CHAIRE AgroTIC

LE NUMÉRIQUE AU SERVICE DE LA RÉDUCTION DES INTRANTS

Le 03 décembre 2019

De la modélisation des techniques aux OAD, l'apport du numérique pour optimiser la pulvérisation des produits phytosanitaires.

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irstea

Plan

1- Détection et caractérisation des maladies et du végétal

2- OAD, IPM et gestion des doses

3- Modélisation applications et gestion des impacts

La généricité des approches est limitée :

Adventices/Insectes/Pathogènes

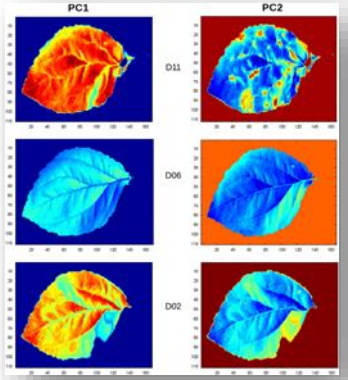
Verrous

- La force intrinsèque de l'idée vraie…
- Lien entre dose émise, dose reçue et efficacité biologique
- Gestion du risque et acceptation

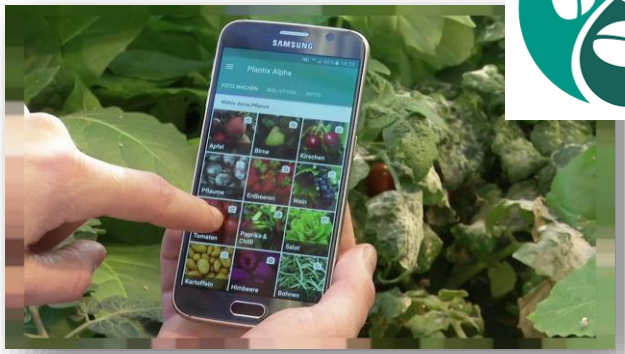
1- Détection et caractérisation

De la détection de mauvaises herbes à la reconnaissance de maladies

Vioix et al., 2004. J. of Electronic Imaging, 13(3). https://doi.org/10.1117/1.1760756



M. Nouri et al., (2017). Data in Brief. 16. 10.1016/j.dib.2017.12.043.

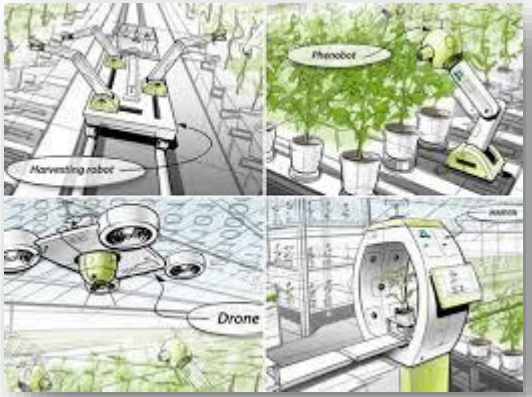


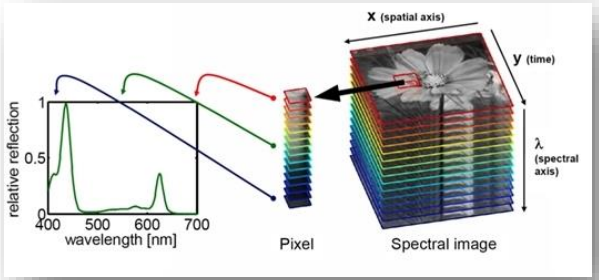
1- Détection et caractérisation

- Information multispectrale
- Reconnaissance, attributs

et apprentissage (phénotypage)

- Traitement de données





OPTIMA

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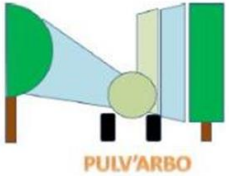
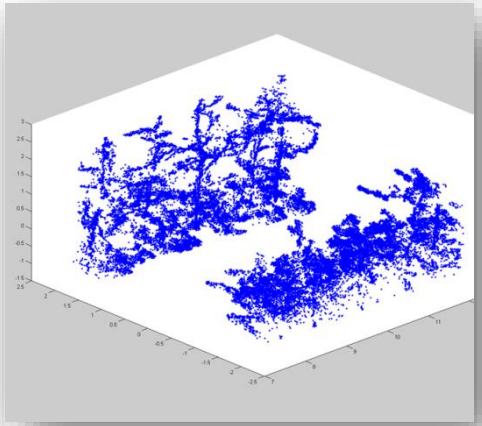
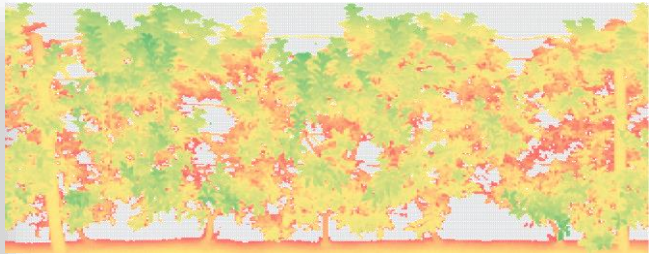
1- Détection et caractérisation

- Phénotypage physique (Lidar 2D) des cultures





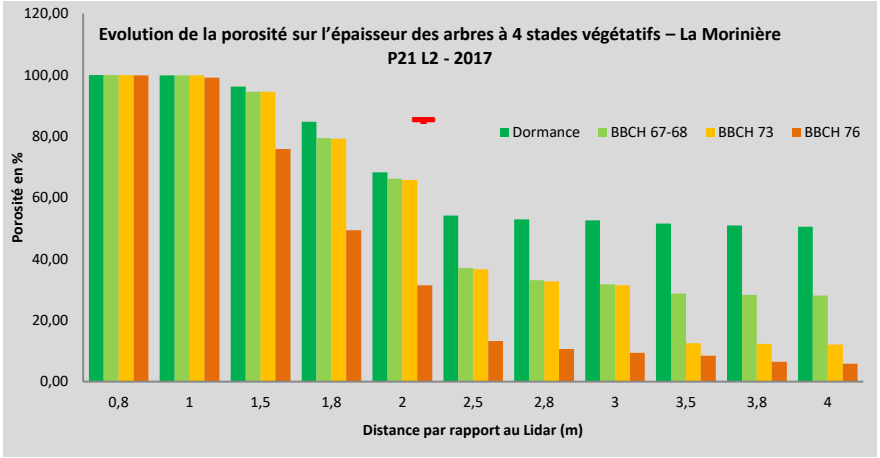


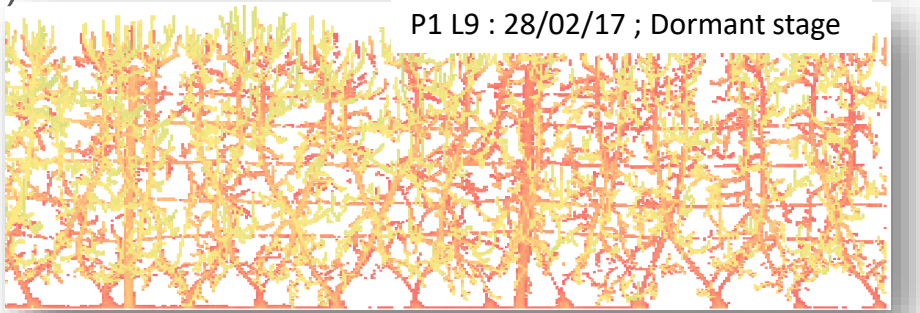
Douzals et al., 2019, Suprofruit Proceedings

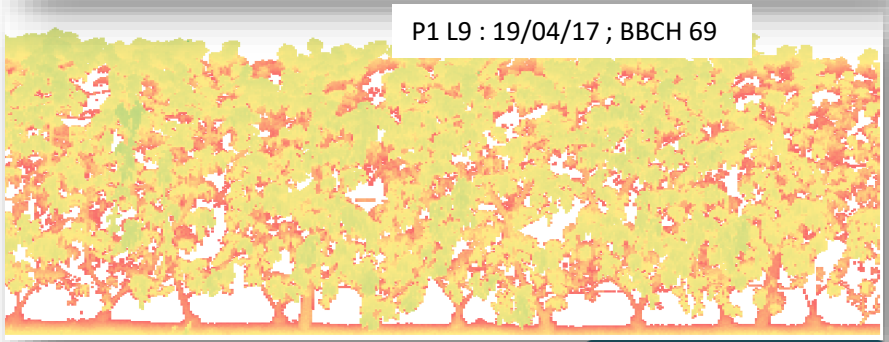
Evaluation surface foliaire et porosité

1- Détection et caractérisation

Phénotypage physique (Lidar 2D) des cultures







2- OAD, IPM et gestion des doses

- Stratégiques (durée/fréquence) ou tactiques (ponctuelles)
- Prédiction du risque épidémiologique
  - Épidémiologie
  - Météo
  - Témoins régionaux
- Compensation des traitements précédents

230 enregistrements Fruits https://data.opendatasoft.com/explore/dataset/oad-gis-fruits%40api-agro/table/?flg=fr&disjunctive.concepteur_fournisseur

2- OAD, IPM et gestion des doses

Ex: POD Mildium® INRA-IRSTEA
Observations Parcelle – Région - Météo

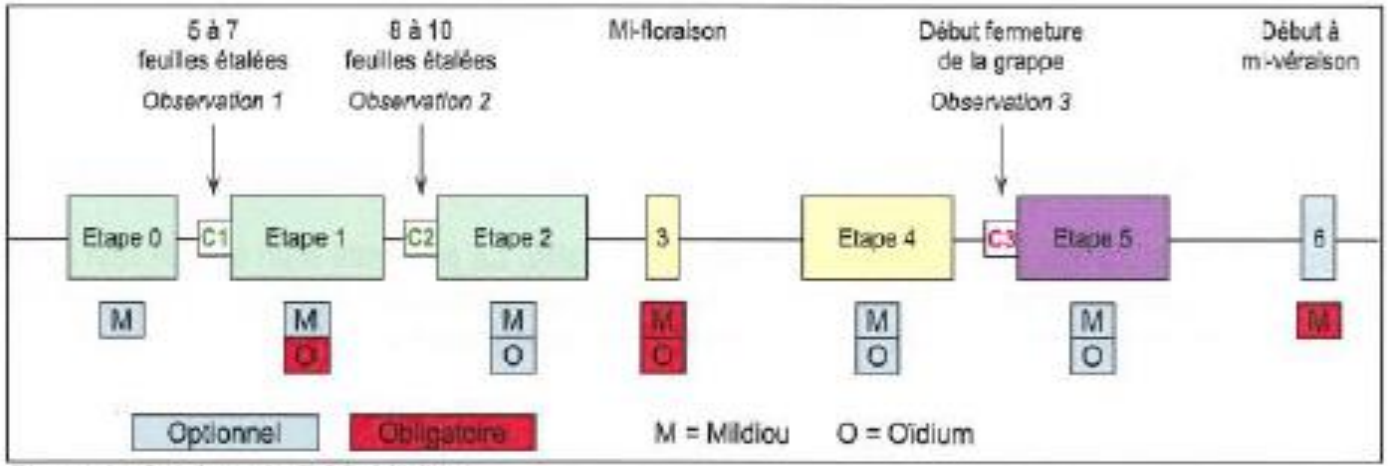


Figure 1 : Schéma du POD Mildium

2- OAD, IPM et gestion des doses

Ex: OPTIMA IPM

PTIMA
Redefining Pest Management - a Holistic Approach

PTimised Integrated Pest MAnagement

for precise detection and control of plant diseases in perennial crops and open-field vegetables

1 Optimise early disease detection method and disease prediction models

2 Screen and evaluate, first in lab then in field, biological and synthetic PPPs for maximal disease control

3 Implement new precision spraying technologies on smart sprayer prototypes

4 Create a DSS for supporting the operator in selecting appropriate time, PPP type and sprayer settings for each application

- Date of treatment • Type of PPP
- Volume application rate (L/ha) • Droplet size (fine, medium, coarse)
- Number of active nozzles • Air flow rate • Etc.

5 Evaluation of new IPM elements in the field

6 Assess health, environmental and socioeconomic impacts of the proposed IPM system

2- OAD, IPM et gestion des doses

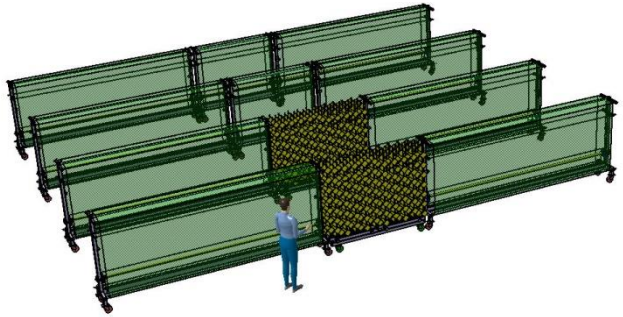
Gestion des doses vs mode d'expression

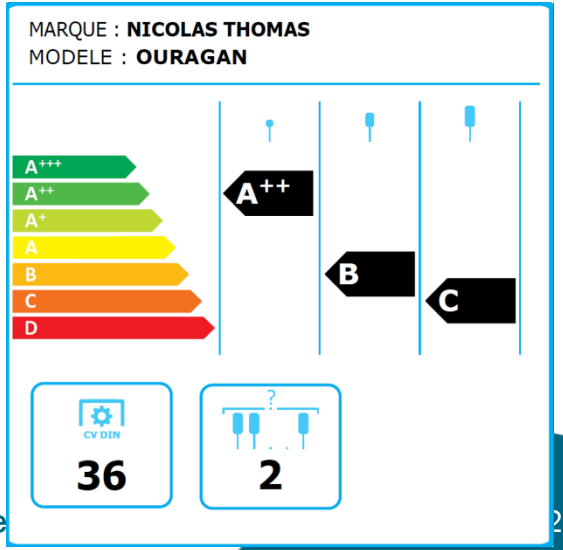
Dose fixe l/ha (FR)
Concentration (ES, IT)
Dose variable (DE, CH)

3- Modélisation applications et gestion des impacts

Modéliser les dépôts - prédire les dépôts

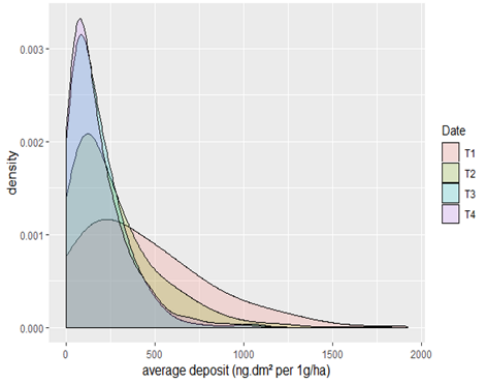
indicateurs physiques d’efficacité

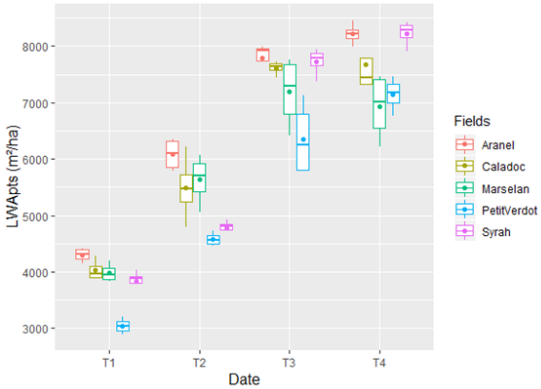


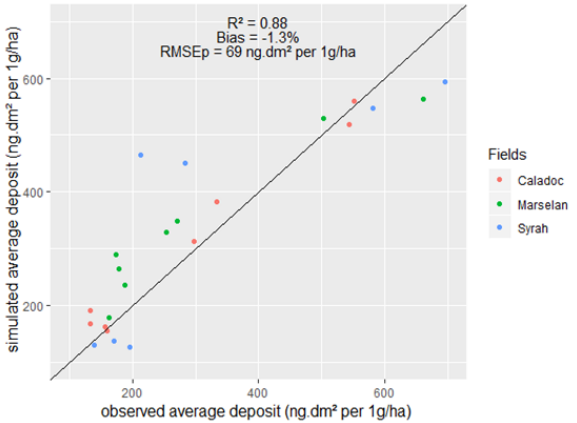


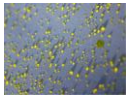
Axe 3: Modélisation applications et gestion des impacts

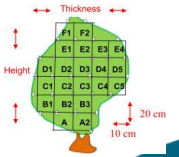
- Gestion de dose variable vs cartes de préconisation







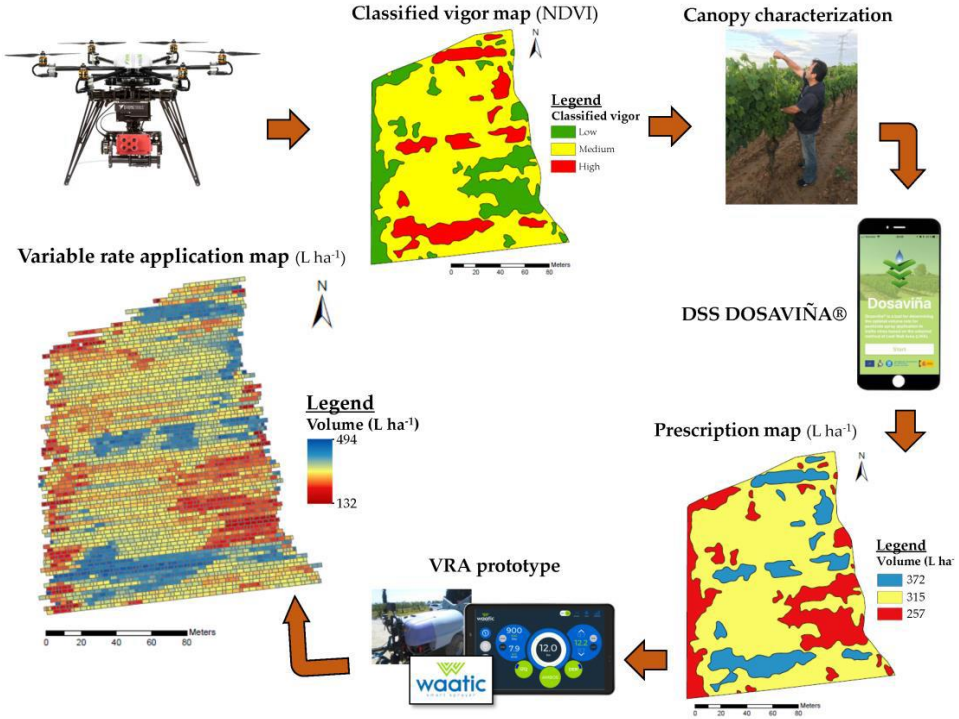




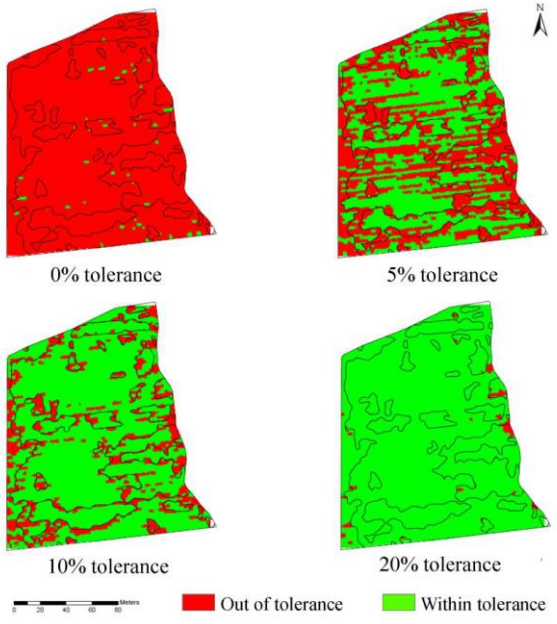
Cheraiet et al., 2019 ECPA Proceedings

Axe 3: Modélisation applications et gestion des impacts

Cartes de préconisation

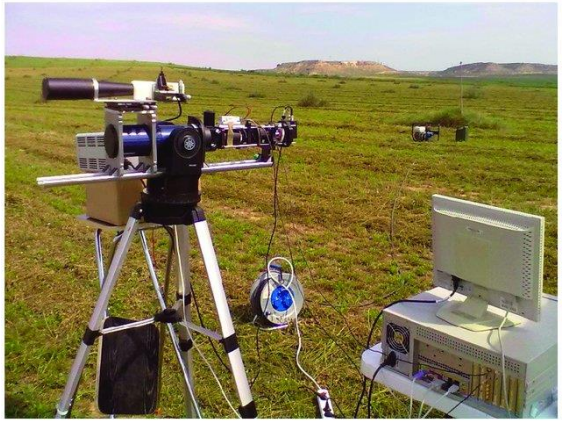


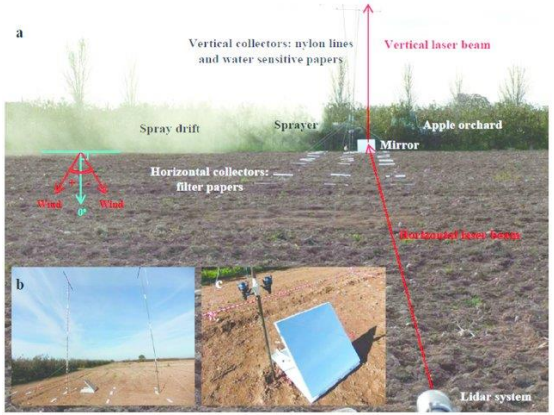
Campos, J. et al., Preprints 2019, (doi:10.20944/preprints201911.0306.v1).

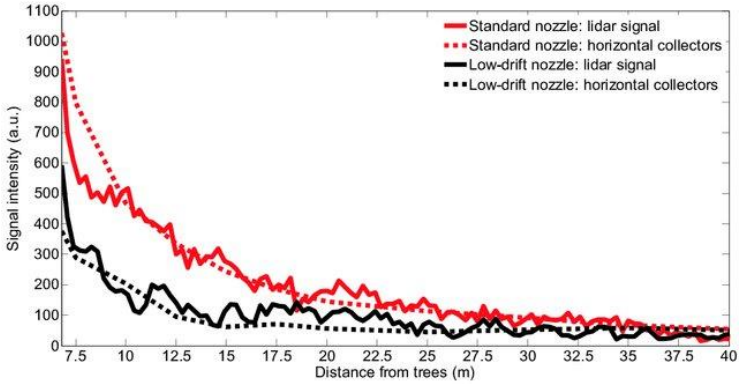


Axe 3: Modélisation applications et gestion des impacts

Evaluation de la dérive de pulvérisation par LiDAR atmosphérique





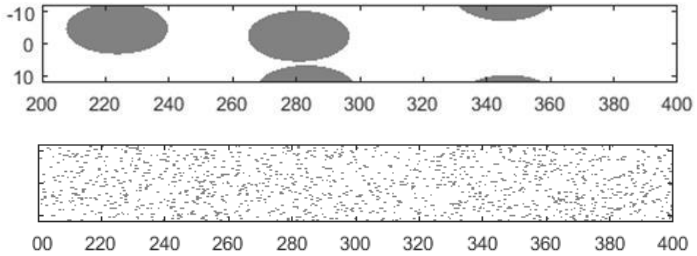


Gregorio et al., 2016. Sensors.

Axe 3: Modélisation applications et gestion des impacts: Application au désherbage localisé

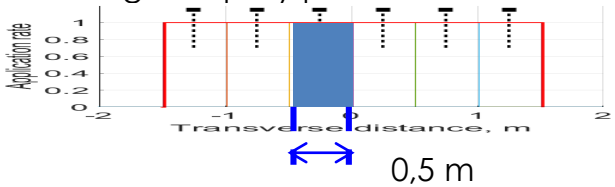
Simulation de désherbage localisé

- Taille des infestations
- Densité d'infestation
- Nombre de sections indépendantes
- Type de spray



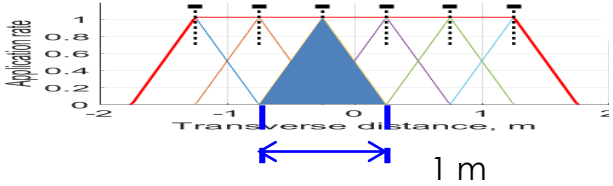
3 nozzle spray patterns

Rectangular spray pattern



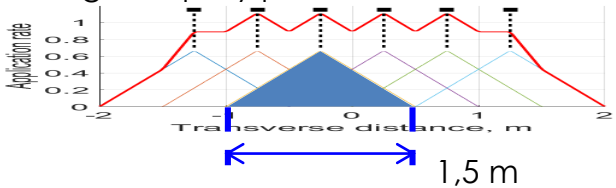
perfect even spray nozzle distribution

Triangular spray pattern



- flat fan spray of a reduced top angle nozzl of 80° to 90°

Triangular spray pattern



- a flat fan spray of a nozzle top angle of 110° to 120°

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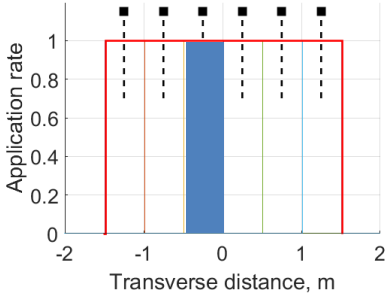
VILLETTE S. MAILLOT T., DOUZALS JP., 2019. *Herbicide site-specific spraying: use of simulations to study the impact of section width,*

Simulation examples

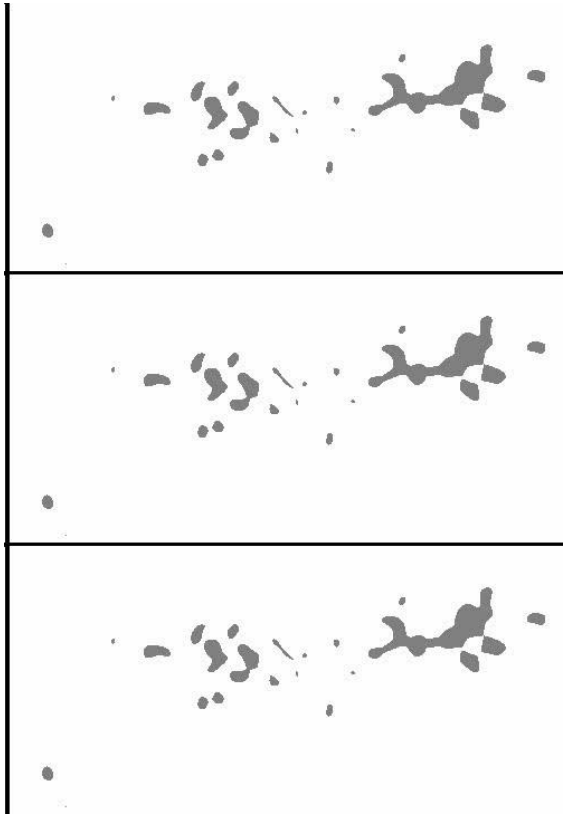
Rectangular spray pattern (0,5 m width)

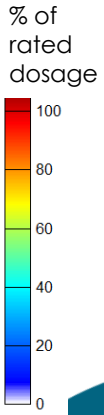


2 x 12 nozzles

4 x 6 nozzles

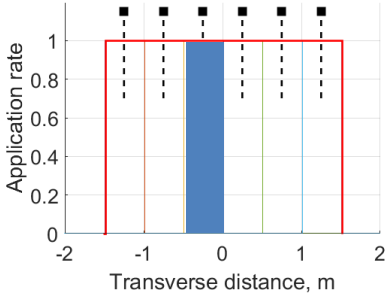
Individual nozzles





Simulation examples

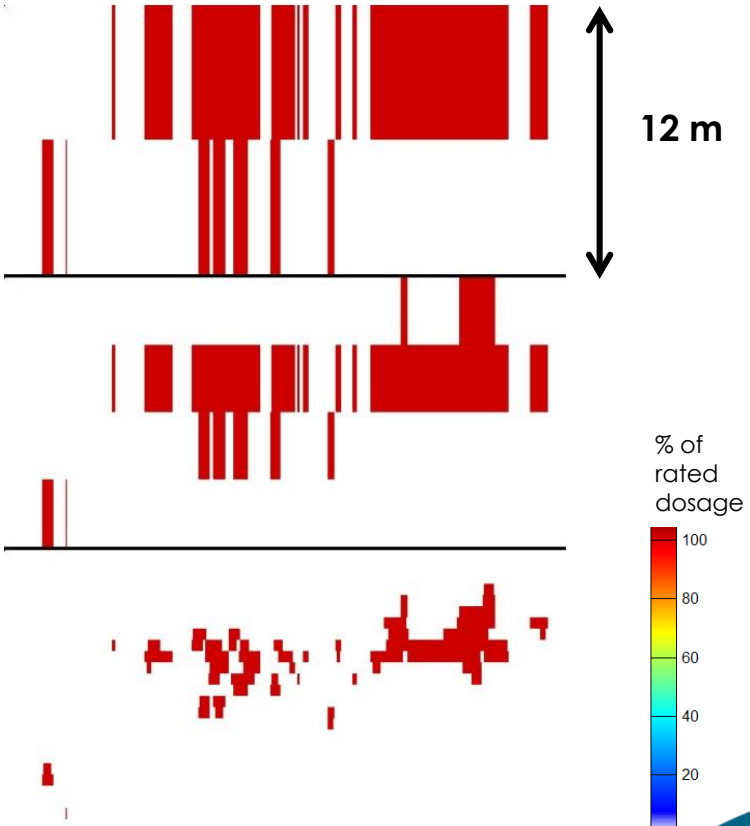
Rectangular spray pattern (0,5 m width)



2 x 12 nozzles

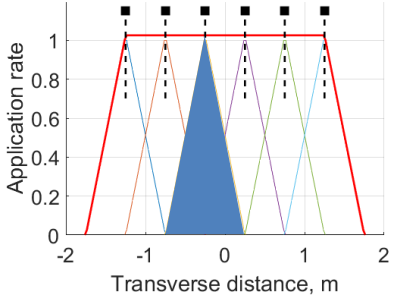
4 x 6 nozzles

Individual nozzles



Simulation examples

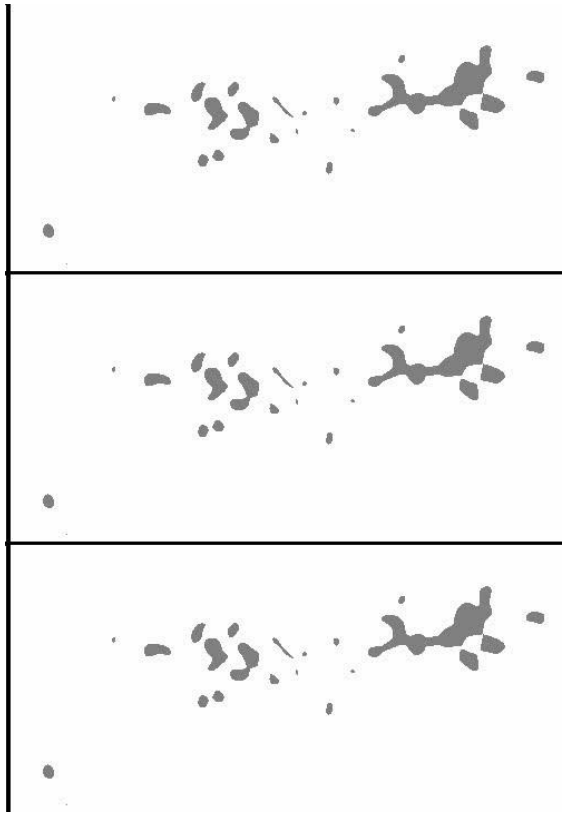
Triangular spray pattern (1 m width)

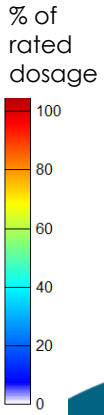


2 x 12 nozzles

4 x 6 nozzles

Individual nozzles





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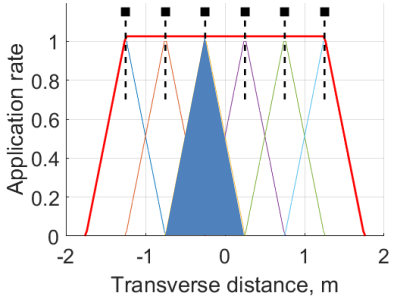
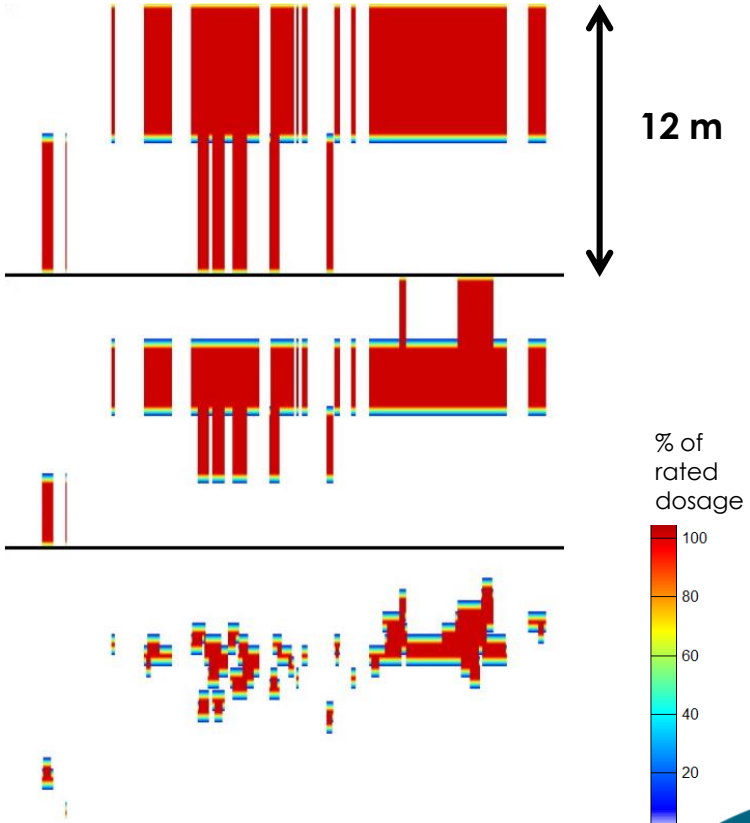
Triangular spray pattern (1 m width)



2 x 12 nozzles

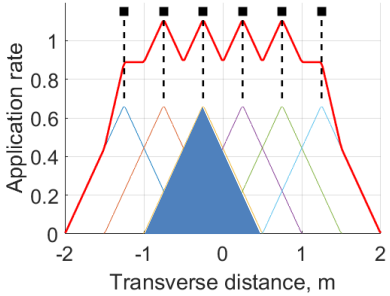
4 x 6 nozzles

Individual nozzles



Simulation examples

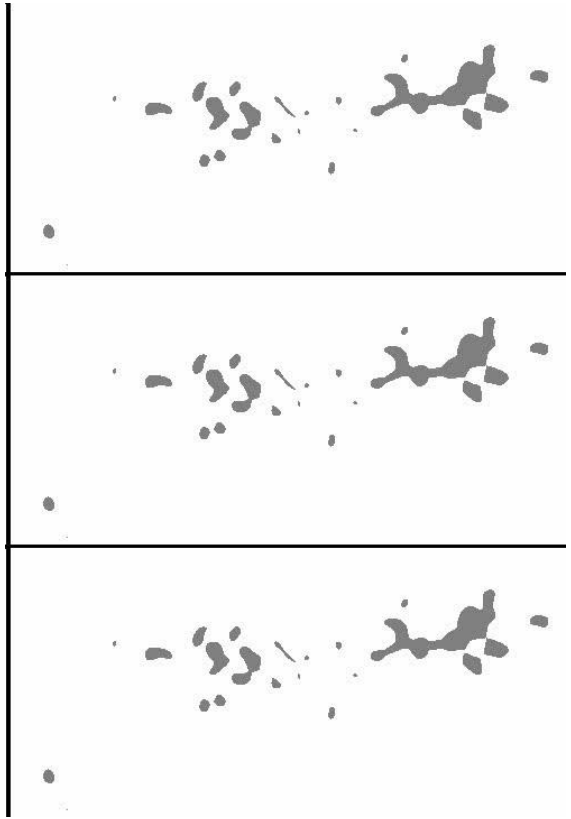
Triangular spray pattern (1,5 m width)

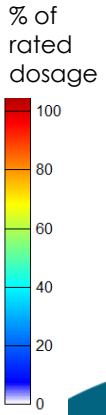


2 x 12 nozzles

4 x 6 nozzles

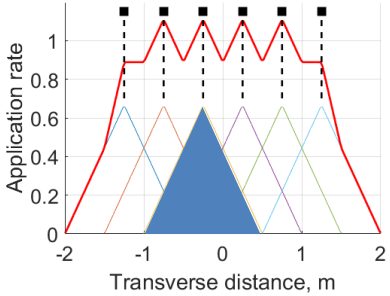
Individual nozzles





Simulation examples

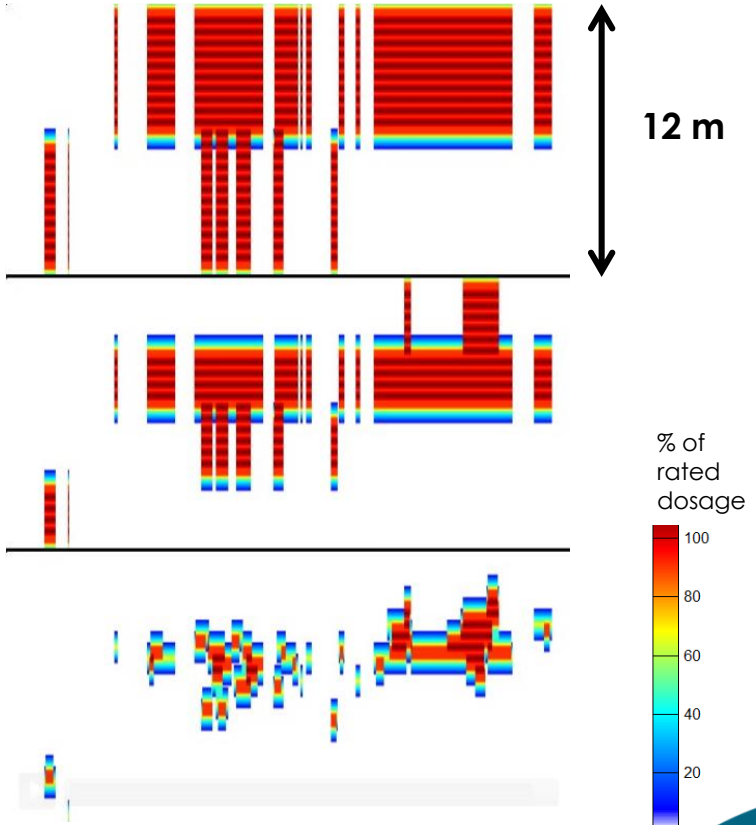
Triangular spray pattern (1,5 m width)



2 x 12 nozzles

4 x 6 nozzles

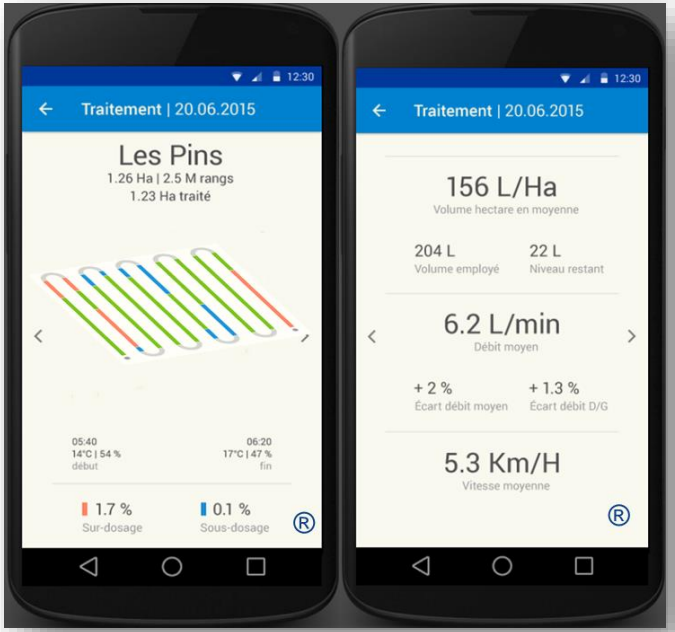
Individual nozzles



VILLETTE S. MAILLOT T., DOUZALS JP., 2019. *Herbicide site-specific spraying: use of simulations to study the impact of section width,*

Axe 3: Modélisation applications et gestion des impacts

- traçabilité



Conclusions: apports du numérique

- 1- Détection/Caractérisation

  Gestion spatiale, apprentissage et outils cloud

- 2- OAD – IPM

  Développement de solutions intégrées de gestion du risque (Phytopathologie, météo)

- 3- Modélisation

  Simulation et développement de machines performantes

Apps

dosaviña

Optidose

PACE dose adjustment calculator

Dosage adapté