

Data issues in agriculture

Modelling crop x environment x management interactions

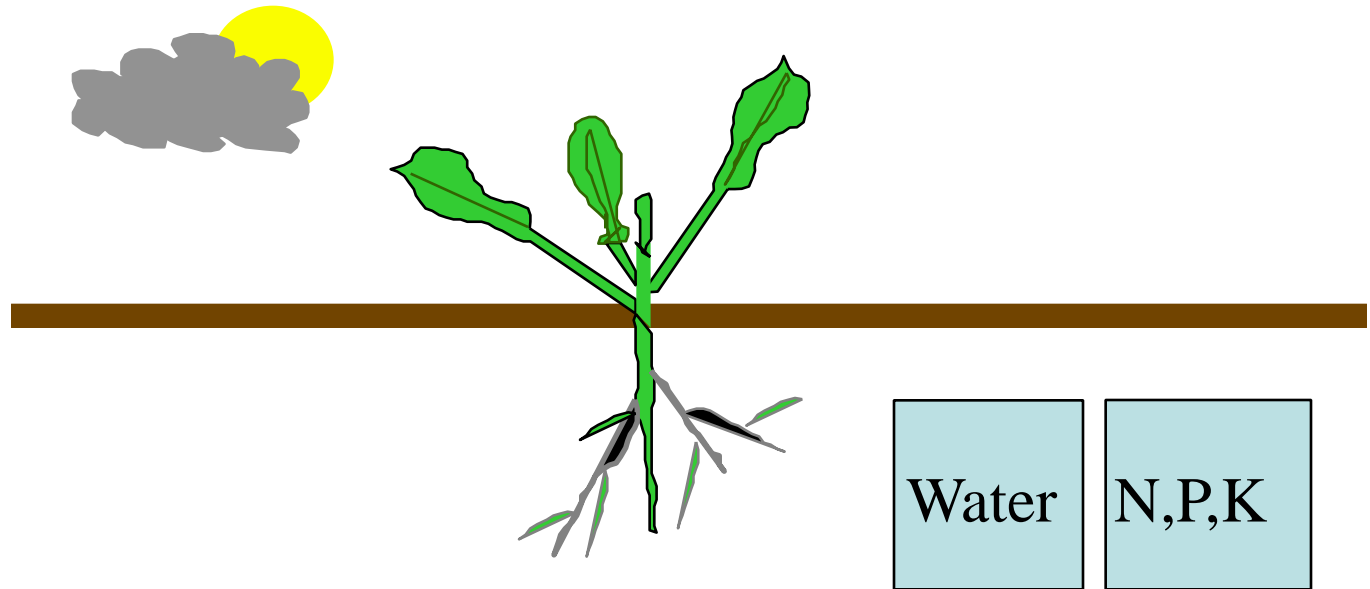
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Outline of talk

- Why using crop models ? (*Background on modelling approaches and data requirements*)
- Existing data bases
- Application highlights
- Conclusion and outlook

Introducing crop models



- Crop models predict the growth and development of crops in relation to their local environment (soil / climate) and management practices
- But also the impact of crops on the environment (soil, water bodies, the atmosphere)

Potential uses of crop models

- Analyse soil x climate x yield interactions
- Plant breeding
- Assess the environmental impacts of crops
- Aid for strategic and tactical decision-making by farmers
- Yield gap analysis, food safety, climate change mitigation and adaptation to
- Aid in policy making
- ... at local to global scale

Two major types of plant models

“Crop models”

- Emerged in the 1970's
- “Big-leaf” approach
- Widely used and disseminated
- Some limitations (GxE, mixed crops)



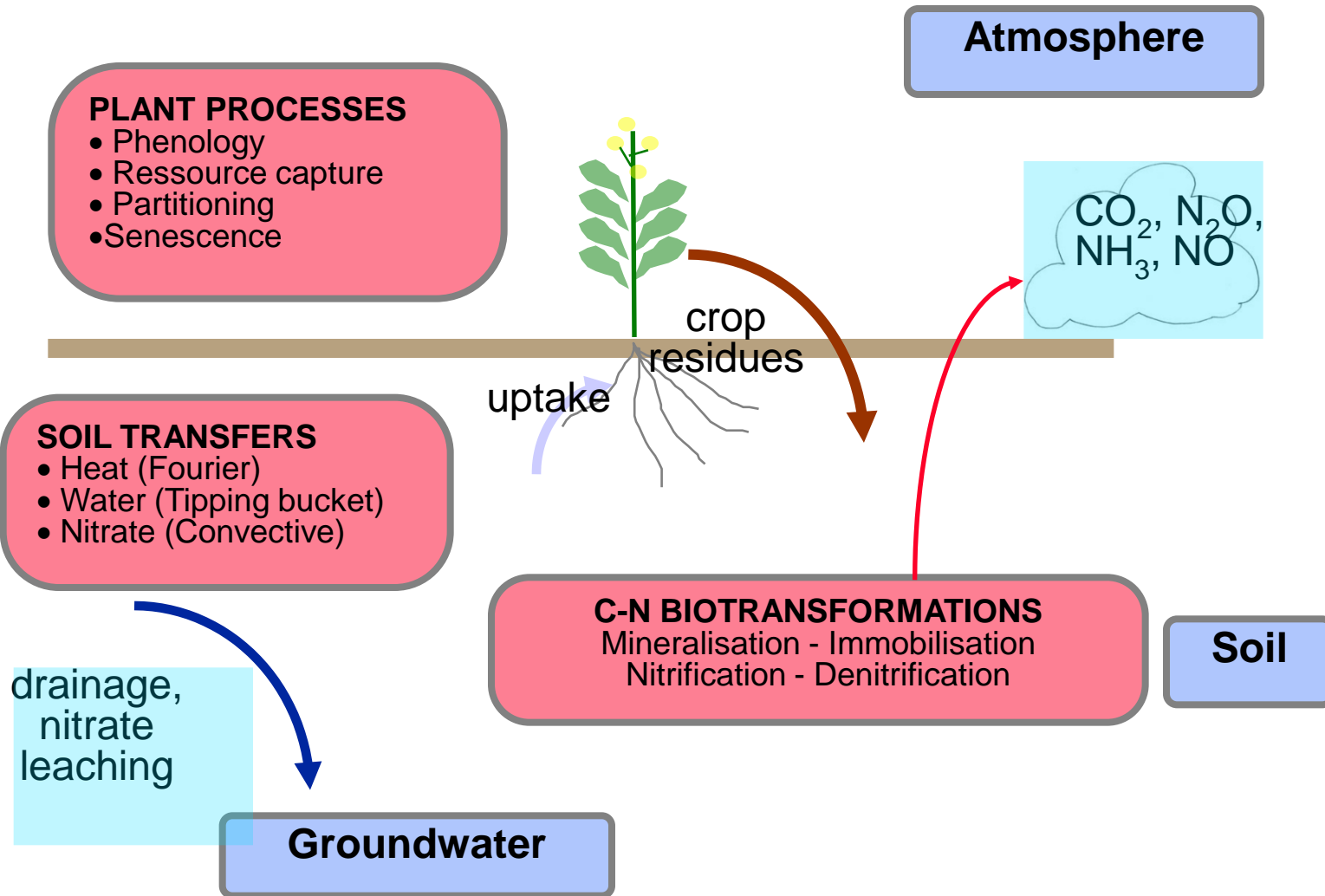
“Structure-function models”

- Developed in the 1990's
- Based on plant architecture
- Differentiate organs and individual plants
- Account for plasticity effects

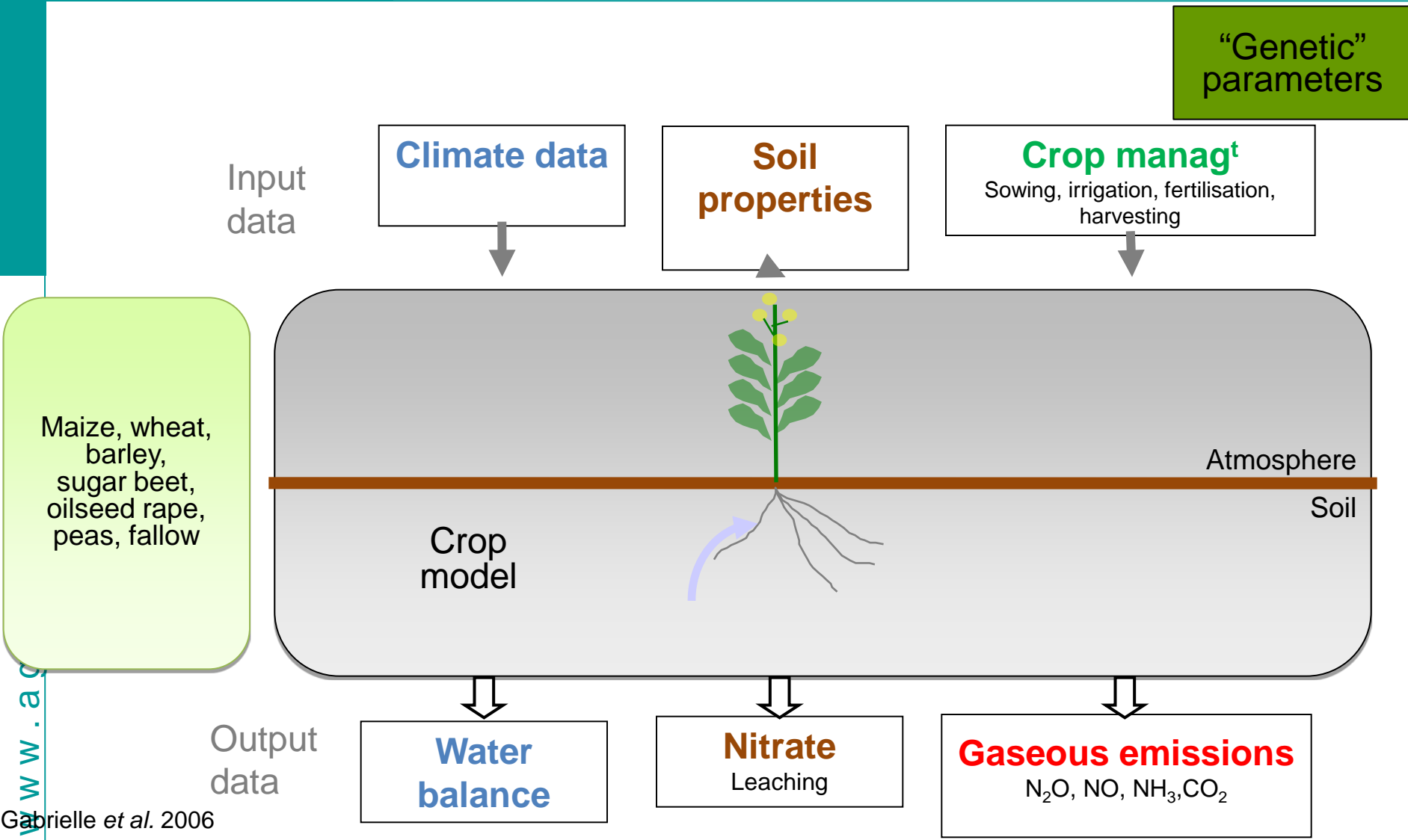


Basic structure of a crop (or agro-ecosystem) model

www.agroparistech.fr



Data requirements



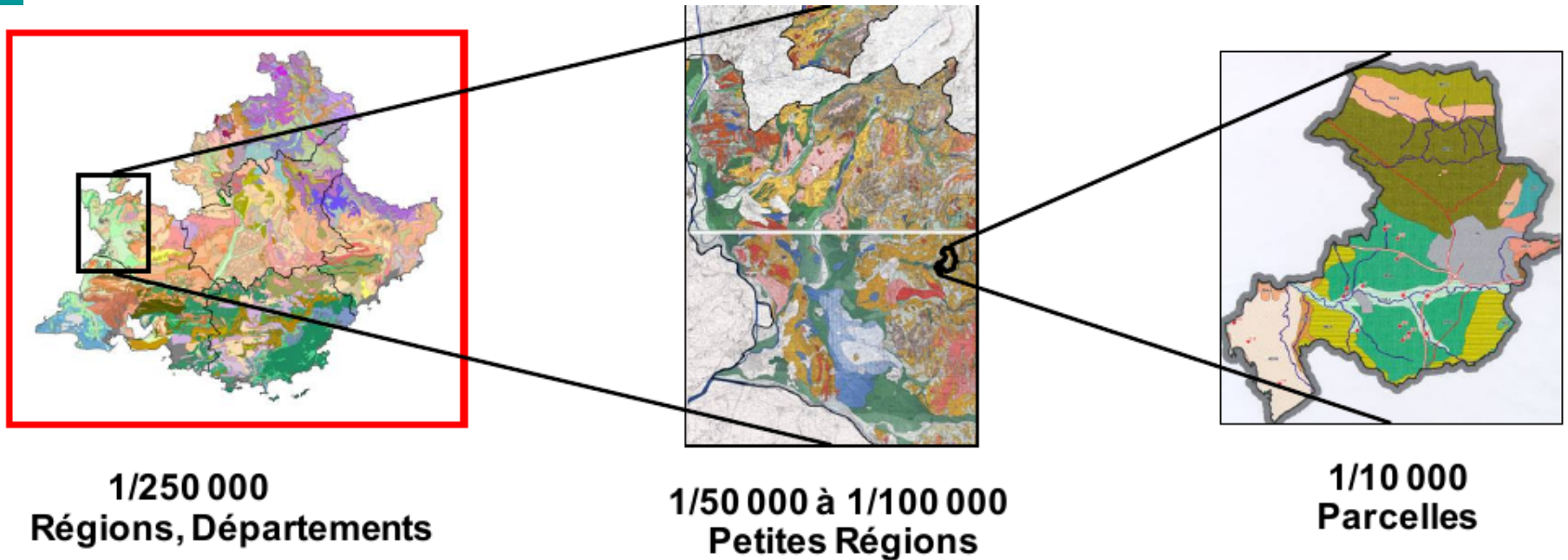
Gabrielle et al. 2006

www.agro-paris.fr

Data bases available at INRA and elsewhere

- **AgroClim**: network of 50 ground weather stations (and 50 more from Météo France)
- **InfoSols**: information system on soil properties
- **AgroSyst**: reference sets of management practices for cropping systems with low pesticide inputs
- Land cover data from Corine Land Cover or the Land Parcel Identification System
- Phenotyping platforms
- To test models with: experimental data sets from long-term observatory fields (EcoInfoORE)

Zooming up and down



Local to regional representations of soils in the mapping systems of the GIS Sol.

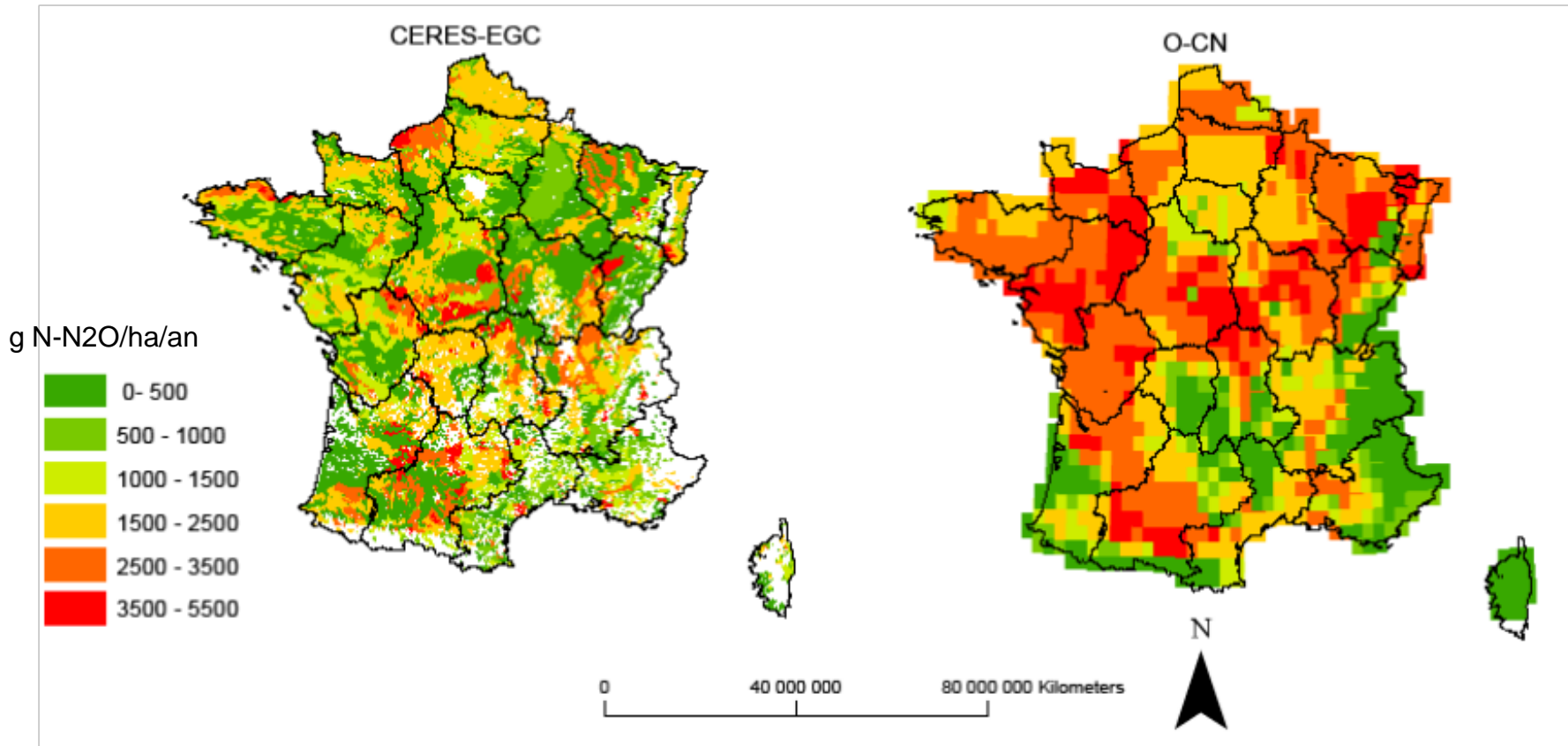
Main issues with data bases for plant modelling

- A matter of resolutions (spatial, temporal, functional)
- Some parameters are difficult to retrieve (eg soil depth, pH) or uncertain
- Management data are usually coarsely defined (esp. genotypes!)
- What about future climate changes?
- Need a good script (and computational powers)

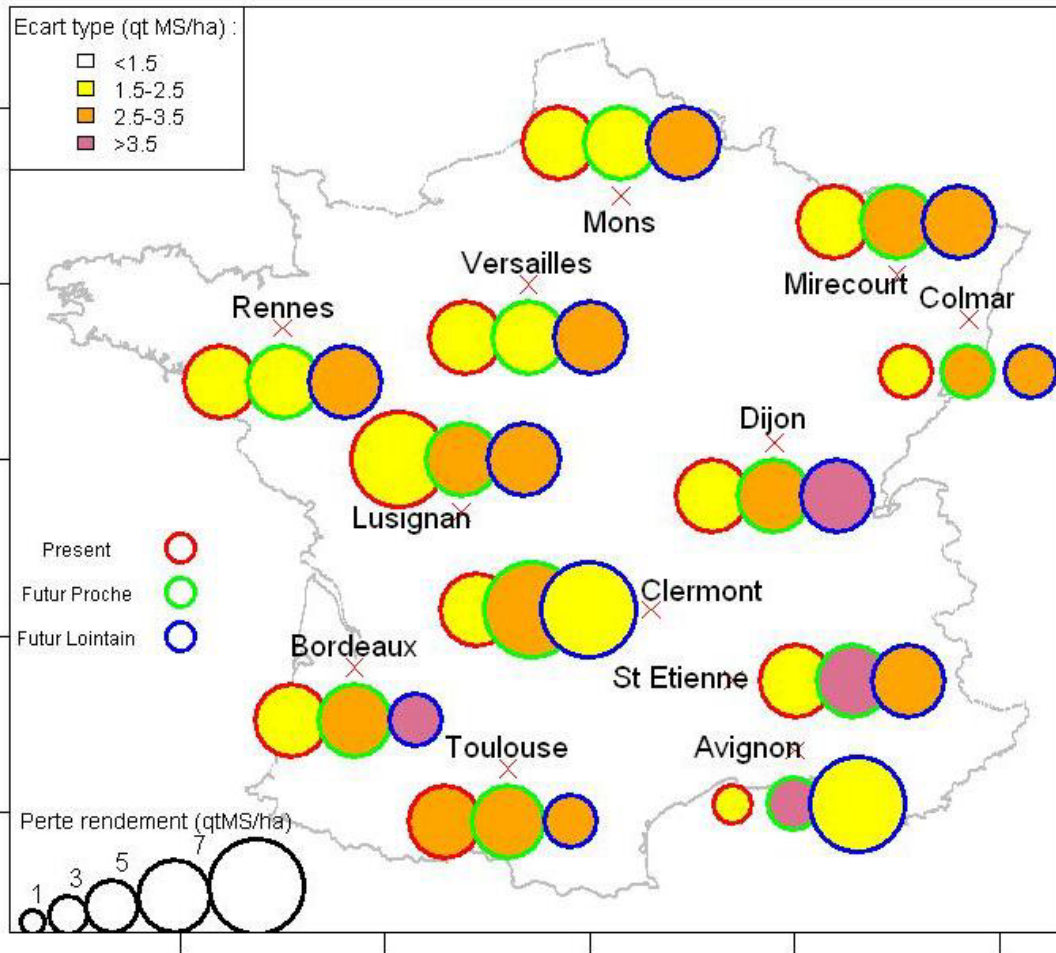
Outline of talk

- Why using crop models ?
- Existing data bases
- **Application highlights**
 - Mapping N₂O emissions from crops
 - Predicting the risk of fungal rust in... 2050
 - Wheat blotch (*Septoria tritici*)
 - A glimpse into GxMxE²
- Conclusion and outlook

Simulated maps of N₂O emissions over France



Future climate changes will affect the risk of fungal diseases for wheat



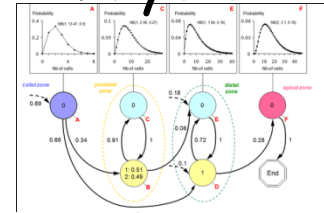
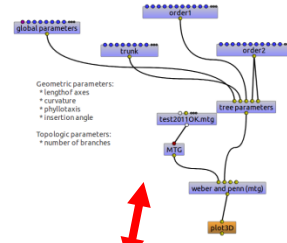
Predicted yield losses due to brown rust for near- or medium-term climate changes in different sites in France (Roche et al., 2010).

Open'Alea: A framework for FSPM modelling

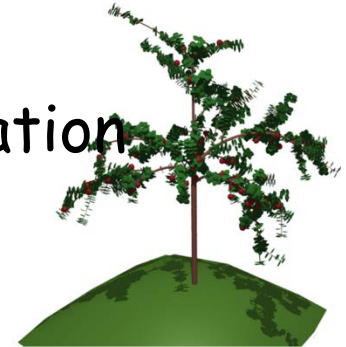
3D reconstruction



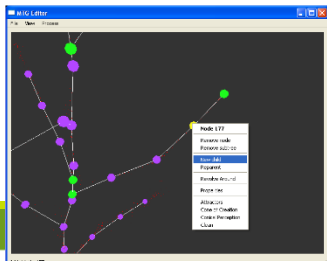
Visual Programming Analysis



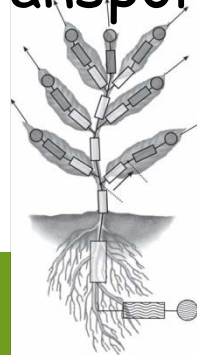
Simulation



Acquisition/ Edition



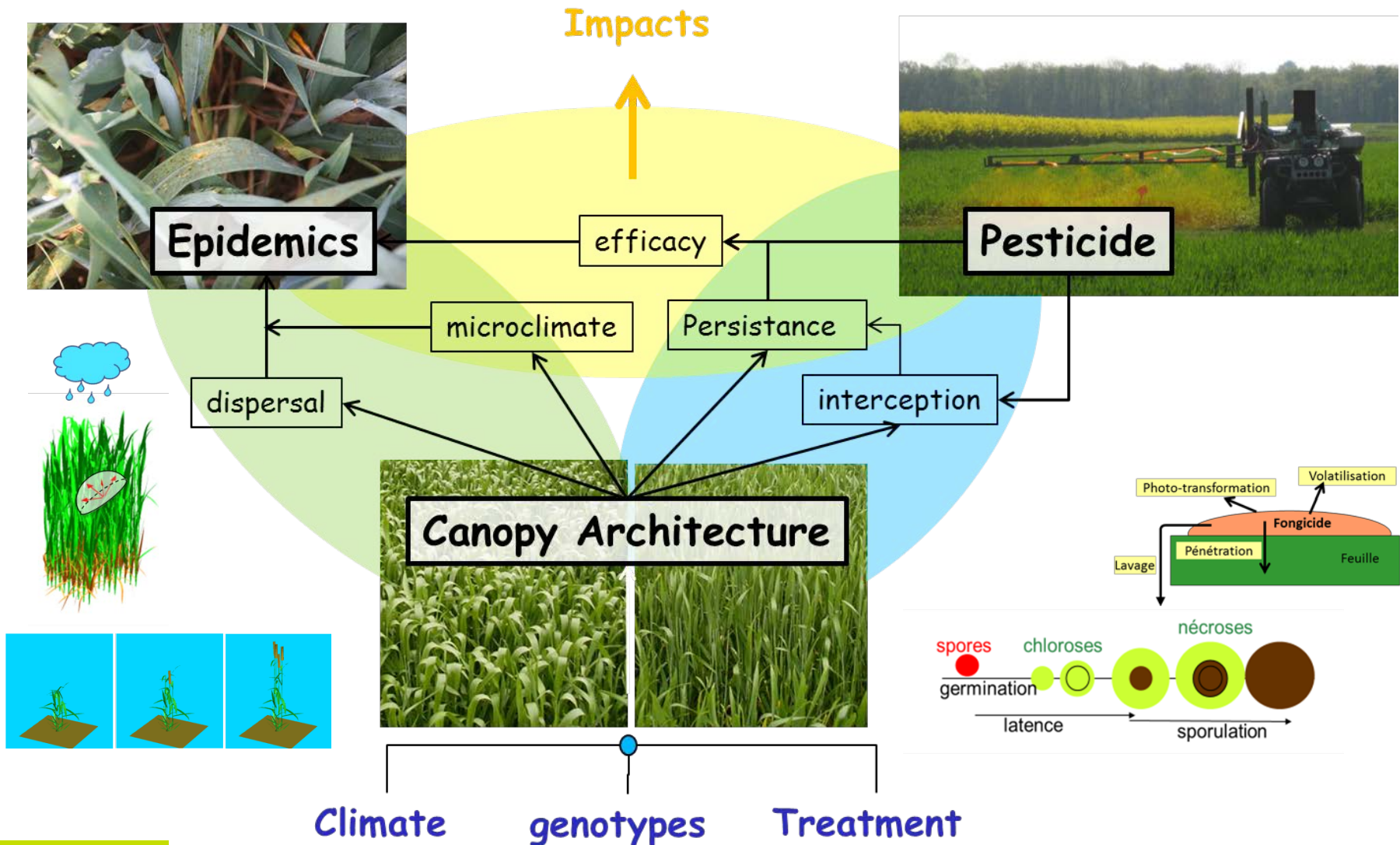
Transport networks



Connexion with other platforms



Echap project : simulating plant-pathogen-pesticide systems



Genetic x Management x Environment ²

Grain yields and N₂O emissions predicted by a crop model (CERES-EGC) in Grignon (Paris area) for 4 wheat cultivars in the 2000-2001 growing season.

Conclusion and outlook

- Promising applications of models (some already commercial, others more prospective),
- Across different sectors, target end-users and scales,
- Both data & computation intensive.
- Applications would combine models and data bases with their specific challenges (availability, resolution & transfer).
- A somewhat gray area in terms of who does (and finances) what,
- But there are definitely good resources to build on!