

Axema-EurAgEng Conference

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A VIRTUAL SPREADER TO OVERCOME EXPERIMENTAL LIMITS: EXAMPLE OF USE TO DEEPEN THE MEANING OF THE TRANSVERSE COEFFICIENT OF VARIATION

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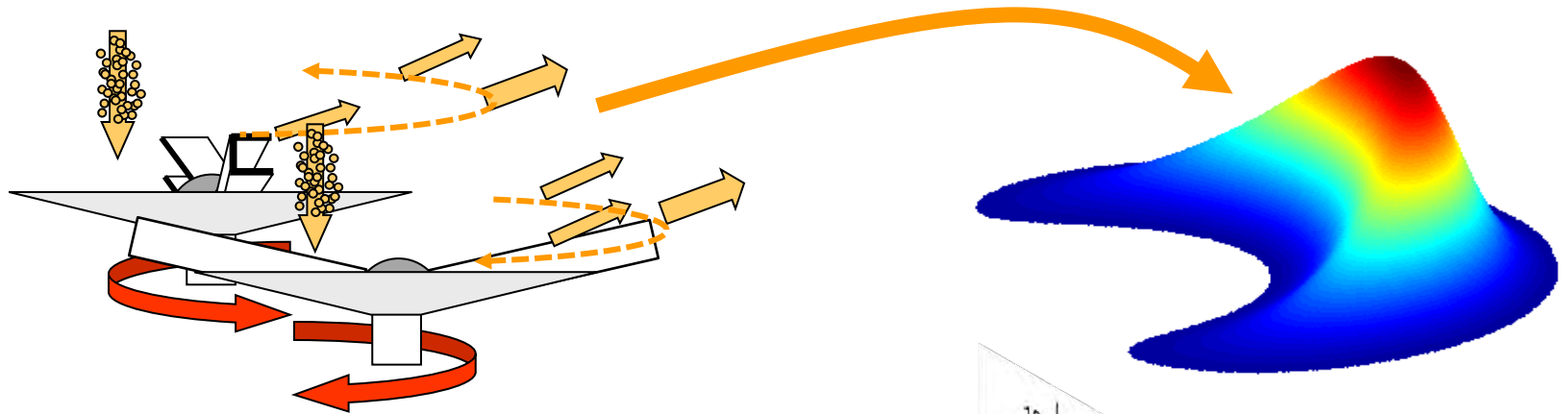
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Introduction: Context and study goal



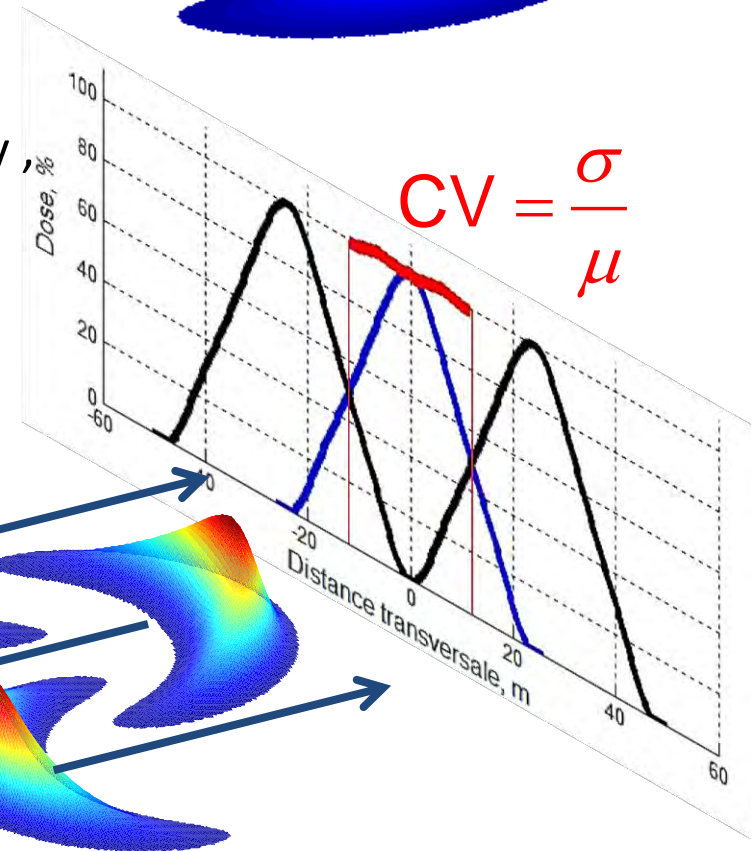
Quality assessed by considering the uniformity, quantified by the transverse VC.

- Reflects spreader performance,
- Does not only depend on the setting,
- Agronomic interpretation is not easy.



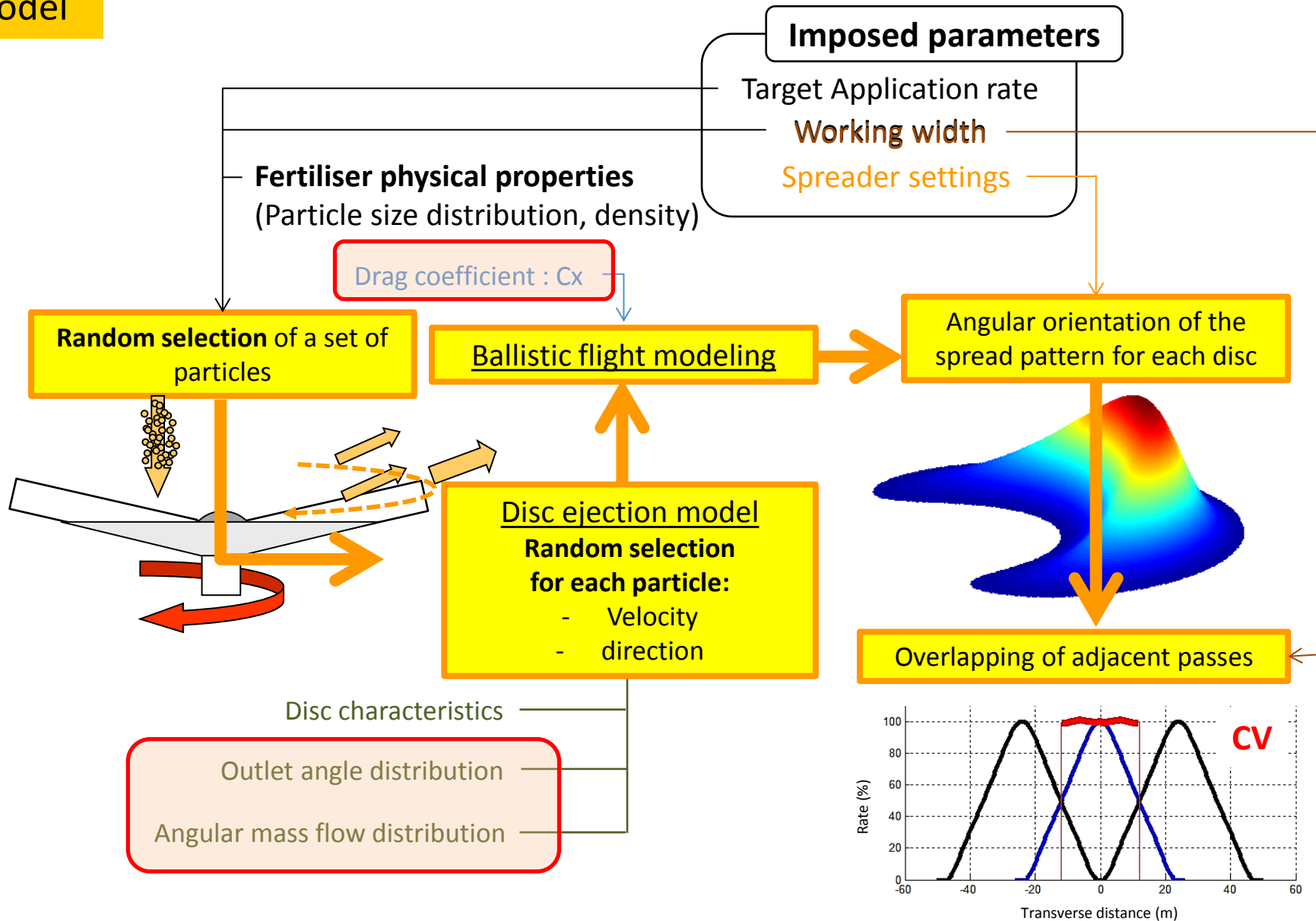
Model and simulations to study:

- the spatial variability of the application
- the meaning of the CV



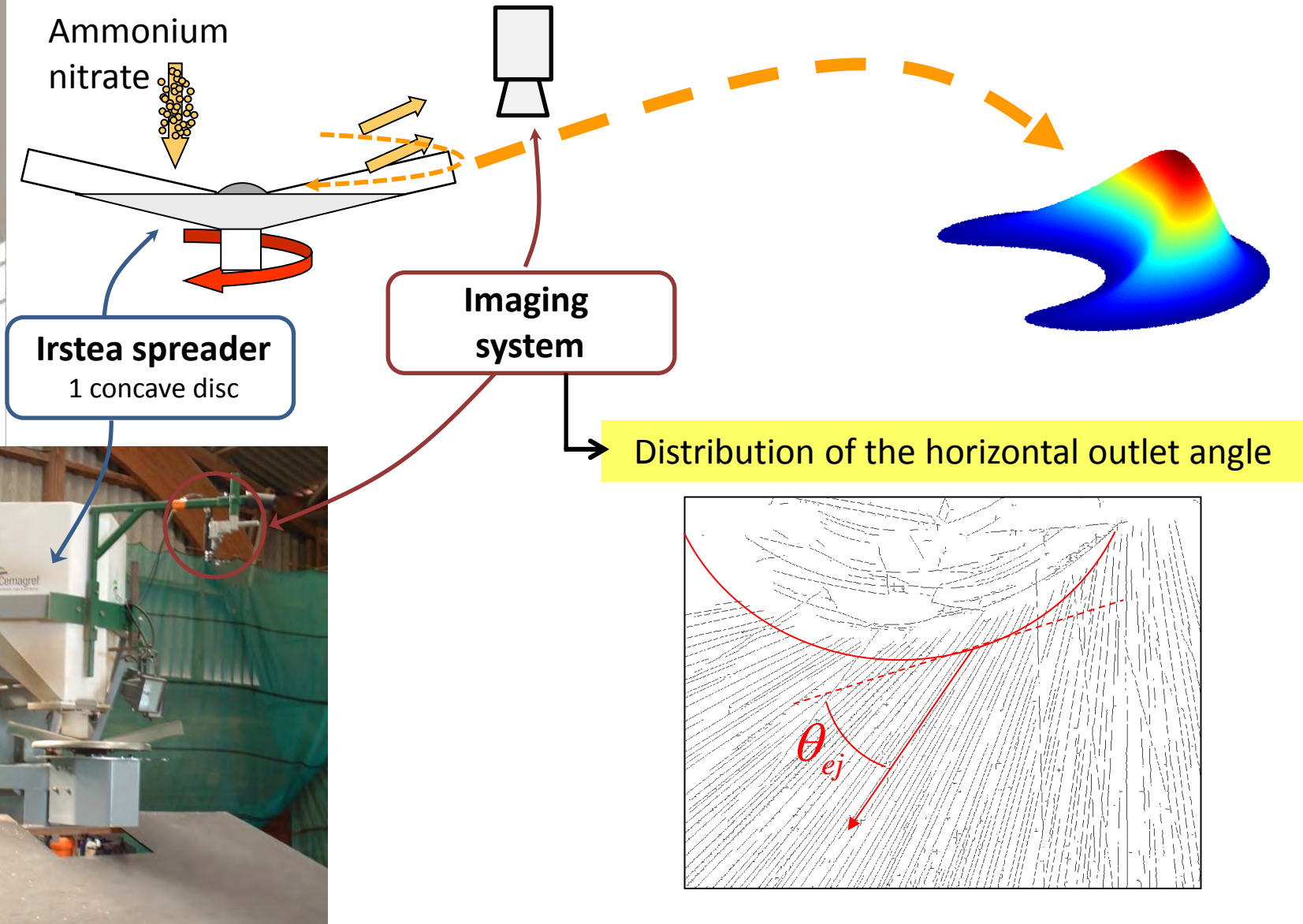
I. Models and its settings

1.1. Model



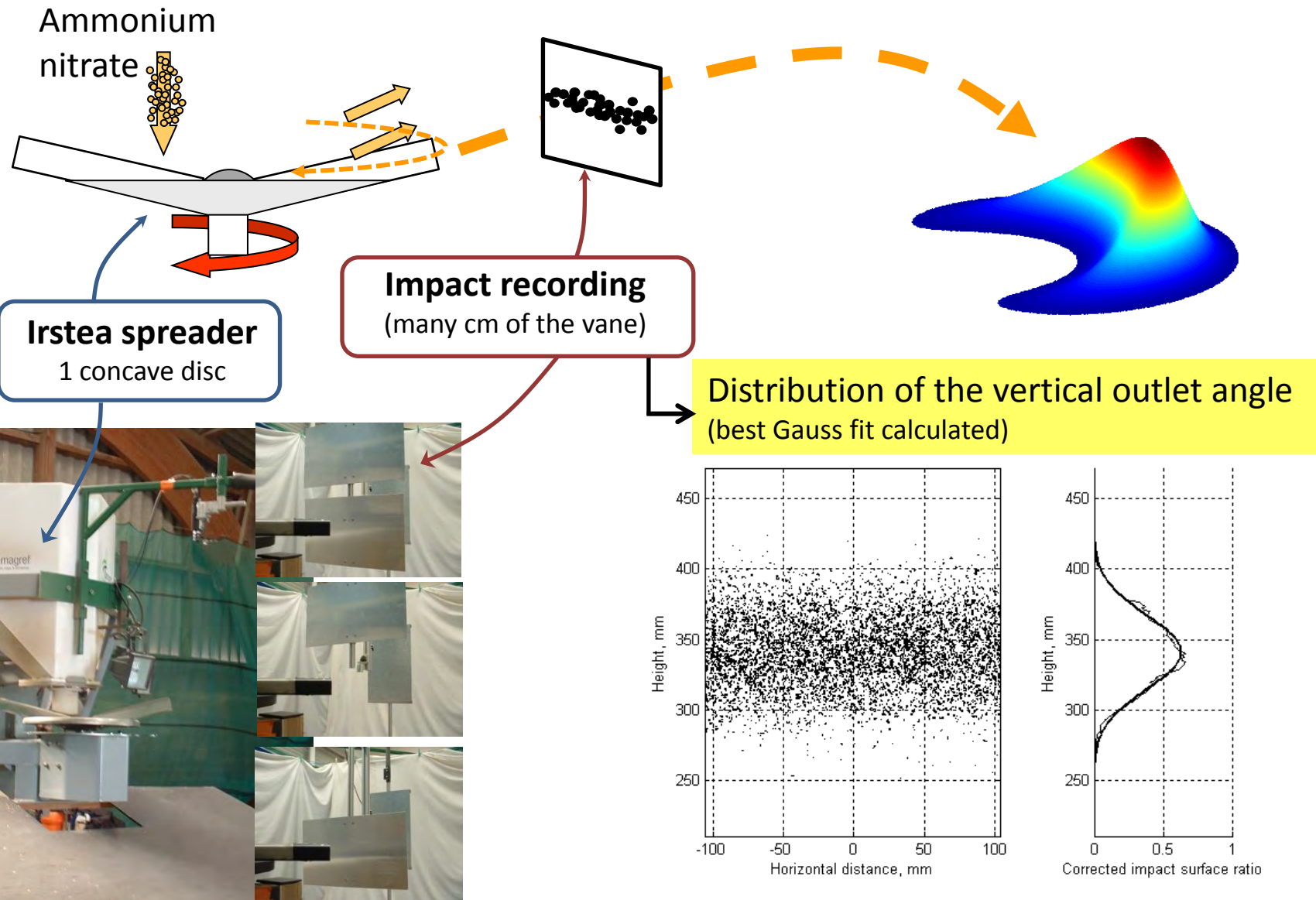
I. Models and its settings

1.2. Ejection parameters: a) Outlet horizontal velocity



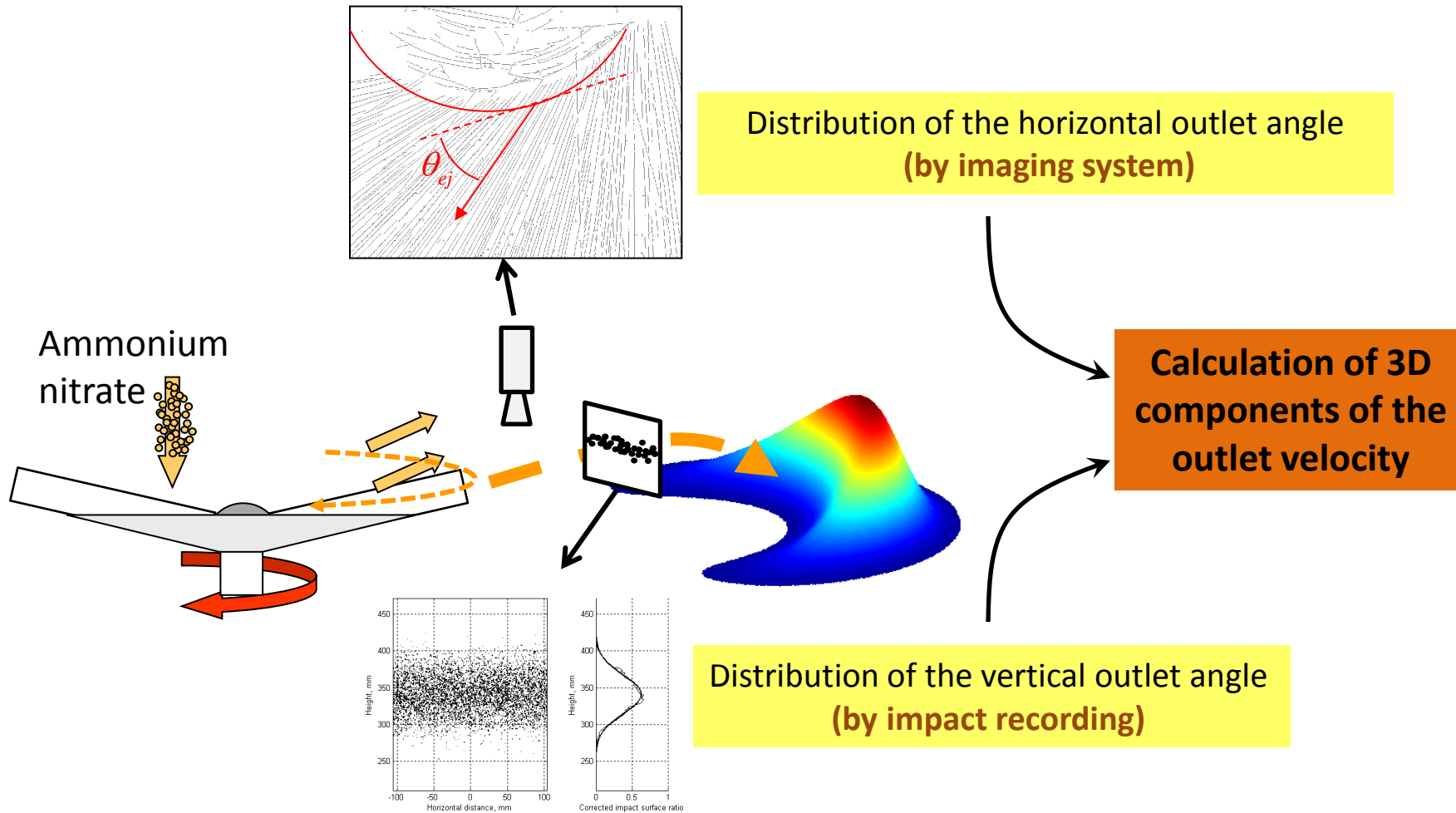
I. Models and its settings

1.2. Ejection parameters: b) Vertical distribution



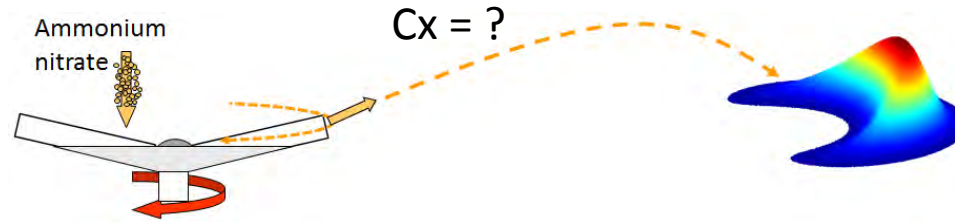
I. Models and its settings

1.2. Ejection parameters: c) **Synthesis**

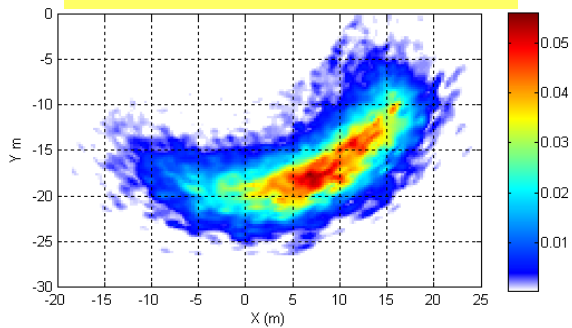


I. Models and its settings

1.3. Cx Value estimation



I) - Real spread pattern
Cemib test bench



Fertiliser:

- Size
- Density

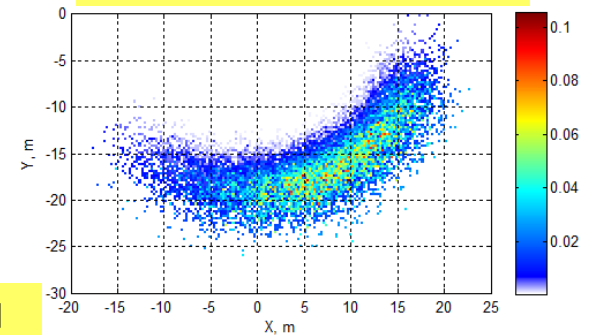
Dynamic parameter:

- Velocity

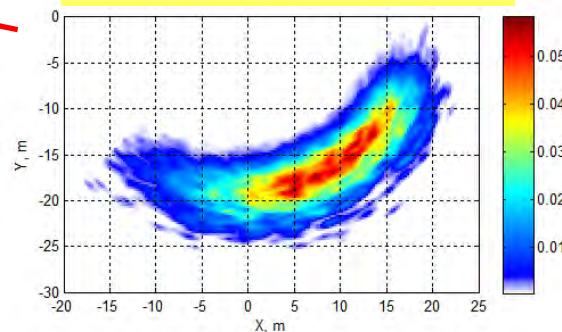
Mass angular distribution

Using a
Cx value

**II) – Simulated spatial
distribution**
1 or 2 million particles



**III) - Interpolated spread
pattern from simulation**

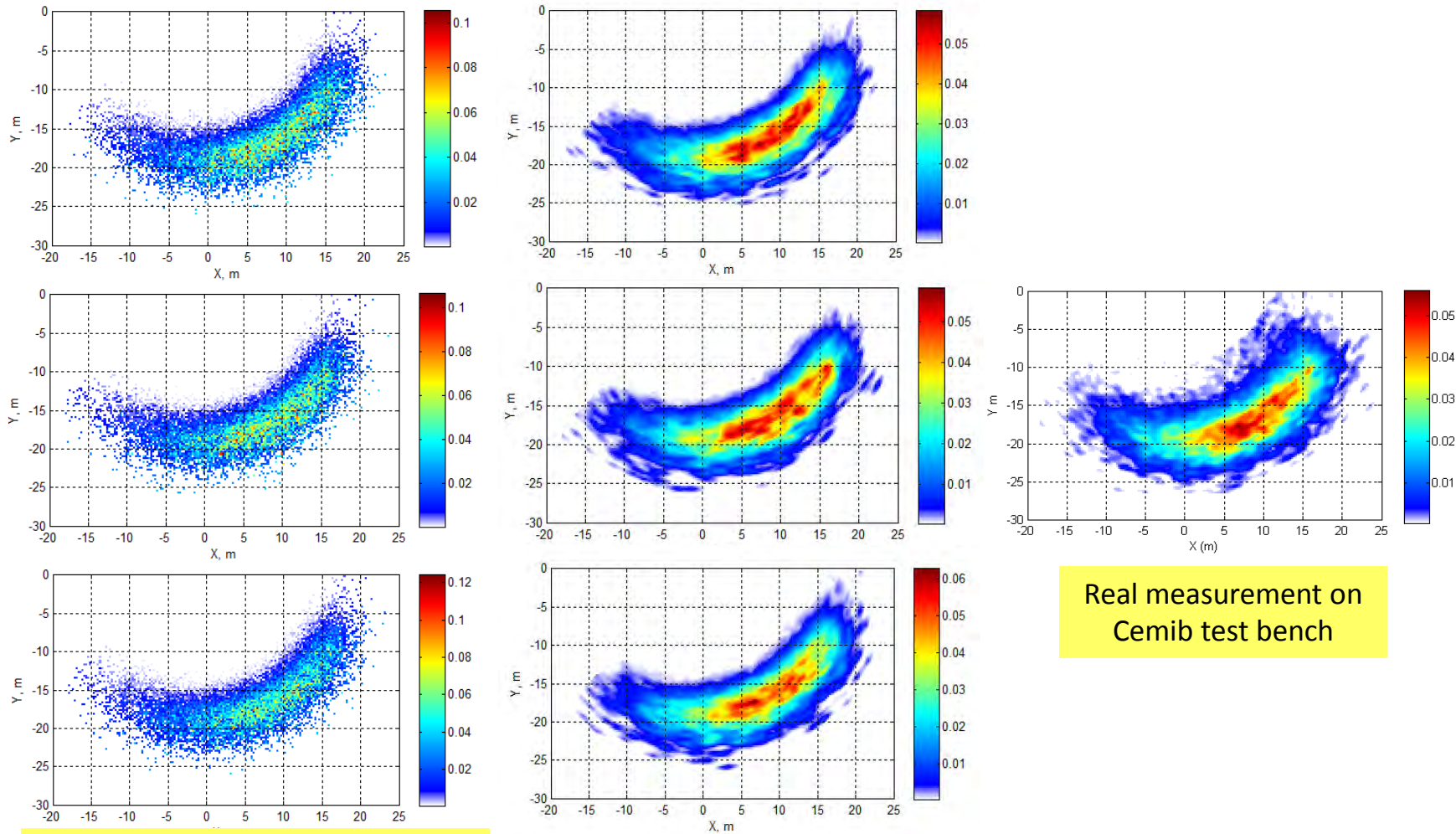


Adjust
Cx value
to fit

Final Cx obtained for CAN
 $Cx=0.47$

II. Simulation results

2.1. Simulated spread pattern vs Real spread pattern



**3 sets of obtained simulations by
random sampling
after model calibration
(Grid size map: 0.25x0.25m)**

**The 3 same sets after polar
interpolation
(Identical to CEMIB software)**

**Real measurement on
Cemib test bench**

II. Simulation results

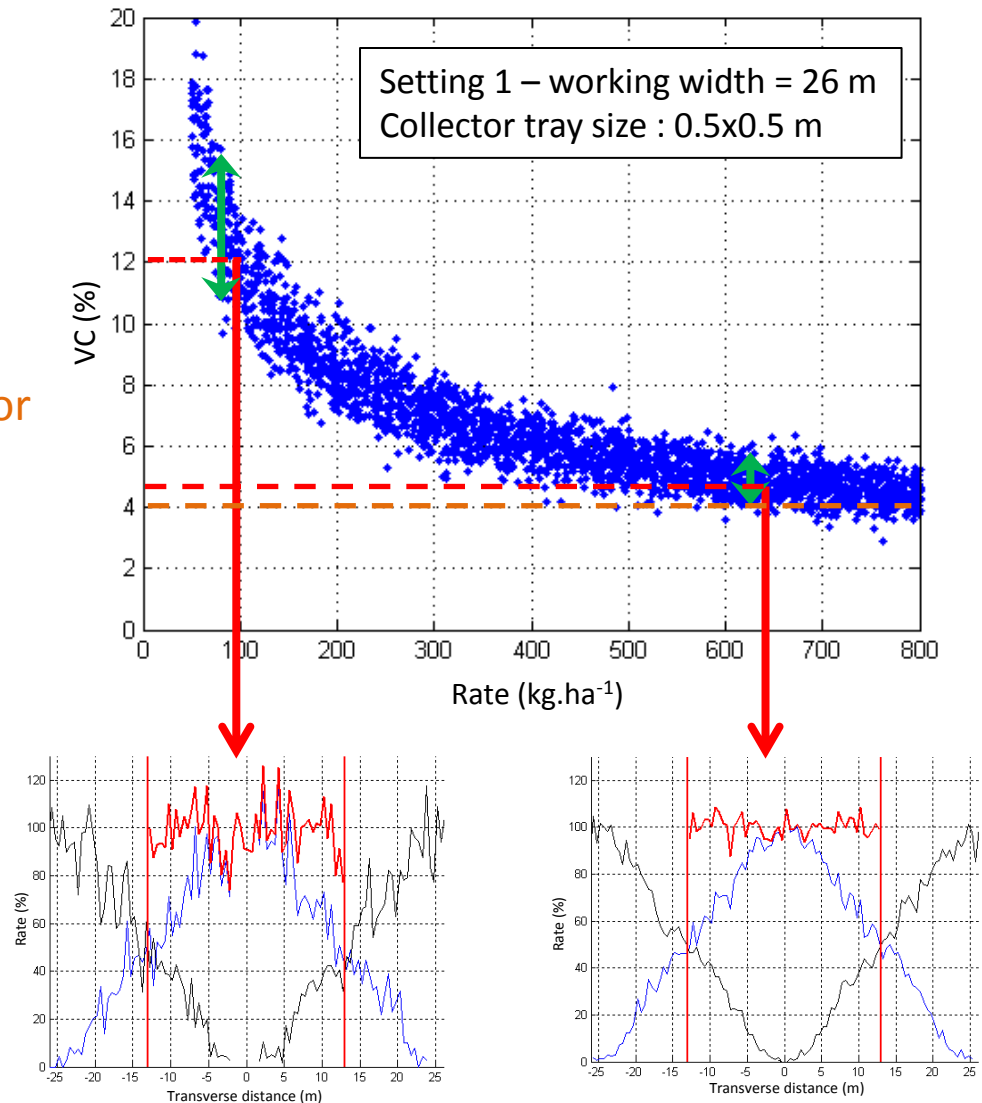
2.2. Rate influence on VC value

For a same working width setting:

- VC increases when the rate decreases
- VC variability increases when the rate decreases
- VC tends to an asymptotic value for high flow rate

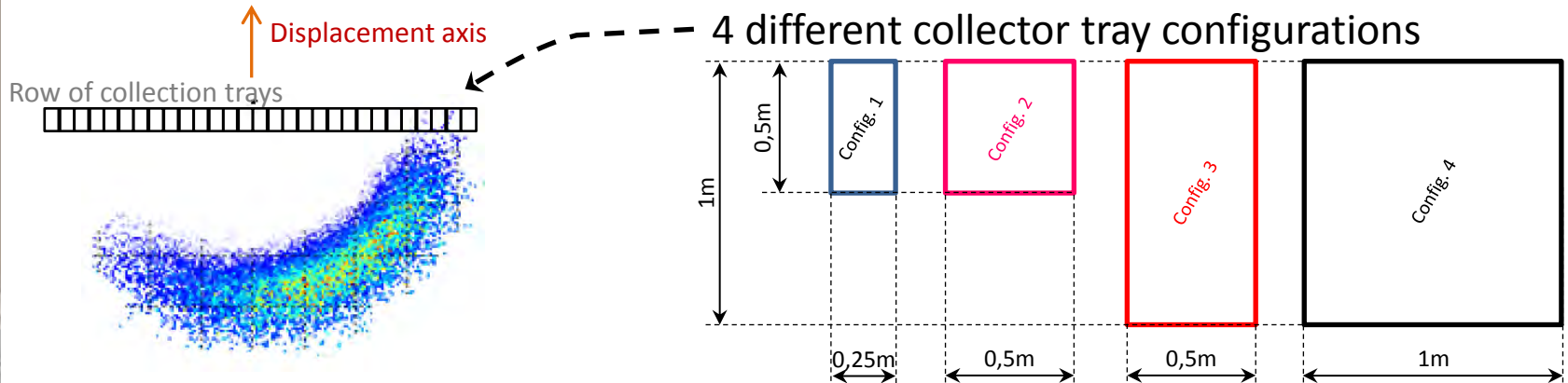
The VC Value depends on:

The global shape of the transverse distribution
+
A random component

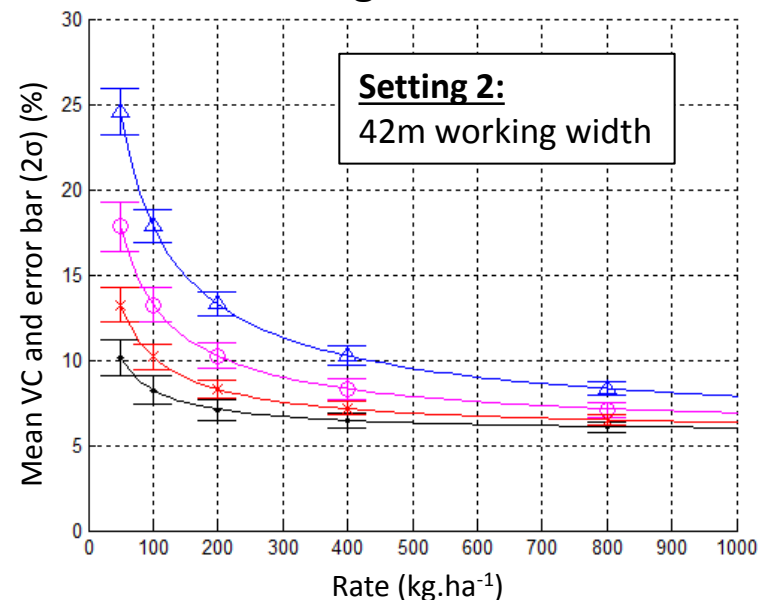
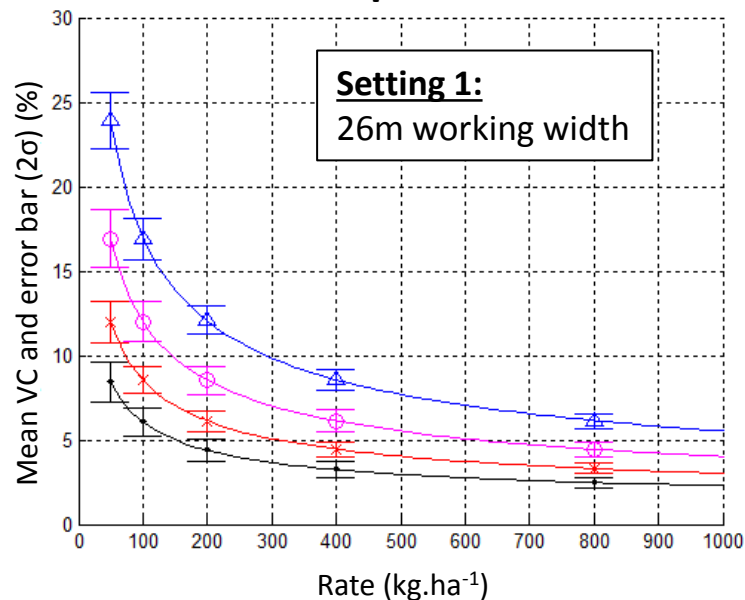


II. Simulation results

2.3. Influence of collector tray size on VC value



Graphs of VC curves for 2 different working widths



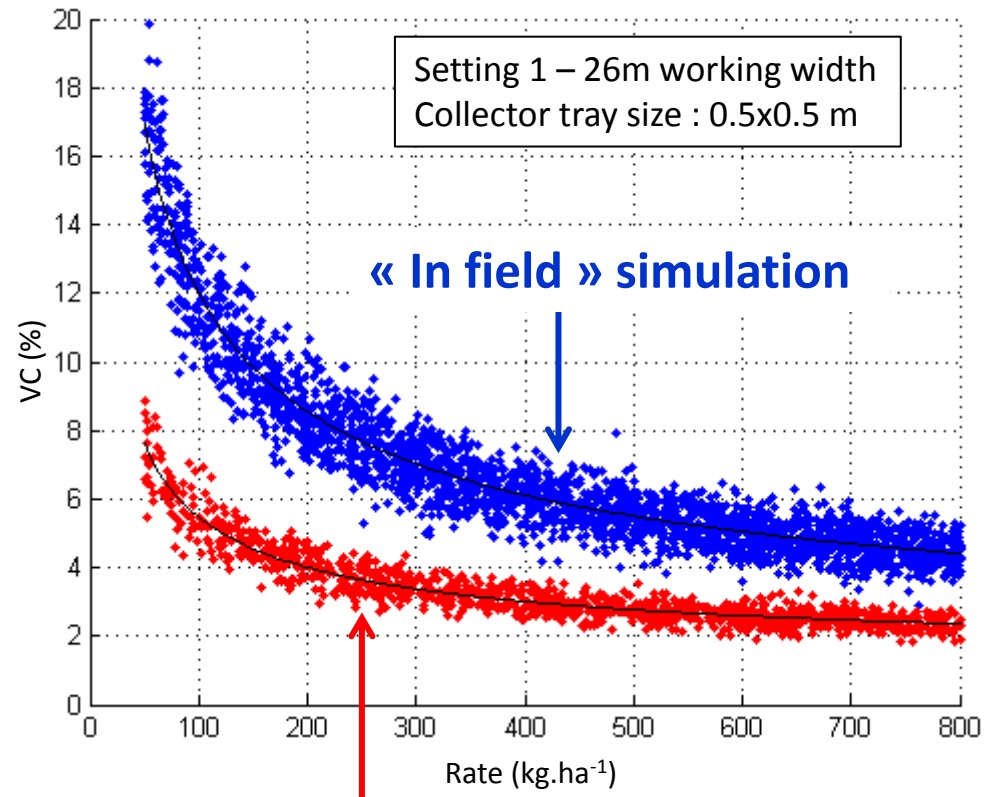
Collection tray size affect the VC value: bigger the tray area is, better the VC is, whatever the working width.

II. Simulation results

2.4. Rate influence on VC value

Comparison of VC obtained using different test protocols:

- **Standard EN 13739-2 simulation (Transverse mode):**
4km/h - 2 runs
- **In field simulation:**
10km/h - 1 run

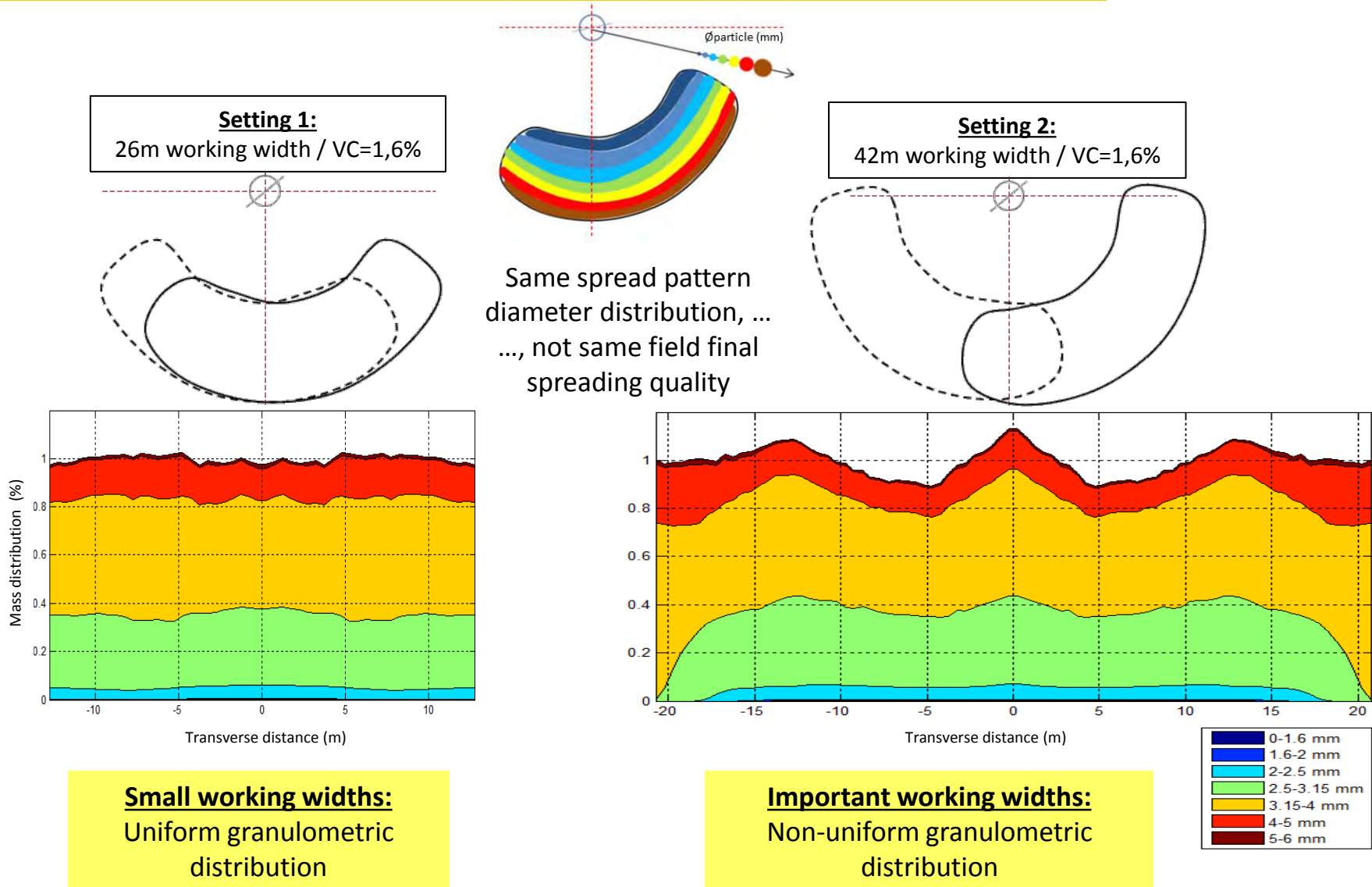


The test protocol affects the VC value

II. Simulation results

Example for Ammonium
nitrate spreading

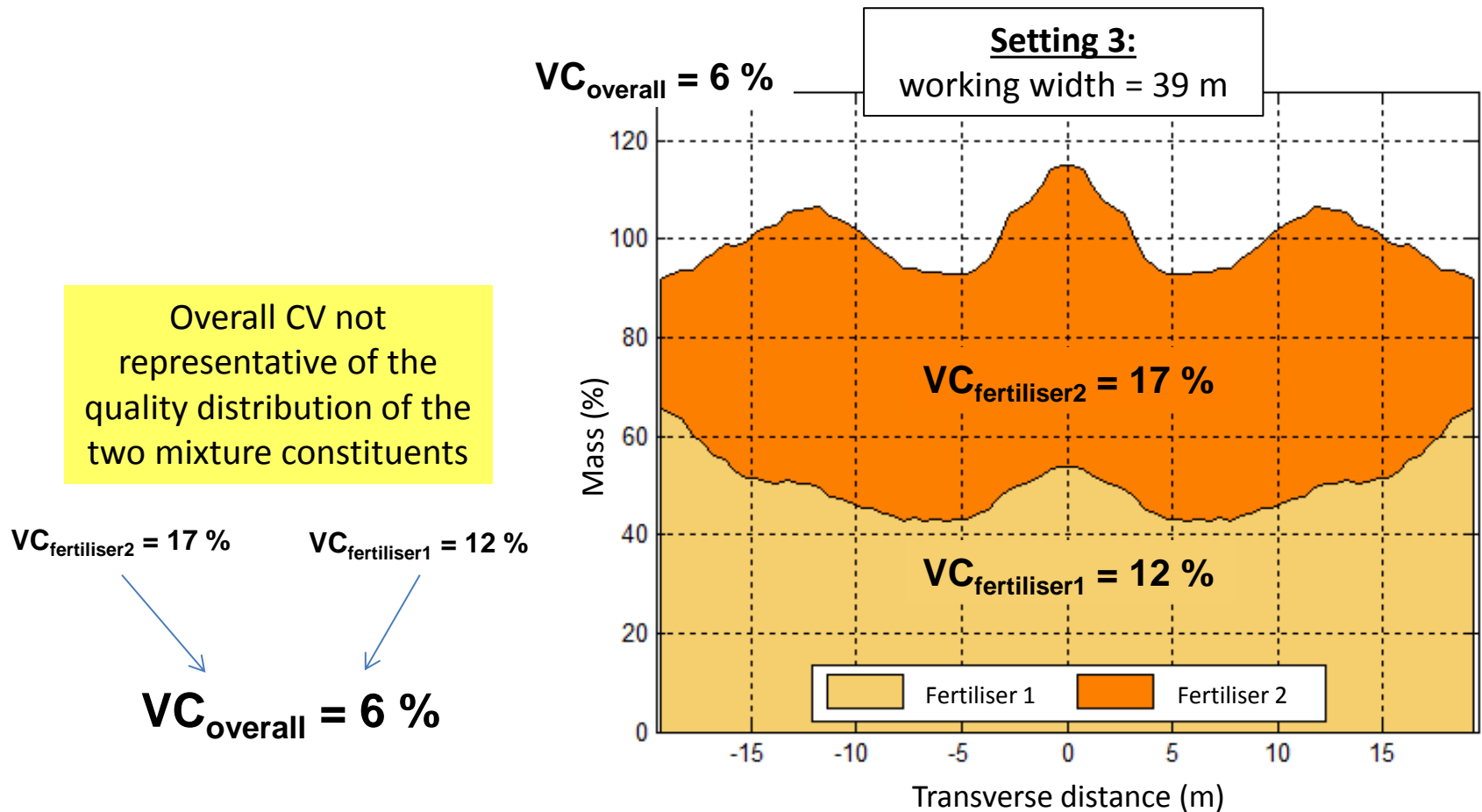
2.5. Ballistic segregation: the classical spreading case of one fertilizer



II. Simulation results

2.6. Ballistic segregation: the case of blended fertilisers

Example for mix of 2 fertilisers: $Cx_1 = 0,47$ et $Cx_2 = 0,60$



III. Conclusions and perspectives

○ Particularity of the model:

- Use of statistical distributions for all input parameters,
(particle characteristics, velocity, flow distribution)
- Use of the monte-carlo random selection,
 - *It allows to analyse phenomena which are difficult to study by traditional experiments.*
 - *It allows to study rate effect on VC value, particle size effect on VC, blended fertilisers effects,...etc (removes also unwanted effects).*
- Allows comparison of different test protocols.

○ Perspectives:

- Establish rules to convert VC values when measured using different protocols
- Could be coupled with **soil-plant transfer models** to monitor the spatial variability of fertilisers in the soil.

THANKS FOR YOUR ATTENTION