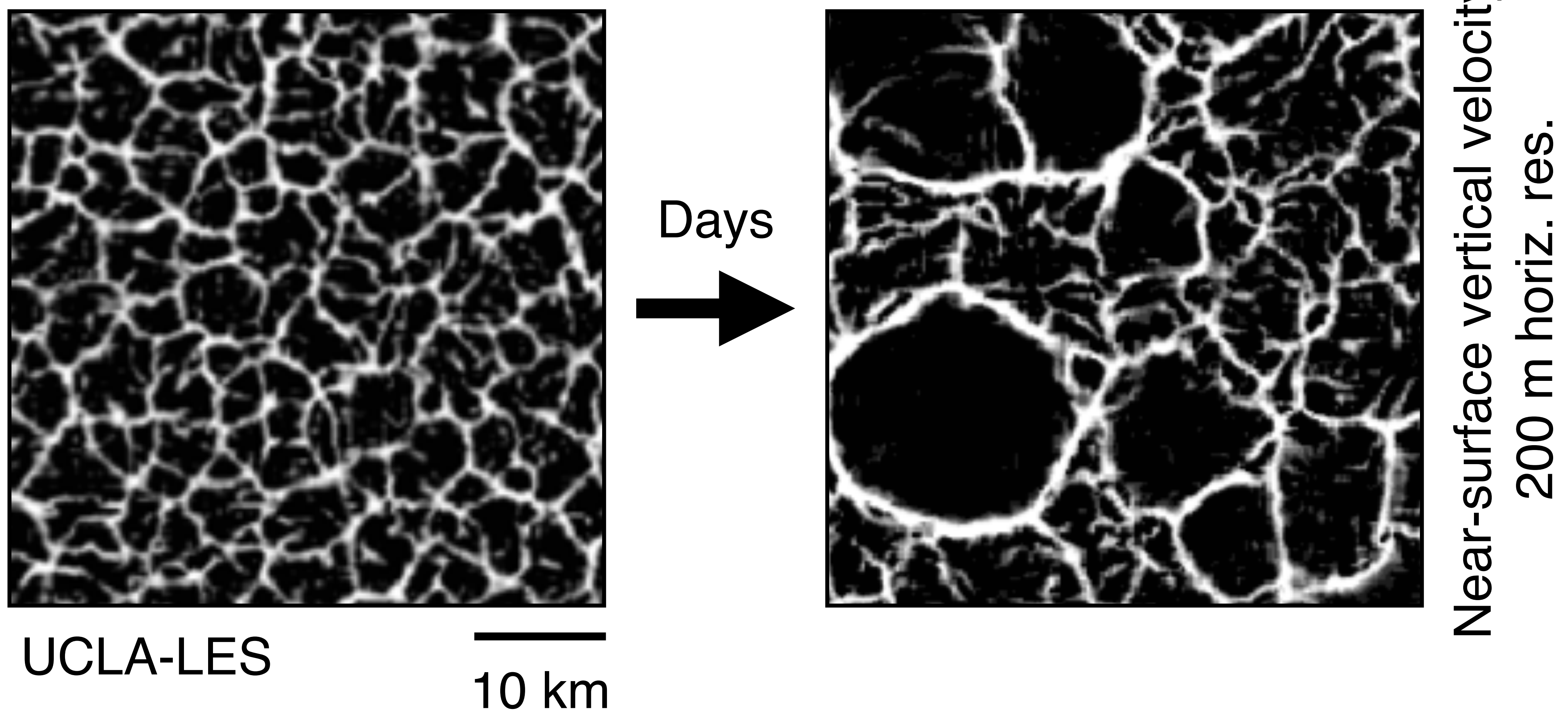
Self-aggregation conceptualized by cold pool organization

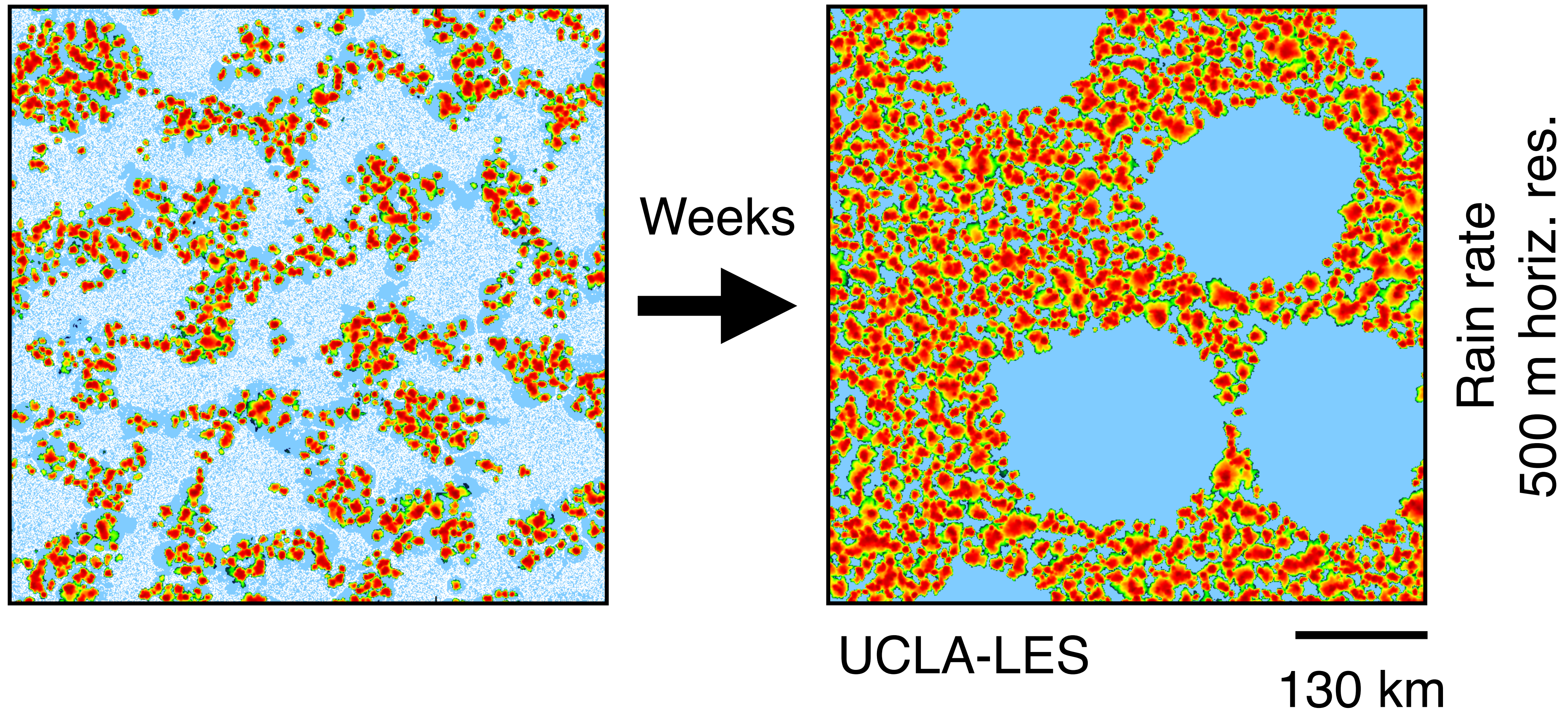
Diurnal convection leads to convective scale increase

A



Radiative-Convective Equilibrium (RCE) simulations lead to self-aggregation

B



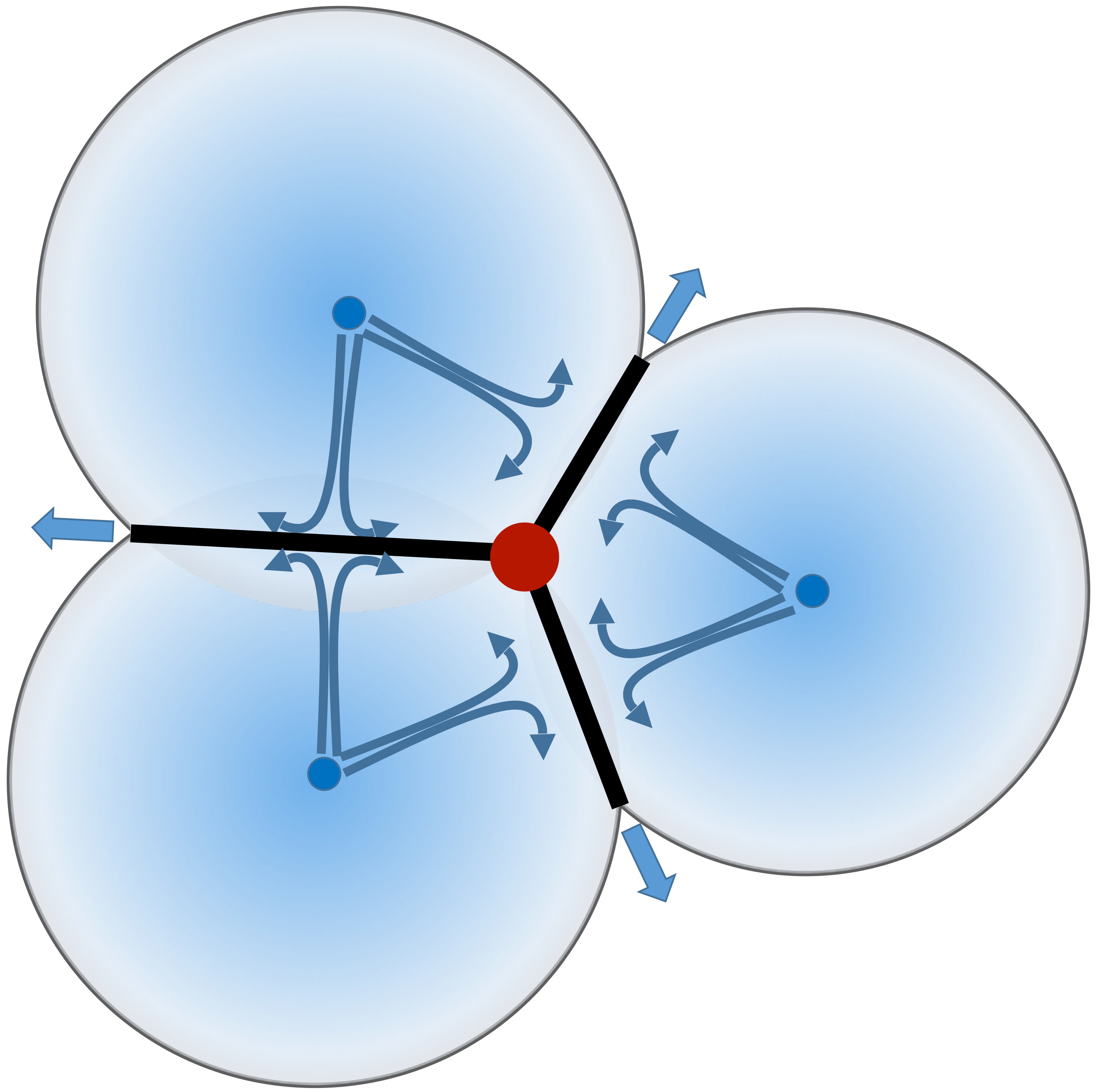
Can these phenomena be unified in one simple model?

Silas Boye Nissen (presenter)
Jan O. Haerter, Steven Böing, Olga Henneberg
University of Copenhagen and University of Leeds

Circling in on Convective Organization

Three cold pools (blue circles) expand radially.

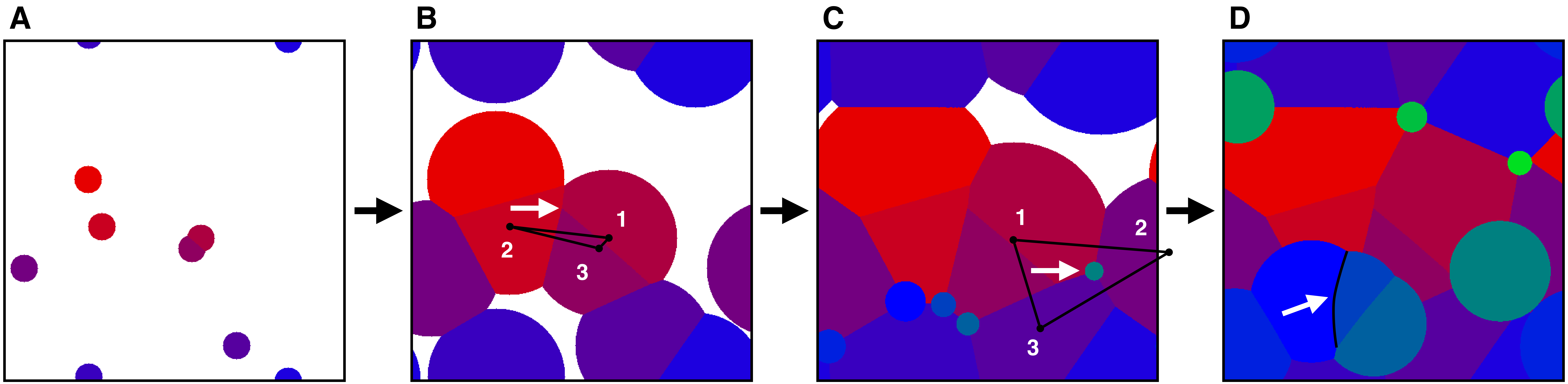
A new cold pool (red dot) form when they collide.



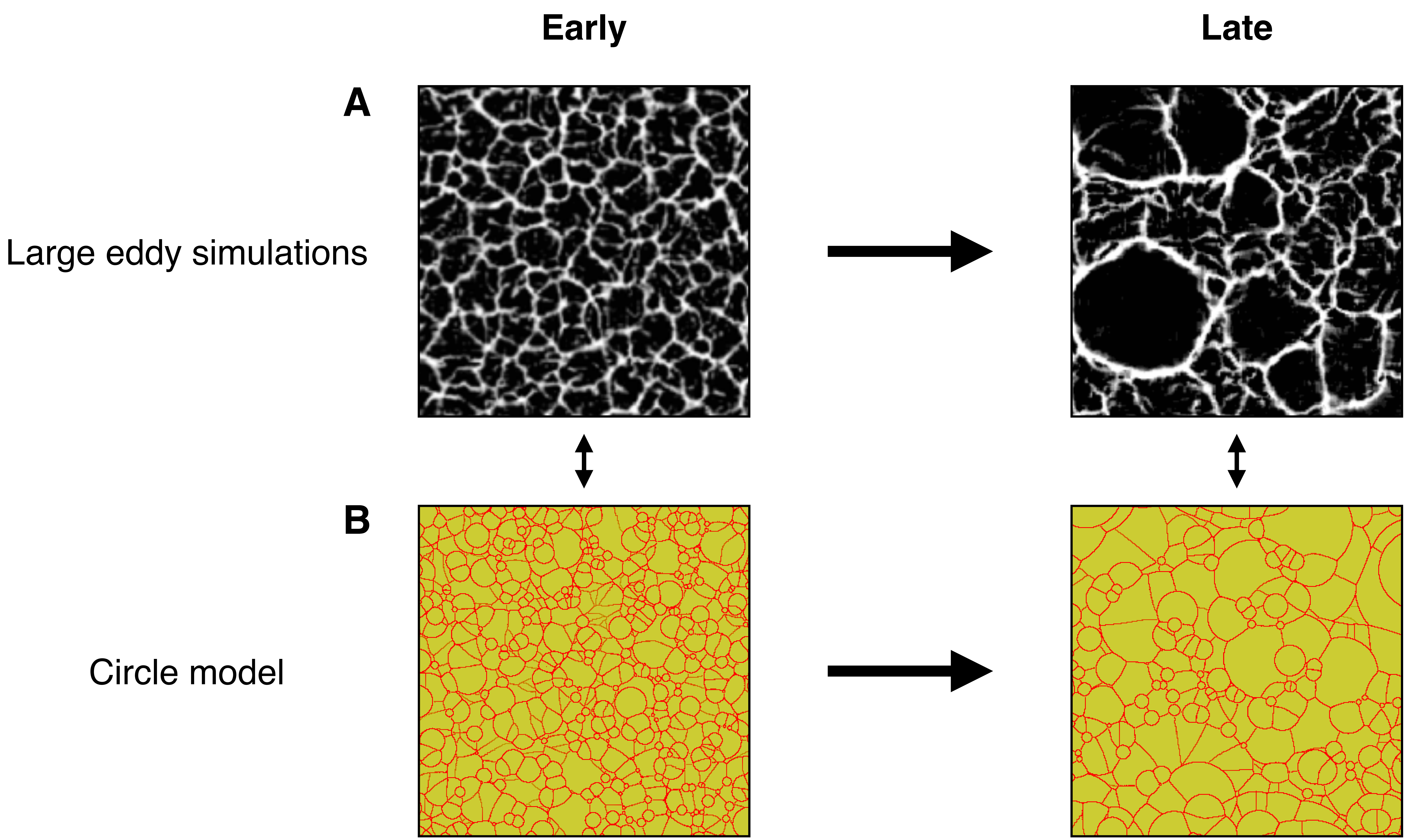
$$(x_c - x_1)^2 + (y_c - y_1)^2 = (R_1 + dR)^2$$
$$(x_c - x_2)^2 + (y_c - y_2)^2 = (R_2 + dR)^2$$
$$(x_c - x_3)^2 + (y_c - y_3)^2 = (R_3 + dR)^2$$

Mathematical circle model representing three cold pool collisions

A world of 8 cold pools | **Three fail to form a new one** | **Three others succeed** | **Curved gust fronts appear**

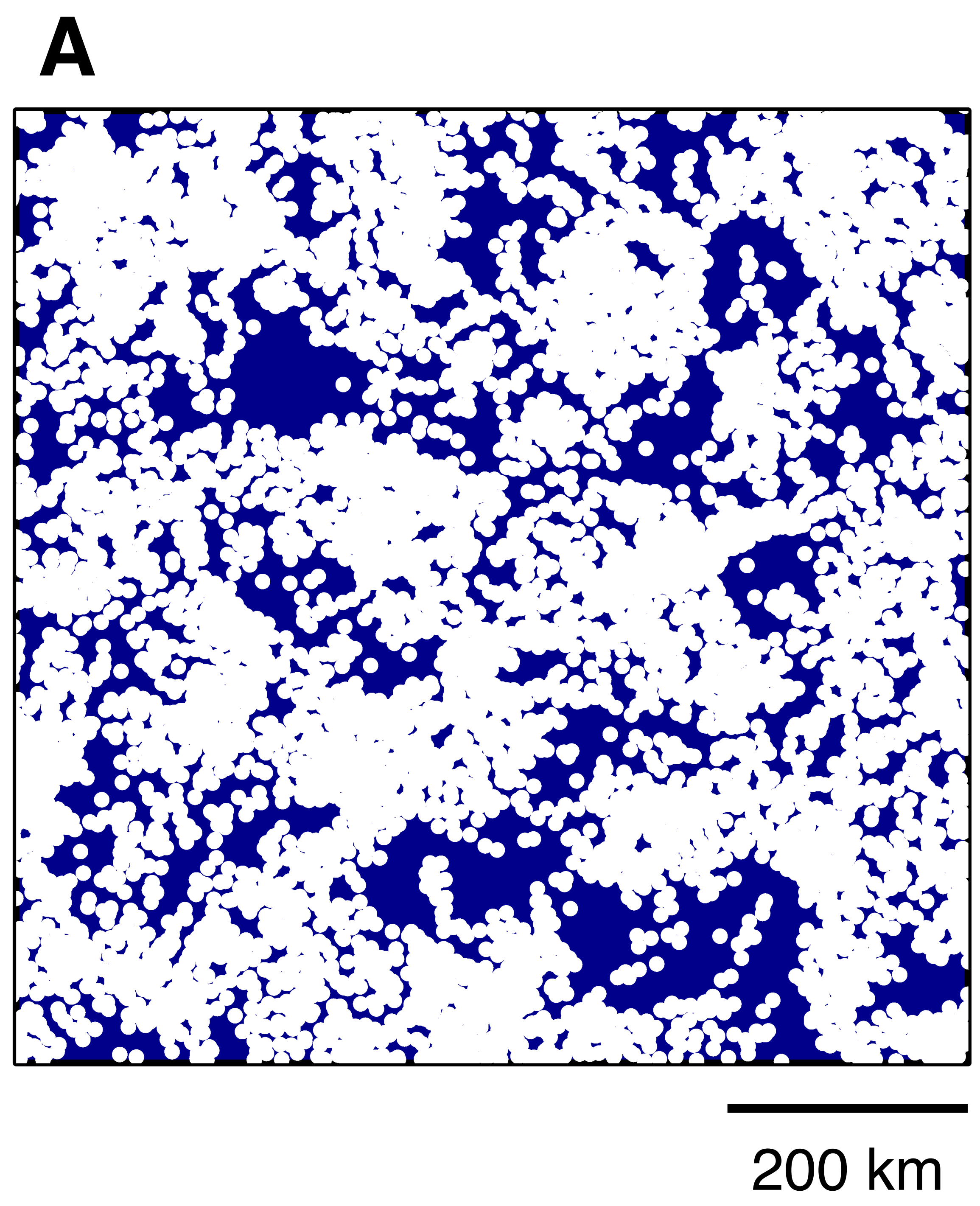


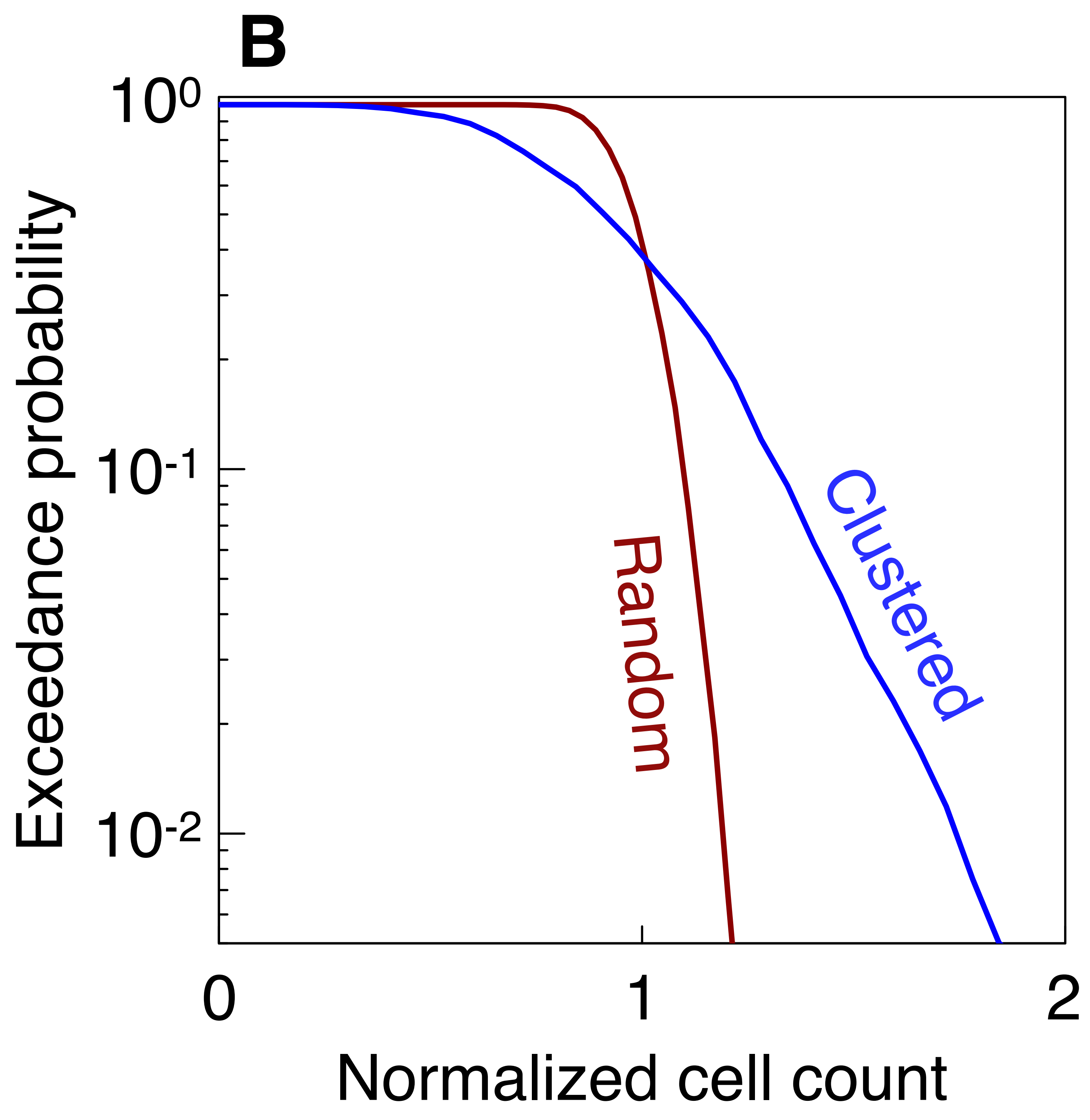
The circle model captures convective scale increase



The circle model captures clustering of precipitation cells

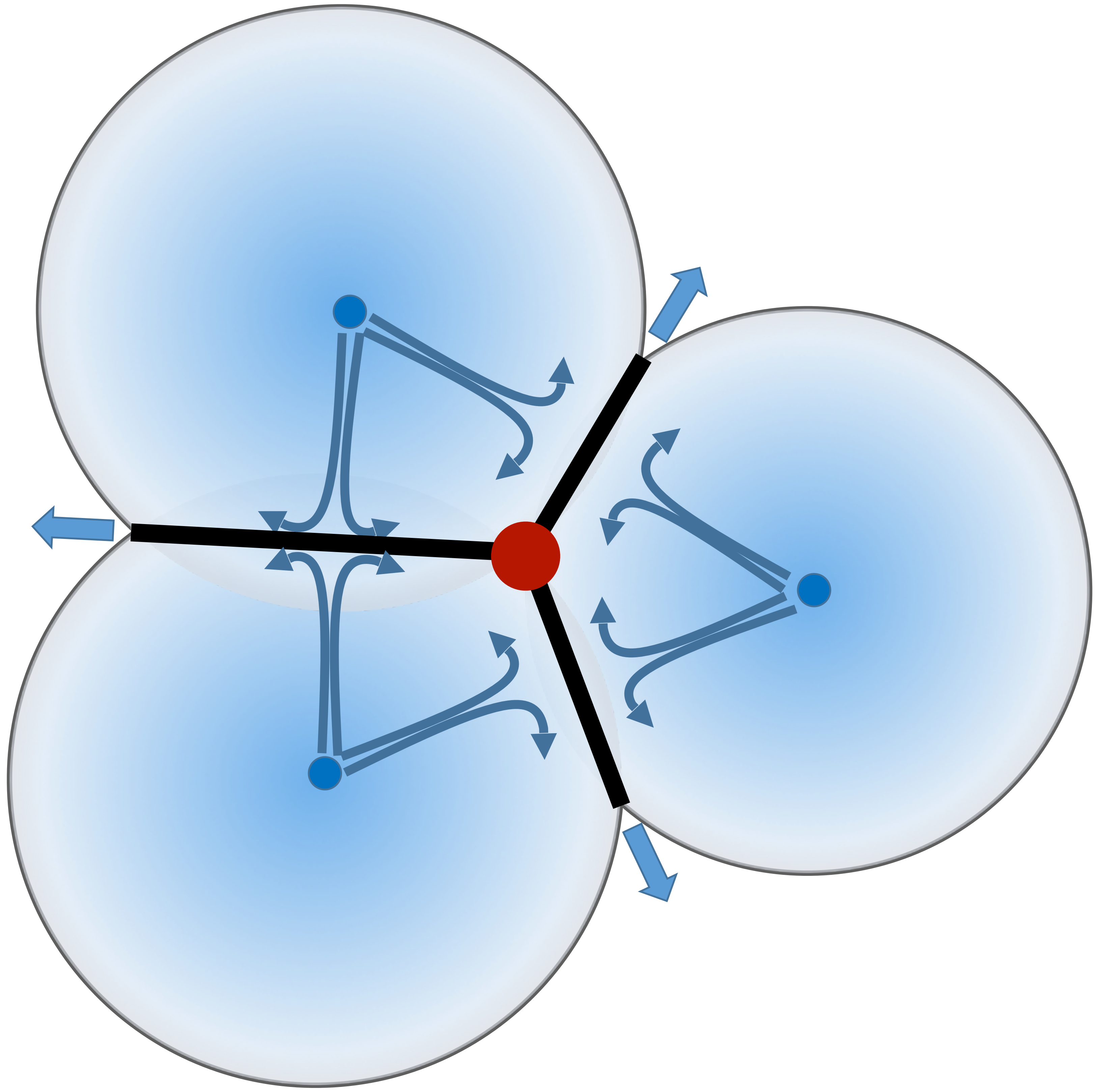
Circle centers (white) **are more clustered than random**





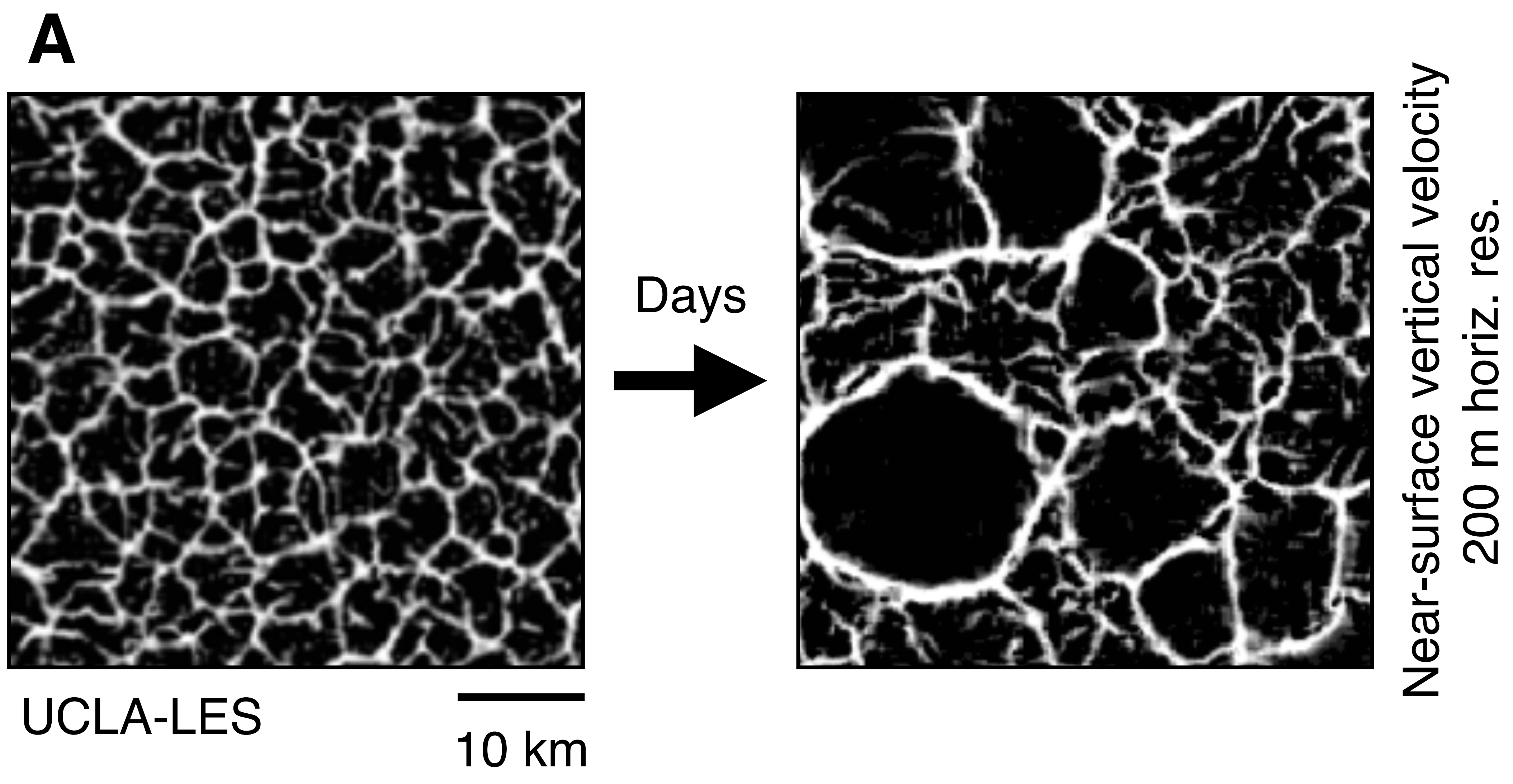
3 key points

1. We introduce a mathematical circle model.
2. The model captures convective scale increase.
3. The model captures clustering of precipitation cells.

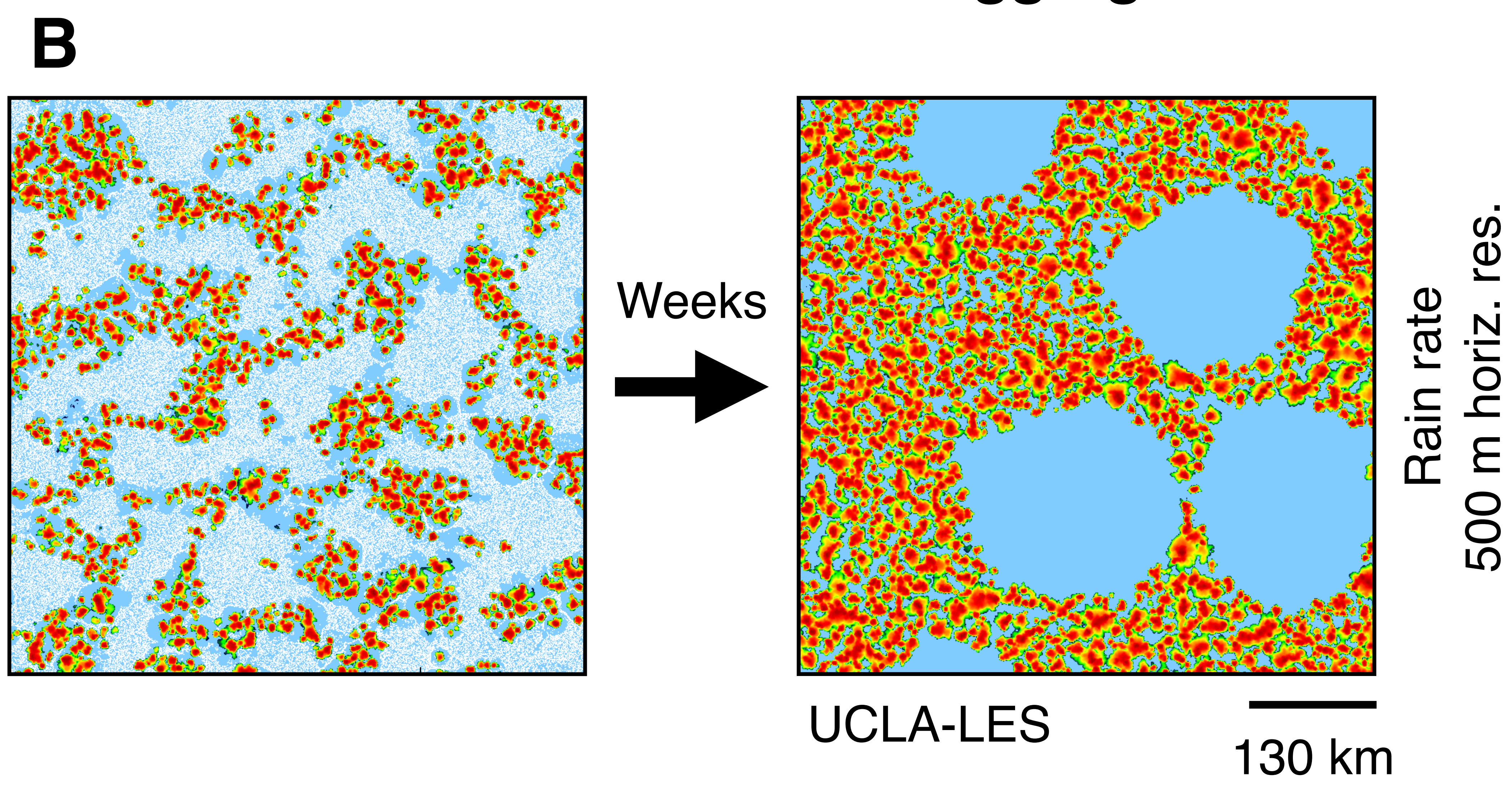


Circling in on Convective Organization

Diurnal convection leads to convective scale increase



Radiative-Convective Equilibrium (RCE) simulations lead to self-aggregation



Can these phenomena be unified in one simple model?

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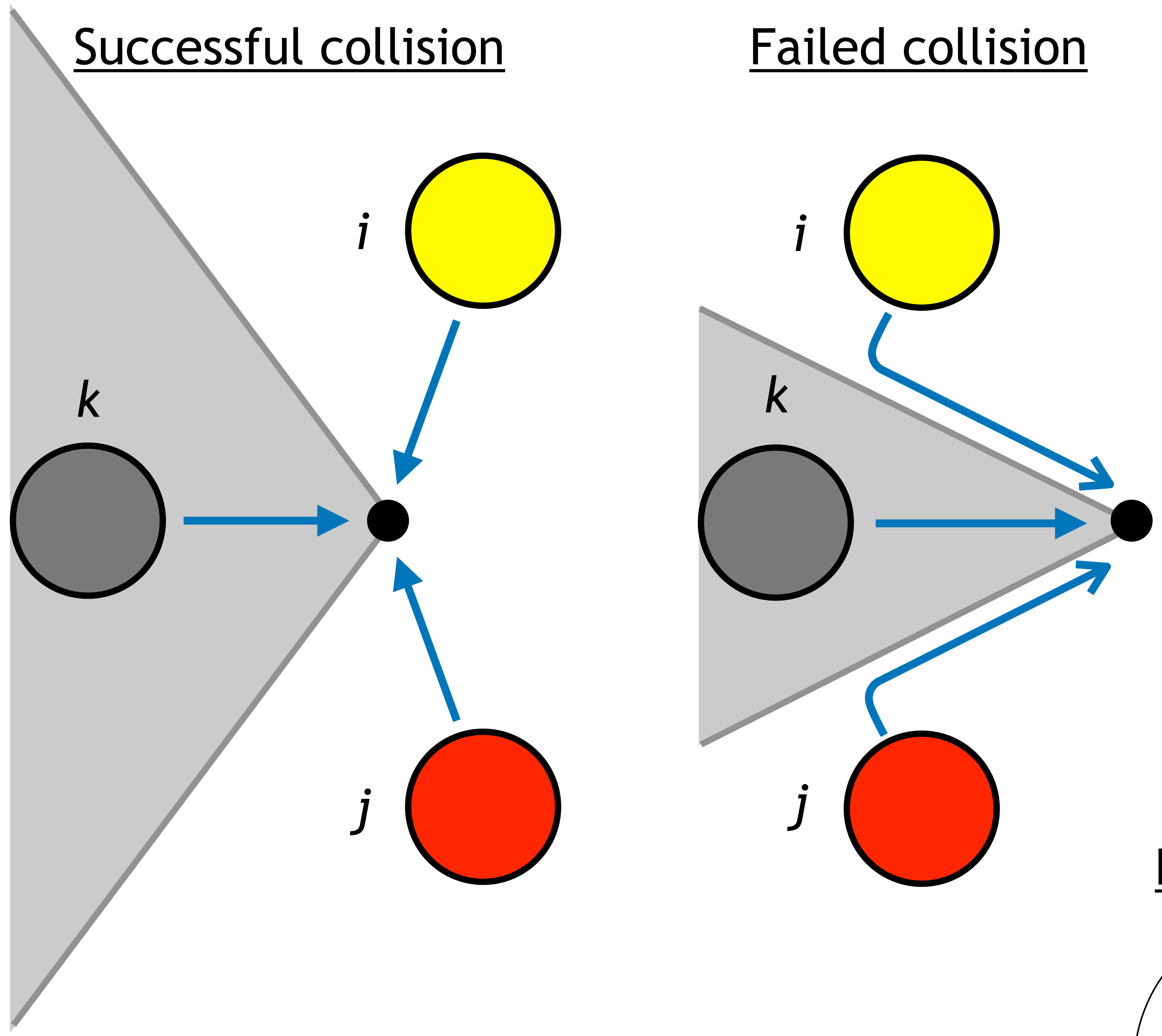
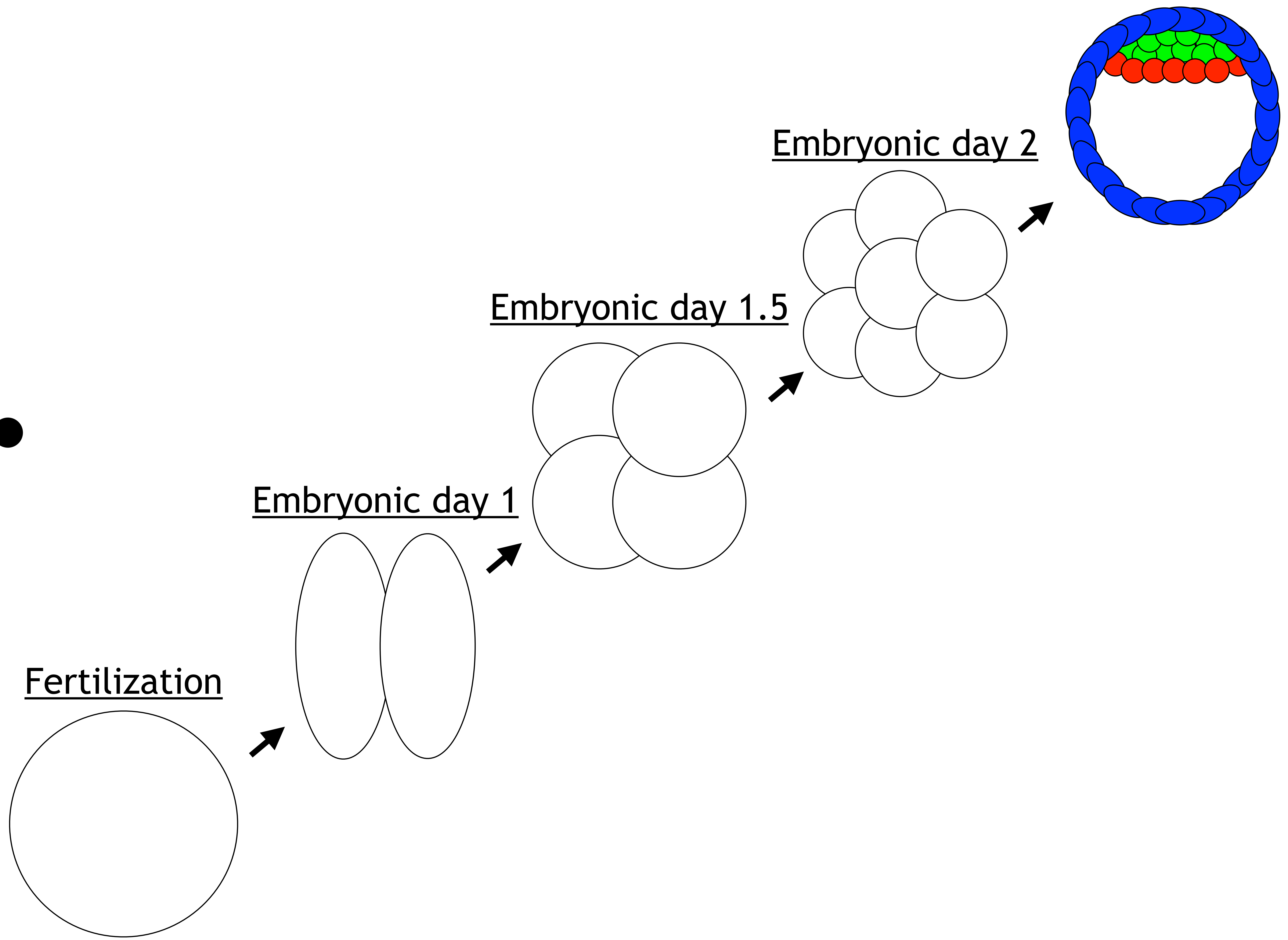
Used in biology…





Nissen et al. (2017); *Plos Biology.* Nissen et al. (2018); *eLife*

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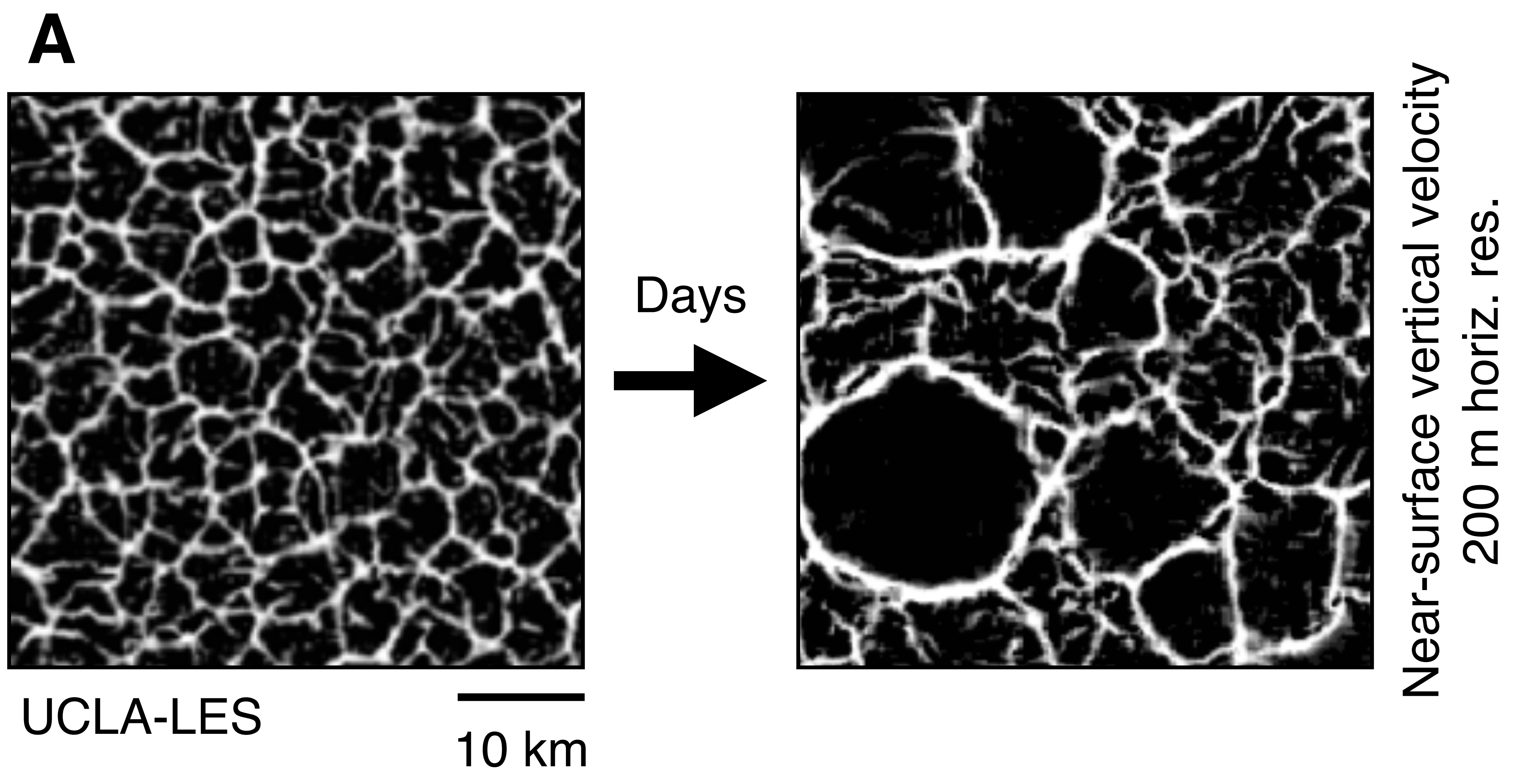
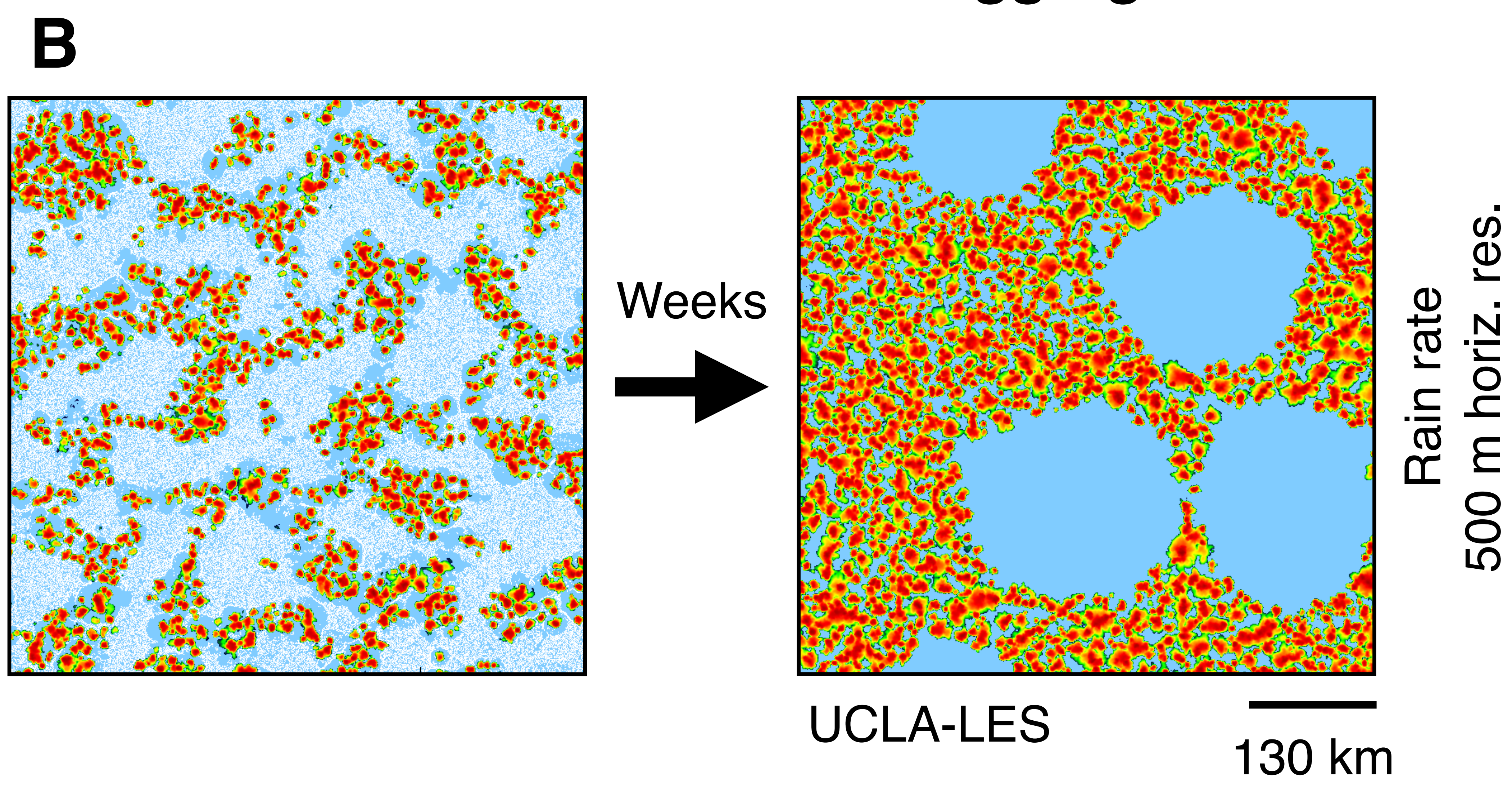
Self-aggregation conceptualized by cold pool organization

Diurnal convection leads to convective scale increase



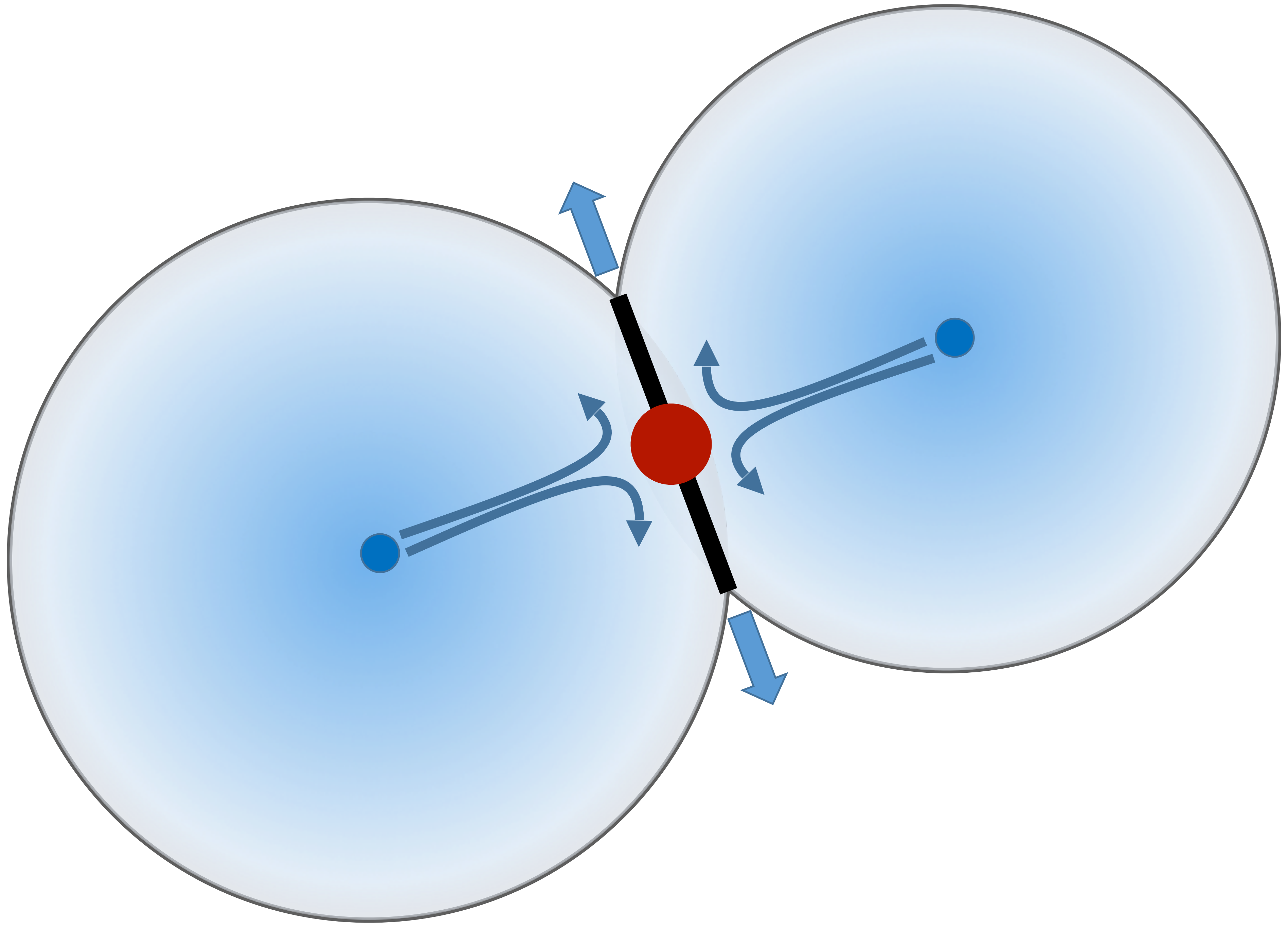
Radiative-Convective Equilibrium (RCE) simulations lead to self-aggregation



Can these phenomena be unified in one simple model?

Self-aggregation conceptualized by cold pool organization

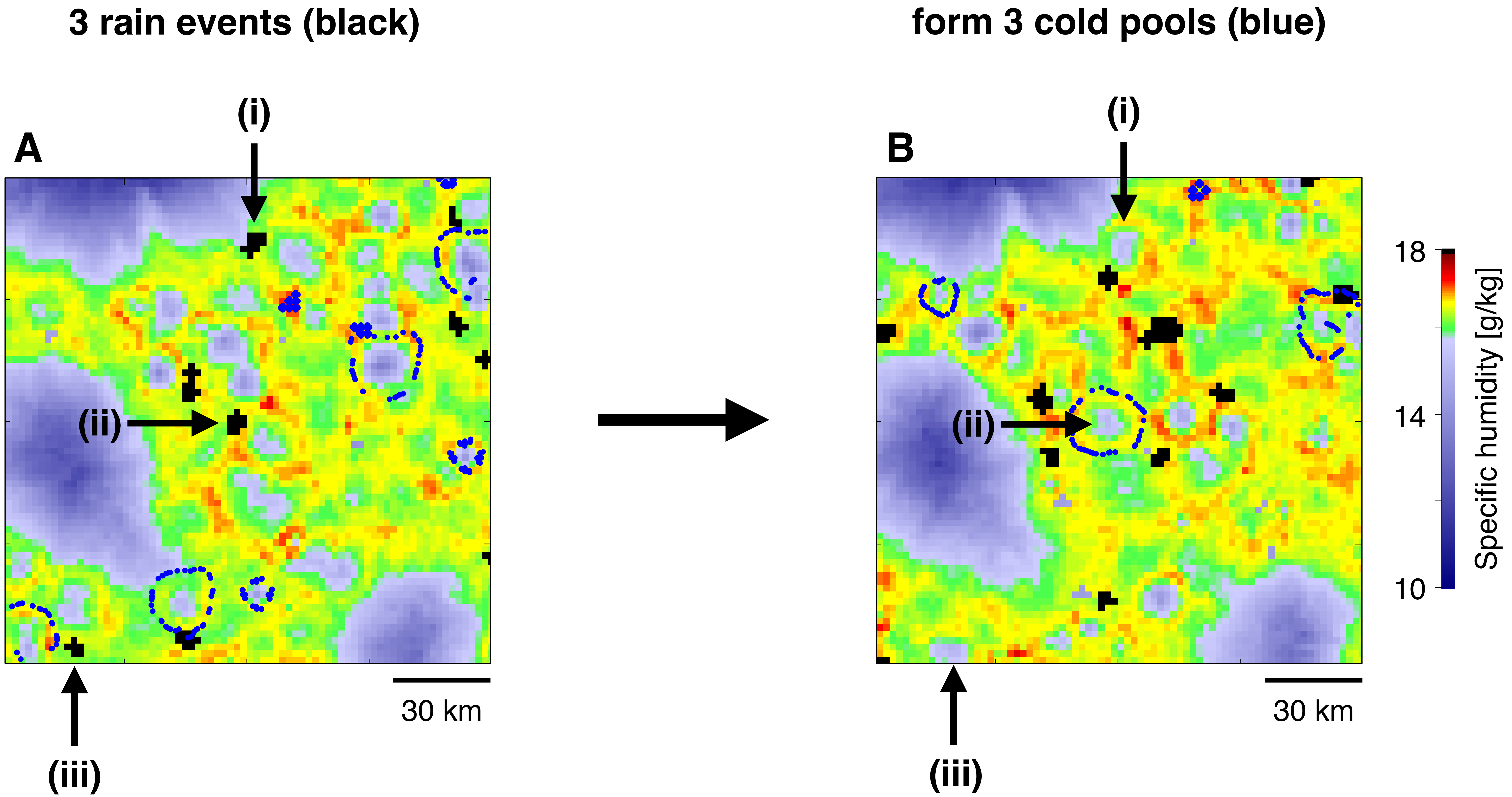
Sometimes two cold pools are sufficient



$$(x_c - x_1)^2 + (y_c - y_1)^2 = (R_1 + dR)^2$$

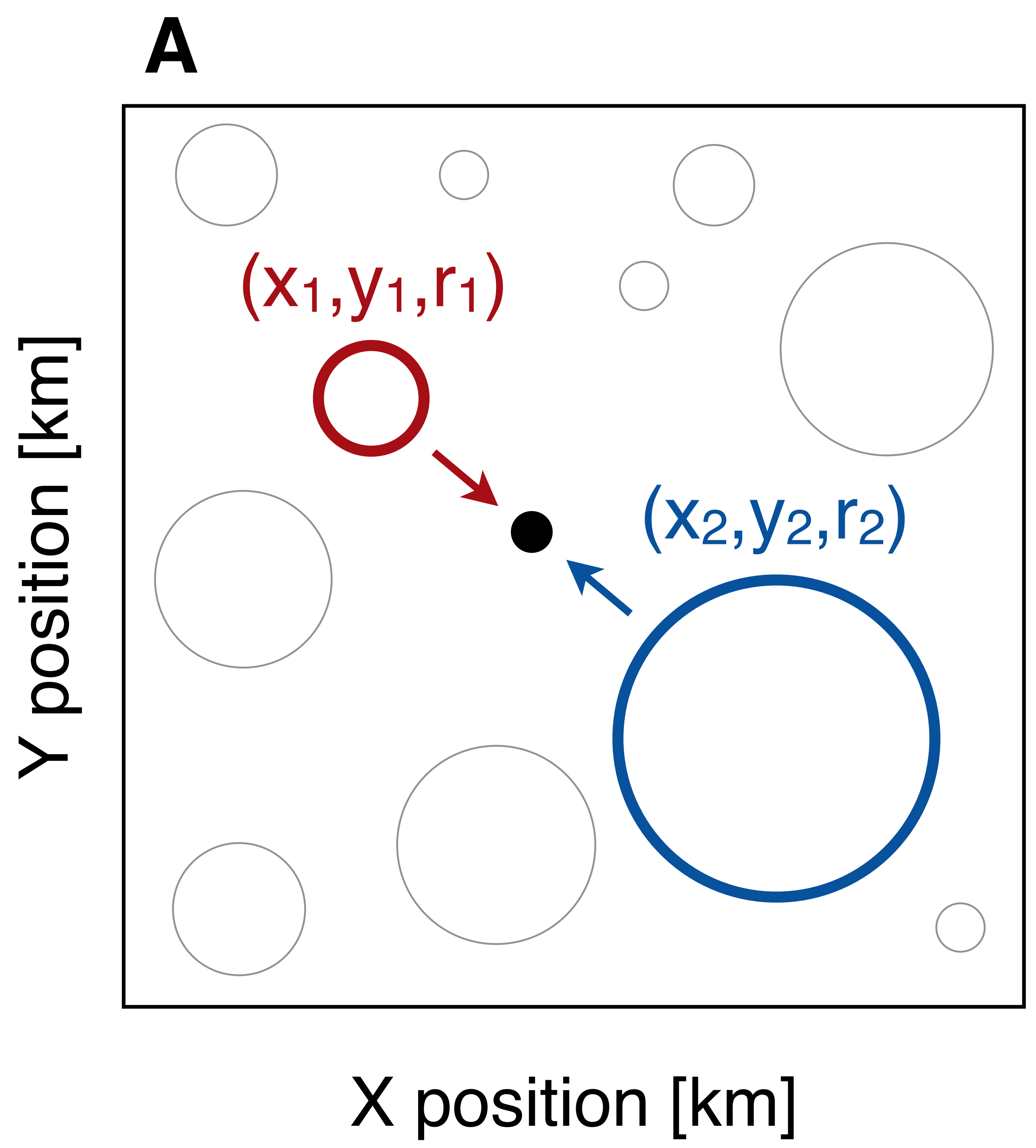
$$(x_c - x_2)^2 + (y_c - y_2)^2 = (R_2 + dR)^2$$

New rain events form in between two cold pools

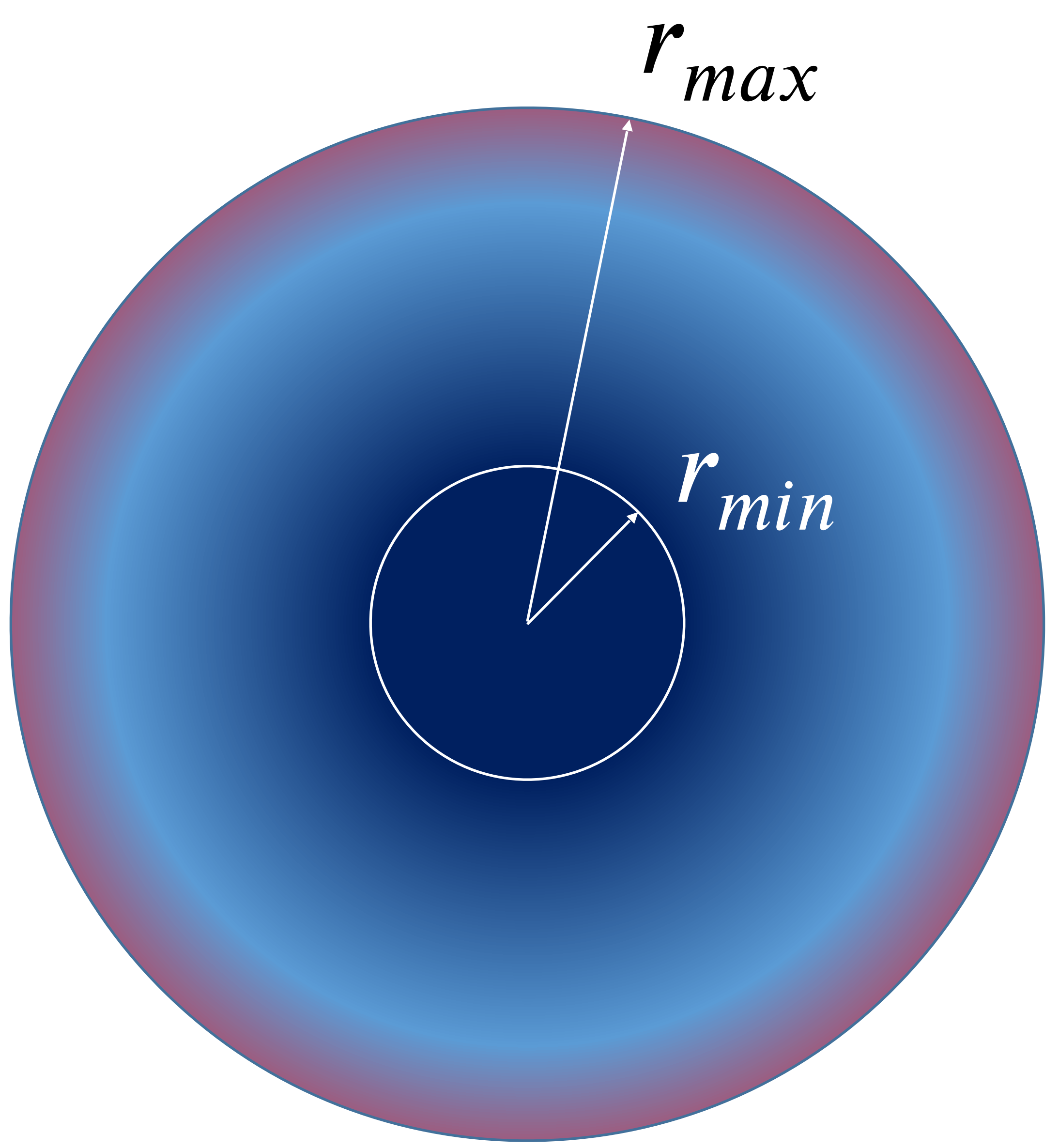


The circle model captures initial cavity formation

Conceptual circle model



with physical limitations



$r < r_{min}$: too cold

$r > r_{max}$: too slow

The circle model captures initial cavity formation

Initially homogenous | **Impuritess initiate cavities** | **One cavity make it** | **And persist in time**

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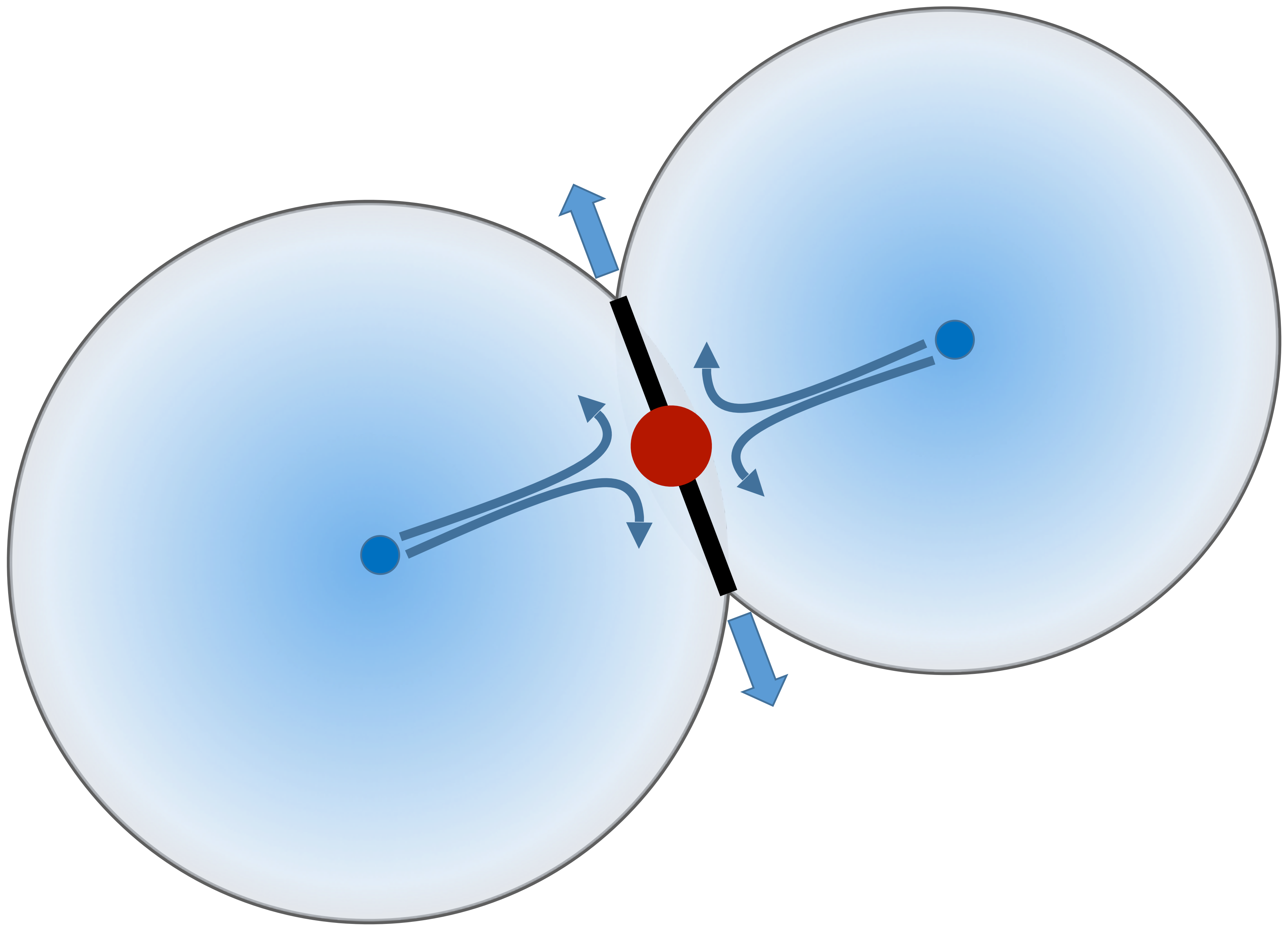
3 key points

1. Physical limitations are added to the circle model.

2. New rain events form in between two cold pools.

3. The circle model captures initial cavity formation.



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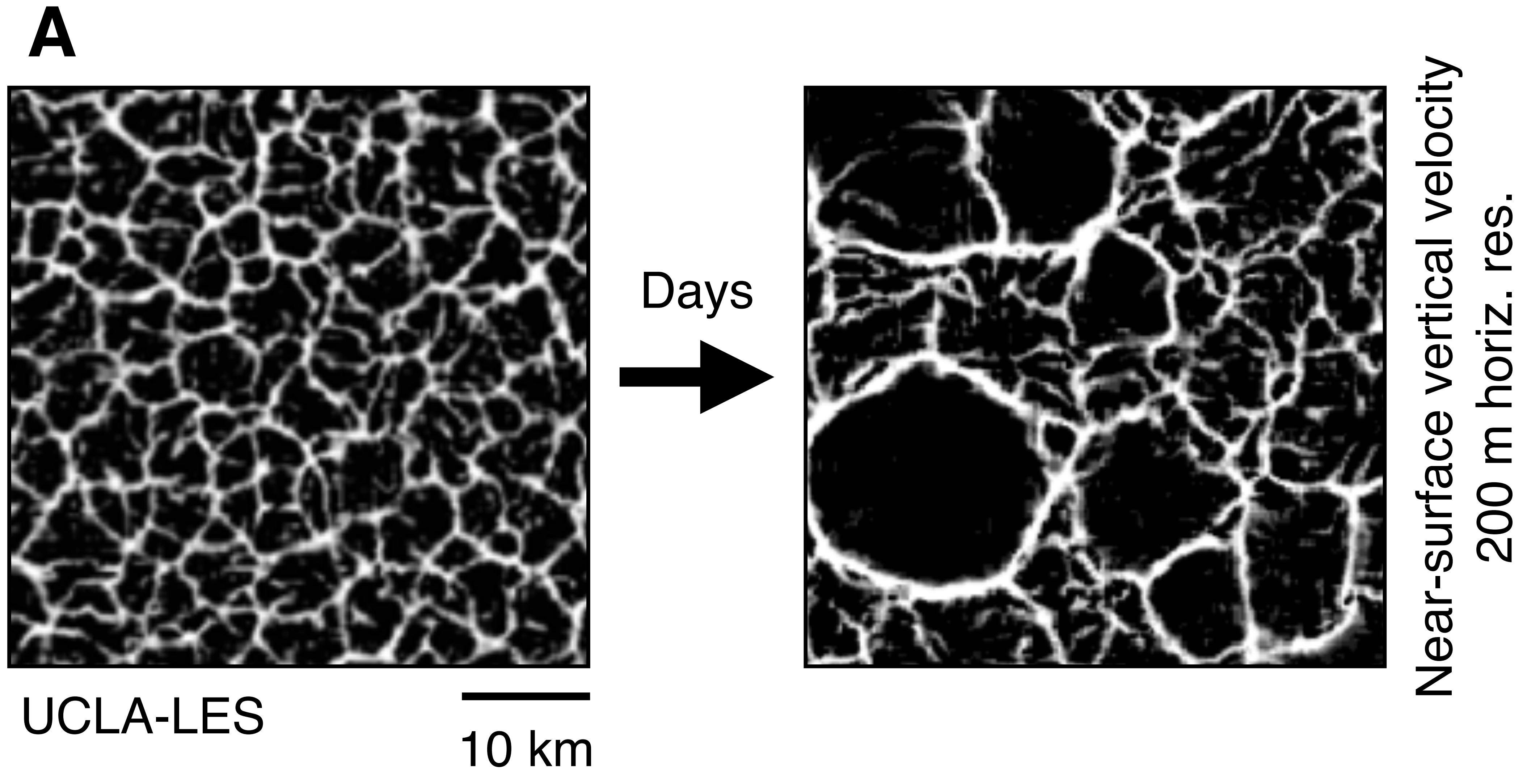
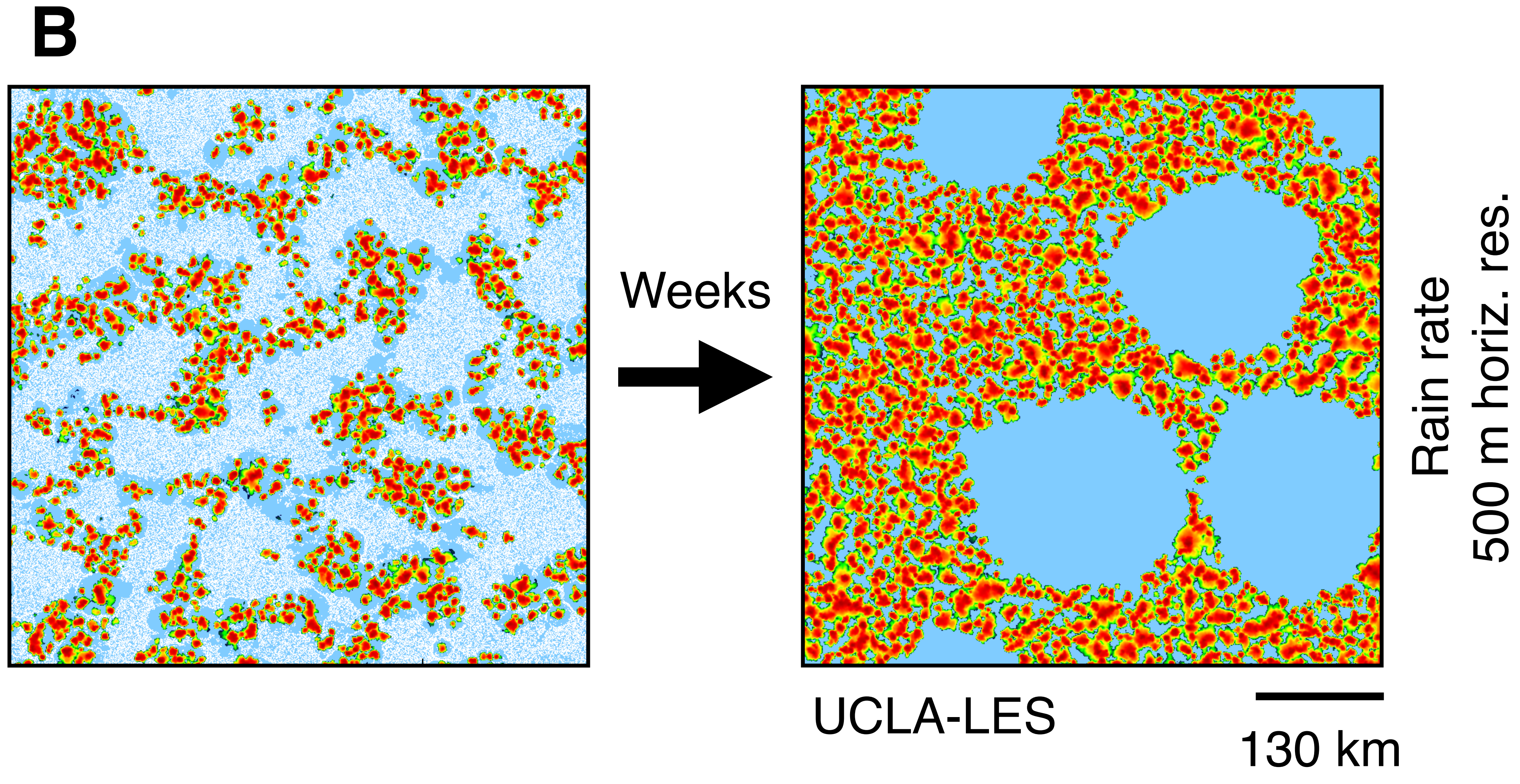
Circling in on Convective Organization

Diurnal convection leads to convective scale increase



Radiative-Convective Equilibrium (RCE) simulations lead to self-aggregation



A simple model based on cold pools can capture both

Thank you!

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Danmarks Grundforskningsfond
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