

# The Development and Validation of a Bystander and Resident Exposure Assessment Model (BREAM)

The NIAB Group



# The Development and Validation of a Bystander and Resident Exposure Assessment Model (BREAM)

## Project Overview

*Paul Miller*

The NIAB Group



## Project Objectives

- 1) To construct a computational model describing the downwind dispersion of droplets and vapours associated with the application of pesticide sprays to arable crops and the associated risks of exposure to residents and bystanders in the countryside.**
- 2) To validate the models in wind tunnel and field trials.**
- 3) To use the models to examine the effect of key variables on exposure risks.**
- 4) To report the results of the work directly to the sponsors and in refereed papers.**

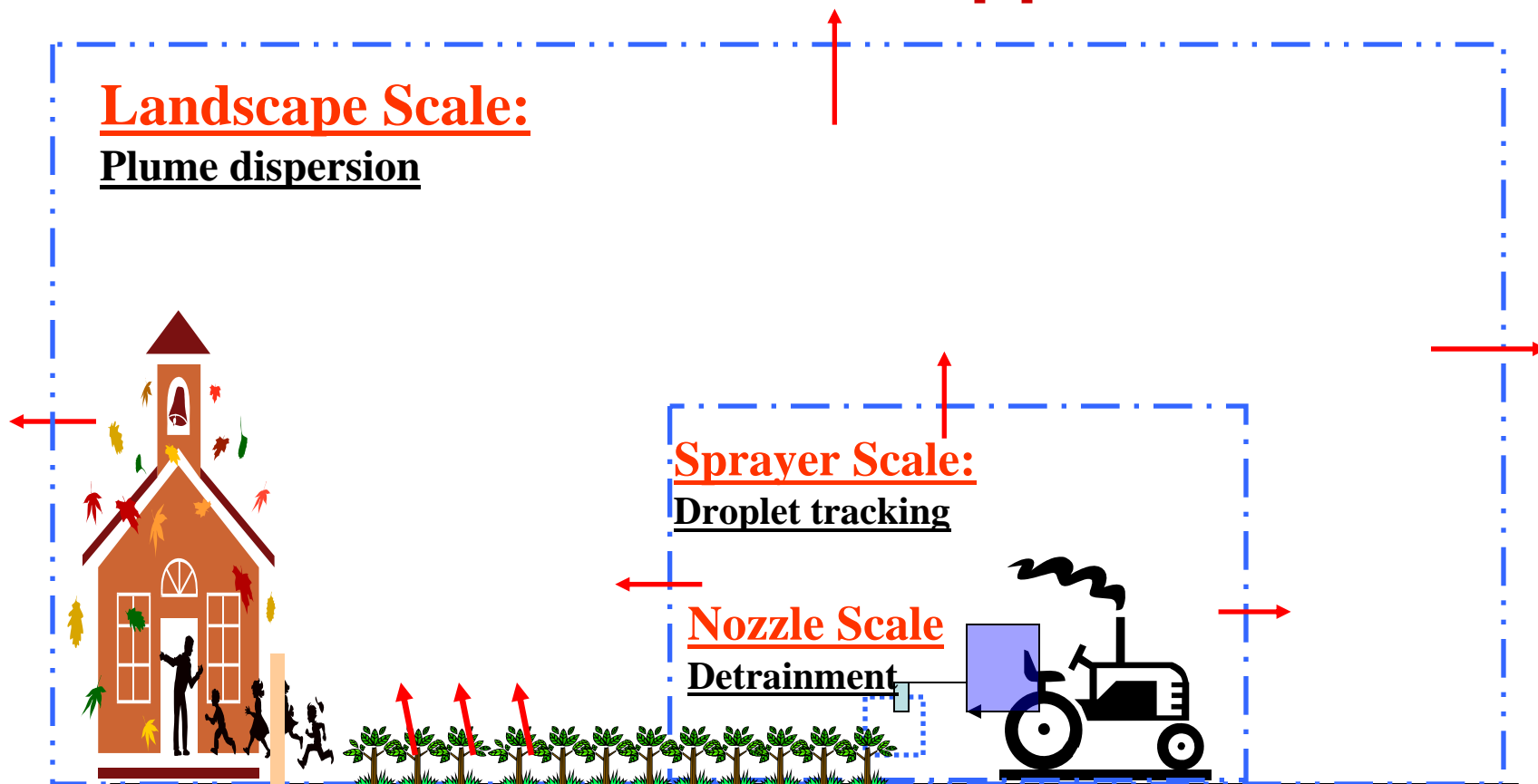
## Approaches proposed

- **Review existing models**
  - *Include both droplets and vapours*
- **Construct new models**
  - *Using three zones around the sprayer*
- **Obtain input data for model predictions**
  - Using:
    - *Spray/nozzle data*
    - *Wind tunnel studies of droplet and vapour behaviour*
    - *Field studies with full-scale vehicles*
- **Validate models**
  - *Wind tunnel experiments*
  - *Field trials*
- **Publish and report results**
  - *In peer reviewed journals*
  - *Reports to PSD/Defra*

## Project Consortium

- **Silsoe Spray Applications Unit (part of The Arable Group)**
  - Lead project
  - Lead data reviews and analysis of results
  - Co-ordinate the modelling work
  - Conduct most of the experimental work
- **AEA Technology**
  - Lead the modelling work particularly close to the vehicle (package) and at landscape scale (e.g. ADMS & AERMOD)
- **Central Science Laboratory (now FERA)**
  - Input to modelling sensitivity and overall systems approach
  - Input to data review and exploring “bystander effects”
  - Statistical analysis

# The three-scale approach



# Modelling approaches

- **Based on:**
  - Particle tracking methods
    - *Definition of “source” condition is critical*
  - Plume dispersion predictions (e.g. ADMS & AERMOD)
    - *Necessary for vapour predictions*
  - *Simulations using CFD*
- **Using:**
  - Three zones around the machine
    - *Close to the nozzle*
    - *Around the machine (wake effects)*
    - *In the surrounding landscape*

■ **To give size droplet size distributions and airborne concentration profiles at defined distances downwind**

## Possible application scenarios

1. **Bystander taking vigorous exercise on footpath 2m downwind of treatment area**
2. **Residential property with house 5 m from treated area and garden butting up to the treated area. 4 - 5 year old child playing in the garden at the time of application**
3. **Residential property 10 m downwind of a treated field and behind a hedge but with a gap in the hedge opposite the house.**

Modelling human exposure

– we have not made assumptions about durations

## Approaches

- **Prediction of:**
  - **Airborne droplet concentrations**
    - ❖ Map to dermal contamination
  - **Ground sedimentation downwind of a treated area to enable estimation of indirect exposure**
    - ❖ e.g. child playing in garden
  - **Airborne vapour concentrations**
    - ❖ Map to inhalation risks

## Approaches

- **Experimental work**
- **Using field trials at full scale and wind tunnel studies**
  - **To establish a basis for model development**
  - **To validate model predictions of**
    - ❖ **Airborne concentrations**
    - ❖ **Bystander contamination**



## Project outcomes

- **Linked to defined scenarios**
  - *For bystanders at distances up to 10 m from the edge of a treated area*
  - *Vehicle effects not currently included in modelling approaches*
  - *Vapour concentrations based on a large treated area*
- **Model delivered via an emulator**
  - *Probabilistic component included*

# Project deliverables

- **A model:**
  - **For spray - based on an emulator for a defined range of application conditions**
  - **For vapours – a predicted distribution of concentrations for a defined scenario**
- **A final report that will be submitted to Defra/CRD**
- **Papers submitted for publication in peer reviewed journals**