Global-local schemes for gyrokinetic simulations

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Local (flux-tube) simulation

the good:

✓ spectral accuracy in the perpendicular dynamics

✓ gyro-averaging is simple

the bad:

✗ simple background profiles

✗ boundary conditions sensible only in a statistical sense

Global simulation

the good:

✓ arbitrary profile variation

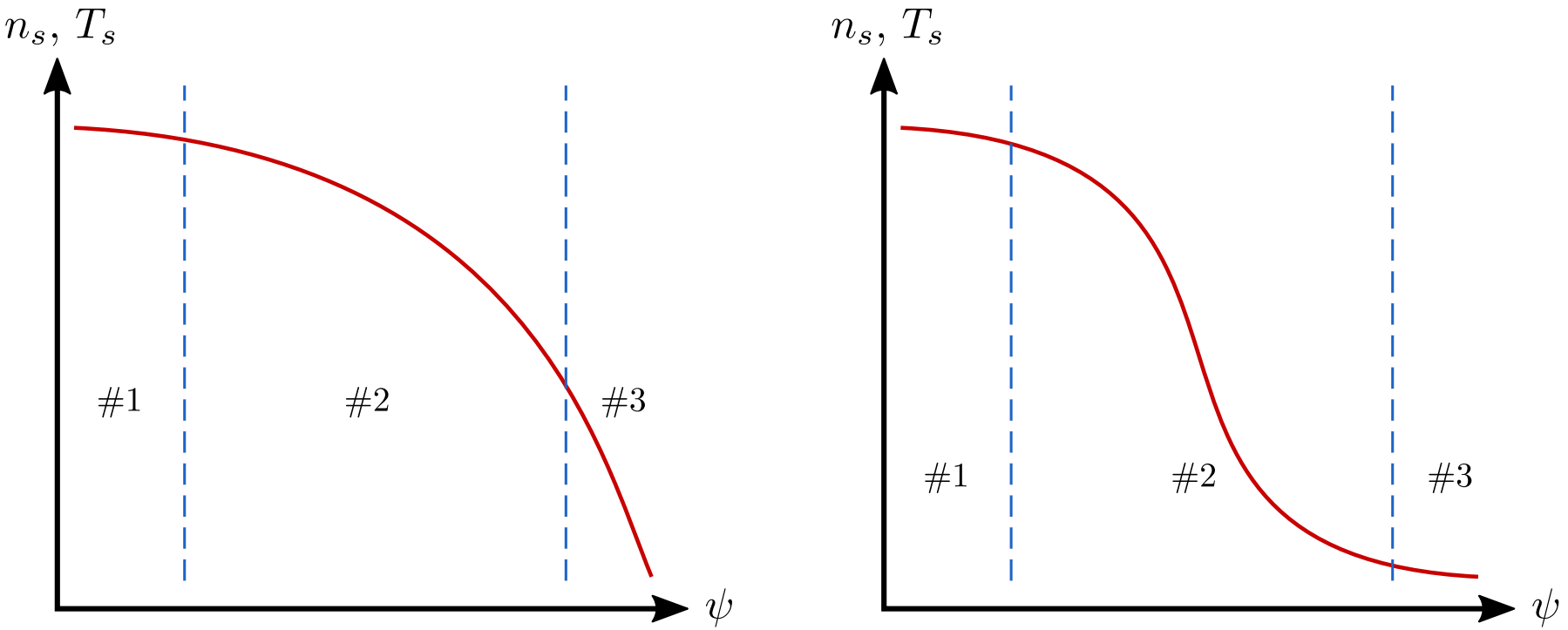
✓ large-scale coherent structures

the bad:

✗ lose spectral accuracy in radial direction

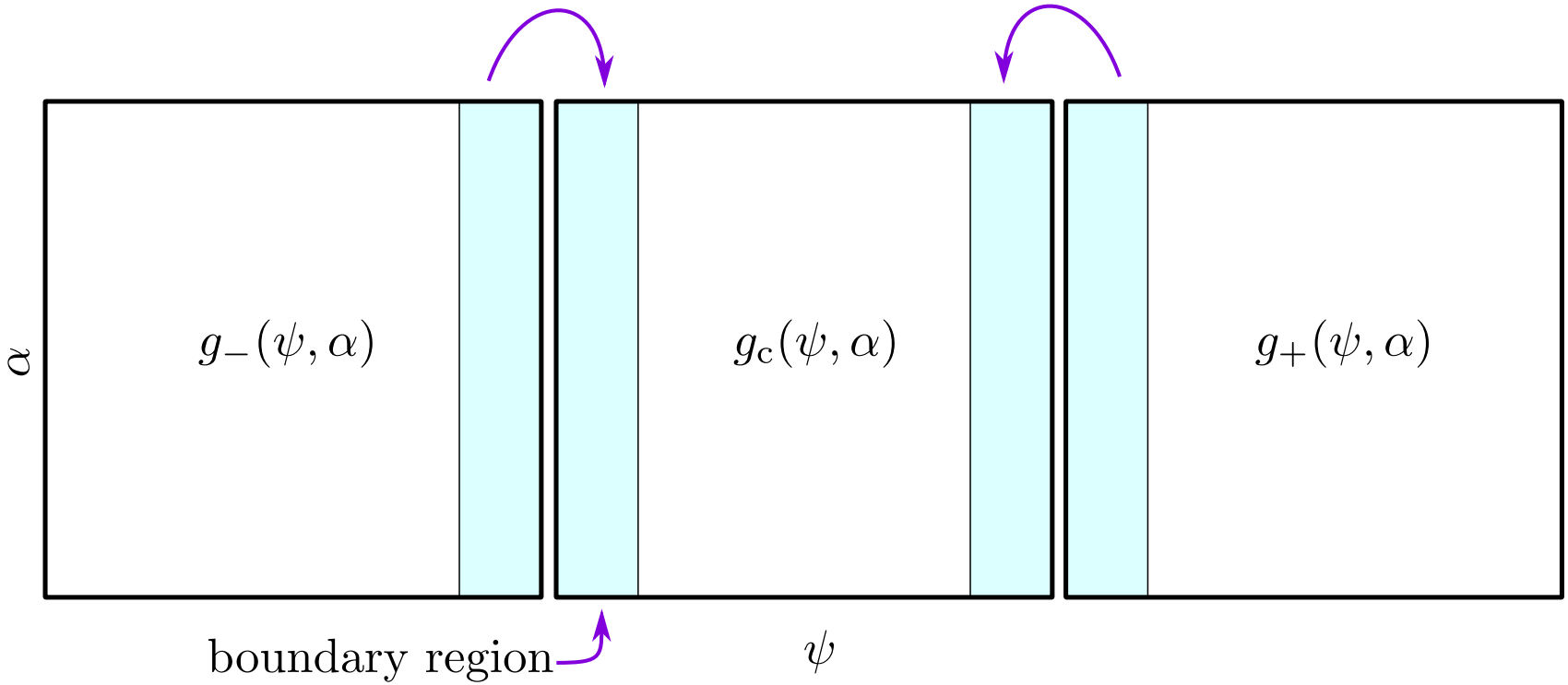
✗ Dirichlet BCs typical – not much better than periodic BCs

IDEA: Use additional flux-tube simulations at different radial locations to determine the boundary conditions in the 'main' simulation.



See Parra & Barnes, PPCF **57** (2015) for motivation.

METHOD:


$g_-(\psi, \alpha)$
$g_c(\psi, \alpha)$
$g_+(\psi, \alpha)$
α
ψ
boundary region

PRELIMINARIES: Try out method using Hasegawa-Mima/Terry-Horton equation.

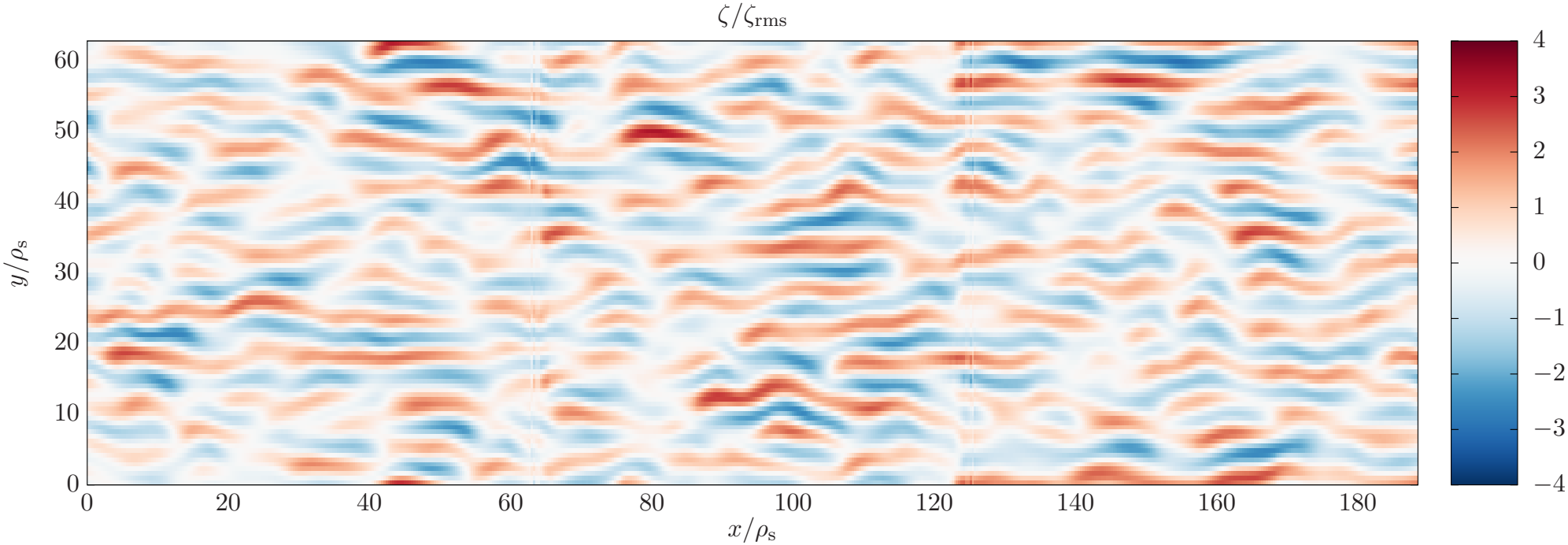


Figure: Terry-Horton model with identical parameters and different ICs.

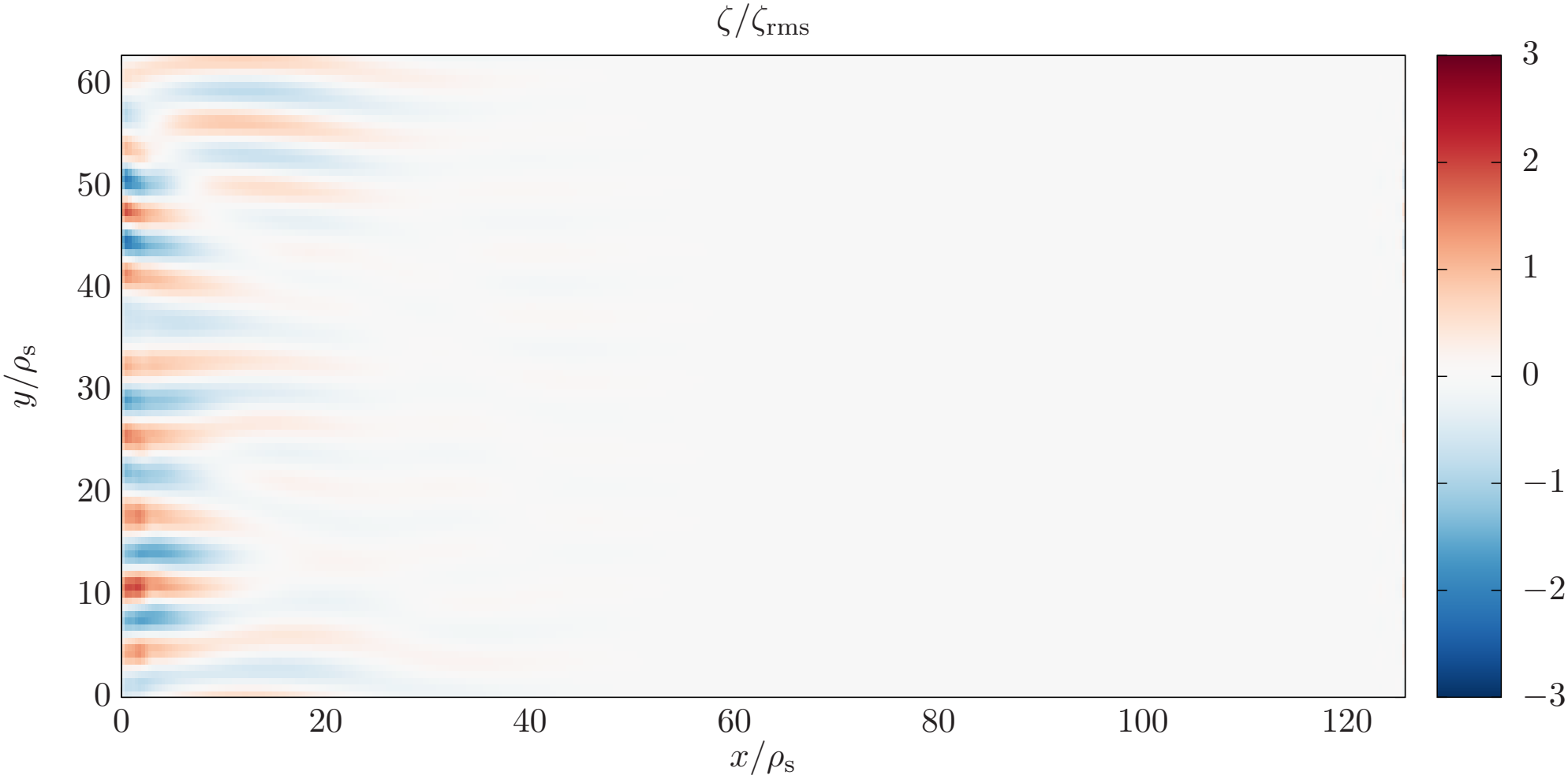


Figure: Terry-Horton model with density gradient profile.

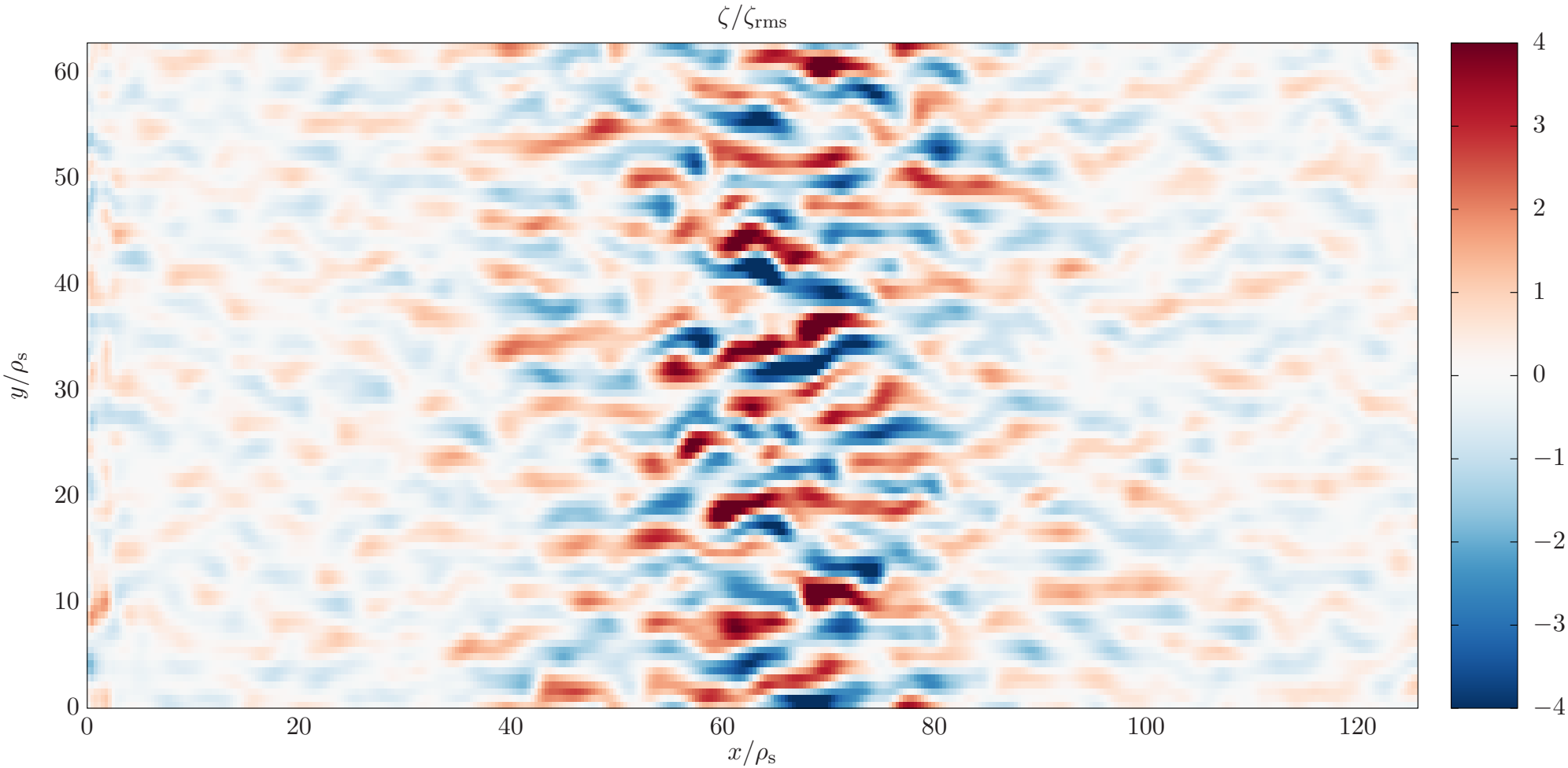


Figure: Terry-Horton model with $\mathrm{sech}^2(x/\rho_{\mathrm{s}})$ density gradient profile.

FUTURE STEPS:

- Implement in a gyrokinetic flux-tube code.
- Add profiles in pressure and magnetic geometry.
- add finite-ρ_* effects.