Combining methods and knowledges for monitoring environmental policies on a territorial scale: Spatial disaggregation of pesticides sales through land use data, reglementary information and expert knowledges

Carozzi M.[a], Descout M.[a], Lungarska A.[b], Girault B.[a], Pomeon T.[b], Martin P.[a]

[a] INRAE, AgroParisTech, Université Paris-Saclay, UMR SADAPT, Palaiseau, FR;   [b] US-ODR, INRAE, 31326, Toulouse, FR

CHALLENGES and AIM: quantify the use of pesticides at territorial scale

- **Directive 2009/128/EC of the European Parliament** established a robust framework for Community action to achieve the sustainable use of Plant Protection Products (PPP).

- France launched the **Ecophyto program** to strategically and responsibly reduce pesticide usage.

  ► However, a critical gap remains: **a lack of data** with adequate spatial and temporal resolution to effectively monitor pesticide use.

  Such data are essential to:
  - Take targeted **actions** on products, substance, crops or specific areas
  - Evaluate and support **public policies**
  - Drive the **research** of substances in watersheds

- The **territorial scale** is where environmental policies are most effectively monitored and where actions are introduced, assessed, and refined to achieve meaningful impact.
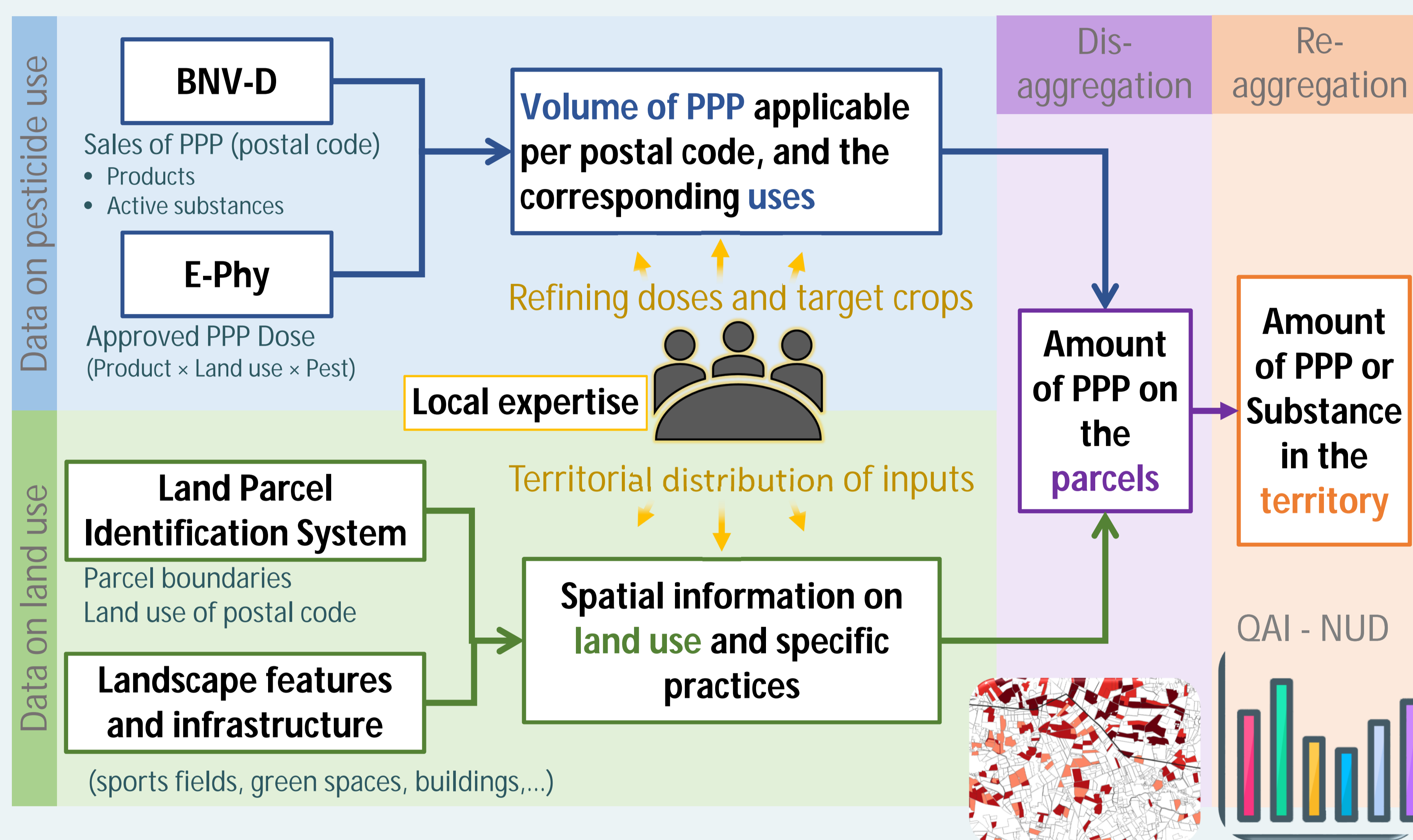
We introduce a cutting-edge method for allocating annual pesticide sales across territories based on agricultural land use:

PHYTO Explorer

This method
- delivers precise spatial and temporal estimates of pesticide application;
- enables **local authorities** to make comprehensive and accurate diagnoses over time and space.

METHOD: disaggregation and re-aggregation

Data on pesticide use

BNV-D — Sales of PPP (postal code)
- Products
- Active substances

E-Phy — Approved PPP Dose (Product × Land use × Pest)

Volume of PPP applicable per postal code, and the corresponding **uses**

Refining doses and target crops

Local expertise

Data on land use

Land Parcel Identification System — Parcel boundaries, Land use of postal code

Landscape features and infrastructure (sports fields, green spaces, buildings,...)

Territorial distribution of inputs

Spatial information on land use and specific practices

Dis-aggregation | **Re-aggregation**

Amount of PPP on the parcels

Amount of PPP or Substance in the territory

QAI - NUD

Key Points
- Use of **Existing and Shareable Databases**
- **Highly Detailed Land Use Description: 350 different crops**.
- Inclusion of **Non-Agricultural Zones**
- Consideration of **Organic Farming** and the corresponding PPP
- Inclusion of Parcels Not Declared to the CAP
- Inclusion of **Local Expertise**: ability to modify target crops, applied doses, and application rules on sub-territories
- **Only a Shapefile is required** to run
- **Accurate matching of parcels to the postal code** of the farm thanks to the agricultural census data
- **Provision of Relevant Indicators**, such as the Quantity of Active Ingredients (QAI) or the Number of Unit Doses (NUD)
- **Spatialization of all PPP** across the territory, or focus on specific products, substances, or crops
- **Uses a 3-year rolling average to account for product storage**
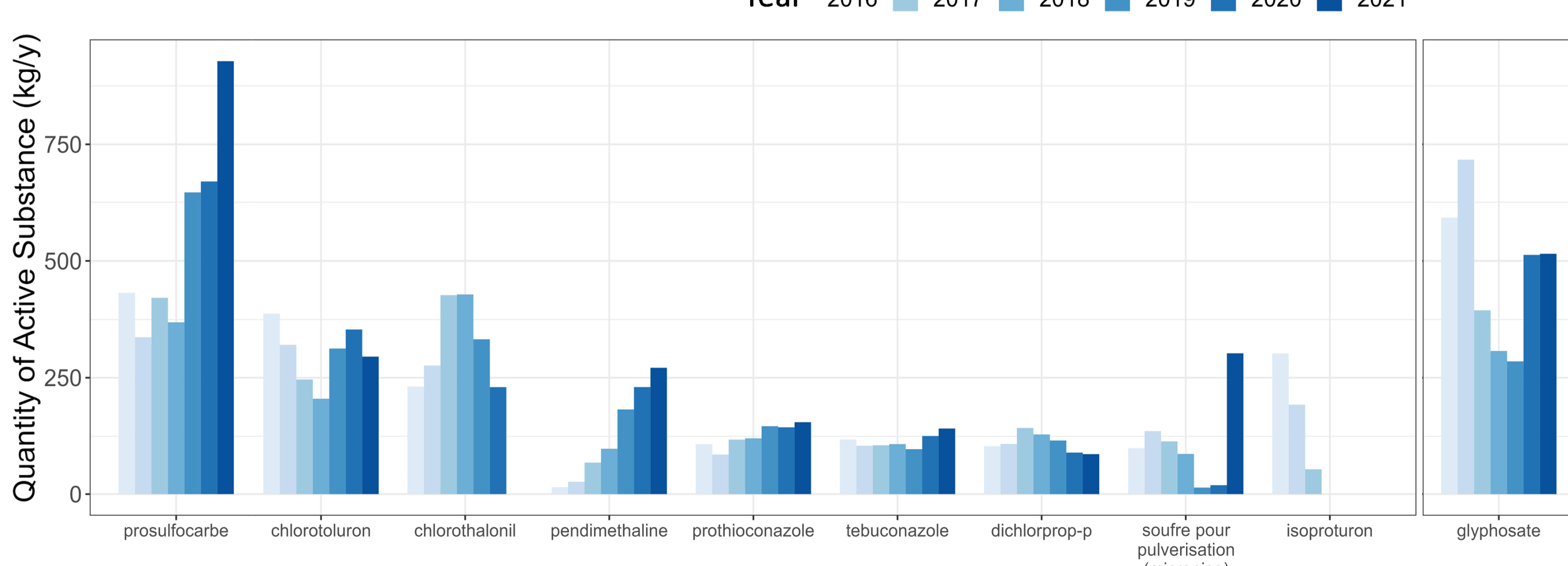
Limitations
- **Use of Annual Data** for both sales and land use information
- **Data Accessibility Timing:** data is available with a 2-year delay
- Higher accuracy close to the years of the agricultural census

RESULTS: examples and comparison

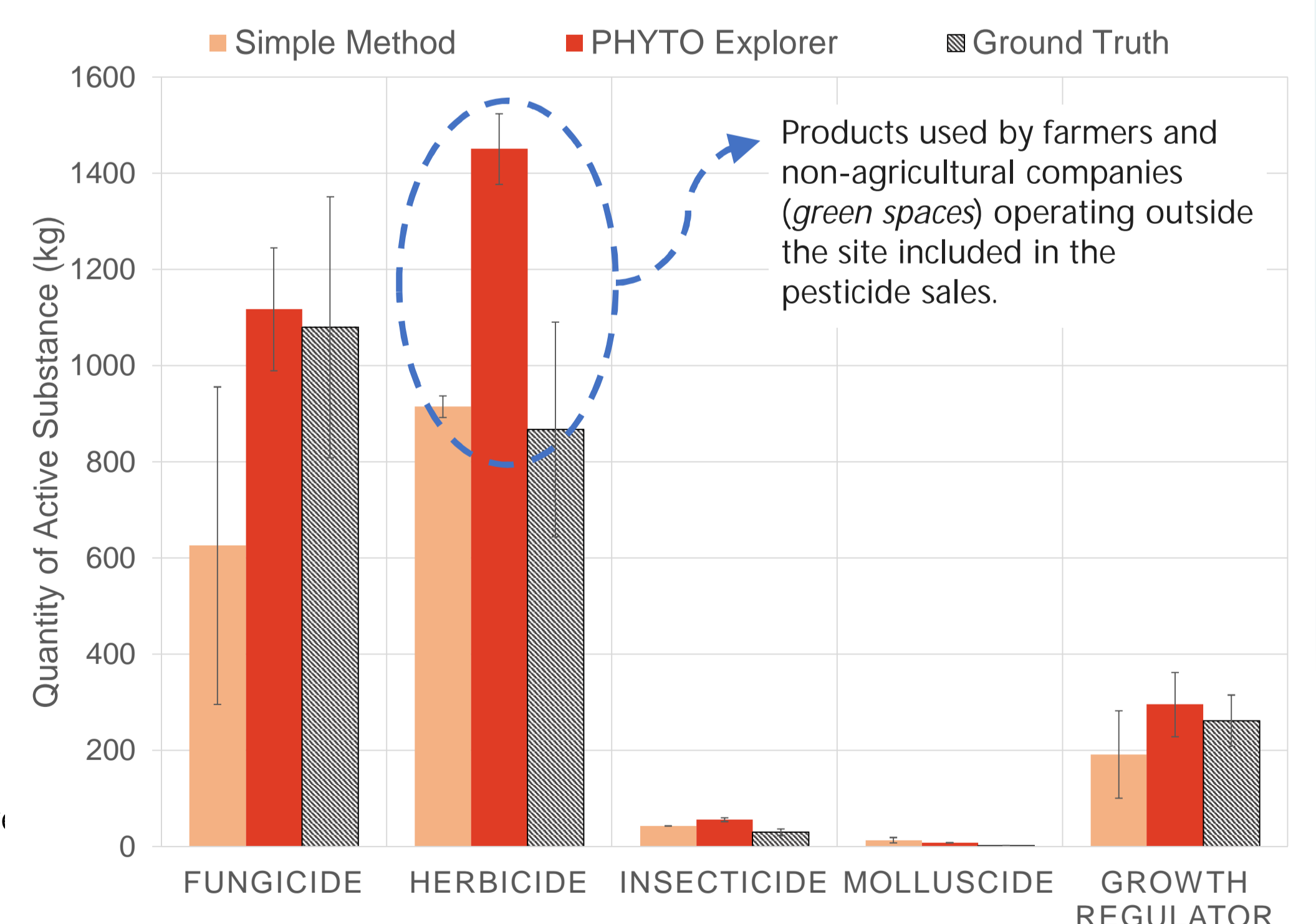### Annual estimates of quantities of active substances

Land Use: Winter wheat, Maize, Winter rapeseed, Winter barley, Professional non-agricultural areas, Sunflower, Silage maize, Soybean

Winter wheat

Year: 2016, 2017, 2018, 2019, 2020, 2021

Comparison of **PHYTO Explorer** estimates with **Ground Truth** at the Bourville site (Seine-Maritime) and with the "**Simple Method**[1]" currently in use, averaged over 2015–2016; standard deviations included (see **Martin et al., 2023**).
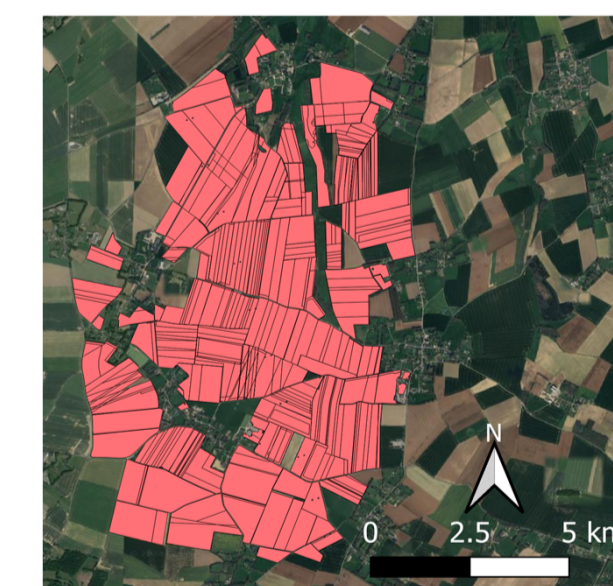
Bourville (830 ha) is France's largest site subjected to 9 years of exhaustive pesticide monitoring (2008–2016).

Simple Method, PHYTO Explorer, Ground Truth

Products used by farmers and non-agricultural companies (*green spaces*) operating outside the site included in the pesticide sales.

FUNGICIDE, HERBICIDE, INSECTICIDE, MOLLUSCIDE, GROWTH REGULATOR

[1]**Simple Model** uses: (1) land area by postal code, (2) pesticide sales data (BNV-d), and (3) study area geometry

IMPLICATIONS

► In line with **EcoPhyto2030**, this methodology will become **the benchmark for territorial data on plant protection products**, stimulating research and strengthening public policy (e.g. River Basin Action Plans, Natura 2000).

► The **direct integration of farmers' practice records** will be considered (in line with EC 1107/2009).

► **Need for data** on farmers practices to ensure validation

Martin et al.,(2023). Modelling the spatialisation of pesticide sales to monitor environmental policies in France. *Journal of Cleaner Production*, https://doi.org/10.1016/j.jclepro.2023.136880

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