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SPRINT
SUSTAINABLE PLANT PROTECTION TRANSITION

“Pesticides in European agricultural soils”

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Coordination of SPRINT project

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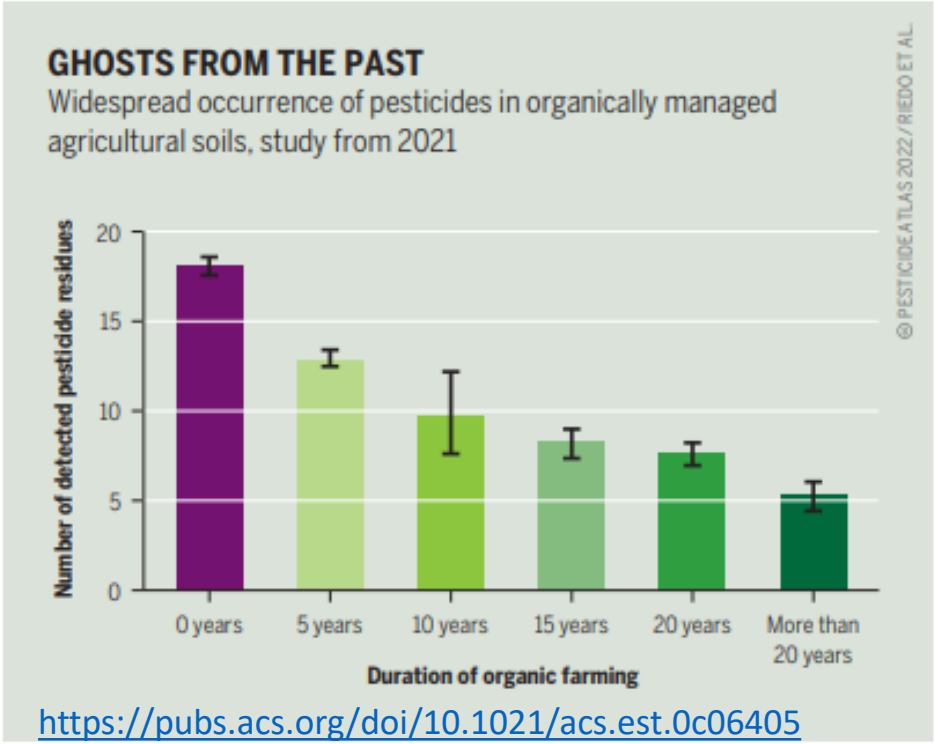
Zero Pollution Action Plan for air, water and soil

Soil pollution monitoring

scientific community, the EU Soil Observatory, the LUCAS soil module.

Pesticides:

Most measurements from targeted studies
(review: S. Sabzevari and J. Hofman, 2022)
- specific area, specific residues
- variable year, sampling depth, analytical methods, etc



https://pubs.acs.org/doi/10.1021/acs.est.0c06405

3 comprehensive, European-scale studies:

	Silva et al. 2019	Vieira et al. 2023	Knuth et al. 2024
Source of samples	LUCAS 2015 survey	LUCAS 2018 survey	SPRINT 2021 survey
Number of samples	317 (11 countries, 6 crops)	2443	201 (10 countries, 8 crops)
Land uses covered	Agricultural	Agricultural	Agricultural (Conventional and Organic)
N pesticides tested	76	118	192
N samples 1 or + residues	83%	86%	97% (C: 99%; O:95%)
N samples with mixtures	58%	74%	88% (C: 96%; O: 79%)
Total pesticide level (max)	2.87 mg/kg	NA	C: 28.7 mg/kg; O: 5.46mg/kg
Most frequent compounds	Glyphosate, AMPA, DDE, boscalid, epoxiconazole and tebuconazole, phthalimide	NA	DDE, AMPA, HCB, chlorpyrifos, glyphosate
Main outputs:	MAP on Number residues in soil (NUTS2) MAP on total pesticide content in soil (NUTS2) Mixtures composition	Mixture risk indicator (RQ=MEC vs NOEC for soil organisms)	Detection vs. Application records Measured vs predicted concentrations

Main findings/implications

- The presence of **multiple pesticide residues in soil is the rule rather than the exception**.

  Mix of currently use and banned compounds.

  Organic fields: off-site contamination and legacy

  Risk of the actual, complex mixtures?

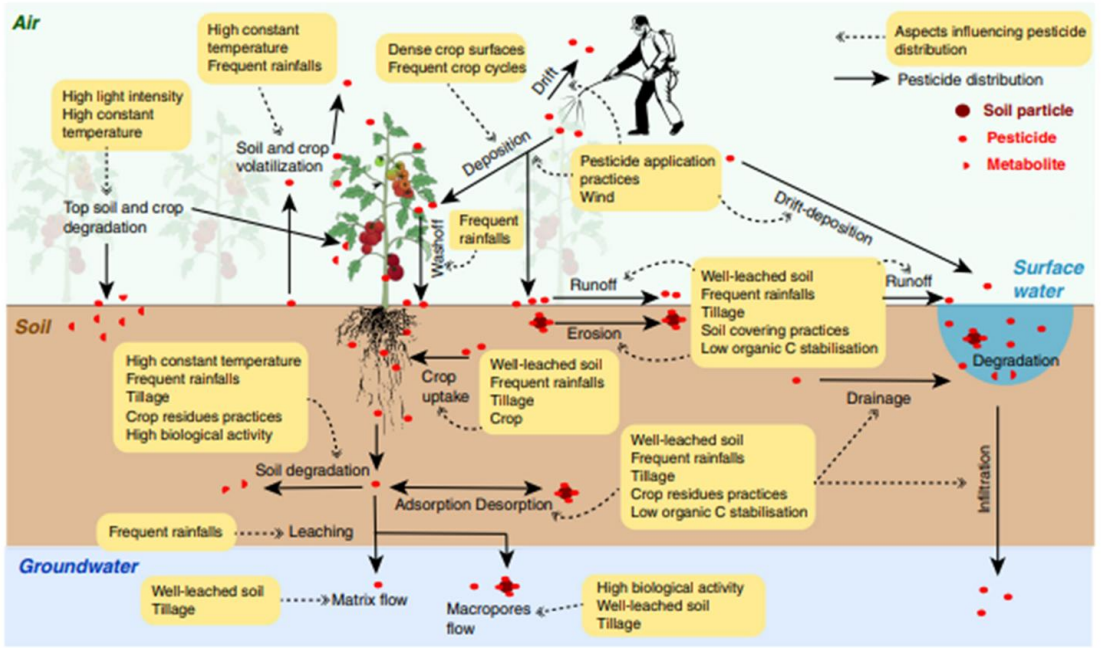
- Considering that we tested less than 20-45% of the active substances currently approved in the EU market, **pesticide occurrence might be higher.**

- The measured content of individual pesticide residues occasionally exceeded the related predicted levels (PECs) -> **are PECs conservative enough?**

- **No thresholds/quality standards for total or individual pesticide residues, and limited NOEC values**

Effects:

- decrease diversity of soil fauna, in organic matter and nutrient fixation <-> soil productivity
- effects on non-standard test organisms and endpoints?
- indirect effects via pesticide-driven alterations on habitat or ecosystem structure/food webs;



https://link.springer.com/article/10.1007/s11367-019-01685-9

- risk to other ecosystems, water quality, human health

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Funded by the European Union

Develop and test an integrated global health approach to assess the risks and impacts of pesticides on ecosystems, plant, animal and human health.

Identify transition pathways toward sustainable use of pesticides.

https://sprint-h2020.eu/; sprint@wur.nl

New concepts

- Holistic health assessment – 3 pillars: resilience, (re)productivity, manifestation of diseases
- Multi-actor approach

Unique coverage and datasets

- Pesticide application records, ~200 fields
- Occurrence and levels of pesticide residues in environmental and biological matrices (from Conventional & Organic farms), ~200 residues analysed
- Hazard information

New approaches lab (mixtures!)

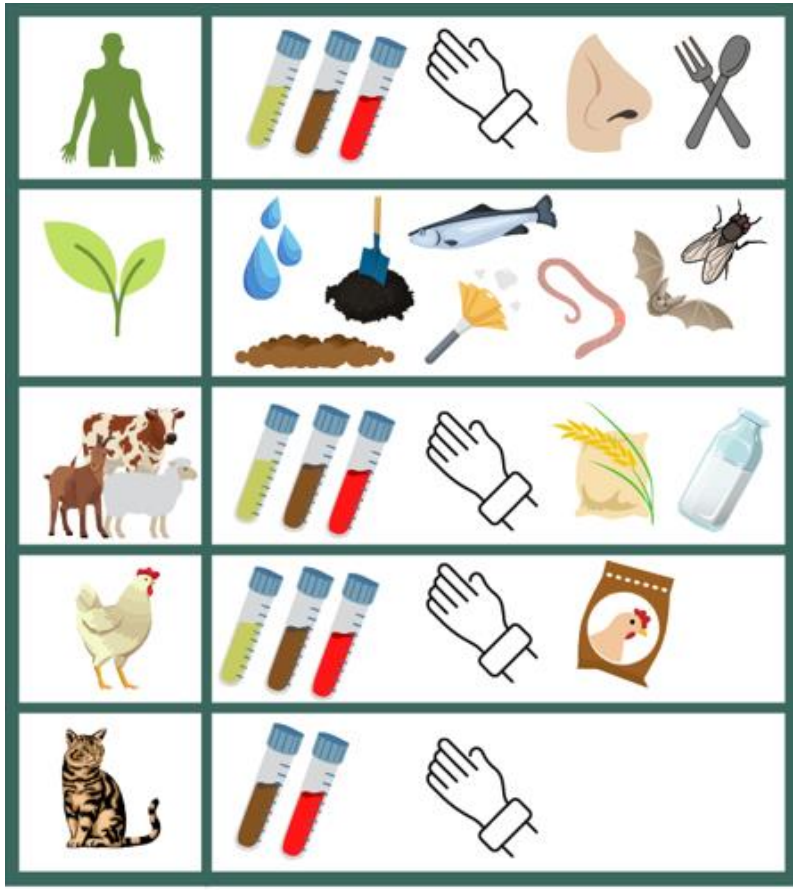
- Prioritization procedure
- New (eco)tox indicators/setups and native species

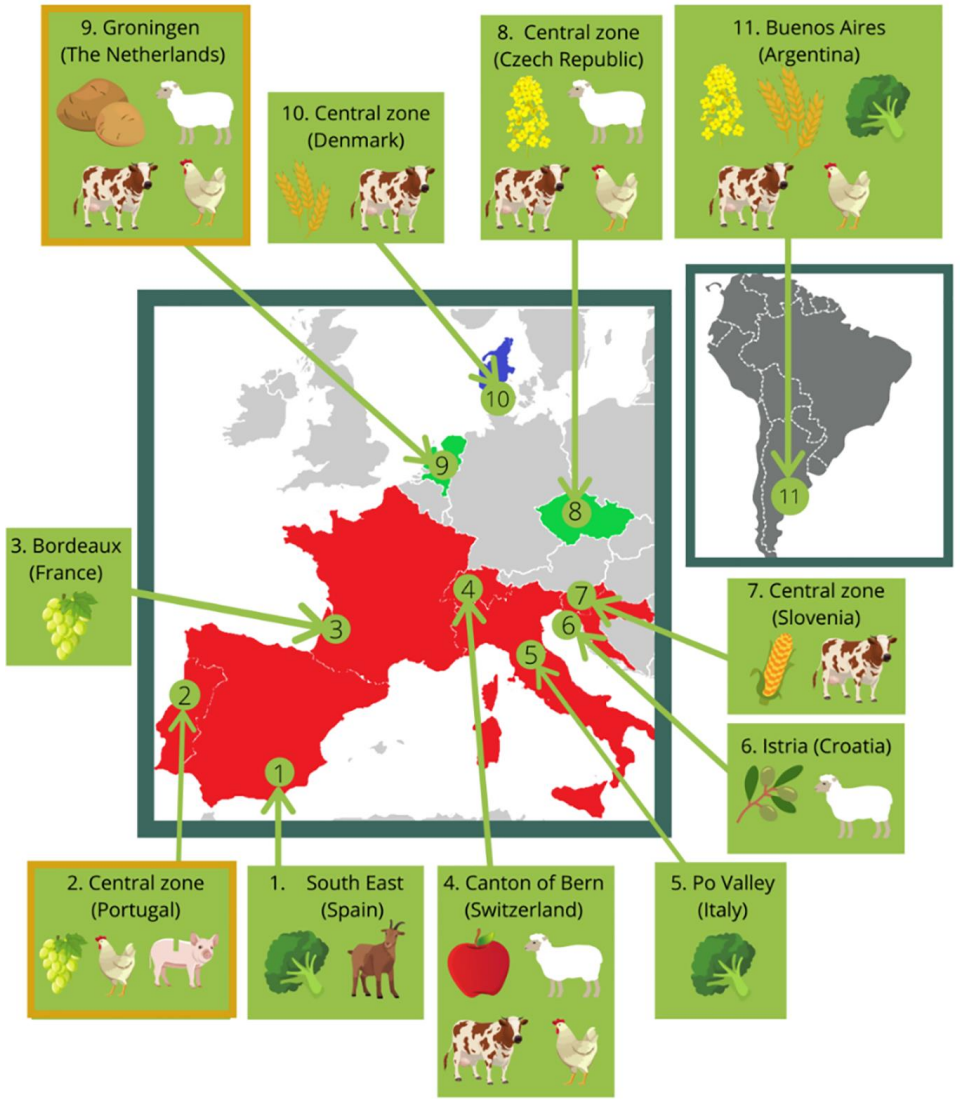
Model improvements

- Development of wind erosion module
- Model chains, PECs...

Global Health Risk Toolbox

Comprehensive field testing

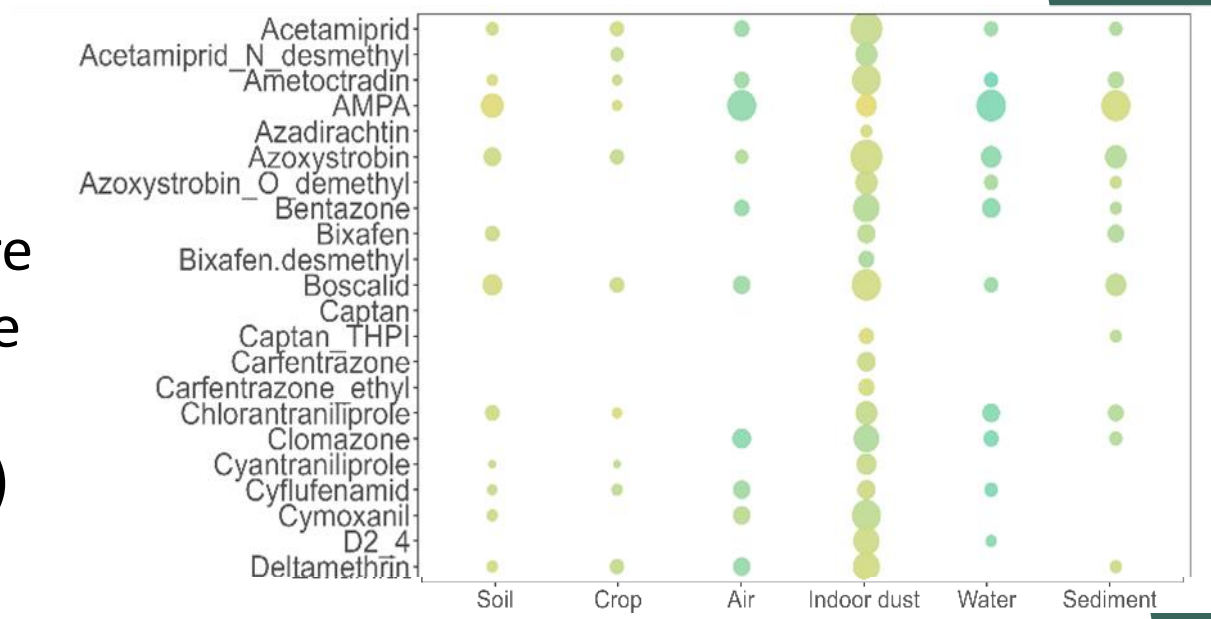


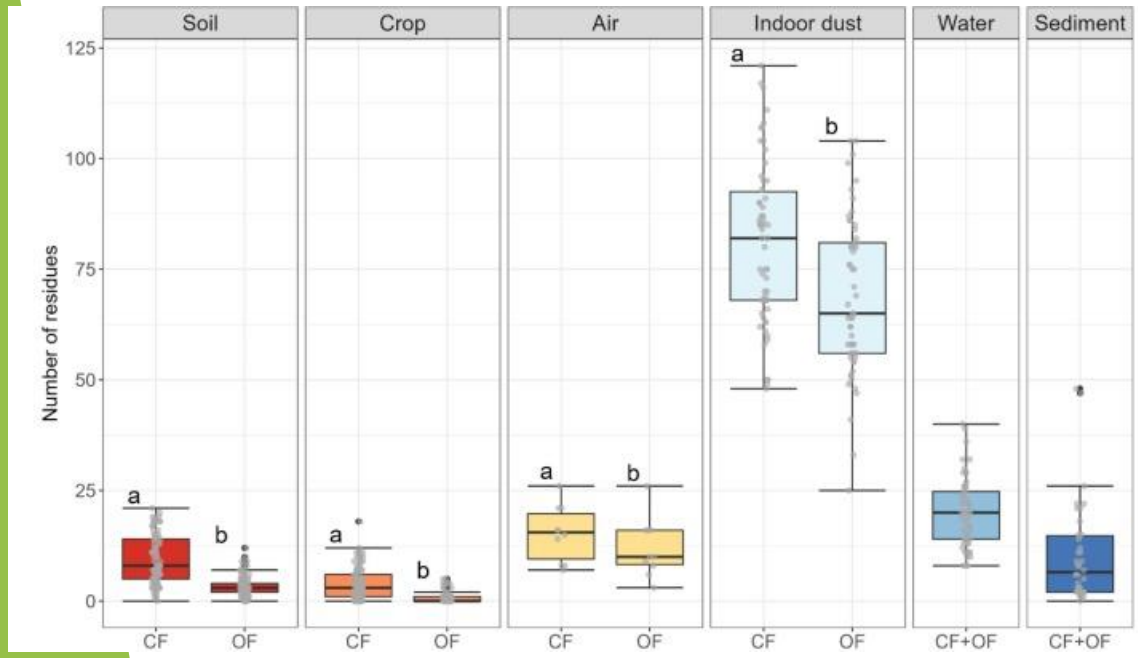


Published field study protocol: Silva et al. (2021). PLoS ONE, 2021, 16 https://doi.org/10.1371/journal.pone.0259748

Pesticides – primary data

- Application records, determinants of exposure
- Number & levels of pesticide residues/sample
- Type of pesticide residues found/not found
- Co-ocurrence of pesticide residues (mixtures)

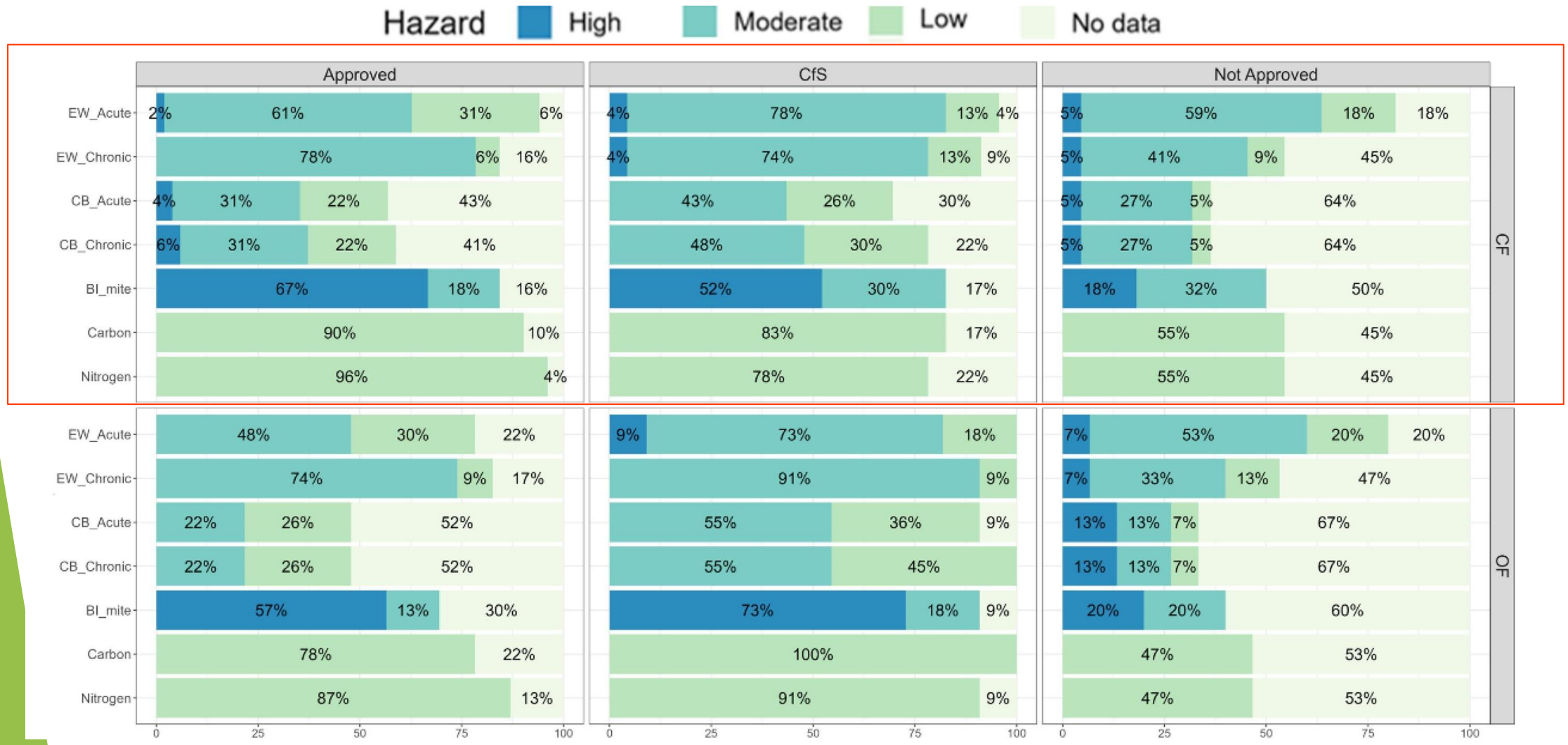




Silva et al.2023

*CF=conventional field; OF=organic field

- Hazard profile (PPDB + EFSA), for organisms of respective compartment



* CF=conventional field; OF=organic field; CfS=candidates for substitution

EW=Earthworms, CB=Collembola, BI=Beneficial Insects - predatory mite; Carbon=soil micro-organisms related to carbon mineralisation; Nitrogen=soil micro-organisms related to nitrogen mineralisation.

Silva et al.2023

Pesticide prioritization indicator (PPI)

$$\text{PPI}_X \text{ for ecosystem} = \sum_{i=1}^{6} (FDi * Ci * HHSi) \quad (1)$$

$$\text{PPI}_X \text{ for human} = \sum_{i=1}^{3} (FDi * Ci) * HHSHIi \quad (2)$$

$$\text{PPI}_X \text{ for matrix} = FD * C * HHS \quad (3)$$

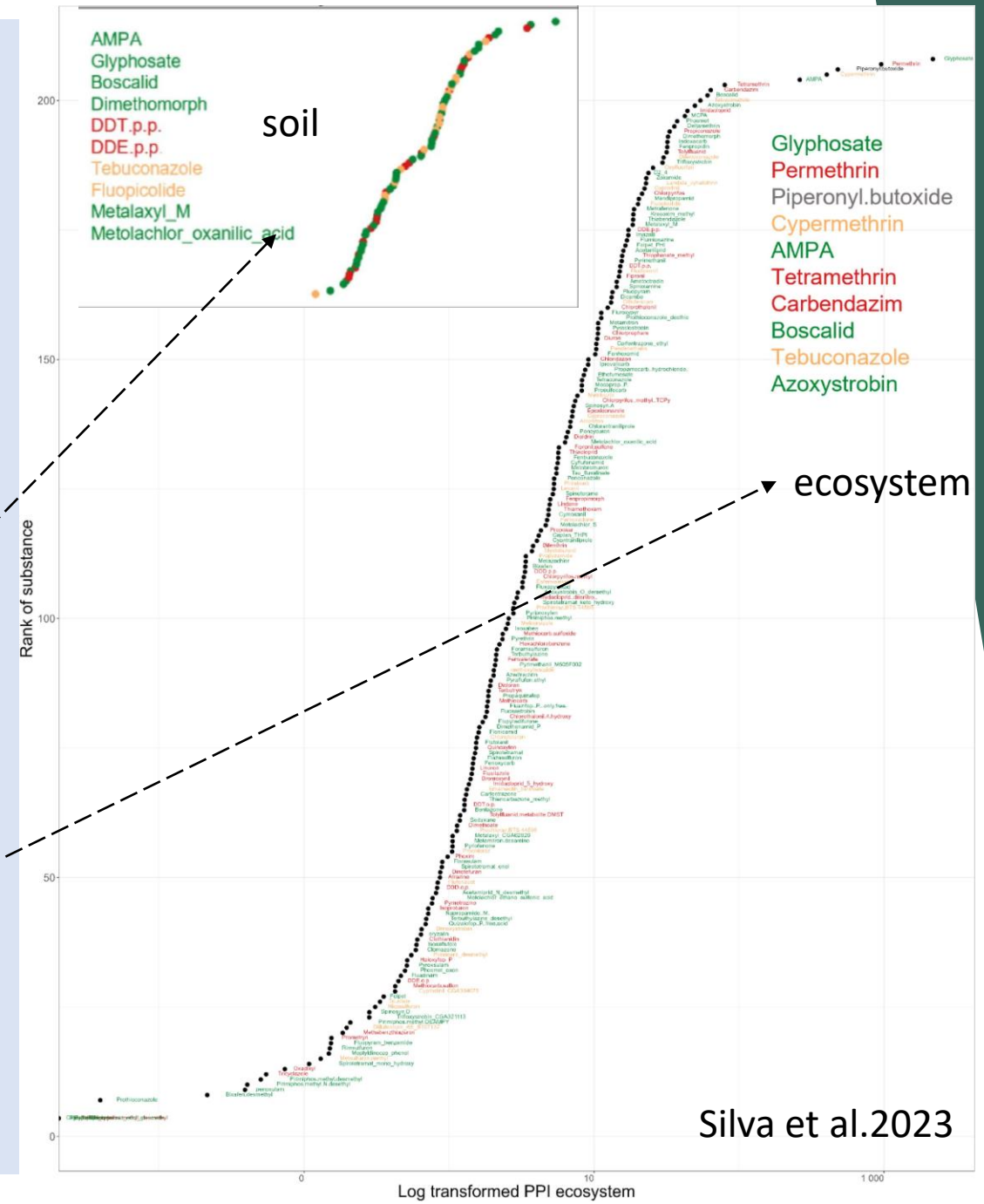
$$\text{Cumulative PPI for matrix} = \sum_{i=analyte\,1}^{analyte\ 209} PPIi \quad (4)$$

where x=pesticide (residue) being considered; FD=frequency of detection of pesticidexin the matrix being considered; C=median concentration of pesticidexin the matrix being considered; HHS=highest hazard score of the residuexamong organisms related to the matrix being considered; 1=crop, 2=outdoor air, 3=indoor dust, 4=water, 5=sediment, 6=soil; and HHSHI=highest hazard score of the residuexamong the eleven specific human health issues considered in the study. For matrix-specific assessments

rationale similar to the EC-Harmonised Risk Indicator 1:
quantities of pesticide-active substances on the market*hazard weighting factor based on the classification of the active substance (Regulation EC No 1107/2009)

Applications:

1) Set monitoring priorities/watch list
2) Support decision-making concerning pesticide use/approvals/transition
3) Assess pesticide pressure on ecosystems and humans, define benchmark values



Thank you very much

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