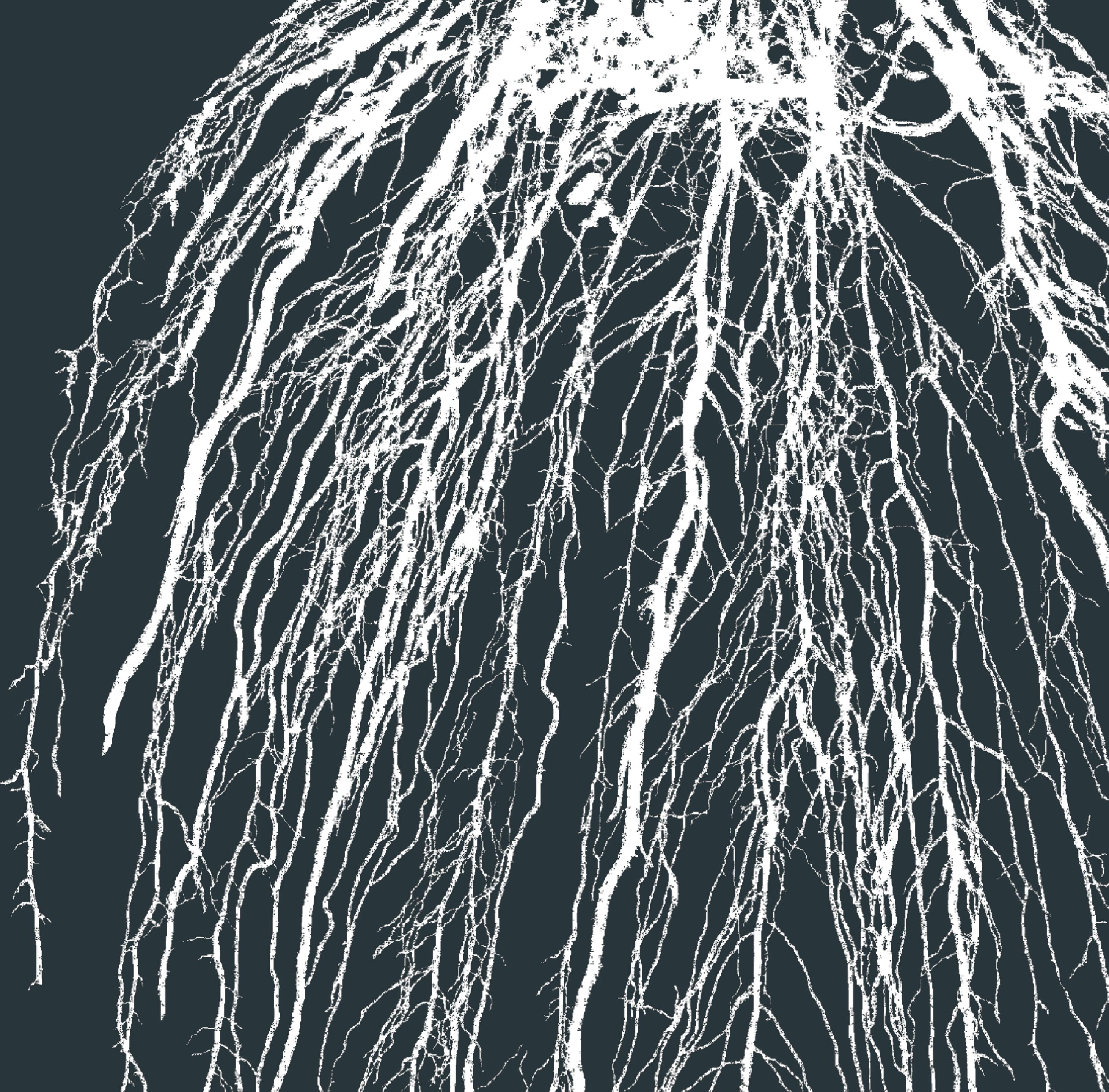


UNDERSTANDING COMPLEX **PLANT PROCESSES** IN HETEROGENEOUS **ENVIRONMENTS**



Guillaume Lobet
@guillaumelobet 



PLANTS ARE
FASCINATING



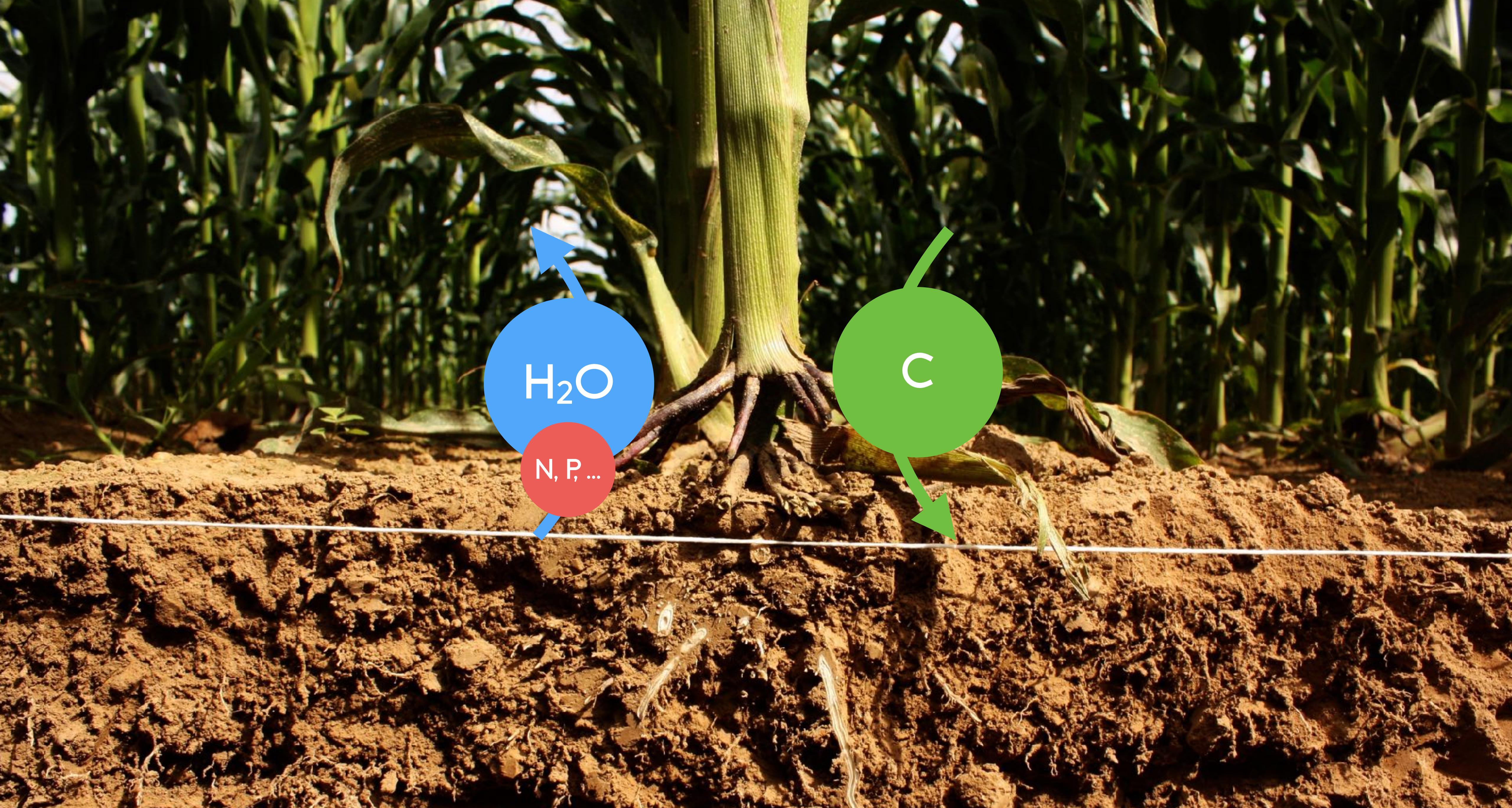
© Wayne Stadler

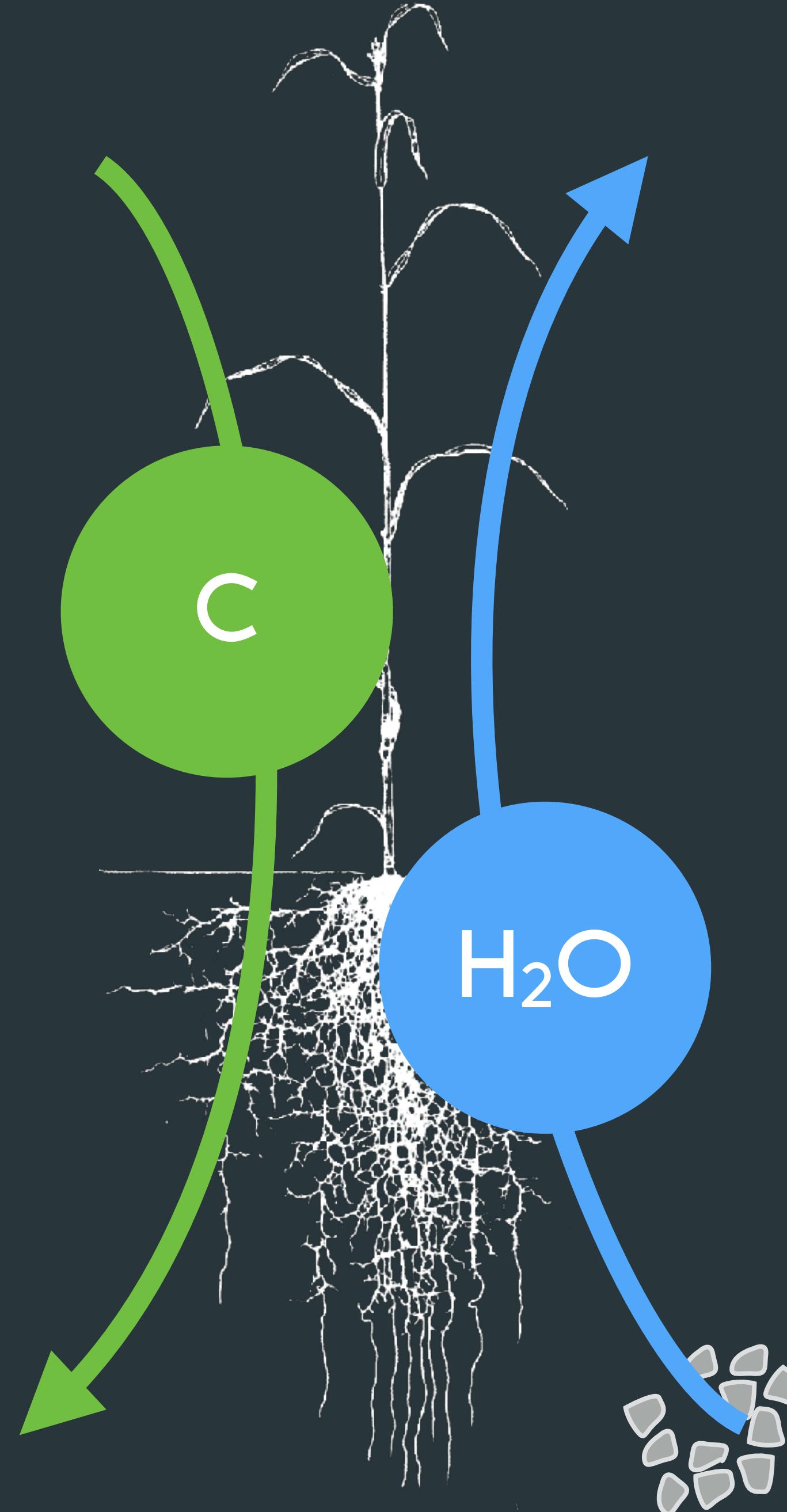


© Jane Kahler



© Eric Hossinger



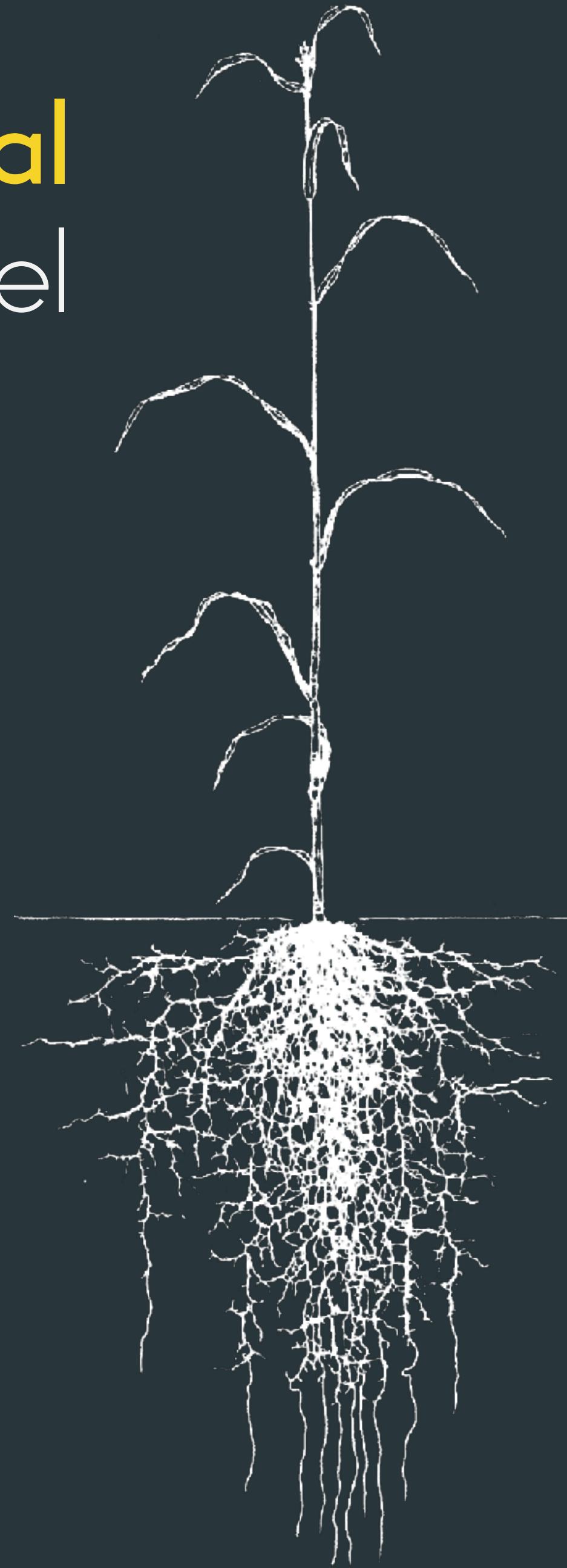


Water uptake
Carbon fluxes
Nutrient uptake
Plant **development**

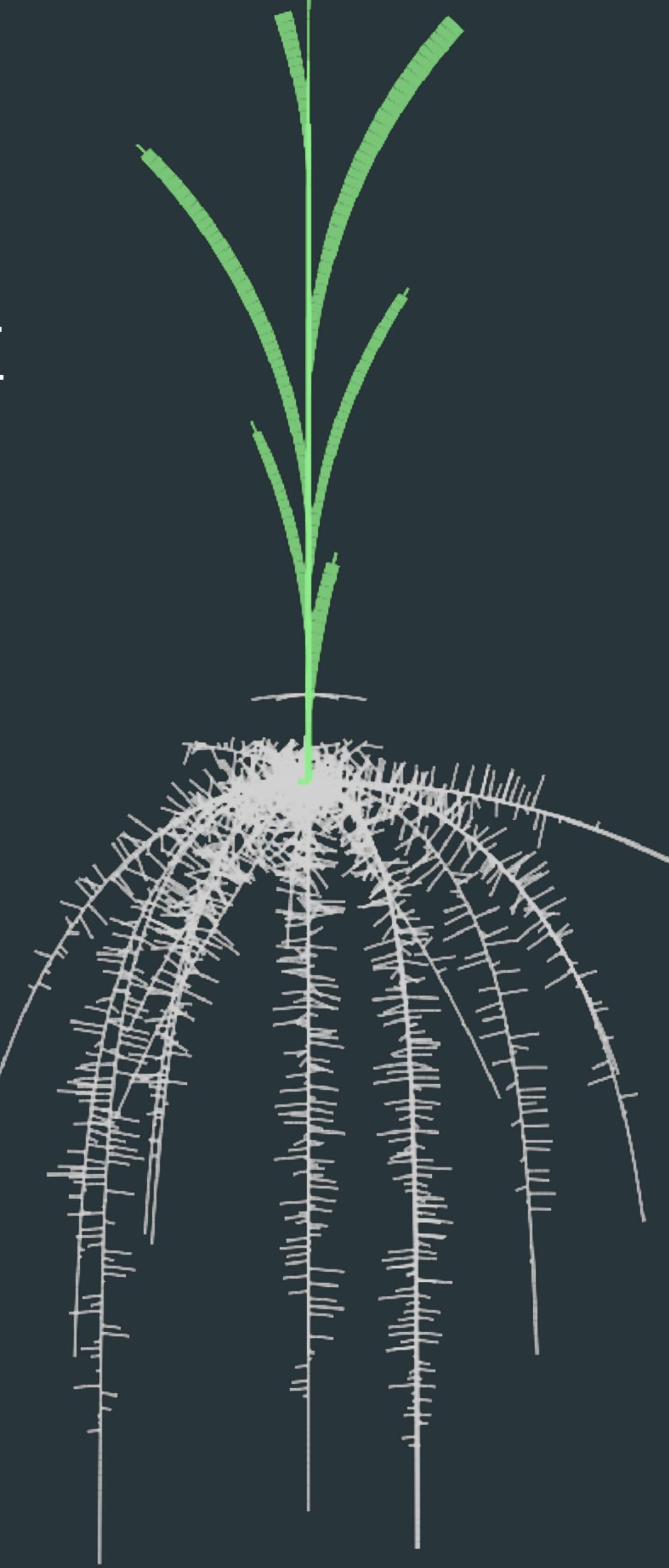
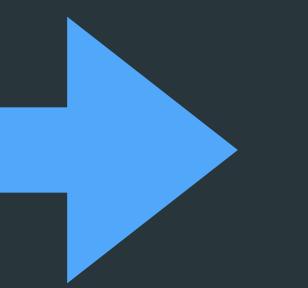
$f(\text{time})$
 $f(\text{space})$
 $f(\text{species})$
 $f(\text{soil})$
...

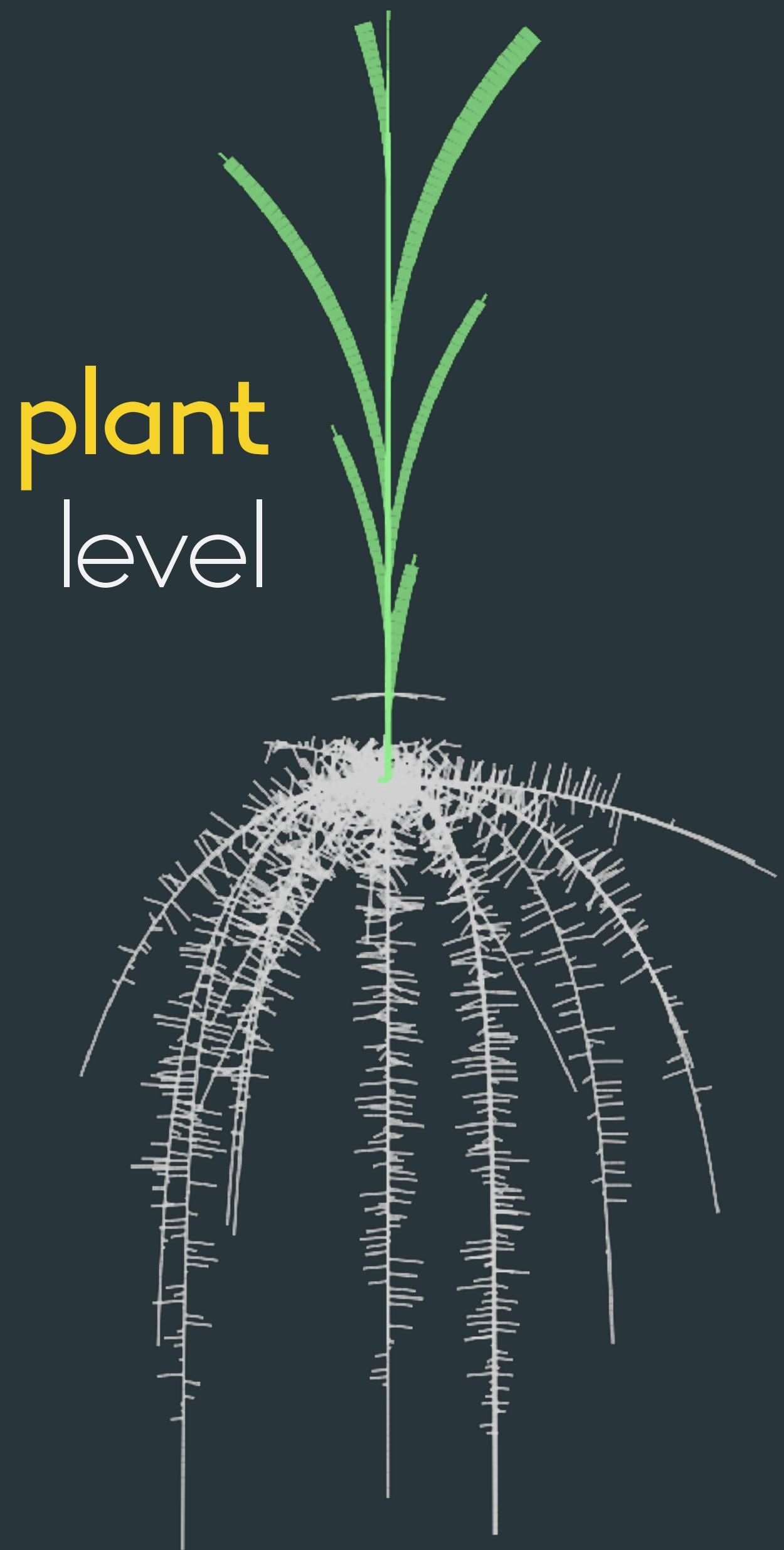
SYSTEMS BIOLOGY

**biological
model**



**functional
structural
plant
model**

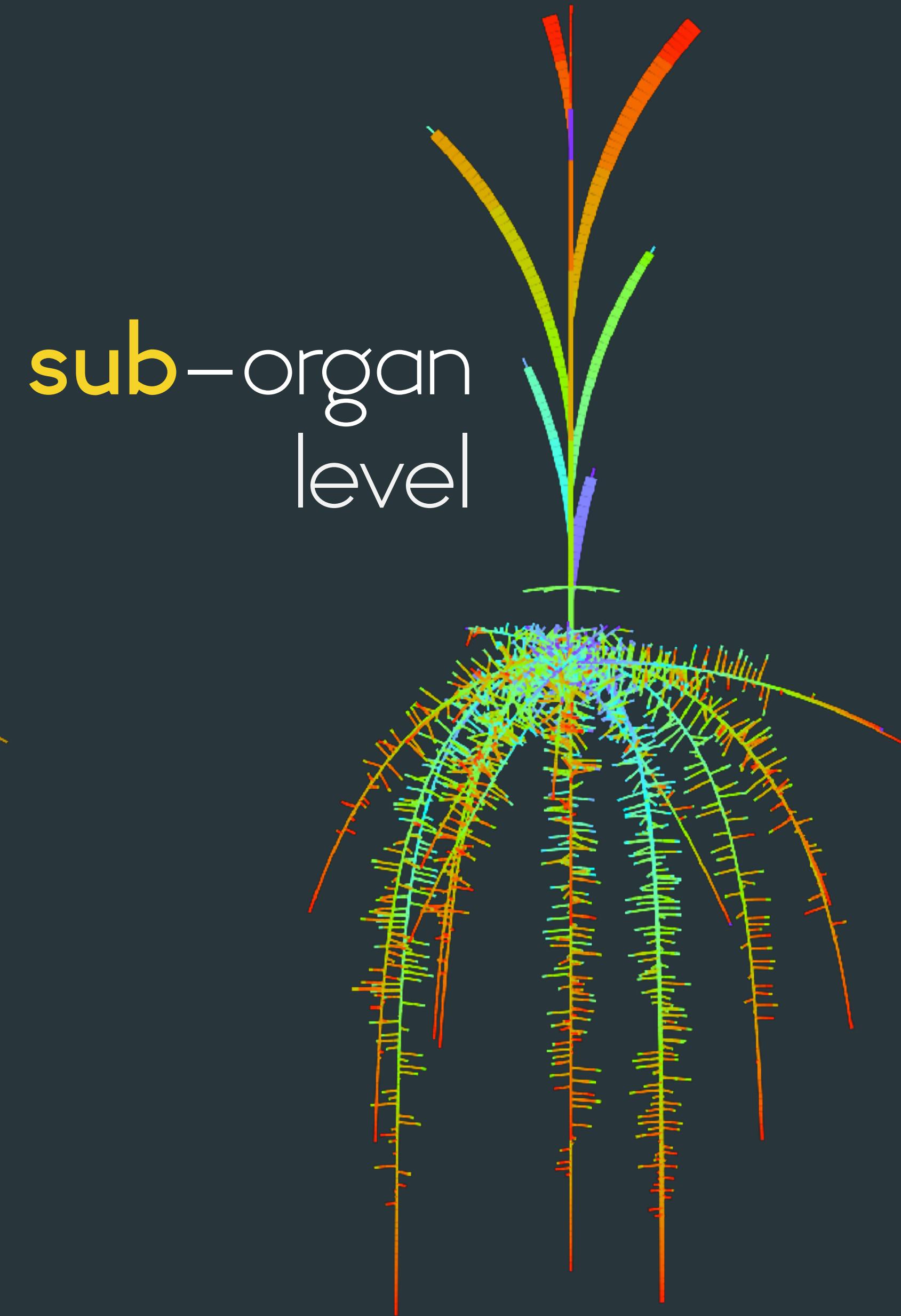




plant
level

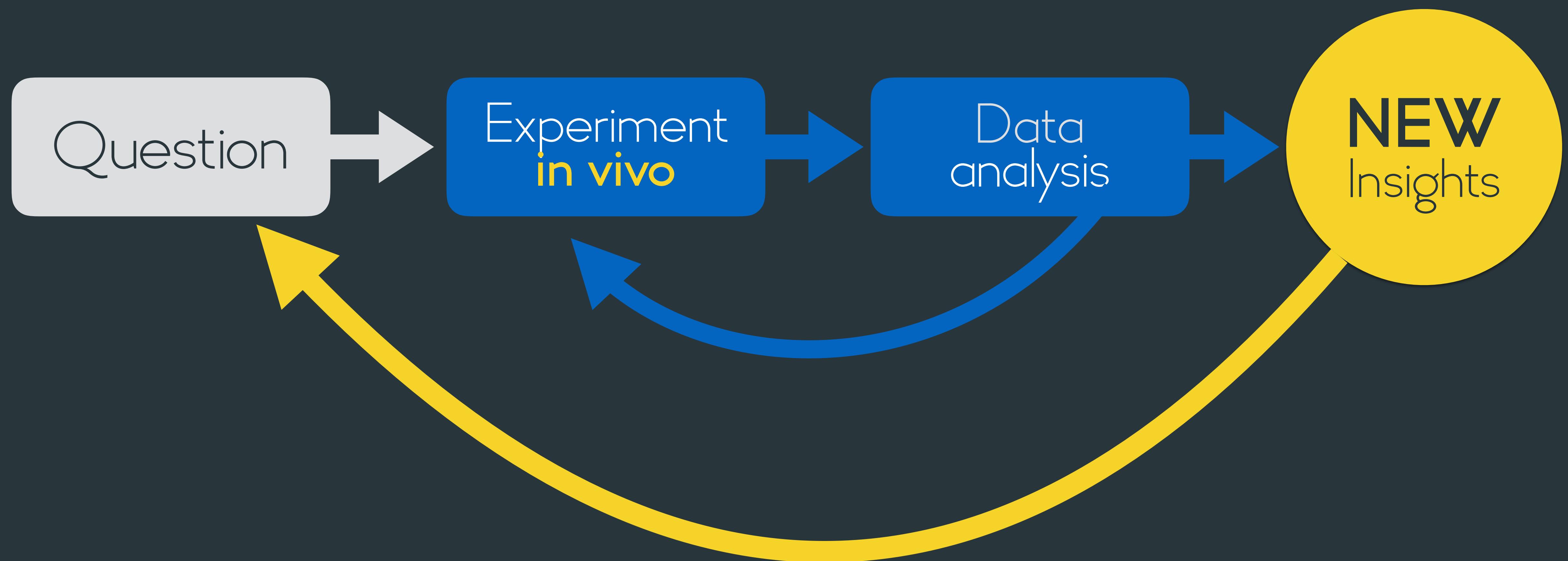


organ
level



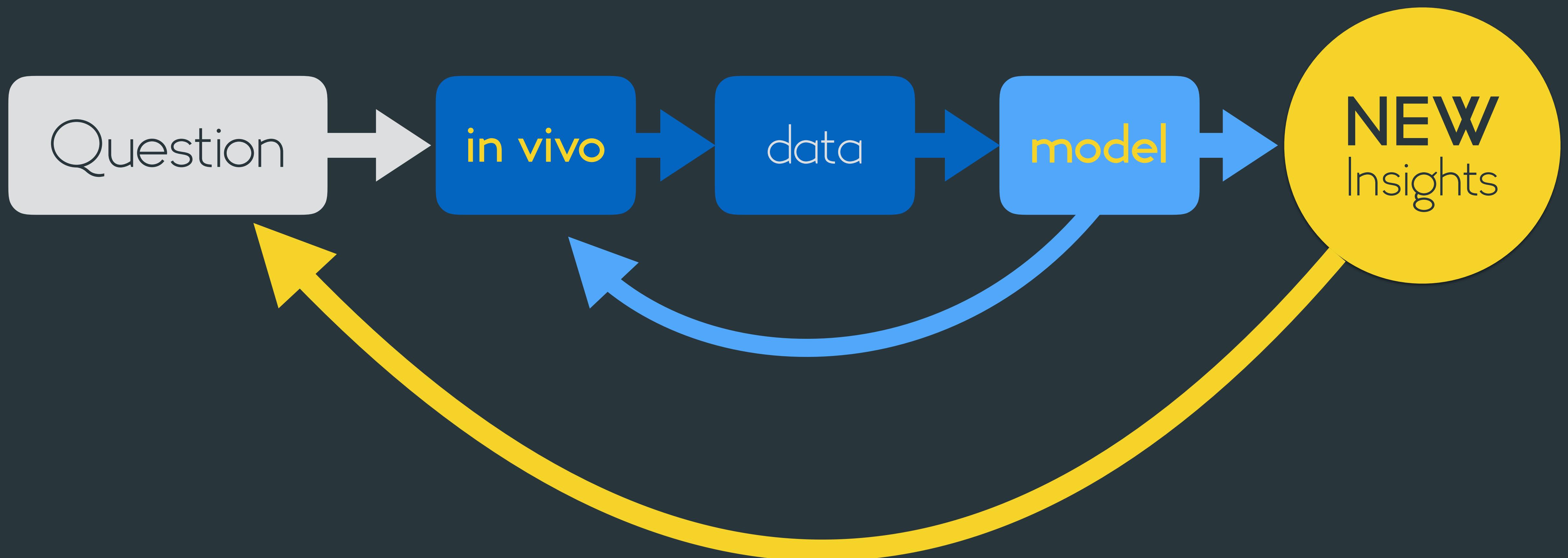
sub-organ
level

DATA-CENTERED SCIENCE PIPELINE



MODEL-ASSISTED SCIENCE PIPELINE

Using models to help understand your data

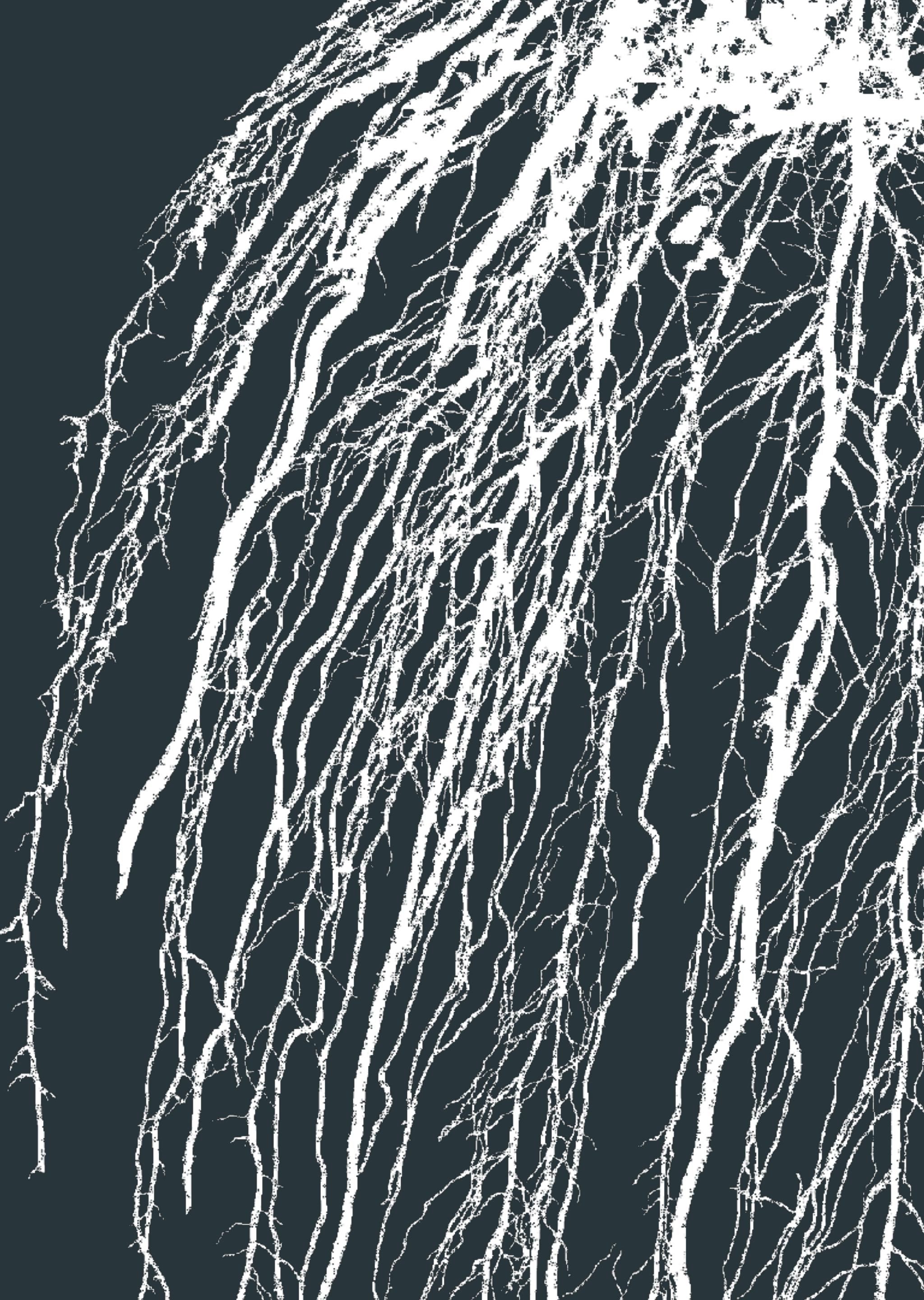


MODEL ASSISTED **BREEDING**

Ideotype
analysis



MY OWN
RESEARCH



2003

MASTER IN BIO-ENGINEERING

UNIVERSITÉ CATHOLIQUE DE
LOUVAIN

2008

PHD AGRONOMICAL SCIENCES

UNIVERSITÉ CATHOLIQUE DE
LOUVAIN

2013

POST-DOCTORAL FELLOW

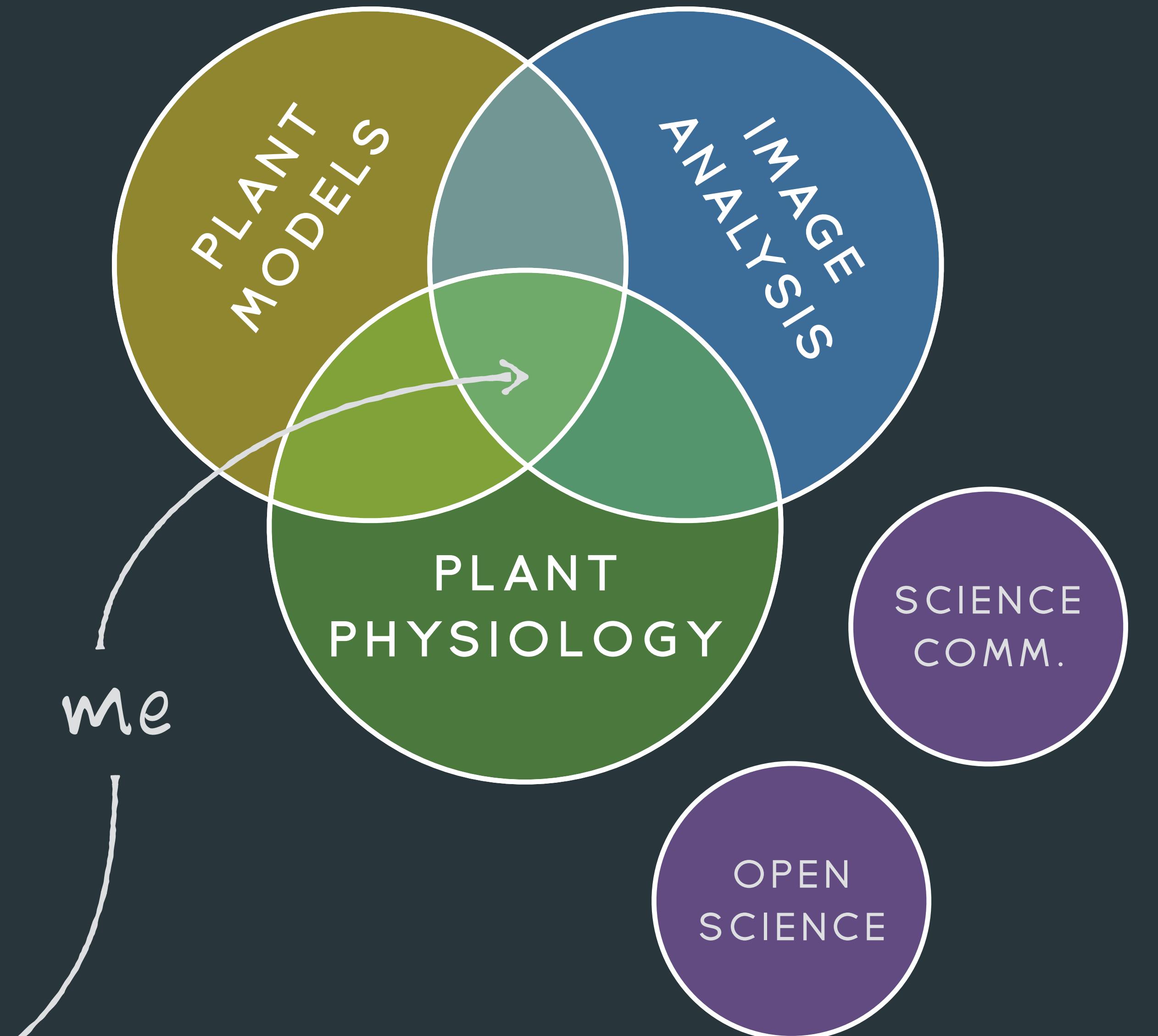
UNIVERSITÉ DE LIÈGE

2016

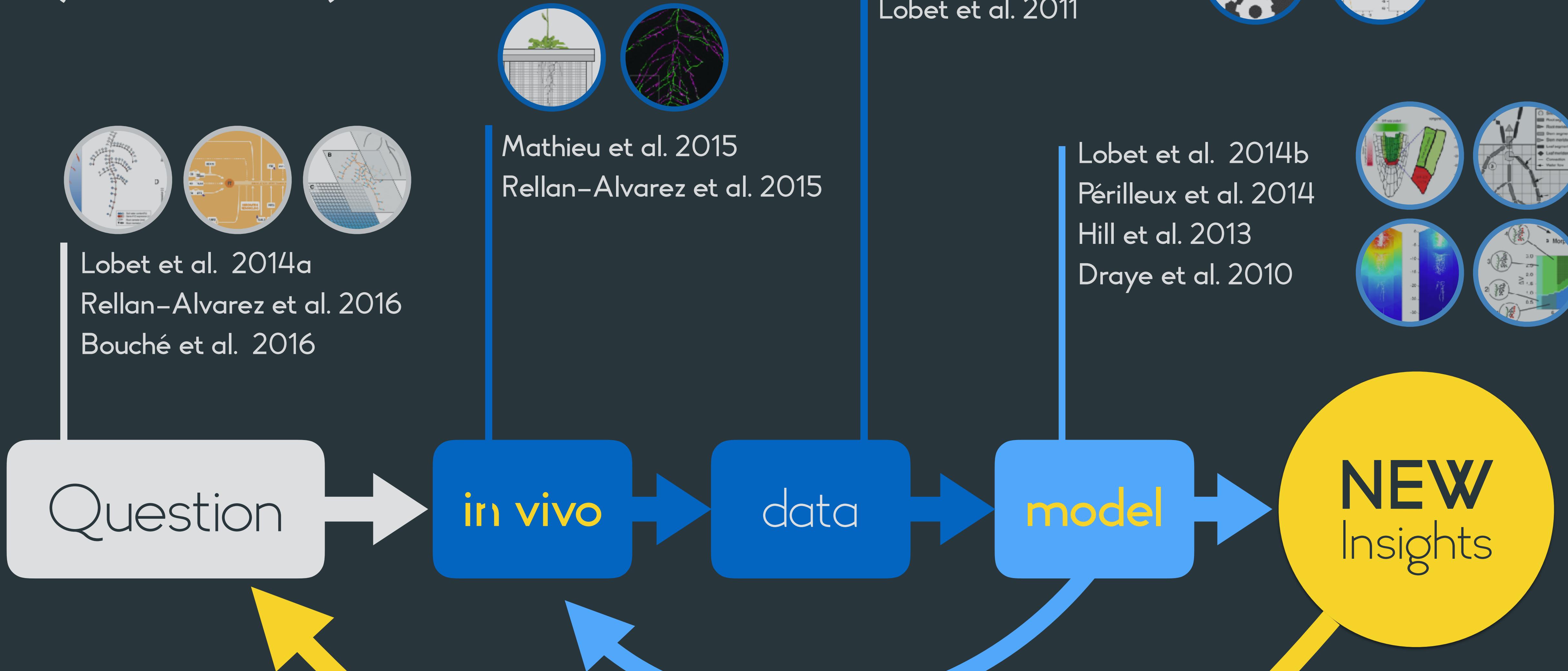
VISITING SCIENTIST

FORSCHUNGSZENTRUM
JULICH

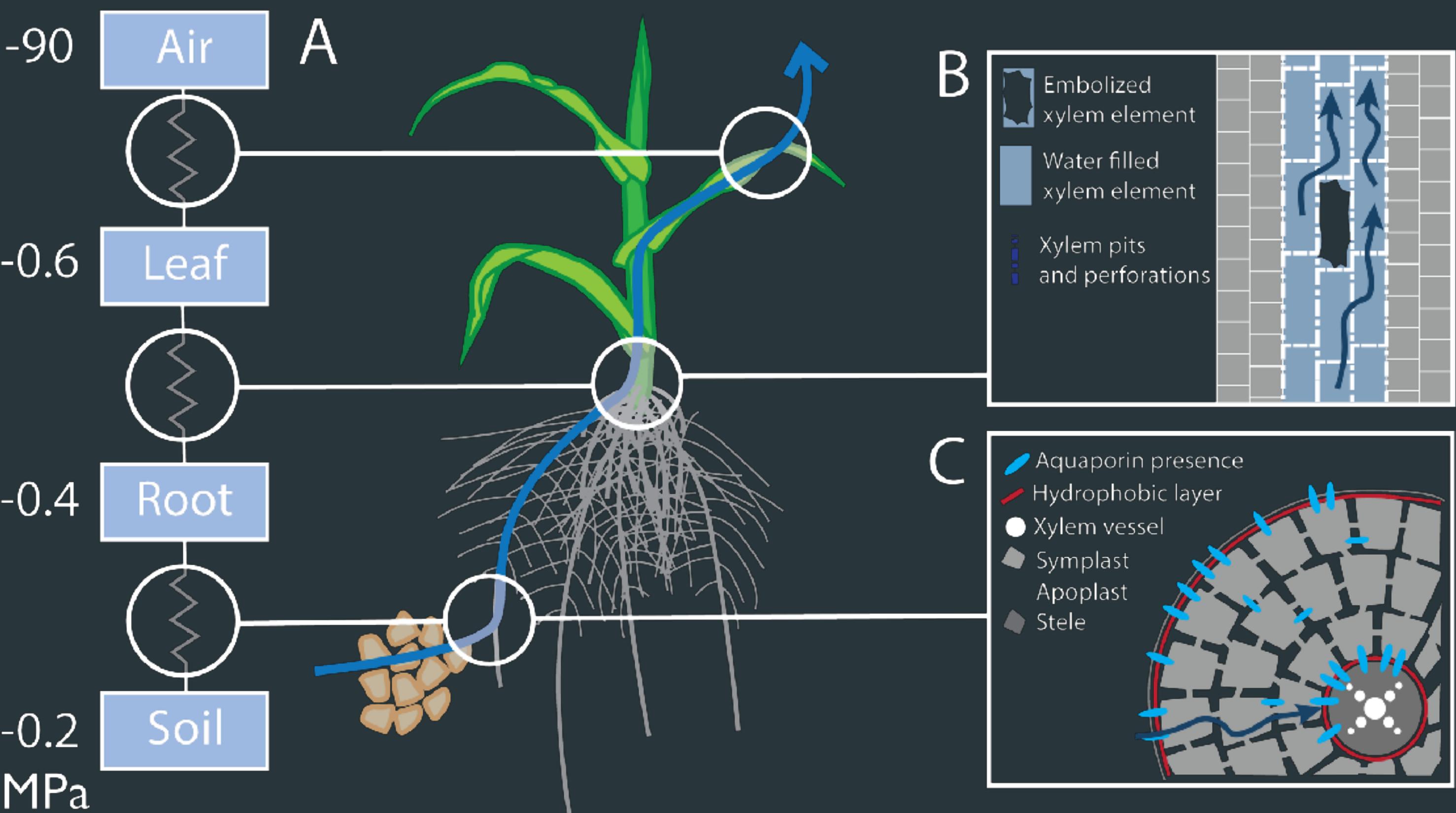
www.guillaumelobet.be



MY CONTRIBUTIONS (SO FAR)



Water uptake is a multi-dimensional and highly heterogeneous process along the root–soil domain



Lobet et al. 2014a
PMID: 24515834

Question →

in vivo →

data →

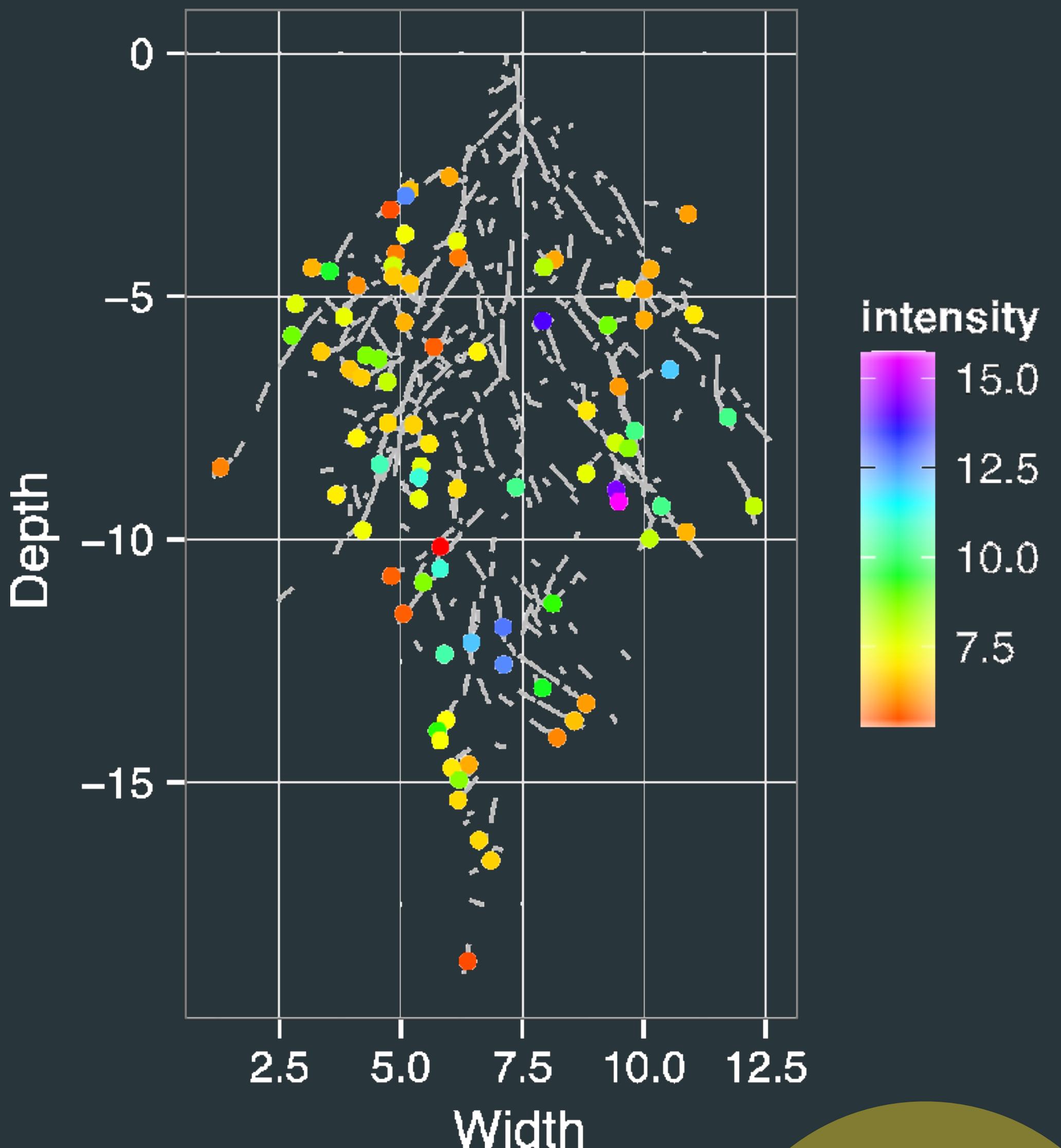
model →

NEW Insights

GLO-ROOT: Tracking root system architecture and specific gene expression in the root system in response to local environmental clues

Rellan-Alvarez et al. 2015
PMID: [26287479](#)

<http://bit.ly/glo-root>



Referencing 140 plant image analysis tools in a searchable web database

+10 000 page views / months

www.plant-image-analysis.org

Lobet et al. 2013

PMID: 24107223

The screenshot shows the homepage of the Plant Image Analysis website. At the top, there is a navigation bar with links for Software, References, Submit, and About. To the right of the navigation are icons for search, email, RSS feed, Twitter, and GitHub. The main content area features a search bar with placeholder text "Search..." and a "Search" button. Below the search bar is a "Choose..." section with dropdown menus for "Plant organ" (set to "any") and "Measurements" (set to "any"). There is also a "MORE OPTIONS +" link. To the right of these controls is a grid of 20 software tool icons, each with a name below it. The tools are arranged in four rows of five. The names of the tools are: Assess, ARIA, ARTT, Balloon Plugin, BiolImageXD; BioLeaf, Bisque, Black Spot, BRAT, Callose Measurer; Canopy Analysis, Canopy Reconstruction, Cefiler, Celer, Cell-o-Tape.

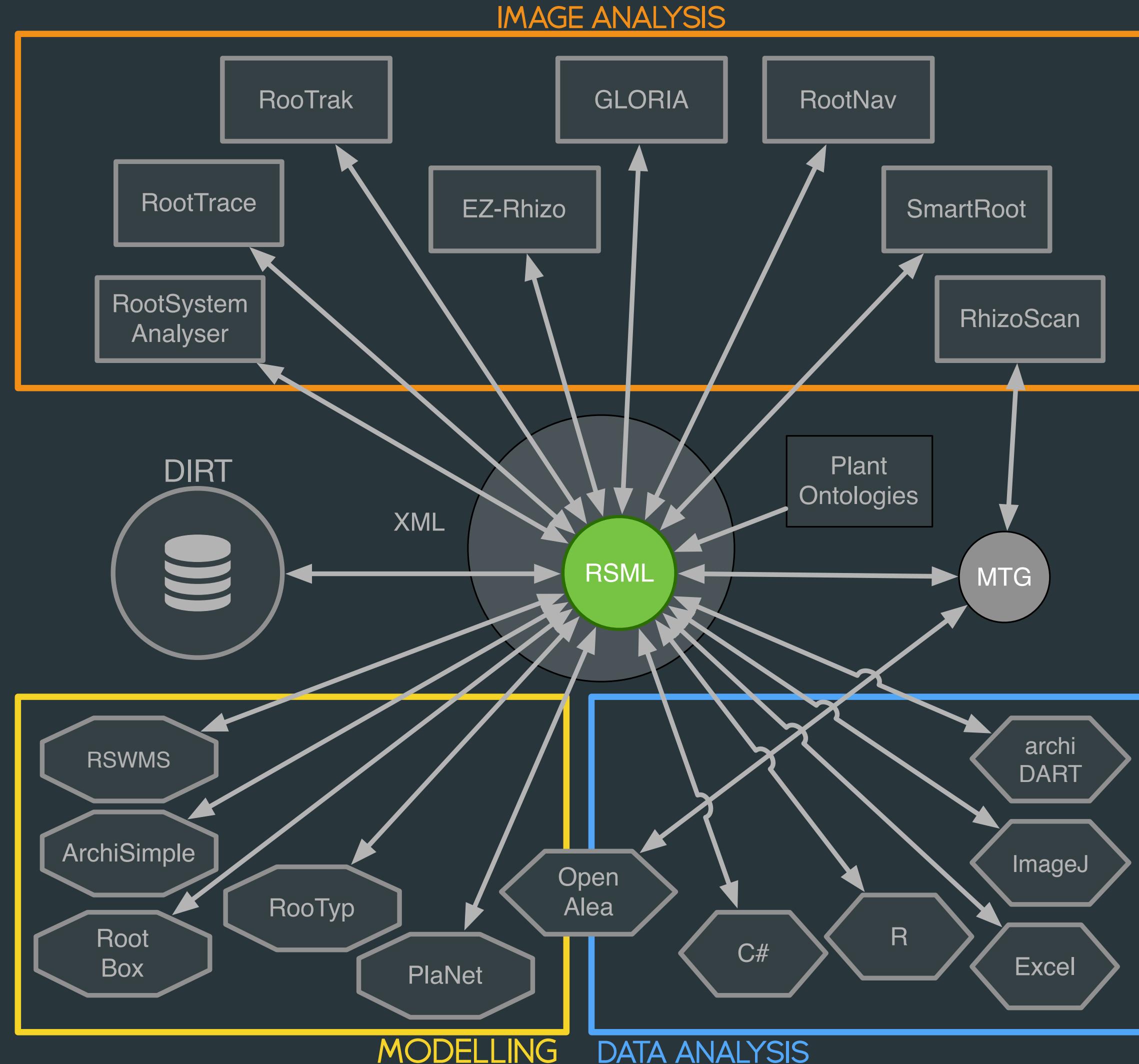


Root System Markup Language:

A common format for root system architecture data

http://rootsystemml.github.io/

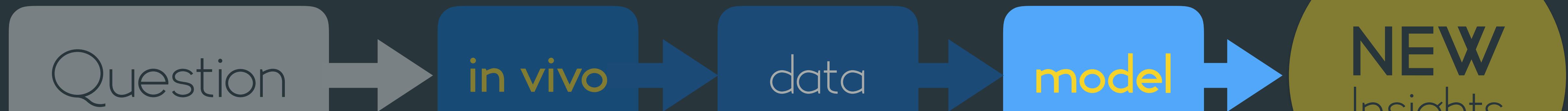
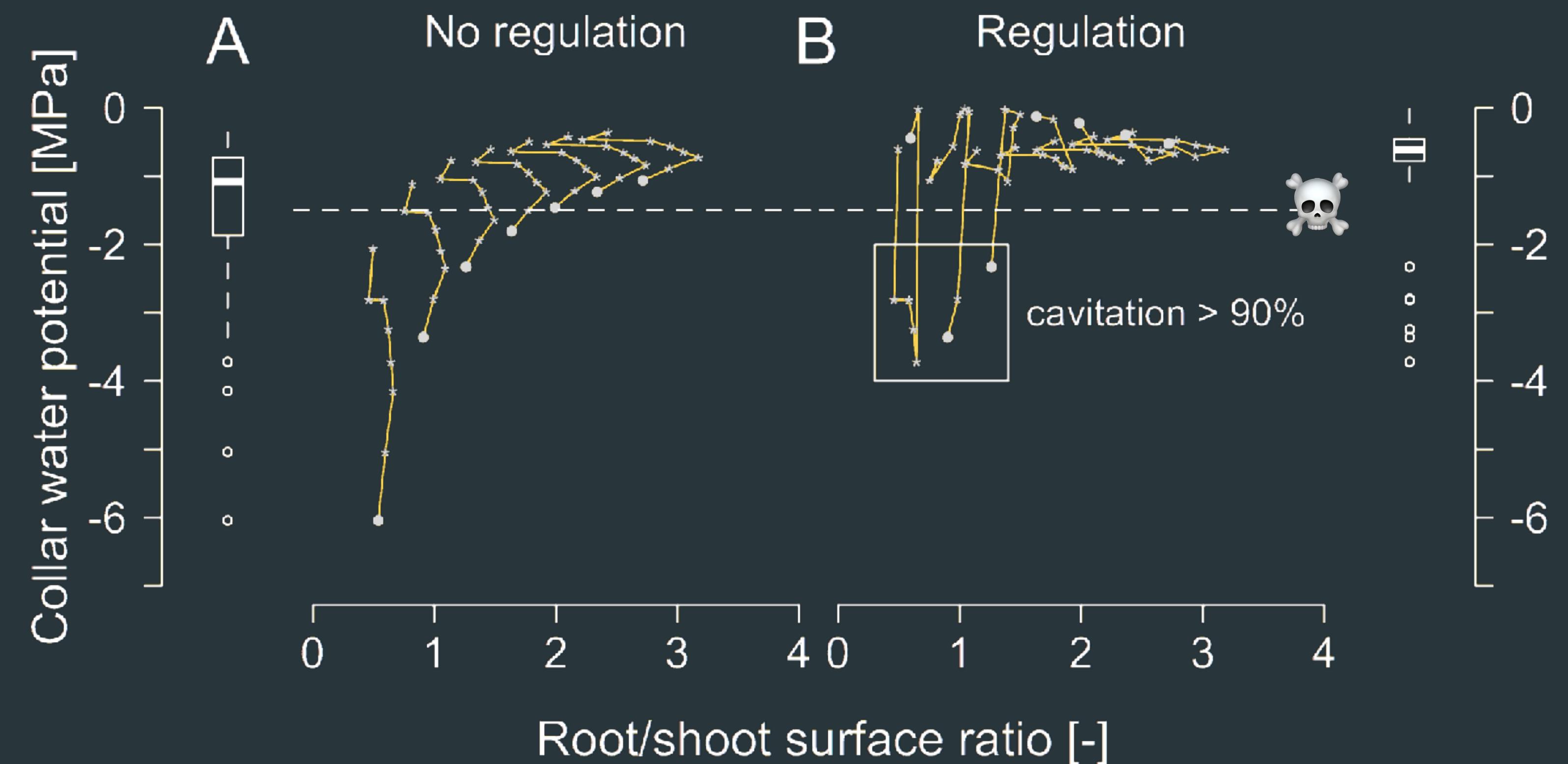
Lobet et al. 2015
PMID: 25614065



PlaNet-Maize: a whole functional structural plant model for water flows in the SPAC

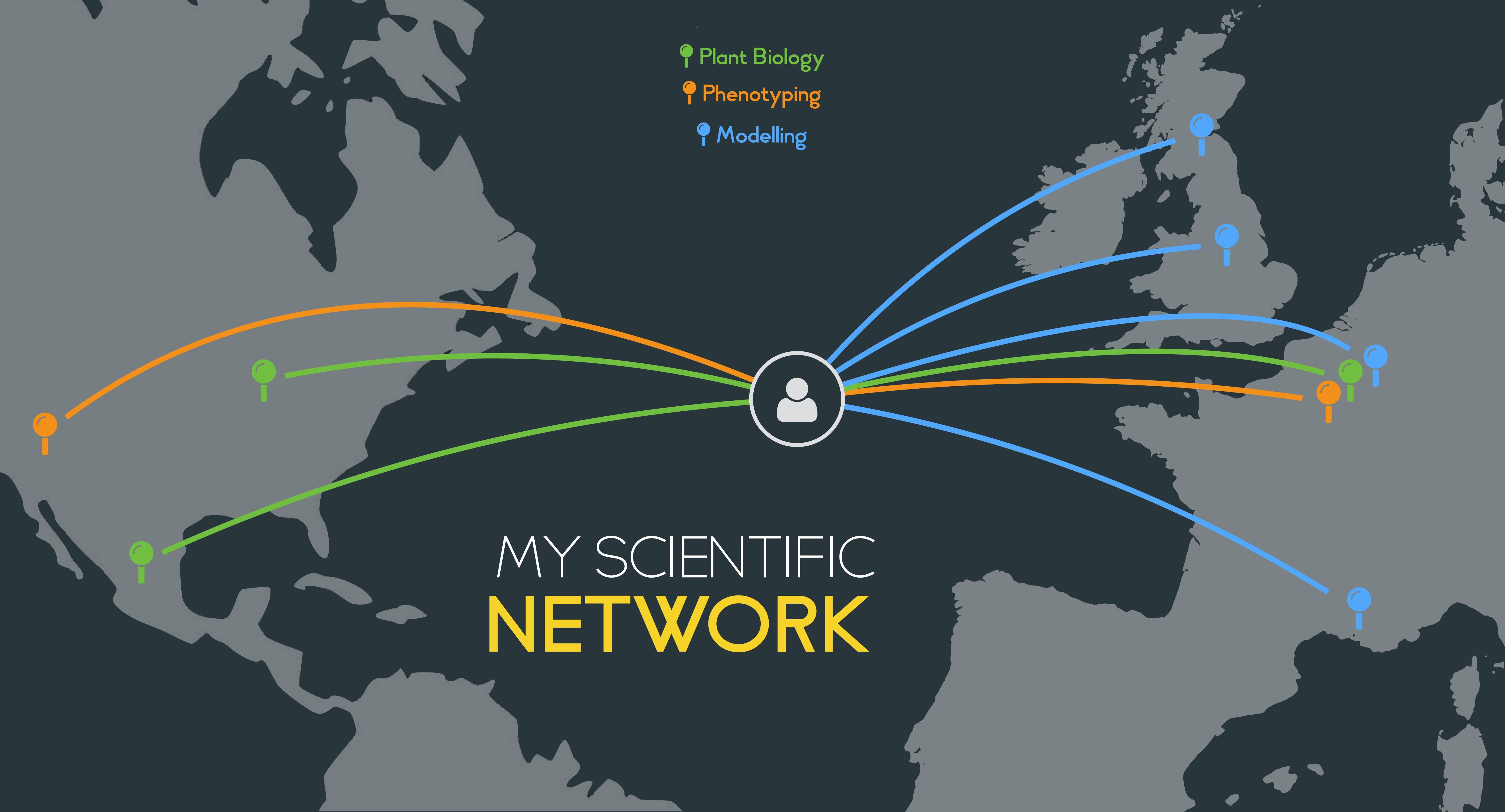
Lobet et al. 2014

DOI: [10.1016/j.ecolmodel.2013.11.025](https://doi.org/10.1016/j.ecolmodel.2013.11.025)

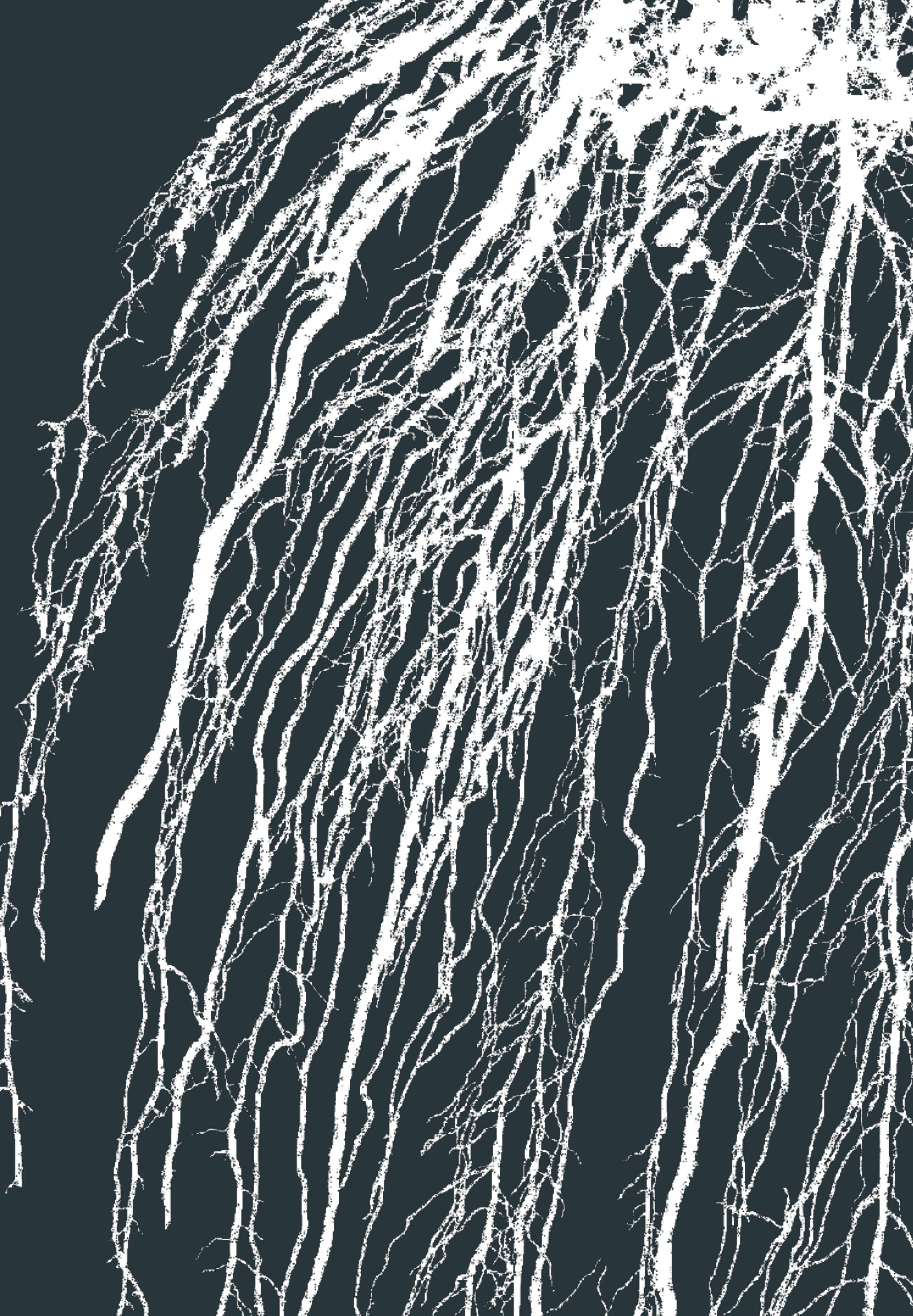


- Plant Biology
- Phenotyping
- Modelling

MY SCIENTIFIC **NETWORK**

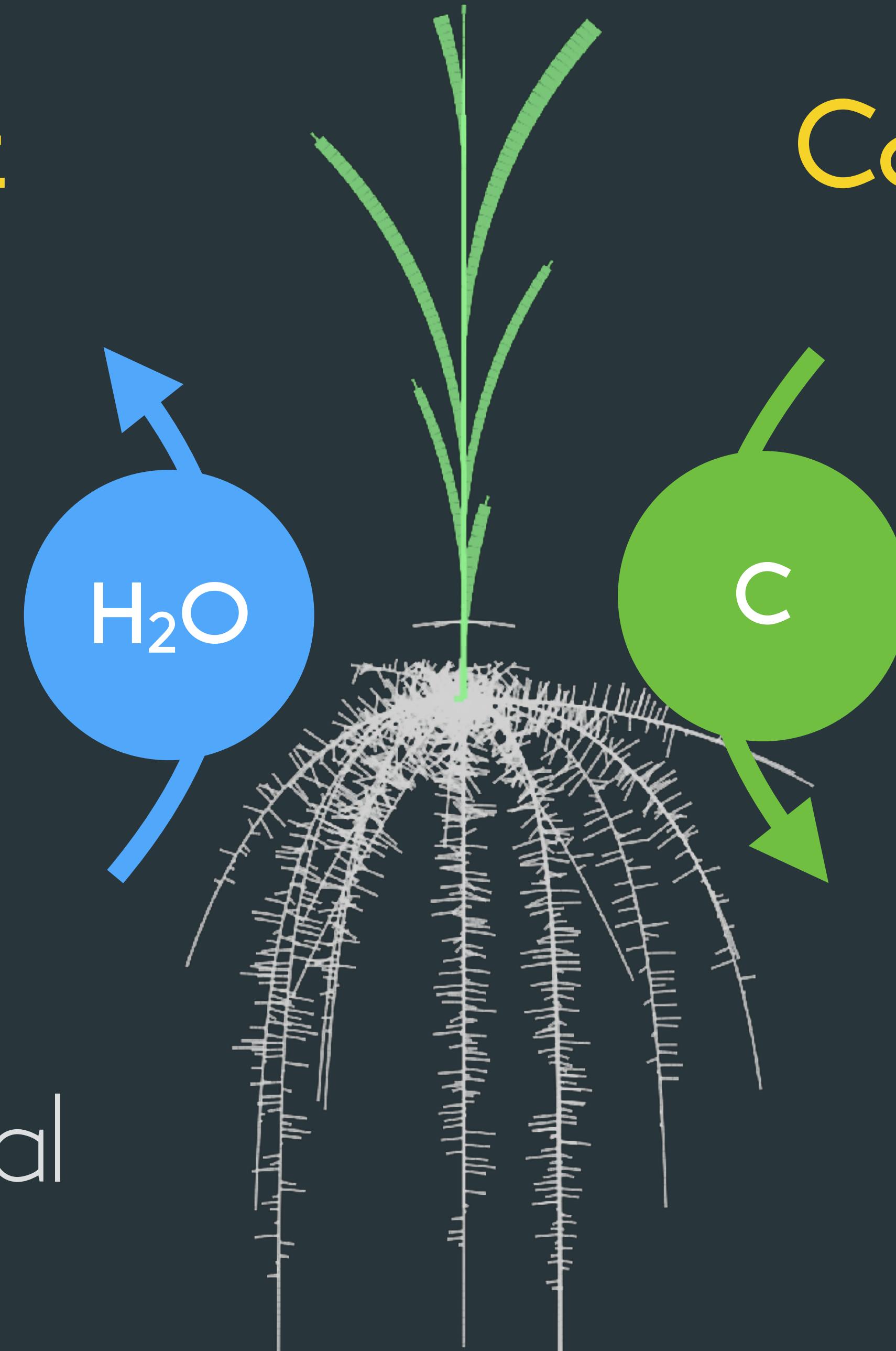


RESEARCH PROJECT



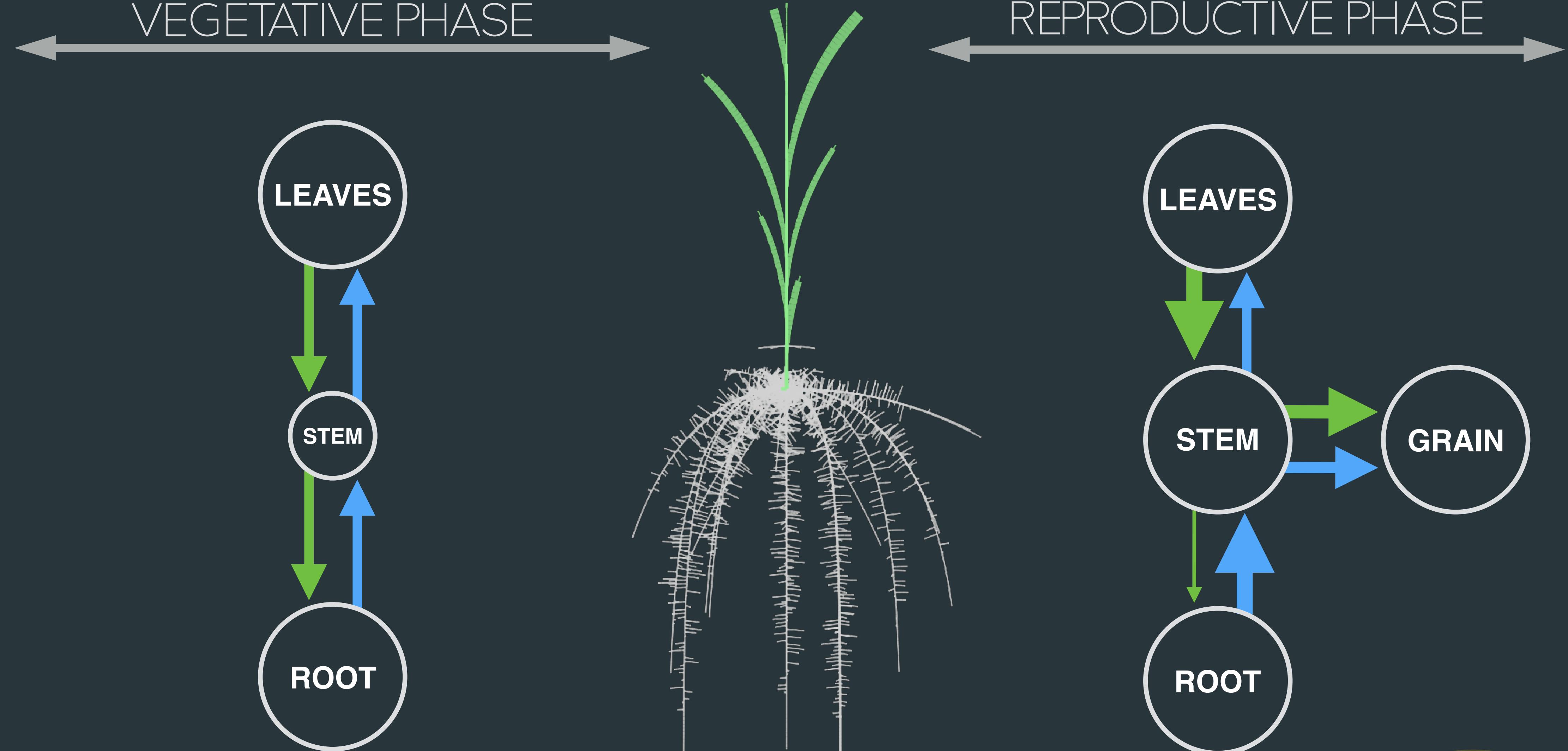
Whole plant
FSPM

Late
developmental
stages



Complex processes
(H_2O , C, Nutr.)

Heterogeneous
environments



Question

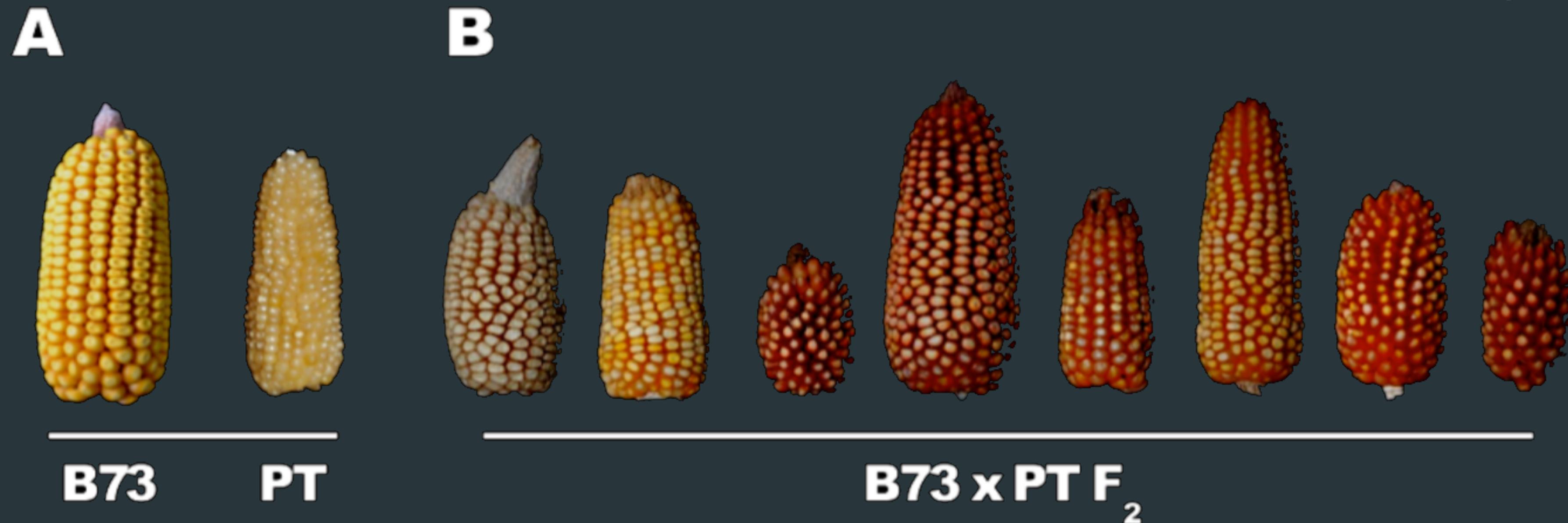
in vivo

data

model

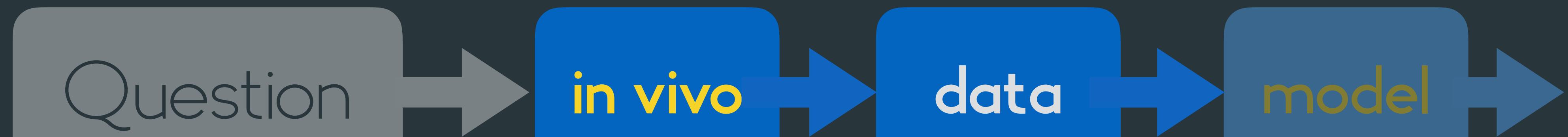
NEW

MAIZE AS A MODEL PLANT



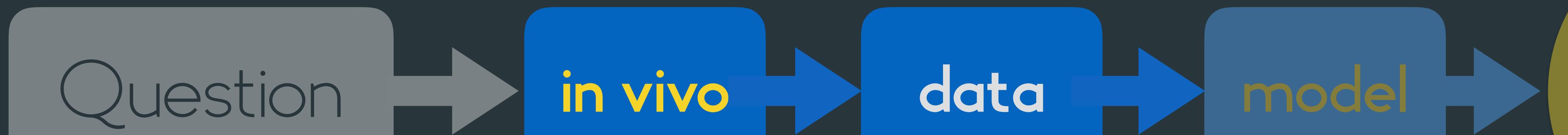
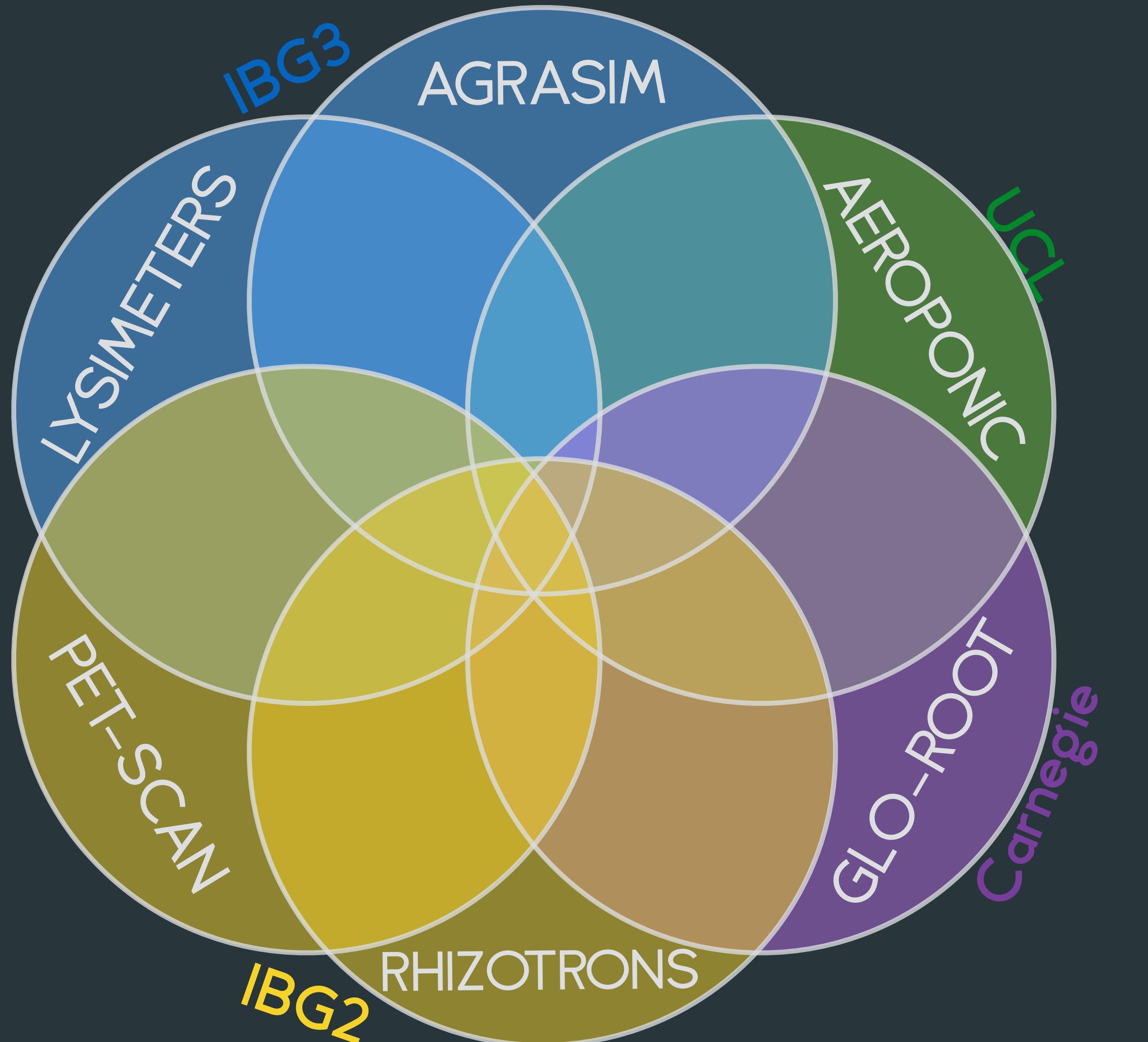
RIL population [Palomero Tolequeno x B73]

Large **phenotypic variability**



UNIQUE INFRASTRUCTURES

Complementary systems
Integrated approach



L-Peach



Cut-Rose



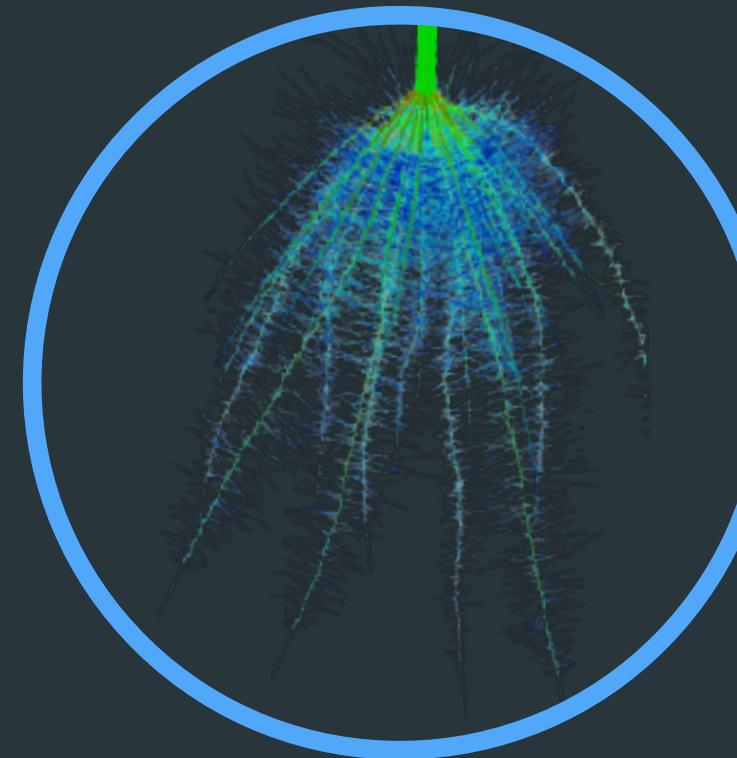
L-Py



WHOLE PLANT

FSPM

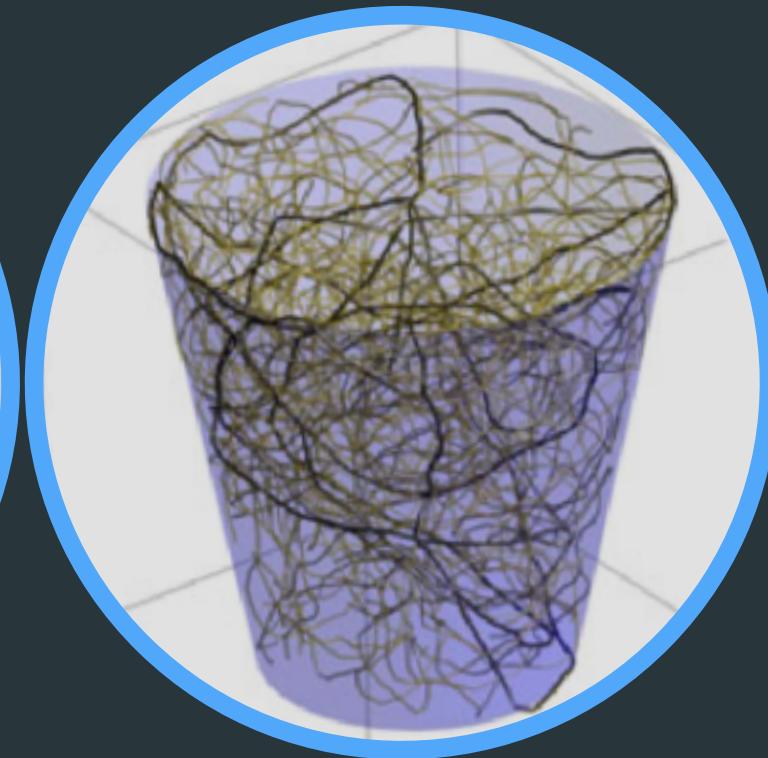
SimRoot



RootMap



RootBox



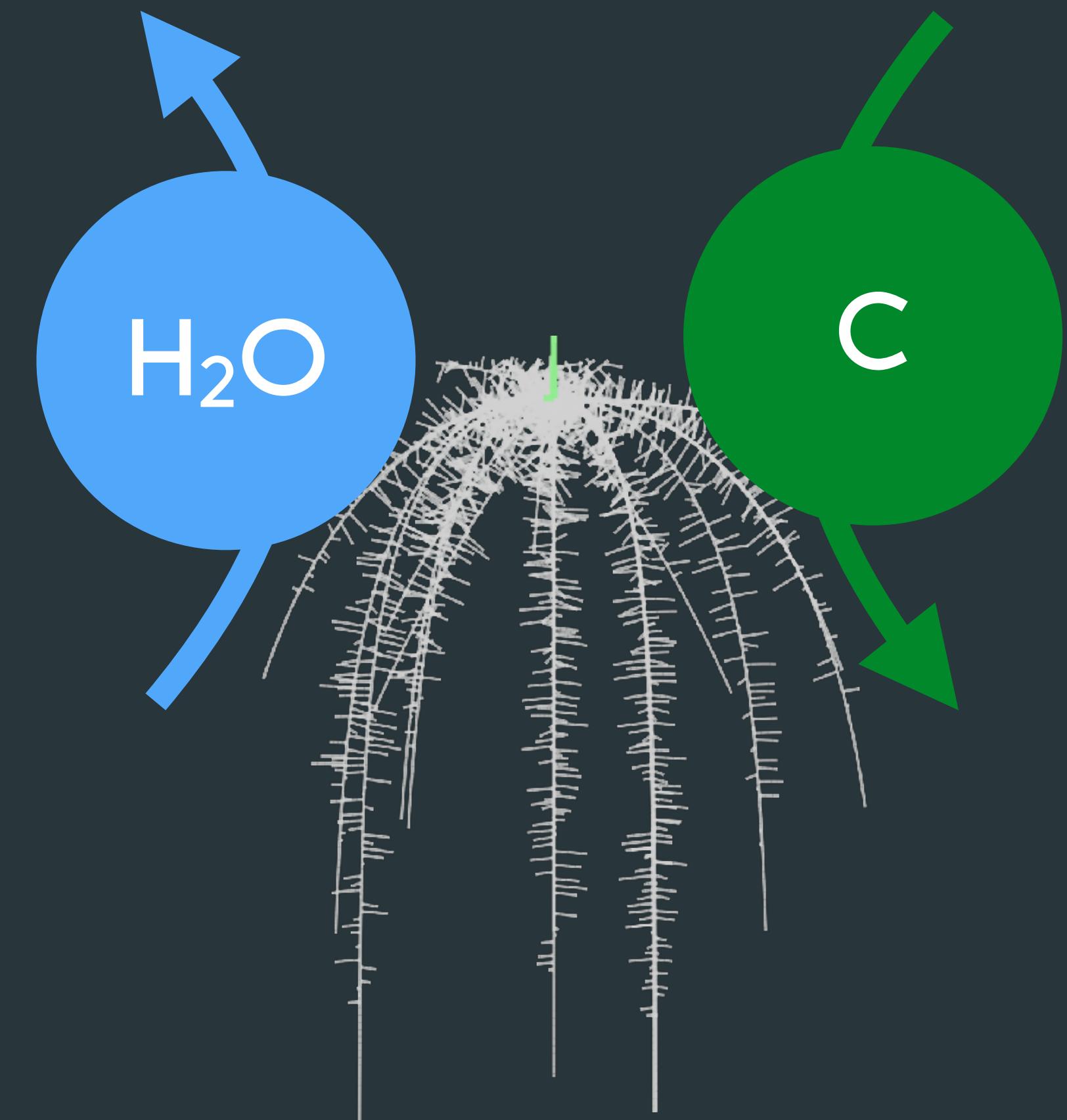
Question

in vivo

data

model

NEW
Insights



PlaNet-Maize

Carbon transport

Atmosphere

DuMuX

Water transport

Soil

Question

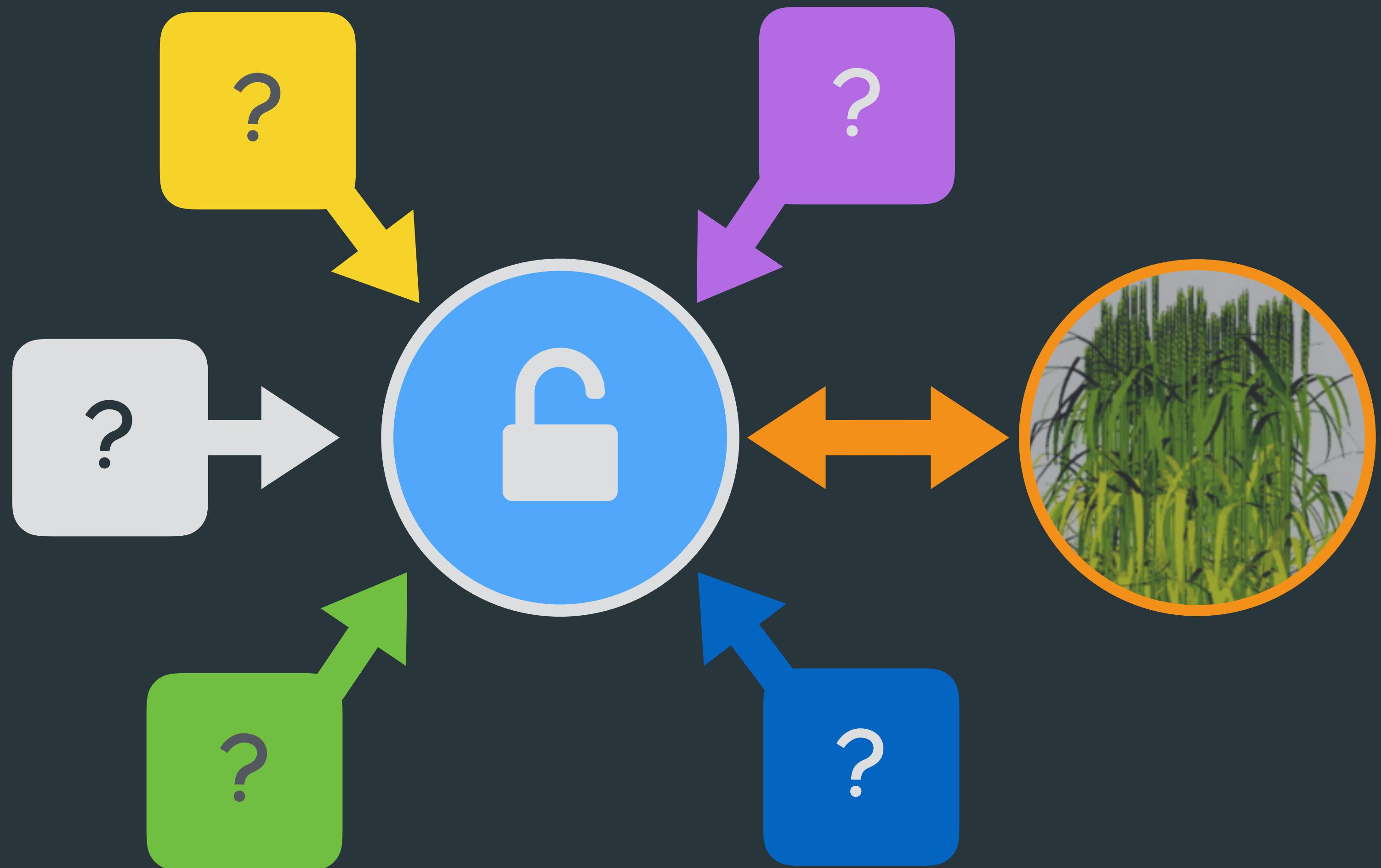
in vivo

data

model

NEW
Insights

MODEL-ASSISTED SCIENCE ...



...FOR THE COMMUNITY

ANY QUESTIONS ?



Presentation
available on **figshare**

bit.ly/lobet-ucl-fzj

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COLOPHON (1/3)

This presentation was made on **Keynote**.

The fonts used are **Glode** (text) and **Font Awesome** (glyphs)

Main colors are:

#28353A

#70BF42

#F6D428

#F48F18

#52A8F9

COLOPHON (2/3)

Figures and illustrations were made using a mixture of:

- **r plot** (slide 18)
- **ggplot2** (simulated plants, slides 6, 7, 15, 21, 22, 25, 26)
- **Omnigraffle** (slides 14, 17)
- **GIMP** (slides 11, 23, 25)
- **Keynote** (everything else)

 COLOPHON (3/3)

Images are coming from:

- Flickr (slide 3)
- www.lobet.eu (slide 2)
- My own library