

# IDEFICS

**a physical model of spray drift  
from boom sprayers in agriculture**

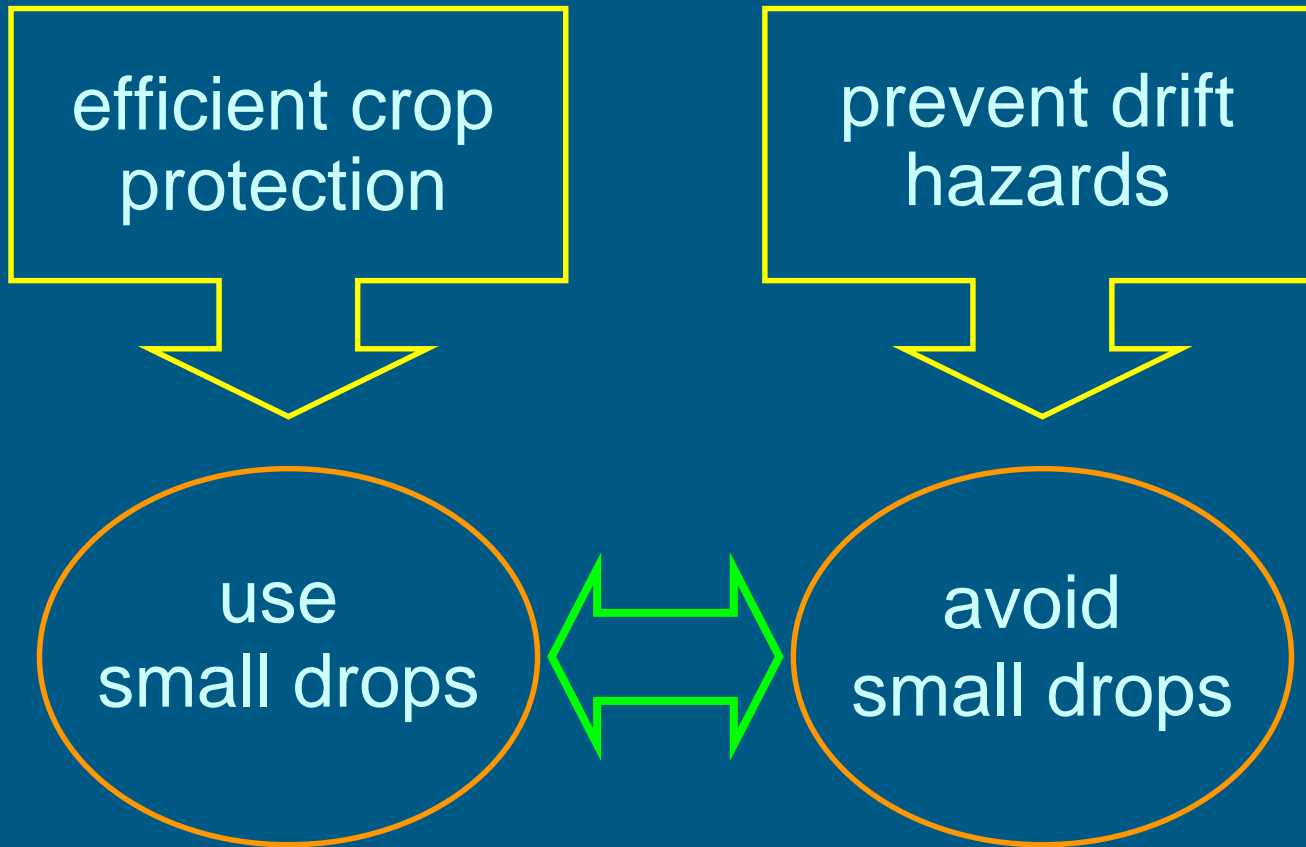
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# Contents

- crop protection
- spray drift model
- calibration
- examples
- conclusion

# Basic dilemma



# Quantifying spray drift

## experimental

- + straightforward
- + direct use for regulations
- laborious
- expensive

## computational

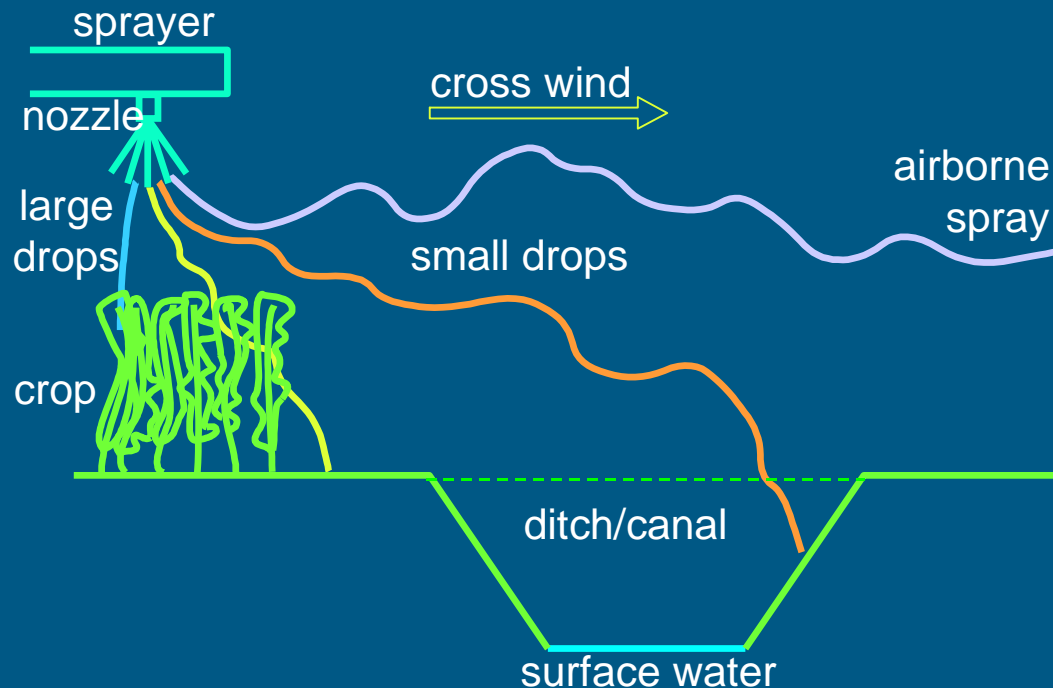
- + time-saving
- + cheap
- + throughout the year
- verification required

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**I** IMAG program for  
**D** drift  
**E** evaluation for  
**Fi** field sprayers by  
**C** computer  
**S** simulation

# IDEFICS model setup



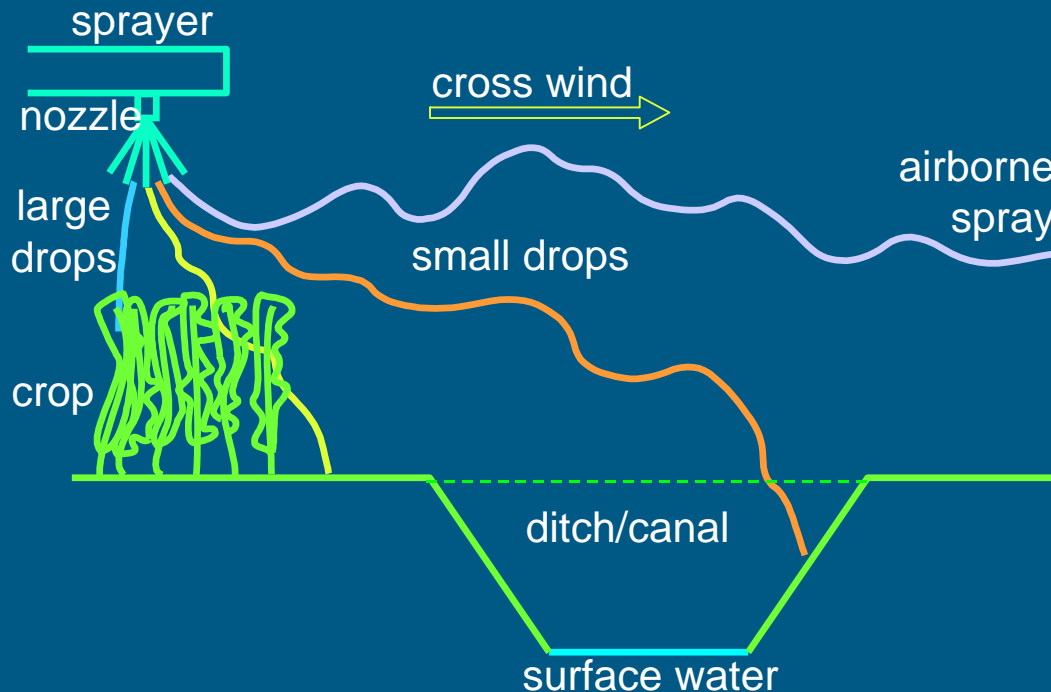
## Features:

- ballistic model (mixed 2D/3D)
- conventional boom sprayer
- cross wind

## Results:

- downwind spray deposits
- airborne spray distribution

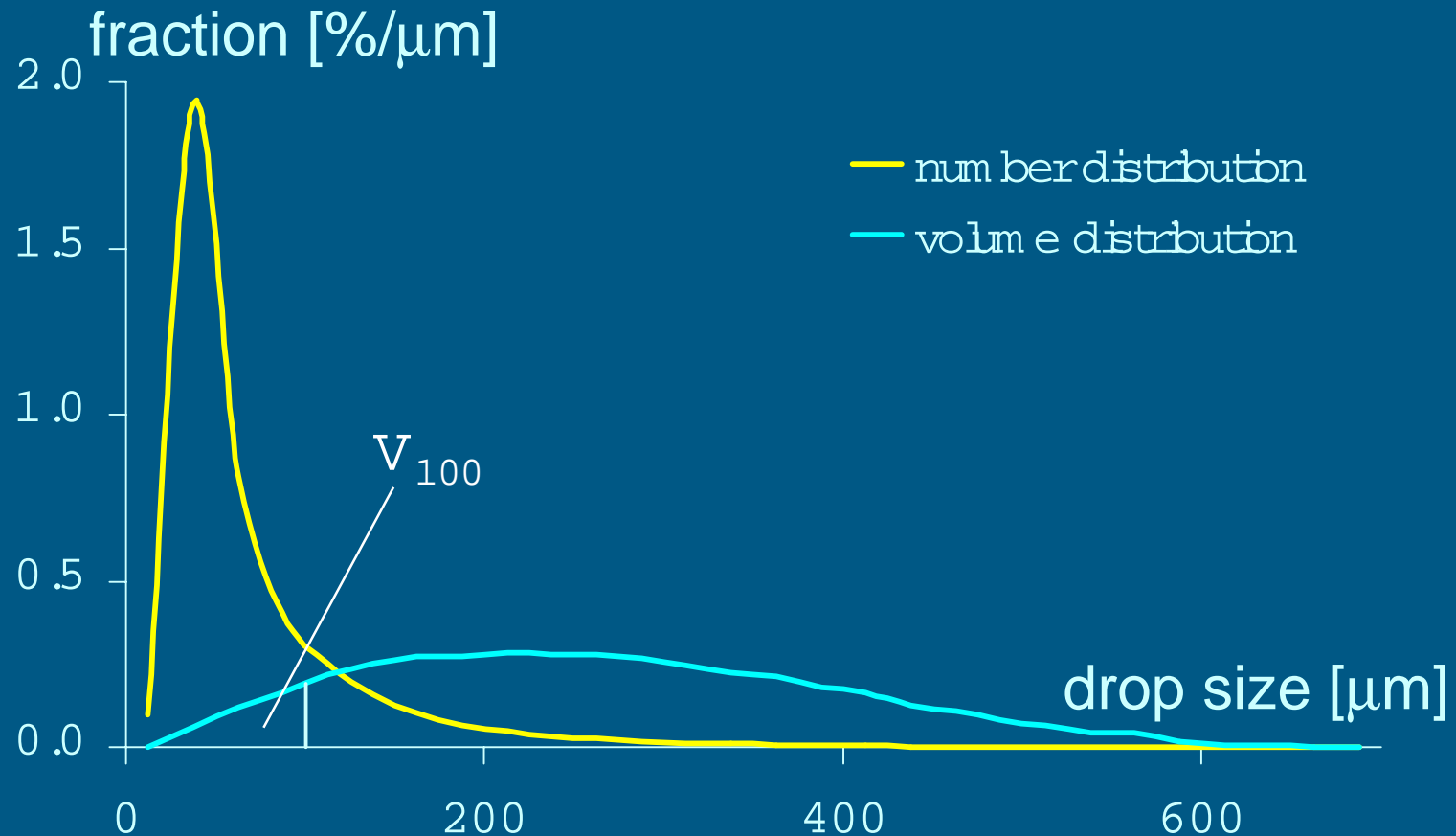
# Essential parameters



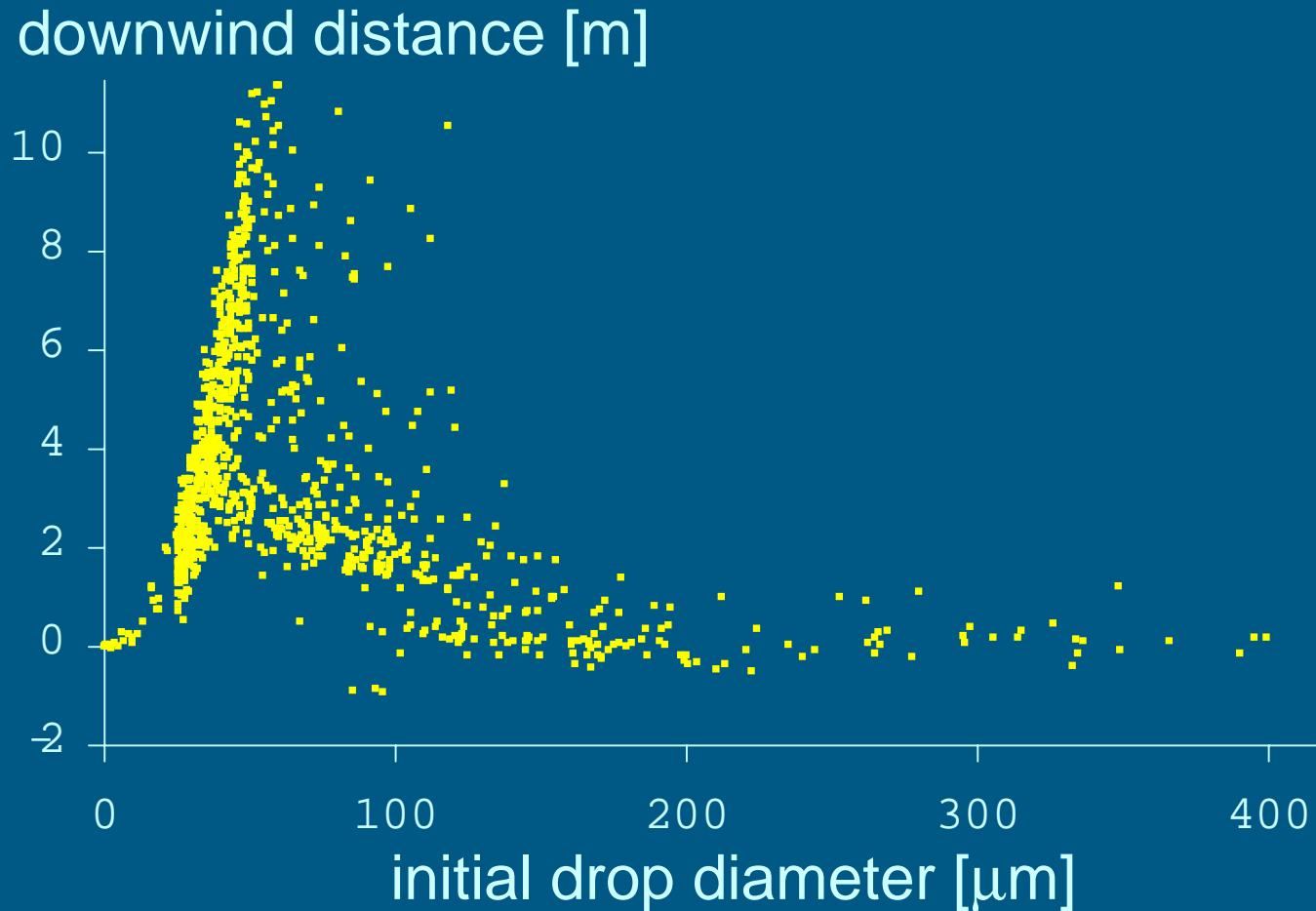
- **field related**
  - crop height
  - ditch geometry
- **sprayer related**
  - height above crop
  - spray-free zone
  - nozzle selection
  - operational settings
- **environmental**
  - wind velocity
  - turbulence
  - temperature
  - humidity



# Drop size distribution (PDA) flat fan nozzle XR11004 @ 300kPa



# Droplet diameter and distance of drift simulation



# Mathematics

- Newton's second law of mechanics

$$\mathbf{F} = m \mathbf{a}$$

*gravity* and *drag* force

- stepwise integrations

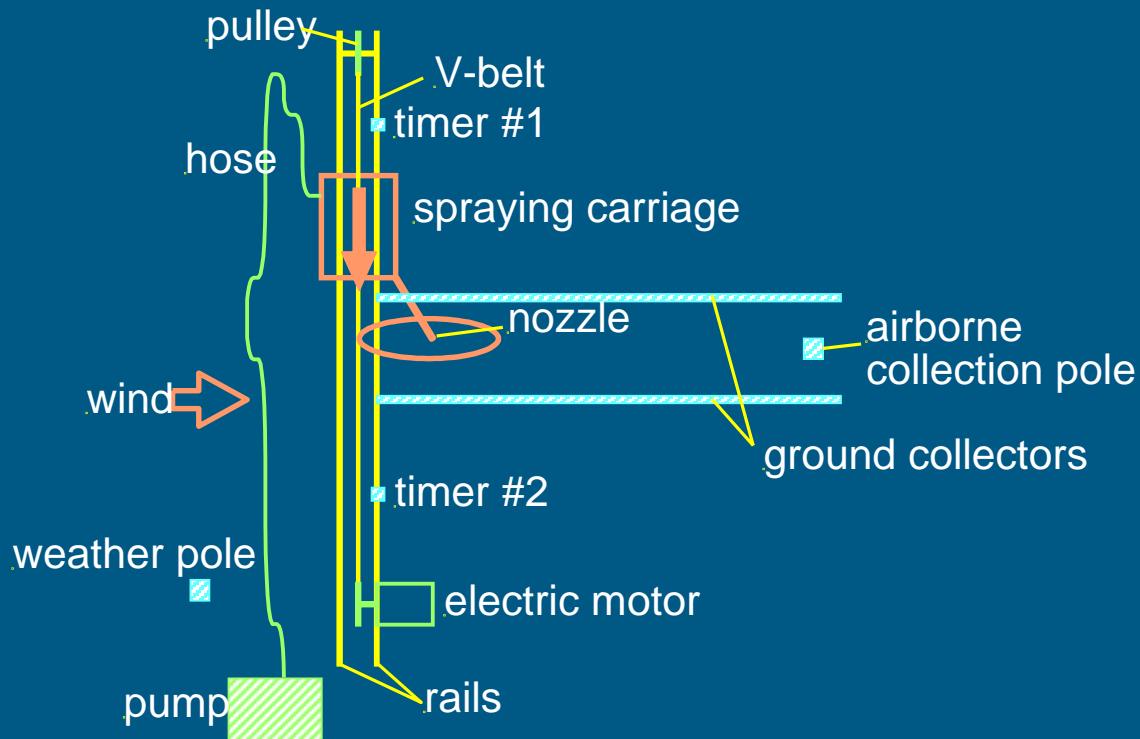
$$\mathbf{a} \rightarrow \mathbf{v} \rightarrow \mathbf{x}$$

- *time step* depends on rate of change of integration parameters

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# Calibration experiments



## Set-up

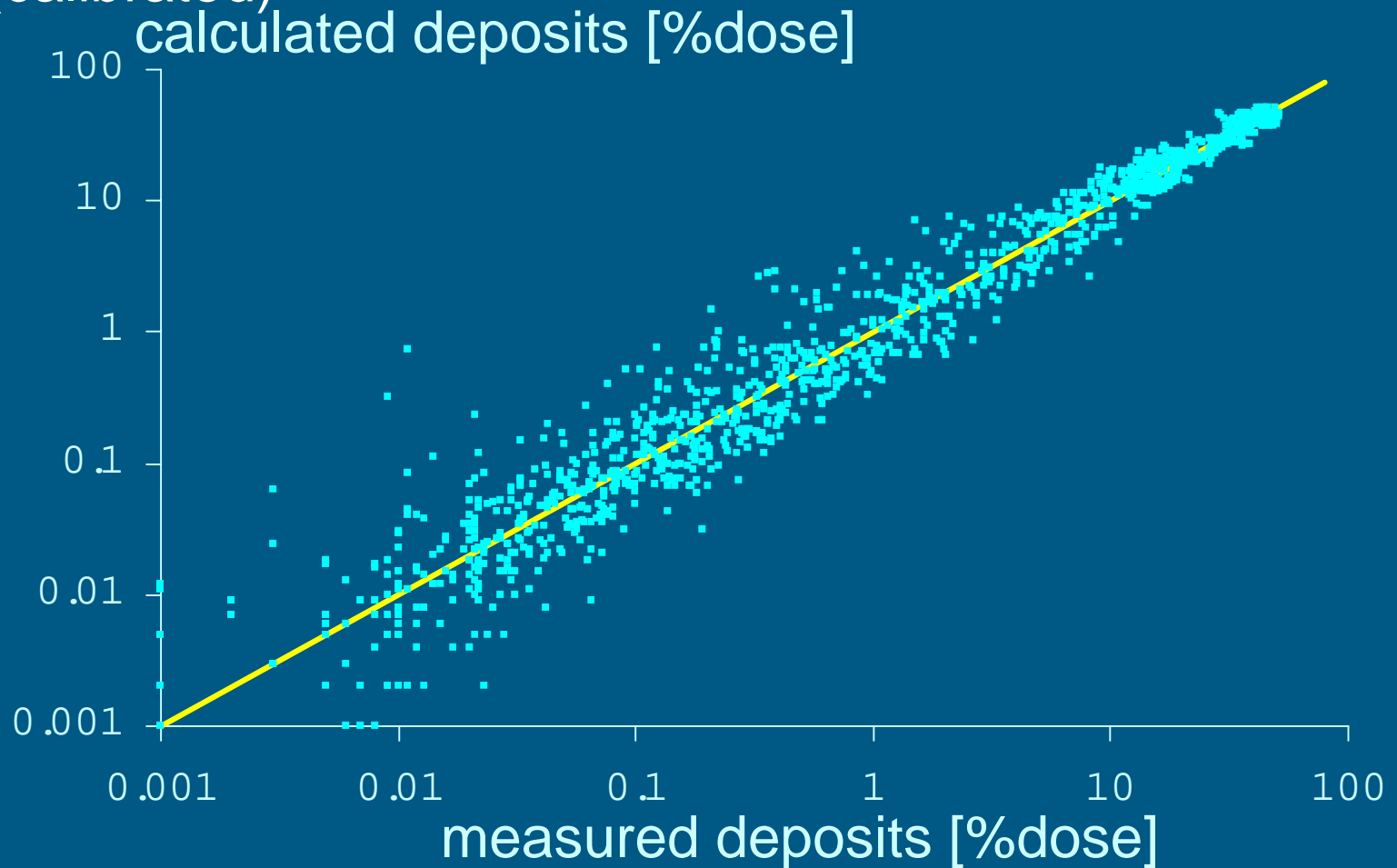
- single-nozzle sprayer
- cross wind
- cut grass

## Variables

- height of sprayer boom
- nozzle type
- liquid pressure
- driving speed
- environmental parameters

# Calibration

comparison of experiments and simulations  
(calibrated)

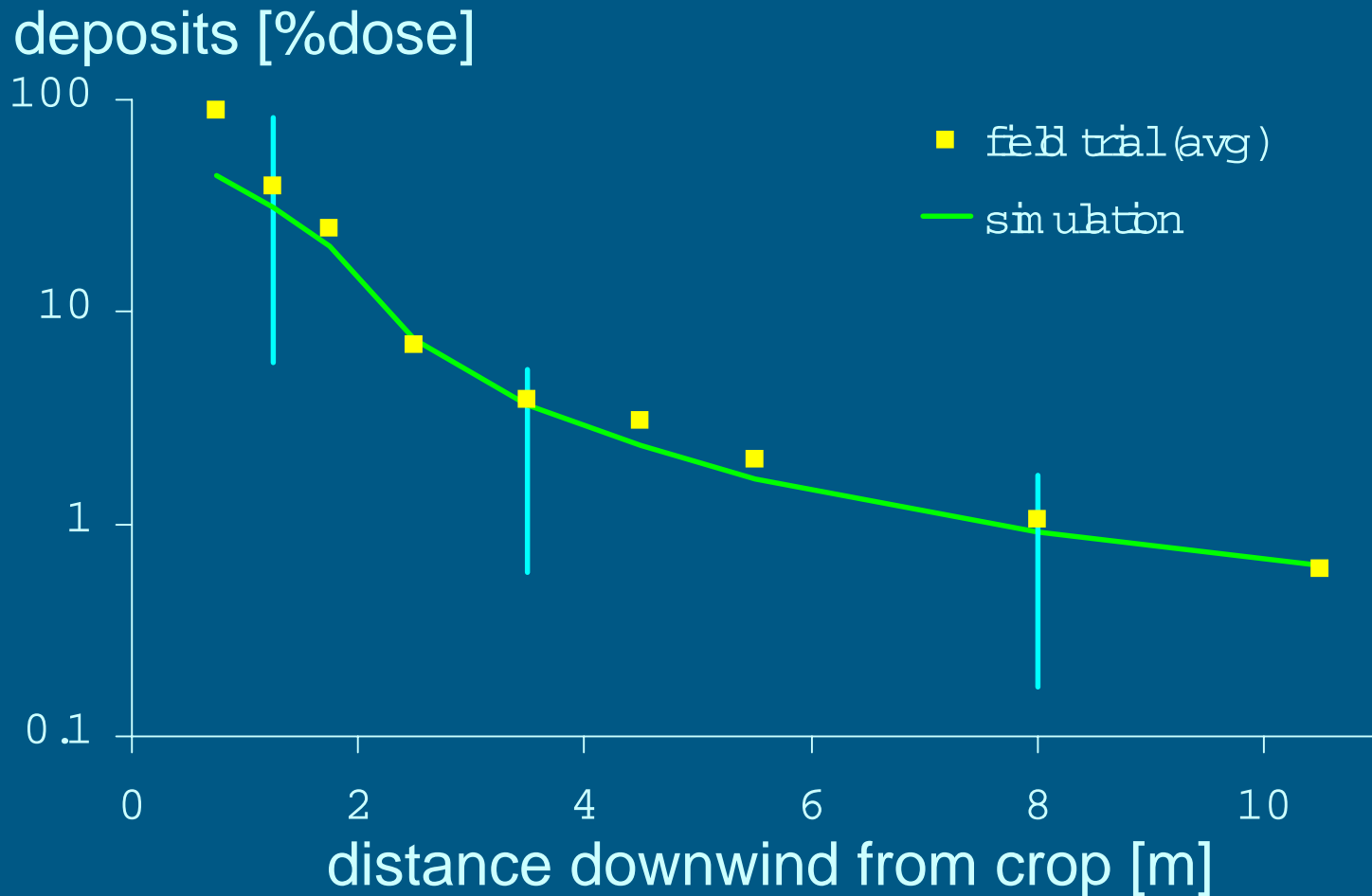


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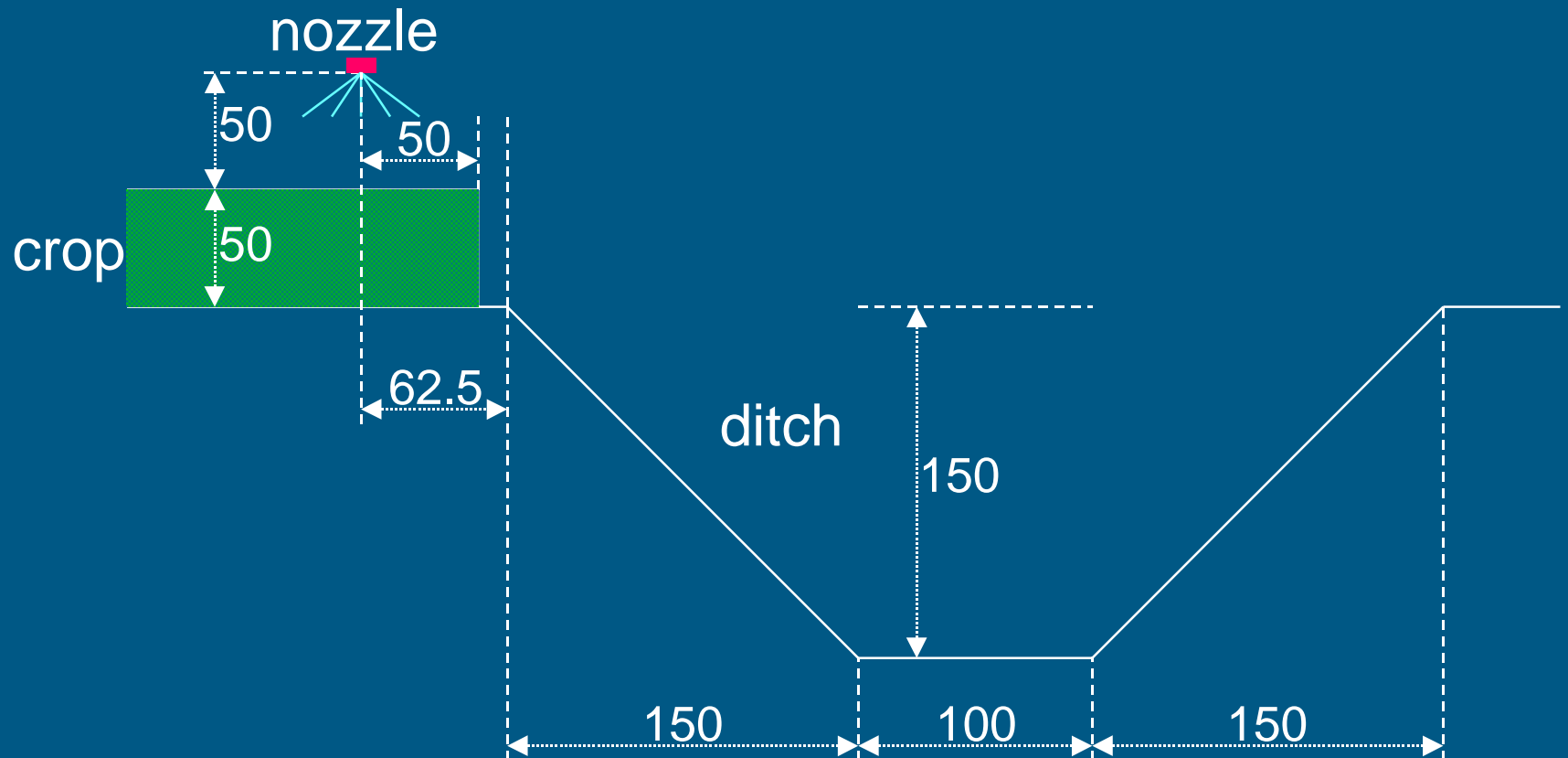
# Downwind ground deposits

## field experiments and simulation





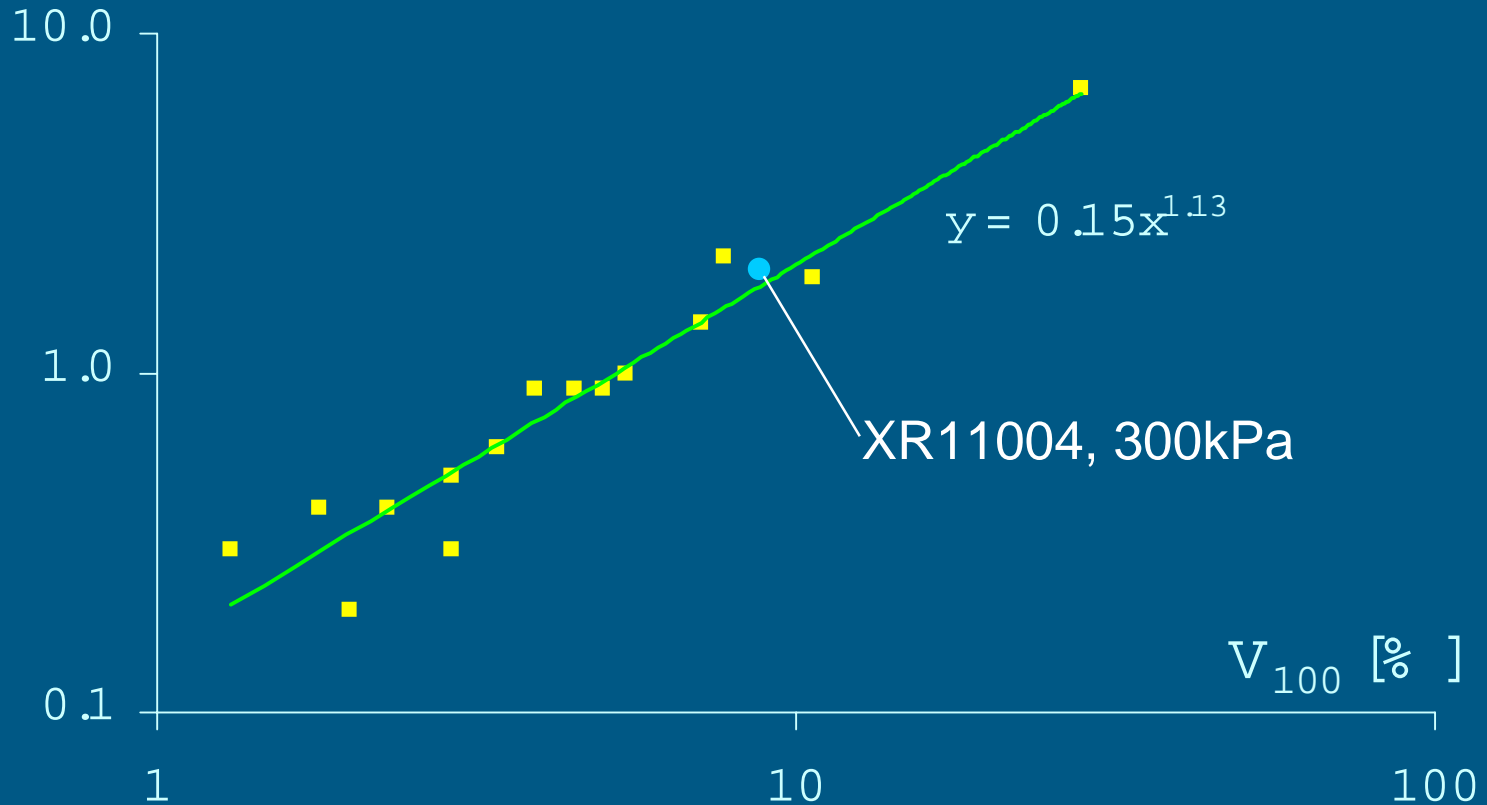
# Reference setup for classification standardized potato crop



Surface water at 2.125-3.125 m downwind from last nozzle

# Spray drift to surface water reference setup; various nozzles

drift (simulation) [%dose]



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# Conclusion

## IDEFICS drift model:

- can simulate spray drift from conventional boom sprayers
- is useful tool for drift hazard assessment
- is useful tool for nozzle classification based on drift hazard

## Developments:

- extension for other nozzle types
- extension for air-assistant devices
- focus on airborne drift and evaporated drops