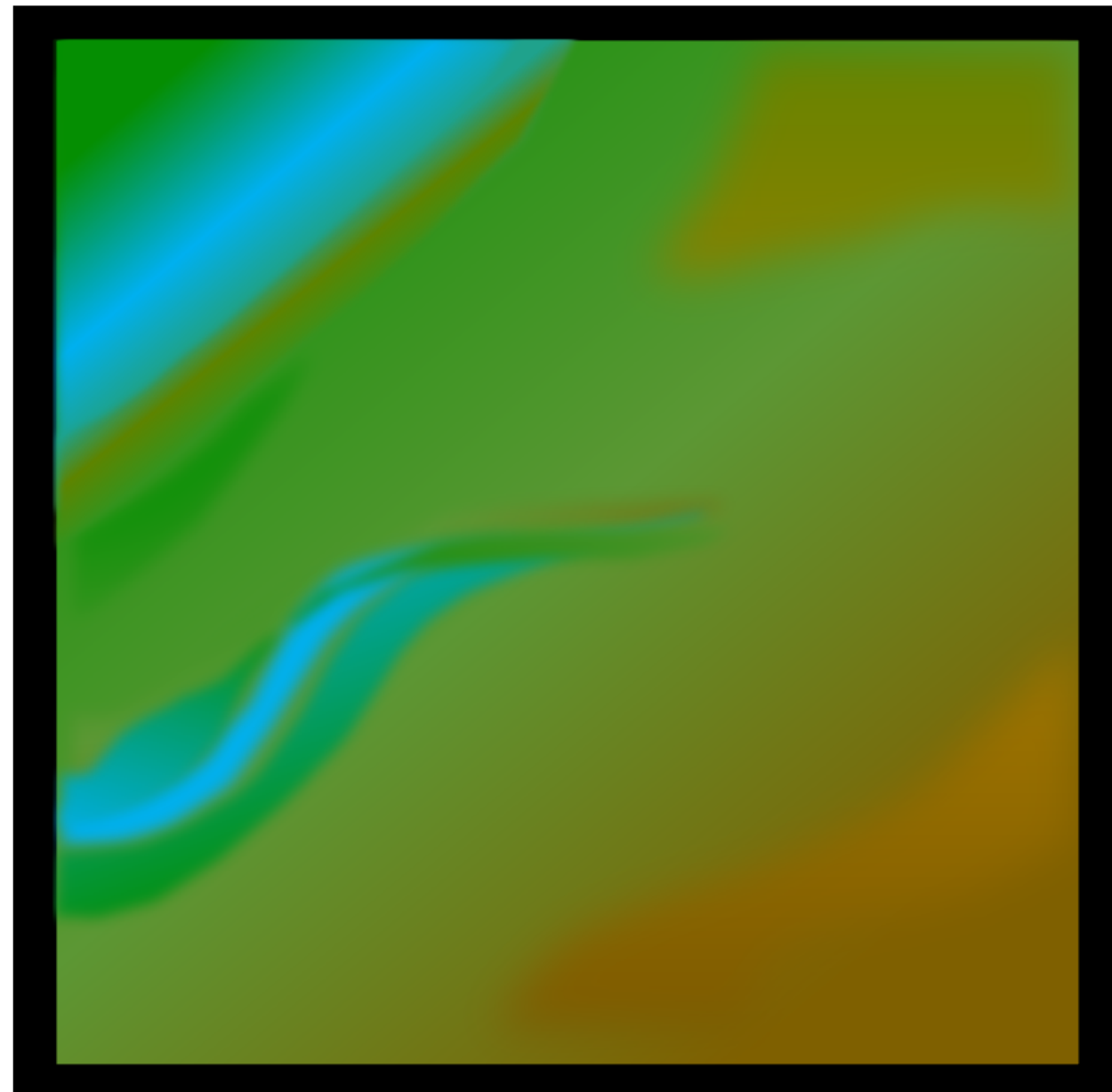

USING SUPERVISED LEARNING FOR OPTIMIZING THE NUMBER OF SUB-GRID TILES FOR LAND SURFACE MODELING

Laura Torres-Rojas, Noemi Vergopolan,
Jonathan D. Herman & Nathaniel W. Chaney

CONTEXT

Challenge for Earth System Models (ESMs): To capture physical sub-grid scale variability without excessive computational cost.



1.



DOMINANT

Region with larger area determines attribute.

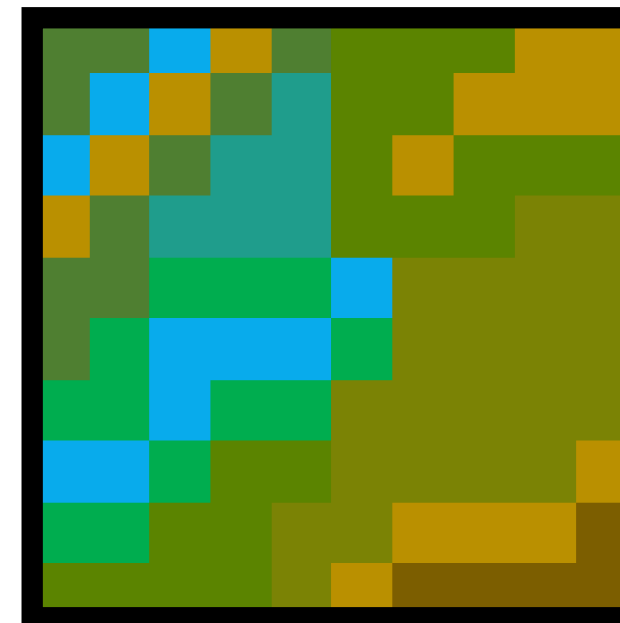
2.



COMPOSITE

Average value: composite homogeneous field.

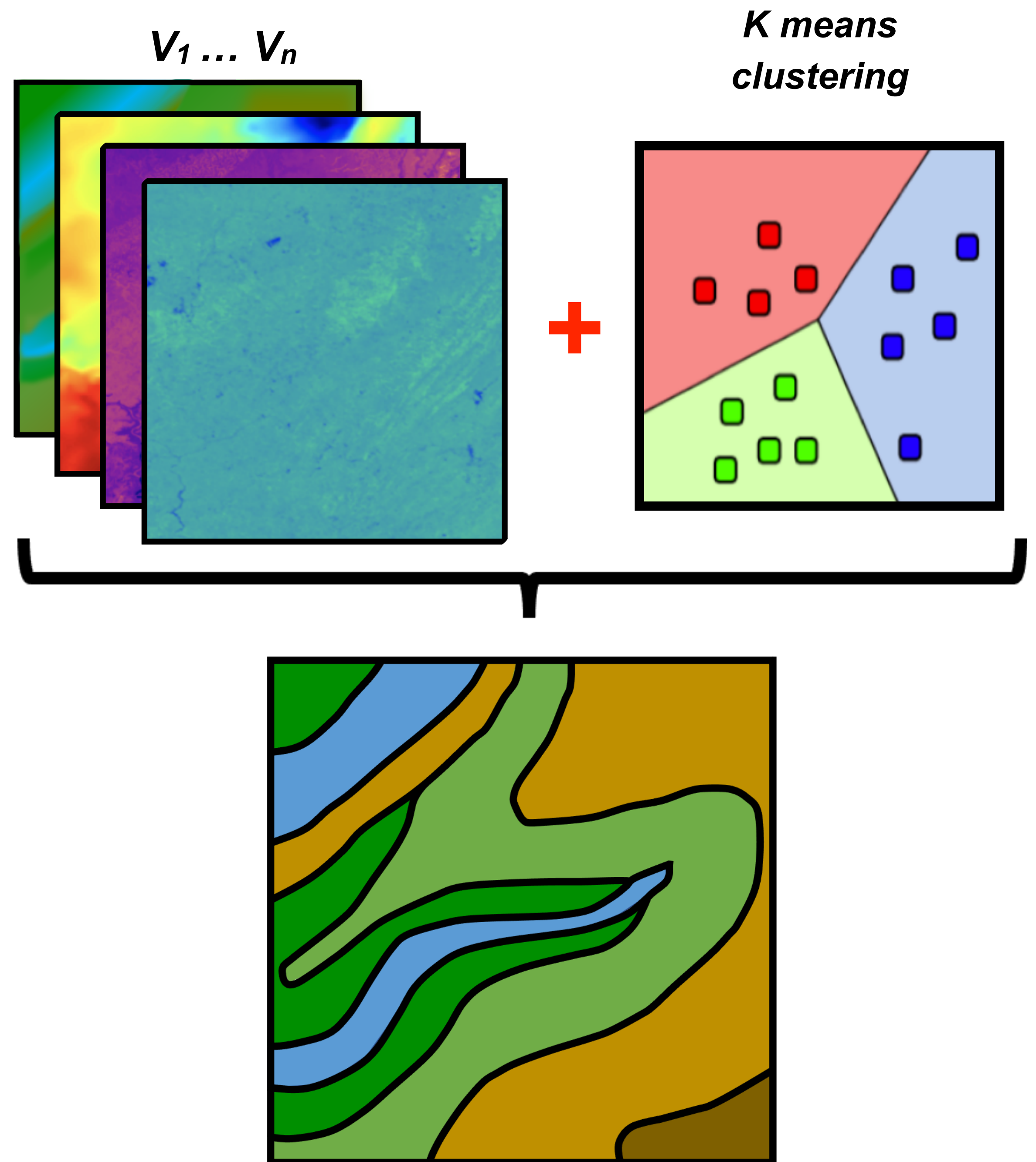
3.



TILING

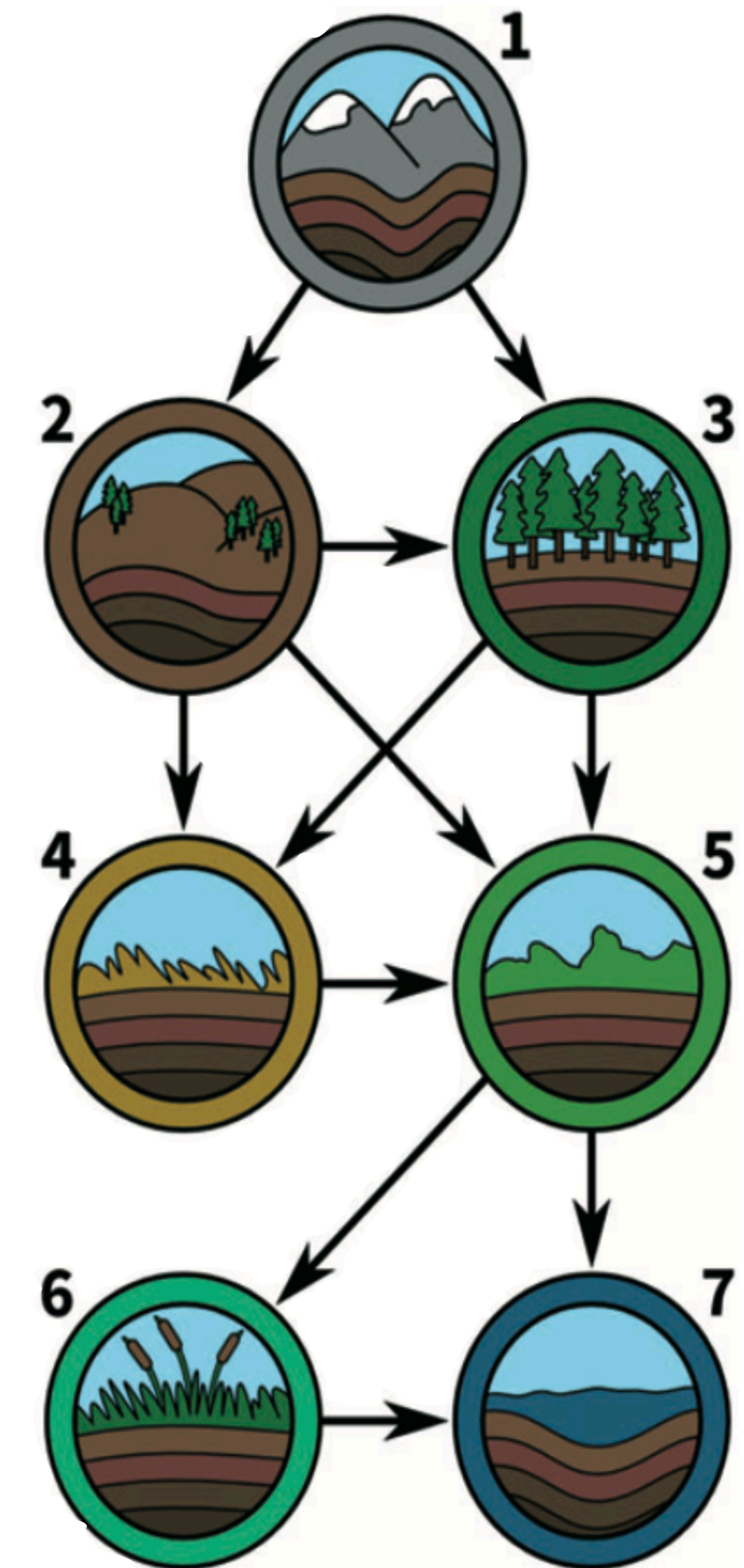
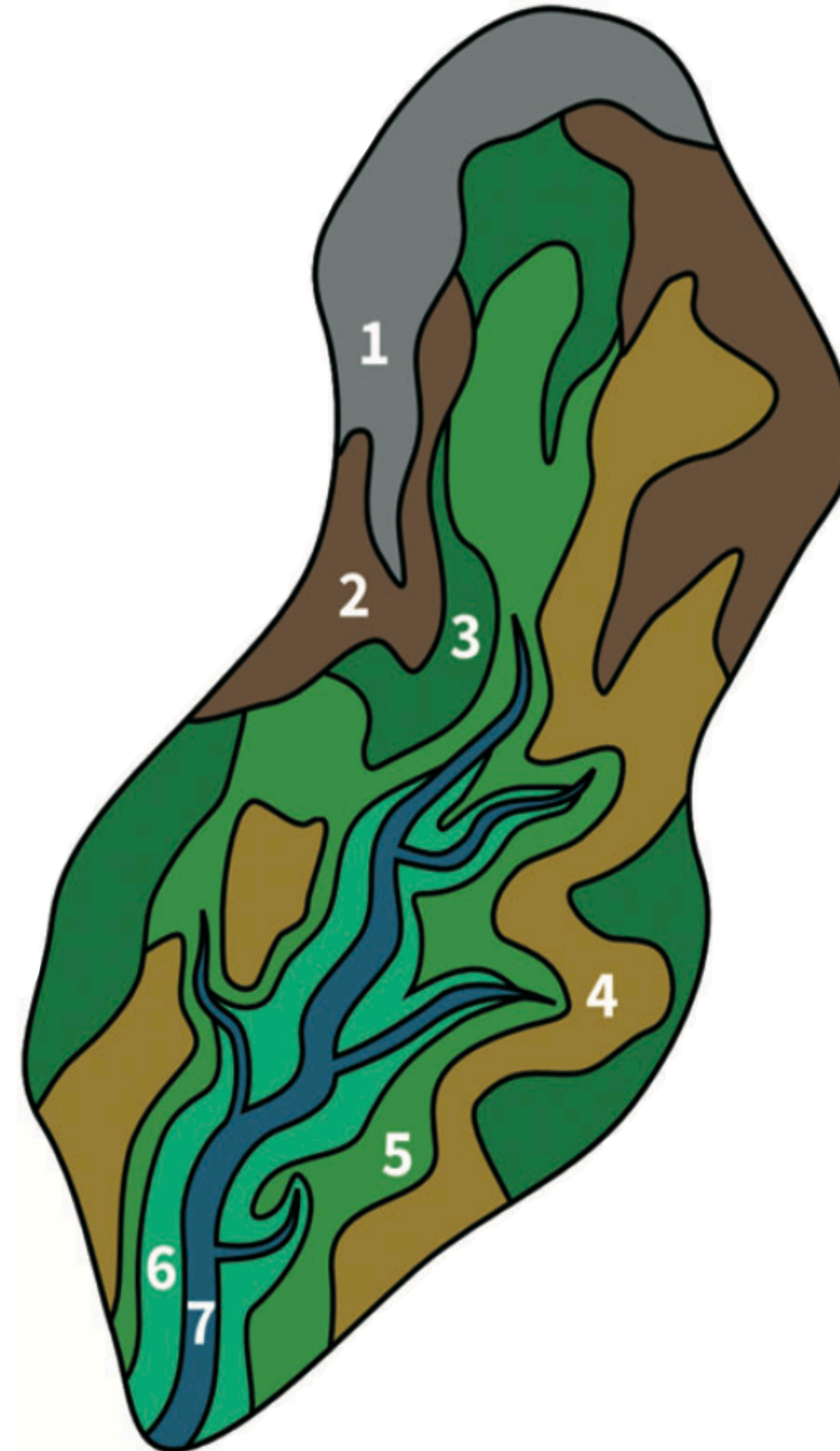
- Partition into smaller units.
- Independent model calculations

TILING

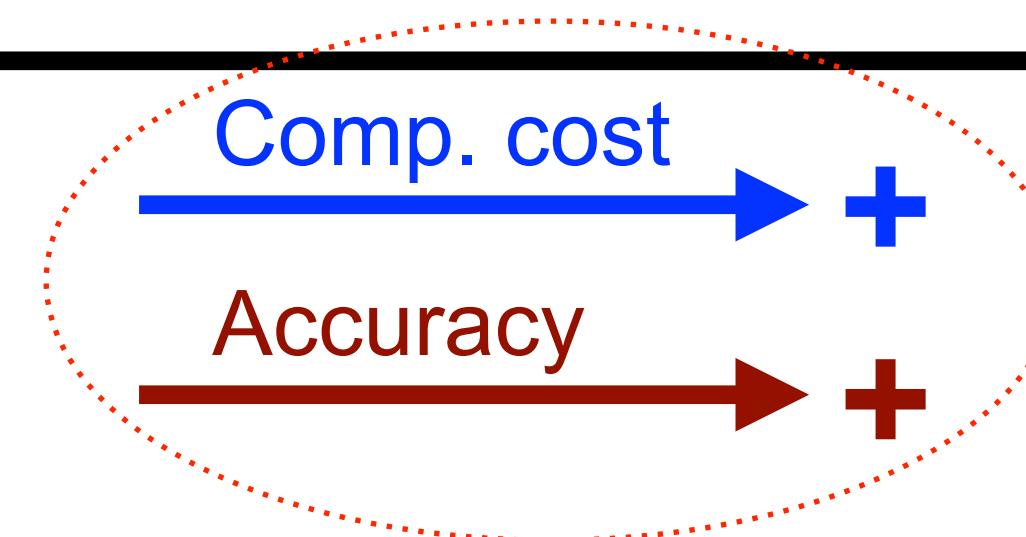
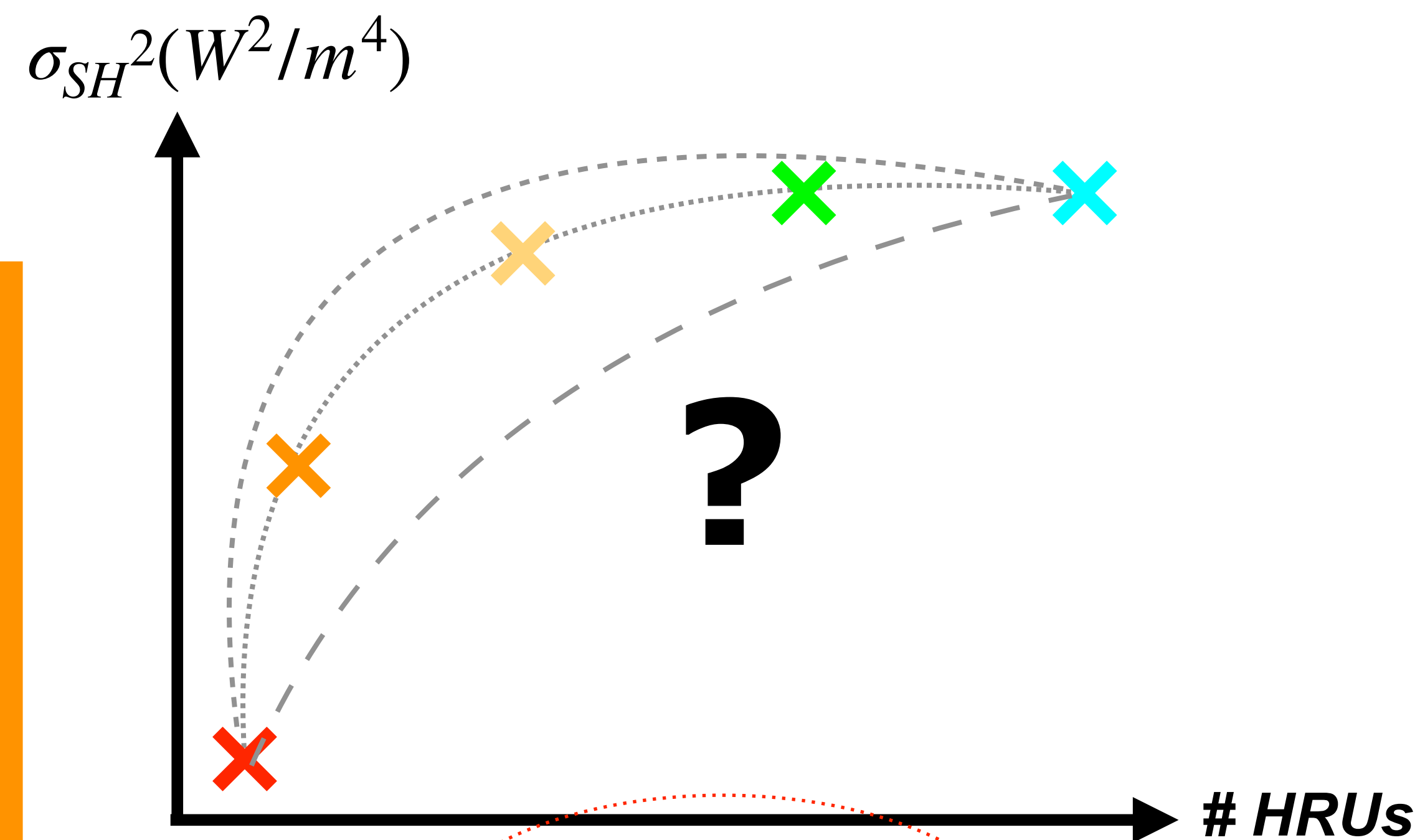
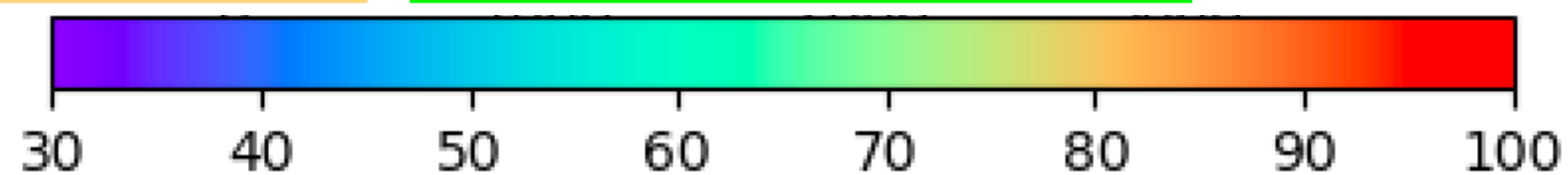
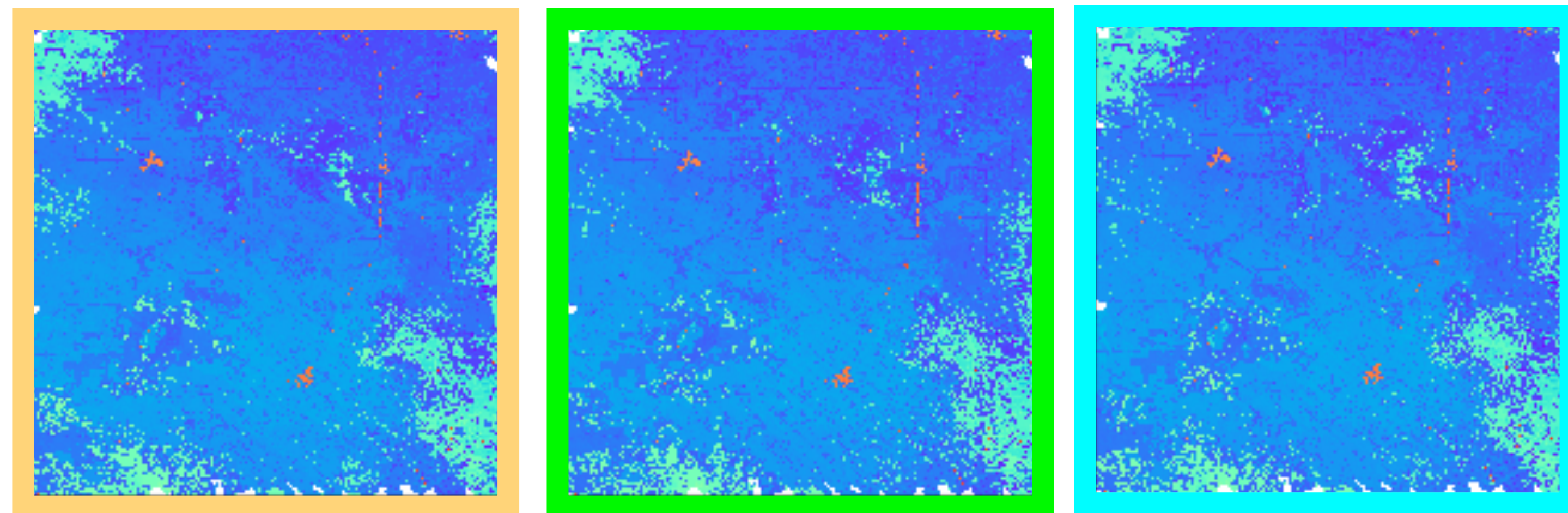
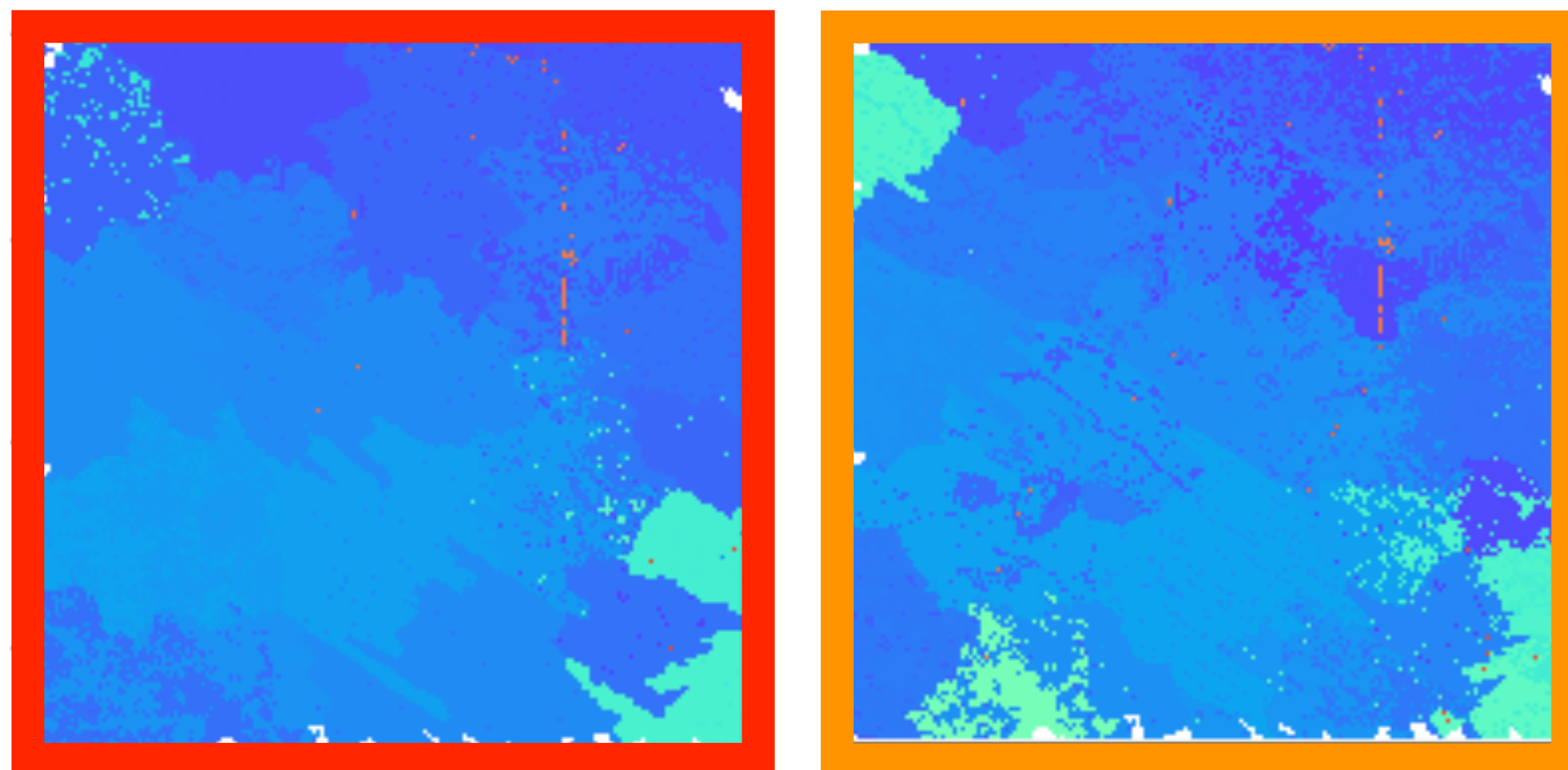


HYDROBLOCKS LSM

- Interacting Hydrological Response Units (**HRUs**).
- 3-stage tiling scheme (**3 parameters**).
 - **K**: Large scale heterogeneity (↑; +HRUS).
 - **N**: Height discretization (↓; +HRUS).
 - **P**: Small scale heterogeneity (↑; +HRUS).



CONVERGENCE

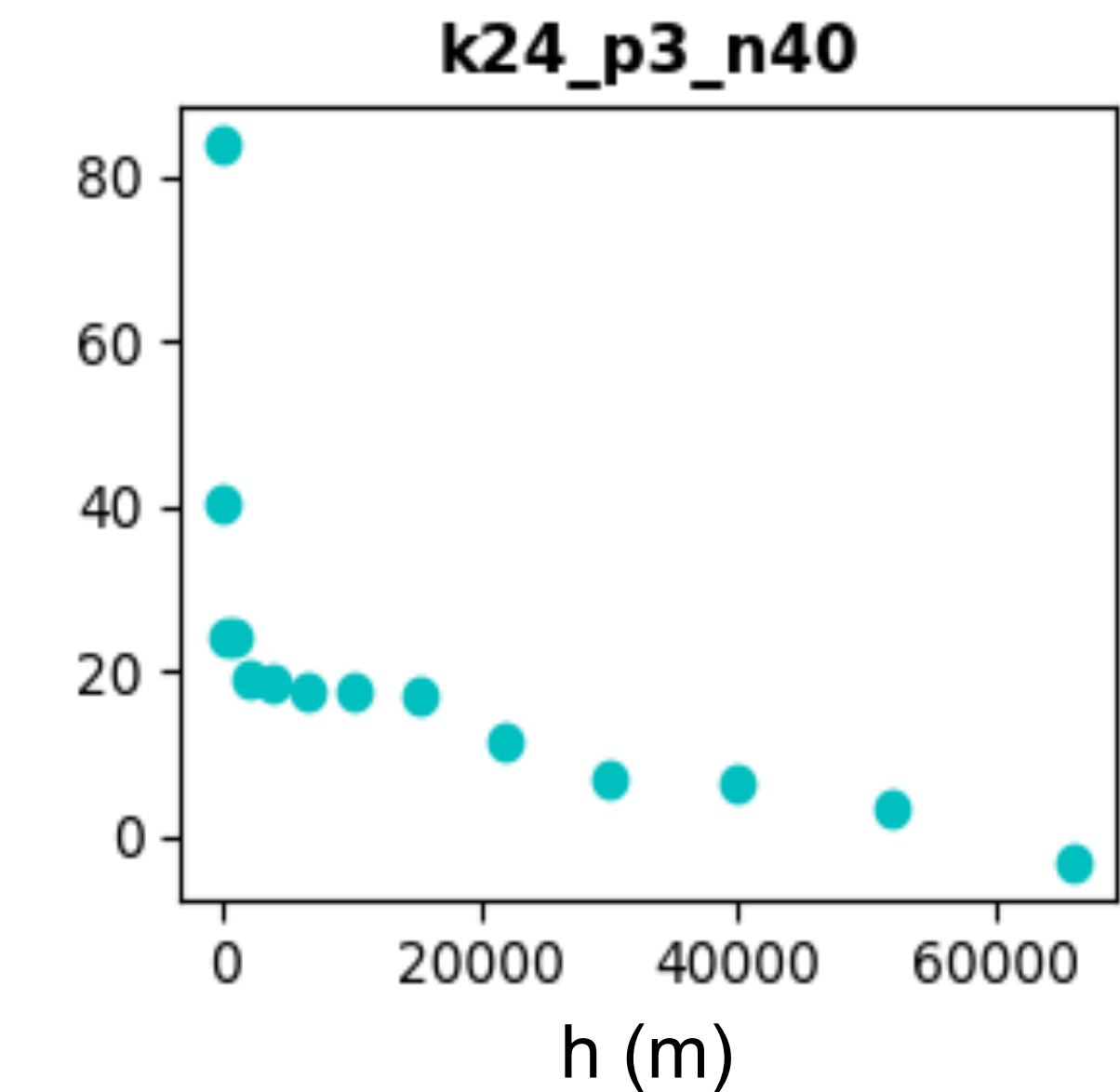
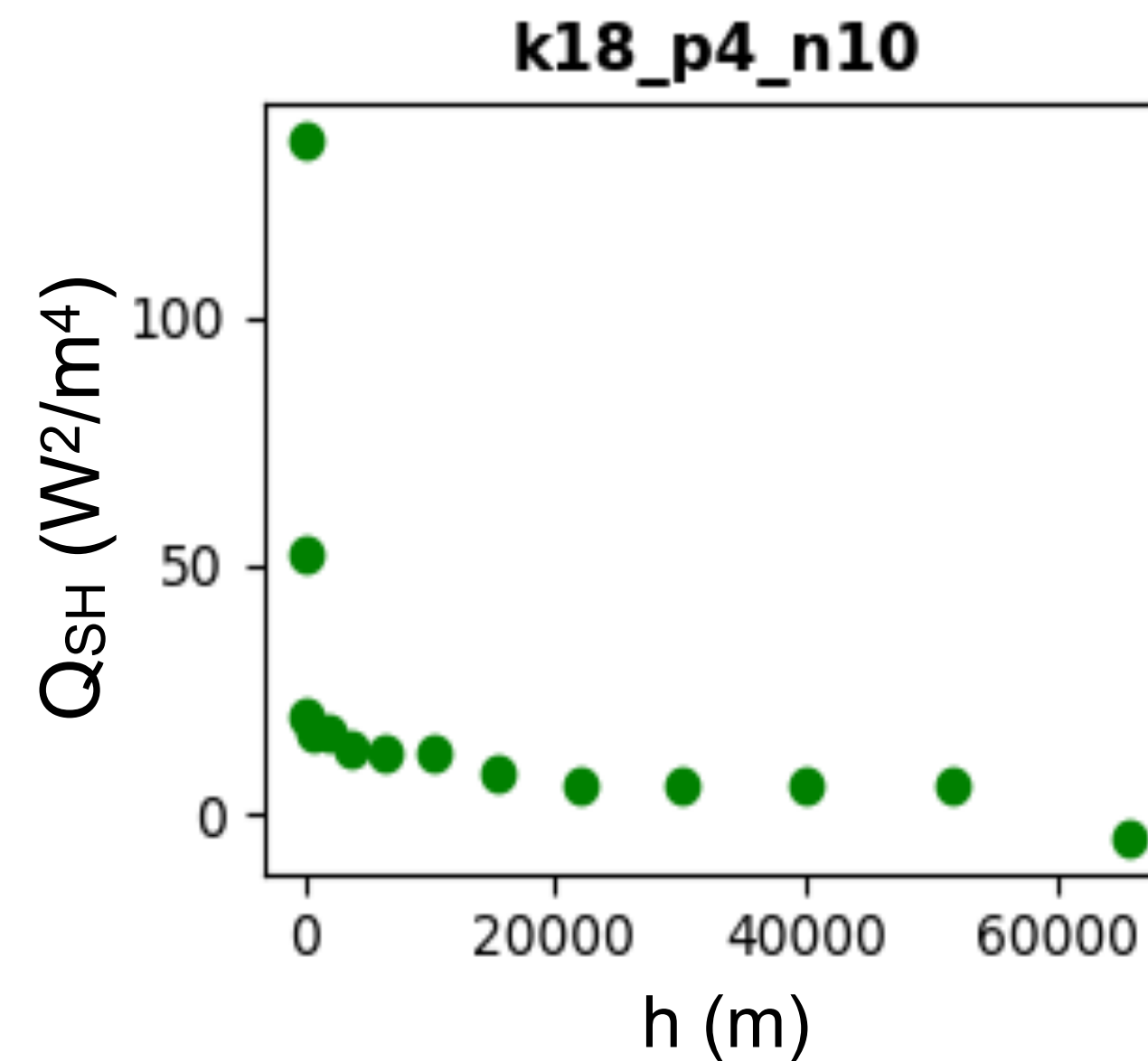
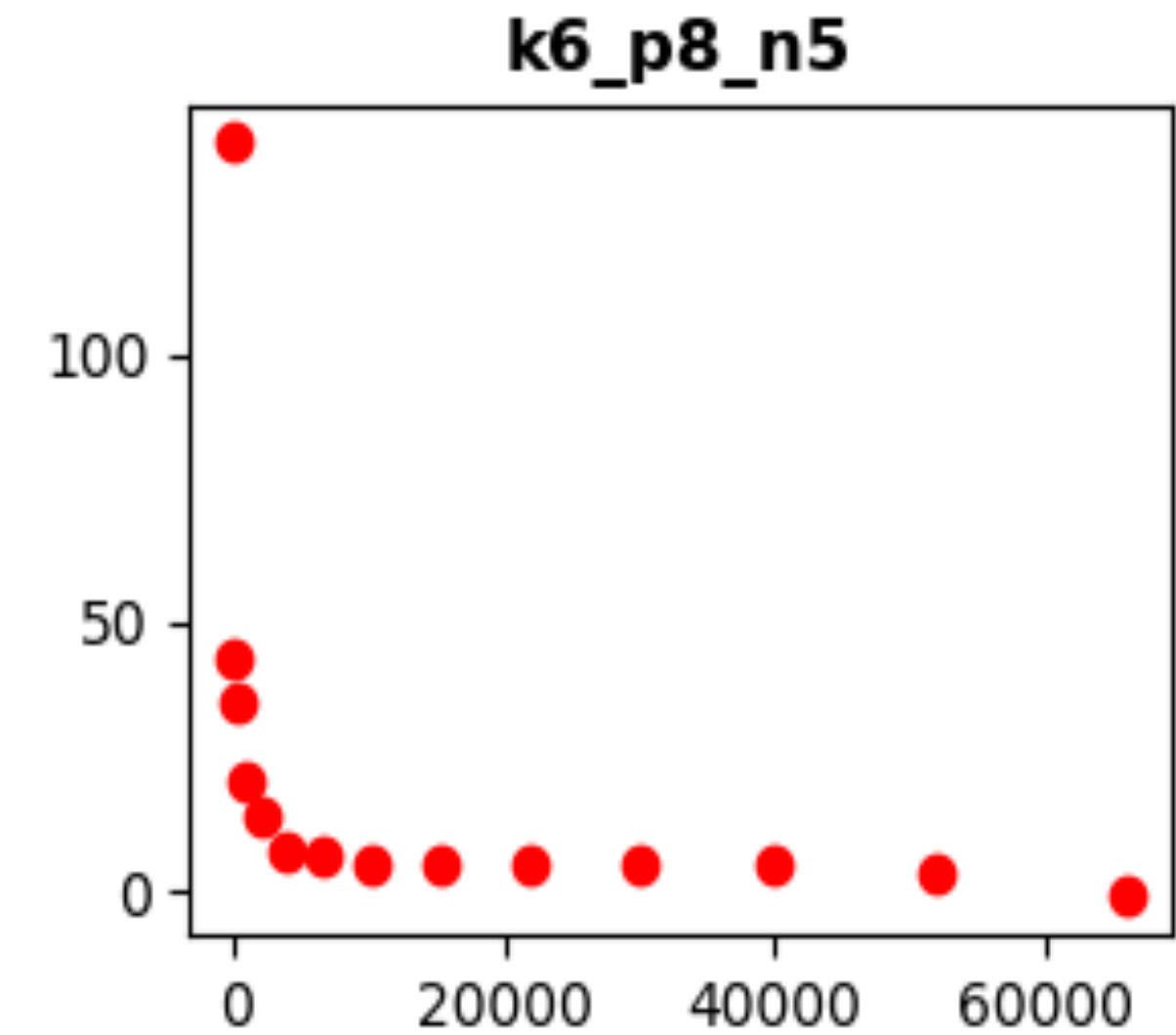
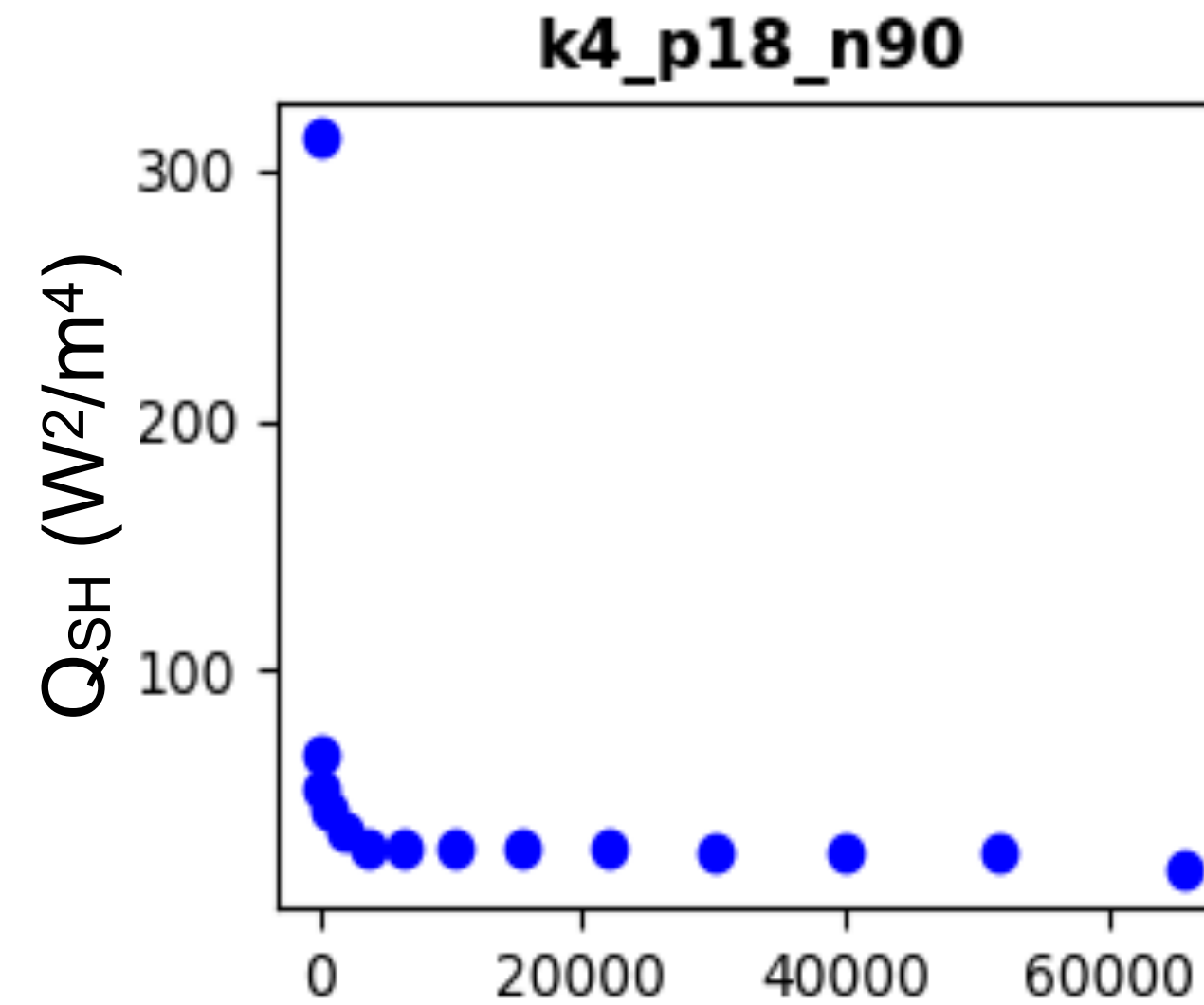


??

CONVERGENCE METRIC

- Significantly different spatial features of fields.
- σ^2 is not enough
- Empirical spatial covariance function¹ (Q):
 - Allows for evaluation of spatial structure.

¹ <https://doi.org/10.5194/egusphere-egu21-14039>



METHODS

1.

HydroBlocks emulator (RFM)

- ~1,500 HB simulations.
- Output: Covariance functions (SMC, SH, LH, and RO).

3.

Compare to “fully distributed” simulation

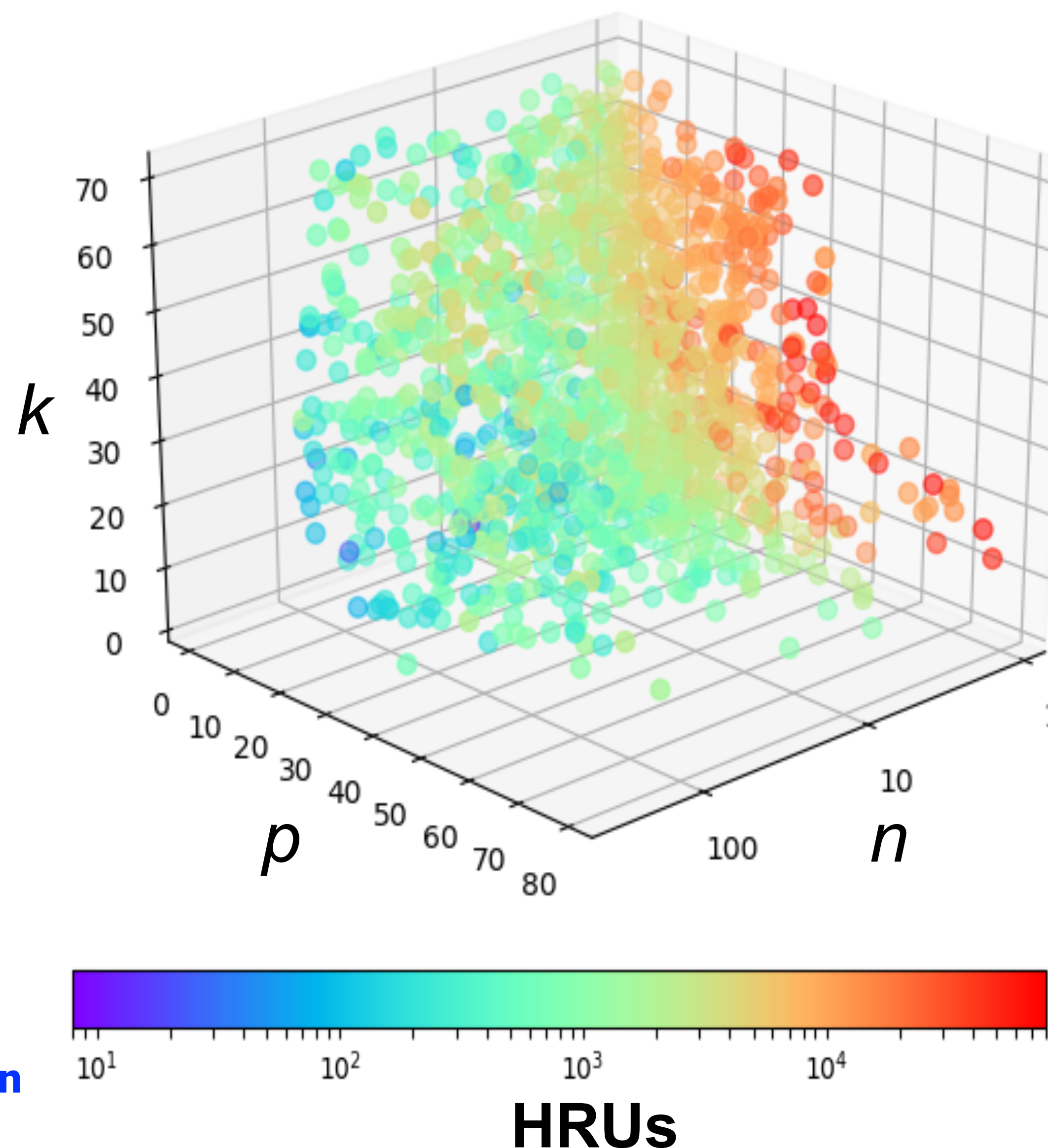
- ~81,000 HRUs
- 3 metrics: $1-R^2$, ΔA , MAXD

2.

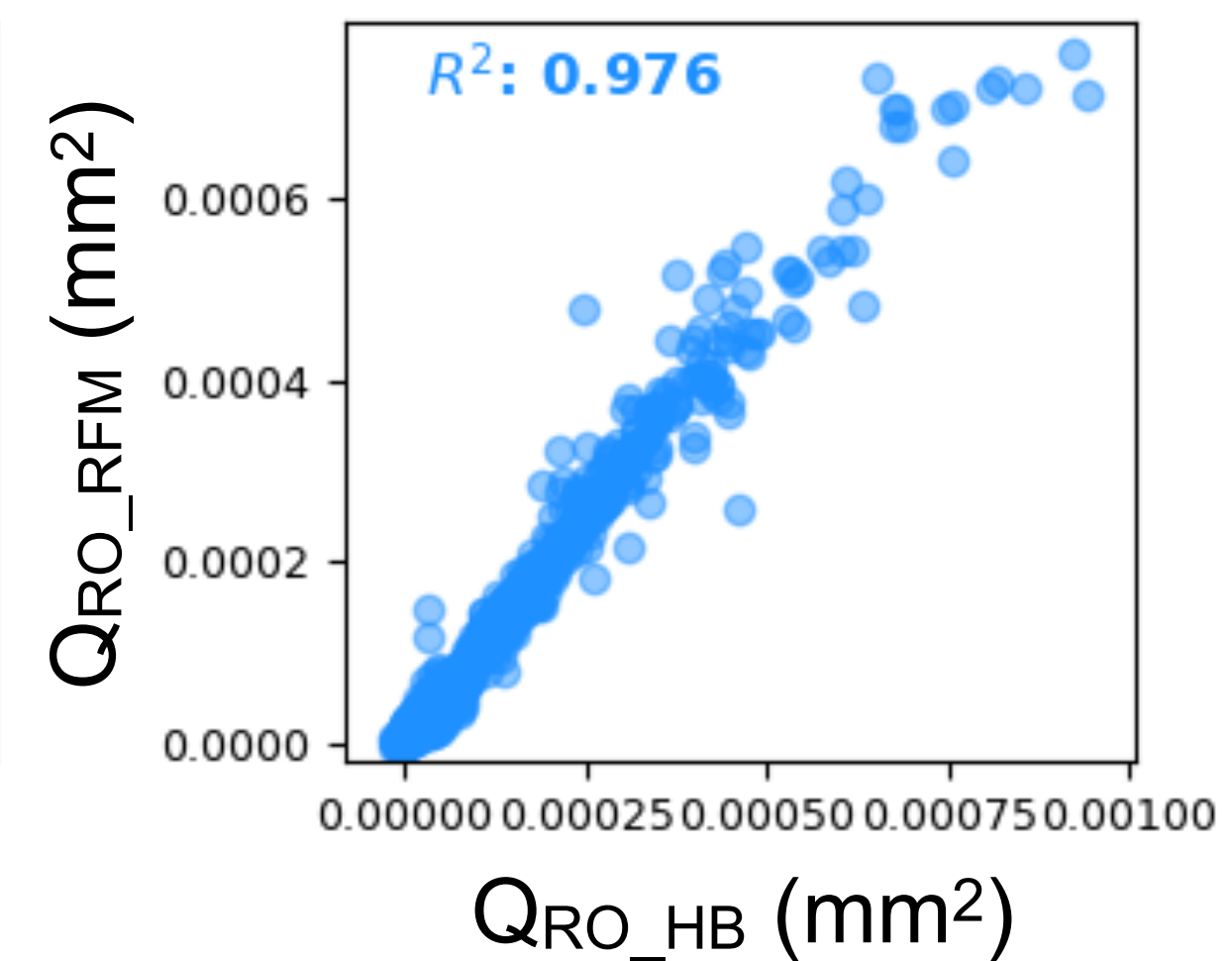
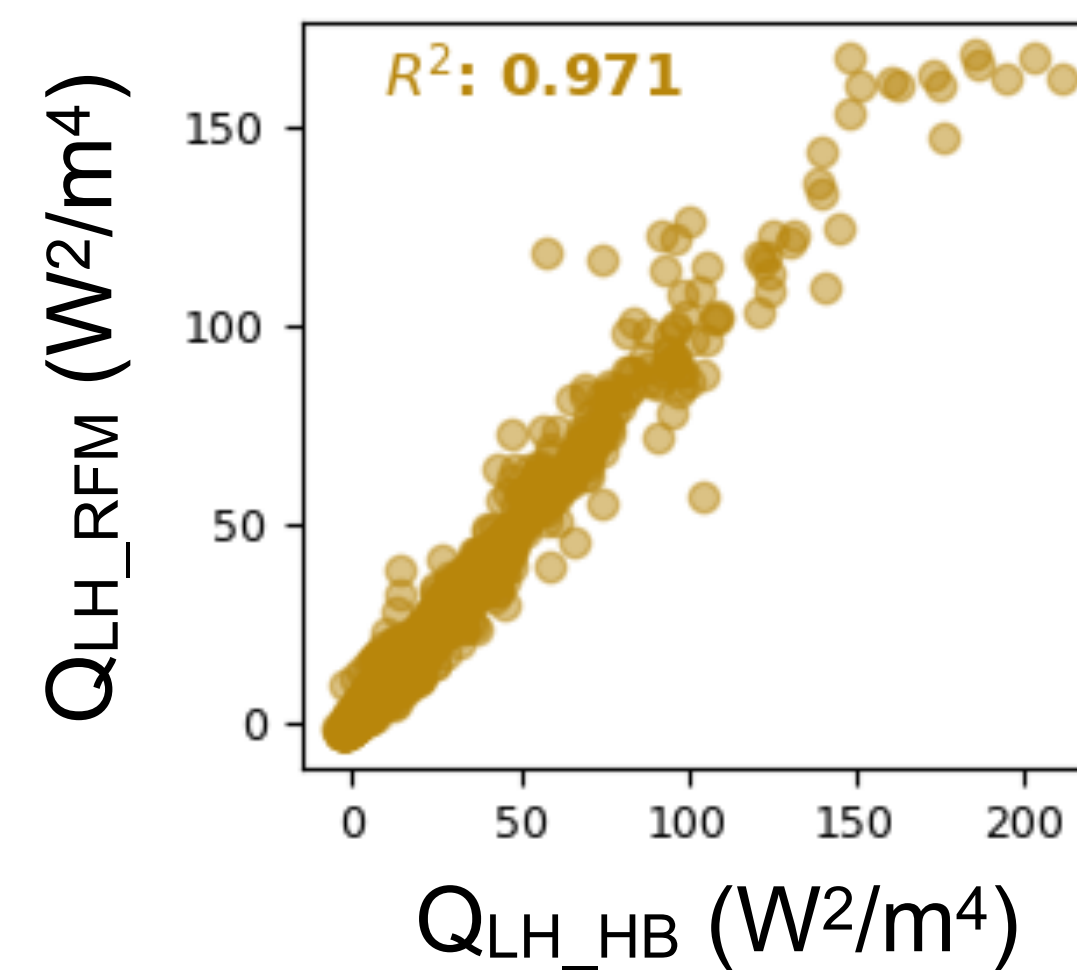
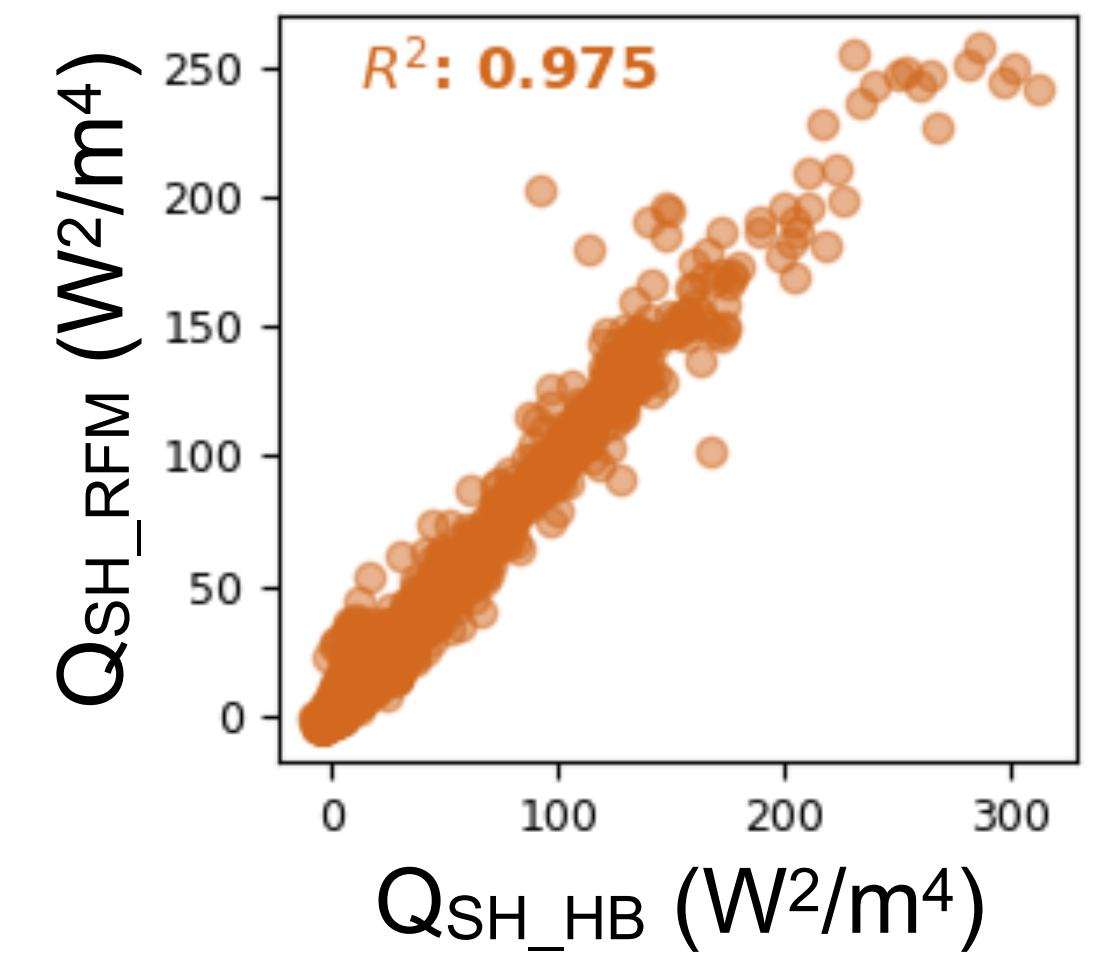
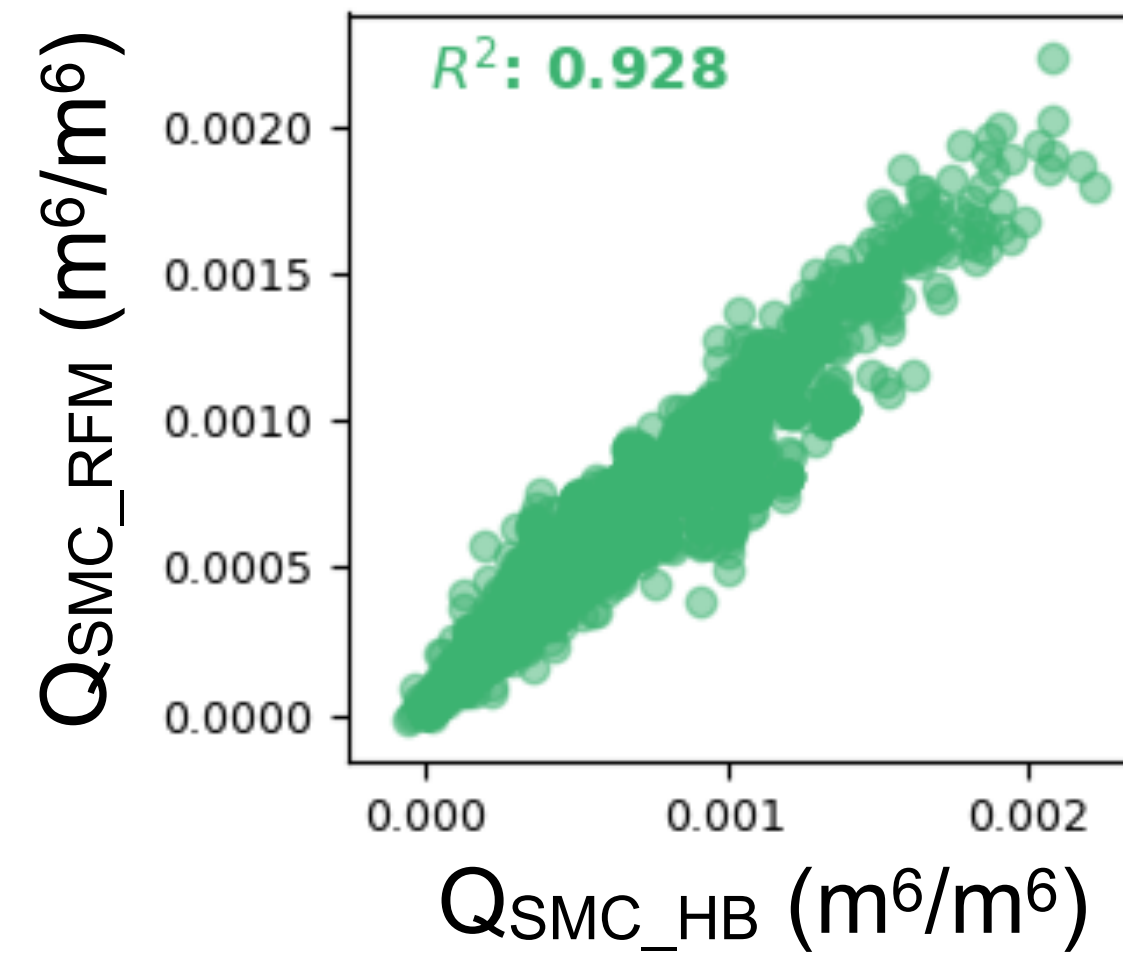
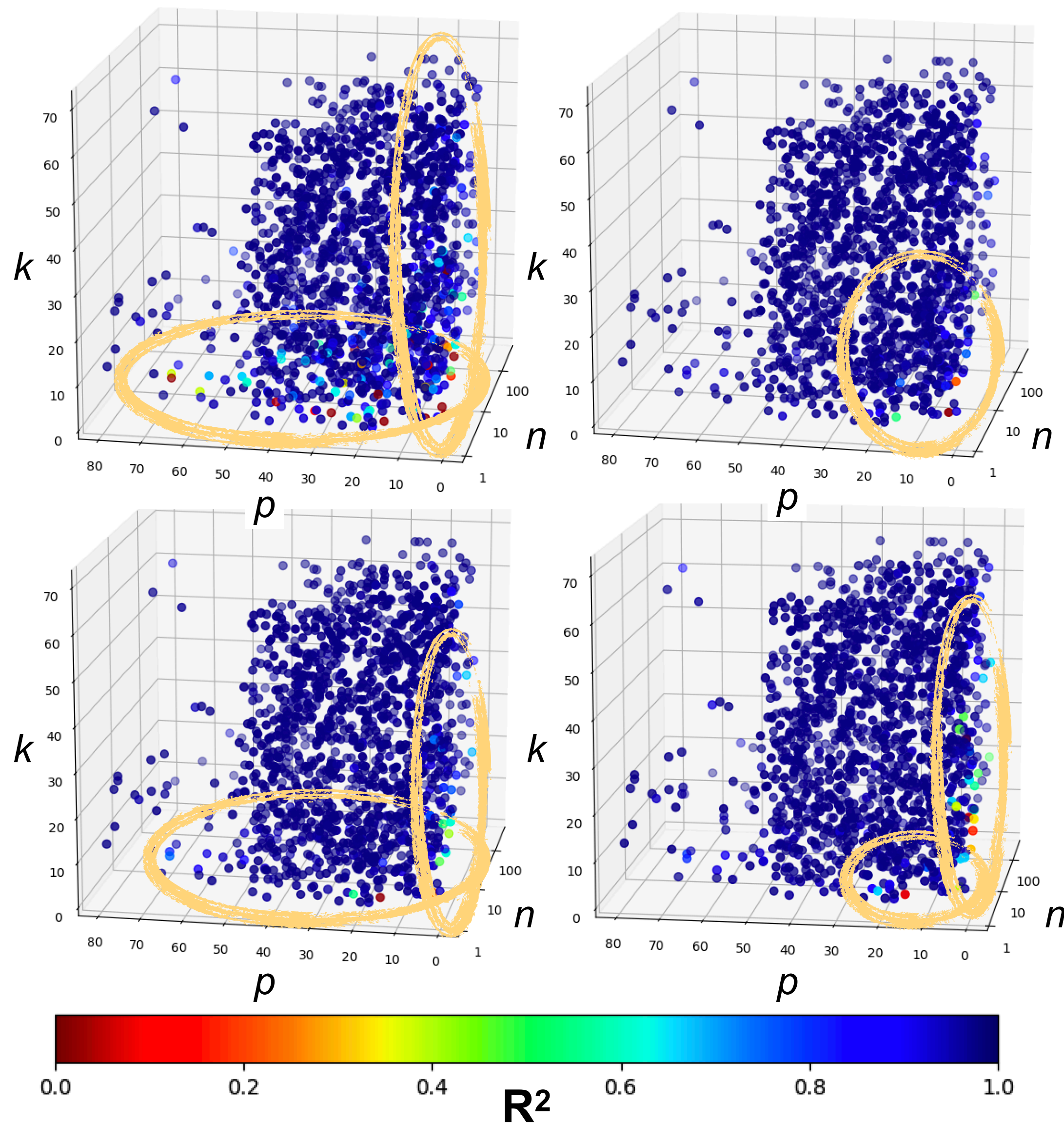
1'000,000 synthetic simulations

4.

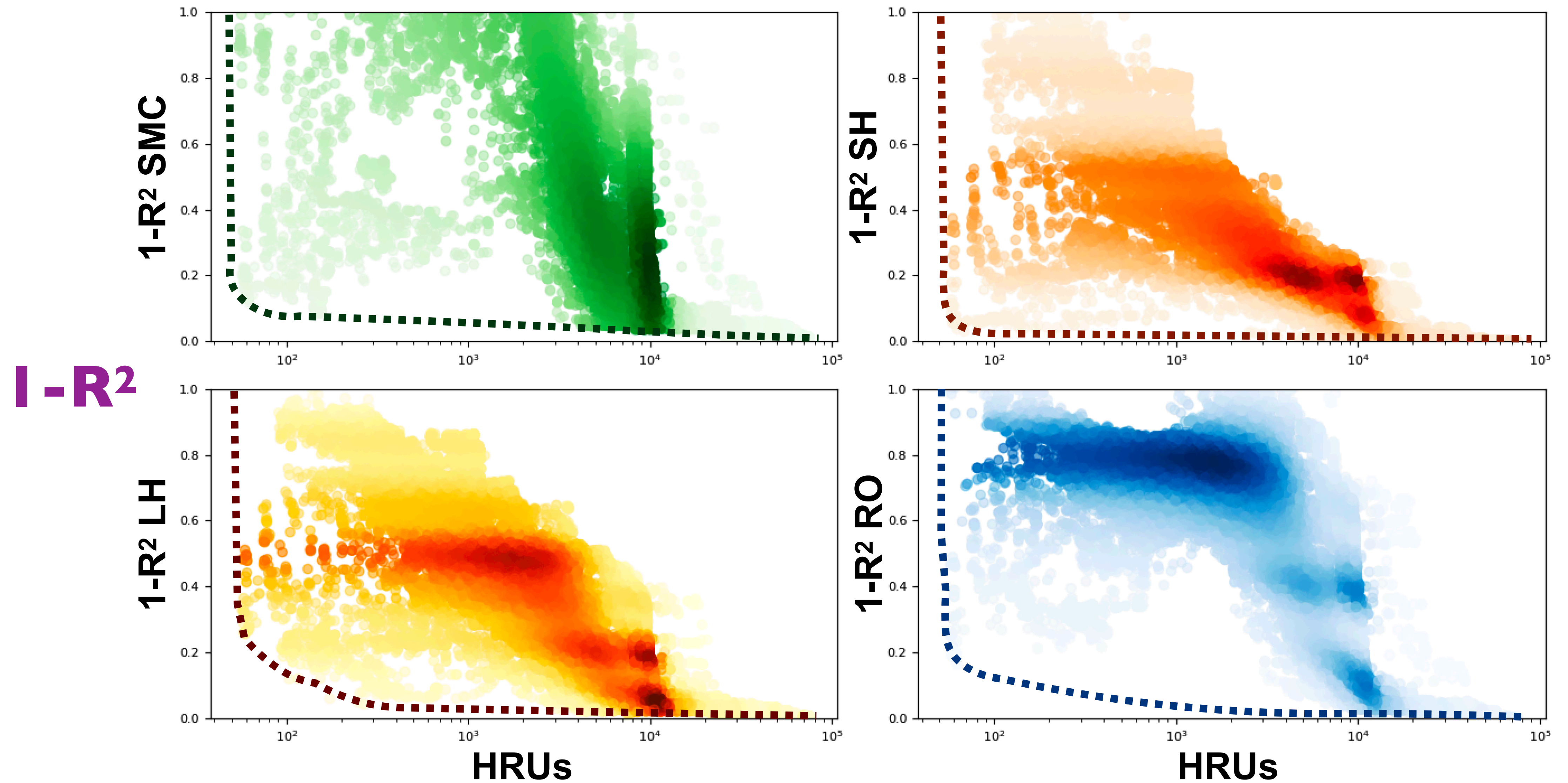
Multi-objective optimization



EMULATOR'S PERFORMANCE

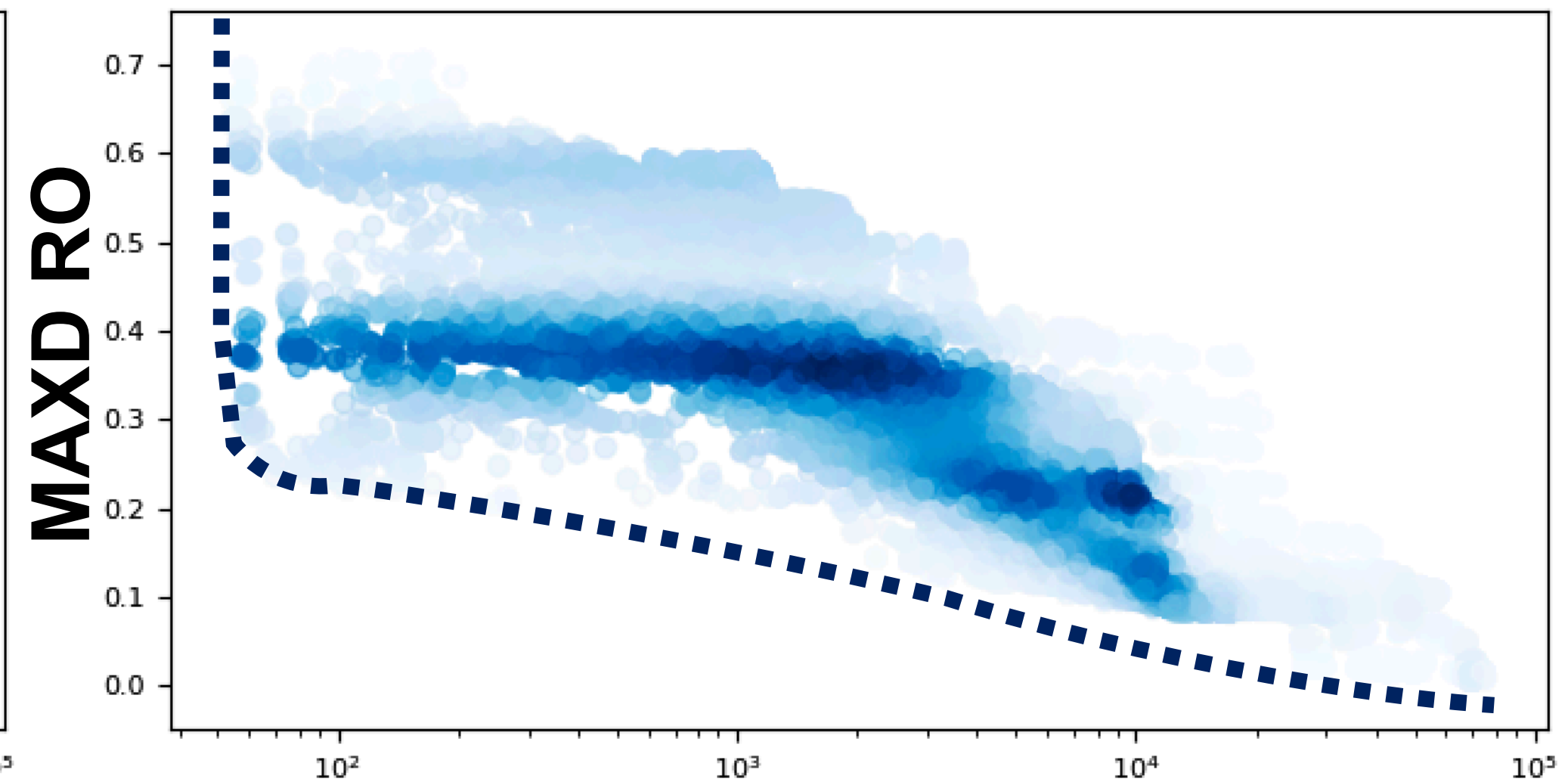
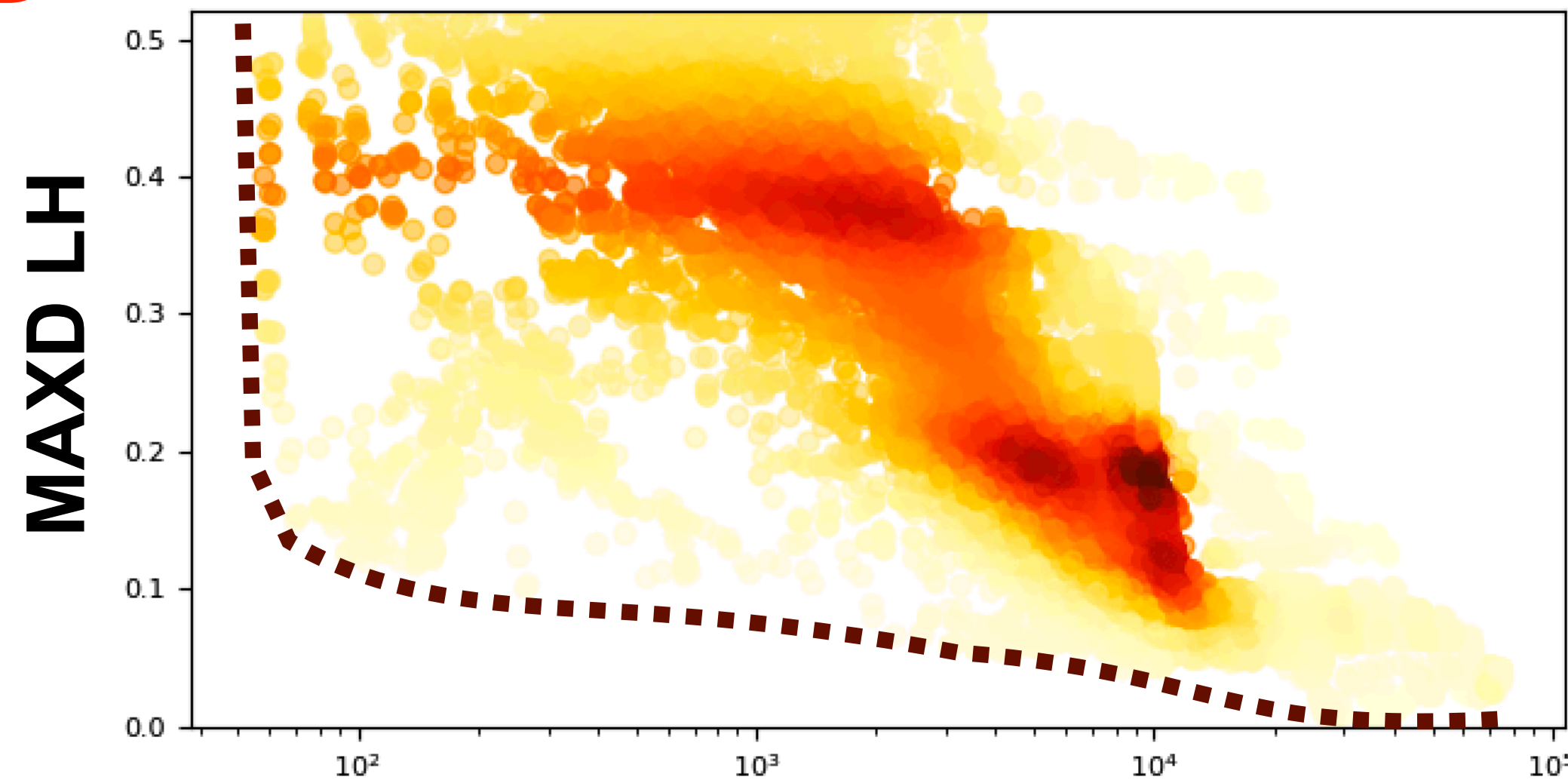
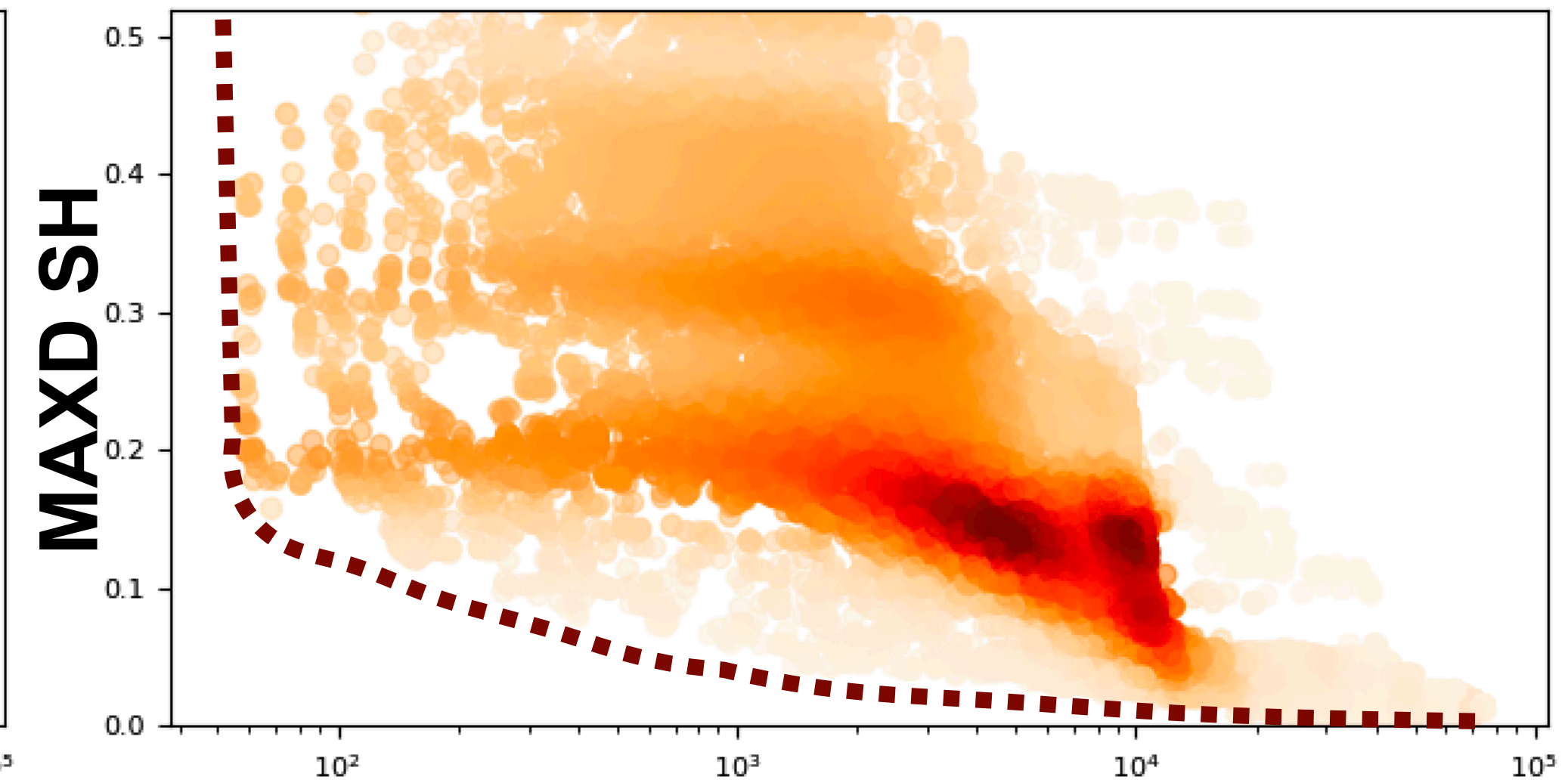
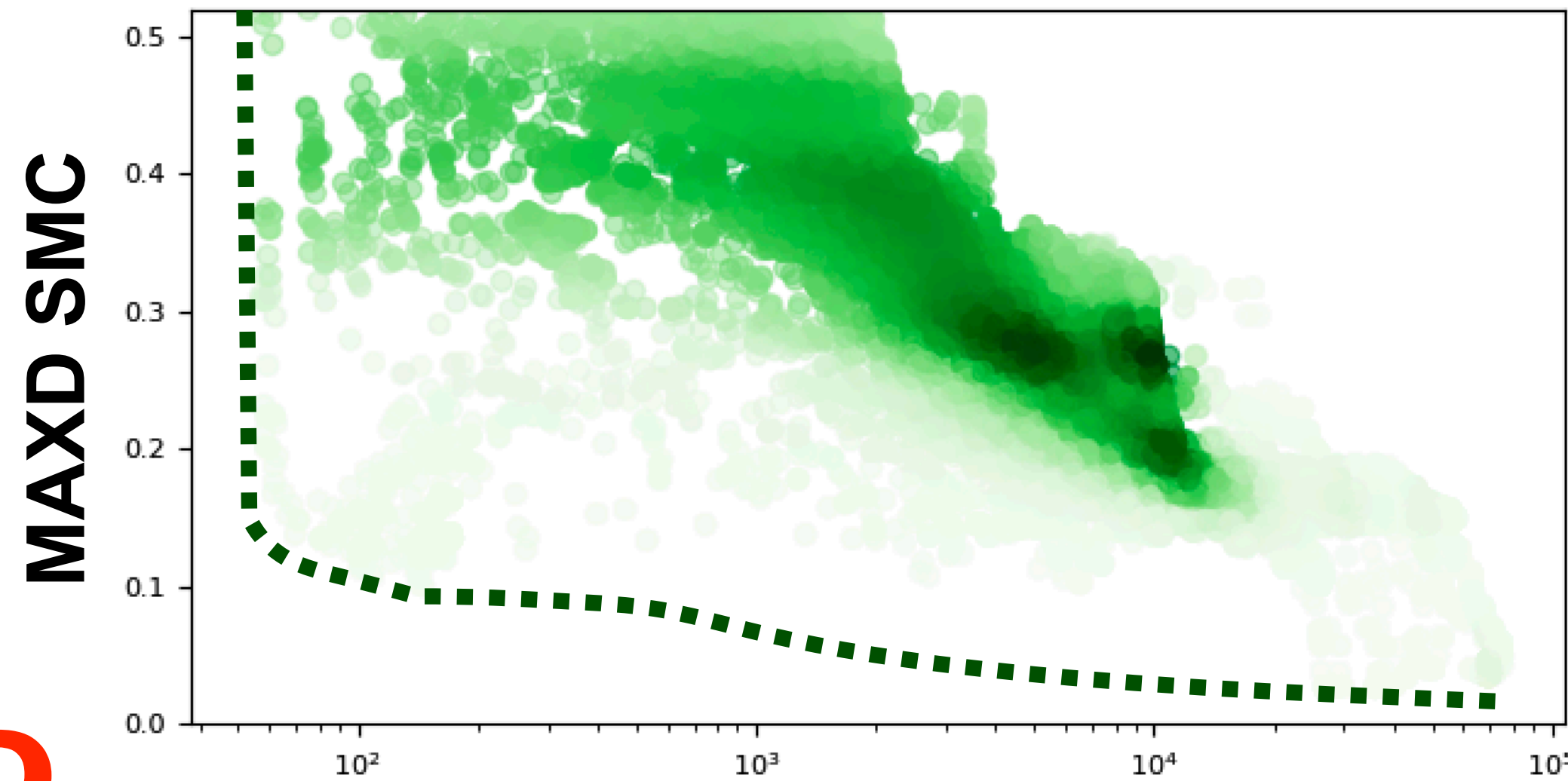


FULLY DISTRIBUTED COMPARISON



FULLY DISTRIBUTED COMPARISON

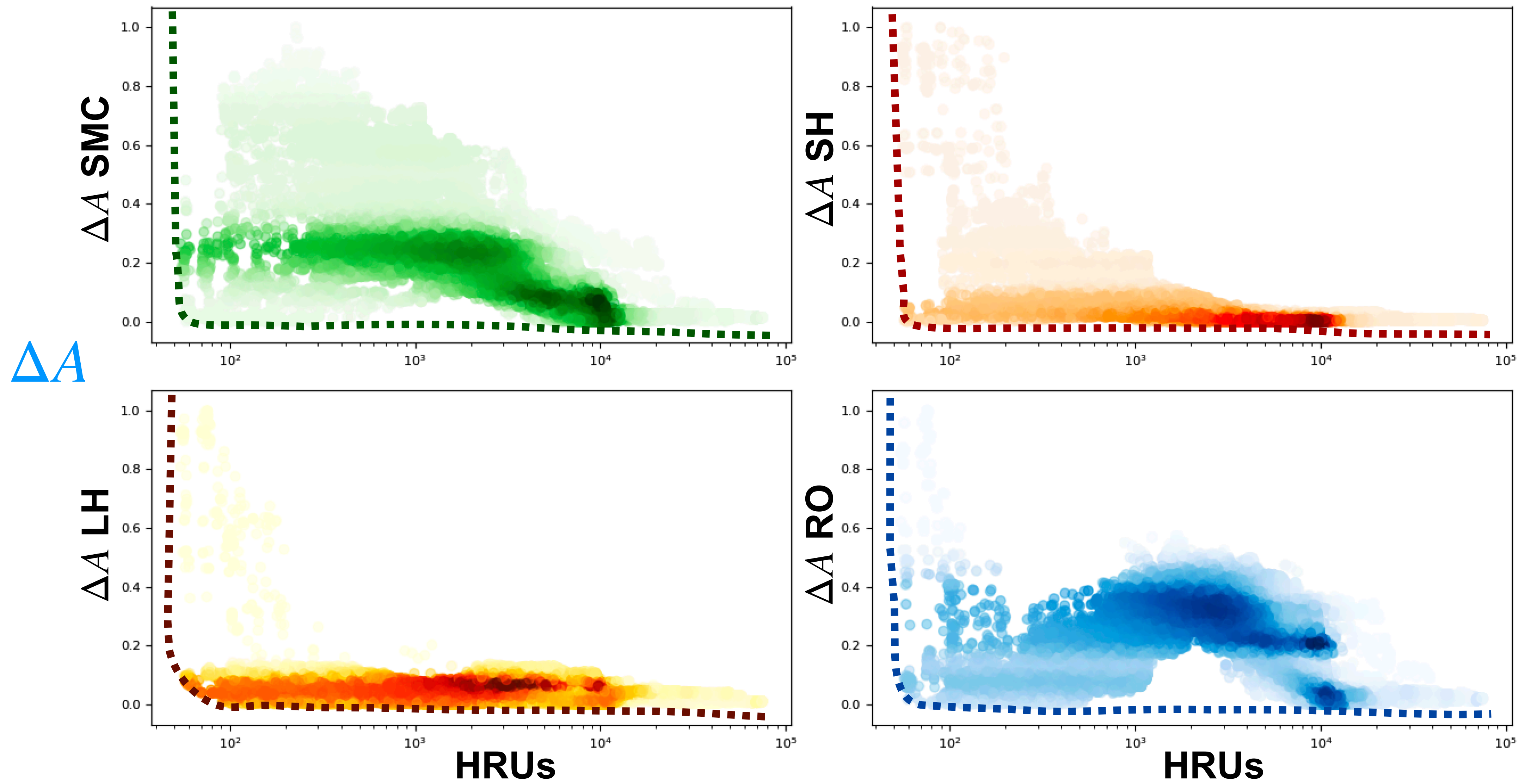
MAXD



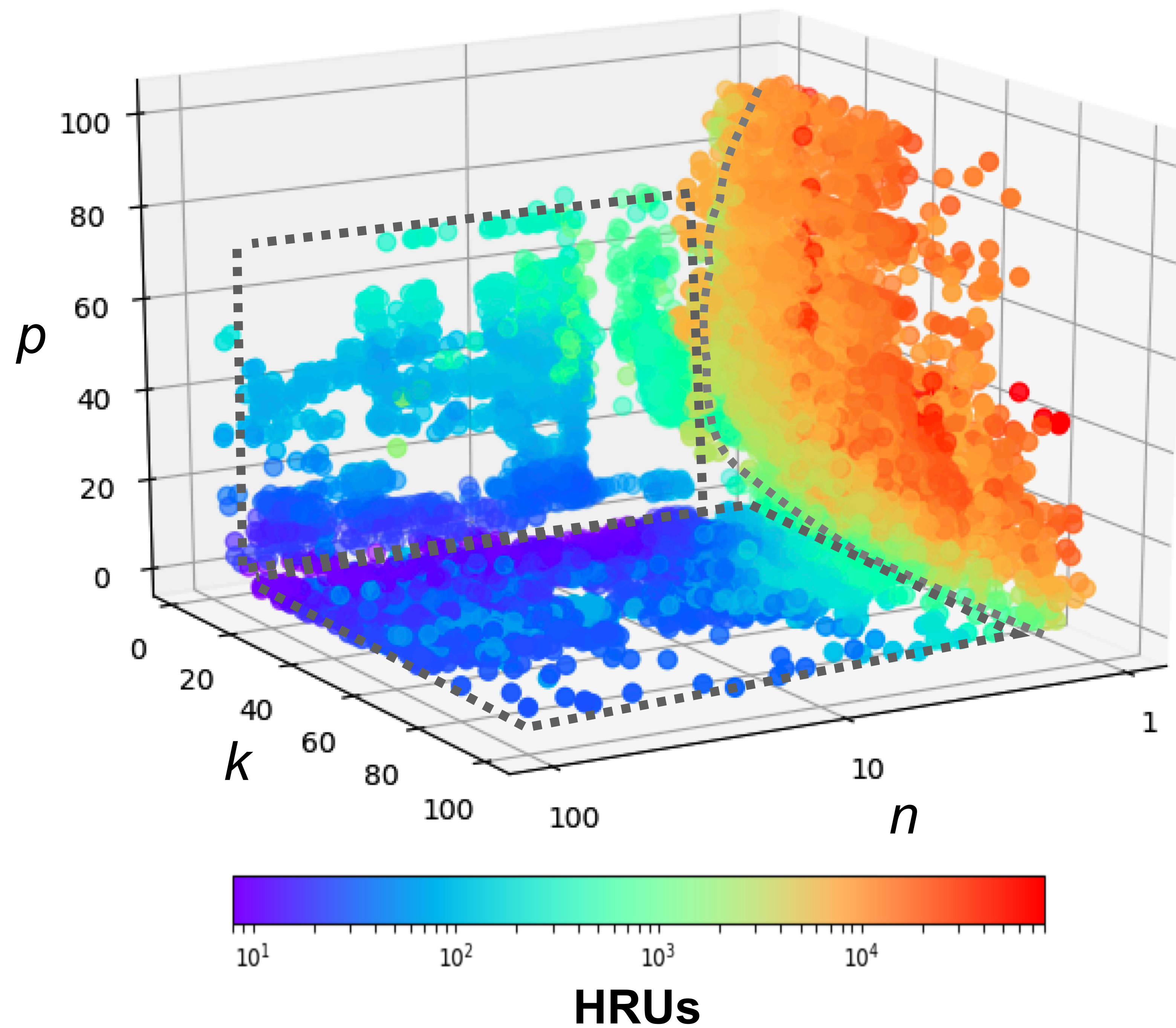
HRUs

HRUs

FULLY DISTRIBUTED COMPARISON



PARETO FRONT



WHAT'S NEXT?

1.

Use of more complex (restrictive) approaches to obtain the Pareto front.

2.

Evaluate the influence of the covariates used for clustering on the convergence pattern.

3.

Test convergence on smaller time scales. Currently: annual

4.

Generalize method: CONUS. More sites.