Cambridge Environmental Assessments

Uncertainties in crop and off-crop exposure estimates for pesticides to non-target arthropods: WEBFRAM 4

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Exposure to arthropods: contributors, tasks

- Application factors, drift cloud behaviour and characteristics
  - Prof. Paul Miller, Silsoe Research Institute, UK
- Interception by crops, off-crop vegetation, linking to exposure
  - CEA (N. Mackay, A. Lawrence, D. Arnold)

- Structure of the model, consideration of important factors affecting exposure

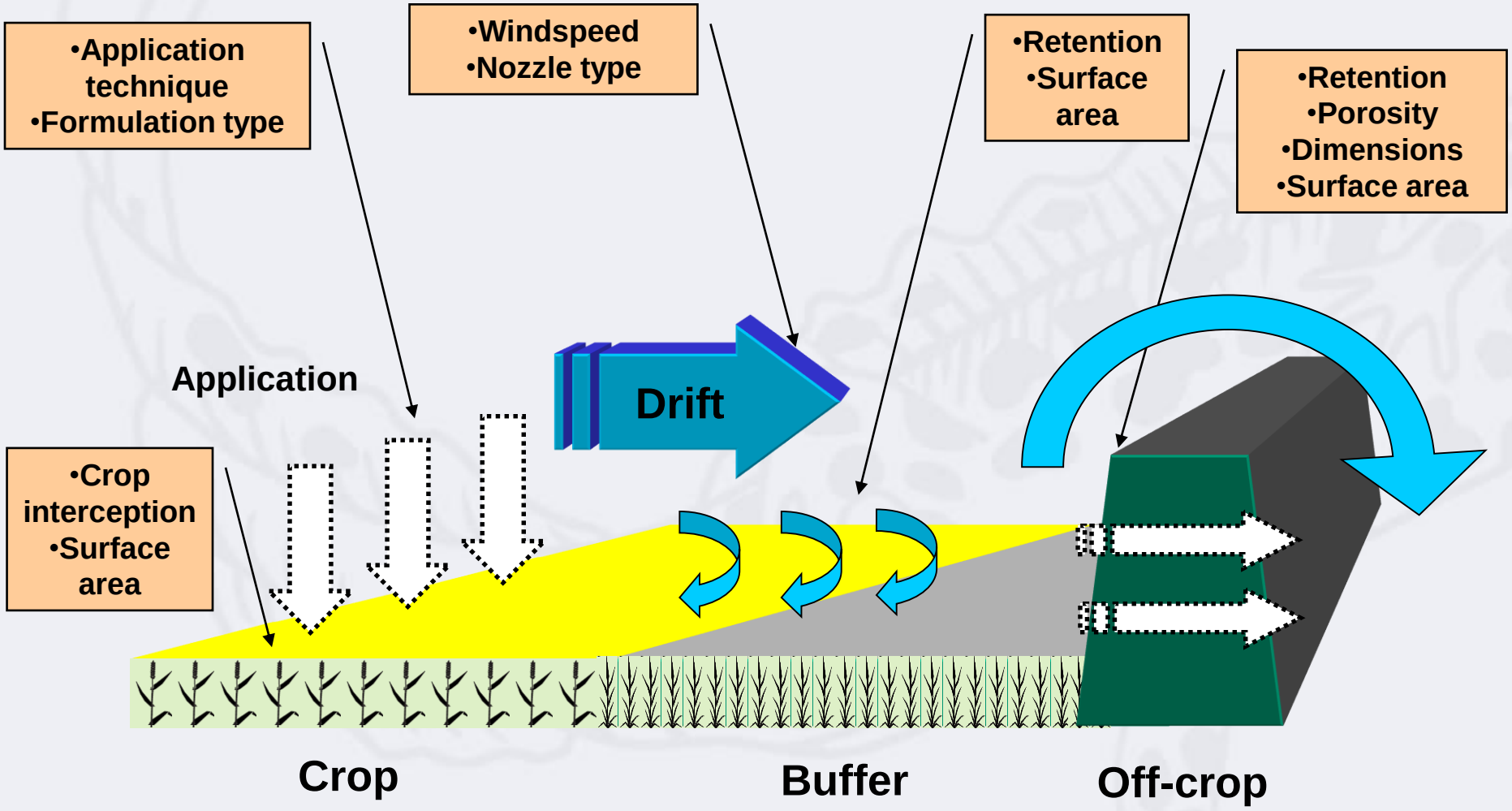
Approach

- Relevant factors identified at WEBFRAM stakeholders workshop
- Assigned importance
- Description, characterisation of variability, uncertainty
  - Best available data, expert judgement
- Assigned default values where appropriate

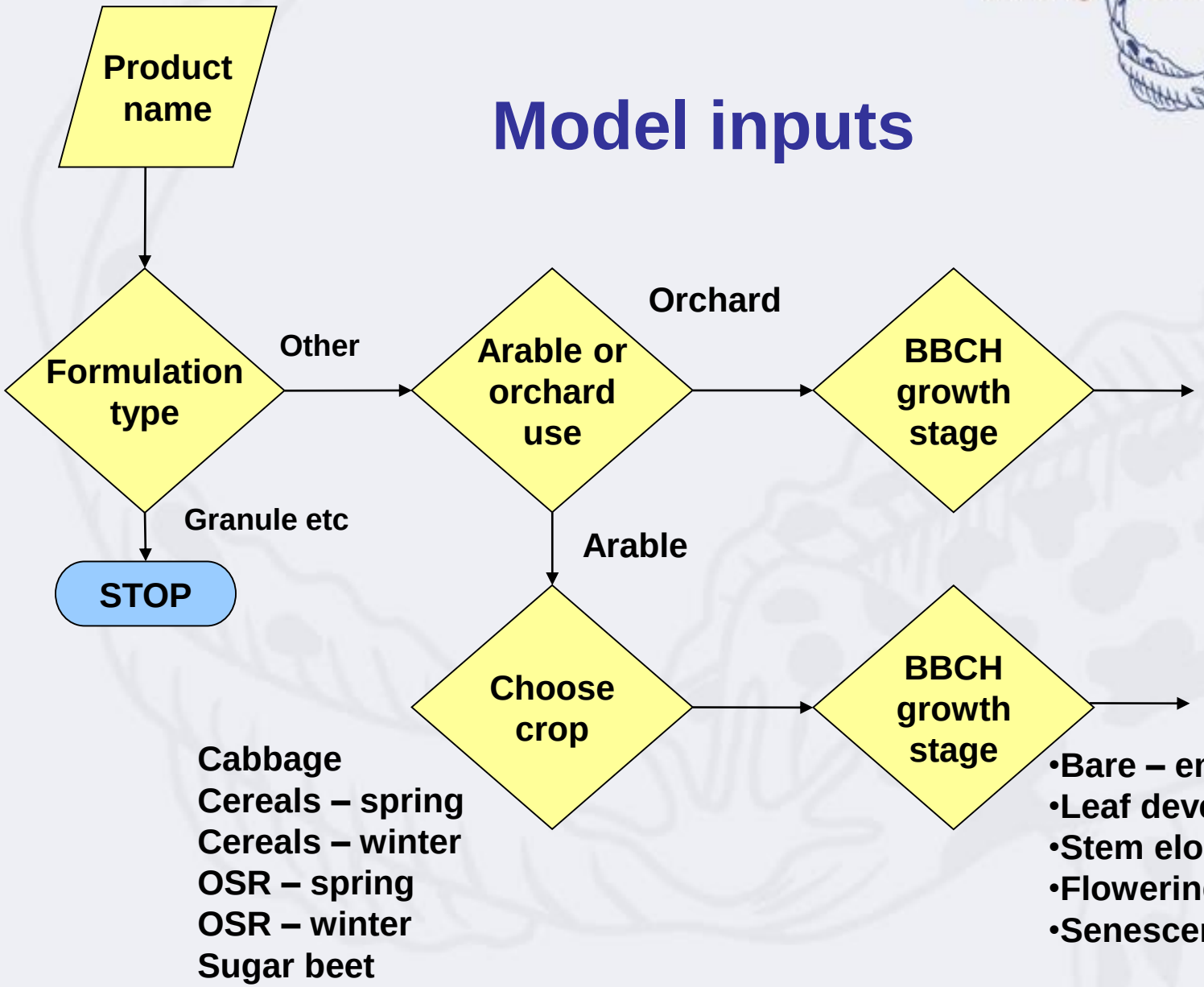
WEBFRAM 4: exposure scenarios

- **In-crop - arable**
  - Scenarios account for crops & growth stages: cereals, OSR, 'beet, cabbage
- **In-crop - orchard**
  - Apples, growth stages
- **Buffer strips & off-crop areas**
  - Buffer strips (bare, grassed)
  - Off-crop vegetation (meadow, hedge)
    - Default properties or user-defined

Arthropod exposure schematic



Model inputs



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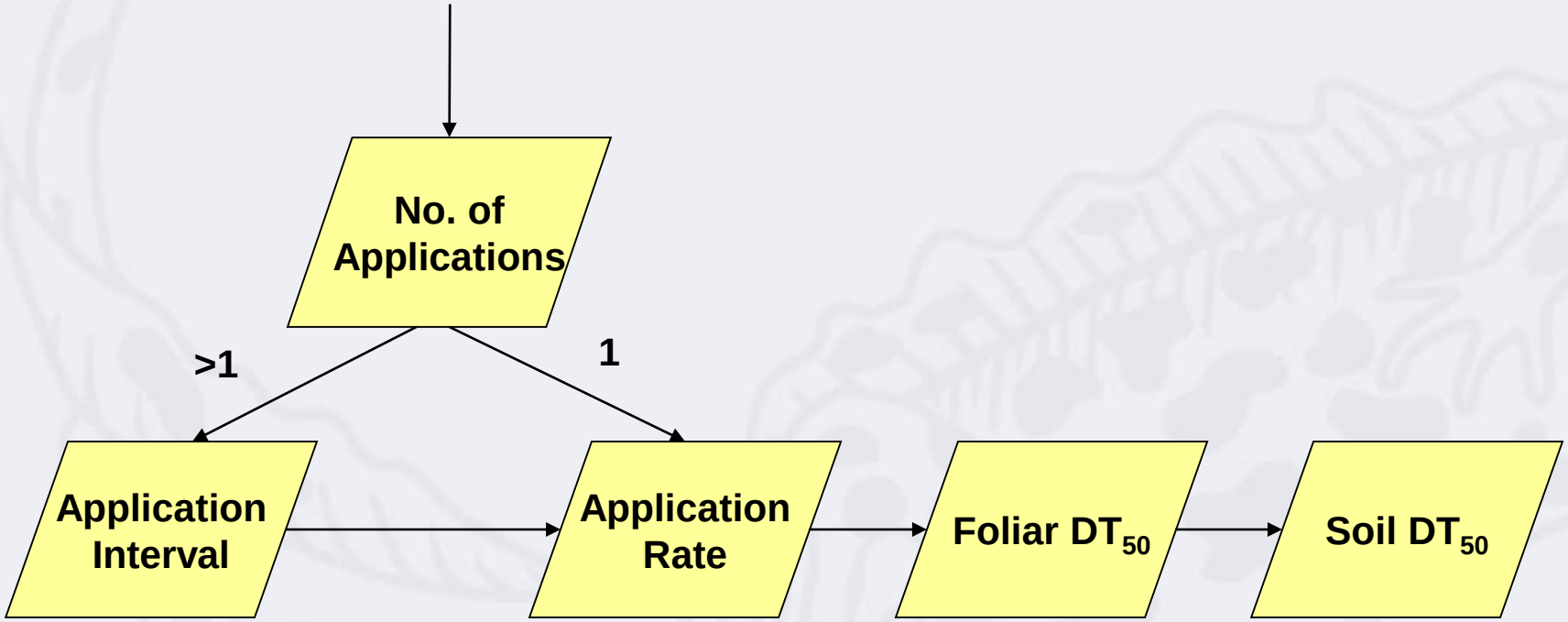
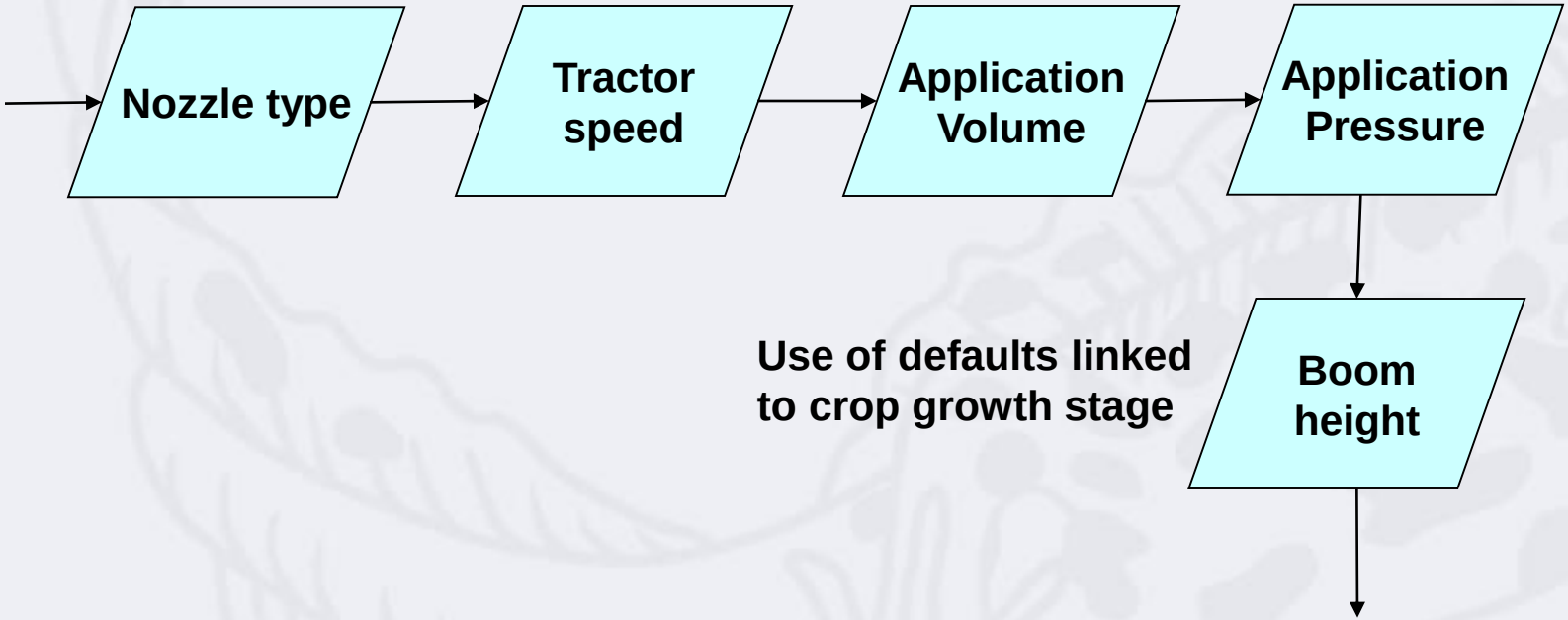
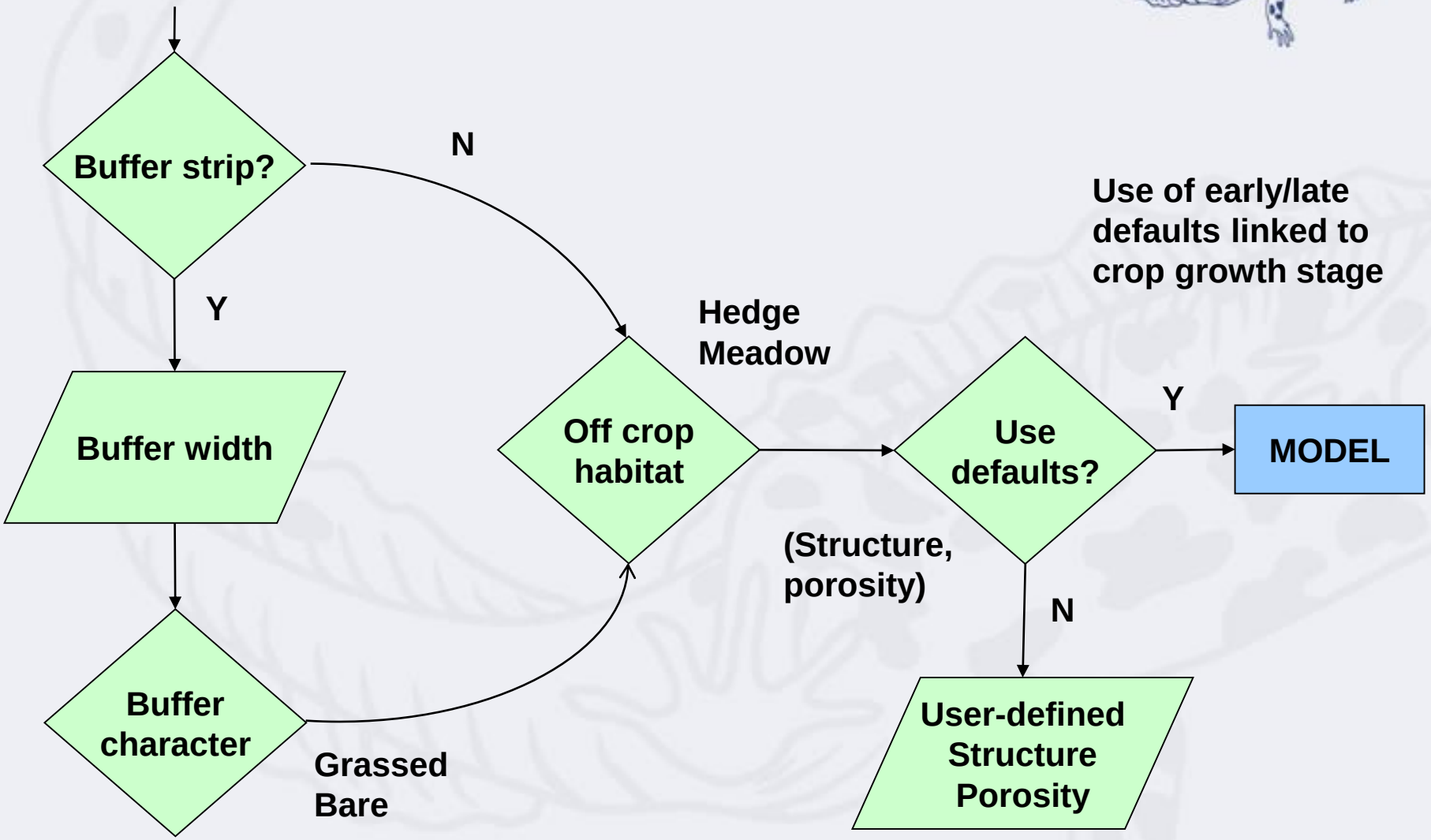


Model inputs: arable



Model inputs: off-crop



Factors affecting exposure: in - crop

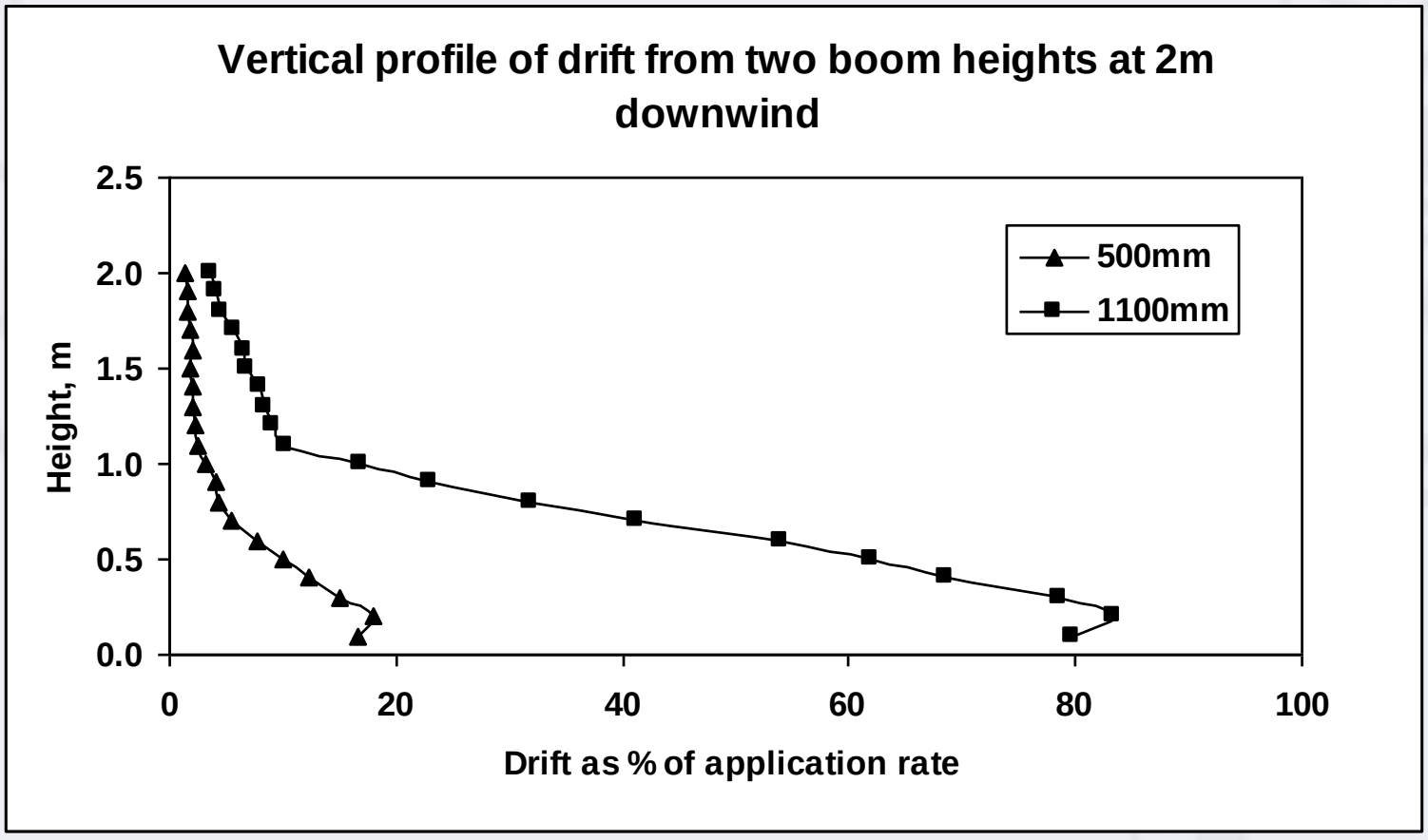
- In-crop interception factors
  - Foliar development
  - BBCH growth stages linked with interception %; variability. Surface area also characterised

Variability **in foliar interception (%) for winter OSR**

	Bare – emergence (BBCH 00-09)	Leaf development (BBCH 10-19)	Stem elongation (BBCH 20-39)	Flowering (BBCH 40-89)	Senescence and ripening (BBCH 90-99)
FOCUS Defaults	0	40	80	80	90
Mean	0	71	86	83	78
Estimated σ	0	43	29	14	18

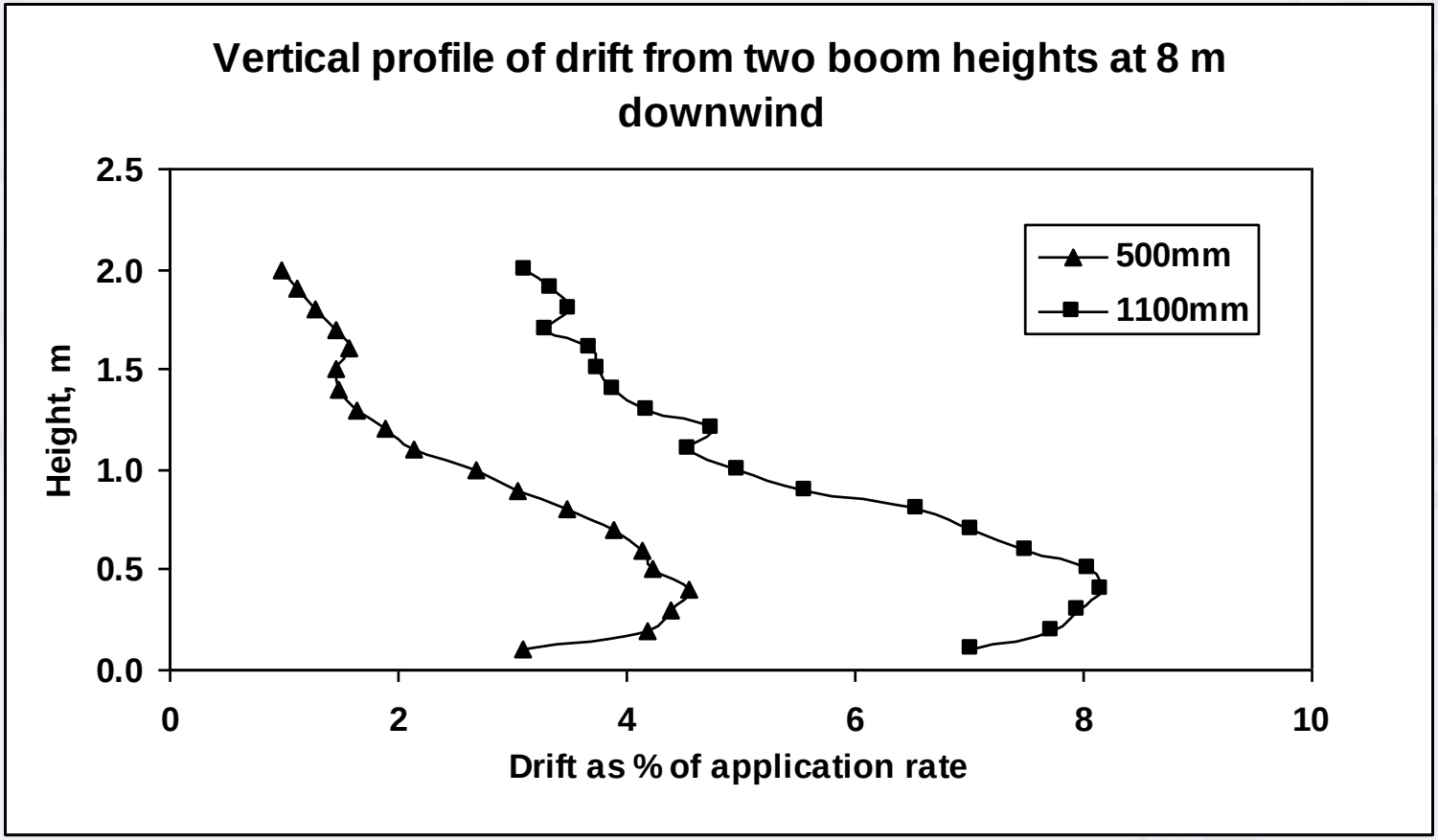
Factors affecting exposure: drift cloud behaviour

- High boom causes more drift at low distances



Factors affecting exposure: drift cloud behaviour

- High boom effects attenuate with distance



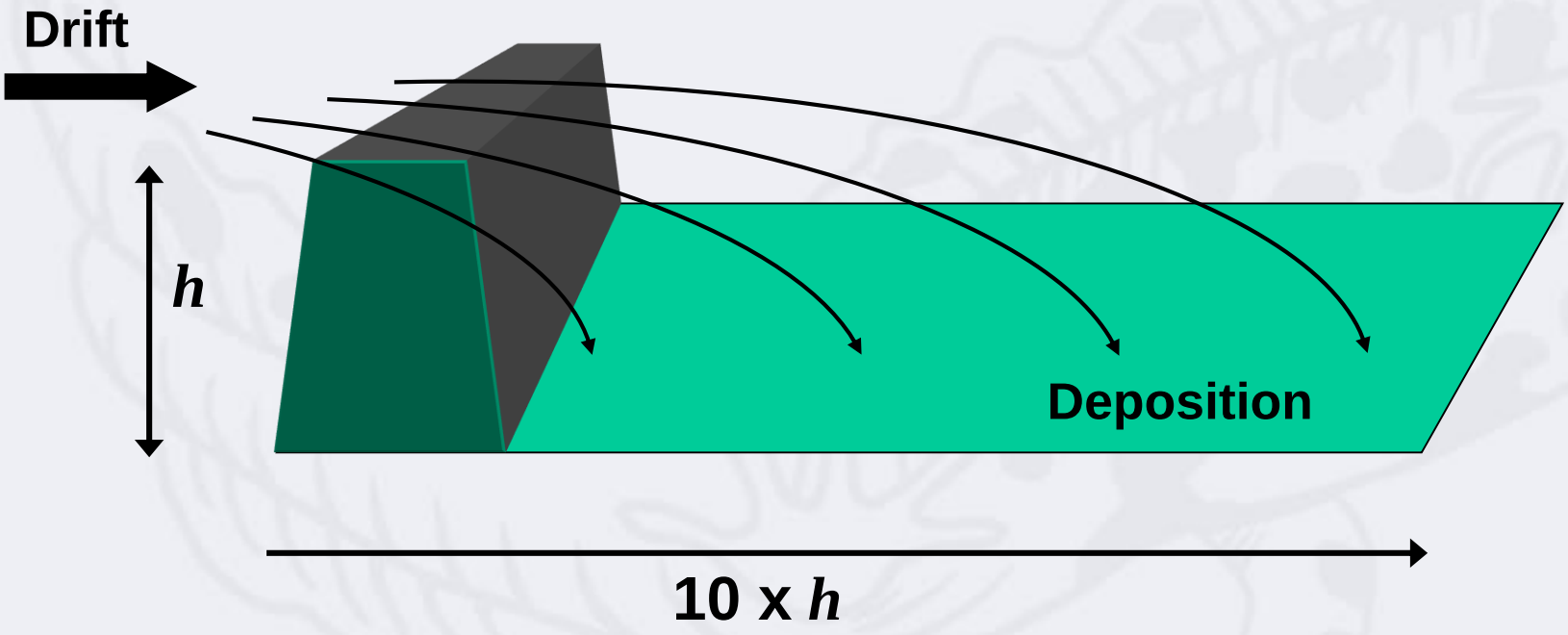
Factors affecting exposure: buffer strips & off - crop

- Buffer strips & meadows
  - Grassed buffer strips & meadows – retention & surface area assumed as cereals*
    - User-defined width, or default values

*The wheat growth guide, HGCA, 1997

Drift profile

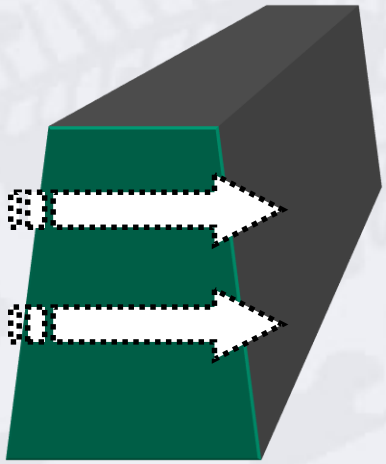
Hedge intercepts vertical drift equivalent to deposition that would occur on horizontal surface 10 x hedge height, ***h***



Hence look up drift at 10 x ***h***, this gives hedge exposure to drift

Factors affecting exposure: buffer strips & off - crop

- Hedges - typical dimensions from literature
- Optical porosity = F, or fraction of particles which pass through structure
- Retention (R) of particles:
  - **R = 1 – F**



- Default porosities link with growth stage of crops: early (50% porosity), late (25% porosity)

Factors affecting exposure: buffer strips & off - crop

- Off-crop vegetation structure
  - Surface area of hedges from literature
  - Major components characterised*
    - Trunk $S_1(D,h) = 3.5211\times10^{-2} \times D^{0.7743}h$
    - Branches $S_2(D) = 2.6026\times D^{1.6440} / \ln(7191.8\times D)$
    - Leaves $S_3(D,h) = 0.4595\times D^{0.8708} h^{1.2944}$
    - Seeds $S_4(D) = 4.7570\times10^{-6} \times D^{4.5616}$
- Default values suggested
- Early (deciduous) hedge, consider only trunk, branches

*Zhou, X. H., Brandle, J. R., Takle, E. S. & Mize, C. W. 2002 Estimation of the three-dimensional aerodynamic structure of a green ash shelterbelt. *Agric. Forest Meteorology*, **111**: 93-108

Outputs

- Exposure to arthropods, g a.i/ha
- Incorporating drift profiles, vegetation interception, surface area – WEBFRAM output is equivalent to ESCORT II, yet more realistic

Summary, desirables

- Exposure of arthropods to spray & drift, in- and off-crop, in g a.i./ha
- Requires:
  - Reality checking - residue data of insects from in- & off-crop
  - Ecological & behavioural data on arthropods – in- & off-crop
  - Information on off-crop habitats, eg farmer survey