THE UNIVERSITY of York

Cambridge Environmental Assessments

SCOPING STUDY FOR REFINEMENTS TO RUNOFF ASSESSMENTS

Colin Brown and Greg Hughes

Background to the study

- CRD considering recommendation from the Environmental Panel of the Advisory Committee on Pesticides that they include surface runoff within calculations of exposure of the aquatic environment to pesticides.
- Uptake of the recommendation would be a departure from current practice where spray drift and drainflow are considered as the dominant routes of entry.
- Established procedures for the refine of the risk assessment at higher tiers approaches are well-developed for spray drift and drainage, but are lacking for surface runoff.

Scoping Study Outline

1. Current status of HT assessment for transfer of pesticides to water via runoff
   - 1.1 Approaches used in EU MS
   - 1.2 Models available for use at higher tiers
2. Options for modelling transfer of pesticides to water via surface runoff at higher tiers
3. Workshop

1.1 Approaches used in EU MS

- Most MS consider runoff as exposure pathway
- Most accept FOCUSsw R scenarios
- Vegetated buffer strips – only mitigation method accepted
- Five MS (FR, DE, SE, IT, AT) accept higher tier vegetated buffer strip mitigations.
- These vary in width between 3 and 20m with standard widths of 5, 10, 15 and 20 m typical.
- The removal efficiencies per buffer strip width vary
  - FOCUS Landscape and Mitigation v2 removal efficiencies (FR, SE)
  - FOCUS L&M v2 in conjunction with MS research (IT)
  - MS research (AT, DE)
- Where MS accepts FOCUSsw – SWAN is used to implement mitigations

1.2 Models available for use at HT

- Review of >90 runoff models for project PS2233
- Those for pesticides based on few approaches
  - Curve number method (e.g. PRZM)
  - Green & Ampt (e.g. RZWQM or similar)
  - Mechanistic models for single-storm events
  - Spatial and temporal heterogeneity vs. ease of parameterisation
- Update of review within current project
- Primary focus seems to be runoff at the catchment scale
  - SACADEAU-Transf (Gascuel-Odoux et al., 2009)
  - PRZM in GIS framework (Luo & Zhang, 2009; 2010)
  - Green & Ampt and WEPP (Cho & Mostaghimi, 2009a;b)
- Explored the integration of VFSMOD-W model into exposure assessment

2. HT Modelling Options

1. Use the PRZM model in a scenario-years type approach
2. Use an alternative model in a scenario-years type approach
3. Use the PRZM model in a GeoPEARL type approach
4. Use an alternative model in a GeoPEARL type approach
5. Use catchment-scale modelling
6. Refine the assumptions on connectivity and surface-water properties
7. Move directly to modelling the impact of mitigation measures

2.1 PRZM model in scenario-years type approach

- UK HT Groundwater approach
- 30 year MACRO simulations for combinations of soil/climate for crop
- Area weighted “scenario years” results
- <7% scenario years exceeded (no concentration in any one scenario)
- Replace MACRO with PRZM in framework?

Soil type	Dry	Medium	Wet	>1000mm p.a.	Total extent (%)
Undrained	-	-	-	-	44.8
Peaty soils	-	-	-	-	1.54
Denchworth	2.0	5.2	1.3	0.0	8.6
Hanslope	5.1	11.4	0.7	0.0	17.3
Brockhurst	2.5	11.8	2.4	0.1	16.7
Clifton	0.6	6.3	1.7	0.1	8.7
Quorndon	1.1	1.0	0.3	0.0	2.4
Total	11.3	35.8	6.4	0.2	100

Soil	Dry climate	Moderate climate	Wet climate
	Years (%)	Years (%)	Years (%)
Denchworth	2 (6.7)	3 (10)	18 (60)
Hanslope	1 (3.3)	2 (6.7)	13 (43
Brockhurst	0 (0)	0 (0)	0 (0)
Clifton	0 (0)	0 (0)	0 (0)
Quorndon	0 (0)	0 (0)	0 (0)

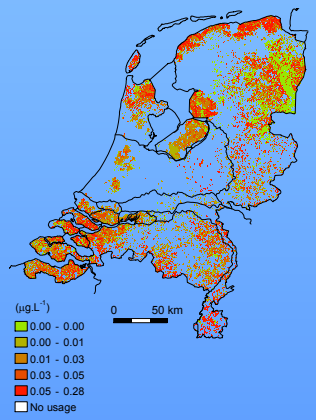
Threshold exceeded	2.7%
Unquantified*	0.2%
Undrained#	44.8%
Drained but below threshold	52.3%
Total	100%

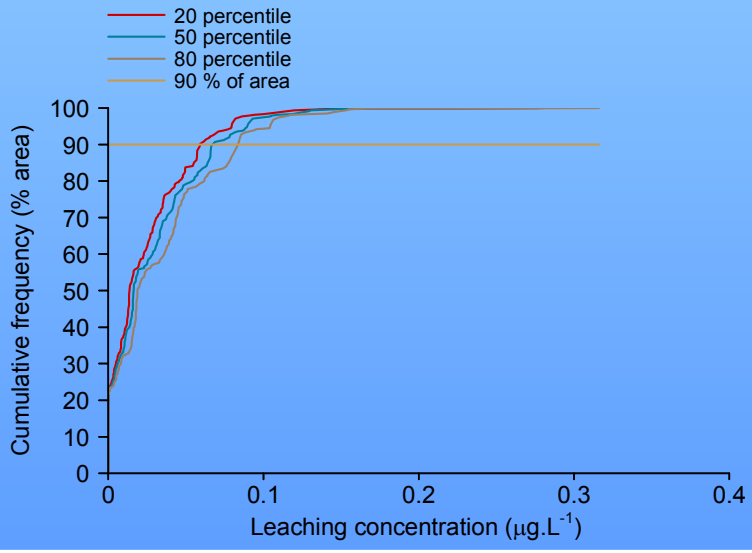
2.2 Use an alternative model in a scenario-years type approach

- Requirements for the model
  - Mechanistic simulation of runoff generation (e.g. Green and Ampt)
  - Ability to simulate erosion
  - Sub-daily timestep (probably hourly)
  - Pesticide sub-routines in line with standard FOCUS models (sorption, degradation etc)
- RZWQM
  - Model evaluation suggests hydraulic simulation equal to or better than PRZM
  - Equivalent pesticide routines to PRZM
  - Lacks erosion sub-routines and these will take two years to put in place

2.3 PRZM in a GeoPEARL approach

- Tiered NL groundwater ERA tree
- “Plots” based on crop, soil, groundwater, …
- PEARL simulations for each plot
- Cumulative frequency distributions
- >90% area < 0.1 µg/L
- PRZM in this framework?





2.4 Use an alternative model in a GeoPEARL type approach

- Rationale
  - PRZM is not well-adapted to a grid-cell approach (1-d soil model with catchment-based runoff component)
  - Model that explicitly accounts for spatial component may be more robust
  - e.g. OECD indicator

2.5 Catchment-scale modelling

- Approaches
  - PestSurf parameterised for two Danish catchments for use in registration
  - SPIDER model developed for use in the UK with lower input requirements
  - SWAT has some application to European situations
  - GREAT-ER is a probabilistic system implemented for use in five UK river basins and 11 other European basins

2.6 Refine assumptions on connectivity & SW properties

Rationale

- Connectivity (Default 100%)
- SW Properties (Default $FOCUS_{SW}$)

- Can we make things more UK-centric?
- Can we address these issues in a GeoPEARL or Scenario Years approach?

2.7 Move directly to modelling the impact of mitigation measures

Rationale

- Move directly from lower-tier estimate of exposure to incorporating some aspect of mitigation
- Matches current approach for spray drift, but not for drainage
- SWANN tool provides a standardised approach that reduces data requirements
- E.g. to simulate effect of a vegetated filter strip – FOCUS LM / SWANN or VFSMOD / SWANN

Stakeholder workshop (April 11)

- 18 participants: CRD, regulatory agencies, industry, NFU, EA
- Present and discuss higher-tier approaches
- Share experiences and future developments on mitigation for runoff

Workshop notes – HT approach

- Overall workshop failed to agree on preferred approach
- ‘Scenario-years’ feasible but difficult to communicate decision - small number of scenarios with adverse risk
- Can PRZM/GeoPEARL represent local variability?
- Catchment modelling most logical but still developing
- Refined field-scale parameters data intensive and difficult to justify what is represented
- Risk mitigation fits with other member states; preferable to have other refinement options at lower tiers

Workshop notes – Other issues

- Prefer to see UK adopt standard FOCUS R scenarios rather than UK modified scenarios
- Vegetated buffer is the primary mitigation measure; experiences shared for DE, FR, SE, UK
- Relationship WFD vs. PPP regulation; potential to manage runoff as a local issue under WFD?
- Possible conflict on vegetated buffers: simplicity required by PPP registration vs. complexity in the field
- Need to match vegetated buffers required for a label with those required for Rural Development

Thank You

Thank you to MS Regulators for inputs
Thank you to workshop participants
Thank you to CRD for funding the project