



## **Improved model for estimating pesticide emissions for agricultural LCA**

PestLCI2.0: Climate, soil and chemical specificity in LCI modelling

**Dijkman, Teunis Johannes; Birkved, Morten; Hauschild, Michael Zwicky**

*Publication date:*  
2011

[Link back to DTU Orbit](#)

*Citation (APA):*

Dijkman, T. J., Birkved, M., & Hauschild, M. Z. (2011). Improved model for estimating pesticide emissions for agricultural LCA: PestLCI2.0: Climate, soil and chemical specificity in LCI modelling. Poster session presented at 21st SETAC Europe Annual Meeting, Milan, Italy.

---

### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



# Improved model for estimating pesticide emissions for agricultural LCA

## PestLCI 2.0: Climate, soil and chemical specificity in LCI modelling

Teunis J. Dijkman, Morten Birkved, Michael Z. Hauschild

Section for Quantitative Sustainability Assessment, DTU Management Engineering, Technical University of Denmark, Kgs.Lyngby, Denmark

### AIM

- To develop a user-friendly, refined tool to estimate pesticide emissions from arable land, applicable for various European soil types and climatic conditions, to 3 environmental compartments:
  - Air -  $f_{air}$
  - Surface water -  $f_{sw}$
  - Ground water -  $f_{gw}$
- To illustrate the climate, soil, and chemical specificity of pesticide emissions using this tool

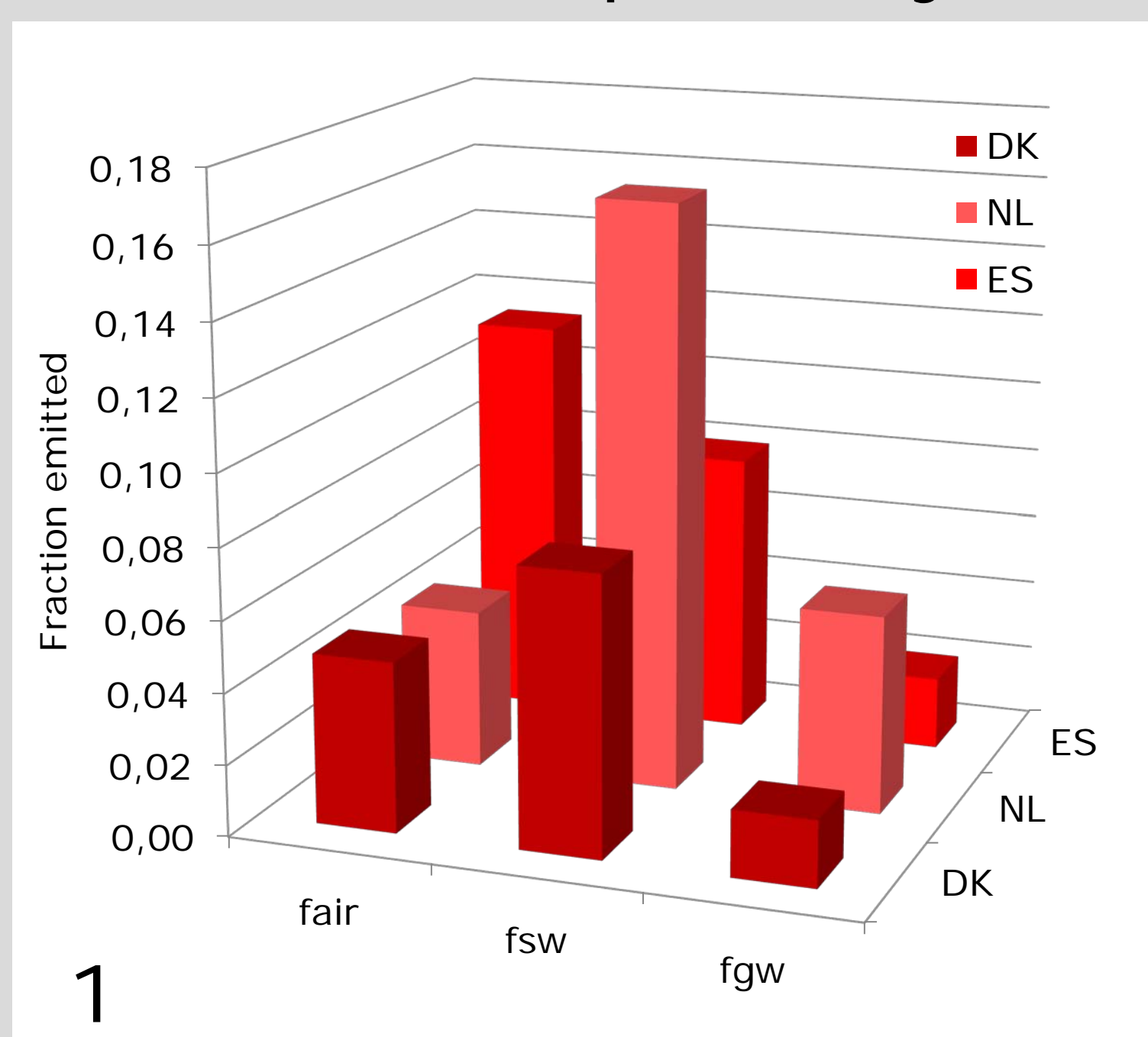
### CONCLUSIONS

- PestLCI 2.0 is capable of estimating pesticide emissions to air, surface water and ground water under various climatic conditions and soil types
- Total emissions and their distribution between the compartments are pesticide, soil and climate specific
- Only a small fraction of what is applied is emitted from the technosphere (i.e. the arable land)
- These conclusions and the proposed approach divert from current state-of-the-art LCIA-practice

### RESULTS

To illustrate the applicability of PestLCI 2.0, realistic pesticide emission scenarios were derived to demonstrate climate, soil and pesticide specificity as well as the variability of resulting pesticide emissions

#### Climate specificity



Variable: climate; Constants: soil (soil 2), pesticide (MCPA)

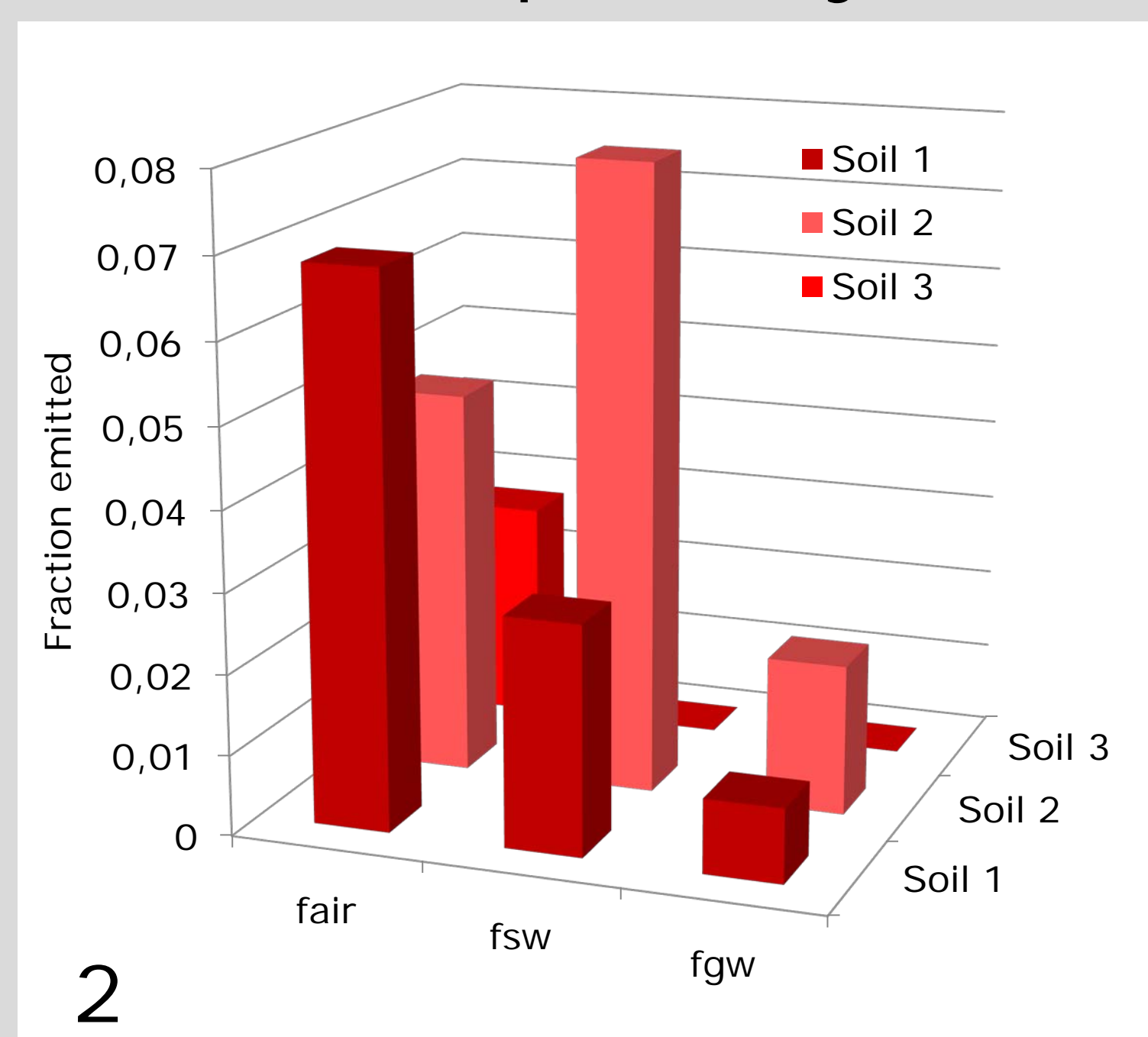
Variation mainly caused by rainfall ( $f_{sw}$ ,  $f_{gw}$ ) and temperature

#### Scenario details:

- 3 climate profiles
- 3 soil profiles/types
- 2 pesticides (a.i.)

Denmark (DK), the Netherlands (NL), south-Spain (ES)  
Soil 1 (high  $f_{clay}$ ), soil 2 (high  $f_{silt}$ ), soil 3 (high  $f_{sand}$ ),  $f_{oc}$  0.6-0.9, pH 4.6-7.7  
Glufosinat-Ammonium (gluf.), MCPA

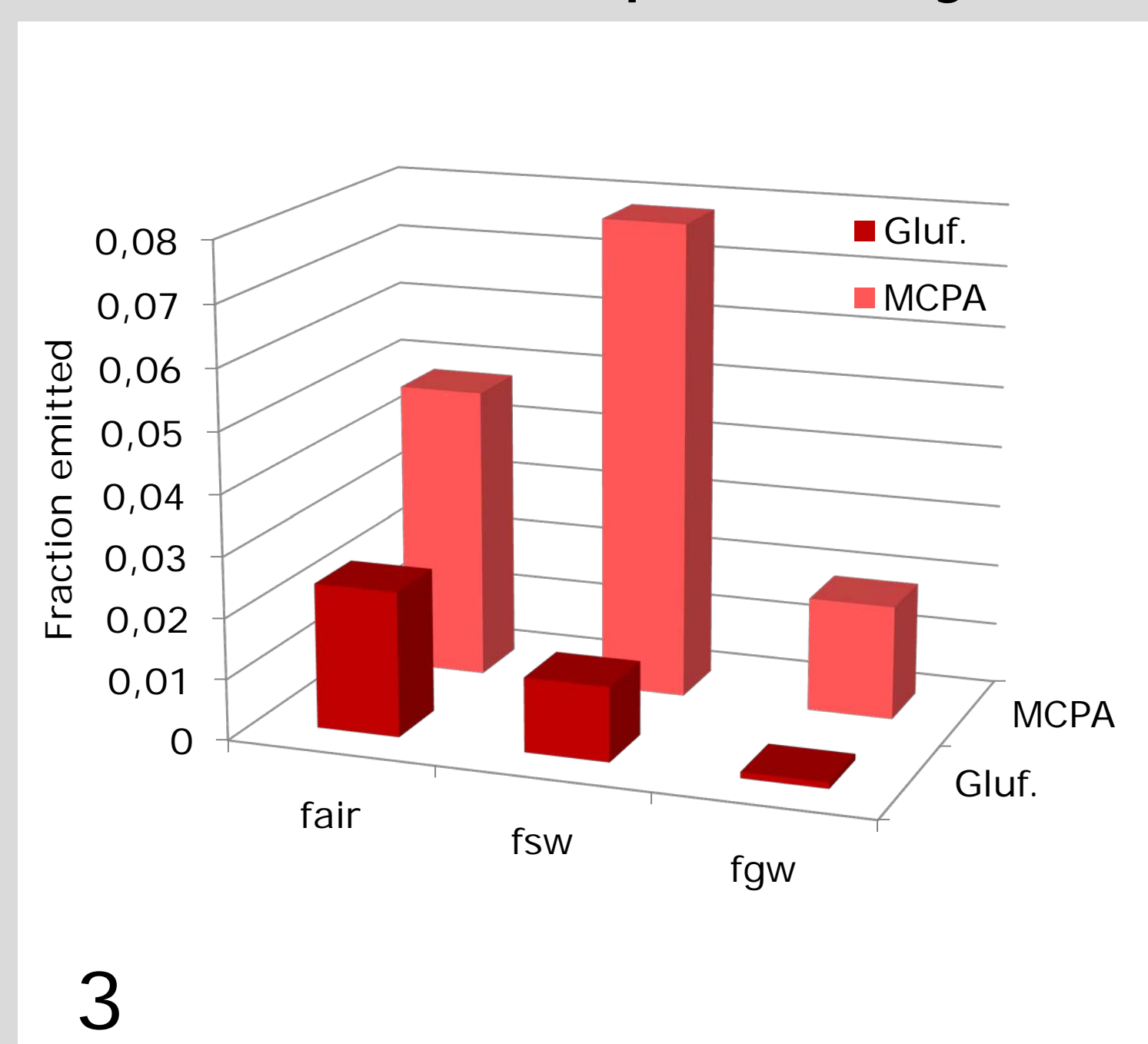
#### Soil specificity



Variable: soil; constants: climate (DK), pesticide (MCPA)

Variation mainly caused by  $f_{oc}$  ( $f_{air}$ ), leaching rate, soil sorption capacity and pH ( $f_{sw}$ ,  $f_{gw}$ )

#### Pesticide specificity



Variable: pesticide; constants: climate (DK), soil (soil 3)

Variation mainly caused by vapour pressure ( $f_{air}$ ),  $pK_a$  and  $K_{oc}$  ( $f_{sw}$ ,  $f_{gw}$ )

#### Total emissions

Scenario	Emission (fraction)
Figure 1, DK	0.14
Figure 1, NL	0.26
Figure 1, ES	0.21
Figure 2, Soil 1	0.14
Figure 2, Soil 2	0.11
Figure 2, Soil 3	0.03
Figure 3, Gluf.	0.04
Figure 3, MCPA	0.14

Only a fraction of the applied pesticide is emitted from the technosphere for all scenarios

### METHOD

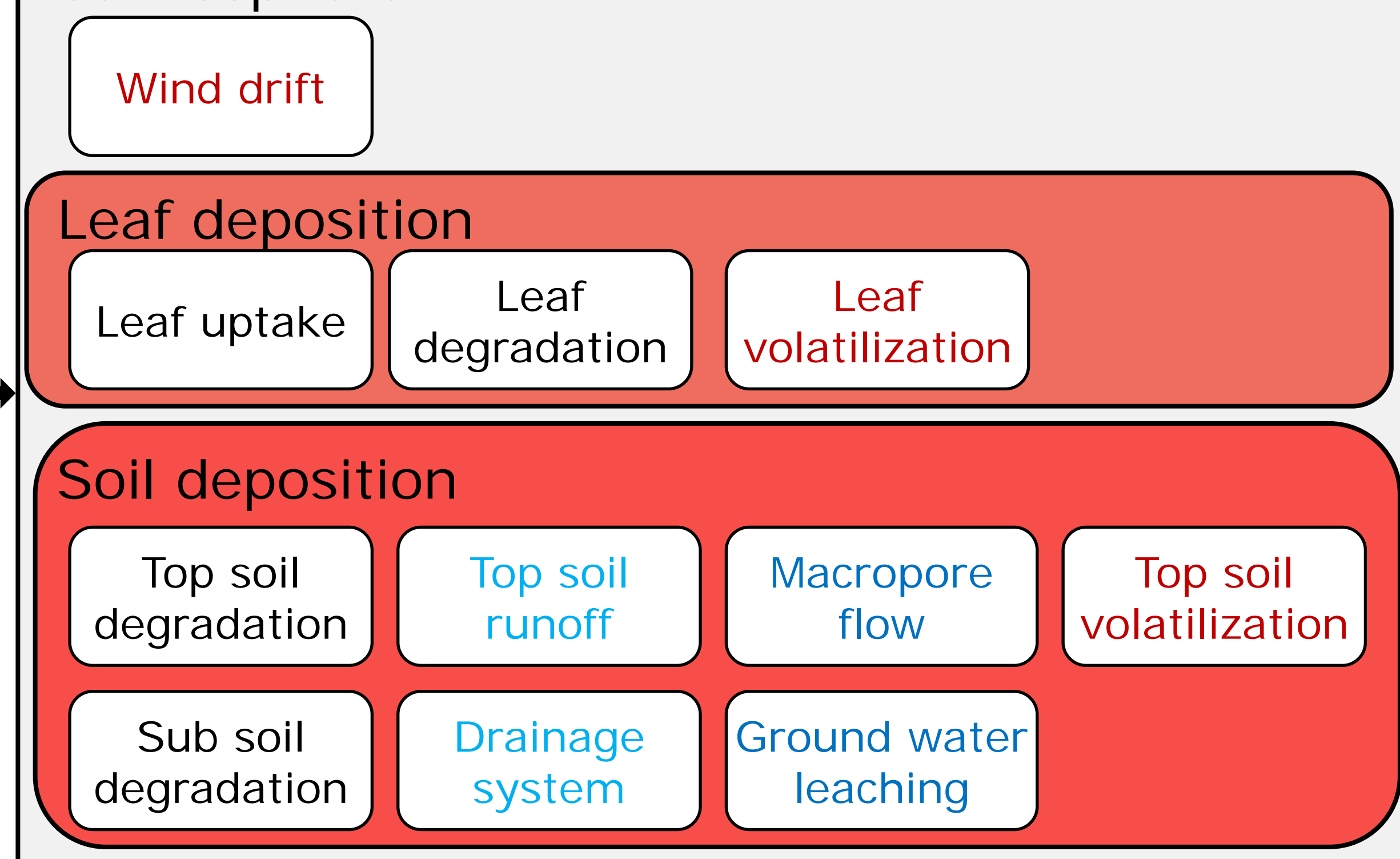
PestLCI 2.0 is an updated, refined and expanded version of PestLCI<sup>1</sup>:

- Expansions
  - Tillage (at 3 levels)
  - Macropore flow
  - Pesticide DB (now 90 a.i.)
  - Climate DB (now 25 profiles)
  - Soil DB (now 7 profiles)
- New user-friendly platform (PestLCI is still freeware)
- Updated and refined algorithm set

PestLCI 2.0 Model structure

- User chooses
- Pesticide
  - Crop type
  - Crop development
  - Climate conditions
  - Soil type
  - Month of application
  - Mode of application

Technosphere



Emissions from technosphere to:

- Air
- Surface water
- Ground water

Removal of pesticides:

- Terminal processes