



Tissue growth couples temporal and spatial fluctuations

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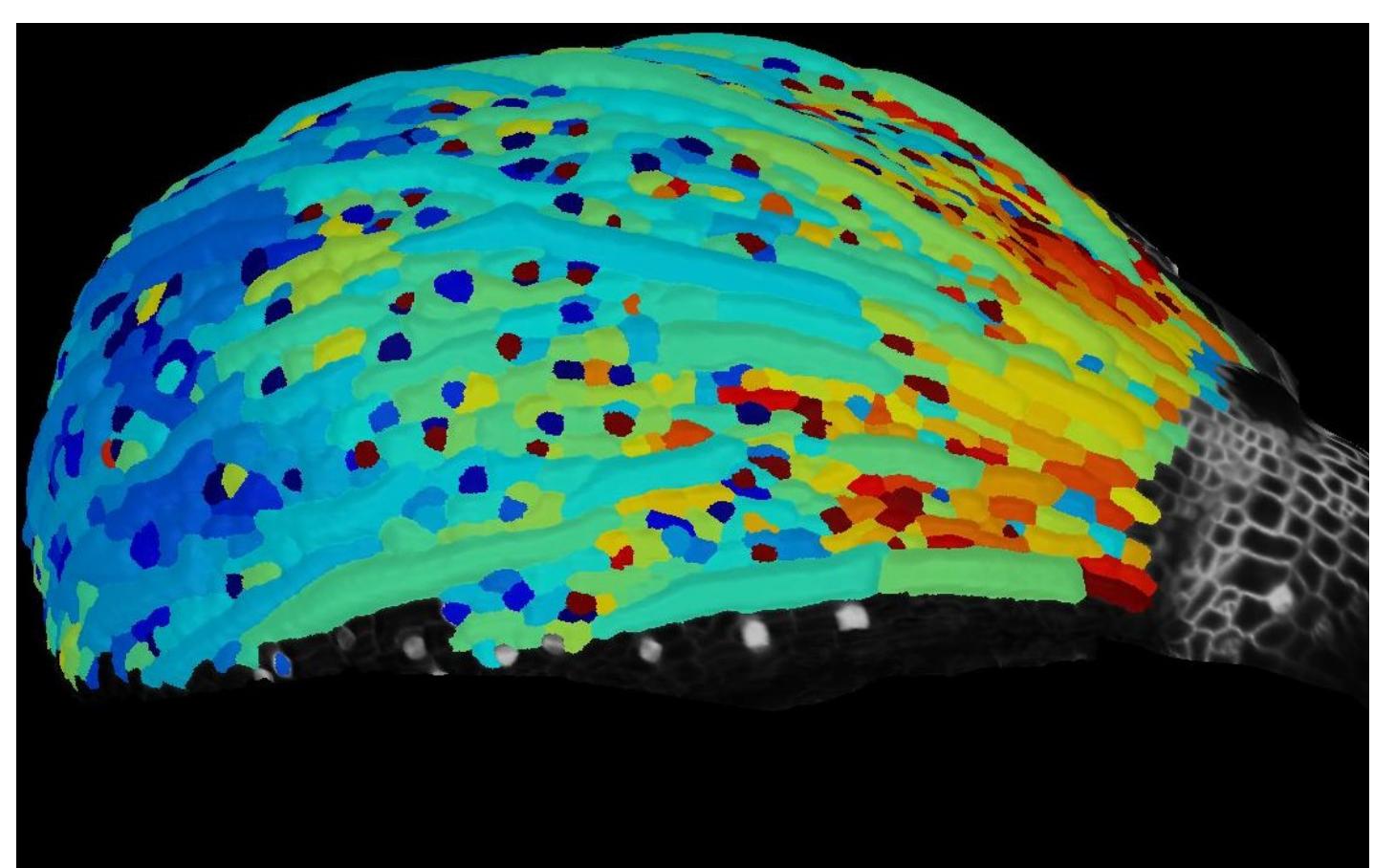
Tissue growth couples temporal and spatial fluctuations

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Cellular variability v.s. organ robustness



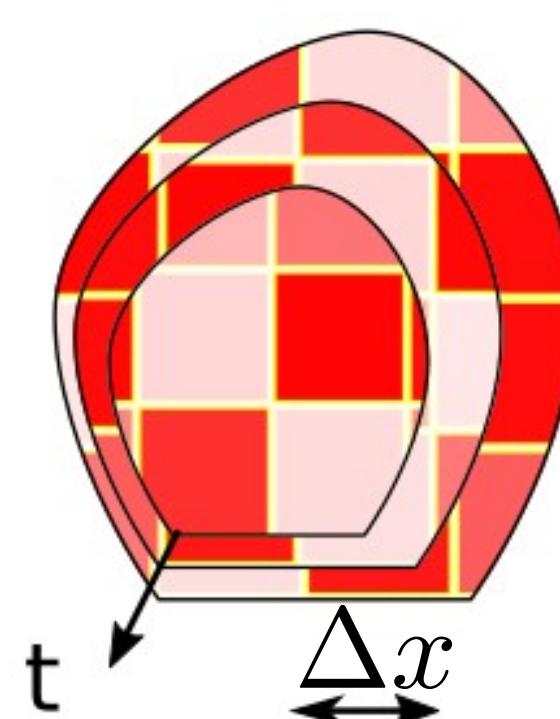
cellular variability
↔
robust organ shapes

Cell growth is heterogeneous in space and time.

→ how to grow robust organ shapes ?

Spatiotemporal averaging

Morphogenesis sums growth over space & time



growth

spatiotemporal averaging

Law of large numbers
↓

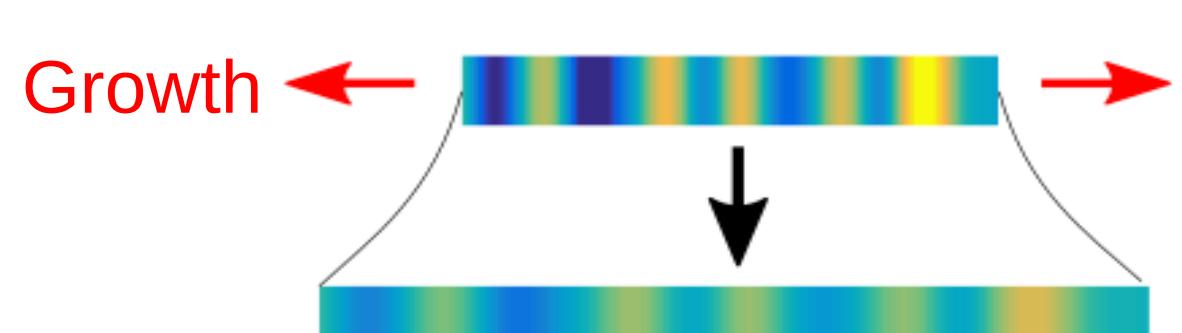
robust organ size/shape

e.g. area increase:

$$\Delta A \simeq t\langle\gamma\rangle A \pm \Delta\gamma \sqrt{\frac{At\Delta t}{\Delta x^2}}$$

But, are growth fluctuations stretched toward large space scales ?

Growth + time persistence = fluctuation stretching



→ Enlargement of
fluctuation's space scale

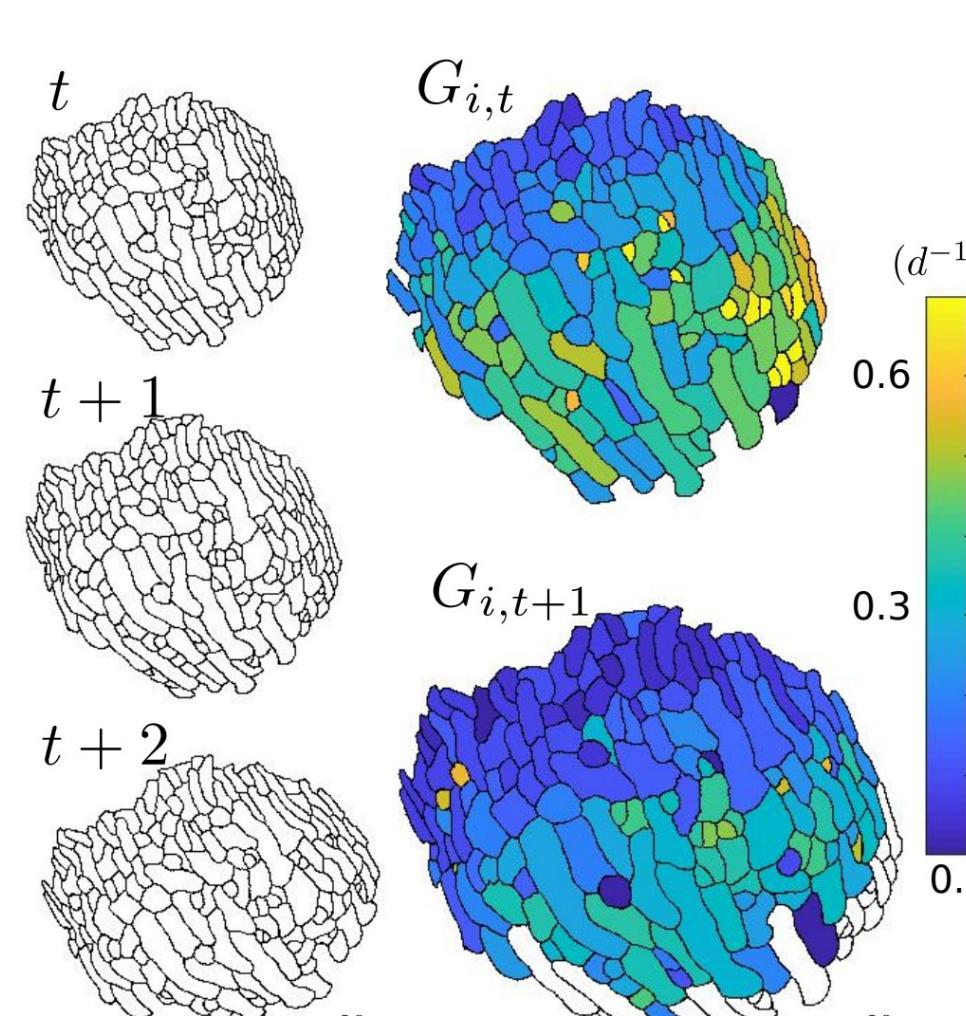
Consequences on morphogenesis

→ Spatiotemporal averaging to be reconsidered

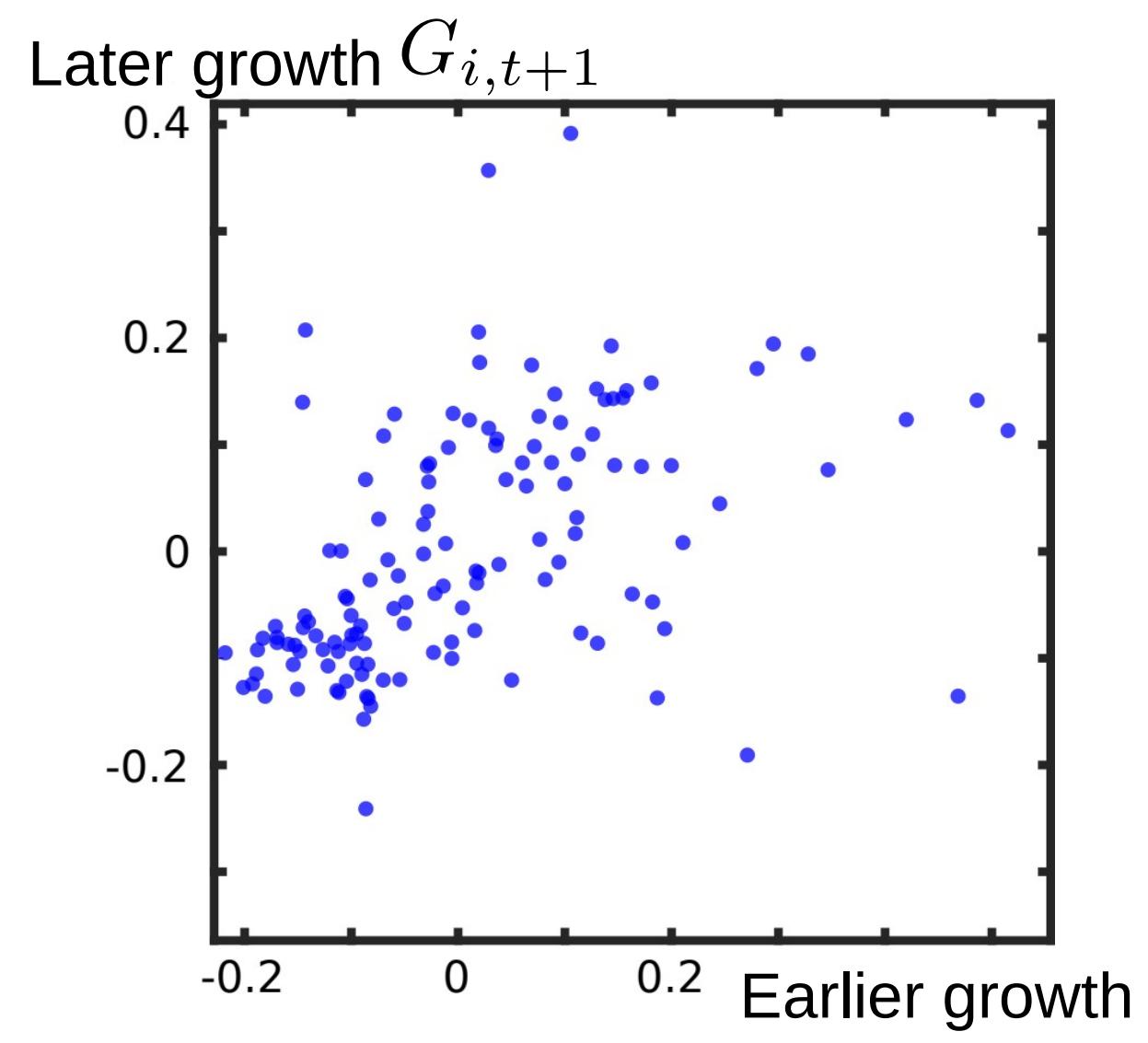
→ Coupling between level of growth, and growth fluctuations' renewal rate & spatial extend

Assessing growth time variability

Cells' areal growth rate



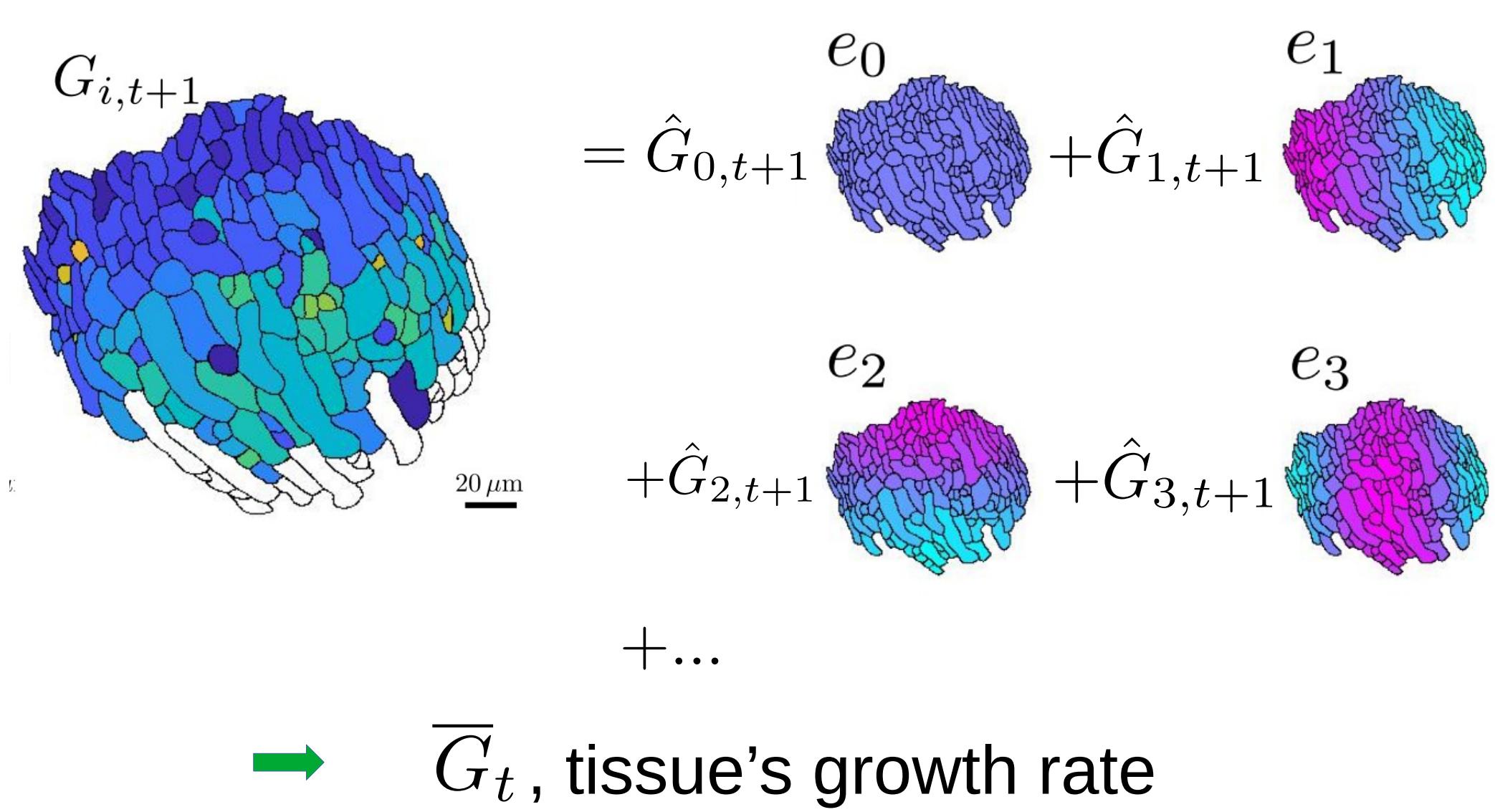
Time correlation



→ Γ_t , time correlation coefficient

Assessing growth space variability

Harmonic decomposition of growth space variations



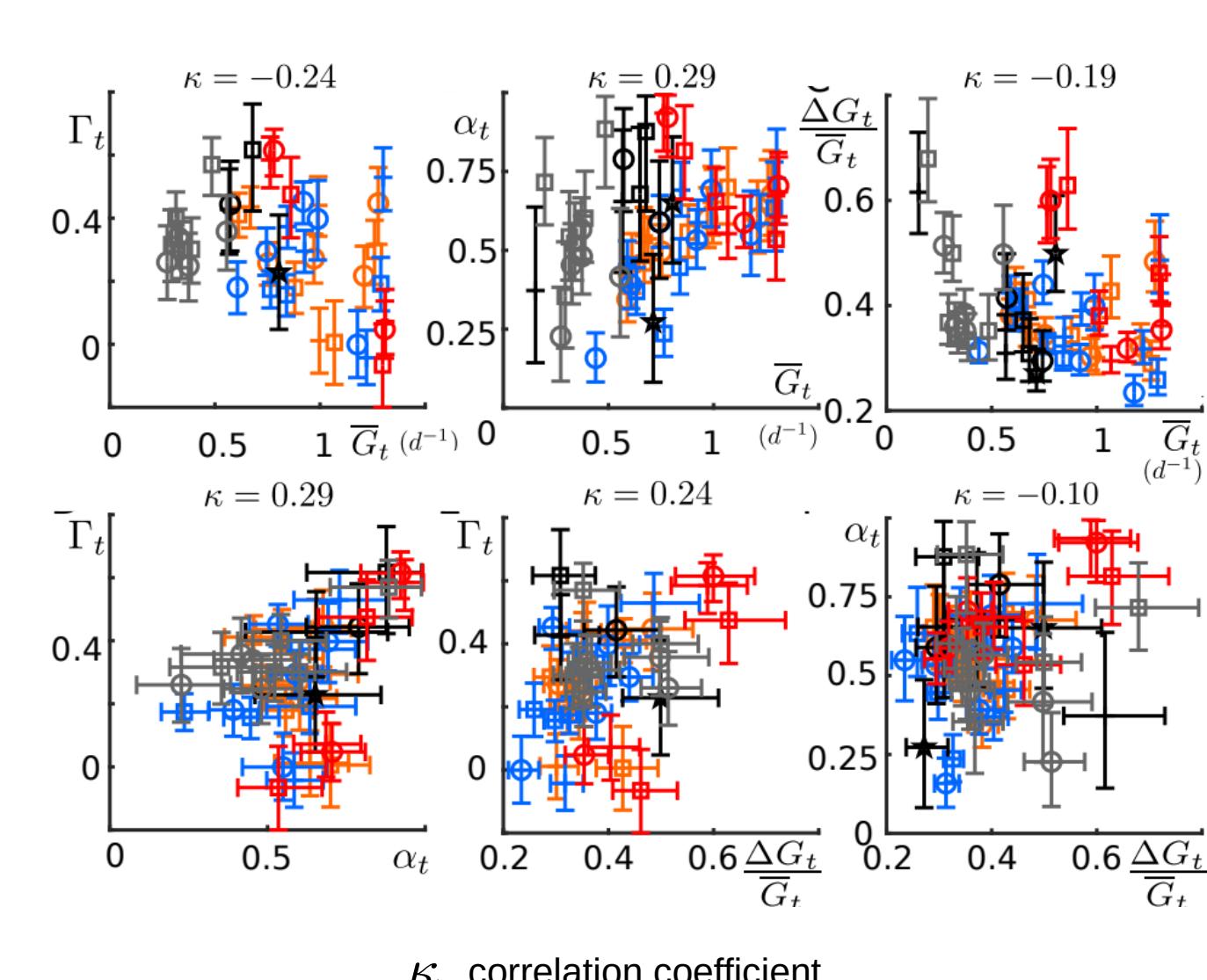
- \bar{G}_t , tissue's growth rate
- ΔG_t , amplitude of growth fluctuations
- α_t , space correlation exponent

Data statistics

Data sets

Lighting condition 1
WT: a, spr2: b, mad5: c, bot1: d
Cell wall mutants
Lighting condition 2
WT: a, b
Distinct tissues followed in time

Generic correlation analysis



→ no clear pairwise correlations among growth parameters

Testing fluctuation stretching

In theory

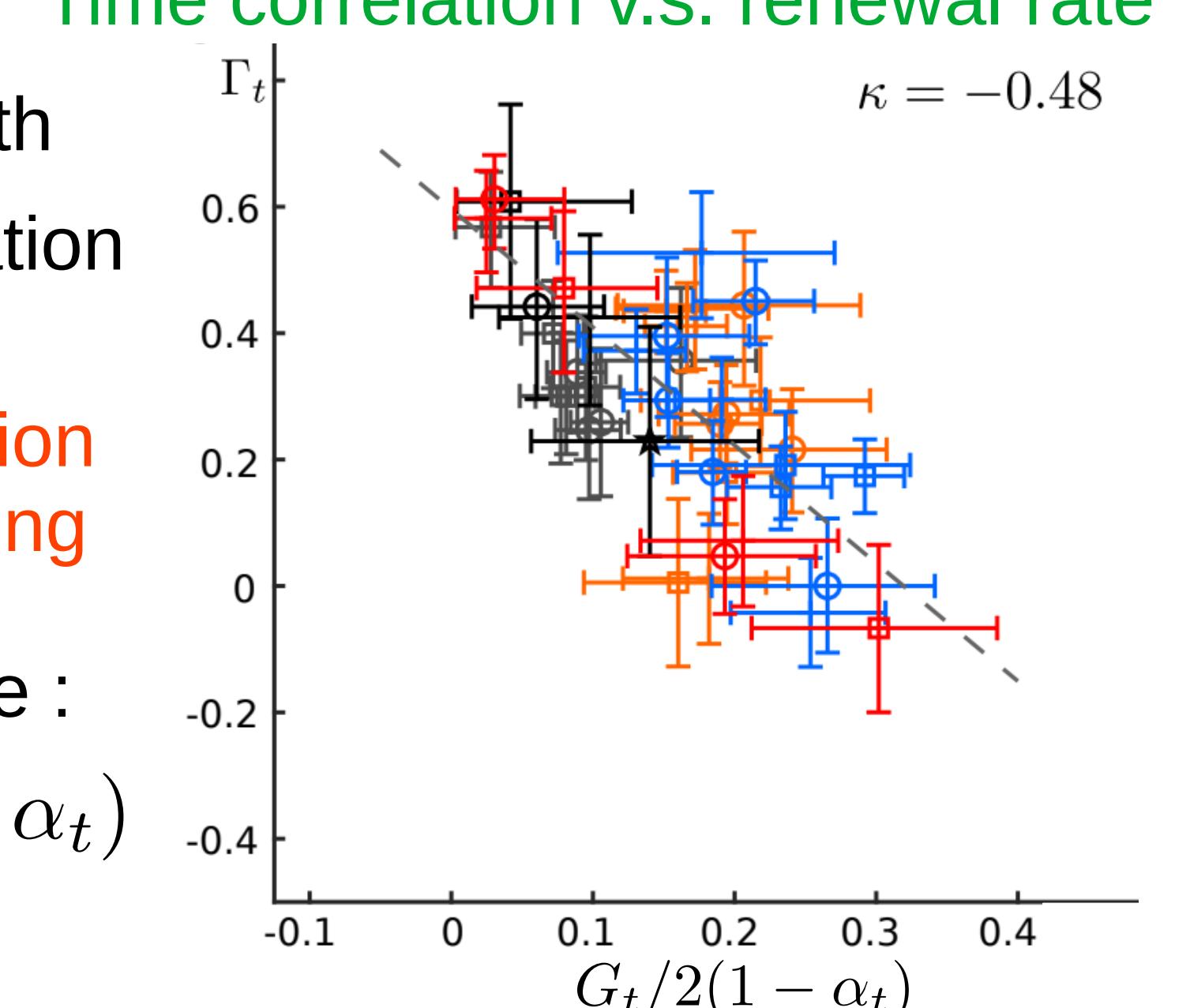
→ \bar{G}_t , tissue's growth

→ α_t , space correlation

fluctuation stretching

induced renewal rate :

$$1/\Delta t = G_t/2(1 - \alpha_t)$$



→ evidence for fluctuation stretching

Results :

- quantification of space & time variability
- coupling between level of growth and its space & time variability
- evidence for fluctuation stretching

Perspectives :

- Considering different tissue types
- Compare plant & animal tissues
- Limiting scale ?