



EXploring PhenOtypic SpacE for mining genotypes and alleles in Maize

Emilie Millet, Claude Welcker, Llorenç Cabrera-Bosquet, Boris Parent, François Tardieu, Denis Vile, Cyrille Violle, Frédéric Chazale, Randall J Wisser

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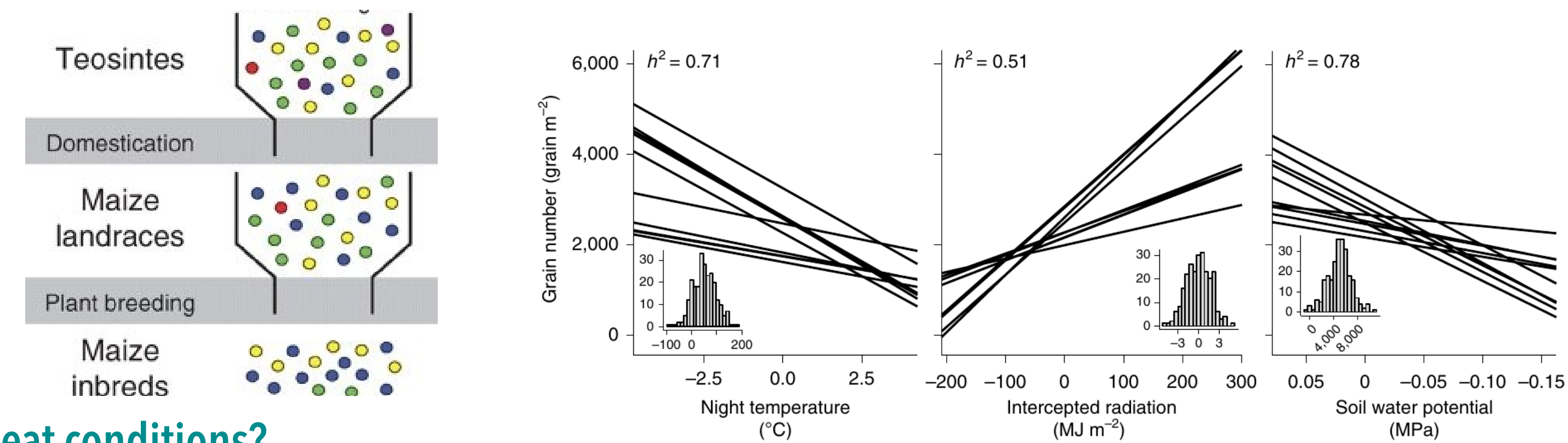
EXploring PhenOtypic SpacE for mining genotypes and alleles in Maize - EXPOSE

¹LEPSE, INRAE, Univ. Montpellier, Institut Agro, 34060 Montpellier, France, ²CEFE, Montpellier University, CNRS, EPHE, IRD, Paul Valéry University, Montpellier, France, ³DataShape, Inria Saclay, Palaiseau, France

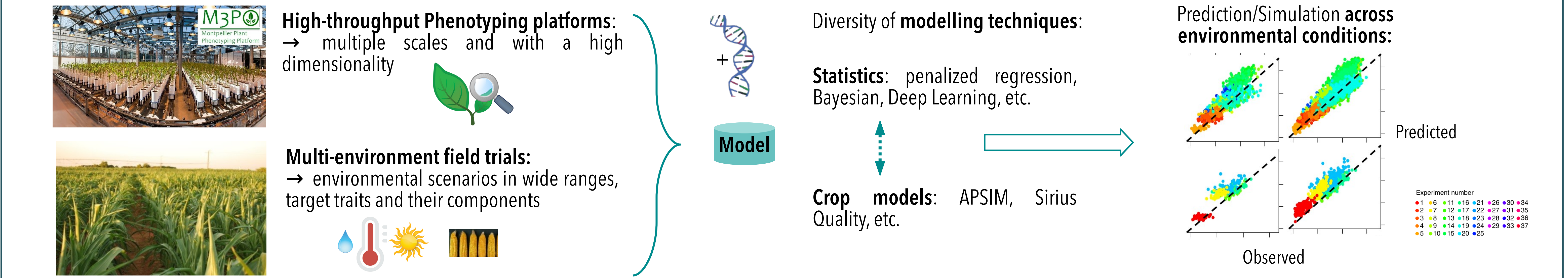
Background

- Climate change: more frequent episodes of drought and/or heat (extreme events) ⇒ Impacting negatively the crop yield
- Maize is a major crop worldwide with large diversity ⇒ can be used for identification of novel alleles for tolerance to drought and heat
- Phenotypic response can differ for different varieties $P = G + E + G \times E$
Detection of genomic regions will depend on the environment ⇒ environment dependent effects

Which genotypes and alleles across the exotic gene pool are favorable under different drought or heat conditions?
How to navigate the vast space of genotype-by-environment (G×E) interactions to discover climate adaptations?



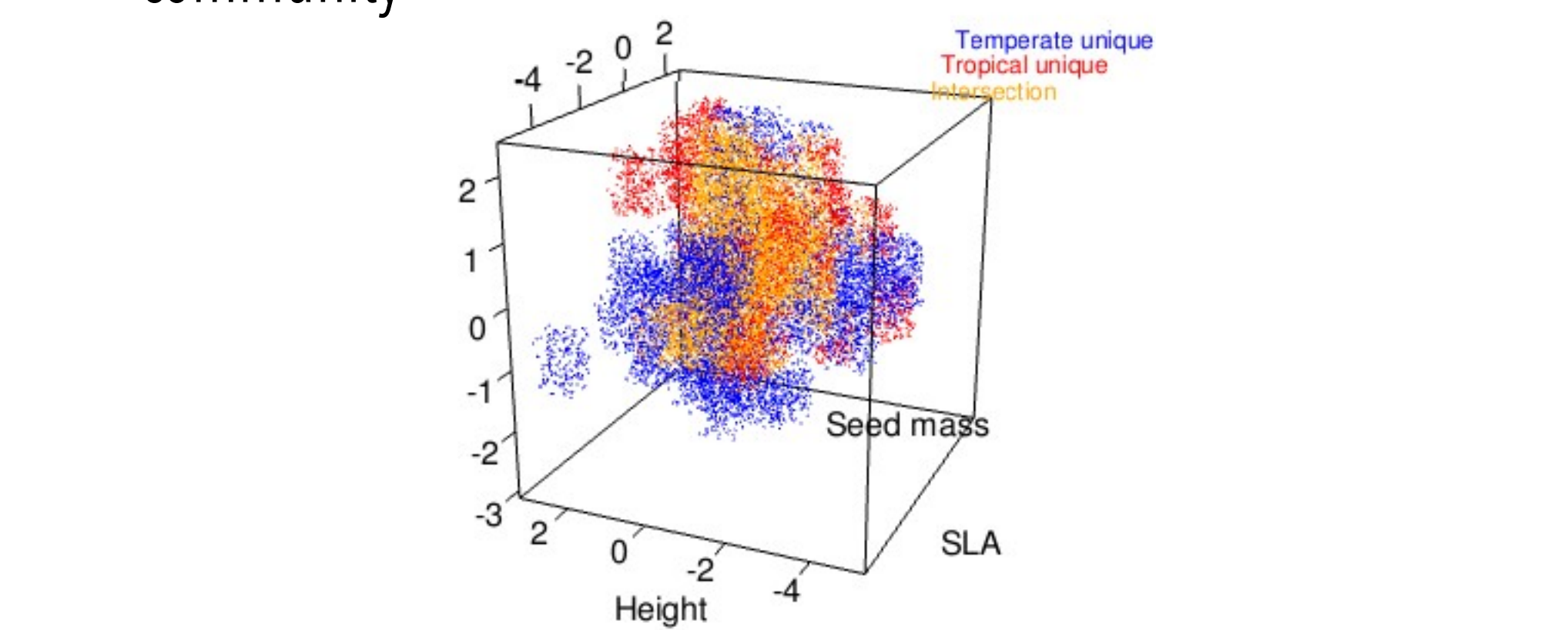
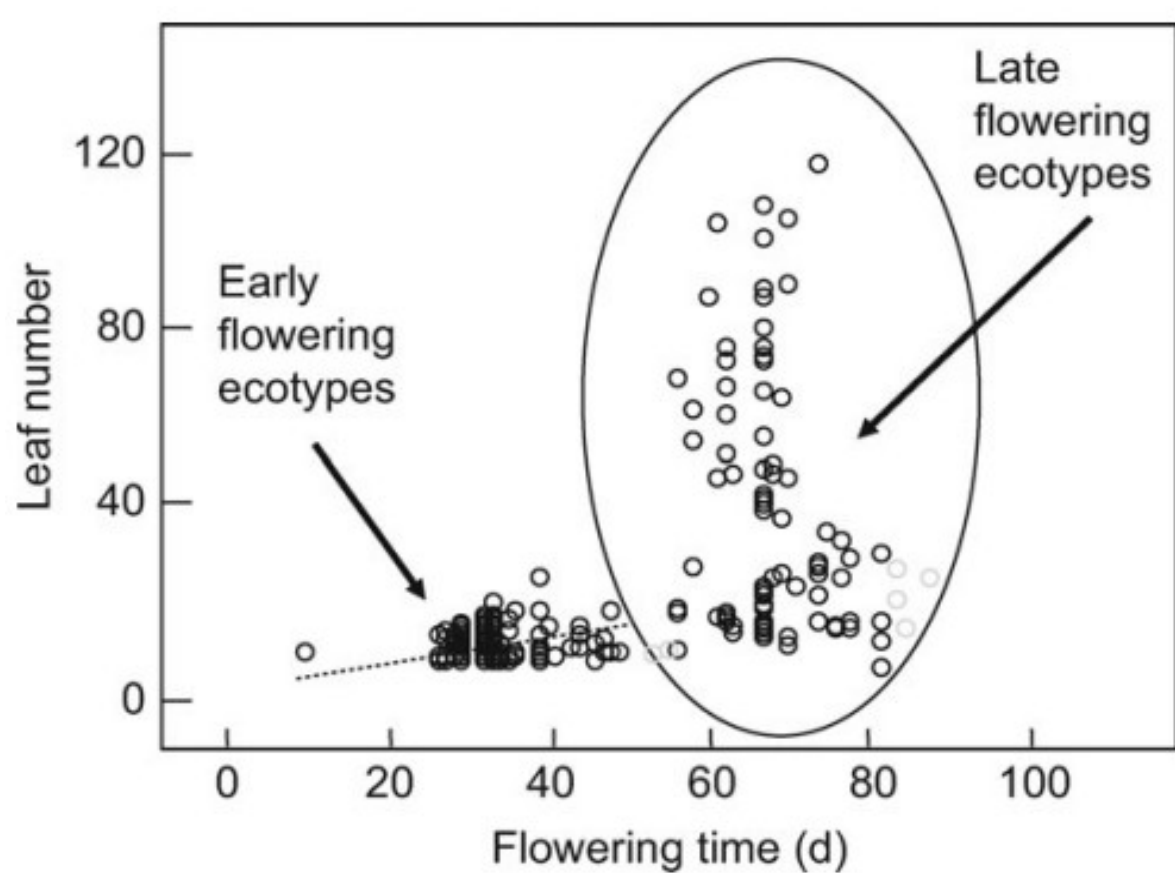
Progress in phenomics and modelling makes it possible to predict G×E from a multitude of physiological traits measured on a phenotyping platform



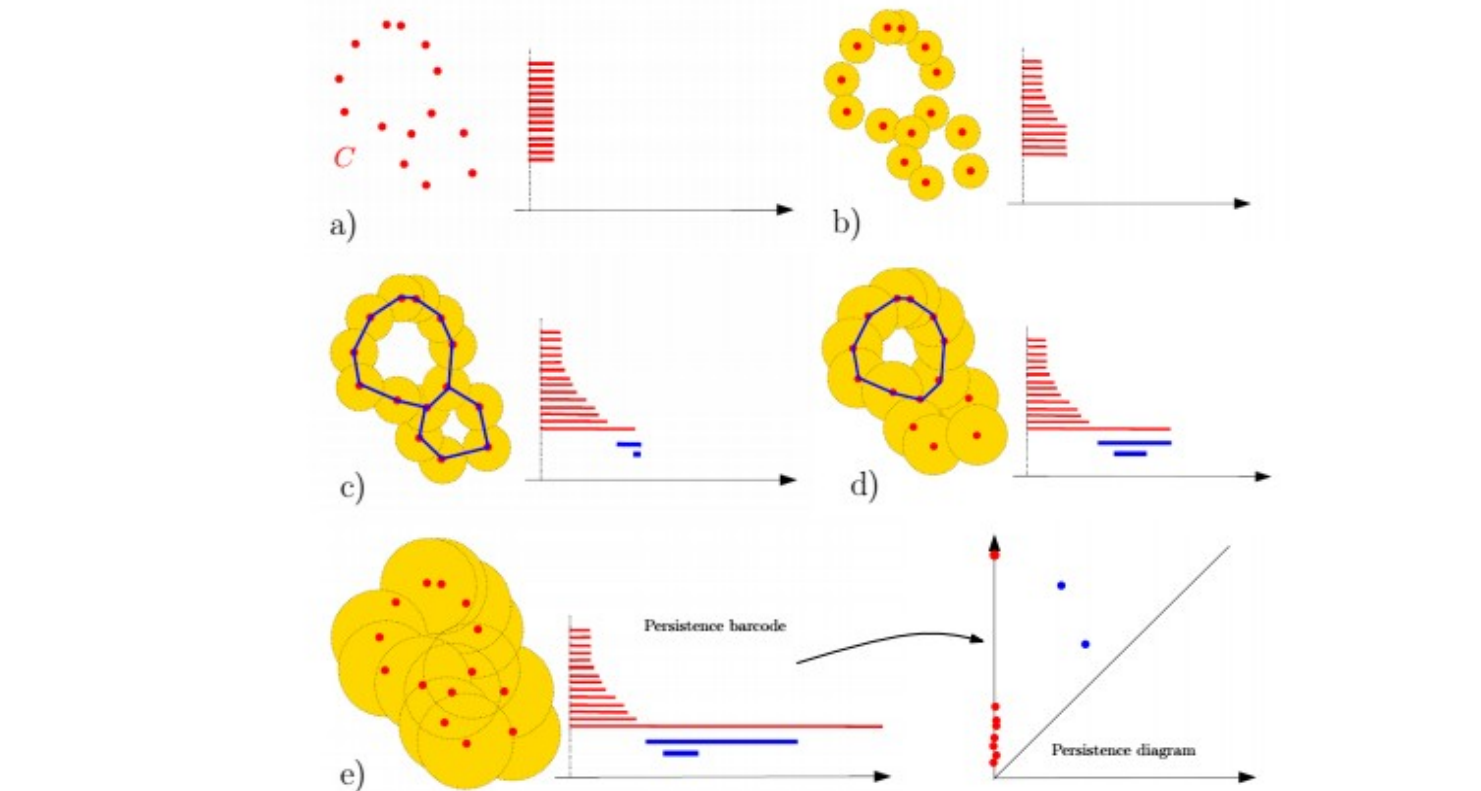
→ However, a considerable effort still needs to be dedicated to understanding the distribution/structure/shape for combinations of correlated traits - phenotypic space.

Objectives

- The **phenotypic space** is not a new concept:
 - Hutchinson (1957) : niche = n-dimensional hypervolume describing the set of environments that permit a species to exist
 - Pigliucci (2007): a phenotypic space shaped by the interaction of various kinds of constraints and selective pressures
- Hypervolume** to investigate ecological niches : multidimensional trait space occupied by species in a community
- Topological Data Analysis** aims at analysing the structures underlying data represented as point clouds in metric spaces



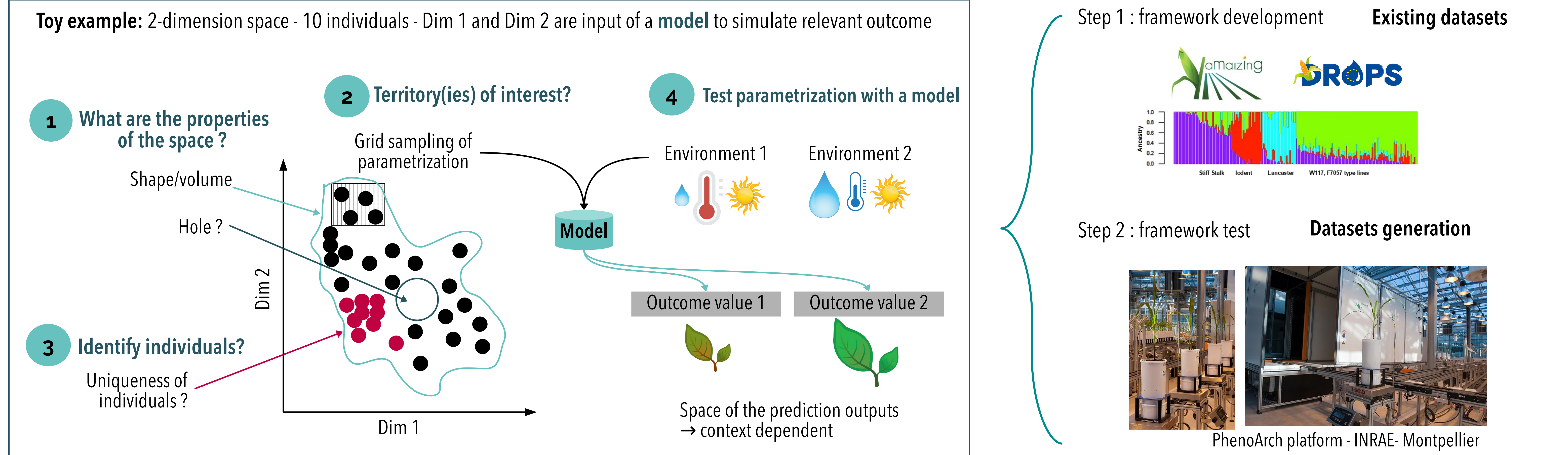
→ geometrical shape can then be delineated within this space and used to describe the **size, position and geometry of the system**



→ Application to plant phenotype: leaf and root shape + QTL

→ Interfacing ecophysiological genetics, ecology/evolution and data science, we aim to EXPOSE new ways of framing and characterizing G×E for crops

Strategy



Expected outcomes

- Development of novel approaches** for the analysis of phenomics data using **cross-disciplinary** ideas and methods
- Generation of new datasets** on immortalized genetic stocks (public resources).
- Perspective in **genomic prediction**
- Breeding for changing climate** (identification of unique adaptation)