

The oyster and the shell

Aaldrik Tiktak, Erik vd Berg, Jos Boesten,
Daniel v Kraalingen, Minze Leistra, Ton vd Linden



Introduction

Overview

Domain

Processes

Database

Graphical User Interface

Examples

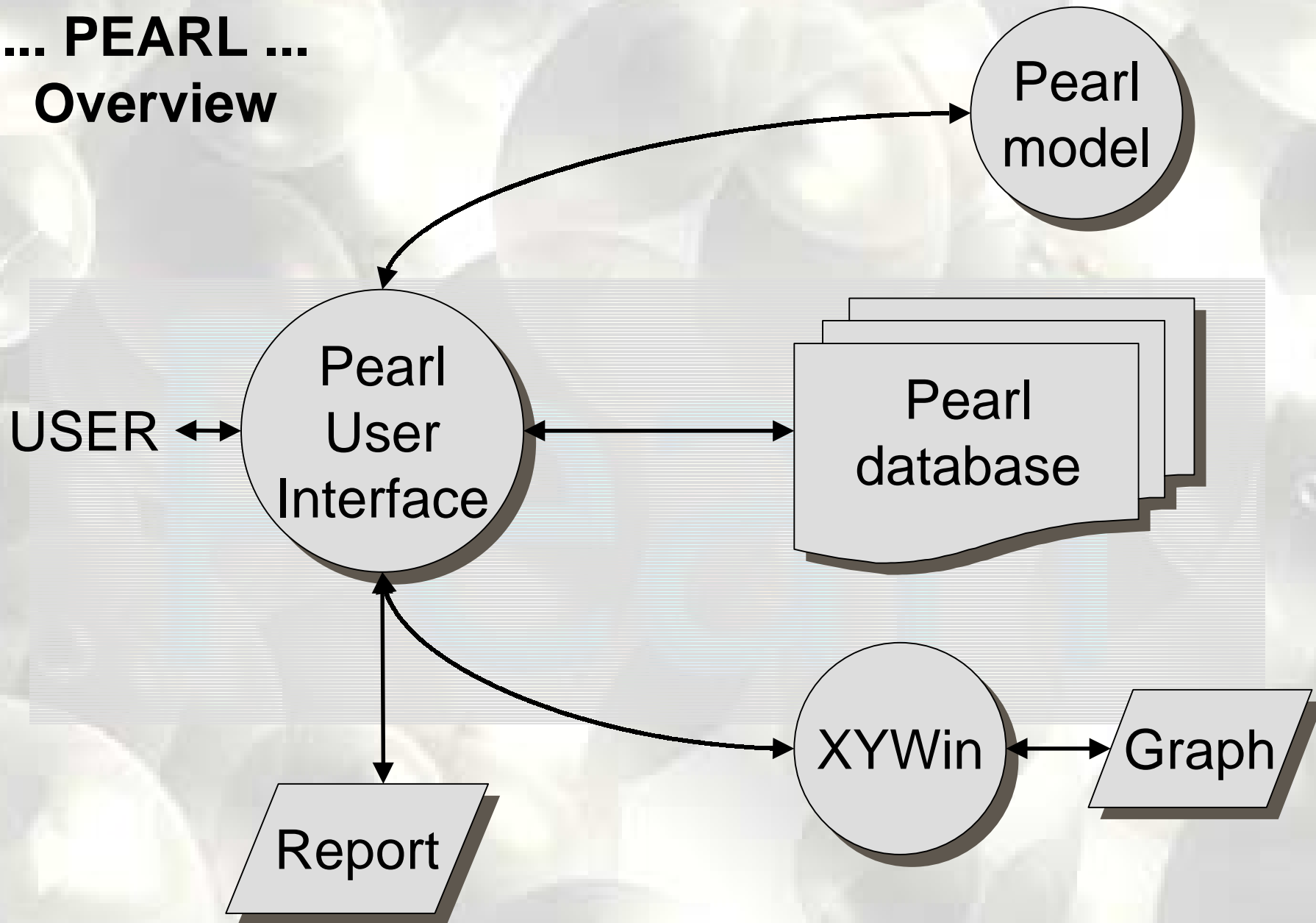
Further development

... PEARL ...

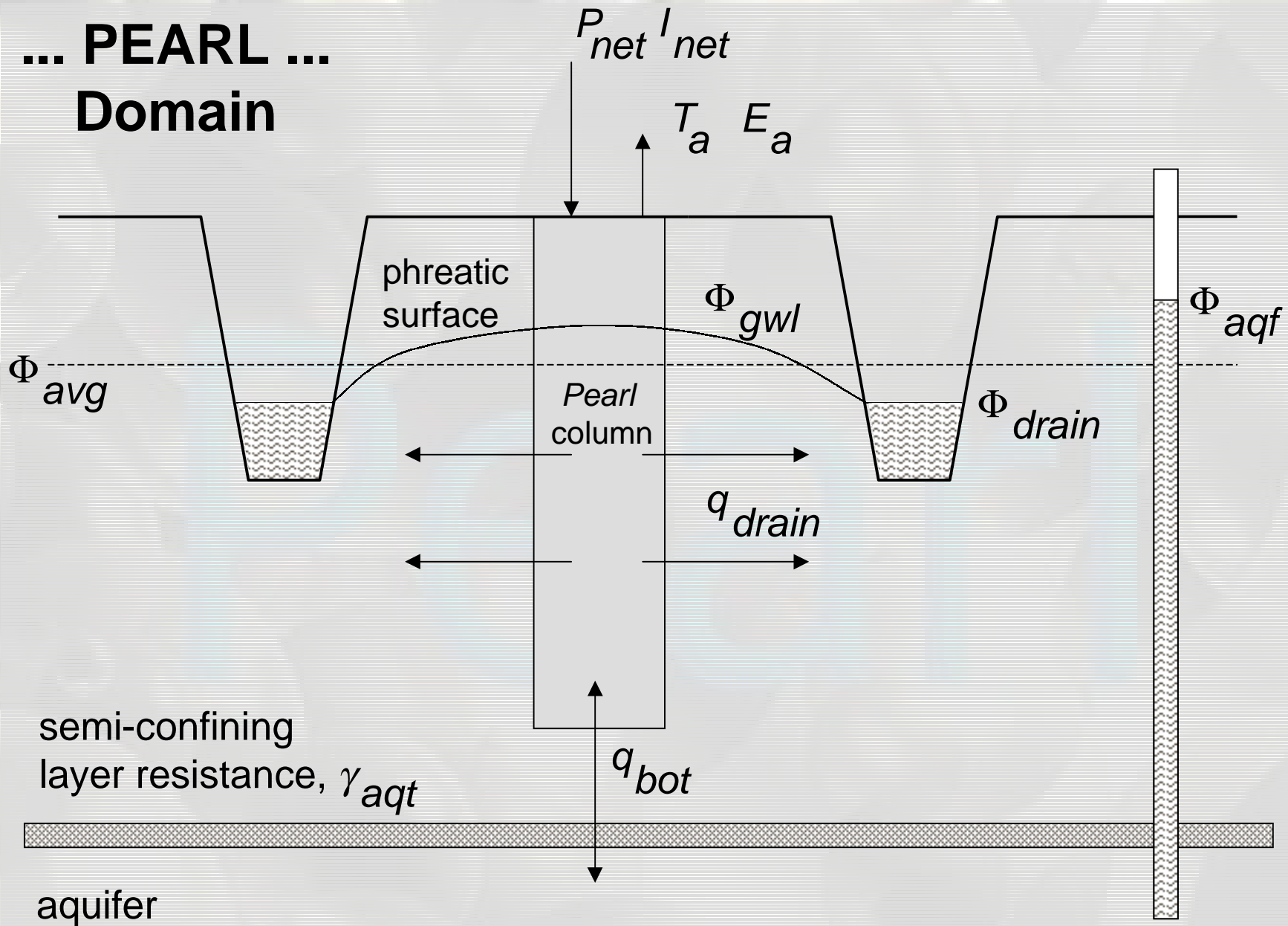
Pesticide Emission Assessment at the Regional and Local scale

- **Leaching, run-off and accumulation of pesticides**
- **Combination of RIVM model PESTRAS en SC model PESTLA**
- **SWAP model for hydrology**
- **XyWin-package for presentation**
- **access PEARL via *Pearl User Interface***

... PEARL ... Overview



... PEARL ... Domain

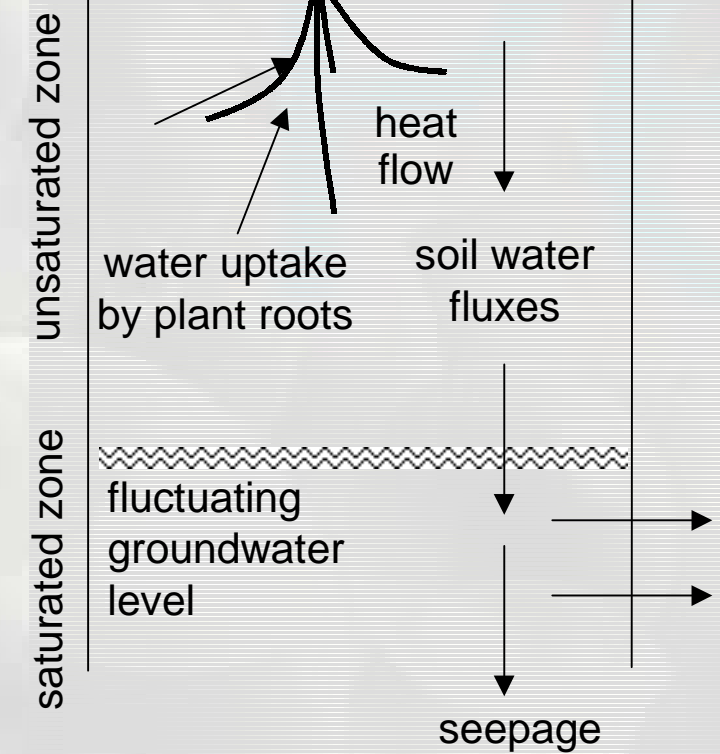


SWAP hydrology

precipitation
irrigation

transpiration
crop calendar
evaporation of intercepted water

soil evaporation
throughfall
ponding

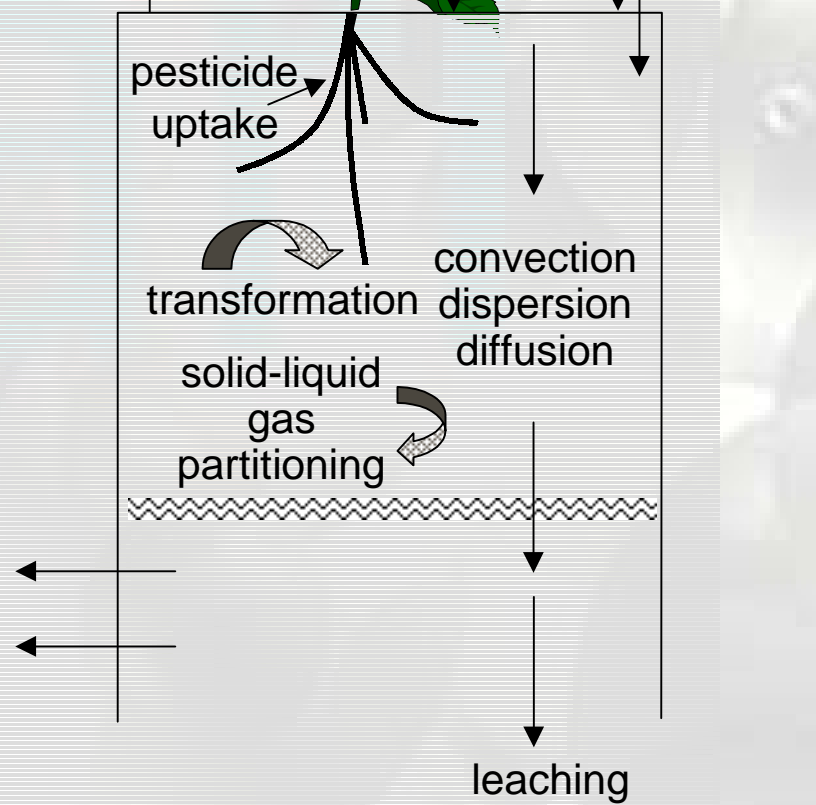


PEARL (pesticides)

deposition
irrigation
application

dissipation at the crop canopy

volatilization
wash-off
injection



... PEARL ...

Concepts, hydrology (model SWAP)

- **Richard's equation**
- **Precipitation, irradiation, temperature and irrigation on daily basis**
- **Potential evaporation according to Penman-Monteith or Makkink. Parameters dependent on method**
- **Actual transpiration according to Feddes' reduction function. Root uptake dependent on root distribution.**
- **Actual soil evaporation reduces according to time dependent reduction function**

... PEARL ...

Concepts - management

- Application on crop or on soil
 - Crop
 - interception dependent on crop LAI or user-defined
 - flexible application scheme
 - Soil
 - spraying on soil surface, or
 - incorporation, or
 - injection at specified depth
- Tillage
 - uniform distribution after tillage operation

... PEARL ...

Concepts - processes crop foliage

- **Initial distribution over crop and soil dependent on LAI or user-defined factor**
- **First order dissipation from foliage:**
 - **transformation**
 - **volatilisation**
 - **penetration**

} **Can be lumped**
- **Wash-off**

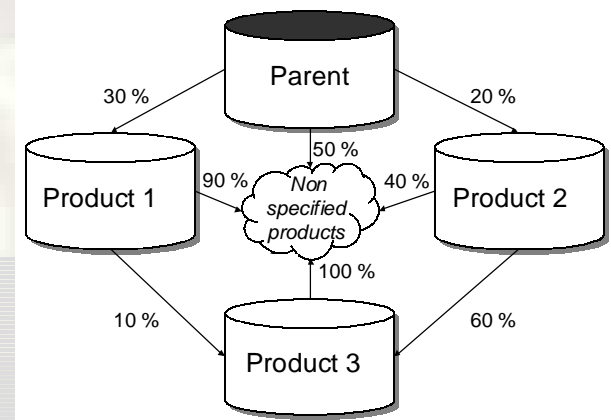
... PEARL ...

Concepts - transport in soil

- **Convection and diffusion/dispersion in soil solution**
- **Diffusion in gas phase**
- **Lateral drainage of solutes by convection**
- **At the soil surface: volatilisation by diffusion through laminar layer**
- **At the bottom boundary: convective transport**

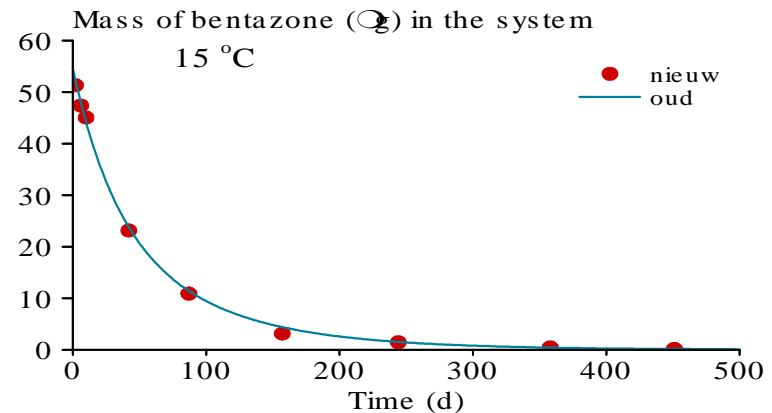
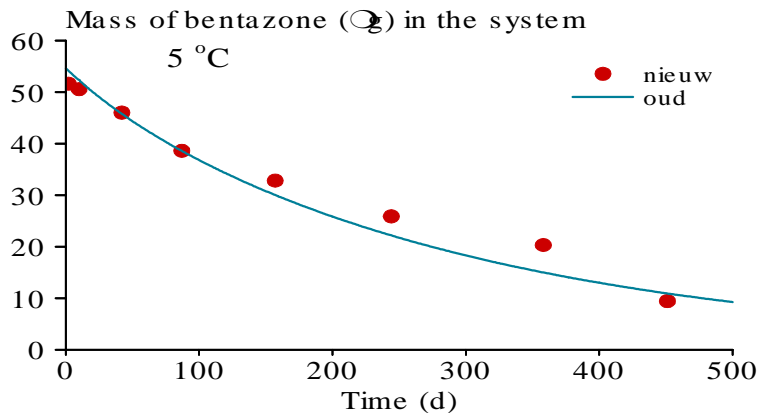
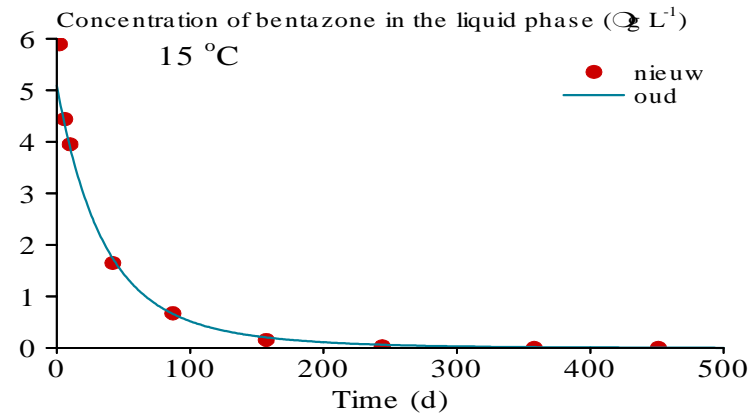
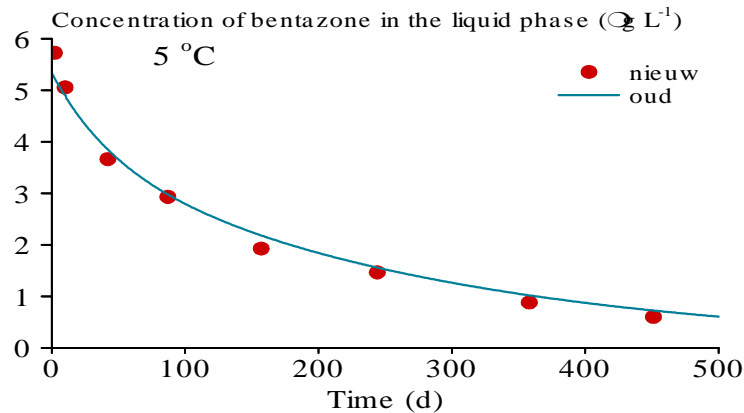
... PEARL ... transformations

- flexible transformation schemes
- first-order transformation, single input for reference conditions
- no transformation in non-equilibrium phase
- Temperature dependency according to Arrhenius, but no transformation below 0 °C
- Moisture dependency according to Walker
- User-defined depth dependency, factor for each soil horizon



Concepts - transformation

DT_{50} , desorption rate and activation energy derived from incubation experiments, if total residues and concentration in soil solution is measured with time.



... PEARL ...

Concepts - partition

- Three phases - gas, solution and solids
- Two-site Freundlich model: equilibrium sites and non-equilibrium sites (no transformation in non-equilibrium sites)
- K_F as function of organic matter (K_{om}) or user-defined for each horizon. pH-dependent sorption is optional
- Henry coefficient is dependent on temperature

... PEARL ...

Concepts - plant uptake

- **Passive uptake, transpiration stream concentration factor is user defined**

PEARL

... PEARL ... Database

- many data per model run
- many runs in batch procedure possible
- Input and output in relational database
- Access through Pearl User Interface (*PUI*):
input screens follow input tables

... PEARL ...

Building blocks

Tables are building blocks:

Location = Hamburg

+

Crop = Maize

+

Substance = Atrazine

+

Applic. = annually 1 kg/ha on May 26

Soil = sandy soil

+

MeteoStation = Hamburg

+

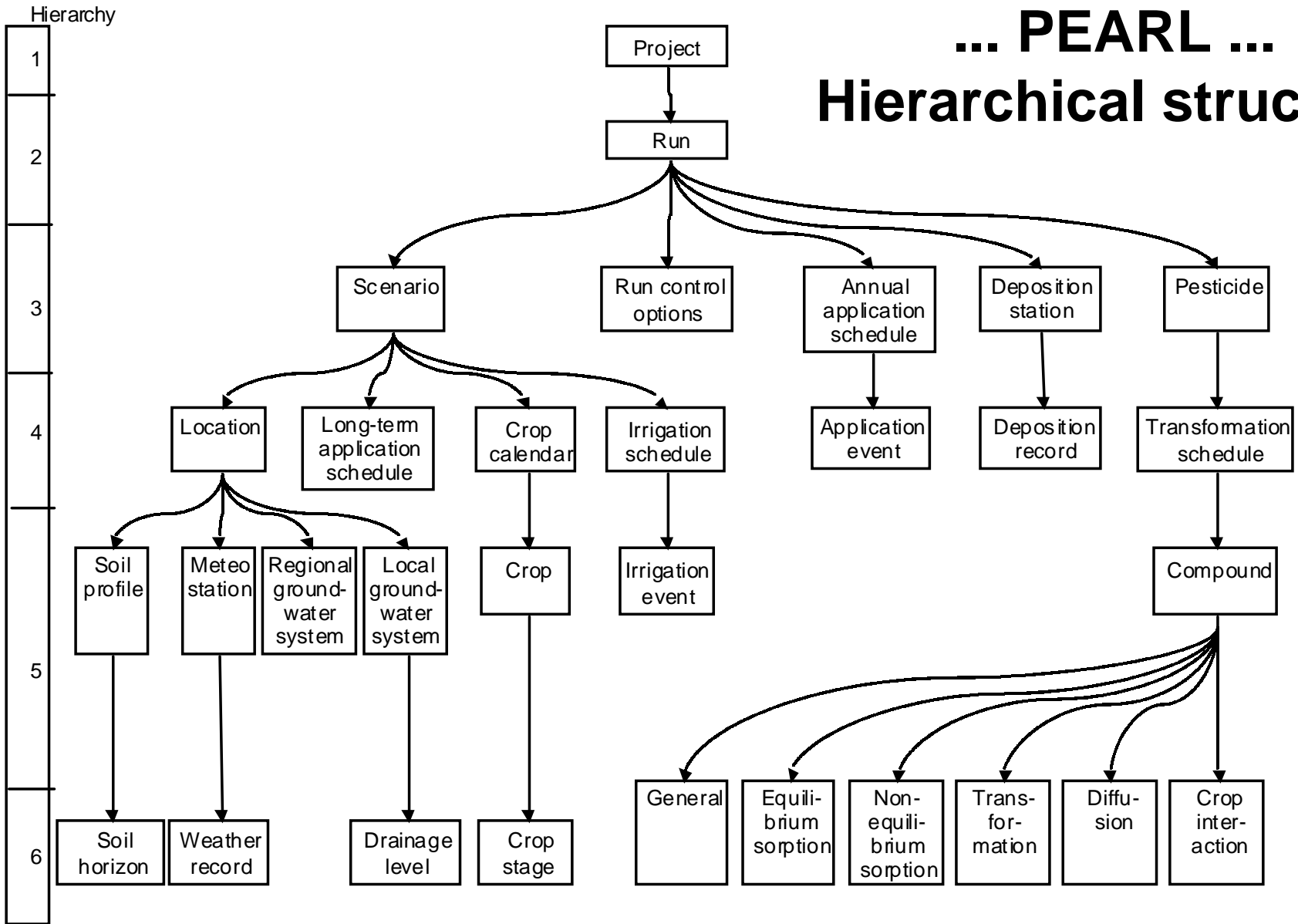
Regional groundwater

system =

free drainage

... PEARL ...

Hierarchical structure





Which crops do you want to do calculations for ?

Available Crops:

- Apples
- Bushberries
- Cabbage
- Carrots
- Citrus
- Cotton
- Field beans
- Grass
- Linseed
- Maize
- Oil seed rape (summer)
- Oil seed rape (winter)
- Onions
- Peas

Selected Crops:

- Winter cereals



Cancel

< Back

Next >

Finish

Pearl - Focus Wizard



Which locations do you want to do calculations for ?

Available locations:

Chateaudun
Jokioinen
Kremsmuenster
Okehampton
Piacenza
Porto
Sevilla
Thiva



Selected Locations:

Hamburg

Cancel

< Back

Next >

Finish

Pearl - Focus Wizard



Which substance, application scheme and
repeat interval for the application scheme (in years) ?

Substance:

Substance A

Application scheme:

FOCUS Autumn application

Repeat interval for years:

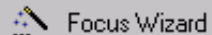
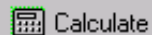
1

Cancel

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Finish



Browse Runs

| RunID | Selected | Name | ResultsSummary | ResultsDetailed |
|-------|----------|------------------|----------------|-----------------|
| 11 | Yes | WCEREALS-HAMBURG | NotThere | NotThere |

Focus report

Graphs, user defined

Graphs, predefined

Copy



Edit Run

Scenario | Simulation Control | Output Control | Run Status

Scenario

Location: Hamburg

Crop Calendar: HAMB-WCEREALS

Irrigation: No

Start: 01/01/1901 Stop: 31/12/1926

Initial conditions for pesticides...

Pesticide and scenario dependent

Substance: Substance A

Application: FOCUS Autumn application

Deposition: No deposition

Repeat interval for events (a): 1

Substances

| Code | Name | Parent | Molar Mass |
|-------|---------------------------|--------|------------|
| A | Substance A | True | 300 |
| B | Substance B | True | 300 |
| C | Substance C | True | 200 |
| D | Substance D | True | 300 |
| MET-C | Metabolite of substance C | False | 150 |

Copy
 Transformation scheme

- General
- Freundlich eq
- Freundlich non-eq
- Transformation
- Diffusion
- Crop

Code: Parent
 Name:
 Molar mass (g/mol):
 Saturated vapour pressure (Pa): measured at (C):
 Molar enthalpy of vaporisation (kJ/mol):
 Solubility in water (mg/L): measured at (C):
 Molar enthalpy of dissolution (kJ/mol):

Comments...

Close

Parent substance

Substance Code:

Substance Name:

Is Parent?:

Molecular mass:

DT50Ref:



Browse metabolites

| Fraction transformed | To substance |
|----------------------|--------------|
| 1 | NSS |

Navigation buttons: < > + - ✓ ✕

Edit metabolite

Fraction transformed:

To substance:

Close

... PEARL ...

Main output

- ***Dutch standard scenario:***
 - Concentration in uppermost groundwater
 - Percentage leached (single application)
- ***European scenarios (FOCUS):***
 - Concentration and amount in leachate at 1 m depth
 - 80% percentile in leachate
- ***For TOXSWA :***
 - drainage to 5 drainage levels

```

* -----
* *****
* 00 00
* 00 00 ***** 0000 00 00 00
* 0000 00 0 0 000 00 00
* 00 ***** 00000 00 00 PearlModel v1.1.1
* 00 00 0 00 00 00 05-May-2000
* 0000 0000 0000 00 0000 0000 (c) RIVM/Alterra
* Pesticide Emission Assessment for Regional and Local scales
* Compiled with: Talford P55 v1.10d
* -----

```

```

* RIVM Alterra Green World Research
* PO BOX 1 PO BOX 47
* 3720 BA Bilthoven 6700 AA Wageningen
* the Netherlands the Netherlands
* Please report errors and other remarks to a.wilmak@rivm.nl
* Always send a copy to i.vandenberg@alterra.wagur.nl
* -----

```

```

* The working directory is C:\Program Files\Pearl\10DG
* Pearl input file is 11.pr1
* Pearl output file is 11.out
* Pearl log file is 11.log
* Pearl summary file is 11.sum
* Pearl run at 16-05-2000 on 15:10
*

```

```

* Warning: this model version will expire at 01-Jul-2000
*

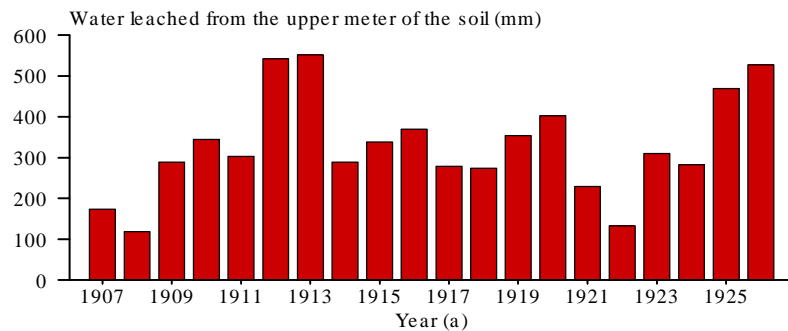
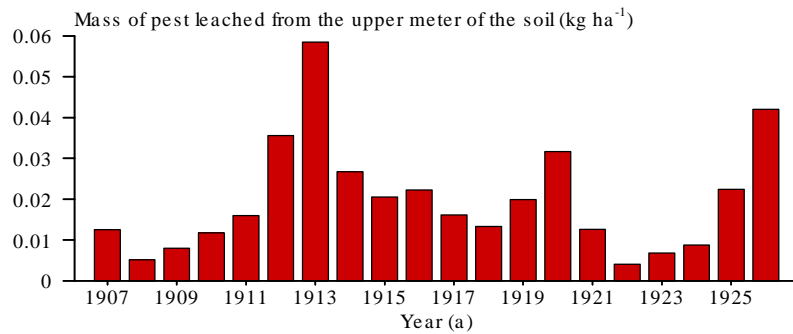
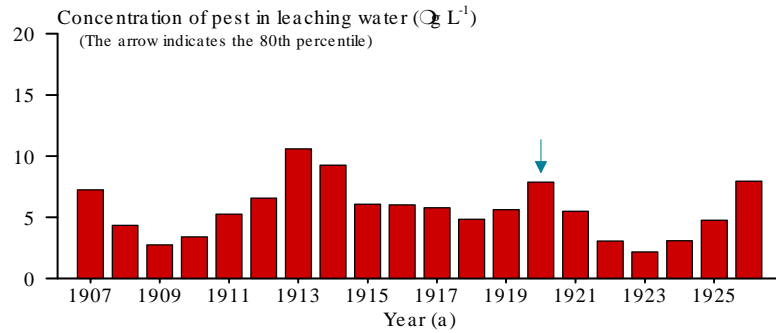
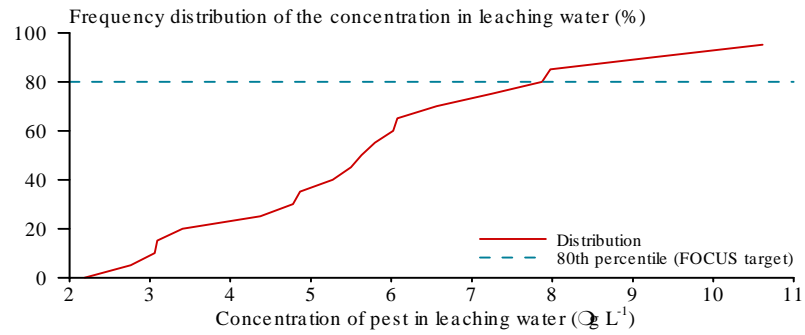
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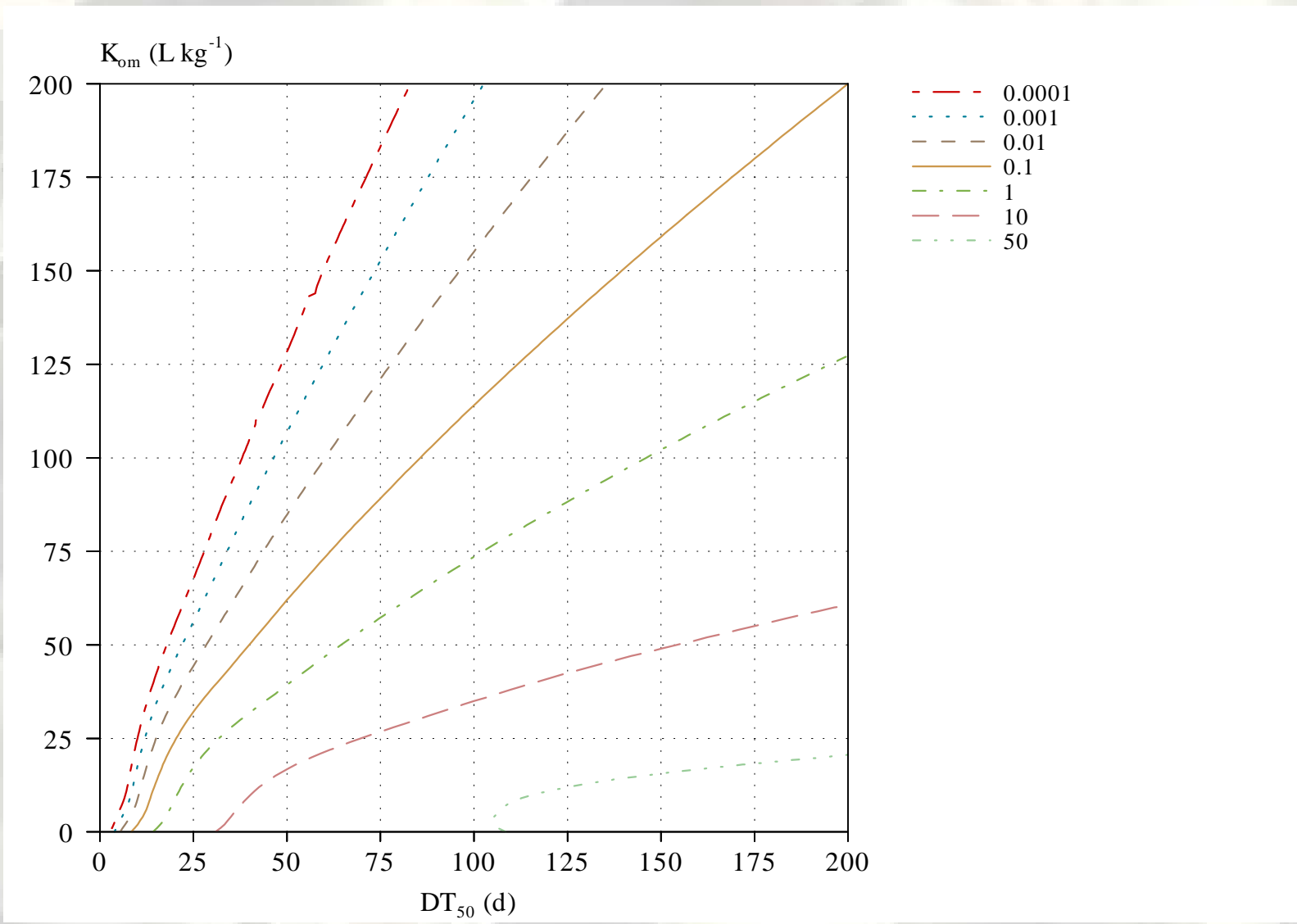
* Location: HAMBURG
* Metro station HAMB-S
* Soil type HAMB-1_Soil
* Crop calendar HAMB-CEREALS
* Substance A
* Application scheme FOCUS_AUTUMN
* Irrigation scheme No
* Deposition scheme No
* Target depth is 1.00 m
*

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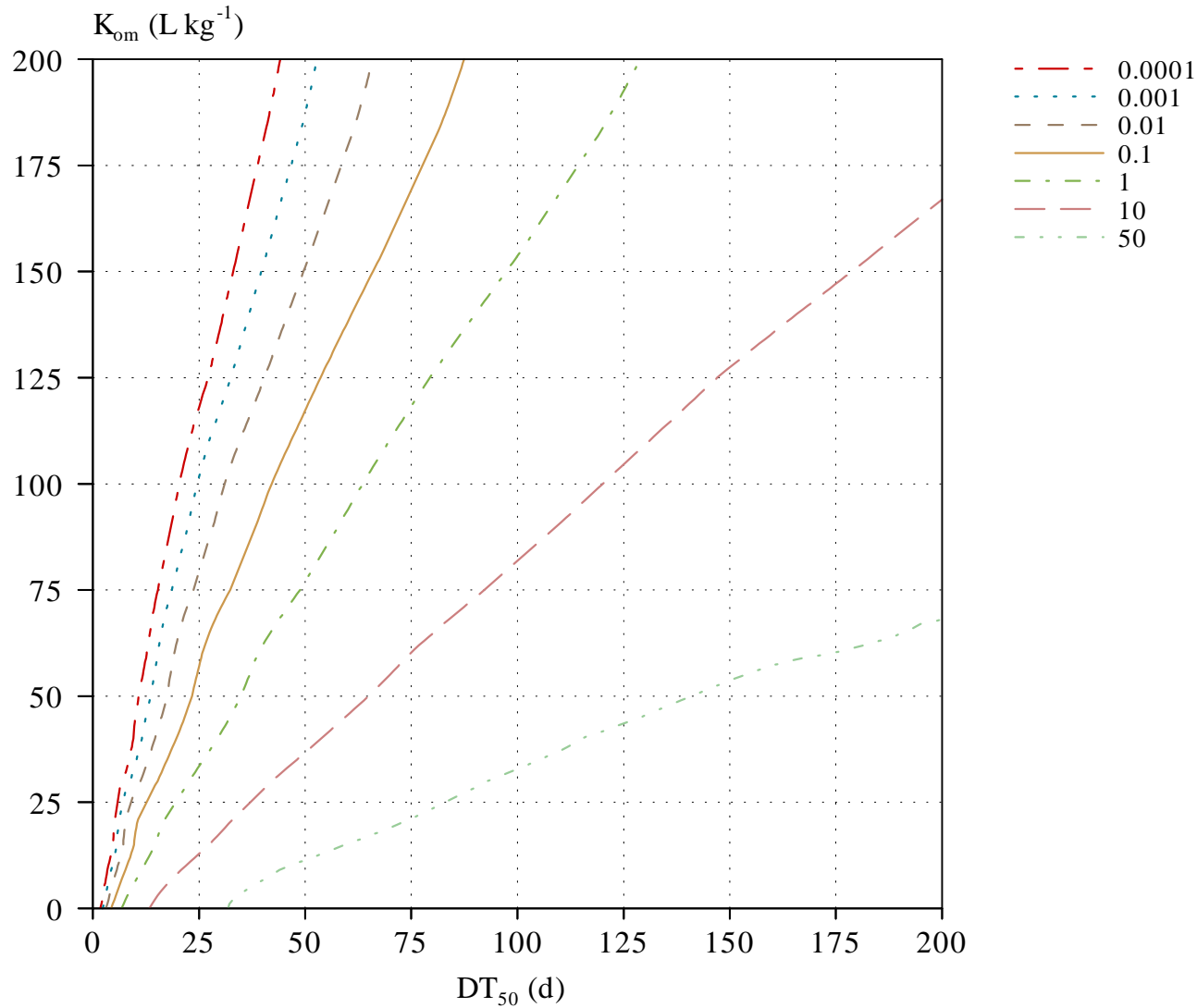
| * Period number | From | To | Water percolated below target depth (mm) | Substance leached below target depth (kg/ha) | Average substance concentration in water at target depth (ug/L) |
|-----------------|-------------|-------------|--|--|---|
| 1 | 01-Jan-1997 | 31-Dec-1997 | 127.300 | 0.0259862 | 7.159 |
| 2 | 01-Jan-1998 | 31-Dec-1998 | 168.950 | 0.0089707 | 6.129 |
| 3 | 01-Jan-1999 | 31-Dec-1999 | 215.620 | 0.0004524 | 2.659 |
| 4 | 01-Jan-1910 | 31-Dec-1910 | 371.600 | 0.0219924 | 3.499 |
| 5 | 01-Jan-1911 | 31-Dec-1911 | 320.370 | 0.0275079 | 5.299 |
| 6 | 01-Jan-1912 | 31-Dec-1912 | 557.550 | 0.0271562 | 6.669 |
| 7 | 01-Jan-1913 | 31-Dec-1913 | 891.940 | 0.0627781 | 10.741 |
| 8 | 01-Jan-1914 | 31-Dec-1914 | 310.320 | 0.0211829 | 5.739 |
| 9 | 01-Jan-1915 | 31-Dec-1915 | 389.540 | 0.0266976 | 6.079 |



Maximum concentration of substance in uppermost groundwater ($\mu\text{g L}^{-1}$) - Dutch standard scenario, spring application



80-th percentile concentration in leachate at 1 m depth ($\mu\text{g L}^{-1}$) Hamburg scenario, spring application



... PEARL ...

Conclusions

- **PEARL has been developed in consensus (Alterra and RIVM), high quality with respect to both process descriptions and IT**
- **Model can be used for national and international (EU) assessments**
- **Database structure is flexible en can easily be adopted to regional calculations (plot structure)**
- **Flexible coupling of modules, basis for easy further development and maintenance**

... PEARL ...

Future development

- **Preferential flow (Apecop project 2000-2002)**
- **Improvement of volatilisation and run-off**
- **Further validation (2000-2002)**
- **Documentation and courses (national and international)**
- **regional applications (PEARL + GIS)**