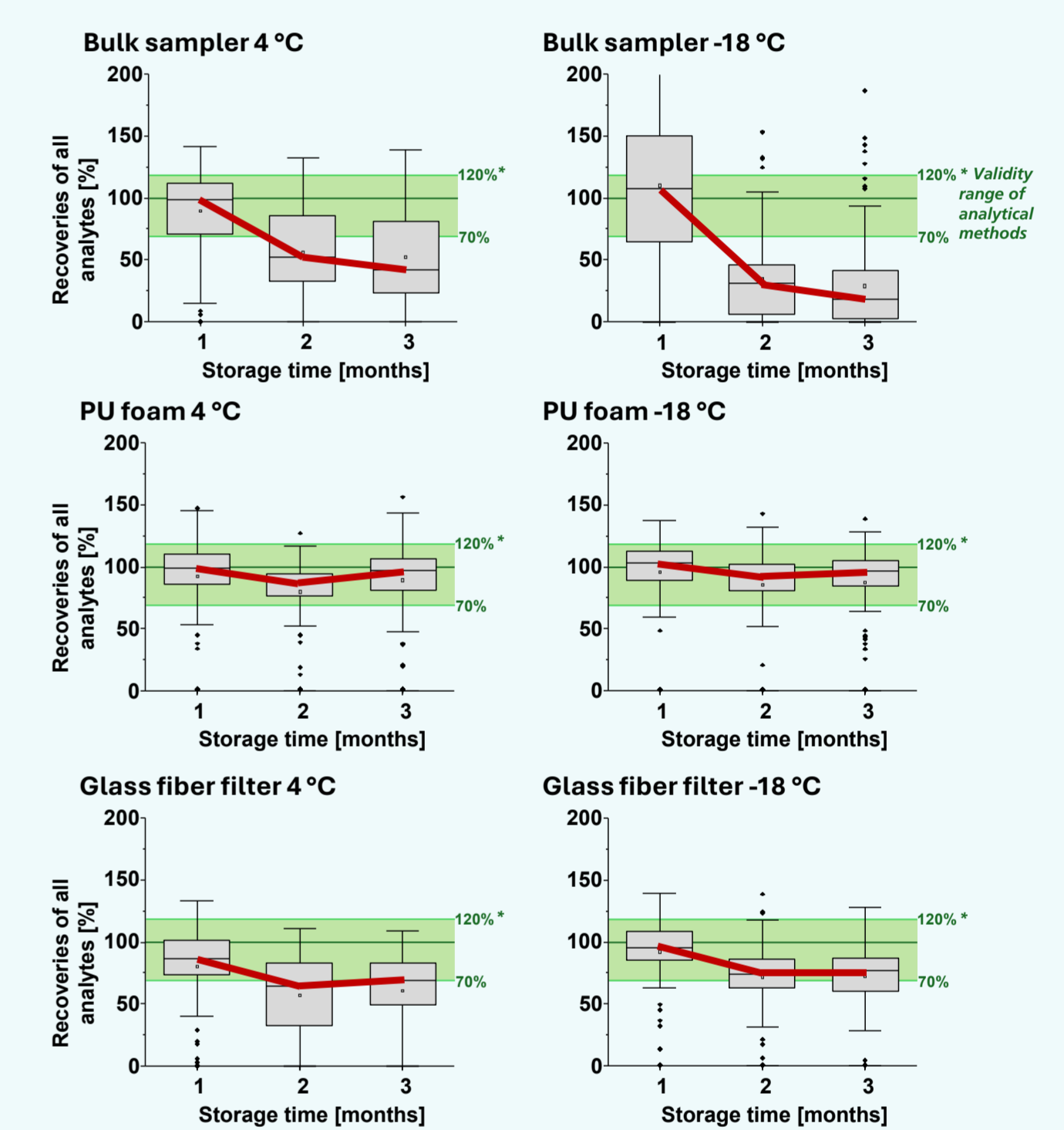
- ▶ Lipophilic analytes showed relevant adsorption to the plastic walls of the sampler → use of glass vessels recommended
- ▶ Recovery was best in PU foam, followed by bulk sampler and by glass fiber filter

Recovery under field conditions must be evaluated individually for each analyte

Use of glass collection vessels in the bulk sampler recommended

### Storage stability of samples

Storage stability was determined for 124 analytes for all three matrices at 4 °C and -18 °C over one, two and three months.



Storage recommendations:  
-Bulk sample: +4 °C (<1 month)  
-PU foam: -18 °C (up to 3 months)  
-Glass fiber filter: -18 °C (up to 3 months)

### Breakthrough in active air sampler

The first PU foam in the active air sampler was spiked to 0.25 ng/m<sup>3</sup> with all 124 analytes. Purified air was provided to observe the migration into the second PU foam of the sampler and eventually the breakthrough:

- ▶ Four analytes showed migration between 4% and 49% into the 2<sup>nd</sup> foam; all other analytes were not detected in the 2<sup>nd</sup> foam; showing in part relevant migration but no breakthrough
- ▶ The investigated analytes had a wide vapor pressure range between 10<sup>-5</sup> and 10<sup>3</sup> mPa; more volatile analytes might break through during sampling

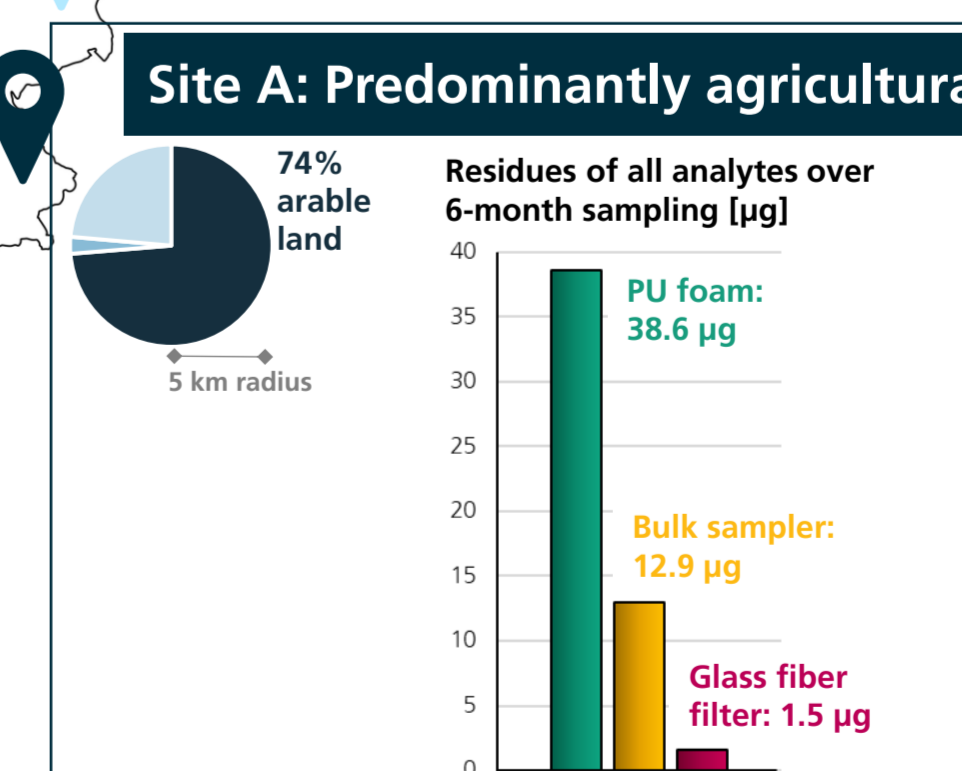
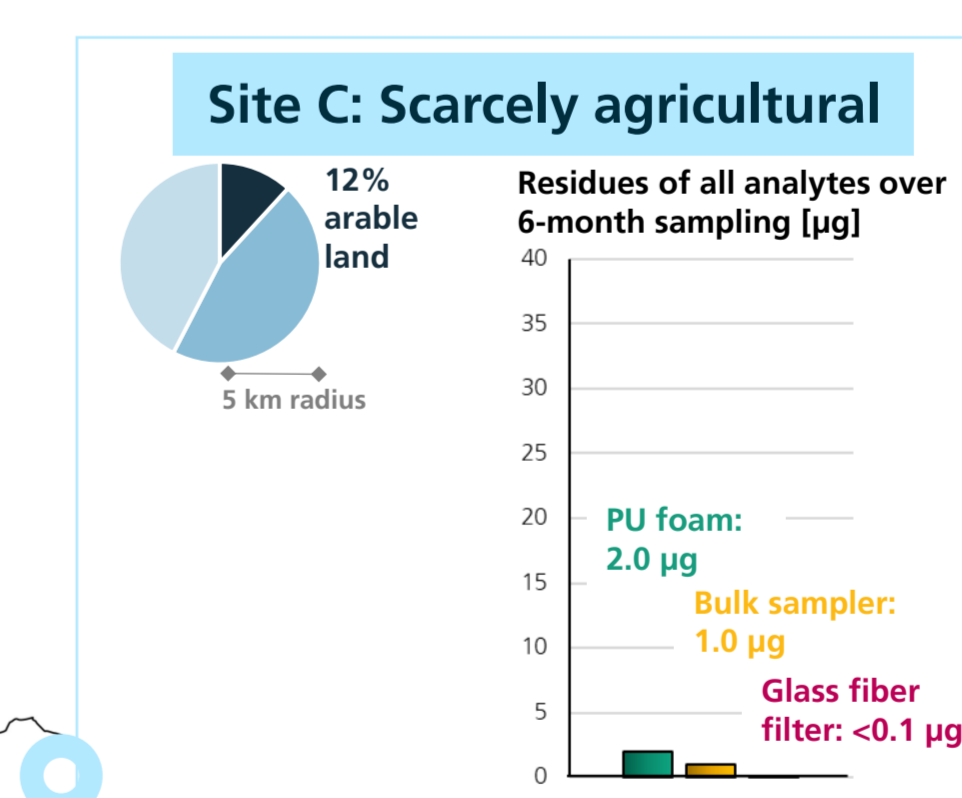
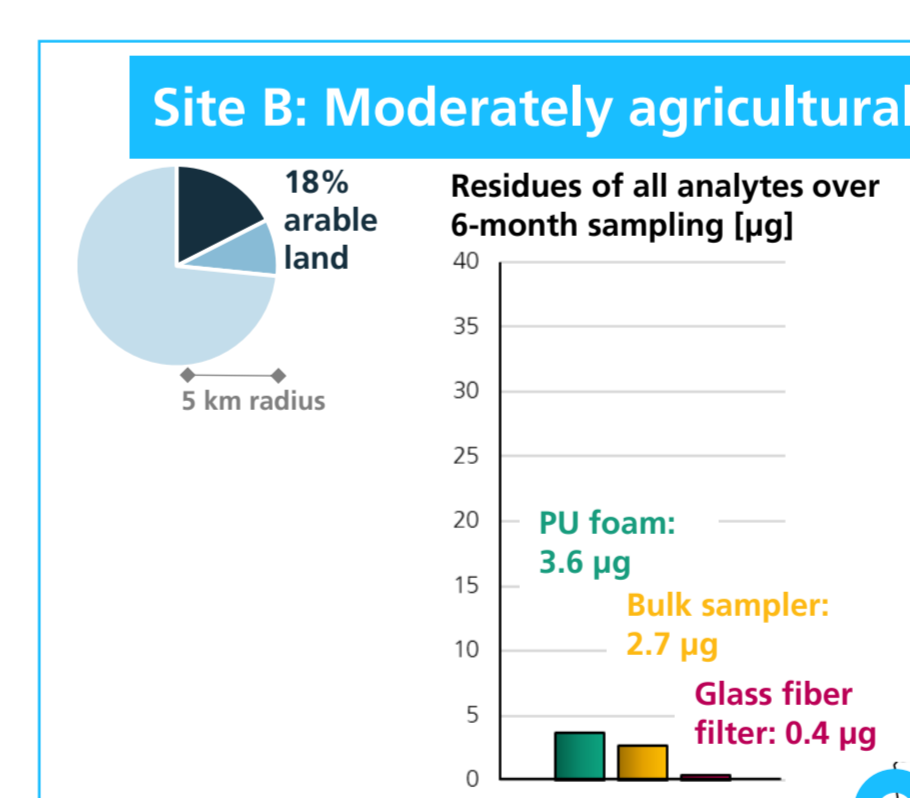
Analytes are well retained in active air sampler over one month at 1 m<sup>3</sup>/h

## Pilot Monitoring

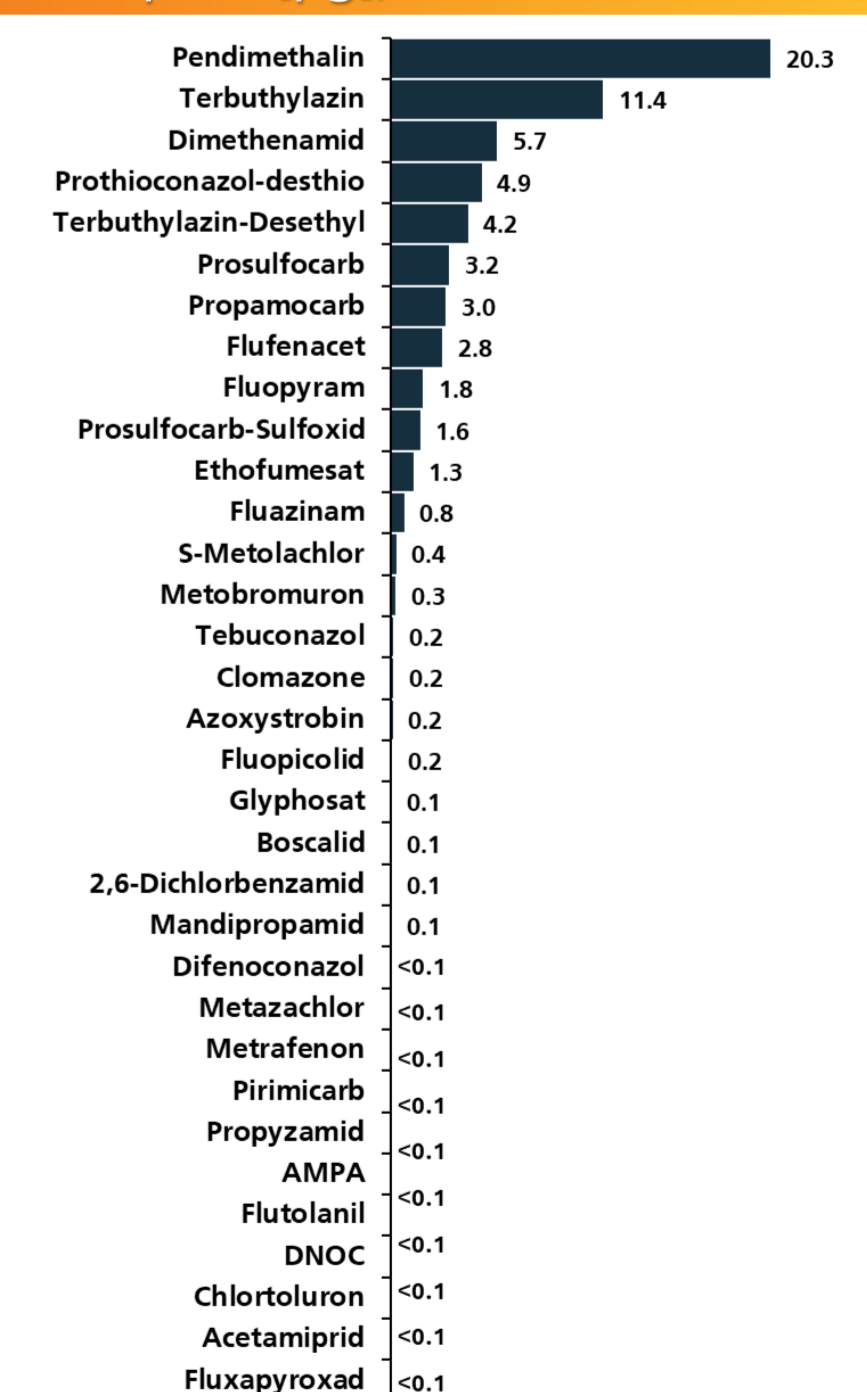
- Total pesticide/metabolite residues in [µg] were determined for the sampling periods in each sampler
- The highest residues were found in PU-foam and bulk sampler, while glass fiber filter had considerably fewer residues
- The detected analyte spectrum was different between samplers, related to the diversity of physical-chemical properties of the analytes

### Conclusion:

This study investigated practical aspects that need to be considered for monitoring airborne transport and deposition of pesticides and/or their metabolites. This includes development and validation of suitable analytical methods, investigating recovery of analytes under field conditions and during storage, as well as breakthrough behavior in the active air sampler. Furthermore, a pilot monitoring identified quantitatively relevant pesticides/metabolites during the monitoring campaign, as well as the potential impact of agricultural land in the vicinity of the sampling site. However, it should be noted that the current data set of this pilot monitoring is too limited to allow for any regulatory or environmental interpretation of the data.



Quantitatively most relevant analytes (summed residues over six months, three sites and three samplers [µg]):



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### References:

The AI program figurelabs.ai was used to generate sketches of the samplers

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