

# PRIMET

## A Decision Support System for assessing Pesticide Risks in the tropics to Man, Environment and Trade

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# PRIMET Course: Introduction

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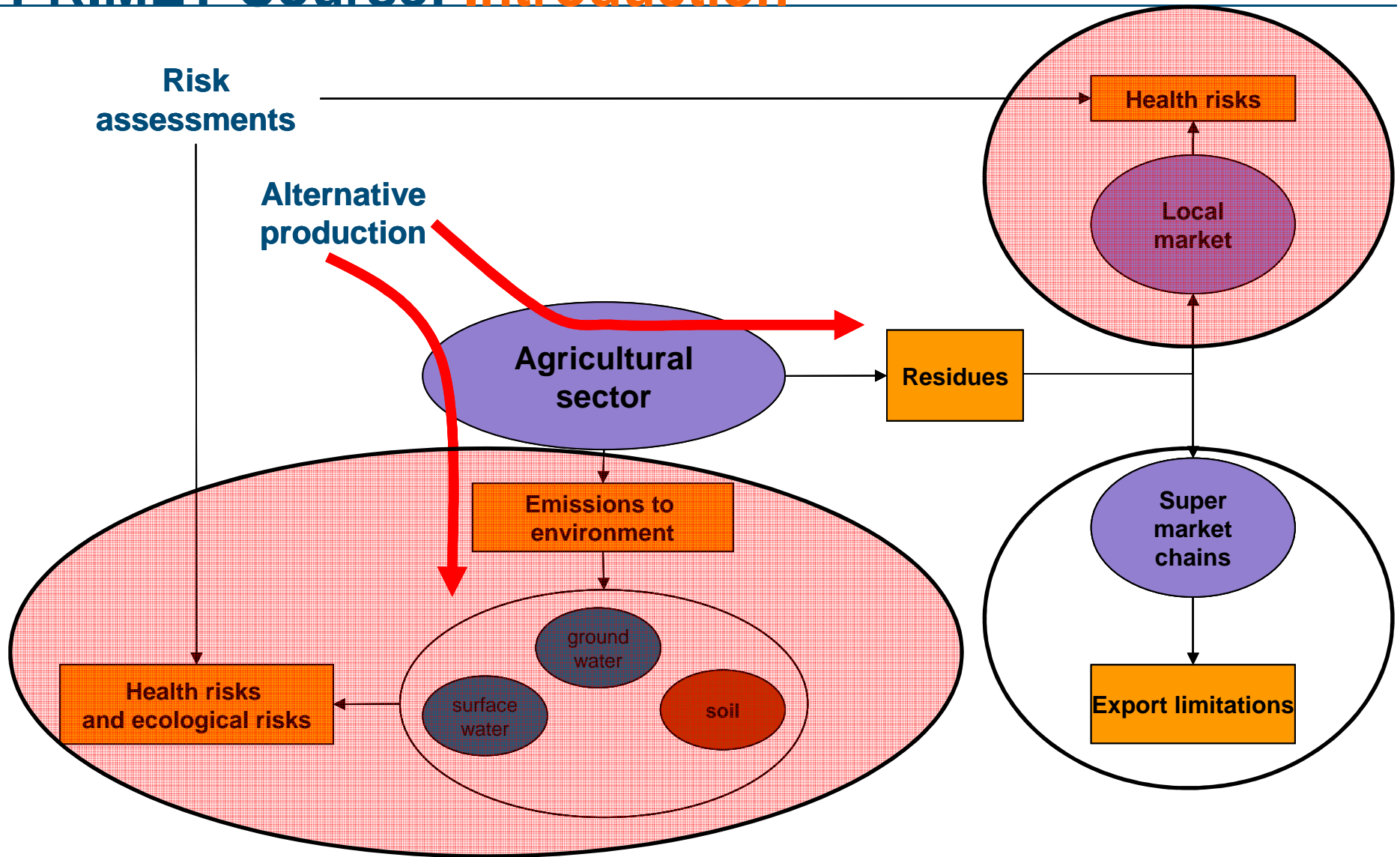
## Background

Alterra research theme:

Analysing, understanding and improving local farmer practices to promote safe-use in SE Asia



# PRIMET Course: Introduction



# PRIMET Course: Introduction

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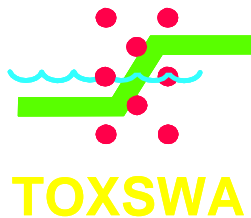
## Aim of PRIMET

- Provide a **simple instrument** to estimate the risks of pesticide application at the household level to:
  1. **aquatic** life (acute and chronic risk)
  2. **soil** life (acute and chronic risk)
  3. non target **arthropods**
  4. **bees**
  5. the use of groundwater as **drinking water**
  6. **dietary exposure** via the consumption of groundwater, vegetables, fish and macrophytes

# PRIMET Course: Introduction

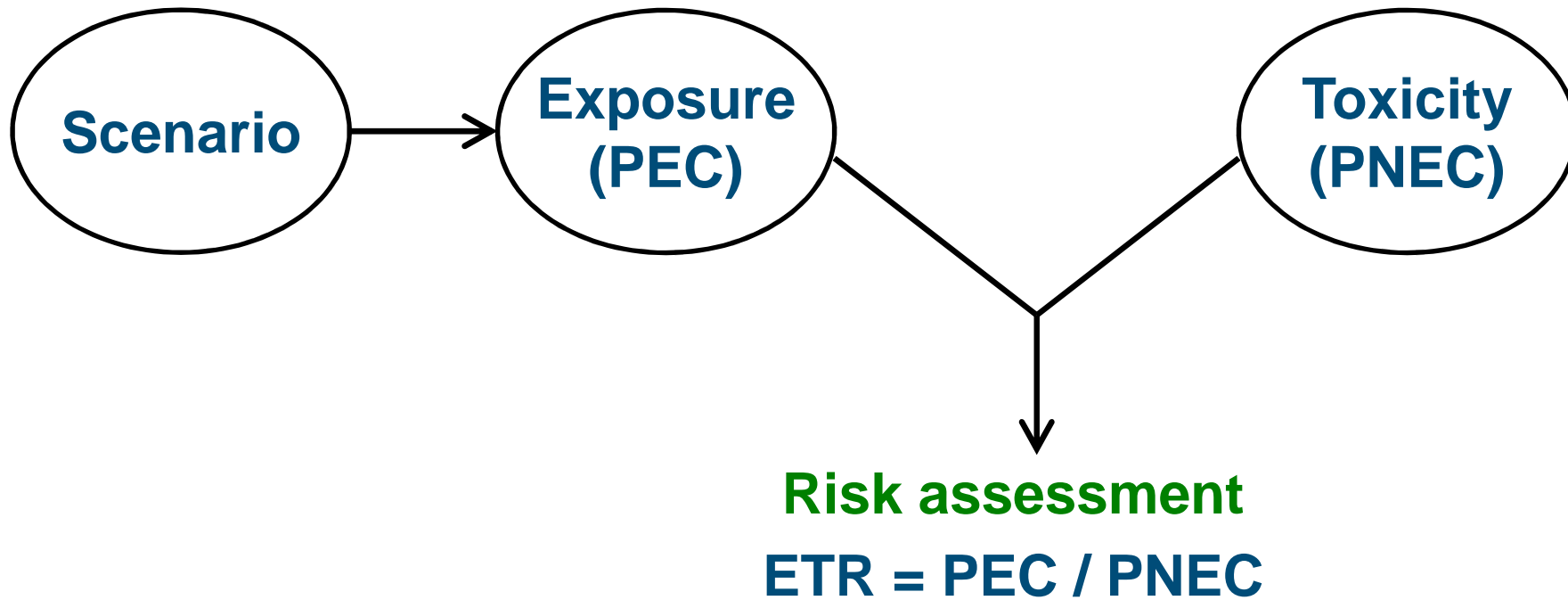
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- Risk assessment scheme in Europe
  - PRIMET based on metaversions of models and concepts used in the registration procedure in Europe
  - Exposure assessment to calculate the Predicted Environmental Concentration (PEC)
  - Effects assessment to calculate the Predicted No Effect Concentration (PNEC)



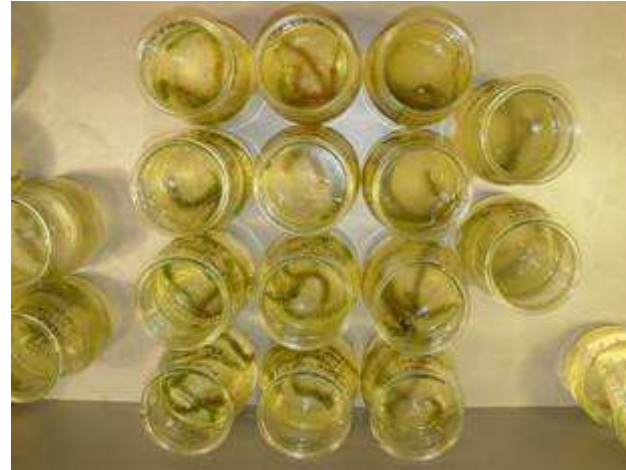
# PRIMET Course: Introduction

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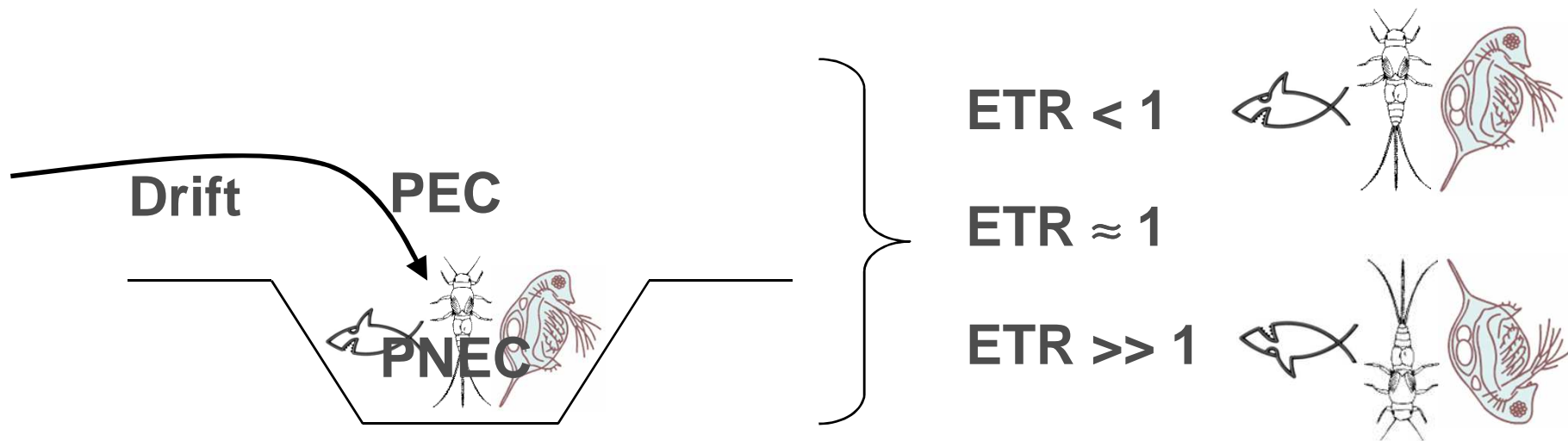
# PRIMET Course: Introduction

- Risk assessment scheme in Europe
  - Exposure assessment mostly based on models
    - Drift
    - Drainage
    - Run-off
    - Fate in water
    - Leaching
  - Effects assessment mostly based on experiments
    - Laboratory tests
    - (semi) Field experiments



# PRIMET Course: Scientific background

- Stages in Ecological Risk Assessment
- Develop a physical and application **scenario (sc)**
- Calculate the **PEC** for that scenario (pec)
- Calculate the **PNEC** for that scenario (pnec)
- Calculate the risk **ETR = PEC/PNEC (etr)**





# PRIMET Course: Scientific background

- **Environmental and human compartments**

- |                   |   |                   |        |
|-------------------|---|-------------------|--------|
| 1. surface water  | → | aquatic life      | (SW)   |
| 2. in soil        | → | below ground inv. | (SOIL) |
| 3. above soil     | → | non-target arthr. | (NTA)  |
| 4. areal exposure | → | bees              | (BEE)  |
| 5. groundwater    | → | drinking water    | (GW)   |
| 6. diet           | → | dietary exposure  | (DIET) |



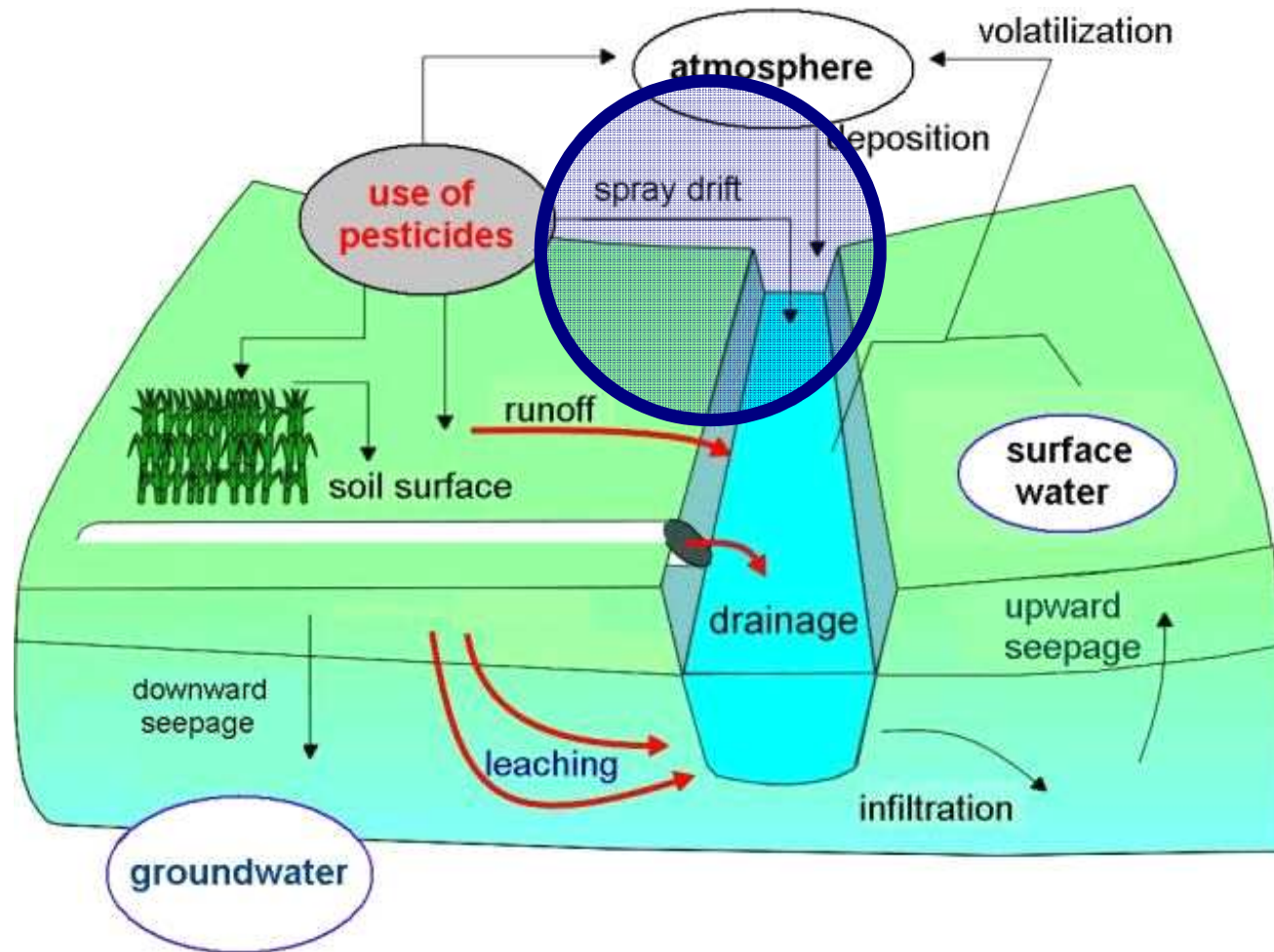
# PRIMET Course: Scientific background

- Compartments by stages matrix

	sc	pec	pnec	etr
<b>SW</b>	SWsc	SWpec	SWpnec	SWetr
<b>SOIL</b>	SOILsc	SOILpec	SOILpnec	SOILEtr
<b>NTA</b>	NTAsc	NTApec	NTApnec	NTAetr
<b>BEE</b>	BEEsc	BEEpec	BEEpnec	BEEetr
<b>GW</b>	GWsc	GWpec	GWpnec	GWetr
<b>DIET</b>	DIETsc	DIETpec	DIETpnec	DIETetr

# PRIMET: Surface water

- Compartments



# PRIMET Course: Scientific background

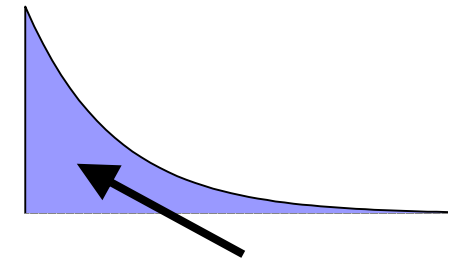
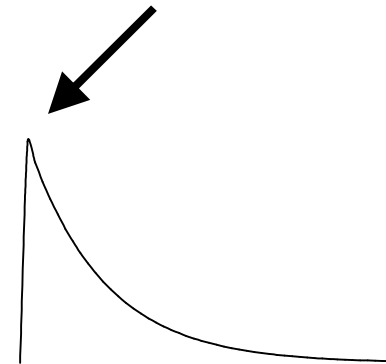
- Compartments by stages matrix

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<b>SOIL</b>	SOILsc	SOILpec	SOILpnec	SOILEtr
<b>NTA</b>	NTAsc	NTApec	NTApnec	NTAetr
<b>BEE</b>	BEEsc	BEEpec	BEEpnec	BEEetr
<b>GW</b>	GWsc	GWpec	GWpnec	GWetr
<b>DIET</b>	DIETsc	DIETpec	DIETpnec	DIETetr

# PRIMET: Surface water scenario

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- Two types of risk assessment
- Acute
  - Peak exposure
  - PNEC based on acute EC50 values
- Chronic
  - Time weighted average exposure
  - PNEC based on chronic NOEC values



# PRIMET: Surface water predicted env. conc.

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## Steps to calculate PEC

### 1. Short-term PEC for

1. single application
2. multiple applications

### 2. Long-term Time Weighted Average PEC for

1. single application
2. multiple application

- calculate the **overall dissipation rate coefficient** for the processes degradation, volatilization and dilution
- **correct the T dependent pesticide parameters**, for degradation and for volatilization to the T in the scenario

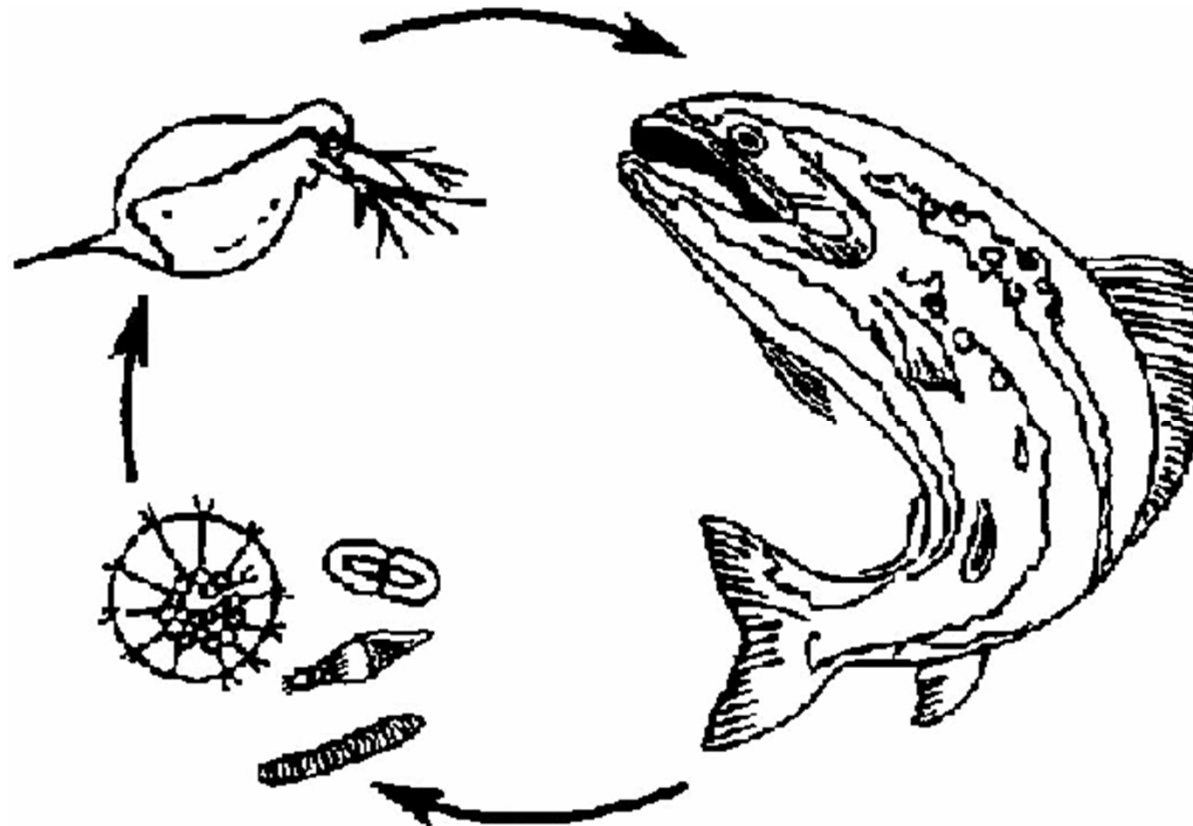
## PRIMET: Surface water pred. no effect. conc.

- Steps to calculate acute and chronic PNECs
- **PNEC = Predicted No Effect Concentration**  
= Safe concentration for aquatic environment
- Based on results of laboratory tests performed with **standard test species**



## PRIMET: Surface water pred. no effect. conc.

- Steps to calculate acute and chronic PNECs
- Standard test species, risk assessment ecosystem





# PRIMET: Surface water pred. no effect. conc.

- Steps to calculate acute and chronic PNECs

LC50 = Concentration that kills 50% of the test organisms

EC50 = Concentration that affects 50% of the test organisms

NOEC = Highest concentration with no statistical effects

- We only use term EC50 (includes LC50)

Control



1 ug/L



NOEC

5 ug/L



EC50

20 ug/L



## PRIMET: Surface water pred. no effect. conc.

- Steps to calculate acute PNEC

### EU legislation, acute risks

- Short-term PEC  $\leq 0.01 * EC50_{96h}$  fish or Daphnia
- Short-term PEC  $\leq 0.1 * EC50_{72h}$  algae

### EU legislation, chronic risks

- Long-term PEC  $\leq 0.1 * NOEC_{28d}$  fish or  $NOEC_{21d}$  *Daphnia*
- Safety factors account for untested species and for extrapolation from 50% effect to no effect

# PRIMET: Surface water exposure toxicity ratio

- Steps to calculate acute and chronic ETR

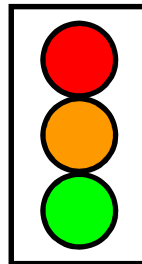
Single application:

- $ETR^1_{water} = PEC^1_{water} / PNEC$

Multiple applications:

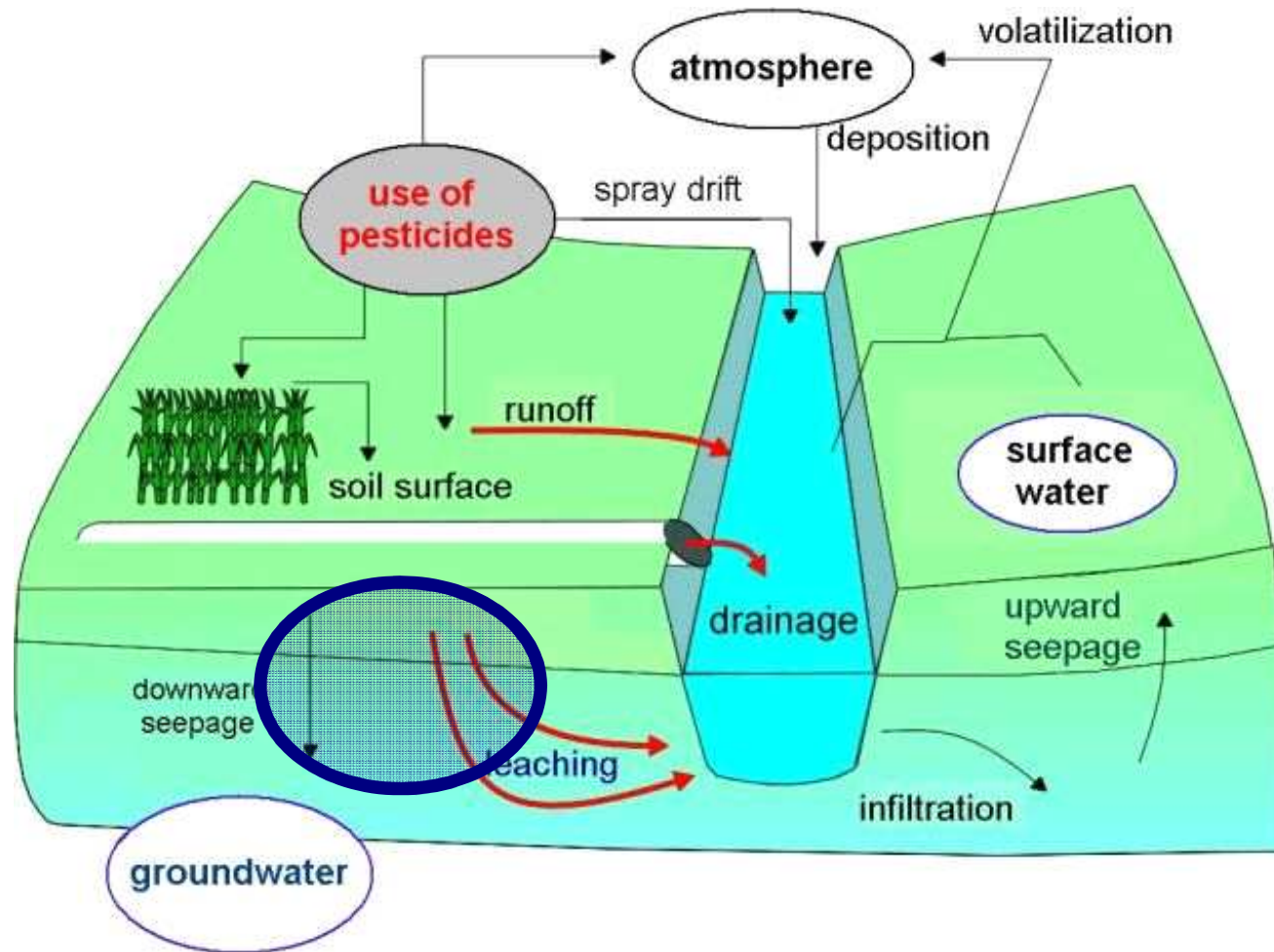
- $ETR^n_{water} = PEC^n_{water} / PNEC$

- If  $ETR > 100$   
 $100 \geq ETR > 1$   
 $ETR \leq 1$



# PRIMET: Soil (below ground)

- Compartments



# PRIMET Course: Scientific background

- Compartments by stages matrix

	sc	pec	pnec	etr
SW	SWsc	SWpec	SWpnec	SWetr
SOIL	SOILsc	SOILpec	SOILpnec	SOILetr
NTA	NTAsc	NTApec	NTApnec	NTAetr
BEE	BEEsc	BEEpec	BEEpnec	BEEetr
GW	GWsc	GWpec	GWpnec	GWetr
DIET	DIETsc	DIETpec	DIETpnec	DIETetr

## PRIMET: Soil predicted environmental conc.

- Steps to calculate **short-term and long-term PEC** (no differentiation between the two)

1. calculate the PEC for a **single** application
2. calculate the PEC for **multiple** applications

- account for the process of **degradation**



## PRIMET: Soil predicted no effect conc.

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- Steps to calculate acute and chronic PNEC

### EU legislation, acute risks

- $PEC_{soil} \leq 0.1 * EC50_{short-term}$  earthworms

### EU legislation, chronic risks

- $PEC_{soil} \leq 0.2 * NOEC_{long-term}$  earthworms
- **Safety factor** account for untested species and for extrapolation from 50% effect to no effect

# PRIMET: Soil predicted no effect conc.

- Steps to calculate PNEC

## EU legislation

- Acute PNEC =
  - 0.1 \* EC50 of earthworms
- Chronic PNEC =
  - 0.2 \* NOEC of earthworms

5 ug/kg

→ ED50



† ???



0.5 ug/kg

→ PNEC = EC50 / 10





# PRIMET: Soil exposure toxicity ratio

- Steps to calculate acute and chronic ETR

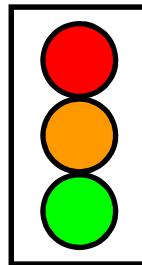
## Single application:

- $ETR^1_{soil} = PEC^1_{soil} / PNEC$

## Multiple applications:

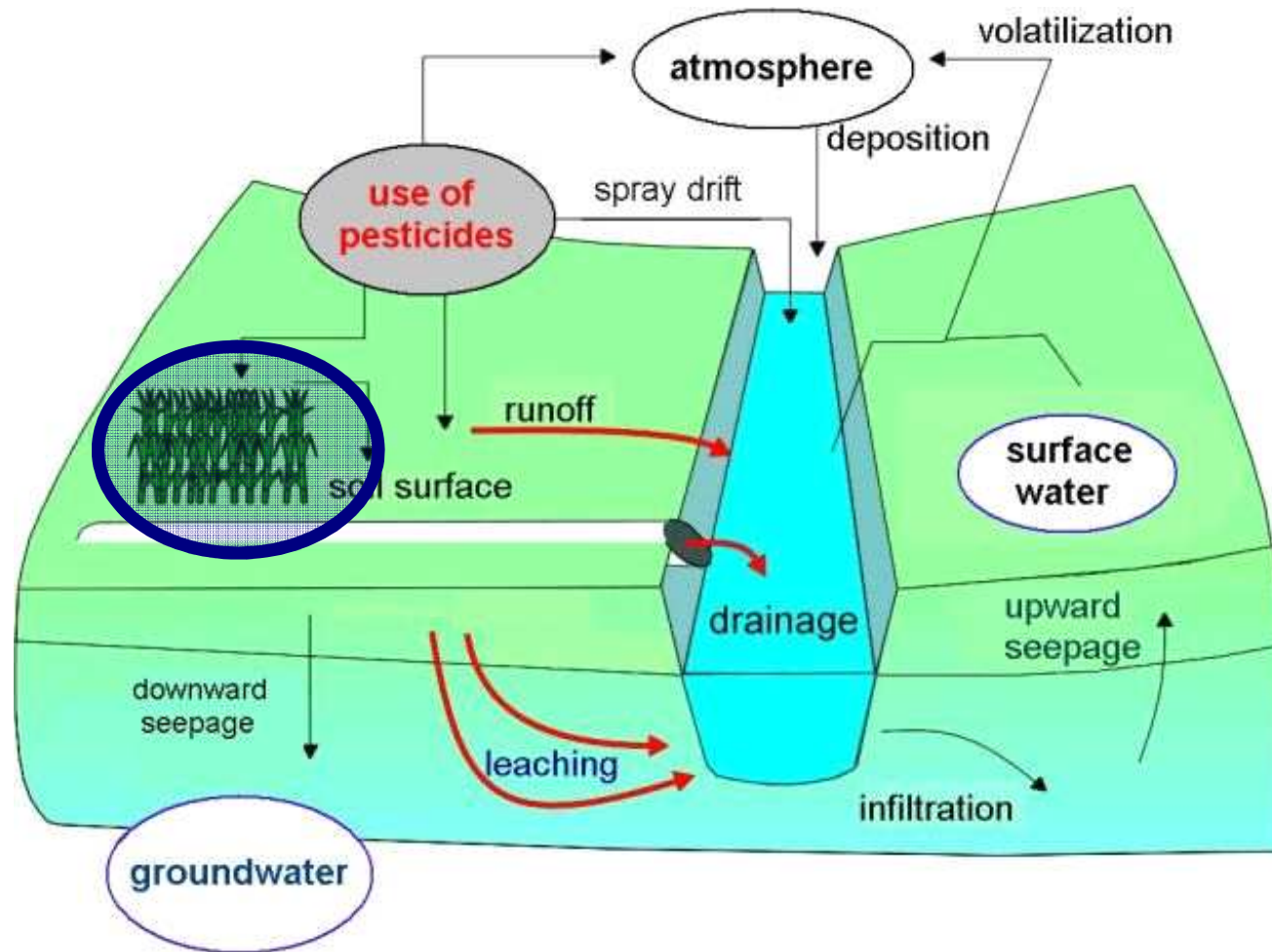
- $ETR^n_{soil} = PEC^n_{soil} / PNEC$

- If  $ETR > 100$   
 $100 \geq ETR > 1$   
 $ETR \leq 1$



# PRIMET: Non Target Arthropods (NTAs)

- Compartments



# PRIMET Course: Scientific background

- Compartments by stages matrix

	sc	pec	pnec	etr
SW	SWsc	SWpec	SWpnec	SWetr
SOIL	SOILsc	SOILpec	SOILpnec	SOILEtr
NTA	NTAsc	NTApec	NTApnec	NTAetr
BEE	BEEsc	BEEpec	BEEpnec	BEEetr
GW	GWsc	GWpec	GWpnec	GWetr
DIET	DIETsc	DIETpec	DIETpnec	DIETetr

# PRIMET: Soil exposure toxicity ratio

- Steps to calculate in- and off-field ETR

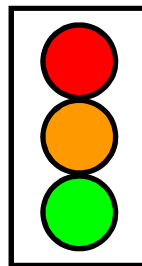
## In-field:

- $ETR_{NTA}(\text{in-field}) = PEC_{\text{in-field}} / AEC_{NTA}$

## Off-field:

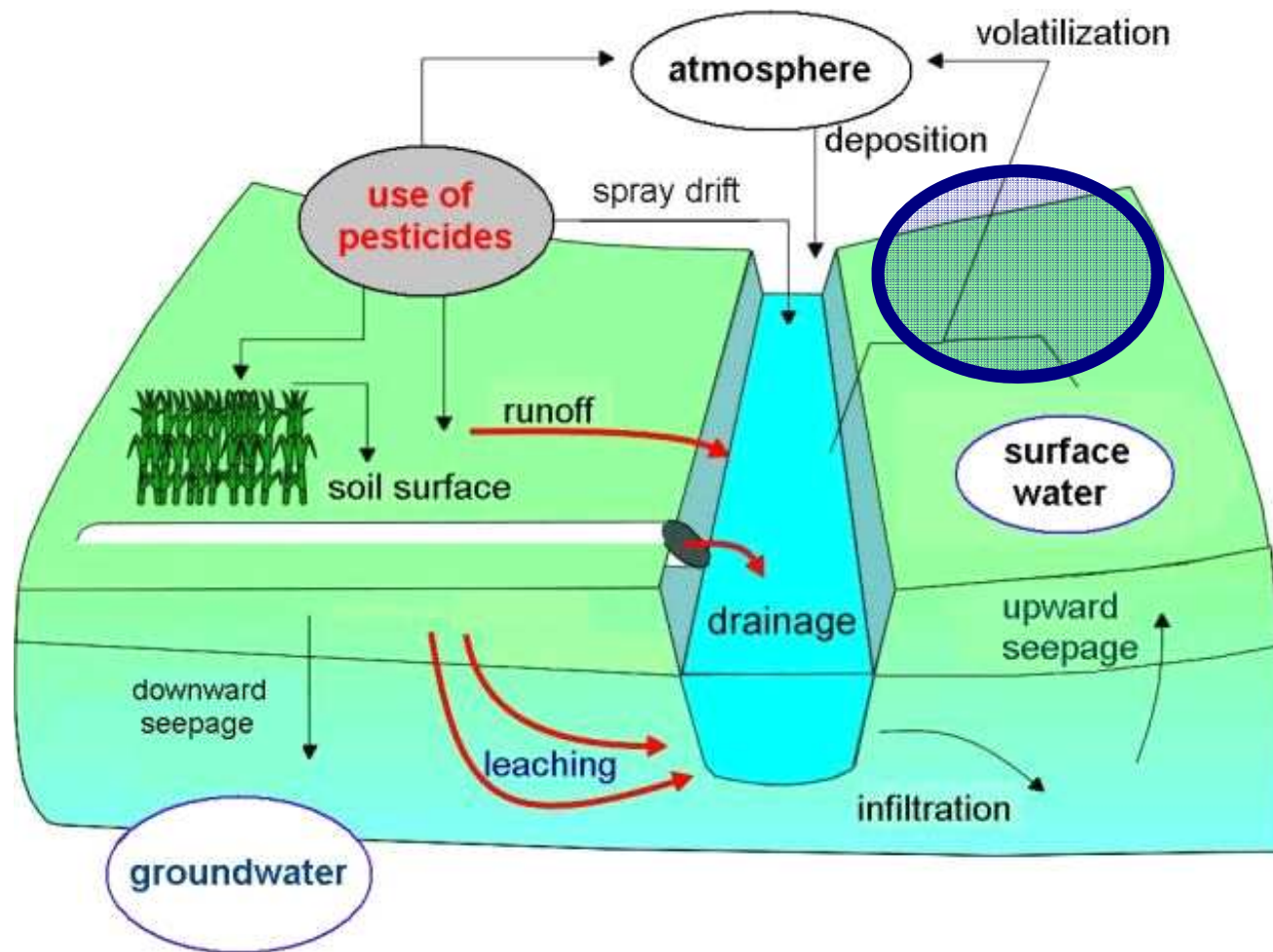
- $ETR_{NTA}(\text{off-field}) = PEC_{\text{off-field}} / AEC_{NTA}$

- If  $ETR > 100$   
 $100 \geq ETR > 1$   
 $ETR \leq 1$



# PRIMET: Bees

- Compartments



# PRIMET Course: Scientific background

- Compartments by stages matrix

	sc	pec	pnec	etr
SW	SWsc	SWpec	SWpnec	SWetr
SOIL	SOILsc	SOILpec	SOILpnec	SOILetr
NTA	NTAsc	NTApec	NTApnec	NTAetr
BEE	BEEsc	BEEpec	BEEpnec	BEEetr
GW	GWsc	GWpec	GWpnec	GWetr
DIET	DIETsc	DIETpec	DIETpnec	DIETetr

# PRIMET: Bees exposure toxicity ratio

- Steps to calculate ETR

Single application:

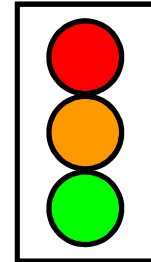
- $ETR_{\text{bee}} = PEC_{\text{bee}} / NEC_{\text{bee}}$

If

$ETR > 100$

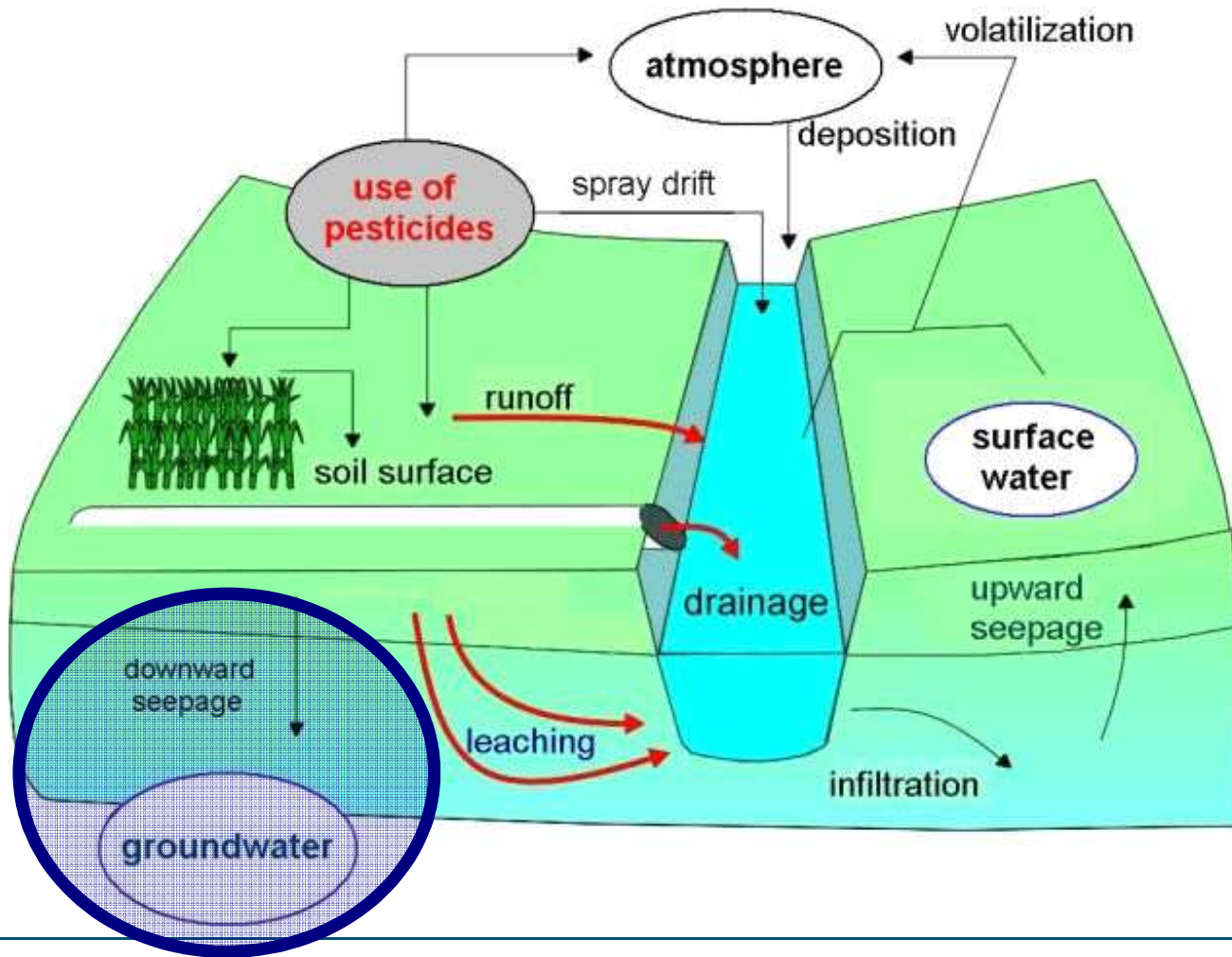
$100 \geq ETR > 1$

$ETR \leq 1$



# PRIMET: Groundwater

- Compartments





# PRIMET Course: Scientific background

- Compartments by stages matrix

	sc	pec	pnec	etr
SW	SWsc	SWpec	SWpnec	SWetr
SOIL	SOILsc	SOILpec	SOILpnec	SOILetr
NTA	NTAsc	NTApec	NTApnec	NTAetr
BEE	BEEsc	BEEpec	BEEpnec	BEEetr
GW	GWsc	GWpec	GWpnec	GWetr
DIET	DIETsc	DIETpec	DIETpnec	DIETetr

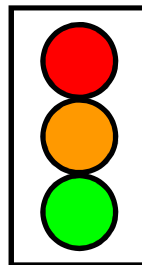
# PRIMET: Groundwater exposure toxicity ratio

- Steps to calculate ETR

Single and multiple application:

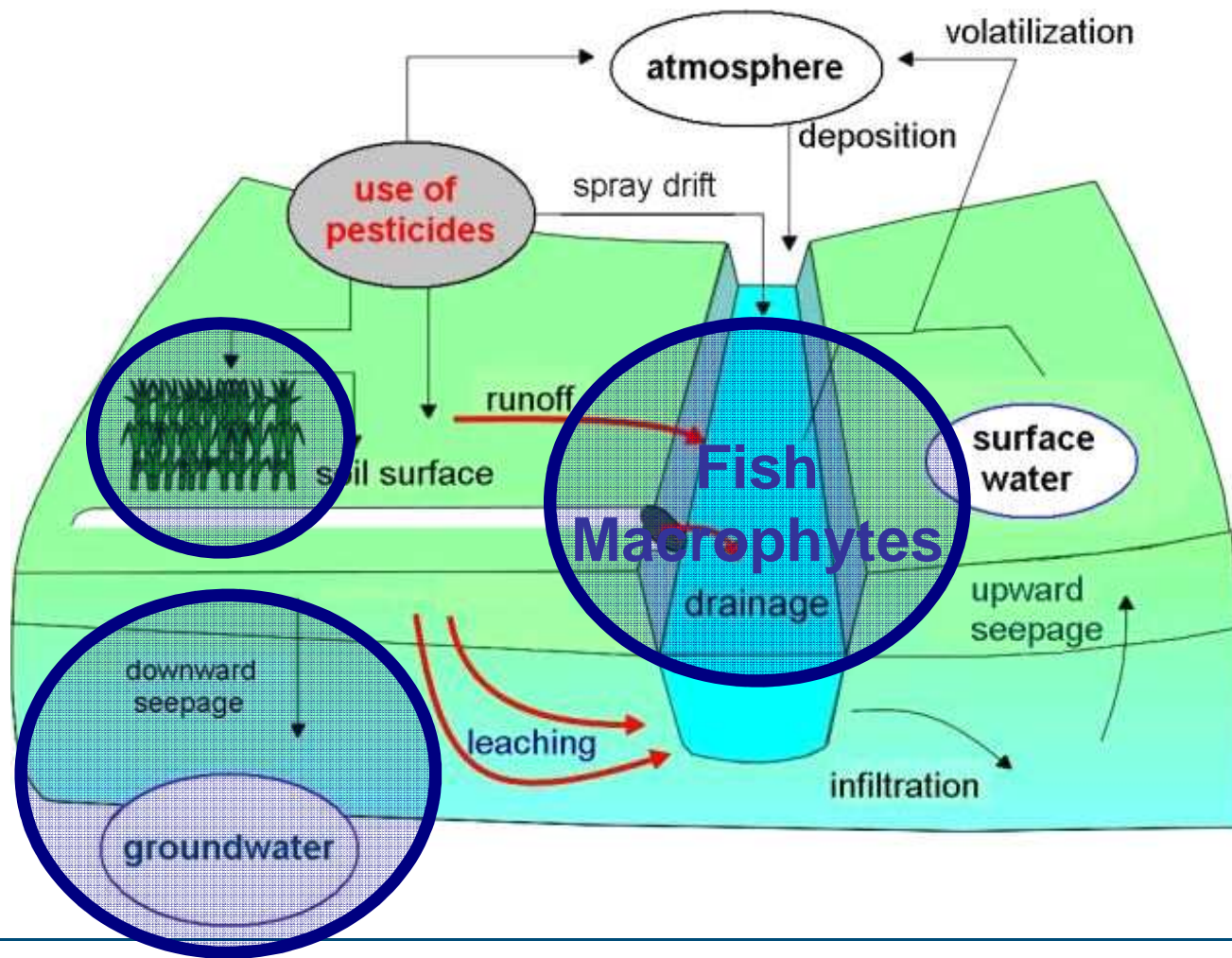
- $ETR_{gw} = PEC_{gw} / (DWS * 1000)$

- If  $ETR > 100$   
 $100 \geq ETR > 1$   
 $ETR \leq 1$



# PRIMET: Diet

- Compartments



# PRIMET Course: Scientific background

- Compartments by stages matrix

	sc	pec	pnec	etr
<b>SW</b>	SWsc	SWpec	SWpnec	SWetr
<b>SOIL</b>	SOILsc	SOILpec	SOILpnec	SOILEtr
<b>NTA</b>	NTAsc	NTApec	NTApnec	NTAetr
<b>BEE</b>	BEEsc	BEEpec	BEEpnec	BEEetr
<b>GW</b>	GWsc	GWpec	GWpnec	GWetr
<b>DIET</b>	DIETsc	DIETpec	DIETpnec	DIETetr

# PRIMET: Diet scenario

- **Input parameters**

$PEC_{gw}$  = annual average concentration at 1 m depth ( $\mu\text{g/L}$ )

$PEC_{water}^n$  = momentary water conc. from  $n$  applications ( $\mu\text{g/L}$ )

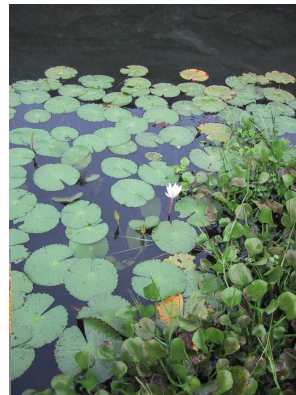
$C_{water}$  = daily drinking-water consumption (2 L/d).

$C_{fish}$  = daily fish consumption (kg/d).

$C_{mf}$  = daily macrophyte consumption (kg/d).

$C_{vegitem}$  = daily consumption of the vegetable item (kg/d).

$b_w$  = body weight (60 kg for adults)



# PRIMET: Diet predicted environmental conc.

- Calculation of Estimated daily intake

$$EDI = EDI_{dw} + EDI_{fish} + EDI_{mf} + EDI_{veg}$$

**EDI** = Estimated Daily Intake  
(mg/kg\*d)

**EDI<sub>dw</sub>** = EDI due to drinking of water

**EDI<sub>fish</sub>** = EDI due to eating of fish

**EDI<sub>mf</sub>** = EDI due to eating of  
macrophytes

**EDI<sub>veg</sub>** = EDI due to eating of a  
vegetable



# PRIMET: Diet exposure toxicity ratio

- Steps to calculate ETR

Single and multiple application:

- $ETR_{\text{diet}} = EDI / ADI$

- If  $ETR > 100$   
 $100 \geq ETR > 1$   
 $ETR \leq 1$

