Implementation of the EFSA guidance on covered crops at member state level

Developments in the Netherlands

25 September 2015, Louise Wipfler

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Set up

- Background of the Dutch greenhouse scenarios
- Greenhouse scenarios overview
- The Greenhouse Emission Model (GEM)
- Results of calculations with example substances

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Horticulture in the Netherlands

- About 11.000 ha horticultural activity
  - Floriculture and pot plants: ca 6.300 ha
  - Vegetables: ca 4.700 ha
- Mainly glasshouses, permanent structures with additional light, that can be heated, shaded and ventilated (high tech and automated)
- 75% soilless (substrate), 25% soil-bound
- Horticulture in a water rich environment

Example crops grown in substrate and soil bound grown crops

Soilless	Soil bound
Tomato	Chrysanthemum
Cucumbers	Alstroemeria
Sweet pepper	Freesias
Bulb flowers	lilies
Pot plants	Other cut flowers
Roses	Beans
Conifers	Carrots
Aubergine	Leek
lettuce	cabbage

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Background of scenario development

- Generally excepted scenario's for exposure due to PPP use in greenhouses not available in NL and EU
- Current Dutch authorisation procedures use a fixed emission percentage of 0.1% (as in drift)
  - Not in line with mayor emission routes
  - Likely to underestimate emissions from greenhouses
- Two scenario's were developed:
  - soil-bound crops
  - crops grown on substrate

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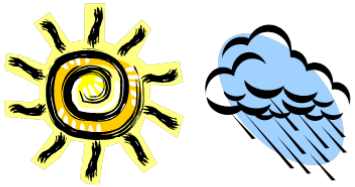
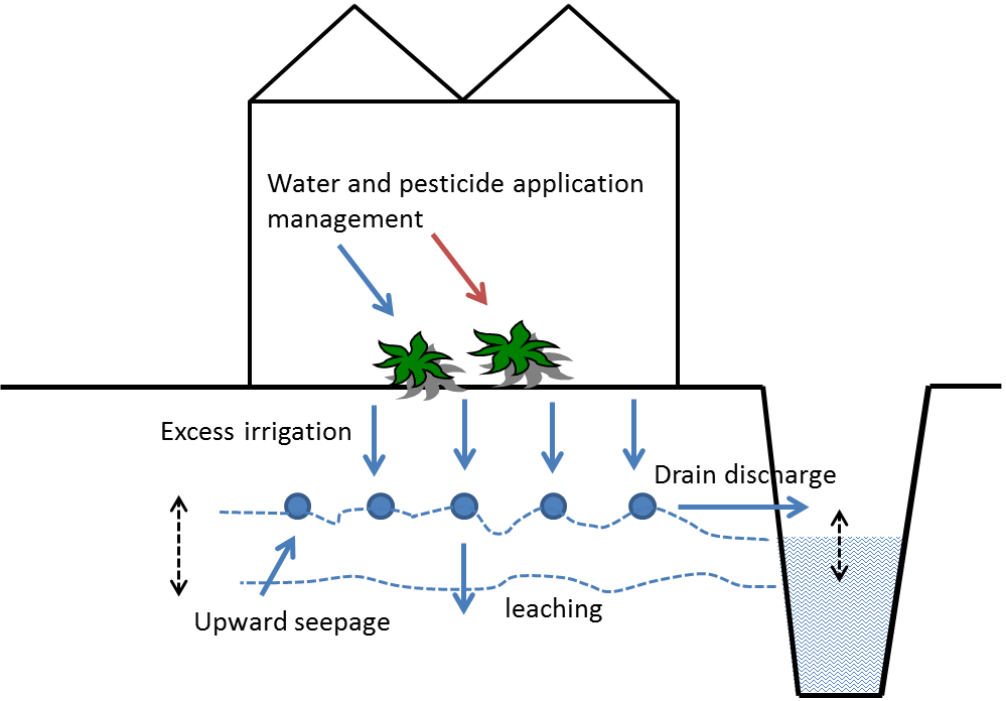
Scenarios soil-bound: endpoints

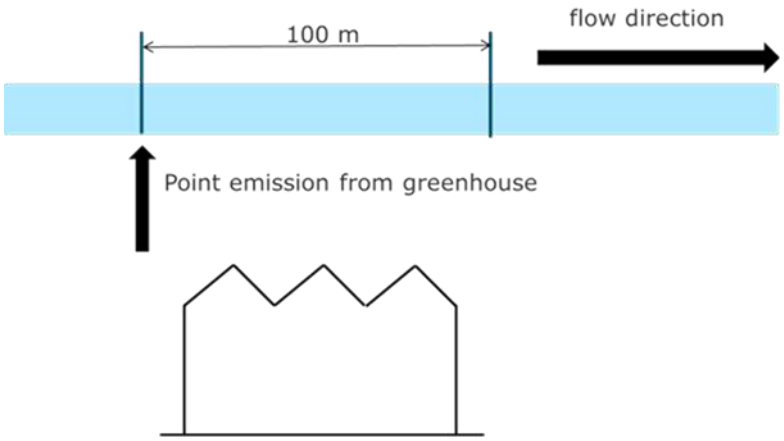
- Protection goals: surface water and groundwater
- Predicted Environmental Concentrations (PEC):
  - 90th overall percentile of annual peak concentration in surface water. Time weighted averaged concentrations are calculated over the selected year.
  - 90th overall percentile average groundwater concentration at 1 m depth

Scenarios soil-bound: drivers for emission





- Irrigation and application management
- Crop type
- Soil characteristics
- Hydrological situation



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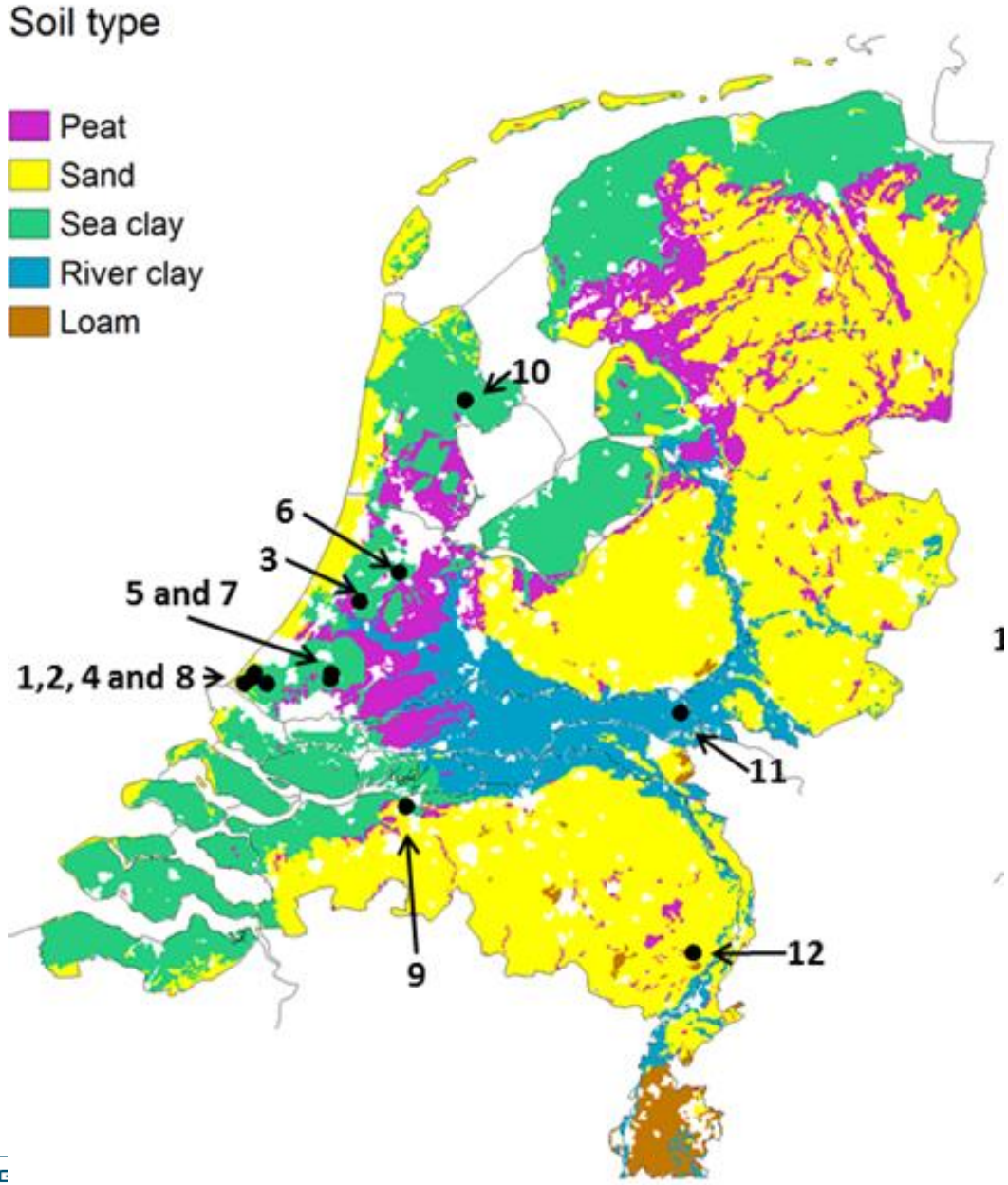
Scenarios soil-bound: differences with field situation

- Controlled irrigation→ less temporal variability
- Higher temperatures
- Top soil enriched with organic matter
- Groundwater level controlled by drains
- Production year around
- Annual sterilization of the soil

Scenarios soil-bound: main features

- Model crop: Chrysanthemum
- Excess irrigation water: 30% (realistic worst case) annual irrigation 1000 mm
- OM enriched top 30 cm of the soil
- Selection of 90th percentile weather year

Scenario	Soil type	Groundwater level
Surface water	heavy clay (macropores)	between 80-120 cm below soil surface
Groundwater	light sandy clay	Deep groundwater



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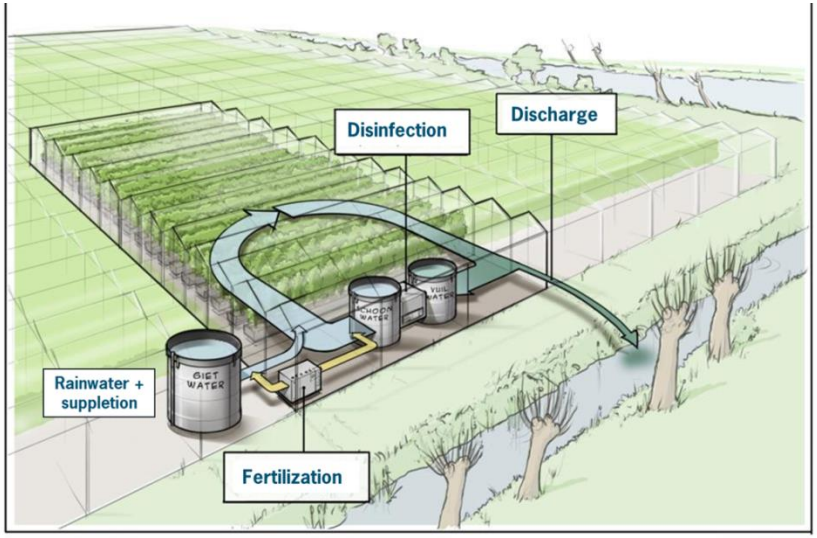
Scenarios soil-bound

- Models:
  - WATERSTREAM model: irrigation, evapotranspiration & temperatures in greenhouse
  - PEARL: PEC groundwater and emission to surface water
  - TOXSWA: PEC in surface water
- Recommendations:
  - Sterilization: degradation is likely lower than in field situation. Use of adjustment factor (10) for DegT50.
  - Higher tier: DegT50 can be measured in greenhouse soils

Scenarios soilless: endpoints

- Protection goal: surface water
- Predicted Environmental Concentrations (PEC):
  - Either 50th or 90th overall percentile annual peak concentration in surface water. Time weighted averaged concentrations are calculated over the selected year.

Scenarios soilless: conceptual model



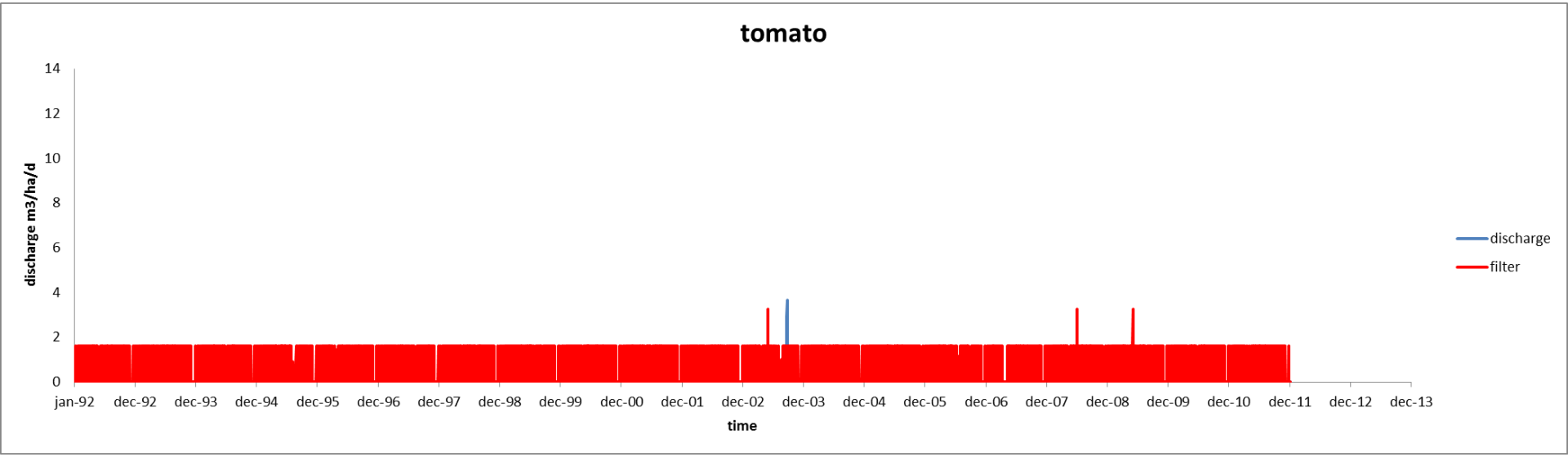
- Predominant irrigation:
  - drip irrigation
  - Ebb/flow (tables)

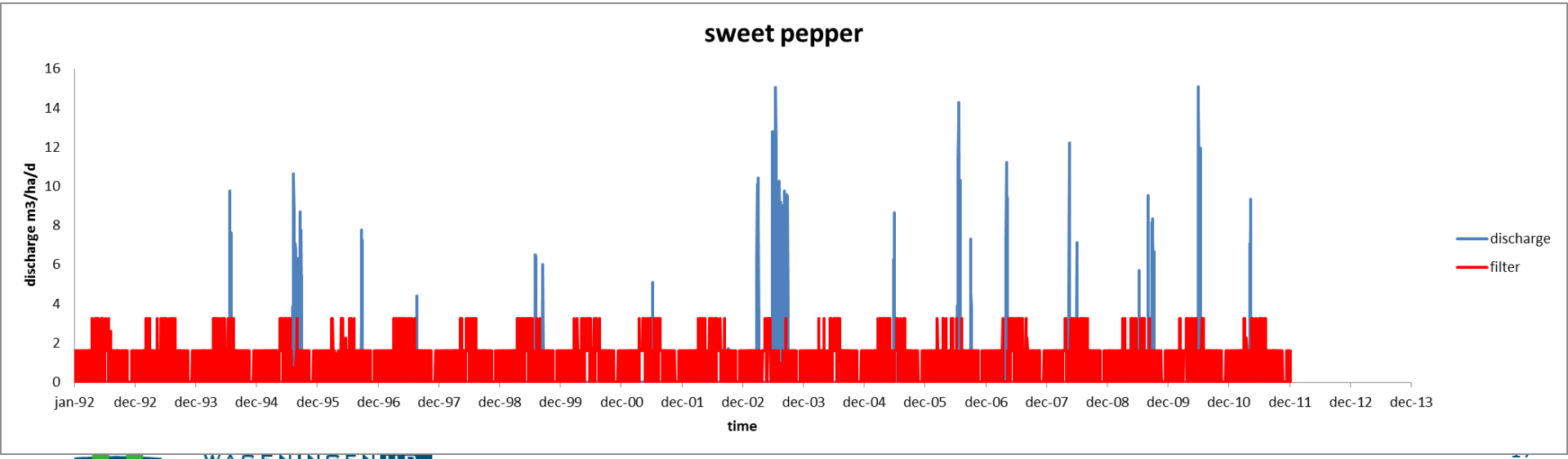
- Closed loop systems (water recirculation is compulsory)
- Water management of grower is very important
- Mayor emission routes:
  - Discharge of deteriorated water (high sodium levels)
  - Filter rinsing water
- Limitation on water discharge due to new directive on nutrients

Scenarios soilless: 4 crop classes

Crop class	1	2	3	4
main crop	Rose	Tomato	Sweet pepper	Ficus
Other crops	Gerbera, starting material vegetables	Cucumber, herbs	Aubergine, strawberry	Pot plants, floriculture, other flower crops
Annual water demand	8250 m^3/ha	7670 m^3/ha	6530 m^3/ha	4640 m^3/ha
Threshold Sodium level	4 mmol/L	8 mmol/L	8 mmol/L	6 mmol/L
Mean annual discharge	720 m^3/ha	450 m^3/ha	430 m^3/ha	205 m^3/ha

Example discharge patterns

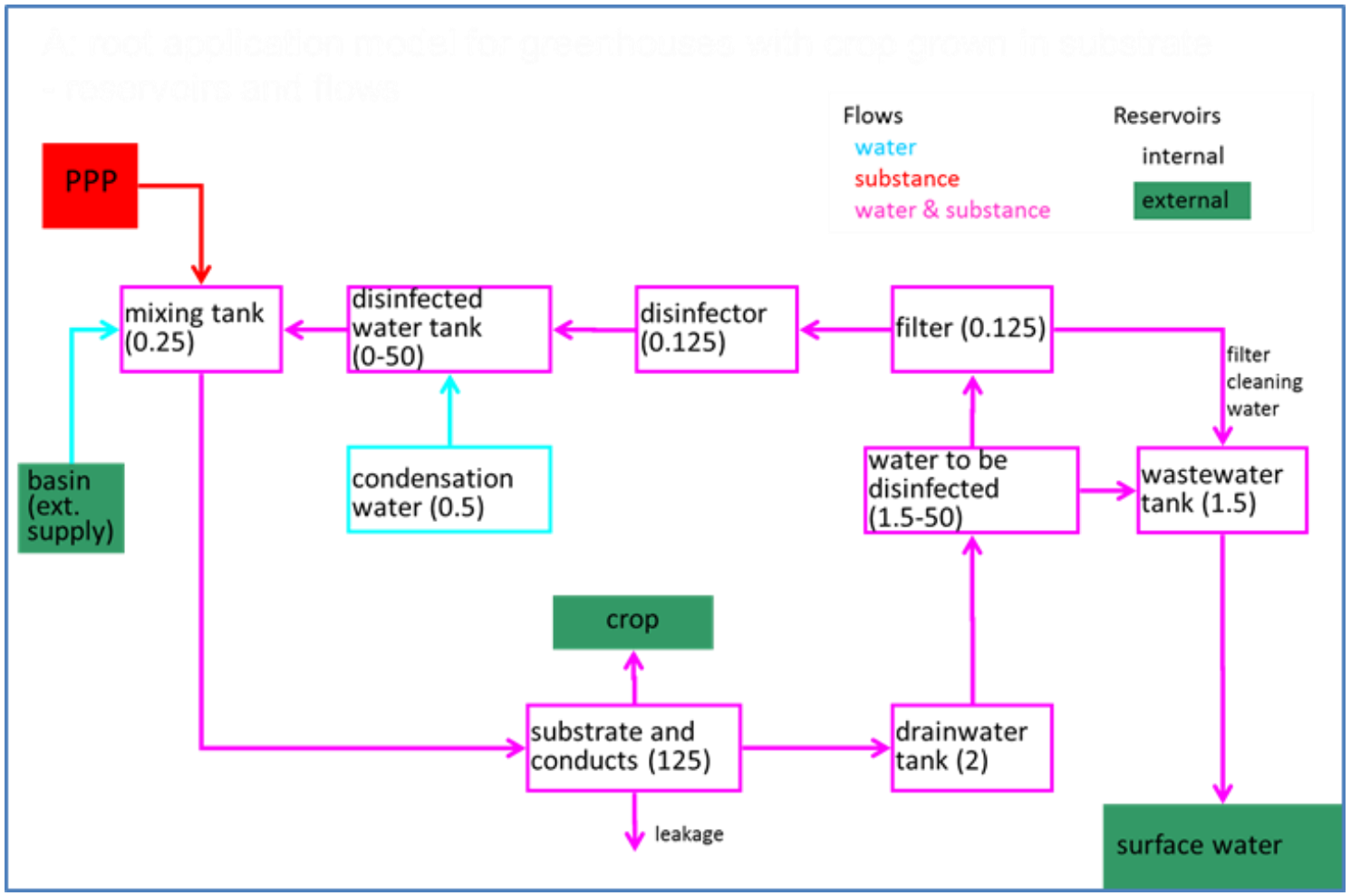




Scenarios soilless: models

- WATERSTREAM model: water demand, filter discharge, discharge of deteriorated water & temperatures
- Substance Emission Model: fate in recirculation water, concentration in discharged water
- TOXSWA: PEC in surface water

Substance Emission Model: lay-out



Greenhouse model lay-out for application via nutrient solution scaled to 1 ha. Reservoir volumes in m^3.

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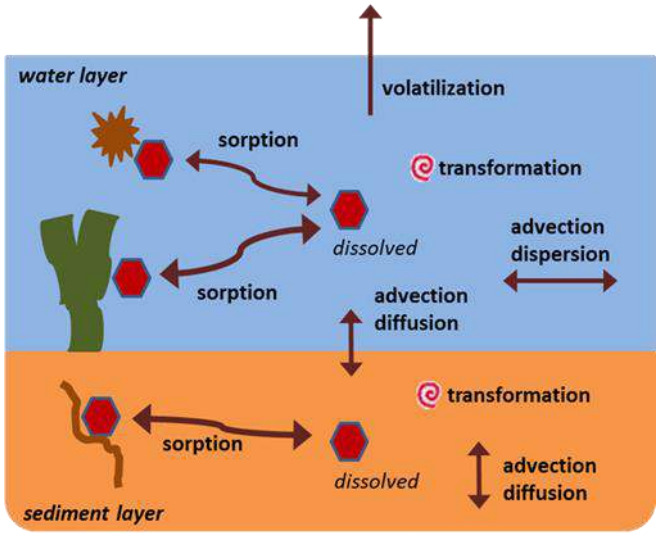
Substance Emission Model: PPP fate

- Number of connected ideally mixed tanks (fixed lay-out)
- Degradation via first order kinetics, formation of metabolites
- Plant uptake assumed to depend on Kow of PPP (Briggs)
- Differentiation between shielded slabs and ebb/flow systems (pot plants)
- Sorption considered to soil for pot plant cultivation only
- Application via nutrient solution (dripping) or via spraying, fogging or low volume mister
- PPP exchange with greenhouse air and condensation water
- Discharge to surface water depends on crop class (rose, tomato, sweet pepper or ficus)

Soilless: recommendations

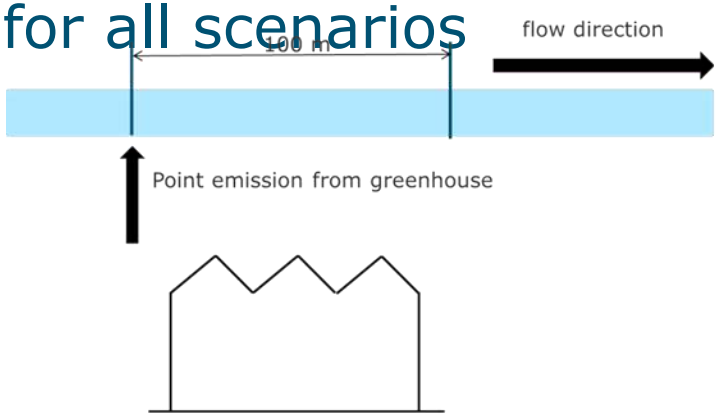
- Degradation rates:
  - First tier: use hydrolysis as basis for degradation rates in recirculation water.
  - Higher tier: measure DegT50 in the recirculation water
- Mitigation option:
  - higher tier option: discharge via water purification system
- Use outside NL:
  - Check carefully whether scenarios can be used
- General:
  - Testing the applied (fate) models against data

Surface water concentrations (1)



PPP fate processes in TOXSWA

- NL specific ditch receives water from greenhouses: point source
- TOXSWA model used to calculated concentrations
- Parameterisation the same for all scenarios



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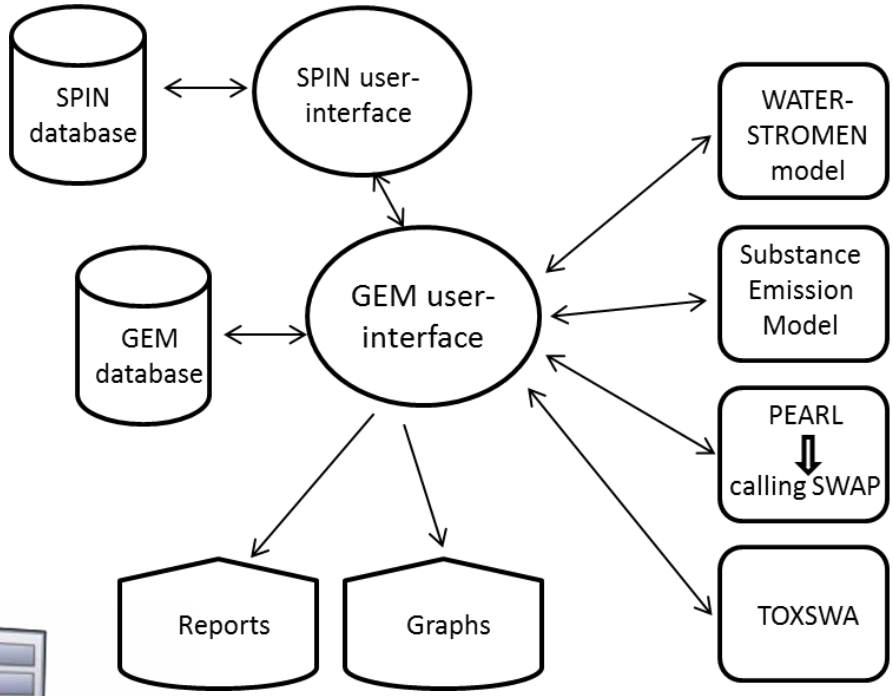
The GEM software

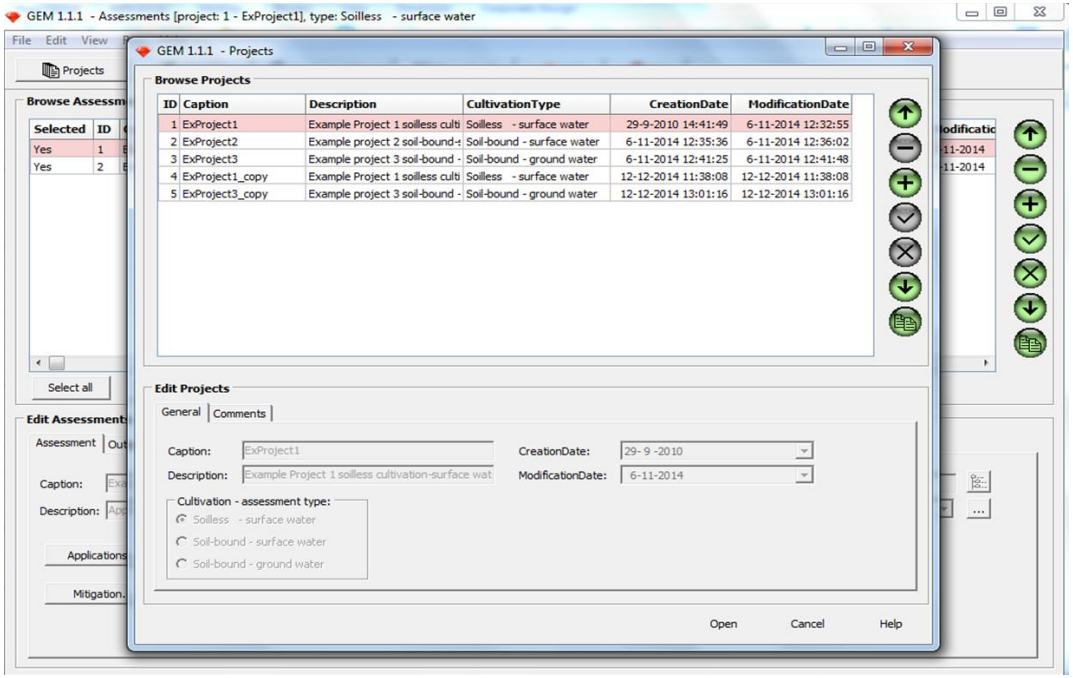
- PEC calculation for soil-bound and soilless cultivation
- Scenarios are largely predefined.
- Main forms:
  - Manage projects
  - Manage assessments

- Structure:



User defined options

- Cultivation type
- Substance properties
- Crop type
- Application scheme
- Mitigation
- Output



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Results example calculations: soil-bound

Substance name	90th overall percentile leaching concentration	
	Kremsmünster-winter cereals	Greenhouses-chrysanthemum
FOCUS A	143.66	17.36
FOCUS B	147.7	32.34
FOCUS C-metabolite	96.51	40.95
FOCUS D	95.9	2.96

90th percentile concentrations of the FOCUS substances A to D, while using the adjustment factor

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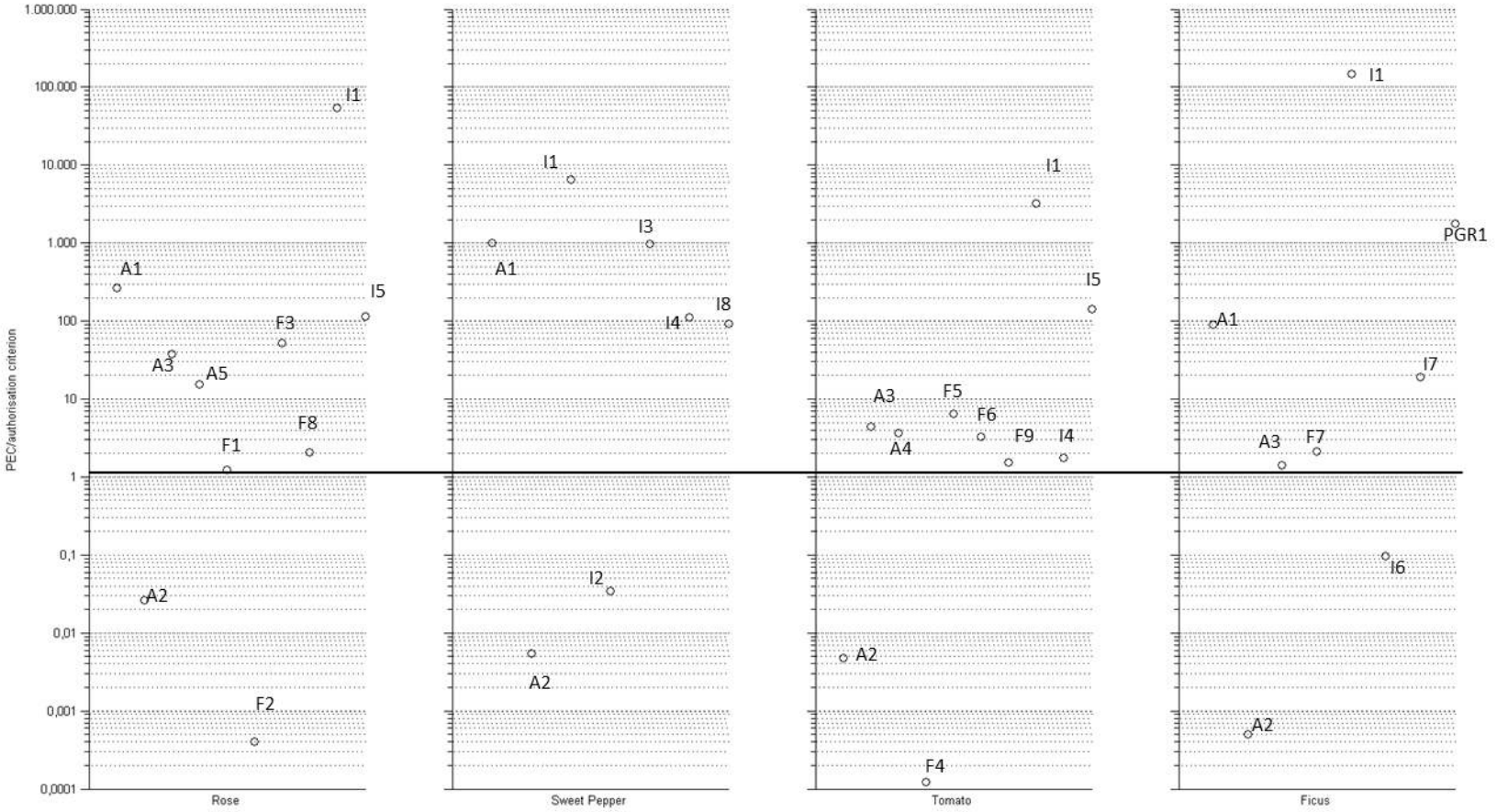
Results example calculations: soilless (1)

- 35 realistic PPP-crop combinations were assessed
- 27 exceeded the authorisation criterion (90th percentile)
- 17 needed a reduction percentage > 90%
- Calculations based on hydrolyses as degradation process: no microbial degradation considered
- Authorisation criterion was based on first tier effect assessment: higher tier effect assessment will lead to more combinations that pass the criterion

Results example calculations soilless (2)



- A= Acaricide, I = insecticide, F= fungicide, PGR= plan growth regulator

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Results example calculations soilless (2)

- A= Acaricide, I = insecticide, F= fungicide, PGR= plan growth regulator

Summary

- GEM is tool that enables the calculation of PECs for Dutch greenhouses:
  - For soil-bound crops and groundwater
  - For soil-bound crops and surface water
  - For soilless crops and surface water
- These scenarios are based on realistic emission routes and state-of-the-art knowledge on greenhouse production systems.
- The use of these scenarios will probably lead to a higher risk associated with PPP use than before, especially for soilless grown crops
- The use of higher tier options is possible but need further elaboration and testing

Main collaborators

- WG soilless:
  - Ton van der Linden, RIVM, NL
  - Erik van Os, WUR Greenhouse Horticulture, NL
  - Adi Cornelese, Ctgb, NL
  - Daniel Ludeking, WUR Greenhouse Horticulture, NL
  - Tycho Vermeulen, WUR Greenhouse Horticulture, NL
- WG Soil-bound:
  - Aaldrik Tiktak, PBL, the Netherlands
  - Wim Voogt, WUR Greenhouse Horticulture, the Netherlands
  - Adi Cornelese, Ctgb, NL
- Software development: Mechteld ter Horst & Arjan de Jong, Alterra Wageningen UR, NL

Background reports and software:
www.pesticidemodels.eu