

Long-term monitoring of pesticides in air and atmospheric deposition in Sweden

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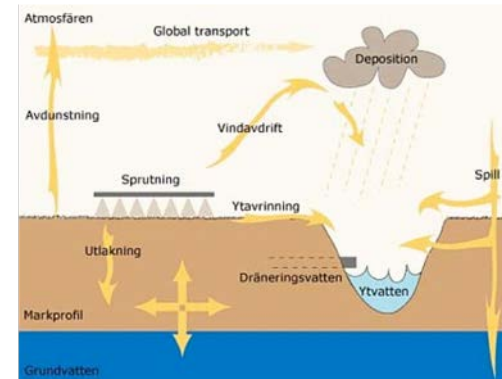
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IUPAC

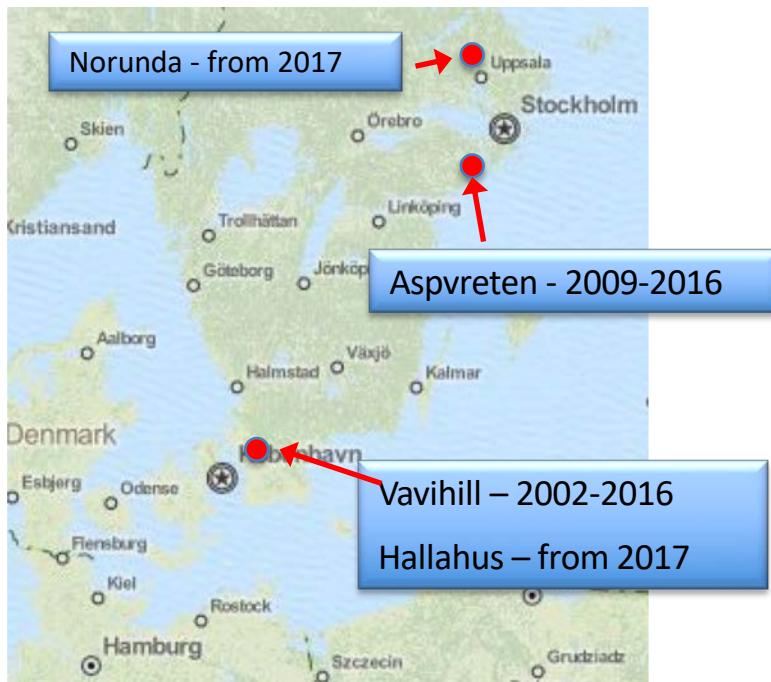
Ghent, Belgium 20 May 2019

Background

- Long-term monitoring of environmental fate of pesticides in Sweden since 2002
 - Main focus on surface water
 - To a lesser extent, also monitoring of pesticides in atmospheric deposition and in air



Sampling sites



- Sampling sites located jointly with other international/national atmospheric monitoring programs (e.g. EMEP & ICOS)
- Located in rural background areas, surrounded by forests, >1 km from treated fields

Methods - precipitation

- Event related sampling using a bulk sampler (a stainless steel funnel, area 0.5 m², above a fridge)
- Ca 12-15 samples/season
- Ca 140 pesticides analysed today
- Sampling during main growing season
 - From 2009 April-October
 - Previously May-June + October
- Started in 2002 at Vavihill & in 2009 at Aspvreten (further north)





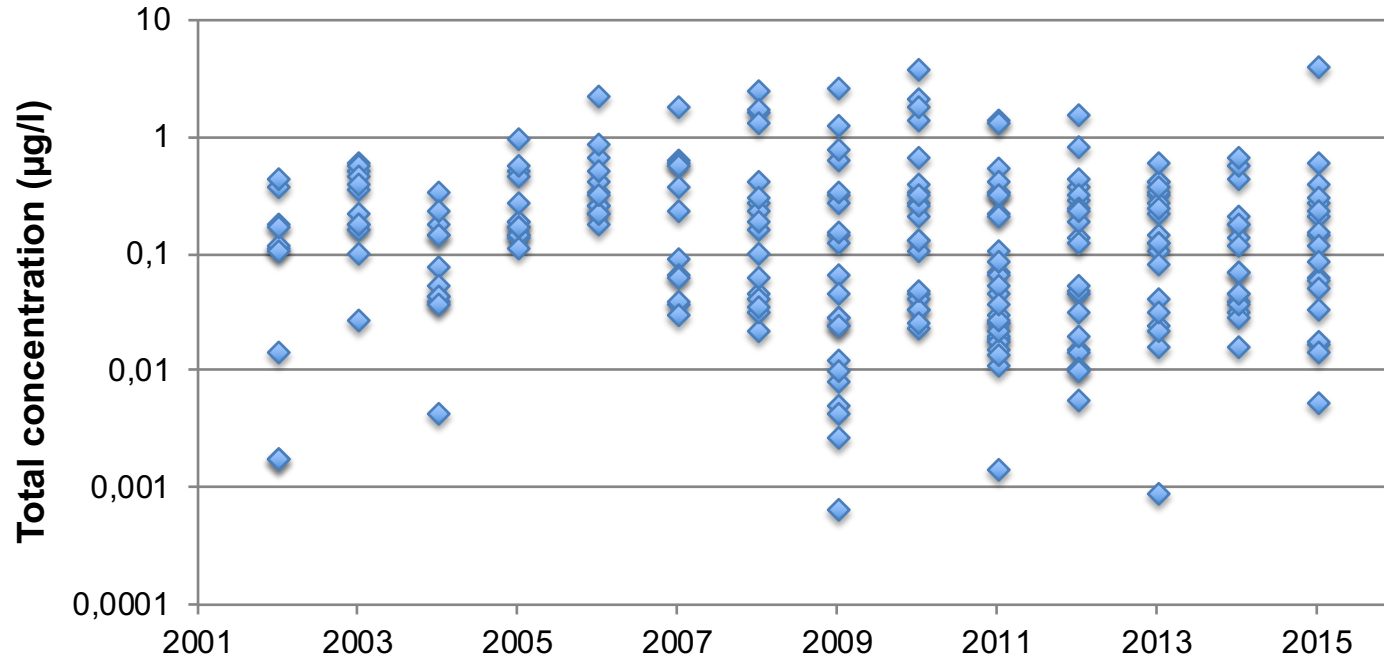
Methods - air

Air samples collected

- At fixed, weekly, intervals using a high-volume pump (ca 400 m³/day)
- Using pre-cleaned cartridges with quartz fiber filter and PUF/XAD/PUF
- Ca 10-12 samples/season
- Ca 100 pesticides analysed today
- Started in 2009 at Vavihill

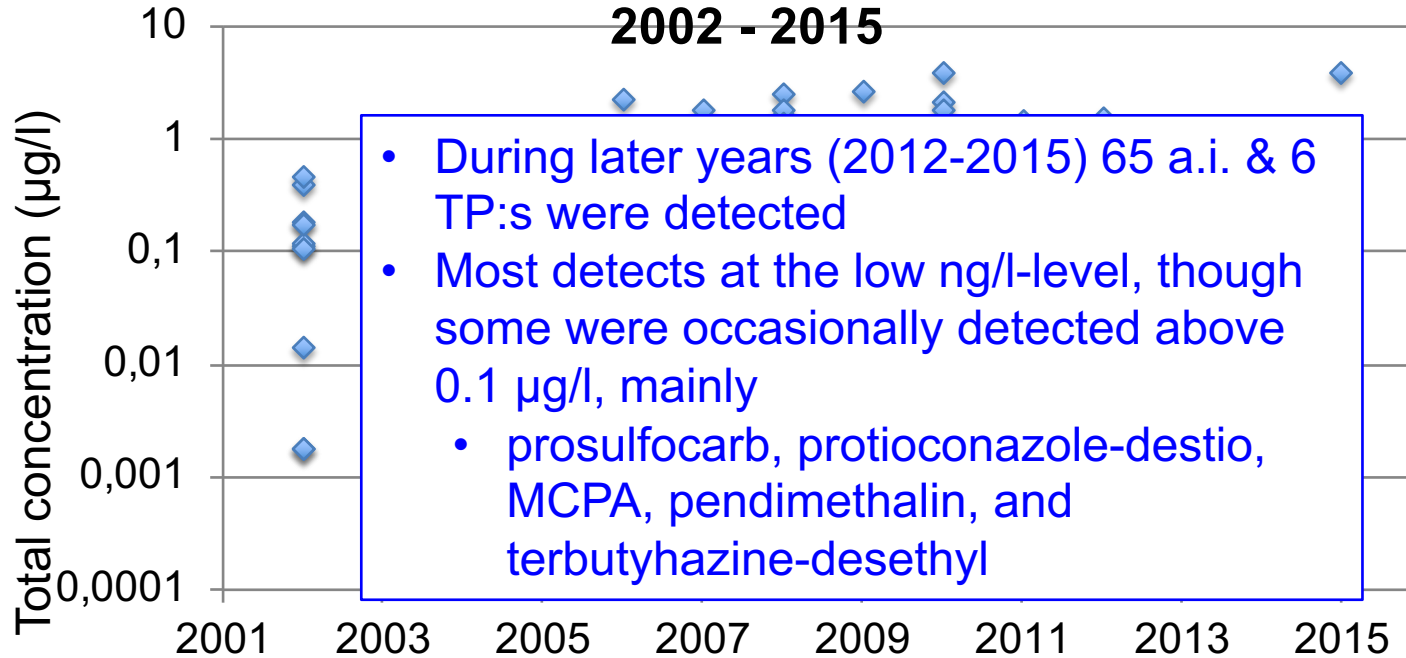


Vavihill (south) - Total concentration in precipitation/ sample 2002 - 2015

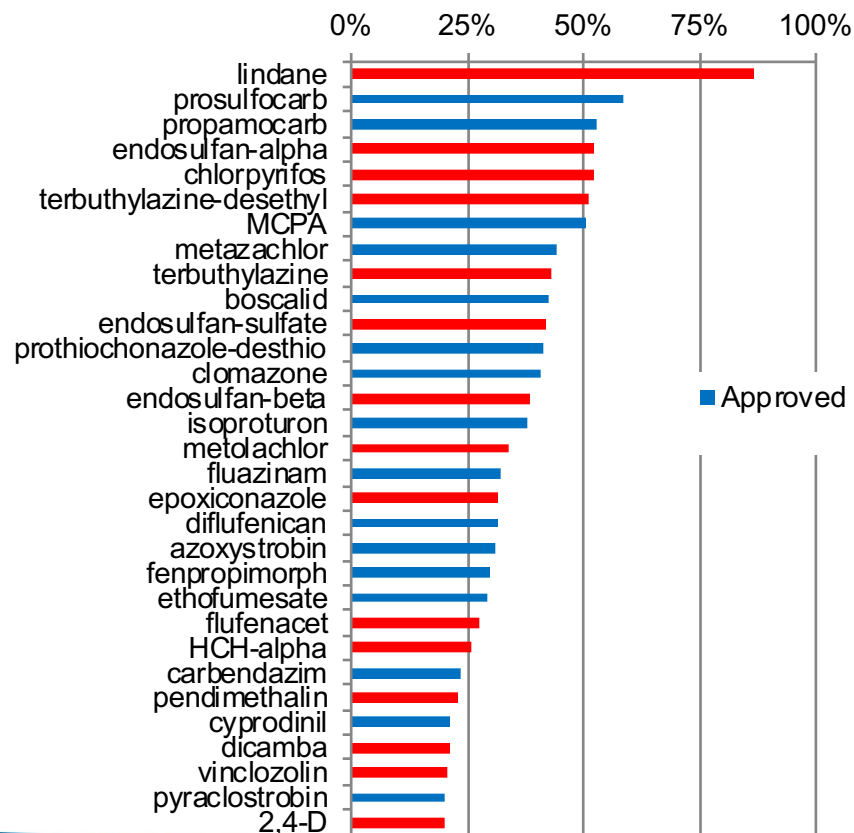


*Max total concentration 3.9 µg/l in a sample from October 2015,
with prosulfocarb constituting the major part (3.8 µg/l)*

Vavihill (south) - Total concentration per sample 2002 - 2015



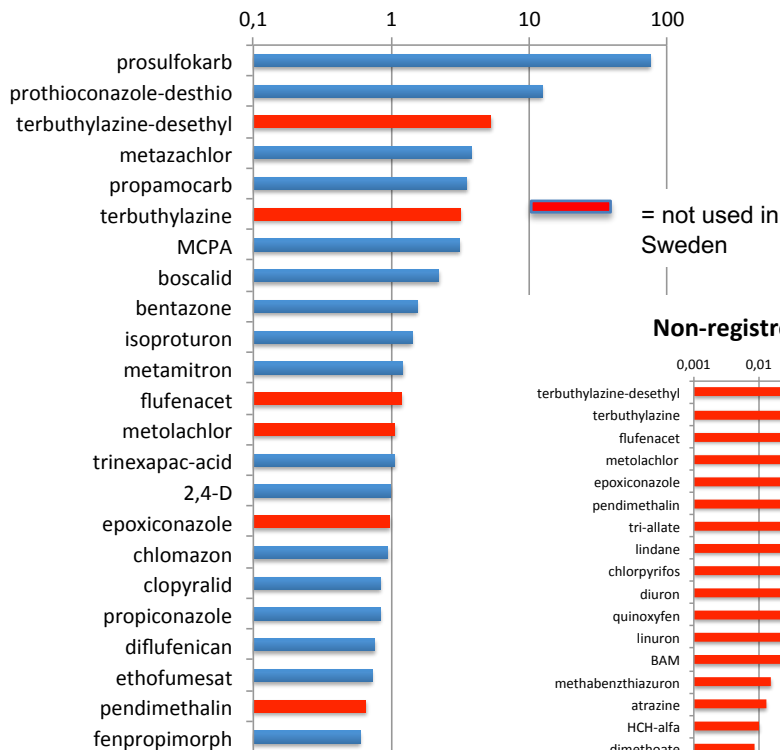
*Max total concentration 3.9 µg/l in a sample from October 2015,
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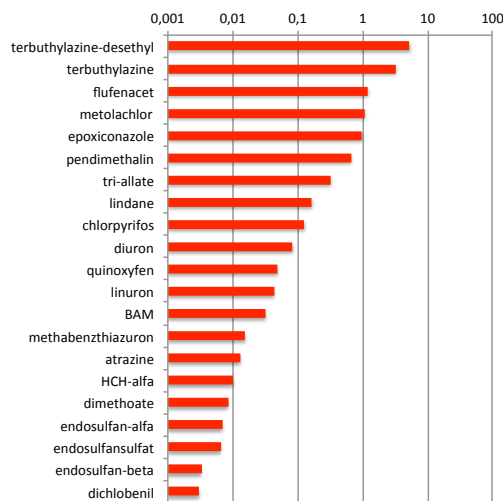
Detection frequency in rainwater at Vavihill (south) during recent years 2012-2015

Of those pesticides detected in $\geq 20\%$ of the samples – ca 50% were not used in Sweden during the investigation period (e.g. lindane, endosulfan, chlorpyrifos, terbuthylazine, metolachlor, epoxiconazole, flufenacet)

Average deposition 2012-2015 ($\mu\text{g}/\text{m}^2 \cdot \text{year}$)



Non-registered pesticides

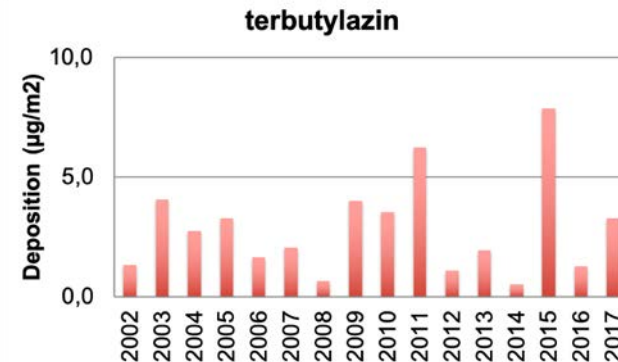
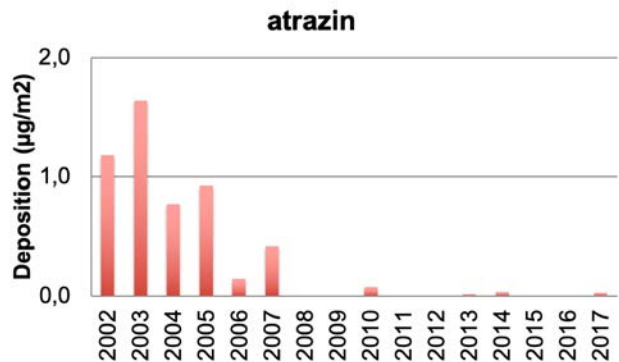
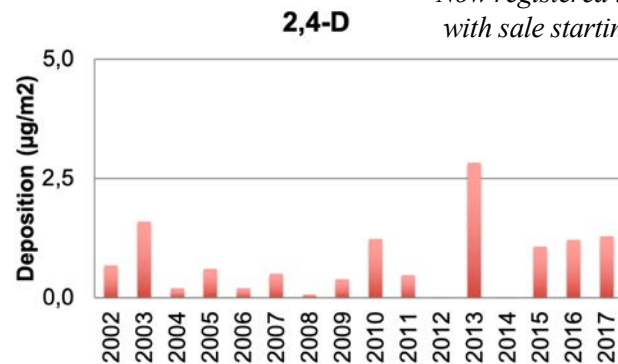
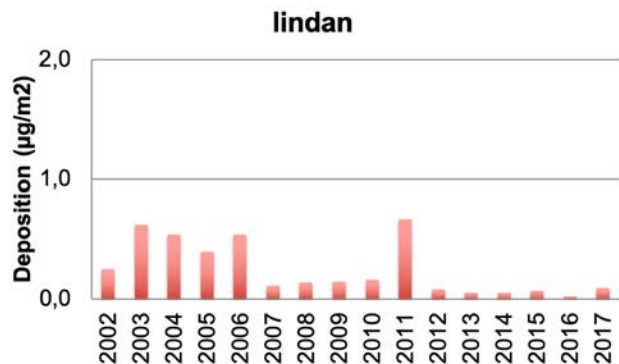


Atmospheric deposition at Vavihill in southern Sweden 2012-2015 (April-October)

- Herbicides dominate, followed by fungicides
- Also pesticides not registered for use in Sweden (red bars) contribute to the total load

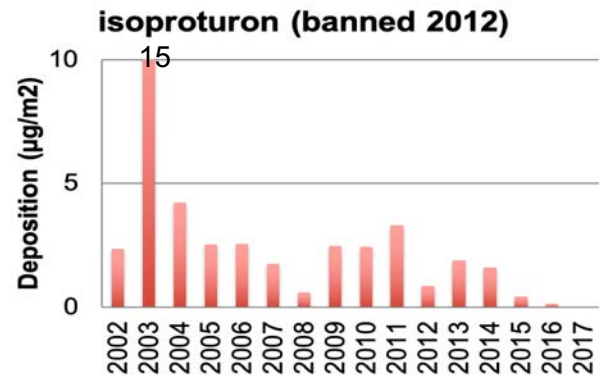
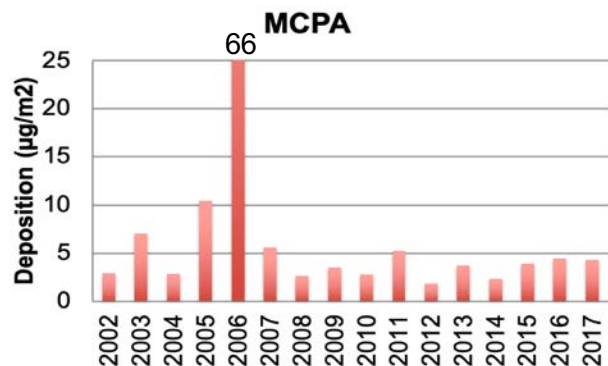
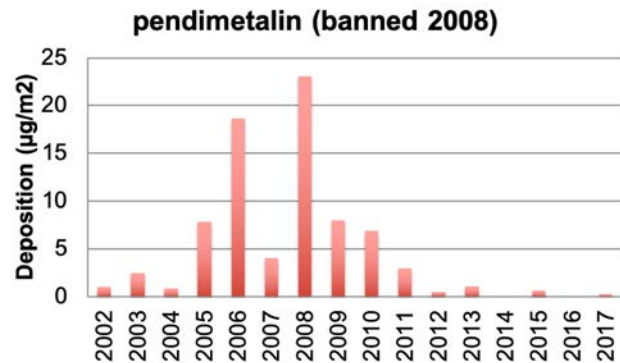
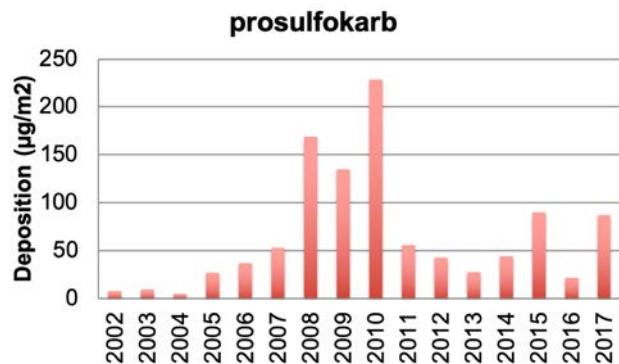
Long-term trends - deposition

*Now registered in Sweden,
with sale starting in 2015*



Yearly \sum 3-month deposition ($\mu\text{g}/\text{m}^2$) 2002-2017 for pesticides not used in Sweden
Banned within the EU (left) and approved within EU (right)

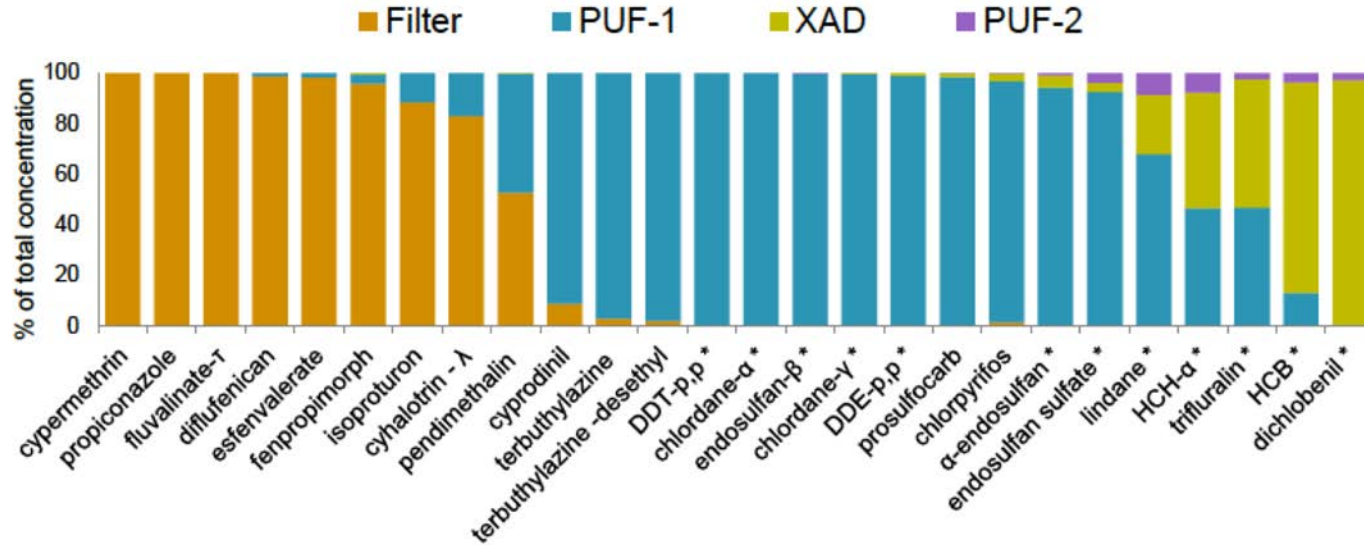
Long-term trends - deposition



Yearly Σ 3-month deposition ($\mu\text{g}/\text{m}^2$) 2002-2017

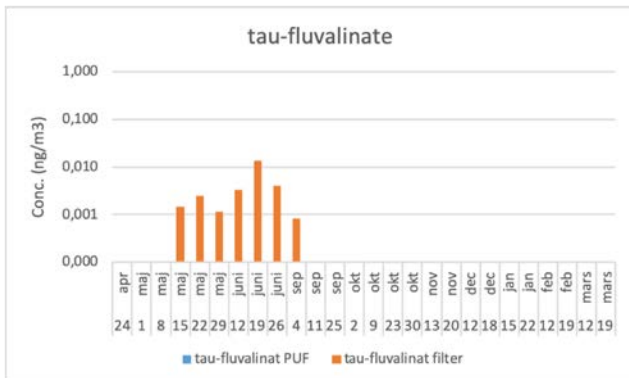
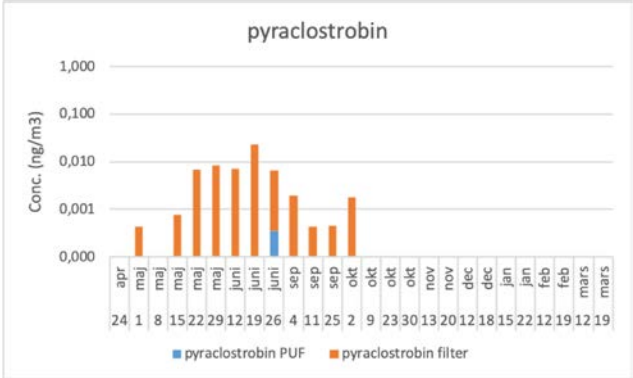
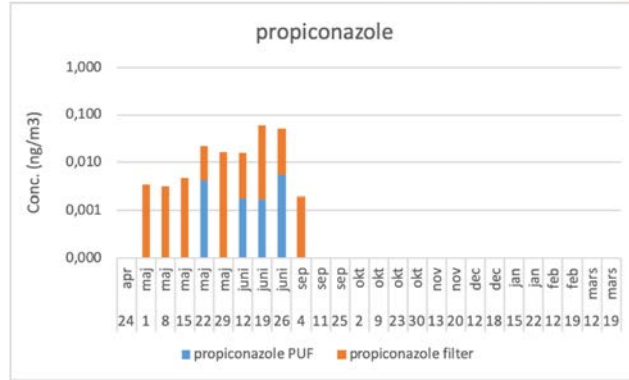
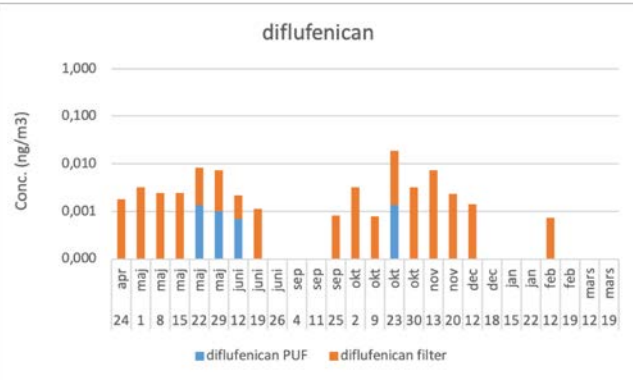
Pesticides used in Sweden (left) and for pesticides banned during the period (right)

Air samples - distribution between filter, PUF and XAD for 26 pesticides detected in >20% of the air samples (n = 34)



- PUF breakthrough (> 30%) for dichlobenil, HCH-a, HCB and trifluralin.
- However, only 4% of total pesticide concentration found in XAD and PUF-2

* Substances not approved for use within EU at the time of sampling



Pesticides in air

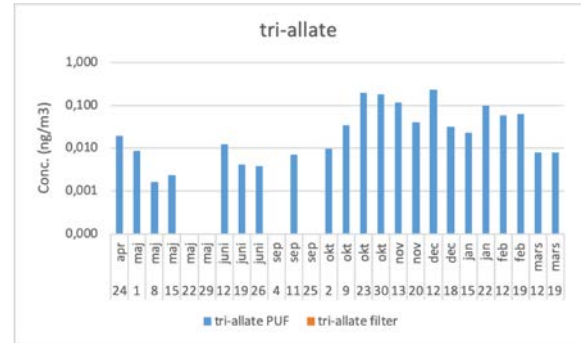
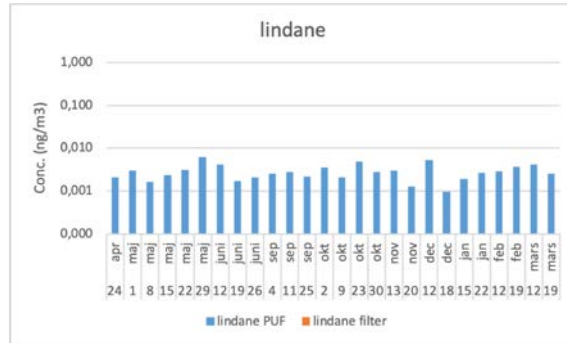
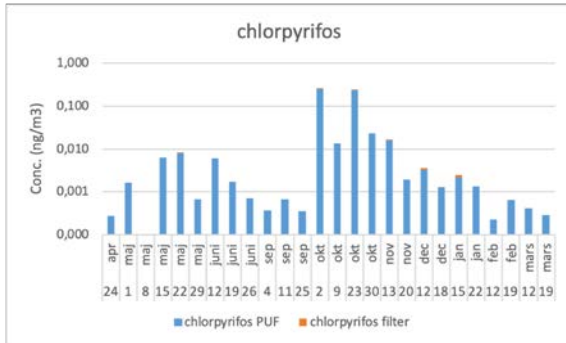
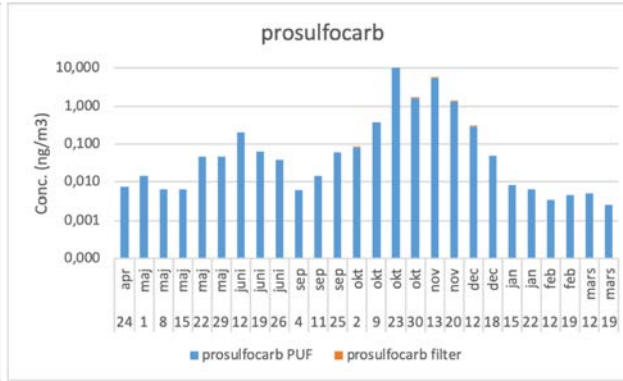
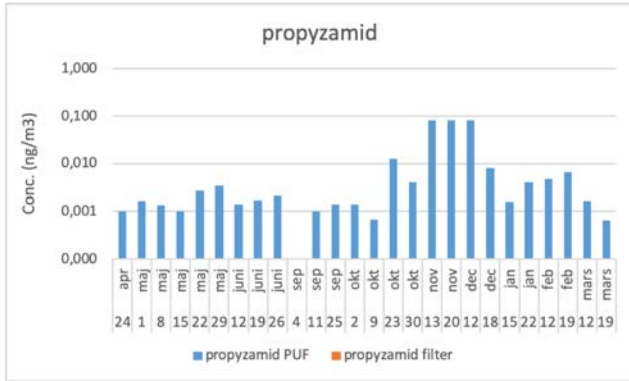
April 2017 – March 2018

- Some were primarily detected on filter
- Seasonal occurrence

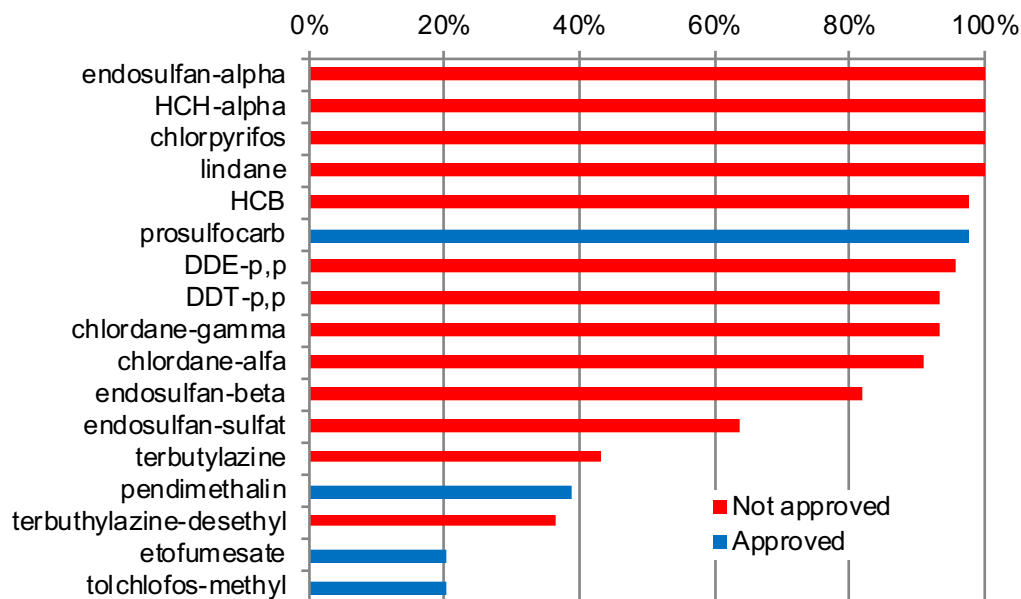
Pesticides in air

April 2017 – March 2018

- Others were detected on PUF
- Year round

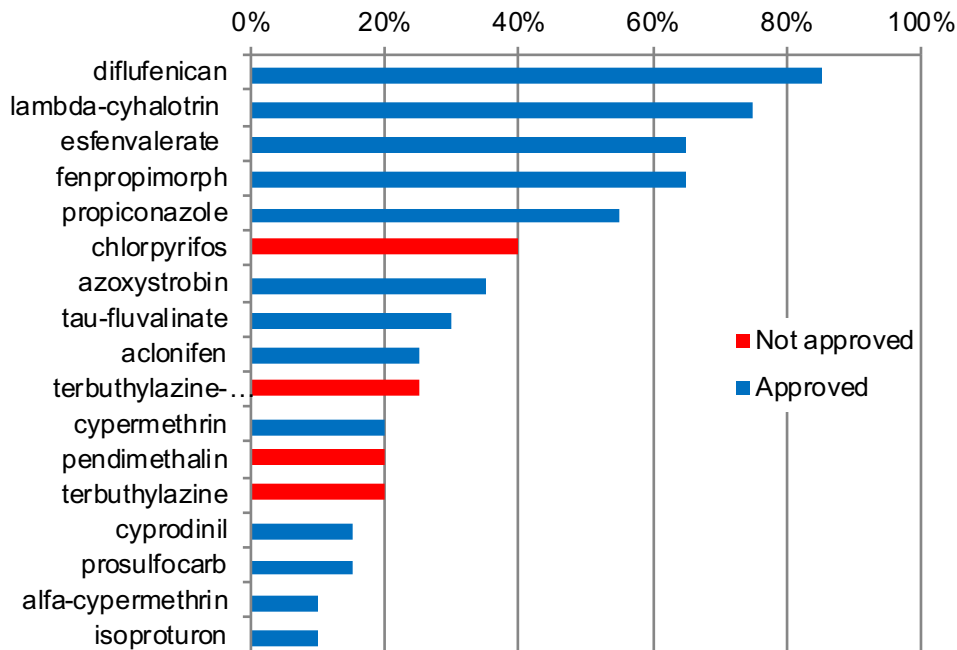


Detection frequency in air (adsorbent, PUF-1) 2012-2015



- A total of 31 a.i. and 5 TP:s
- Majority of pesticides detected in the gas phase are not approved for use within Sweden, many not even within the EU
- Most concentrations at low levels ($< 0.1 \mu\text{g}/\text{m}^3$ air), mainly prosulfocarb detected above this level (max. $30 \mu\text{g}/\text{m}^3$ air)

Detection frequency in air (filter) 2012-2015



- Majority of pesticides detected in the particulate phase are approved for use within Sweden
- Most concentrations at low levels ($< 0.1 \mu\text{g}/\text{m}^3$ air), mainly fenpropimorph detected above this level (max. $0.8 \mu\text{g}/\text{m}^3$ air)

Conclusions

- Currently used pesticides are regularly detected at ng/l-levels in rainwater, with occasional $\mu\text{g/l}$ -level findings
- A larger number of pesticide detected during spring/early summer, however higher concentrations were detected during fall (mainly prosulfocarb)
- Deposited amount corresponds to ca 0.1 - 0.0001% of the applied dose in the field
- A significant contribution to atmospheric deposition in southern Sweden from pesticides not used within Sweden, i.e. a transboundary atmospheric transport of pesticides

Thank you! Questions?

Acknowledgement:

- The national pesticide monitoring programme is funded by the Swedish Environmental Protection Agency
- Information about the pesticide monitoring program at
 - [Department of Aquatic Sciences and Assessment](#) or
 - [Centre for Chemical Pesticides](#)

