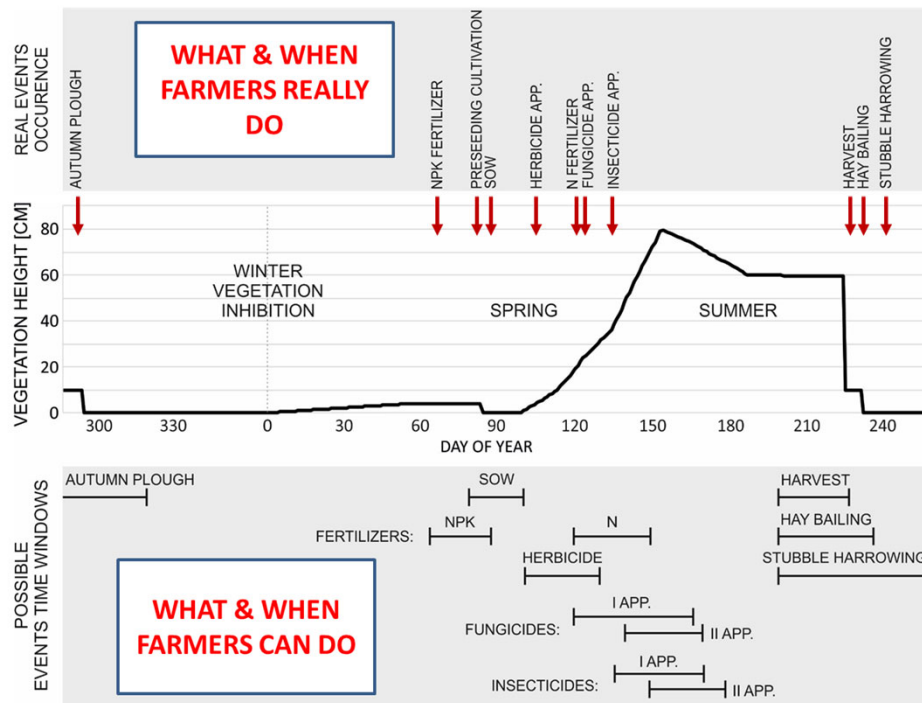


An Introduction to the Landscape Model in ALMaSS



Pesticides are often used in ALMaSS scenarios

Crop management [spring barley example]



- ▶ The initiator of the pesticide application is in the crop management
- ▶ This means pesticide is applied to an individual field at a particular time
- ▶ We distinguish between two approaches to modelling pesticides and their effects
General and Specific Pesticides

1 - Background pesticides

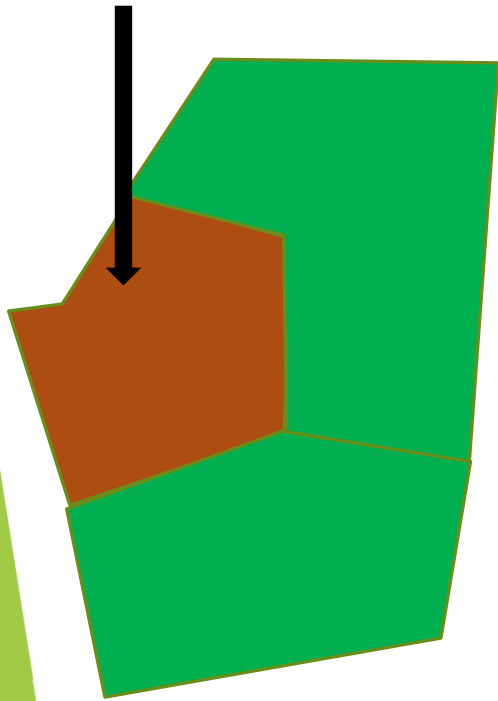
- ▶ Background pesticides are very simple:
 - ▶ Applied following the crop management plan on a certain date
 - ▶ They are registered as being applied to the field polygon as an event
 - ▶ This event appears on the event list for the field, and any organism can access this and respond to that event
 - ▶ Normally this is used to apply generic pesticides e.g. insecticide, herbicide and fungicide
 - ▶ Responses are generic, e.g. 70% mortality of beetles in a field that is sprayed on the day sprayed
 - ▶ There is no drift, and no environmental fate

2 - Specific pesticides

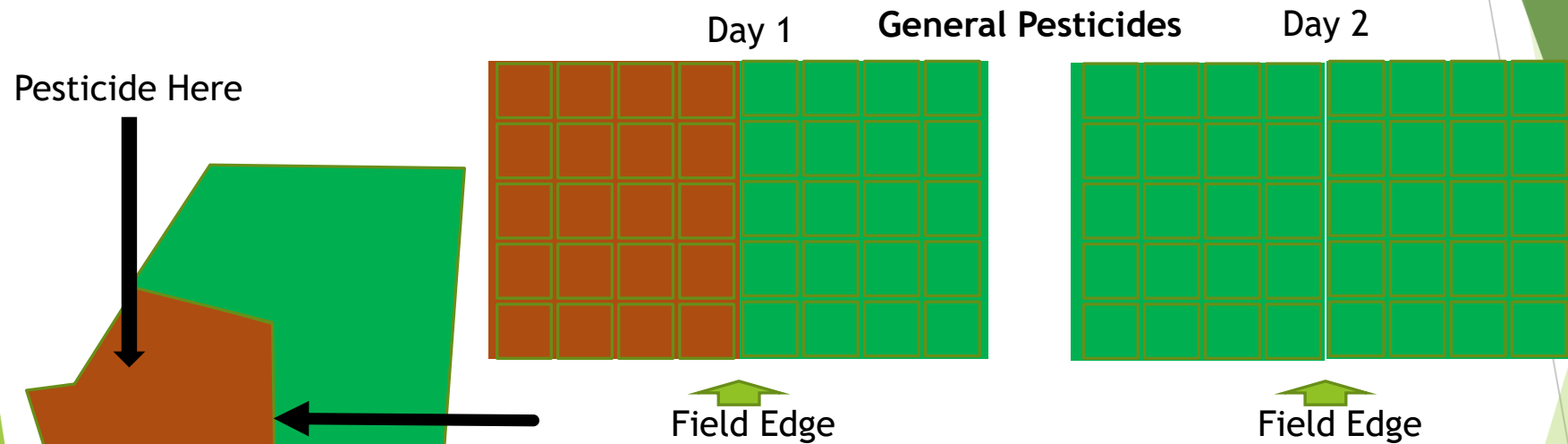
- ▶ Specific pesticides are also part of crop management plans, which often need to be modified to accept their use.
- ▶ The trigger for application is the same as background pesticides but the representation from there on is very different:
 - ▶ Drift can be included
 - ▶ Wind direction is used if drift is included
 - ▶ The pesticide is recorded as being applied on the raster not the polygon (up to 1m resolution)
 - ▶ Application includes environmental fate, so pesticides persist in the environment, decaying with time

Representing the two types of pesticides

Pesticide Here

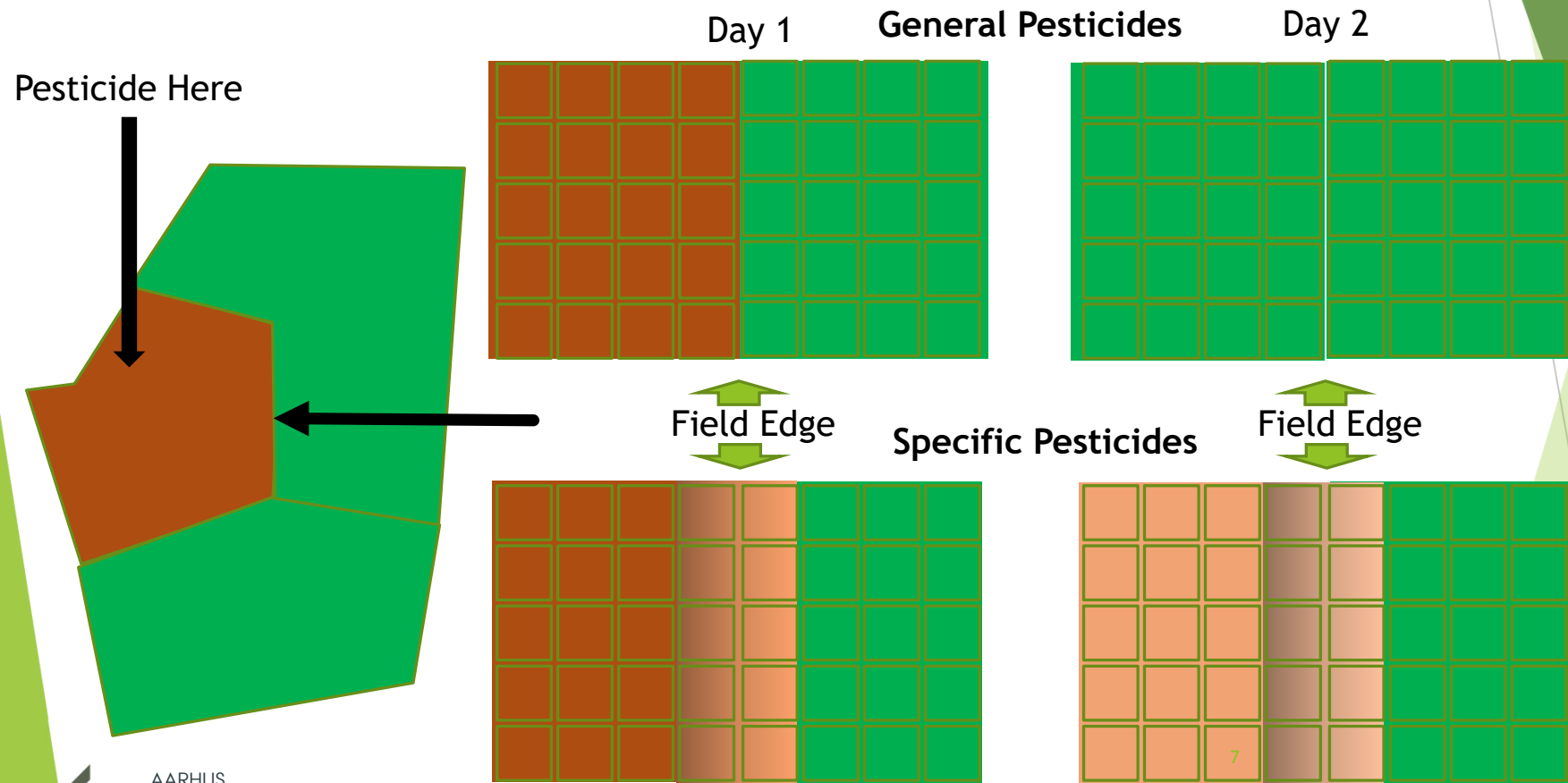


Representing the two types of pesticides



A hard field boundary, no drift, and next day no environmental concentration

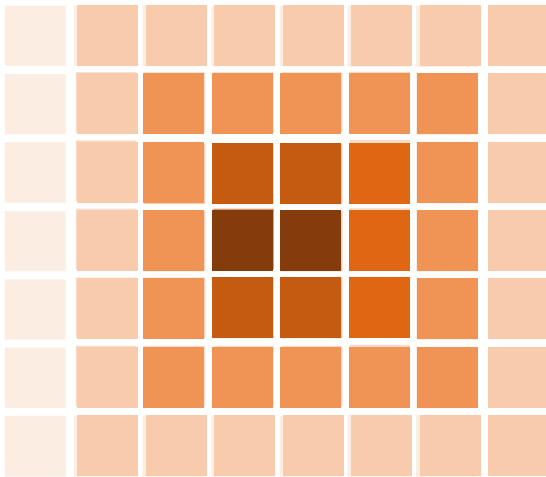
Representing the two types of pesticides



'Soft' field boundary, specific pesticides decay over time

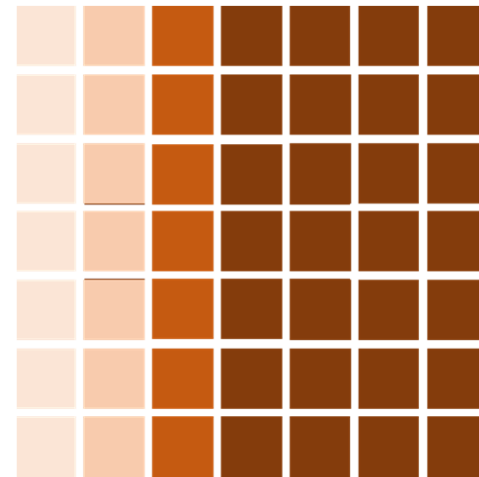
Spraying by pixel

Spraying is carried out pixel by pixel over a field using a “mask”



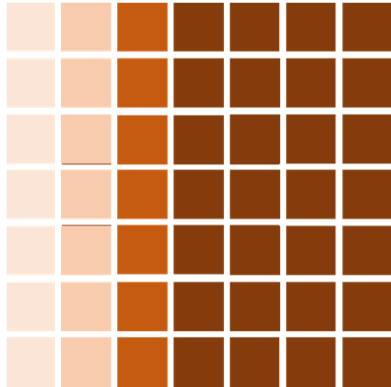
The mask represents the pattern of spray from a point source. This one is assuming no wind, but it can be changed to simulate wind direction.

We then move to the next location and spray the same mask again



This is continued until all locations in the field have been ‘sprayed’ with the mask:

Environmental fate

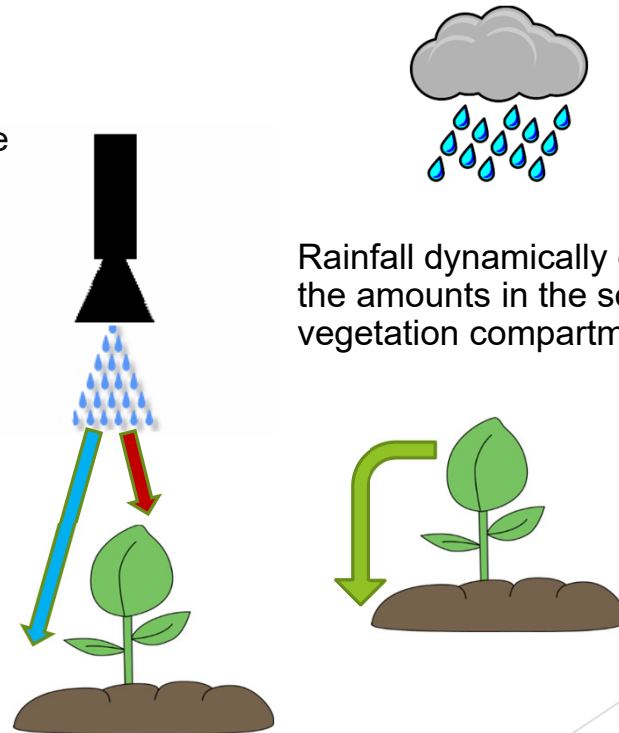


- ▶ Once the pesticide appears in the grid we can change its value with time using assumptions about environmental fate.
- ▶ These are equations in ALMaSS, and currently depend on the temperature
- ▶ However it can be a bit more complicated.

Not all pesticide lands in the same place

So we can also consider whether the pesticide is on the leaves or in the soil.

These two compartments have different decay rates



Rainfall dynamically changes the amounts in the soil and vegetation compartments

Toxicology

Agents in ALMaSS can be exposed to pesticides in three basic ways:

1. Overspray – they are in the field when the pesticide is sprayed
2. By eating contaminated vegetation
3. Contact exposure in the environment e.g. running on the soil

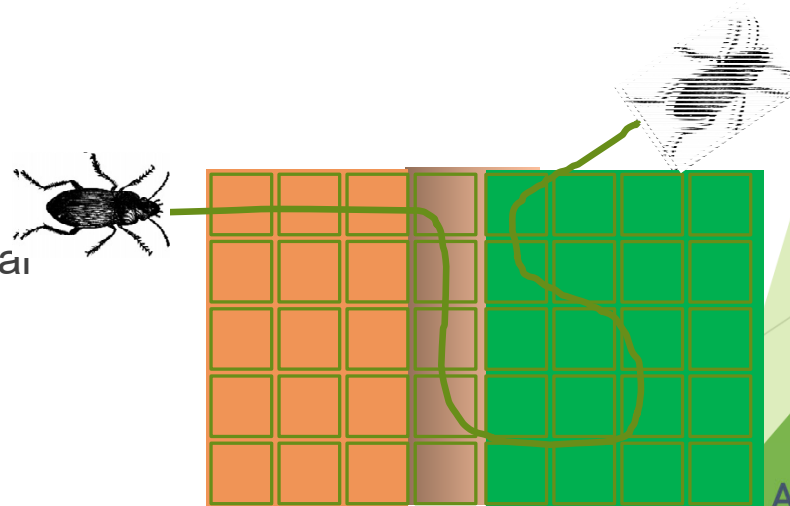


Toxicology

...but exposure is only the first part of the story – we need effects, and this can be complicated by time and movement

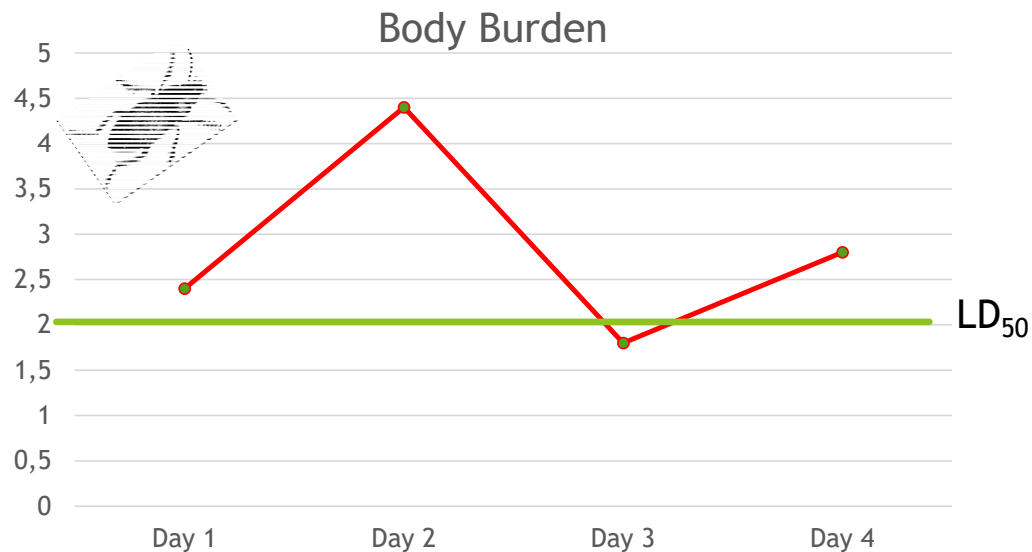
This beetle is exposed to different concentrations during its movement, so we have to consider integrating this somehow.

This is usually done by defining a 'body-burden' together with an internal decay rate that works like the environmental decay



Toxicology

Next we need to consider the effect, e.g. acute mortality



If we assume that the chance of dying is 50% (LD₅₀), then after 4 days the chance of this beetle surviving is $0.5 \cdot 0.5 \cdot 0.5 = 0.125$, not 50%

What about history of exposure?
Differences between beetles
(resistance/health)?

All these things need to be considered before a toxicological model can be implemented.

Then we must also consider the effects – they may be sub-lethal, based on dose responses, and even having combined effects of different pesticides

Thanks for your attention!

