# High soil moisture heterogeneity supports the growth of organized convective systems

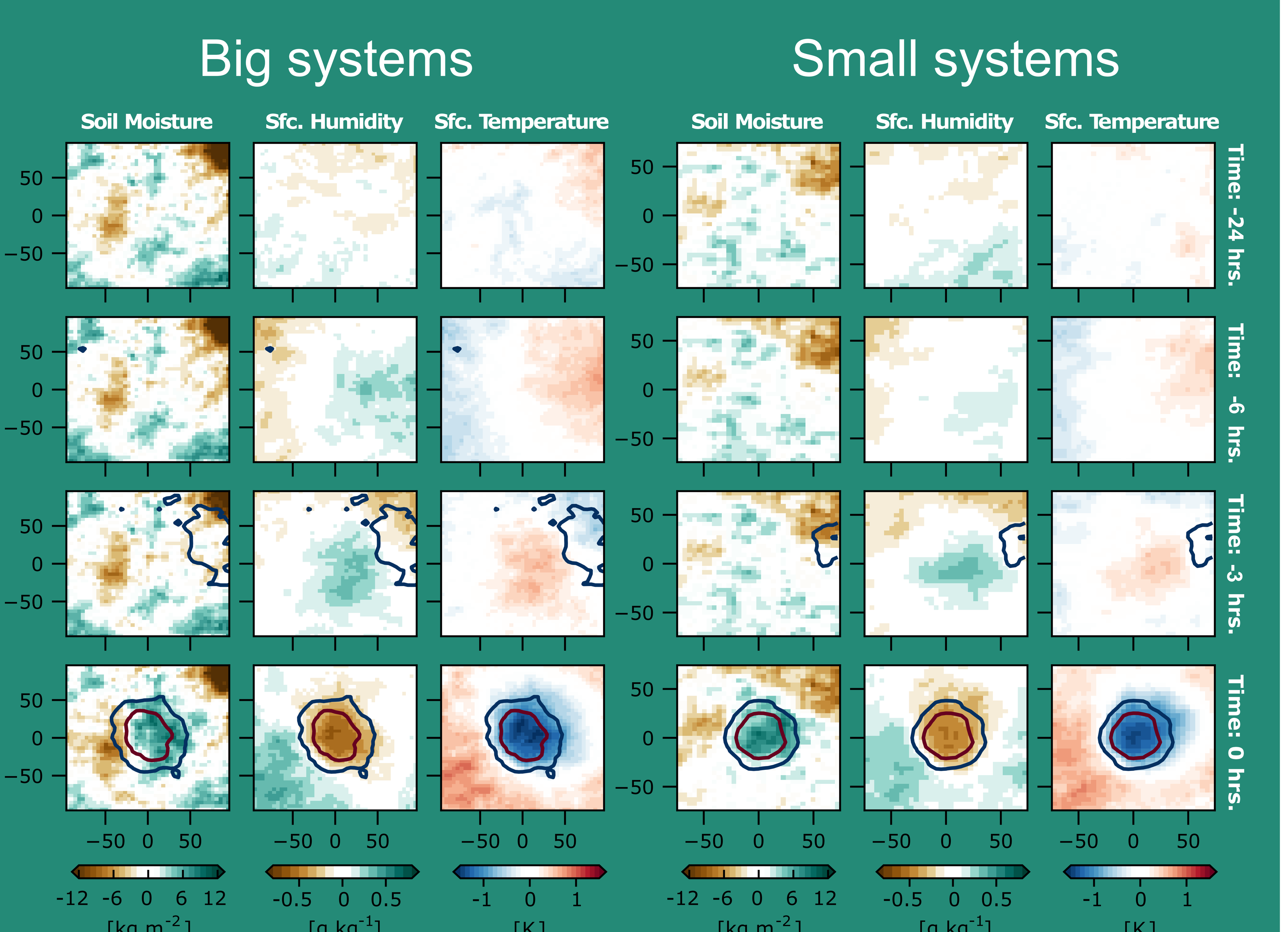


Fig1. As in Fig5, but for the Control Experiment

# Influence of soil moisture heterogeneity on the development of organized convective systems


**Laura Paccini*** and Kathleen Schiro

* lpaccini@virginia.edu, @laurapaccini

UNIVERSITY of VIRGINIA


## BACKGROUND

The simulation of organized convective systems at convection-permitting scales is a significant advancement for enhancing our understanding of their controls and interactions with the environment.
This study aims to investigate how soil moisture affects the development of convective systems in South America, specifically addressing :

- Which aspects of soil moisture are significant for the development of convective systems?
- Does the development of convective systems get inhibited by disabling interactions with soil moisture?

## SETUP

- We use the ICON-NWP model.
- Experiments: The control experiment enables the interaction with soil moisture using the TERRA-ML scheme. The fixedSM experiment held the soil moisture (SM) constant over time.
- An ensemble of 3-member simulations are integrated for 20 days at 5km over tropical South America.
- Organized convective systems are identified by selecting contiguous grids with precipitation > 1mm/hr and total size > 2500 km$^2$

## RESULTS

1. Convective system growth is more related to the spatial variability of SM rather than its mean value

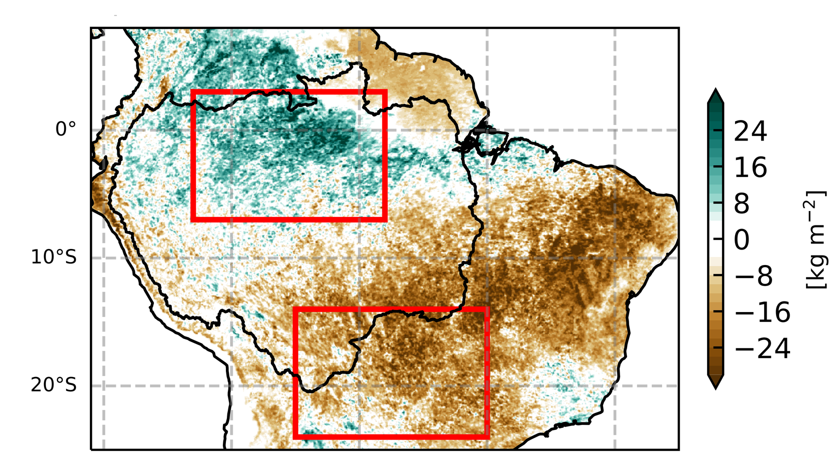


Fig2. Mean difference between the Control and FixedSM experiments of soil moisture. Outlined boxes in show the domains for analysis: Amazon (upper box) and SESA (lower box).

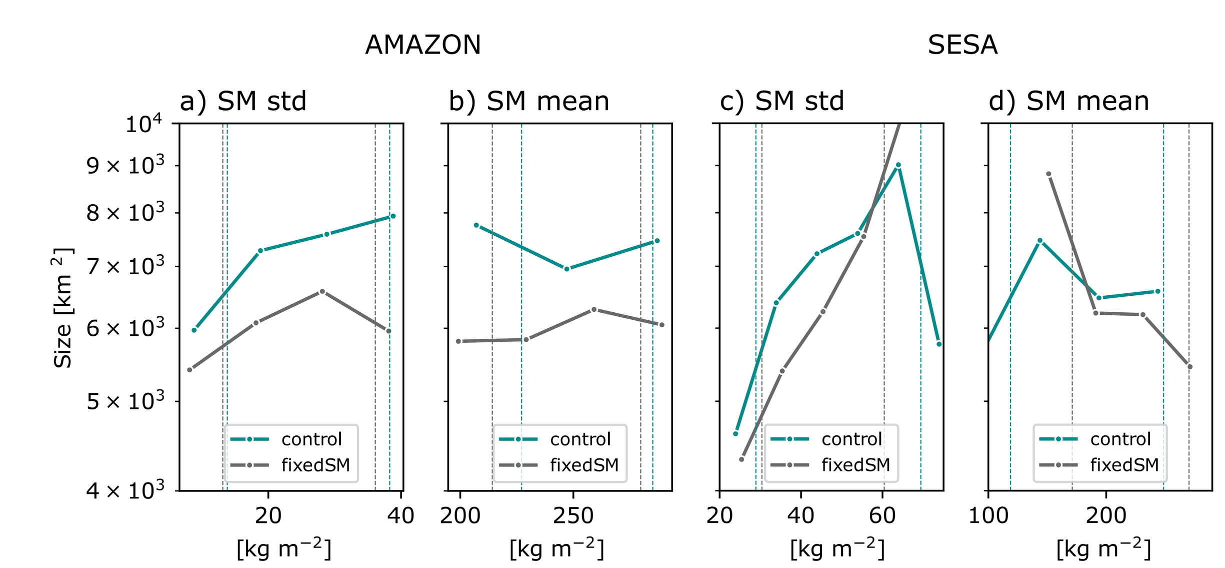


Fig3. Median value of convective system size per bin of soil moisture spatial standard deviation (a, c) and soil moisture spatial mean (b, d) for the Amazon (a, b) and SESA (c, d) regions in the simulations. Vertical lines represent the 10th and 90th percentile for the Control (cyan) and FixedSM (grey) experiments.

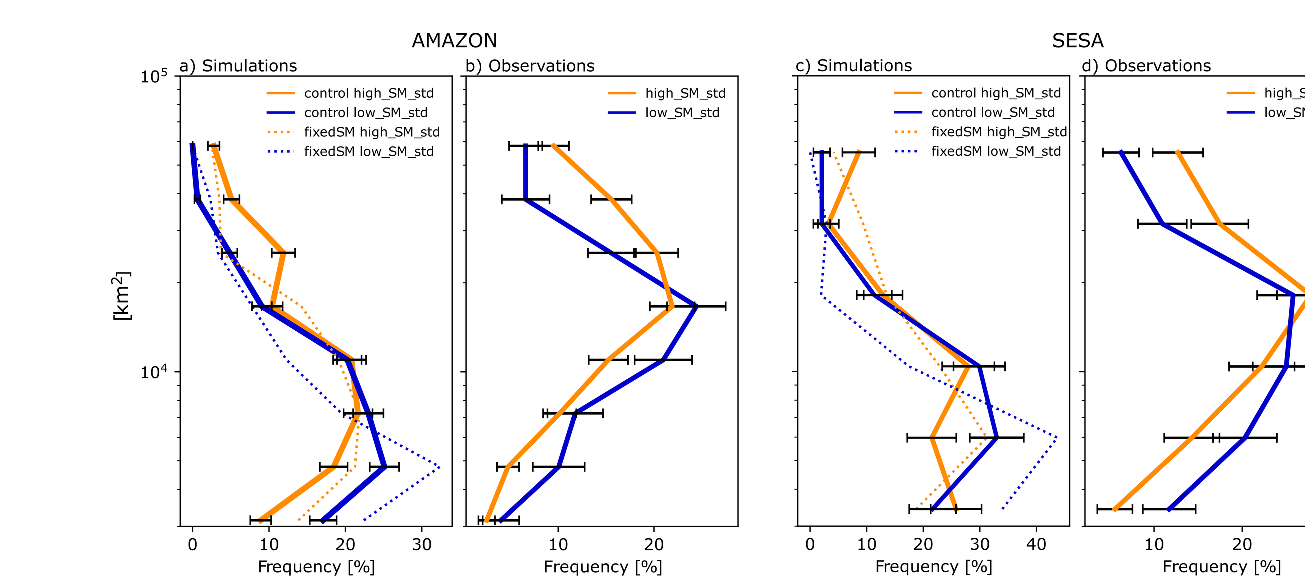


Fig 4. Size distribution of convective systems by regime of SM heterogeneity in simulations (a, c) and observations (b, d) for Amazon (a, b) and SESA (c, d) regions. Regimes of high SM heterogeneity (orange) include values between the 50th and 90th SM standard deviation; regimes of low SM heterogeneity (blue), between the 10th and 50th SM standard deviation.

2. SM heterogeneity amplifies temperature and moisture perturbations that are important for convective growth.
3. Interactions between SM and the atmosphere during the growth phase do not appear to be as important.

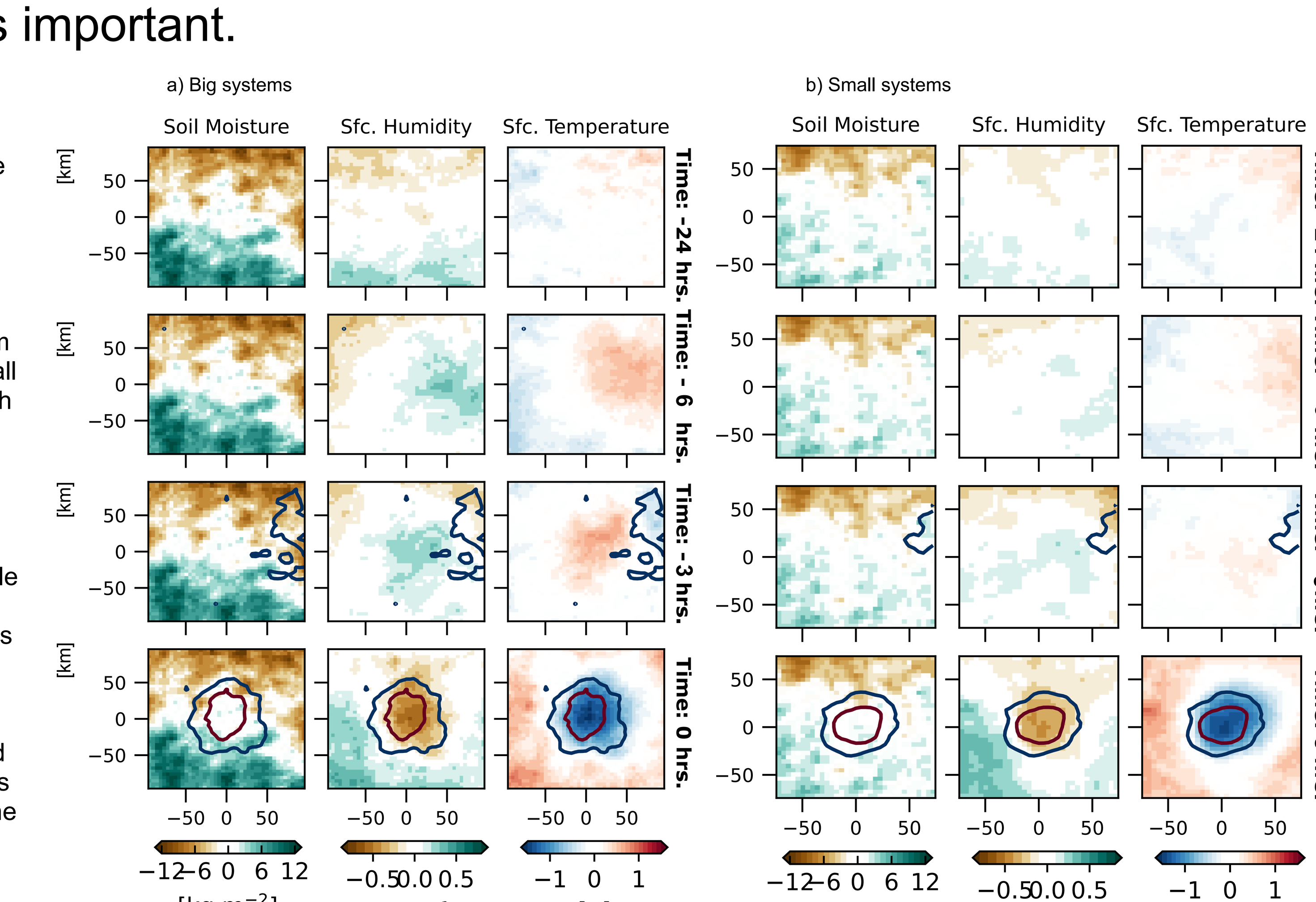


Fig 5. Composite evolution of convective system growth in the FixedSM experiment. Columns show soil moisture, surface humidity, surface temperature (shaded) and precipitation (contours). The analysis spans 24, 6 and 3 hours before system detection for (a) big and (c) small systems. The bottom row in both panels displays the instance of convective system detection, centered at (0,0). The size classification is based on percentiles (0.5 to 0.9 for big systems and 0.1 to 0.5 percentile for small systems). The environment region is defined as the area within two times the equivalent radius of the convective systems from their center of mass in horizontal and meridional directions. Anomalies are calculated with respect to the spatial mean. Contours represent 1 and 5 mm/hr precipitation anomalies.

4. The role of SM heterogeneity (~100km) is less evident over the SESA region probably due to the greater impact of surface wind variability on the development of convective systems compared to the Amazon region.

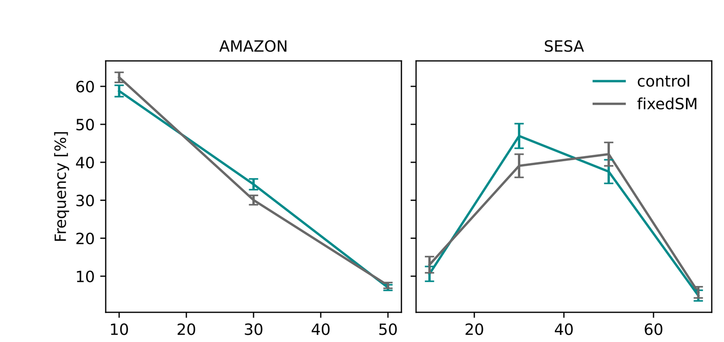


Fig 6. Distribution of soil moisture heterogeneity for the control and fixedSM experiments in the (a) Amazon and (b) SESA regions. Soil moisture heterogeneity is determined as the spatial standard deviation within the near environment of convective systems.

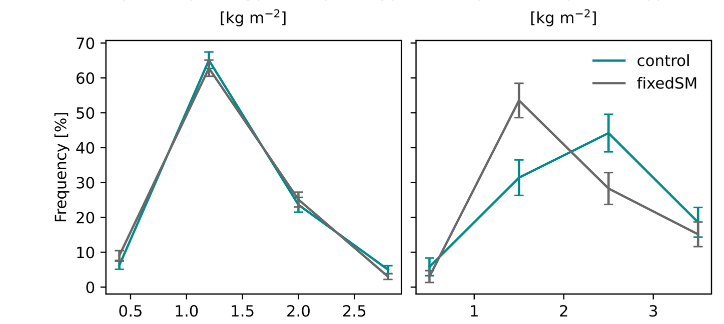


Fig 7. Distribution of antecedent environmental wind for the control and fixedSM experiments in the (a) Amazon and (b) SESA regions. Mean wind is calculated 3 hours prior to system detection.

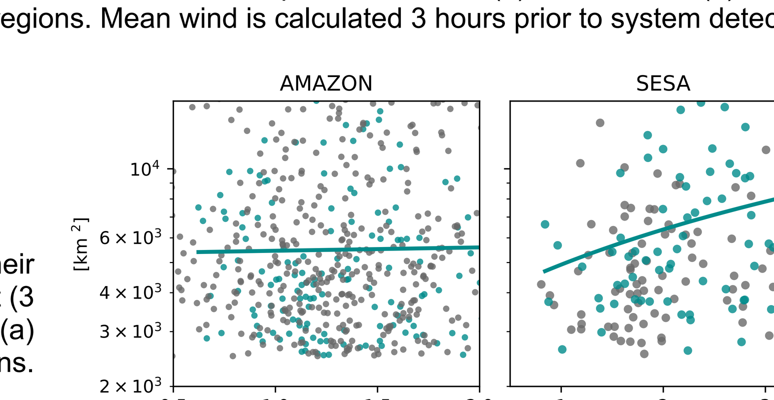


Fig 8. The size of convective systems at their initial state is plotted against the antecedent (3 hours before system detection) wind in (a) Amazon and (b) SESA regions.