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Supplemental Information

Simple Rho GTPase Dynamics Generate a Complex Regulatory Landscape Associated with Cell Shape

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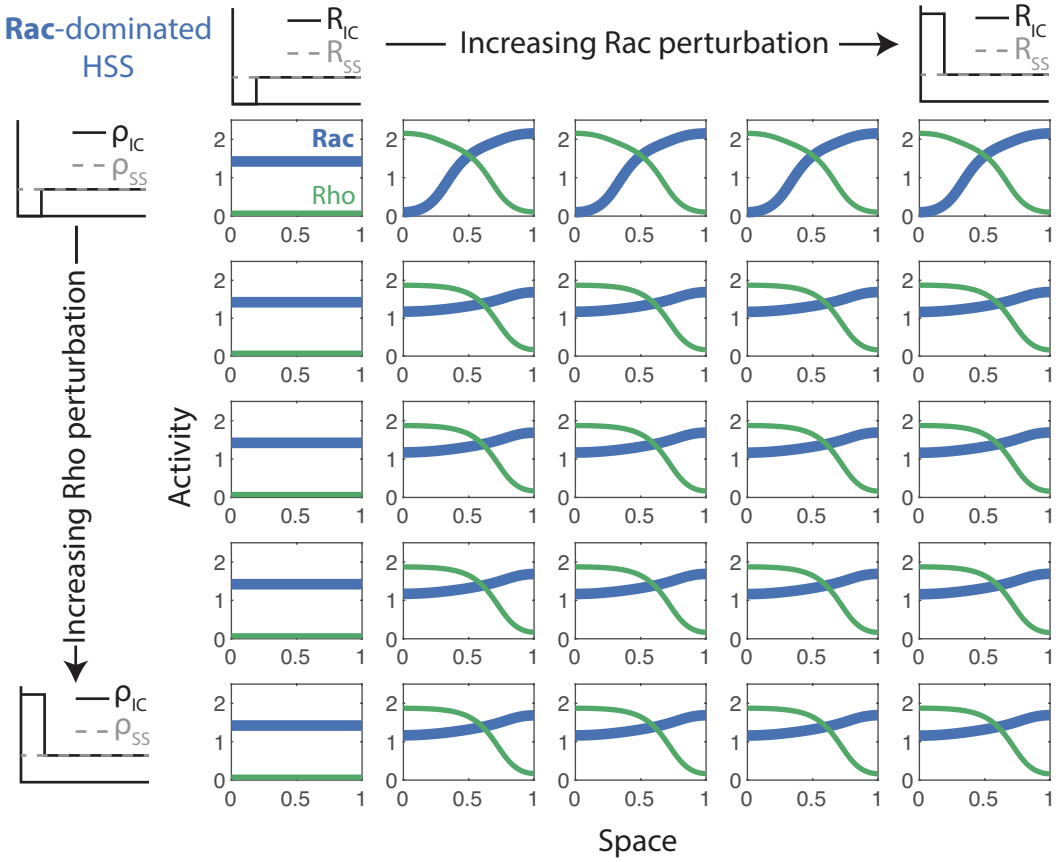
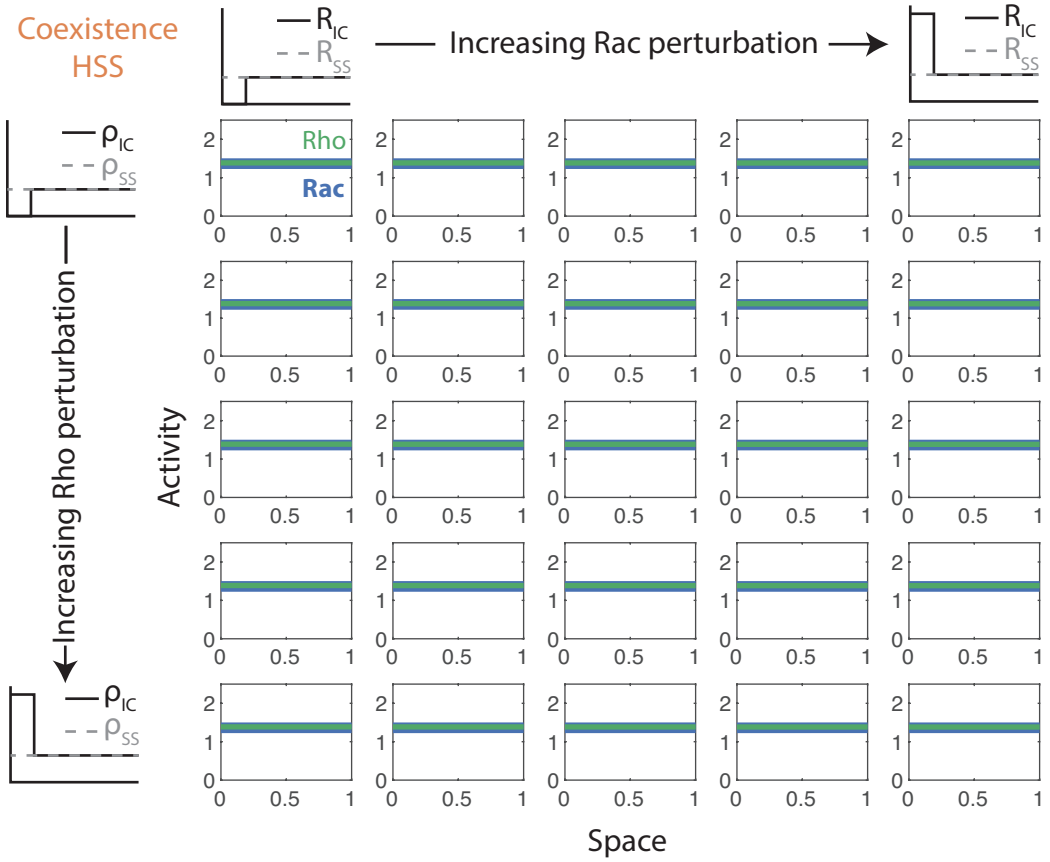
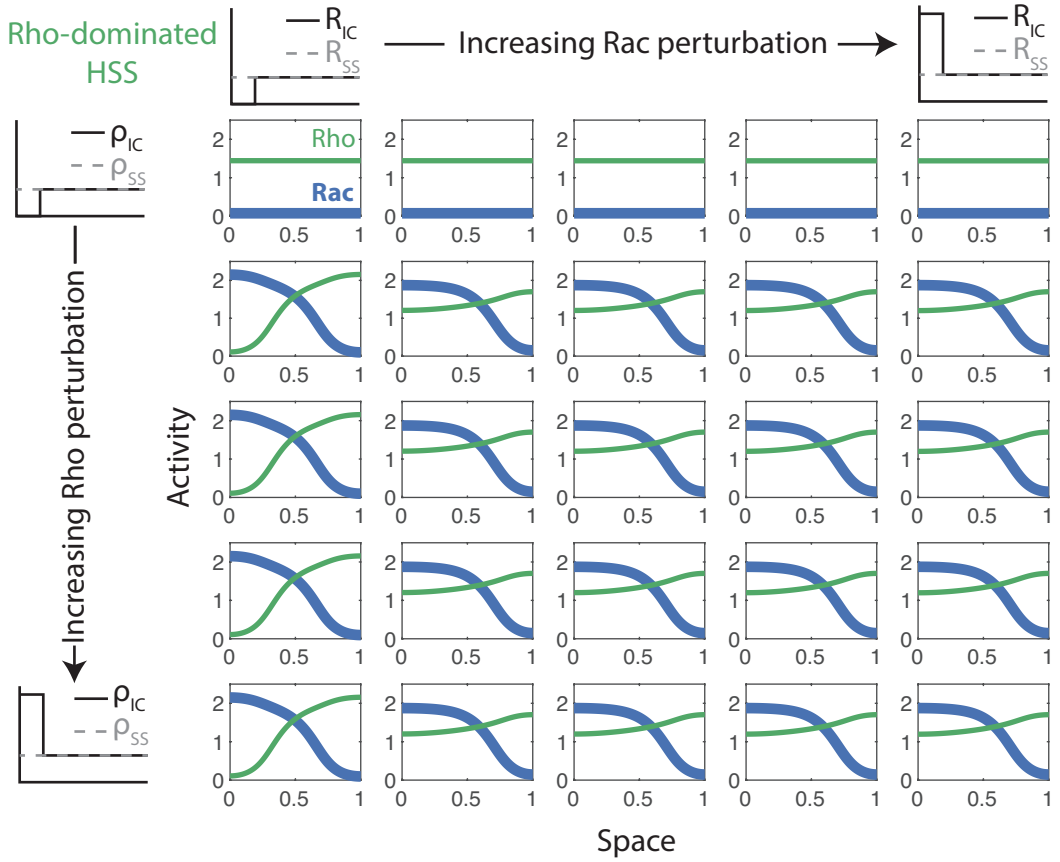


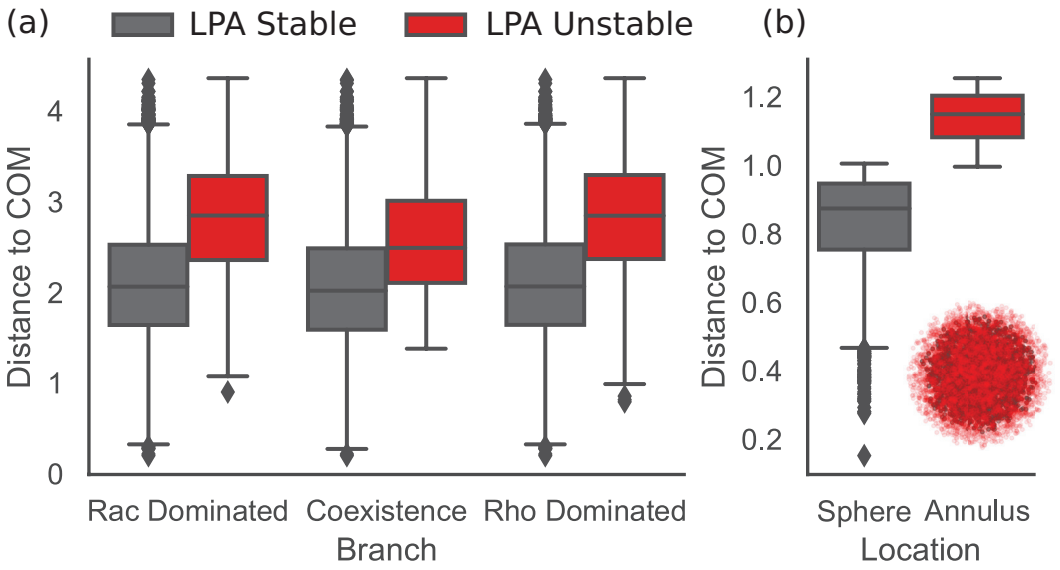
SUPPORTING FIGURE 1. **Initial condition PDE screen from the Rac-dominated HSS in a tristable parameter set.** Each panel shows the steady-state active Rac (bold blue curve) and Rho (thin green curve) GTPase activity resulting resulting from a spatially heterogeneous initial condition with the parameters used in Figures 4 and 5. Given the model parameters, it is possible to obtain the Rac-domainted steady-state, balanced polarity pattern, and a Rac-dominated polar regulatory phenotype from perturbations to the Rac-dominated HSS. The initial conditions R_{IC} and ρ_{IC} for each simulation consist of local perturbations (localized to $0 \leq x \leq 0.1$) of various heights from the Rac-dominated steady-state (R_{ss}, ρ_{ss}) as illustrated in the cartoons along each axis. Moving horizontally or down across panels increases the height of the local perturbation. The panel in the top-left depicts the steady-state activity resulting from an initial condition with both Rac and Rho activity diminished in $0 \leq x \leq 0.1$, whereas the panel in the bottom-right depicts the steady-state activity resulting from an initial condition with both Rac and Rho activity enriched in $0 \leq x \leq 0.1$. The heights of the local perturbations were chosen so that in the first column (respectively row) the initial Rac (respectively Rho) activity is 0 in the perturbed region. Similarly in the last column (respectively row) Rac (respectively Rho) activity is maximal in the perturbed region. The Rac-dominated HSS is $R_{ss} = 1.4230$, $\rho_{ss} = 0.0764$. The Rac perturbation heights are: -1.4230, -0.0082, 1.4066, 2.8214, and 4.2362. The Rho perturbation heights are: -0.0764, 4.4212, 8.9188, 13.4164, and 17.9140.



SUPPORTING FIGURE 2. **Initial condition PDE screen from the coexistence HSS in a tristable parameter set.** As in Supplemental Figure 1, expect the local perturbations are from the coexistence HSS. In this case, no local perturbation results in a non-trivial regulatory phenotype. The coexistence HSS is $R_{ss} = 1.3655$, $\rho_{ss} = 1.3856$. The Rac perturbation heights are: -1.3655, 0.1786, 1.7227, 3.2668, and 4.8109. The Rho perturbation heights are: -1.3856, 0.1663, 1.7138, 3.2702, and 4.8221.



SUPPORTING FIGURE 3. **Initial condition PDE screen from the Rho-dominated HSS in a tristable parameter set.** As in Supplemental Figure 1, expect the local perturbations are from the Rho-dominated HSS. In this case, the Rho-dominated HSS, balanced polarity, and Rho-dominated polarity are possible. The Rho-dominated HSS is $R_{ss} = 0.0740$, $\rho_{ss} = 1.4422$. The Rac perturbation heights are: -0.0740, 4.3759, 8.8258, 13.2757, and 17.7256. The Rho perturbation heights are: -1.4422, -0.0178, 1.4067, 2.8312, and 4.2556.



SUPPORTING FIGURE 4. **Quantification of nested structure in parameter space.** **(a)** For each tristable parameter set the three HSS may be LPA Stable (black and yellow points in Figure 6(g)-(i)) or LPA Unstable (red points in Figure 6(g)-(i). The LPA Unstable points appear to be further from the center of mass (COM) in parameter space than the LPA Stable points, indicating that the LPA Stable points form the nucleus of parameter space. **(b)** Distributions of the distance to the COM of 50000 points sampled from a 5D sphere (grey) of radius 1 surrounded by a 5D annulus (red) of inner radius 1 and out radius 1.25. Inset: 3D visualization of points sampled from the 5D sphere (black) and annulus (red).