



Independent Research.  
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## A model of spray drift for the 21<sup>st</sup> Century

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## A model of spray drift for the 21<sup>st</sup> Century

- Why do we need a spray drift model
- How the Silsoe spray drift model has been developed
  - The BREAM project
- Potential model uses
  - Regulatory exposure assessment
  - Drift mitigation

## Spray drift matters

- Drifting pesticide is a problem for biodiversity, public health, water, sensitive neighbouring crops
- By law, pesticide should be confined to the area to be treated
- Regulatory process recognises that zero drift is not feasible and therefore attempts to quantify and restrict exposure to spray drift

## Spray drift highly dependent on

- Environmental conditions
- Application equipment
- Application practice

## Ignoring the factors that influence drift in the risk assessment process:

- Is often over-protective if a genuine worst case is used
- Is sometimes under-protective if not
- Risks exposure assessment becoming out of date if practice changes
- Does not allow or encourage risk reduction through appropriate mitigation

## Silsoe Spray Drift Model

- Specifically to address the issue of exposure of bystanders/residents to spray drift from boom sprayers
- BREAM project – 3 ½ years developing and validating a model of exposure of people to spray and vapour
- BREAM model uses the Silsoe spray drift model, and based around specific scenarios.

## Development of Silsoe spray drift model

- Original Silsoe spray drift model developed in 1980s and 1990s
  - Droplet tracking model
  - Ballistic near nozzle; random walk further downwind
- Now updated
  - Includes multiple nozzles and a moving sprayer
  - User-friendly interface for inputs
- Specific 'bystander' scenarios
  - 12 – 16 kph, 24 m boom
  - Bystanders 2 – 10 m from sprayer

## Model validation

- New data obtained
- Ensure 'high drift' conditions are included
- Commonly-used nozzle designs
- Airborne and ground deposit
- Bystander contamination

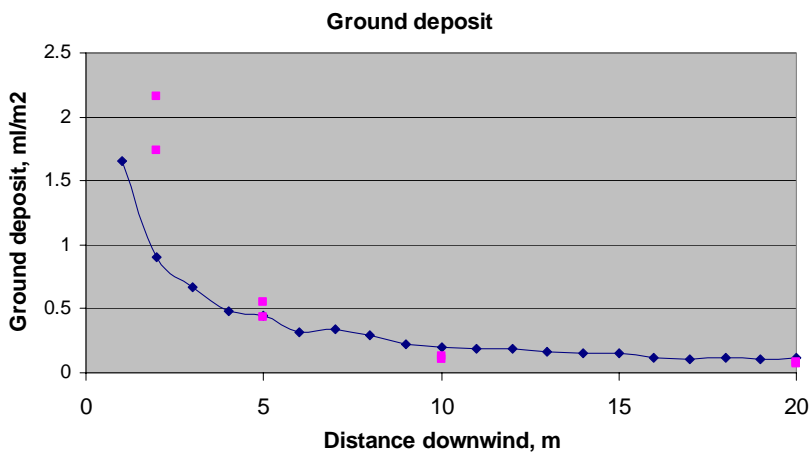


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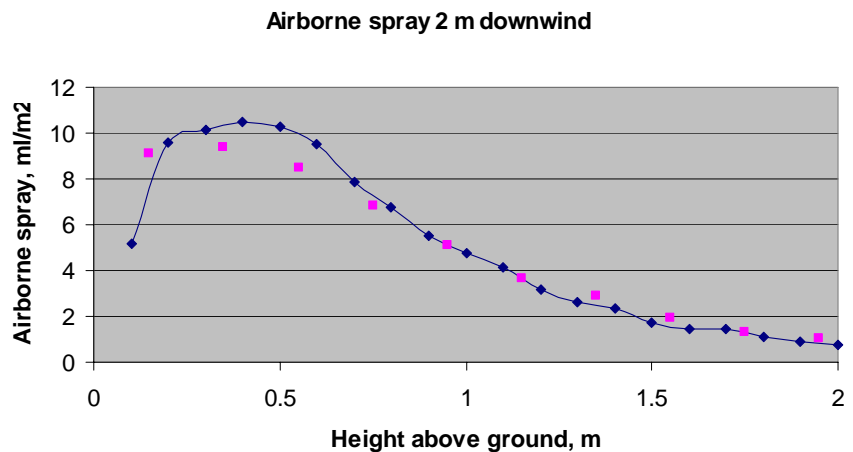


## BREAM field measurements

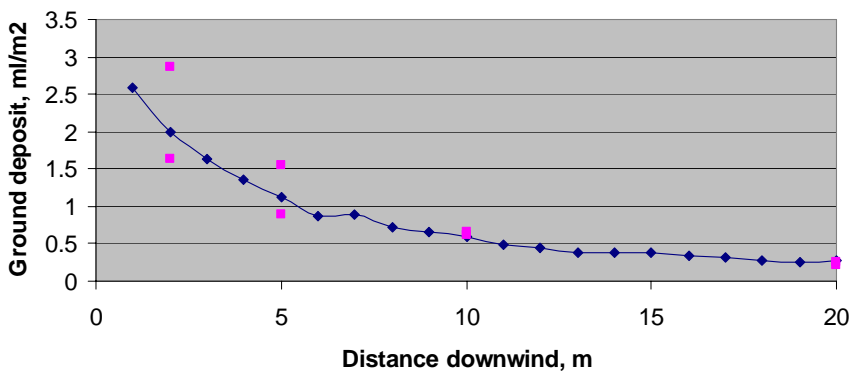


## Comparison with experimental data

**Standard flat fan nozzle**



### Ground deposit

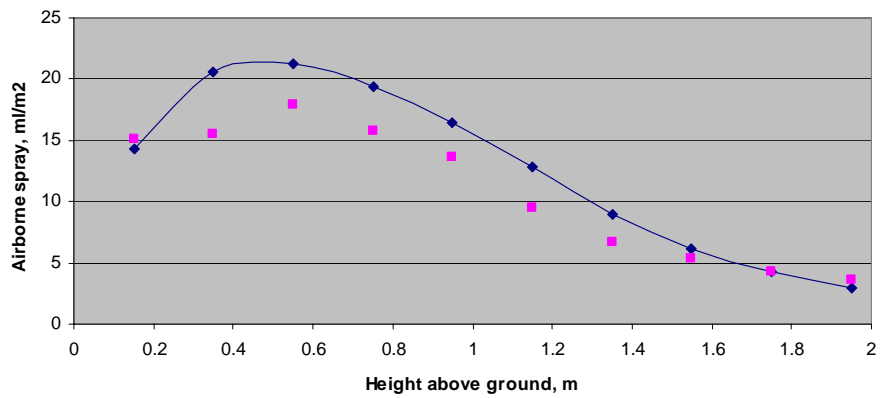


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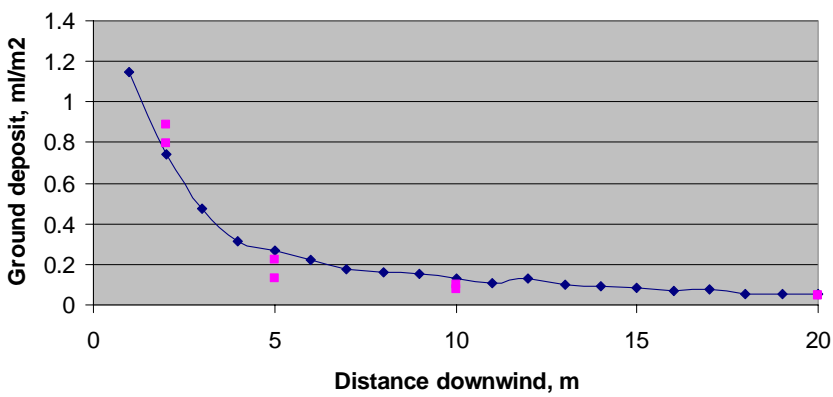
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### XR nozzle

### Airborne spray 2 m downwind



### Ground deposit

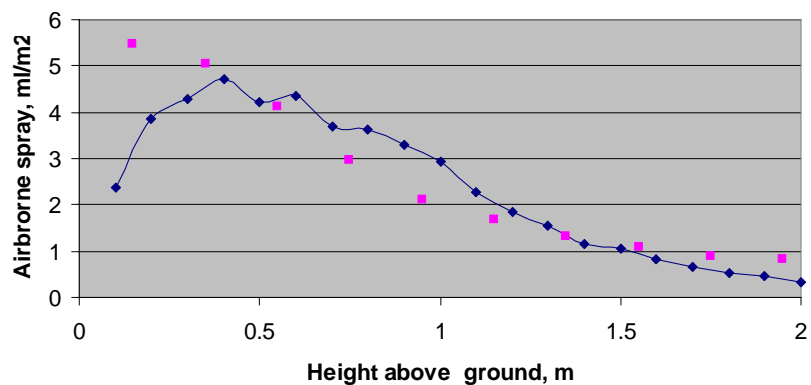


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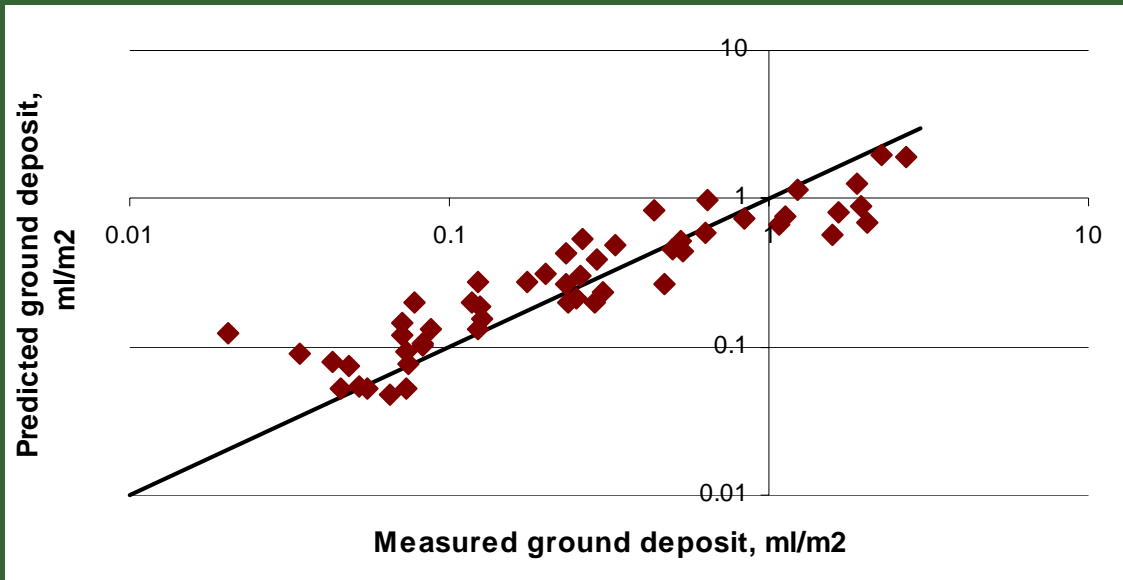
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### Air induction nozzle

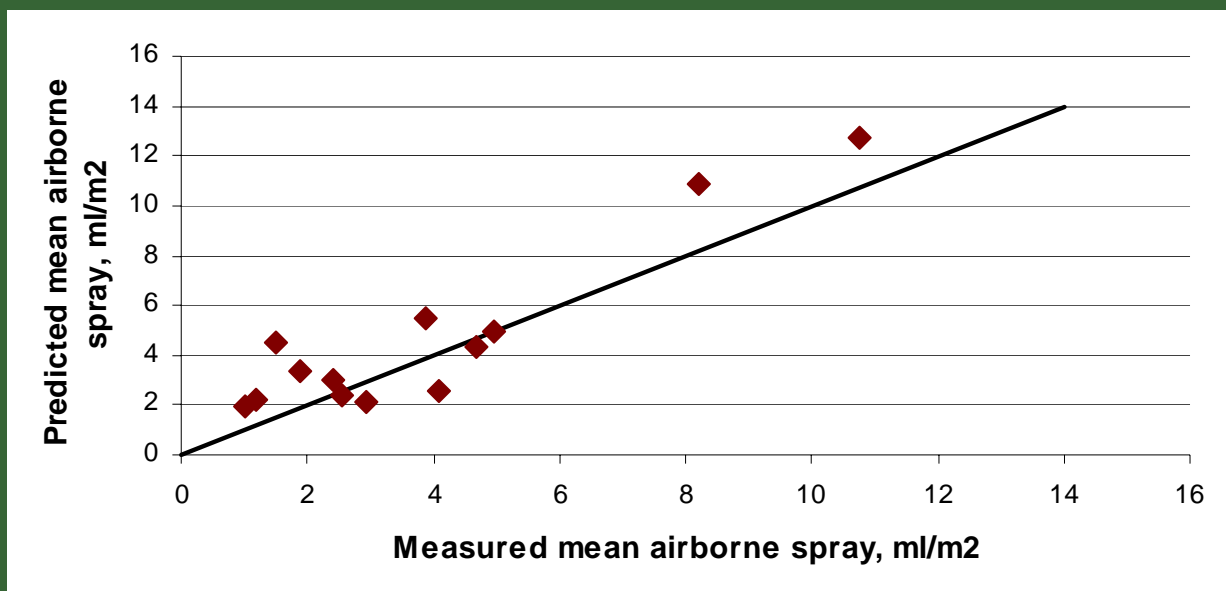
### Airborne spray at 2 m downwind



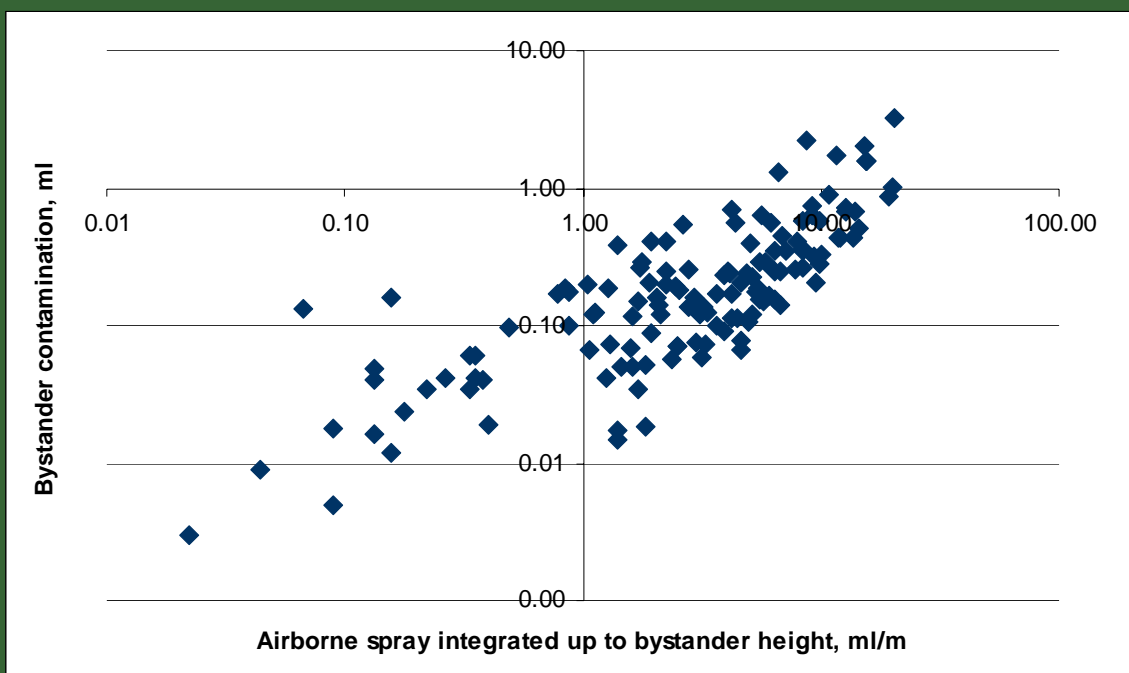
## Comparison between predicted and measured ground deposit – one field trial



## Comparison between predicted and measured mean airborne spray up to 2.0 m height, measured 2.0 m downwind



## Relationship between airborne spray and bystander contamination



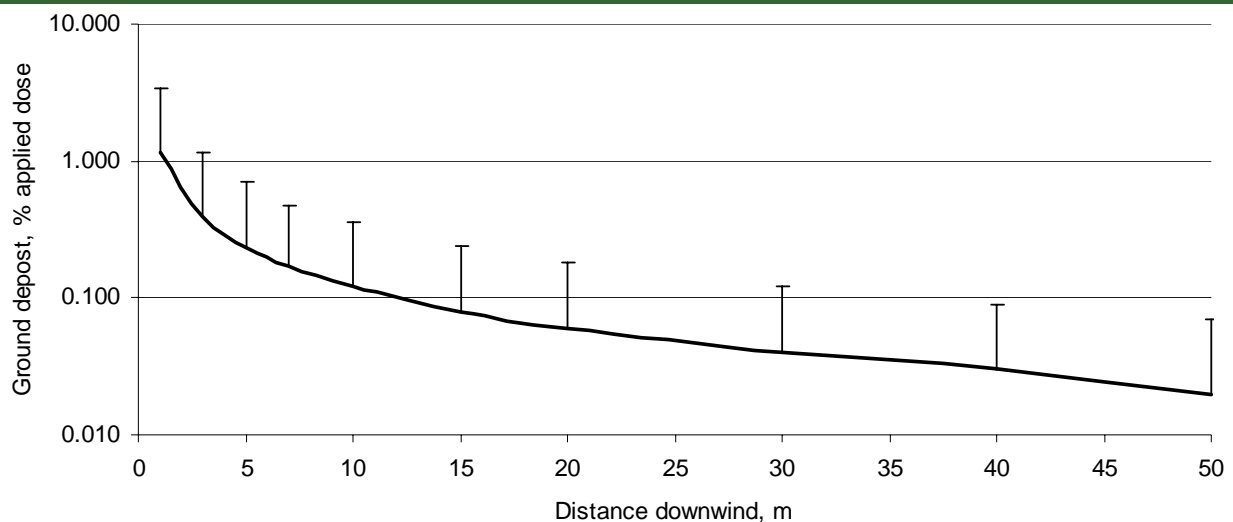
## Modelling variability

- Uncertainty over relationship between airborne spray and bystander contamination
- Wind turbulence/ variation
  - Short timescale, built into model
  - Medium timescale (few seconds)
  - Long timescale (minutes or more)
- Variation in sprayer operation
  - Boom height
  - Forward speed – pressure – spray characteristics
- Emulator being created to allow inputs to be selected from a distribution
  - Include boom height instability and medium timescale wind speed variation
  - Predicted bystander contamination has a distribution

## Example of use for drift onto surface water

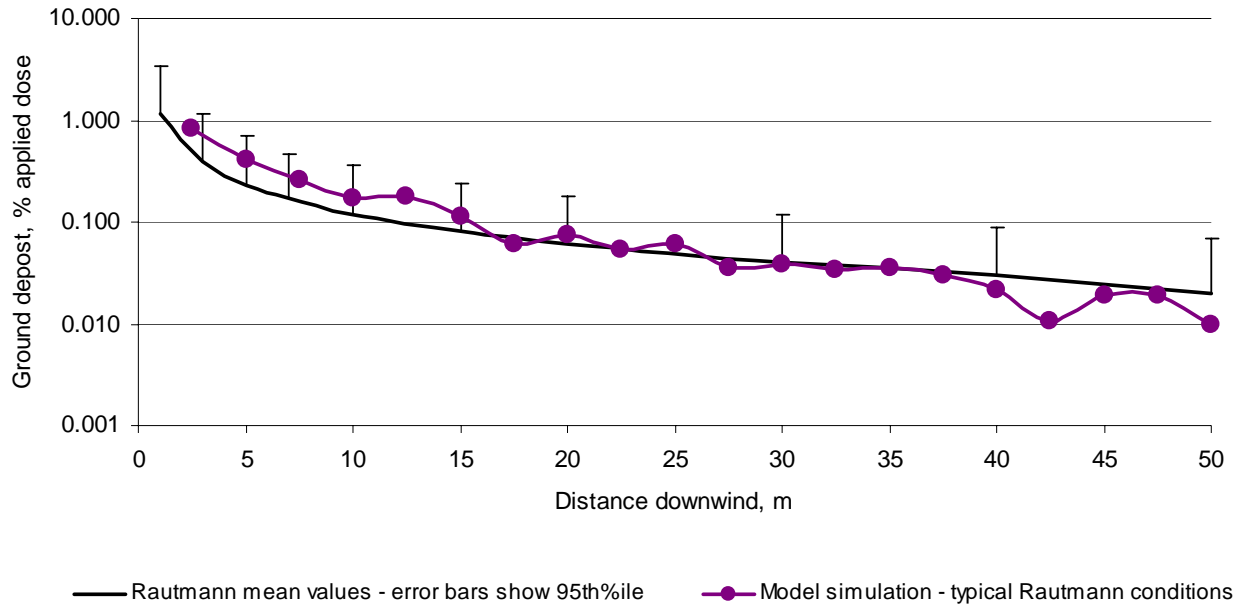
- Currently data from Rautmann et al (2001) are used in regulatory process
- Not necessarily representative of application practice across Europe
  - 0.5 m boom
  - 10 m boom width
  - 6 km/h forward speed
- UK conditions now very different

## Rautmann et al (2001) ground deposit data

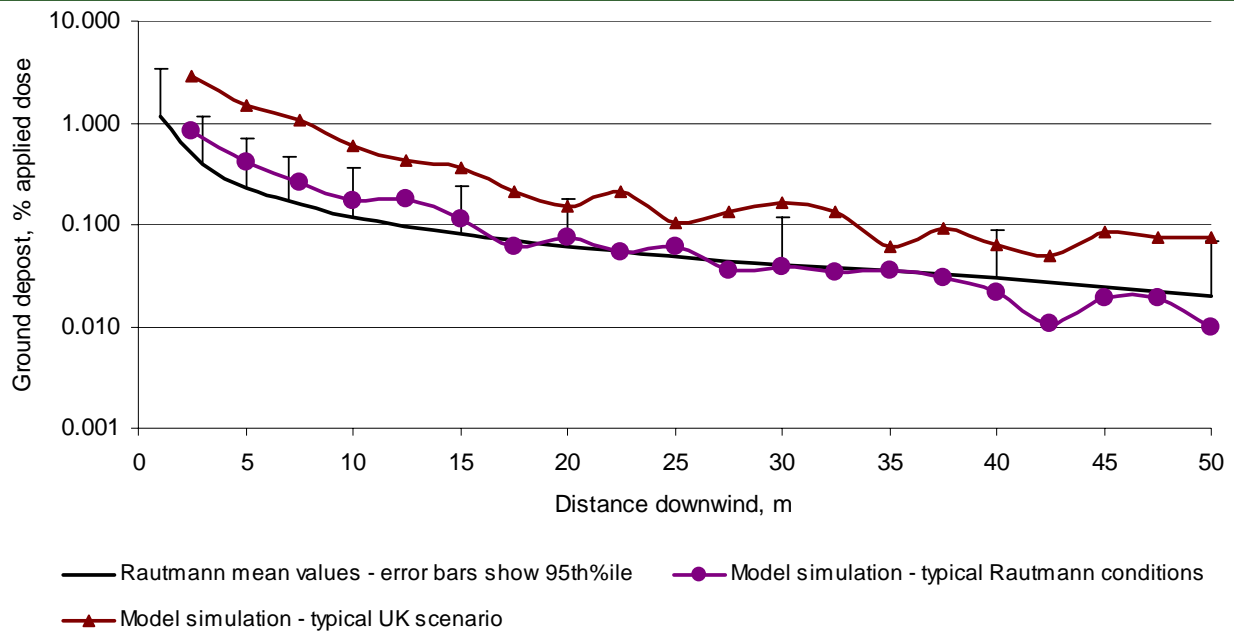


— Rautmann mean values - error bars show 95th%ile

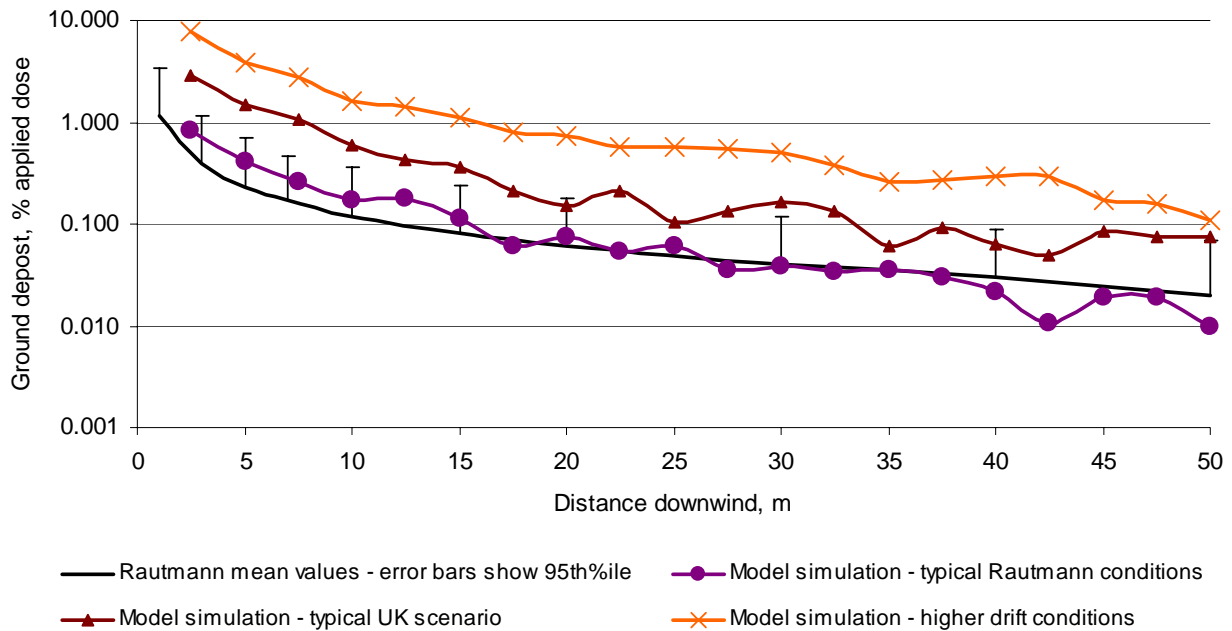
**Model simulation: "04" nozzle, 6 km/h speed, 0.5 m boom height, 2.0 m/s wind speed**



**Typical UK scenario: "03" nozzle, 12 km/h speed, 0.7 m boom height, 2 m/s wind speed**



## Higher drift conditions: "XR 03" nozzle, 16 km/h speed, 0.9 m boom height, 3 m/s wind speed



## Potential uses for a spray drift model:

- Model can be used to generate more appropriate data sets for regulation
  - Same model across EU
  - Different scenarios for member states
- Model can be used to explore mitigation approaches
  - Distance (buffer zones)
  - Nozzle type
  - Application practice (boom height, forward speed)
- Empirical data relating spray drift to contamination of species will allow model to be used for all assessments of exposure to spray drift.

## Conclusions

- A model is essential for estimating exposures from spray drift
- The Silsoe spray drift model has been validated for UK conditions and can provide more realistic data than is currently used
- The model can already be used for estimating exposures to bystanders and to surface water
- Empirical data can be combined with model predictions to give estimates of all other non-target species' exposure
- Emulators can be developed to allow variability and uncertainty to be taken into account giving distributions of outputs

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