# Explorations of Noise in the Shoot Apical Meristem

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# The SAM is a developmental hub in *A. thaliana*

- Development of aerial organs (flowers, leaves, tissue) is determined at the SAM
- The stem cell population is located at the apex
- Gene expression specifies cell identity
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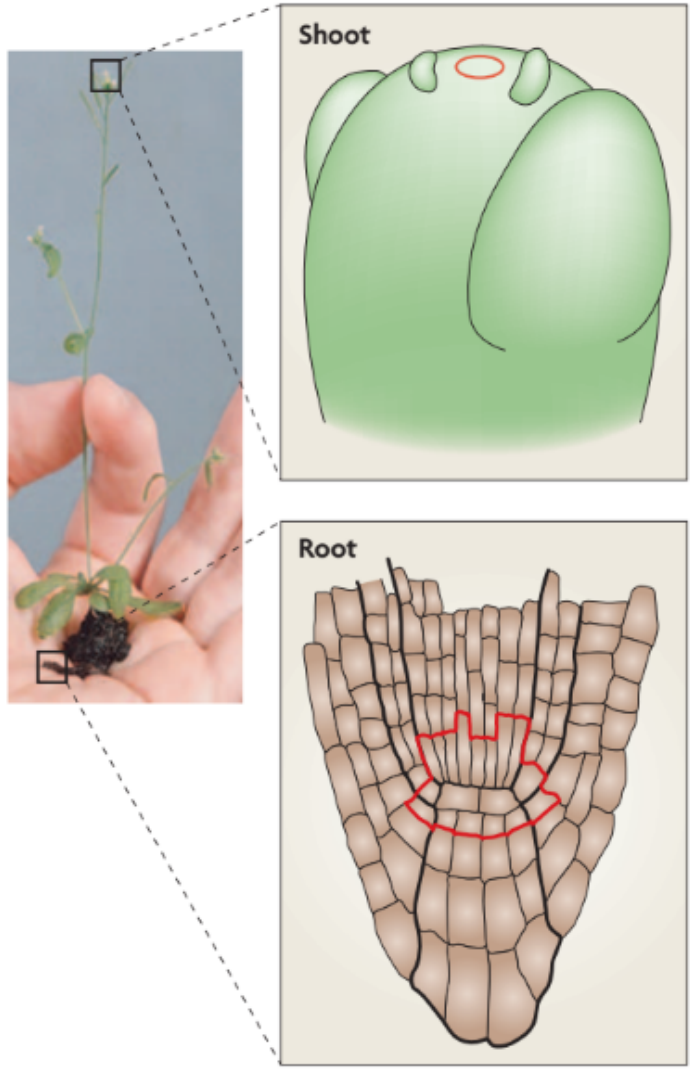
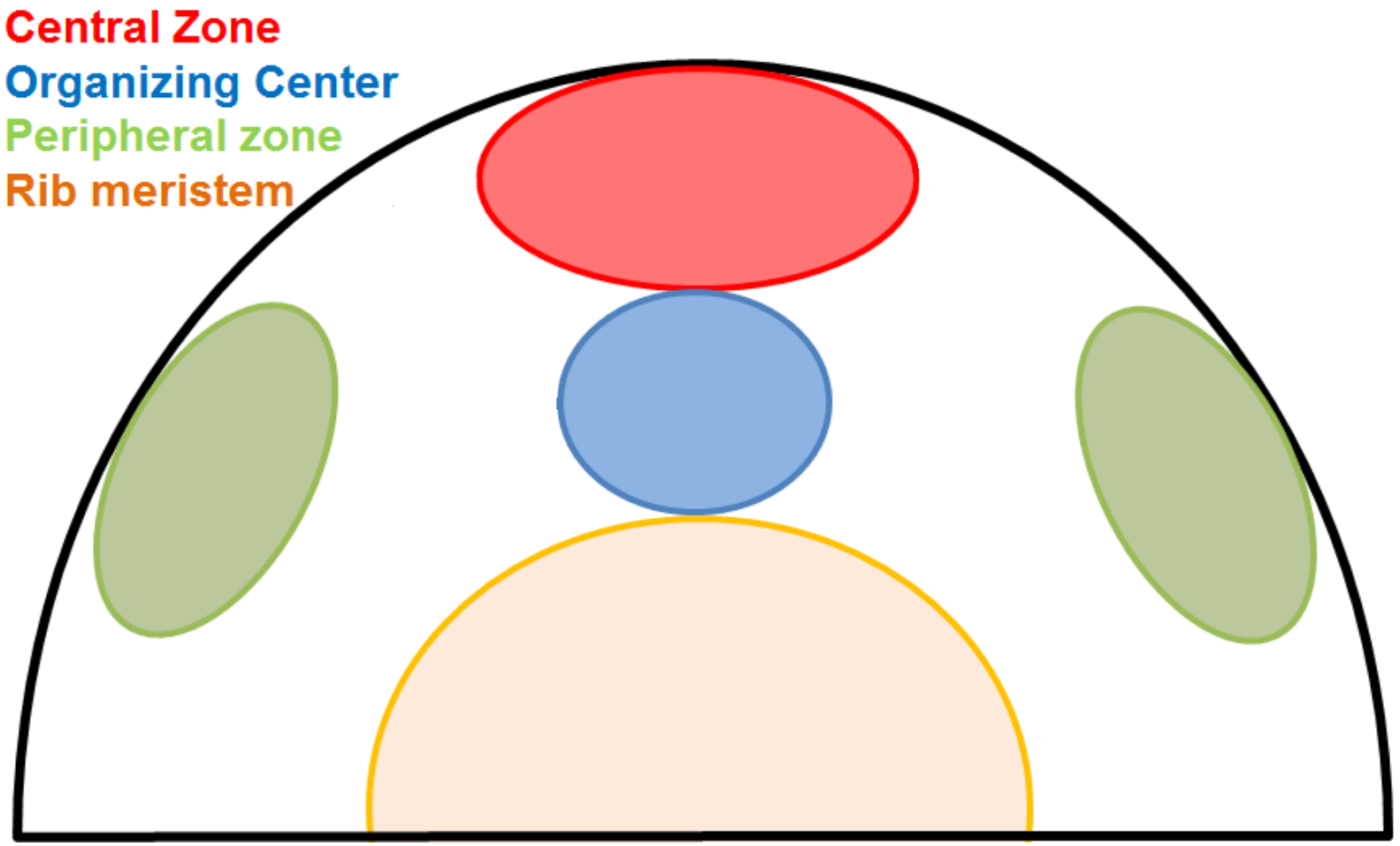



Scheres, 2007

# negative feedback loops

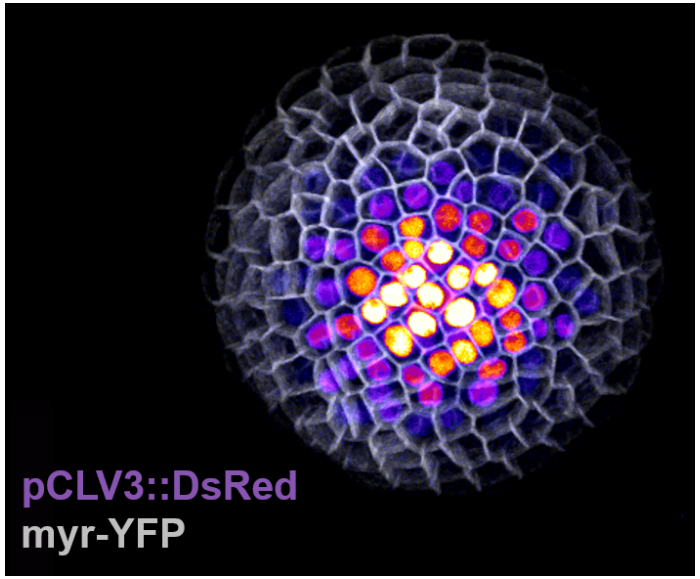


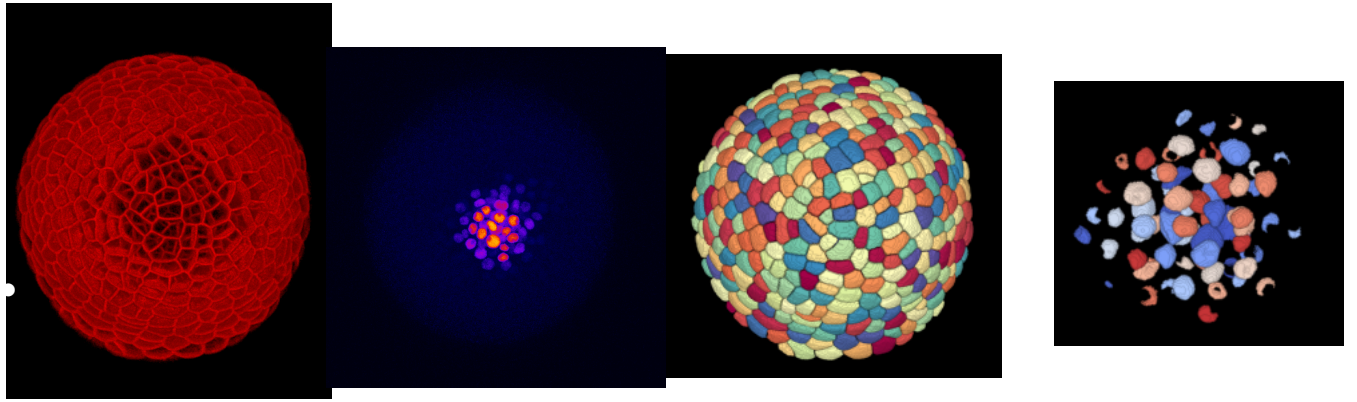
# Project outline

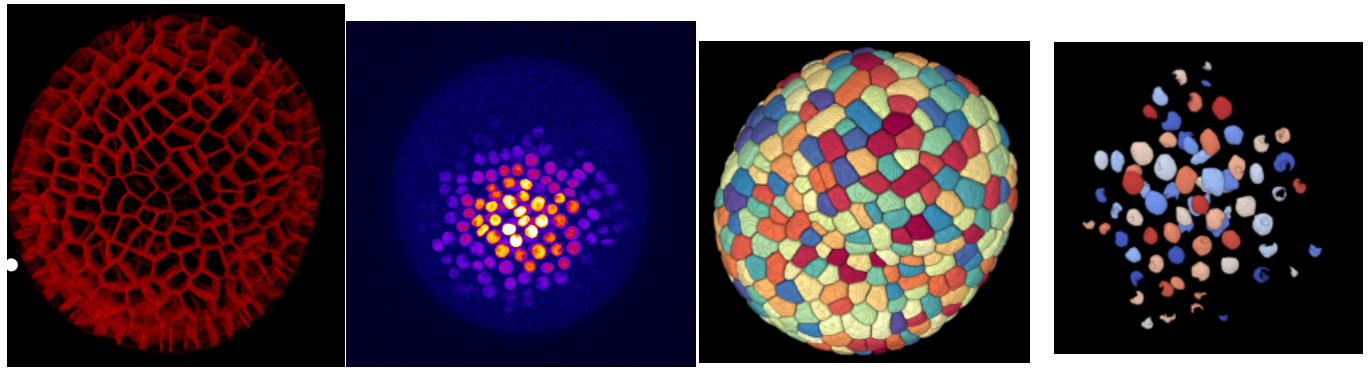
1. Design of data analysis pipeline:
    - Tidies, prunes and computes segmentation, cell line and division data
    - Written in R
    -
2. Exploration of data used in Willis et al. (2016)

3. Stochastic model investigations of data findings

# Data: High-resolution timecourses of plant growth

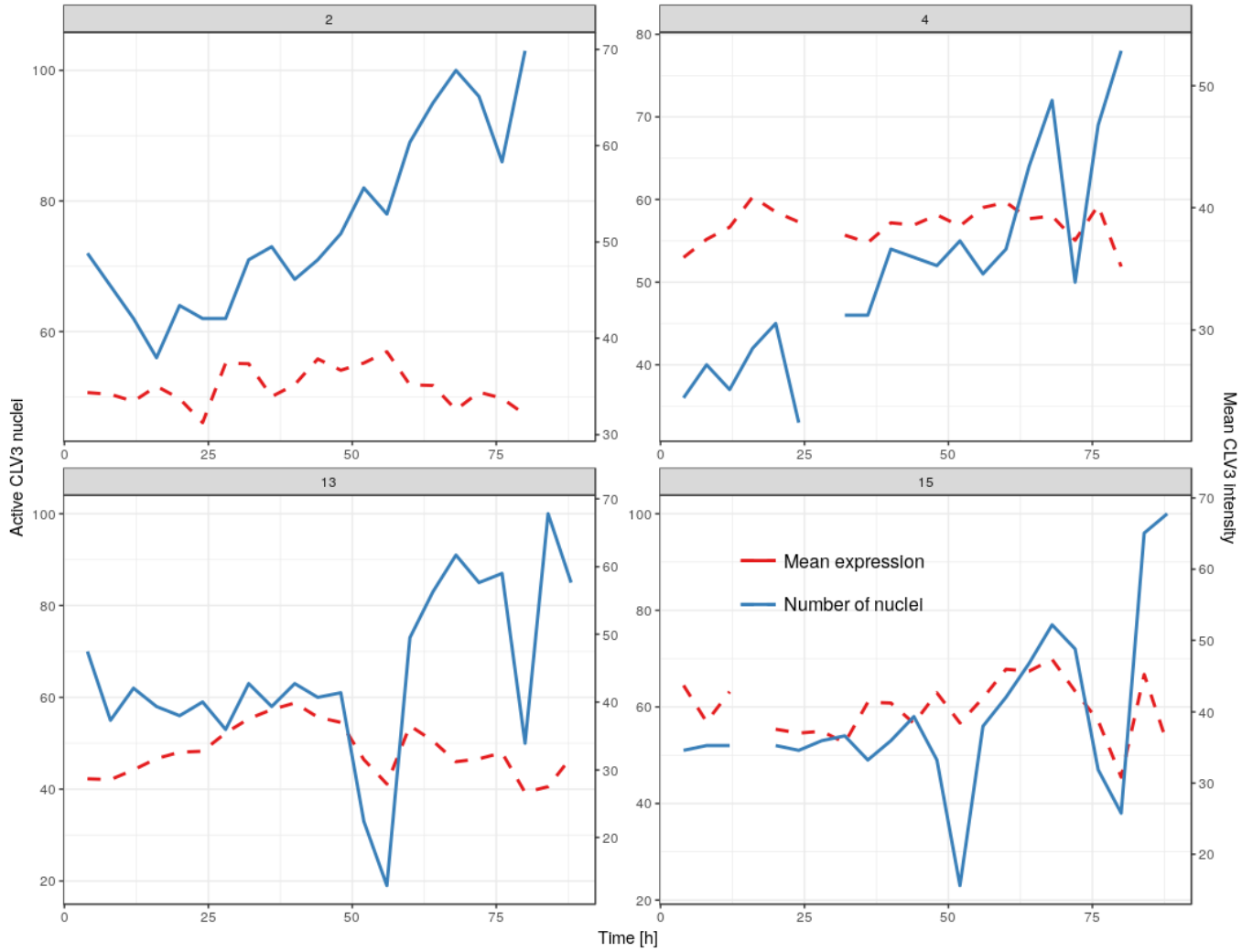




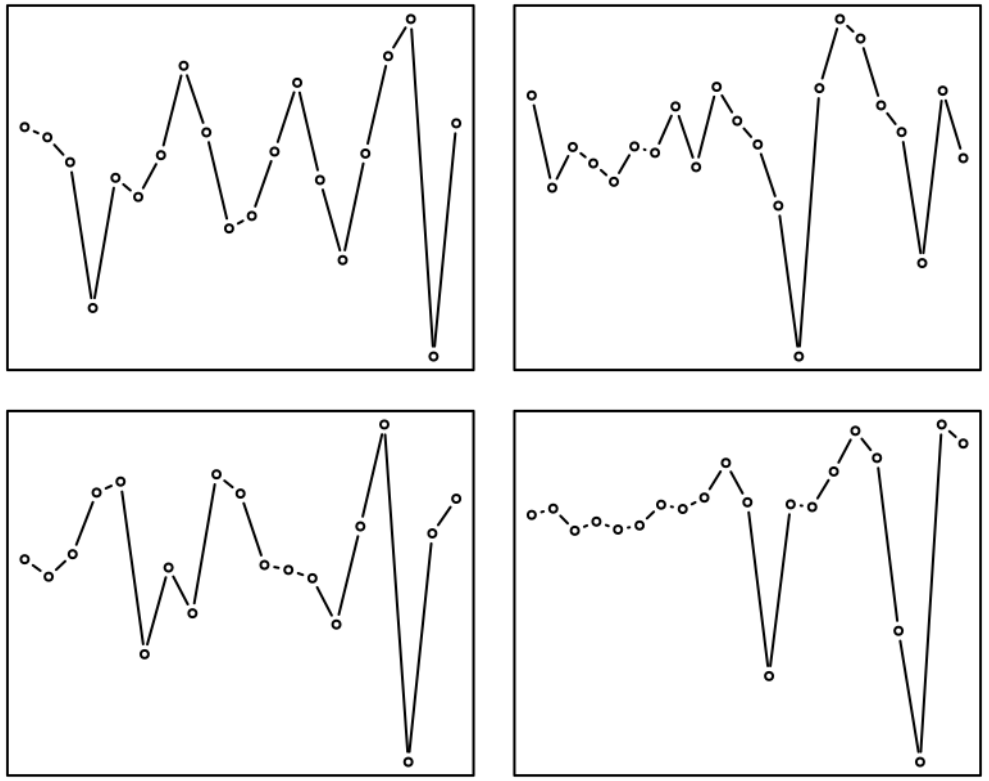
# Data shows large perturbations I

- Dilution of NPA perturbs system
- Oscillations not linked to mean expression
- Visually observable domain fluctuations in raw images



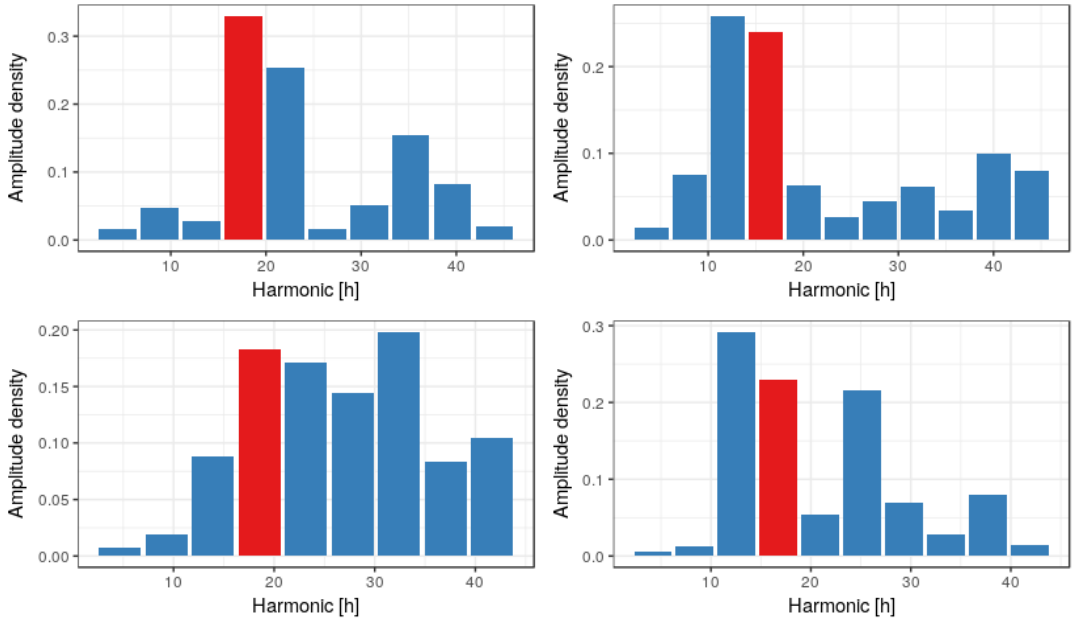
# Data shows large perturbations I

Detrended curves



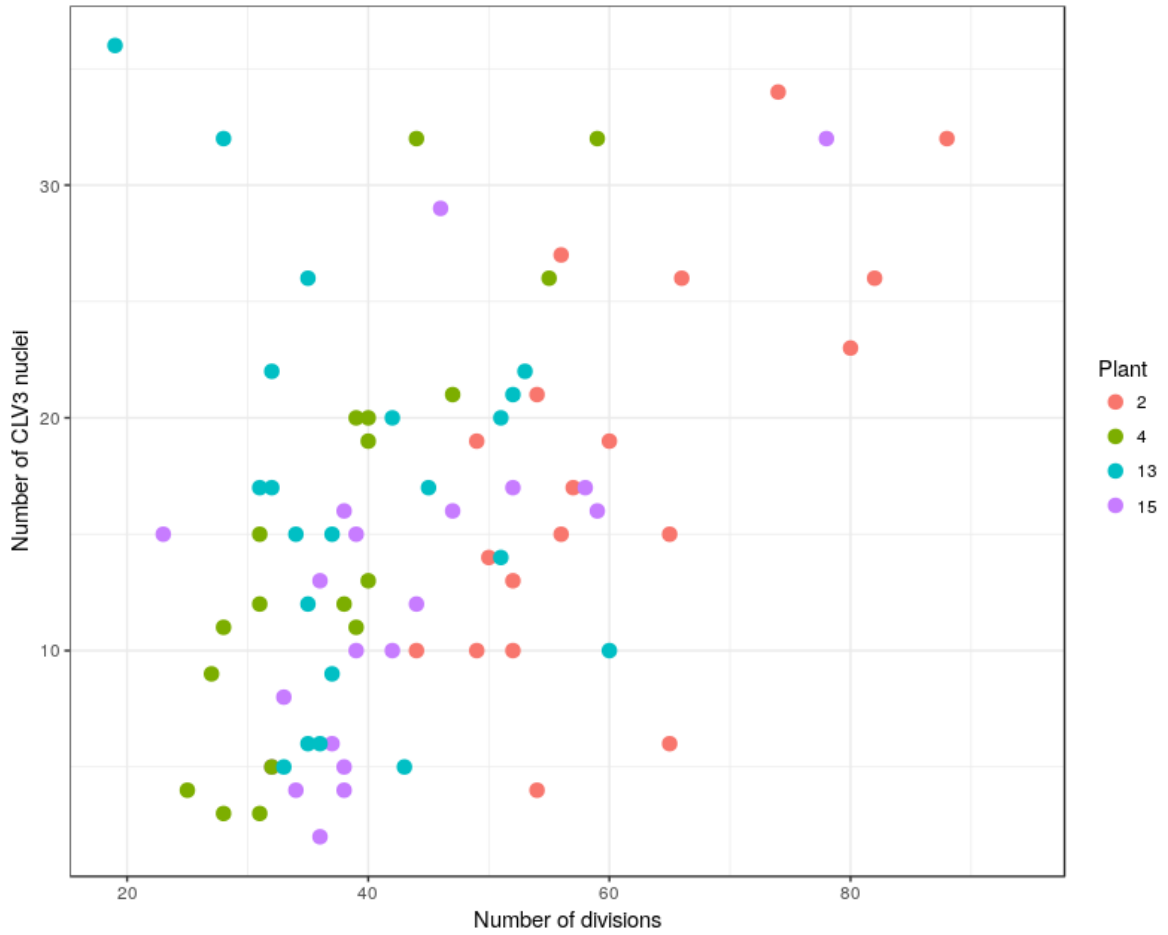
Fourier decomposition

Frequency density



# Data shows large perturbations II

- #Nuclei correlates with #Divisions
- All: R = .43, p = 6.01e-05
  - Plant 2: 1.90e-04
  - Plant 4: 6.79e-06
  - Plant 13: 0.21
  - Plant 15: 8.38e-05
- Plants appear to undergo significant functional variance



# Cells at apex behave robustly I

- Analysis hampered by definition of apex
- Drops in expression at apex likely from loss of signal at division
- Investigations of bimodality show no results
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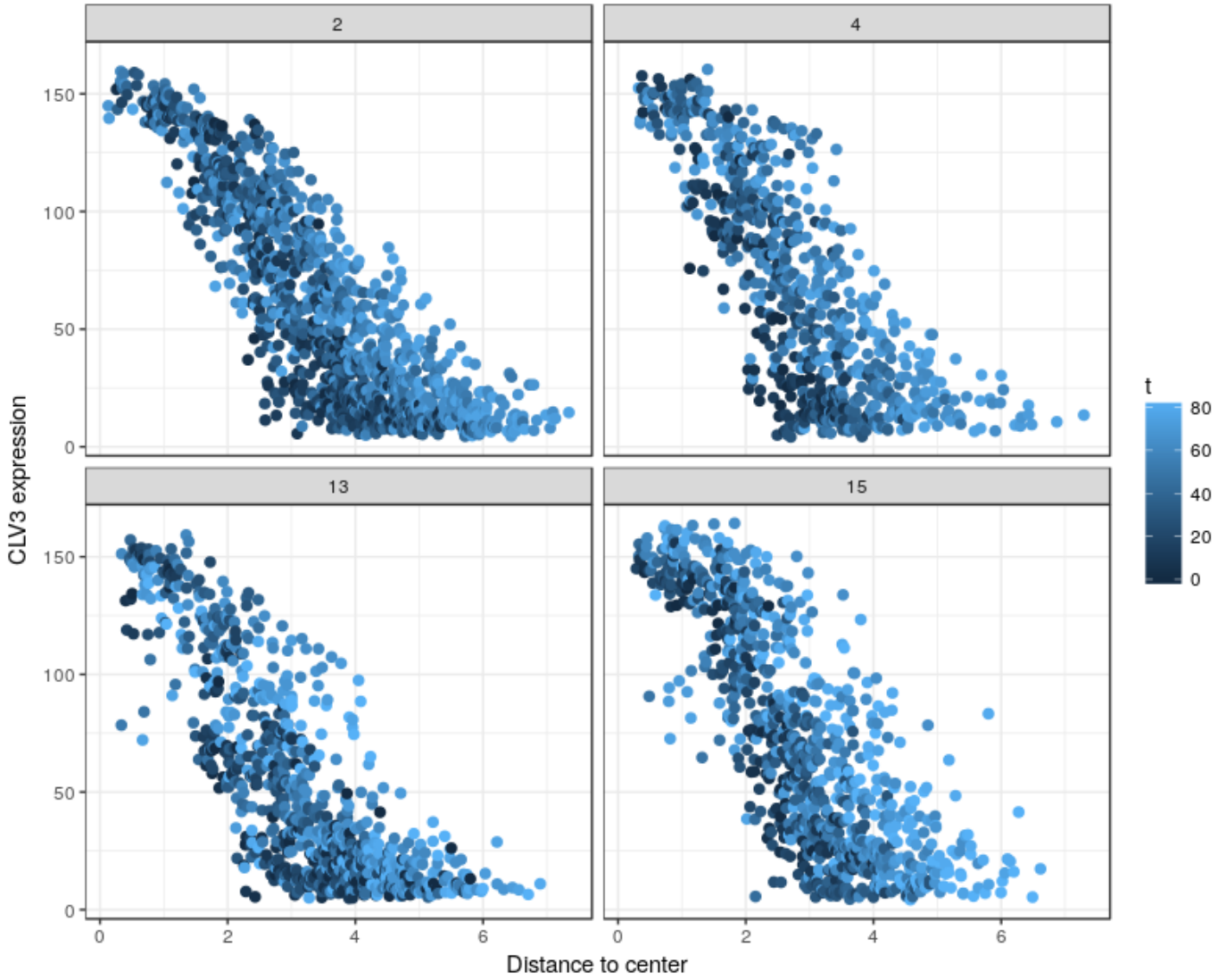
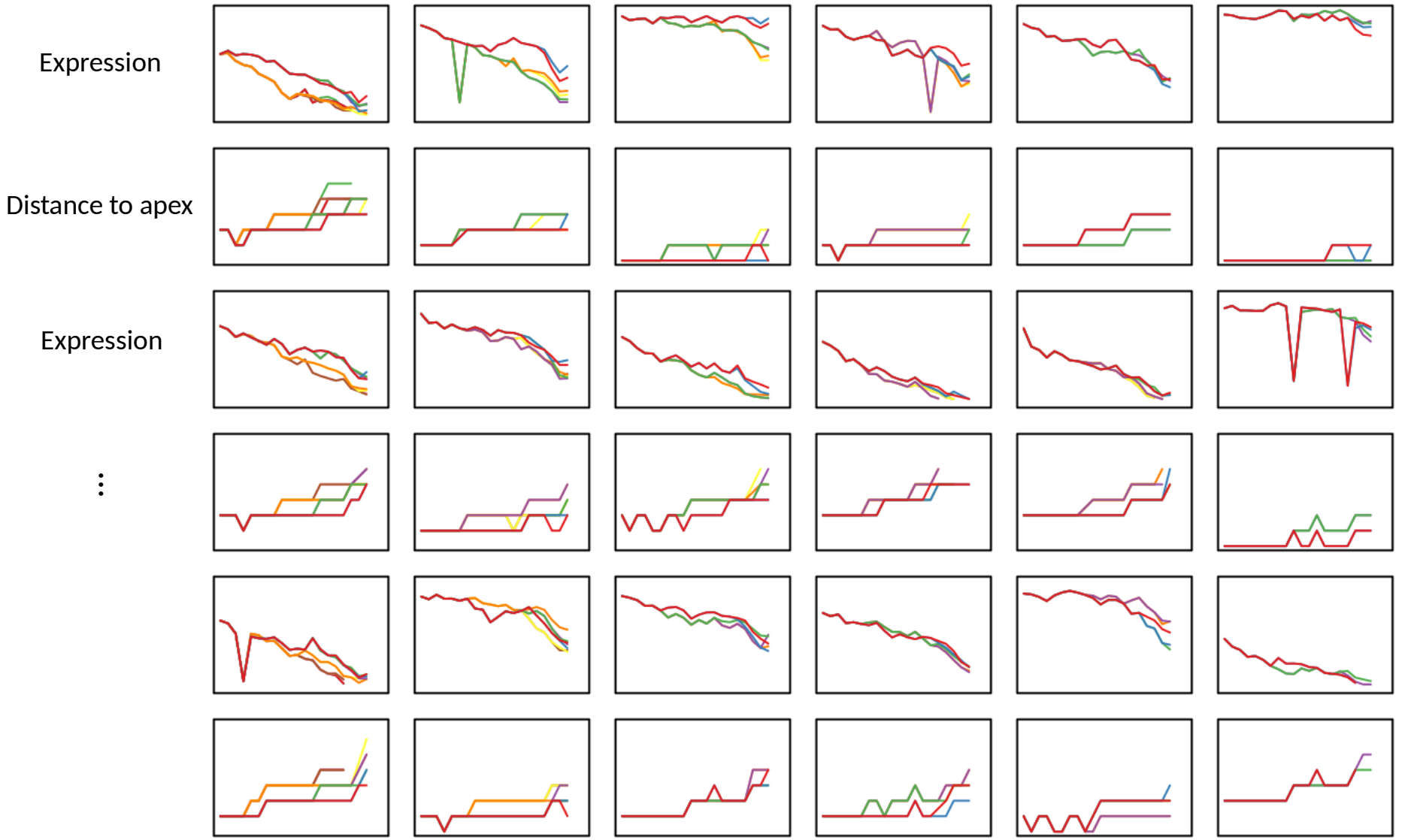


# Cells at apex behave robustly II



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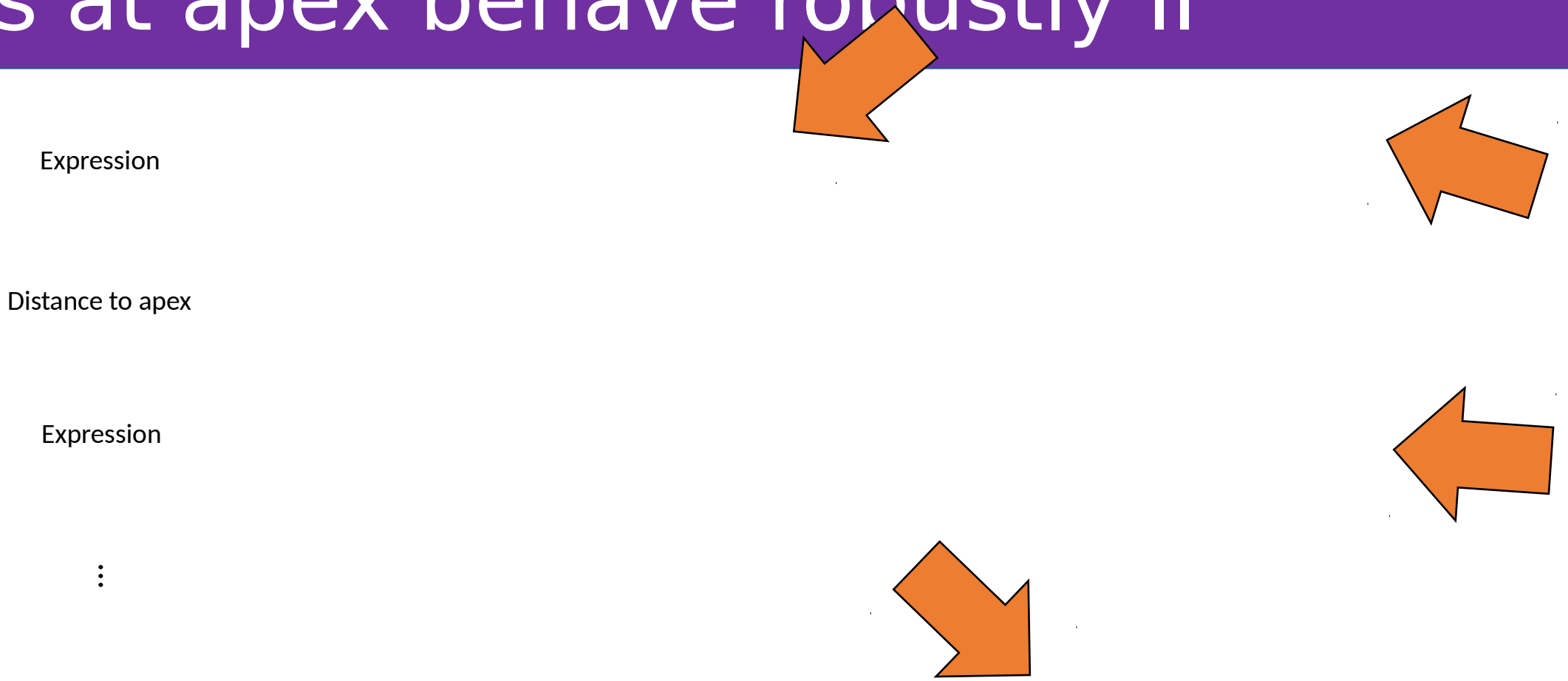

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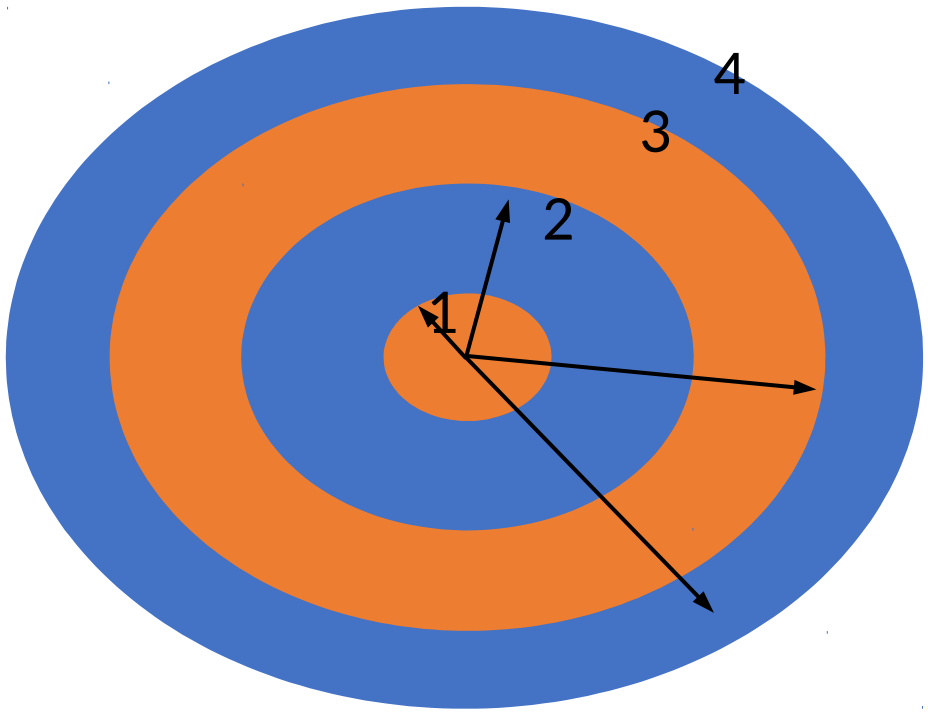


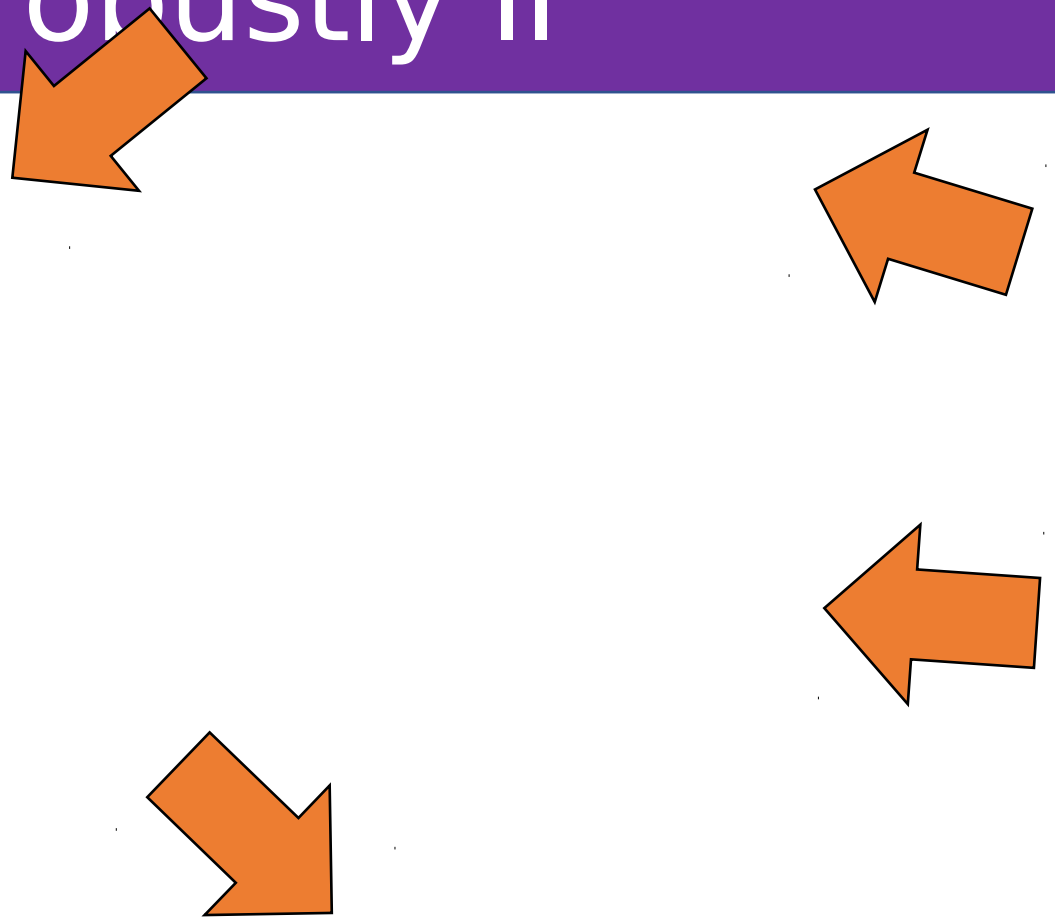

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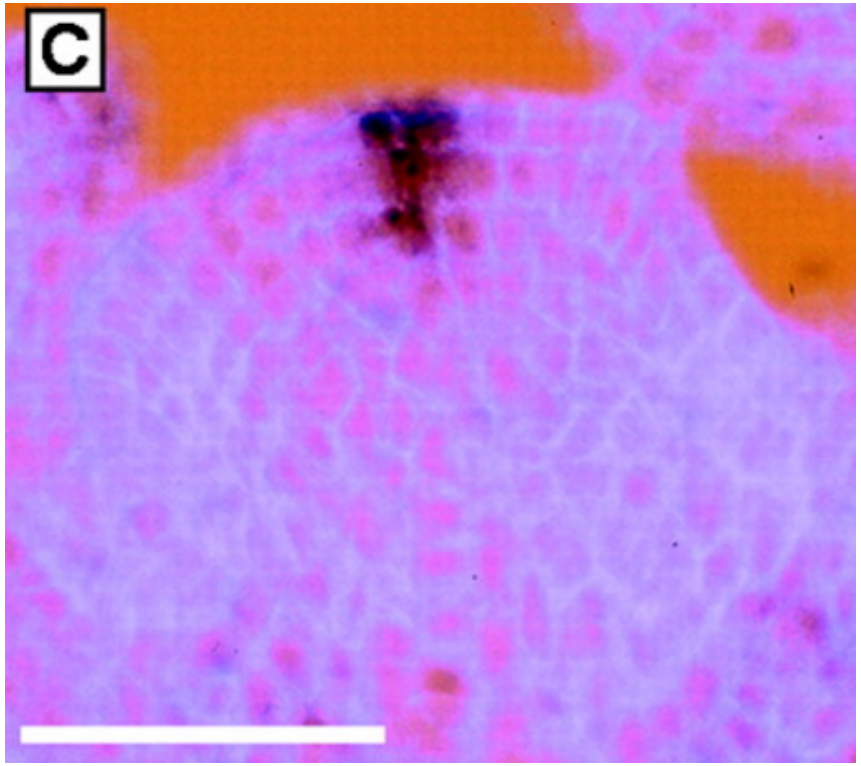


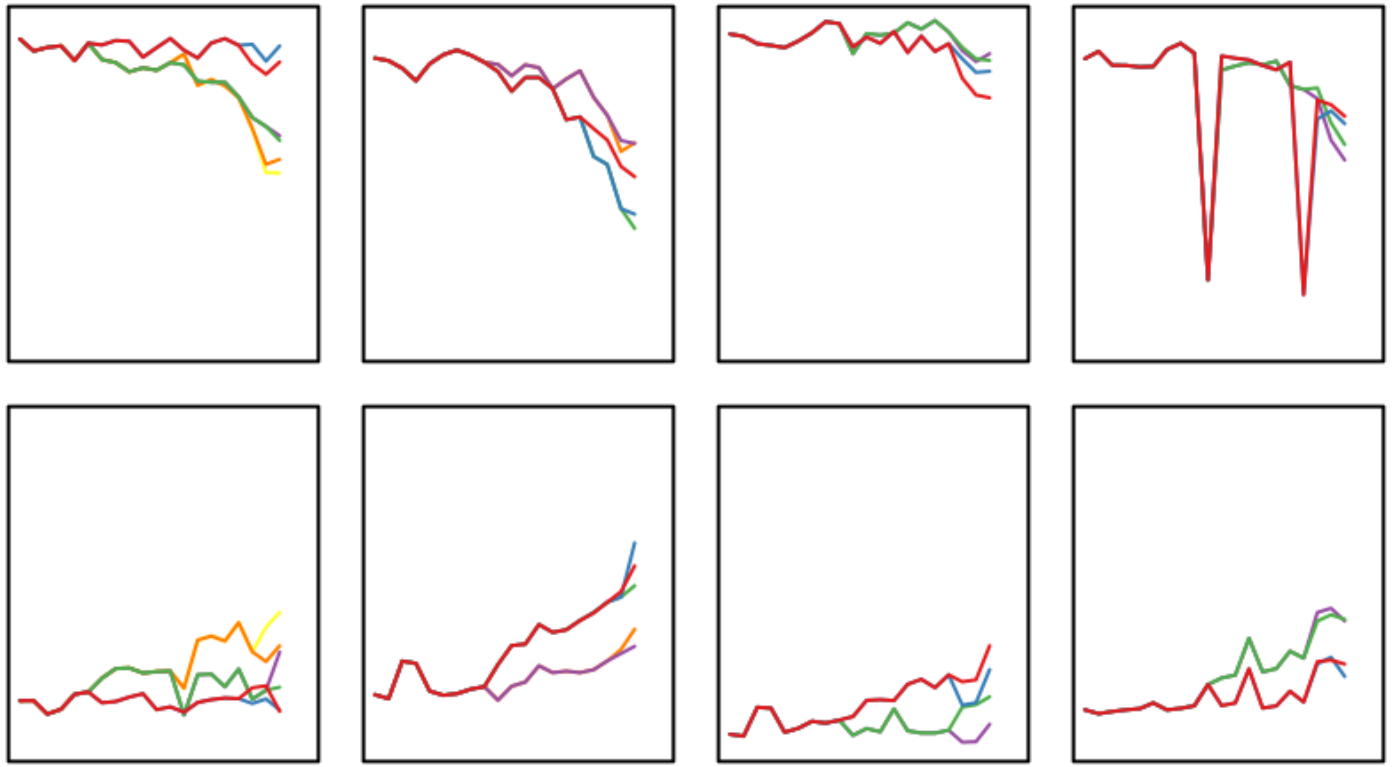

Fletcher et al. (1999)

# … and just differently

- Top cells divide less frequently due to a lower growth rate
- Average membrane volume at apex significantly lower than in other periclinal layers
- 
- CLV3 expression not related
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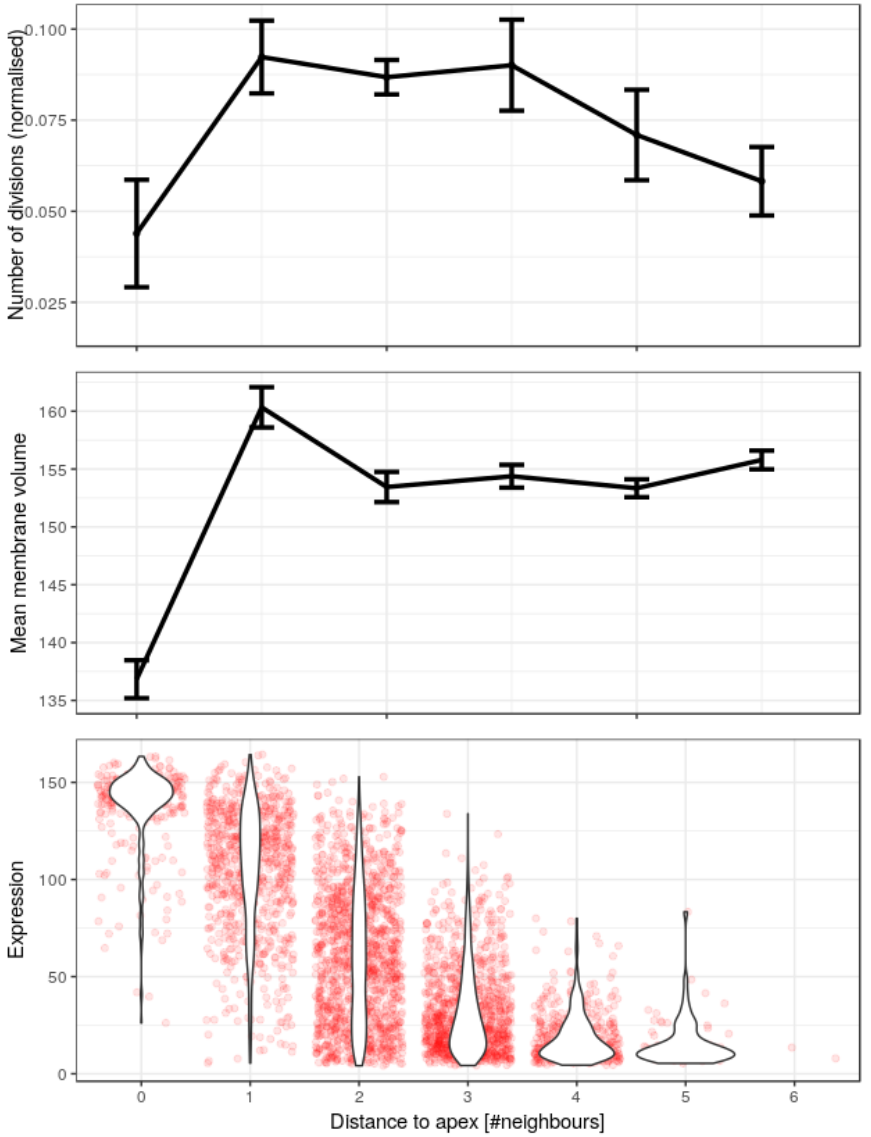
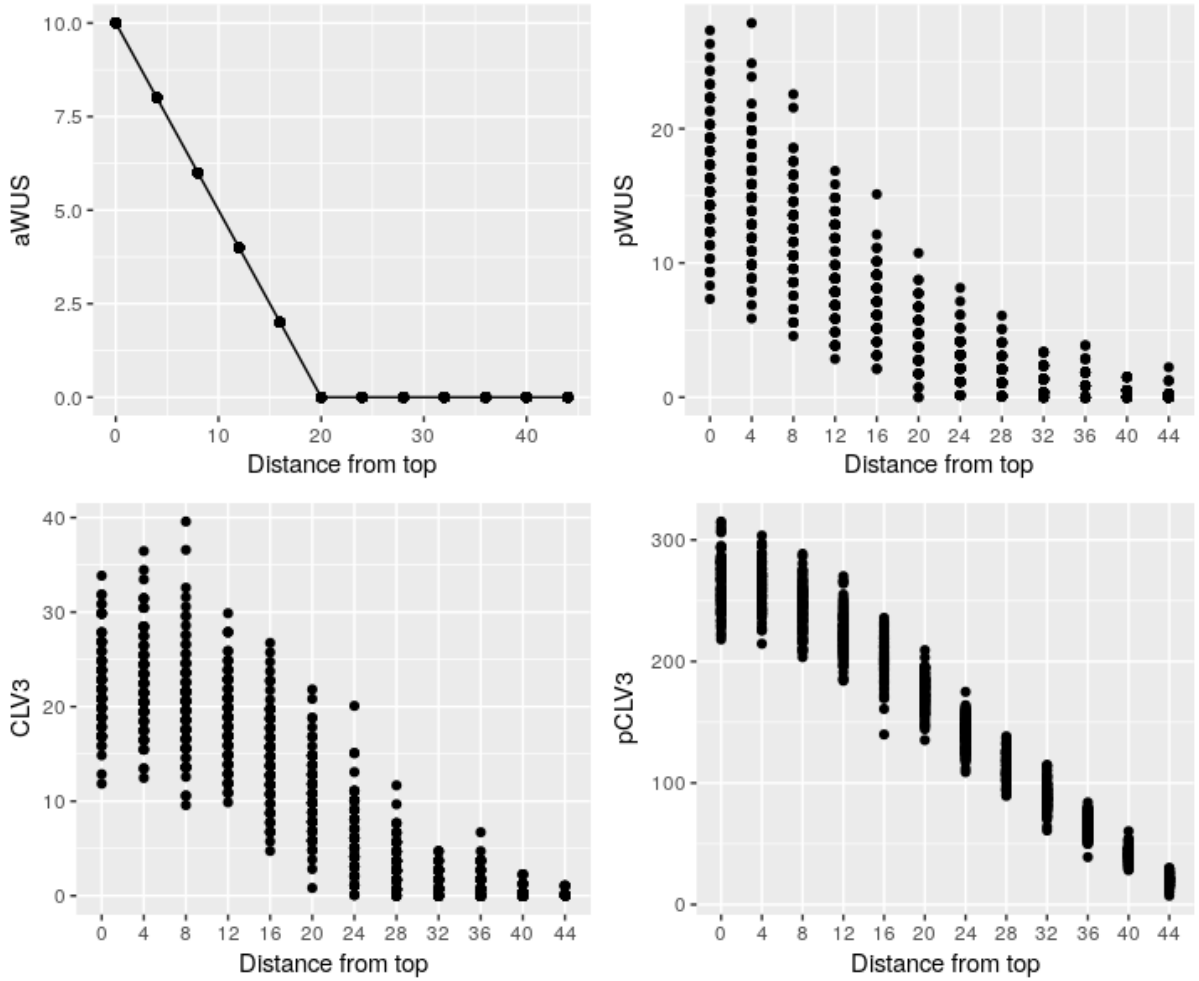


# A simple model tests the possible regulation

$$WUS \longrightarrow CLV3$$

- Epidermal 1D model
- Gillespie and / or Milstein's method
- Optimised using genetic algorithms
- Cannot suppress noise at apex



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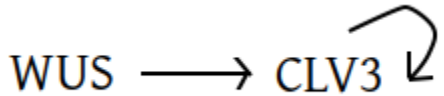
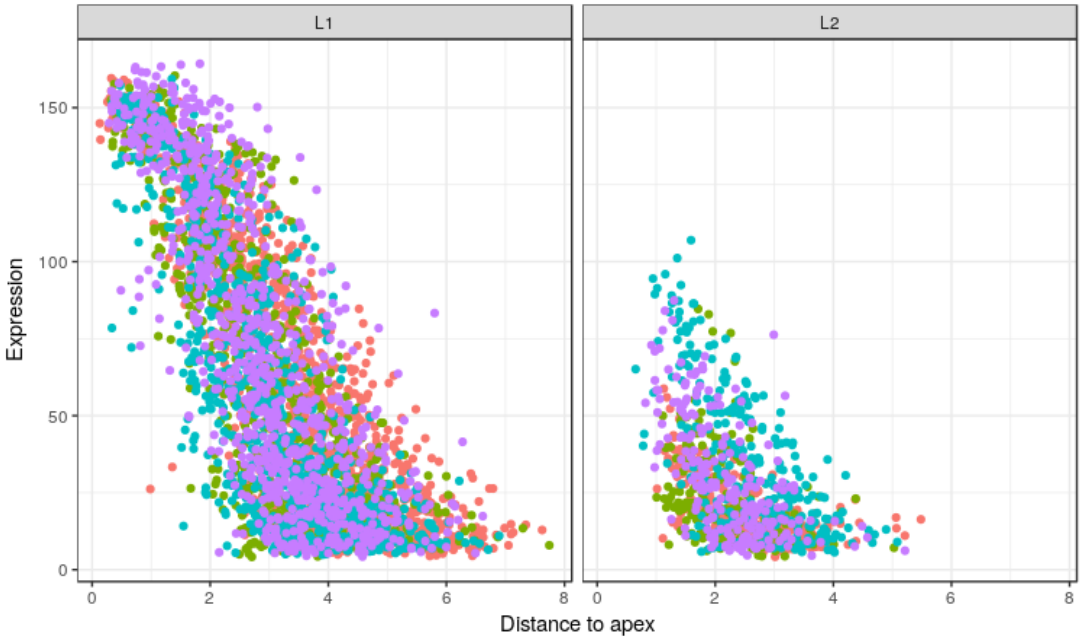
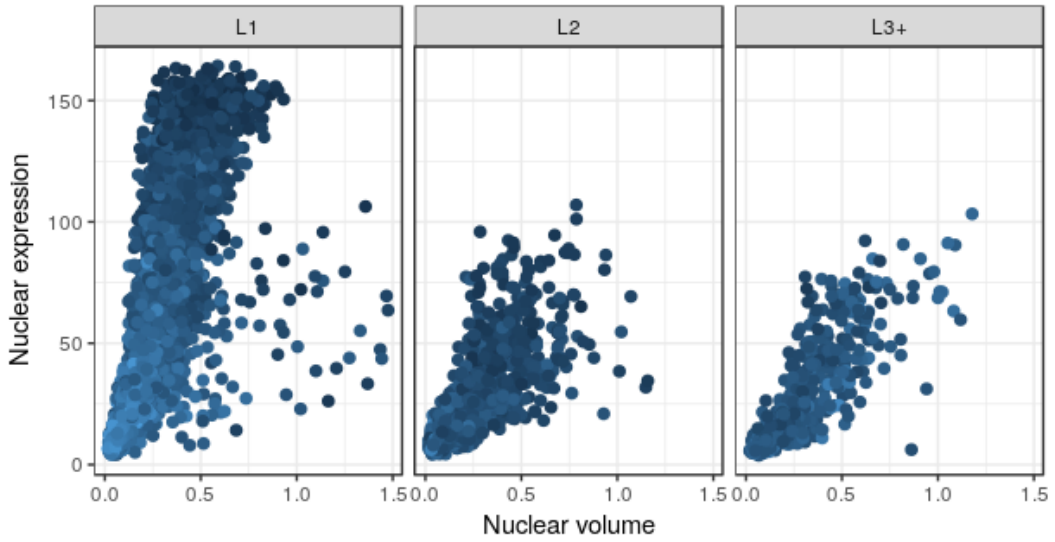


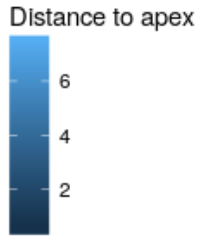

- Possibly? More work needed.

# Layer analysis suggests L1 regulation







# Acknowledgements

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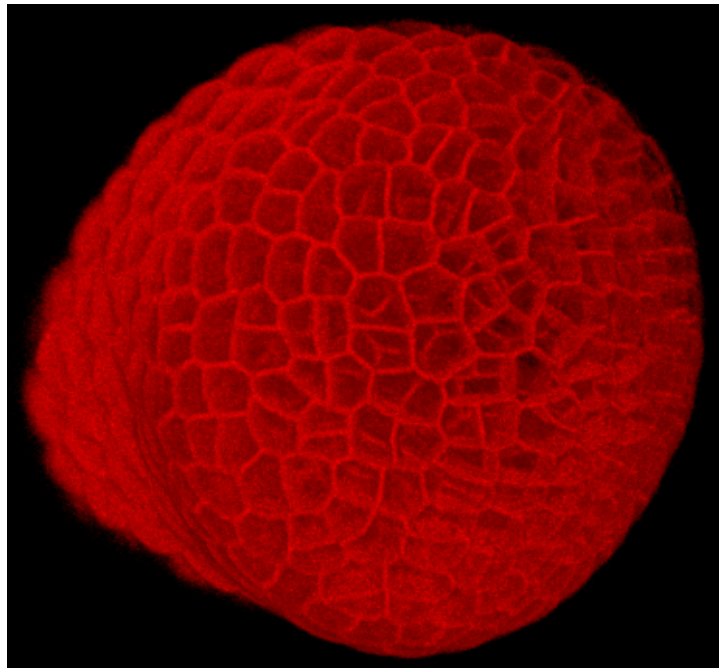
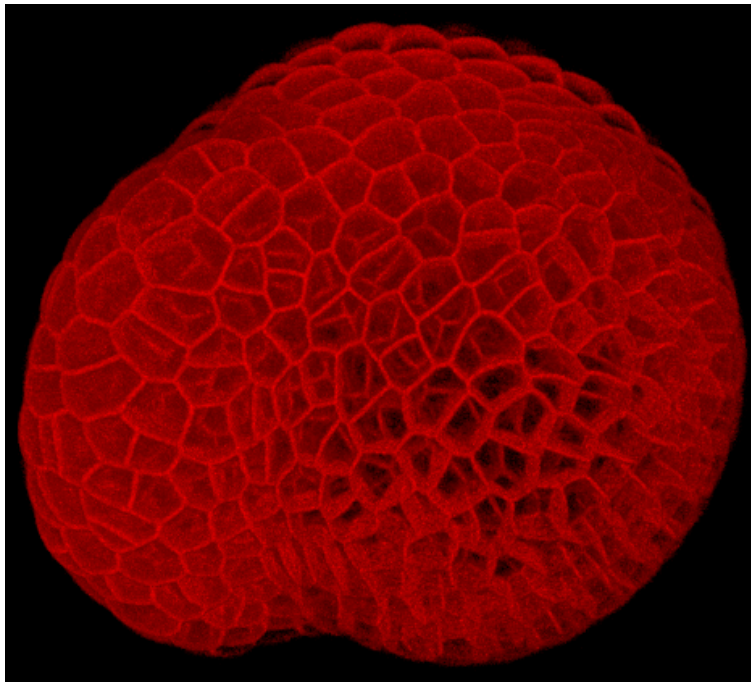
+ everyone else

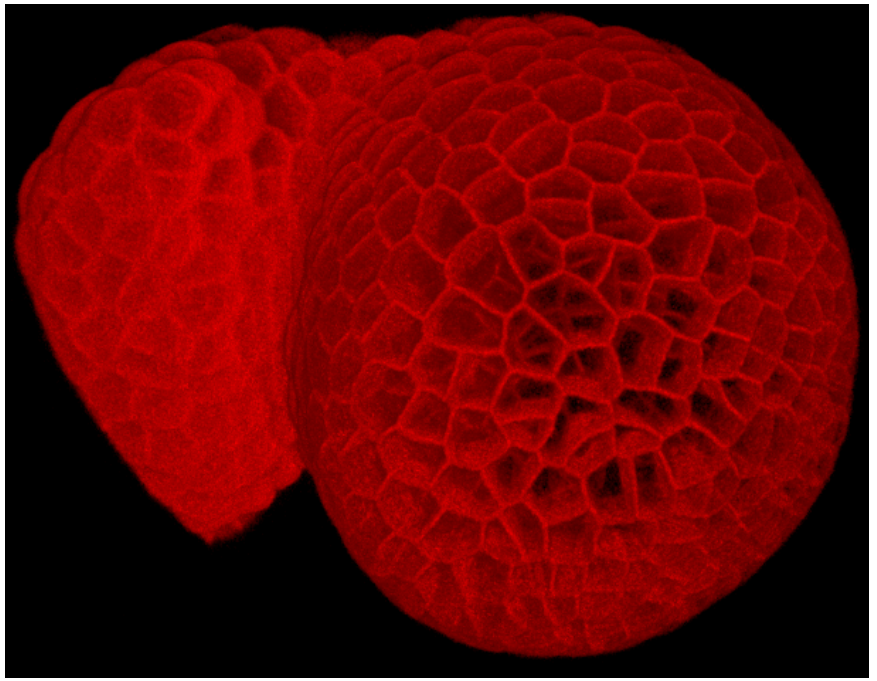
Thank you!


THE SAINSBURY
LABORATORY
UNIVERSITY OF CAMBRIDGE

# Initiation of organs implies NPA dilution







# Additional results: Longevity

- WUS domain affects

  longevity?

- Currently investigated