The Thermal and Kinematic Evolution of Circumgalactic Gas

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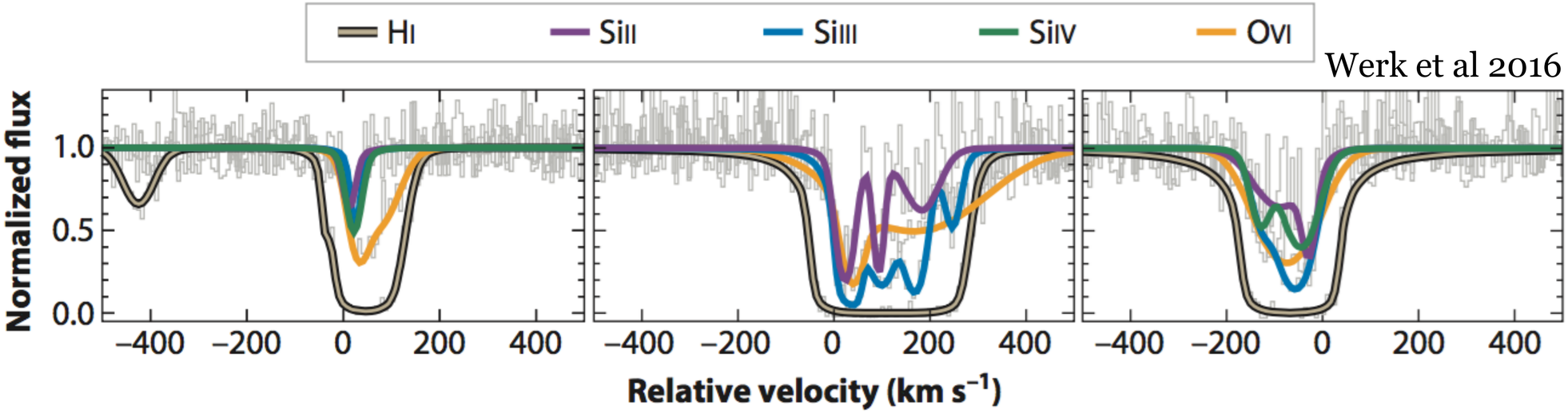
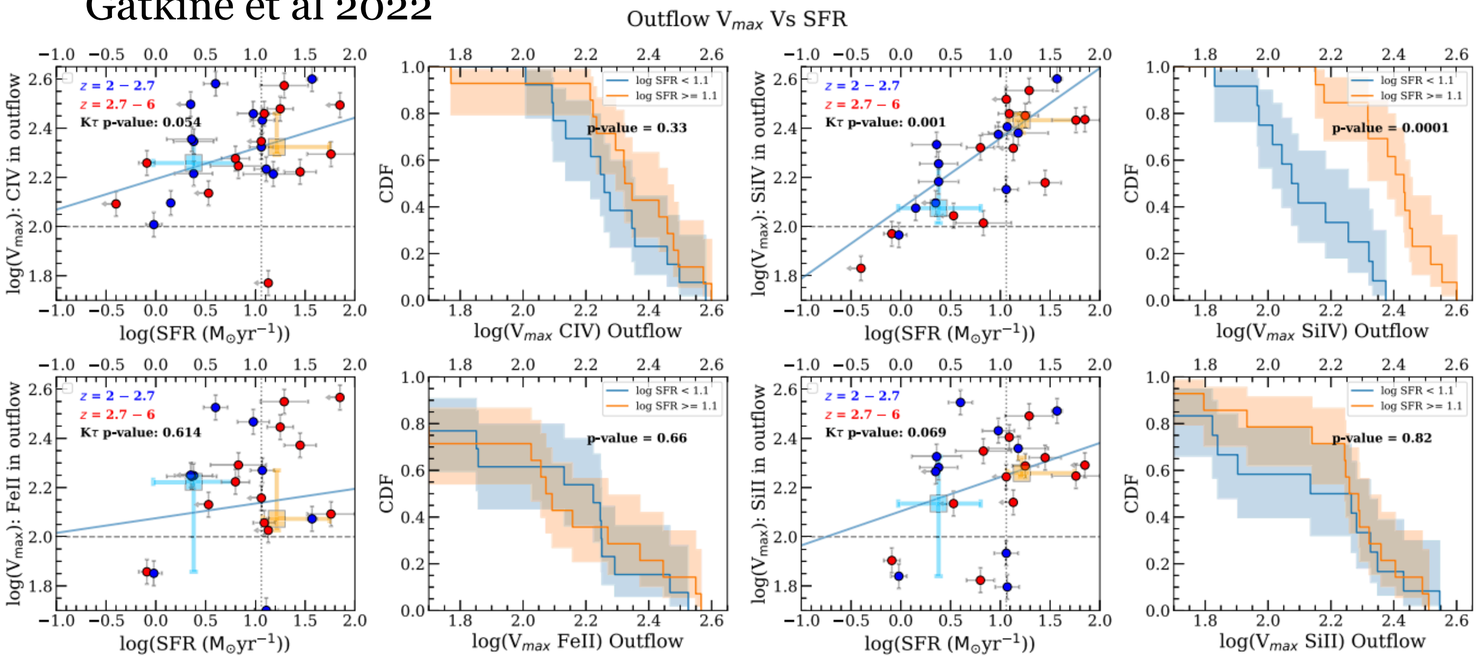
The kinematics of the multiphase CGM are varied and complex

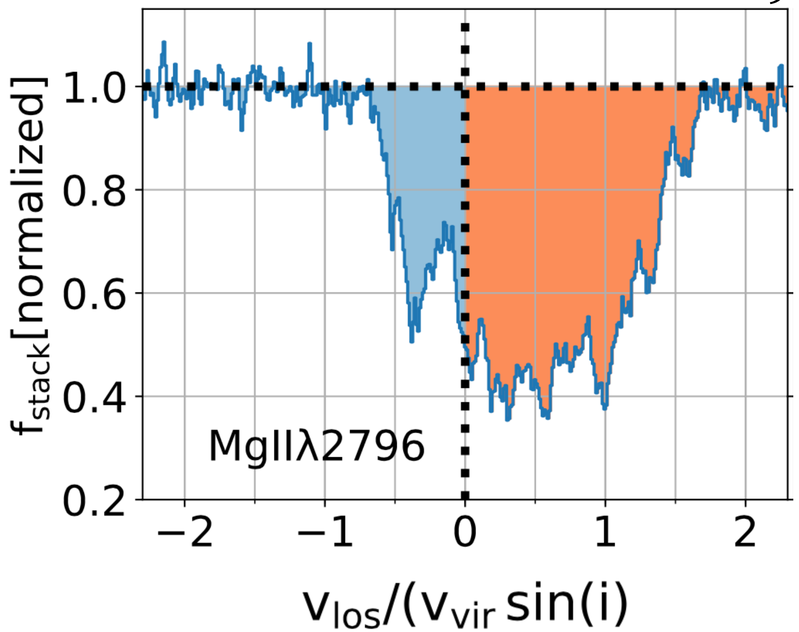
Werk et al 2016



Gatkine et al 2022

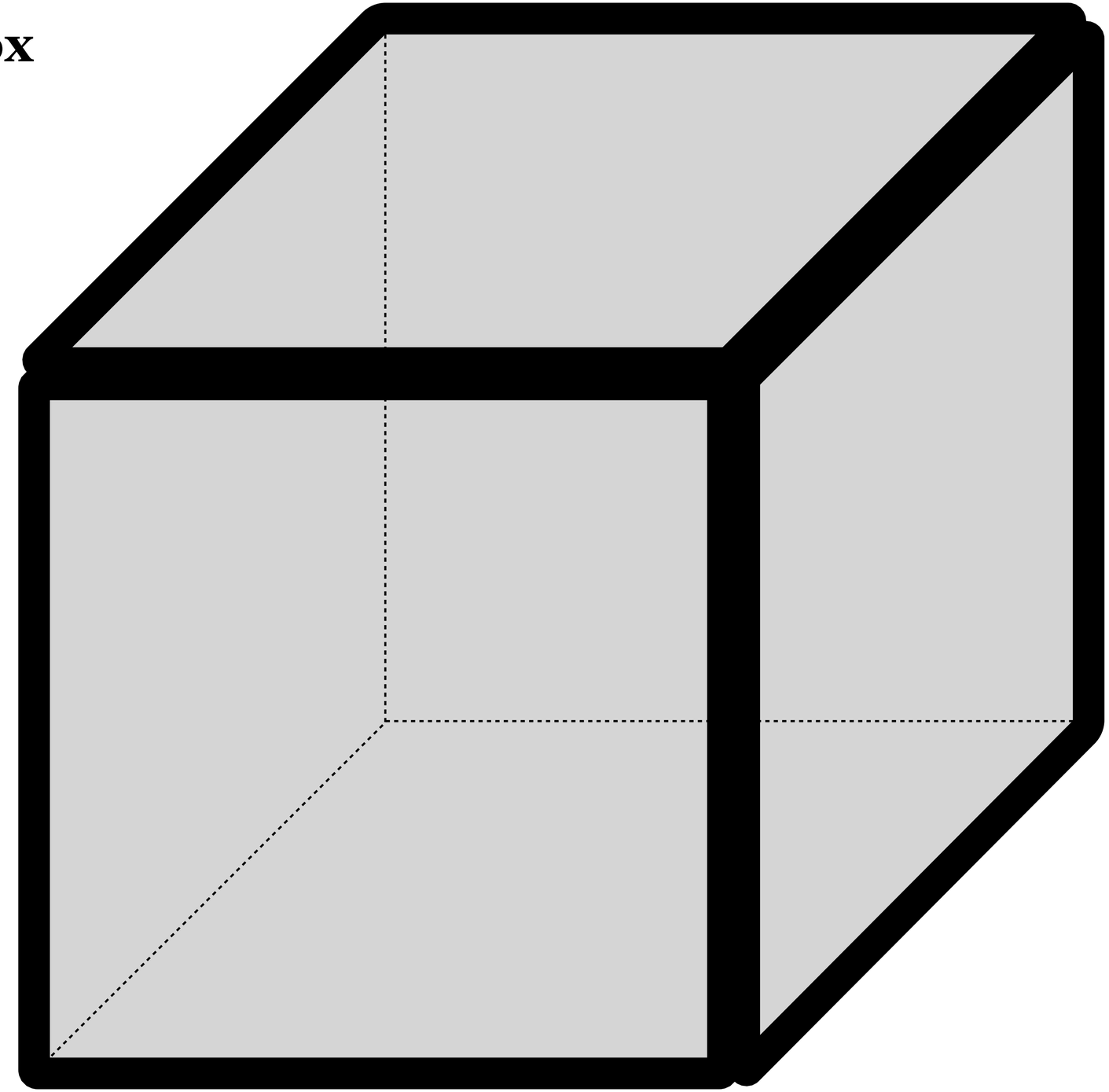


Zabl et al 2019



CGM Science with a TNG Subbox

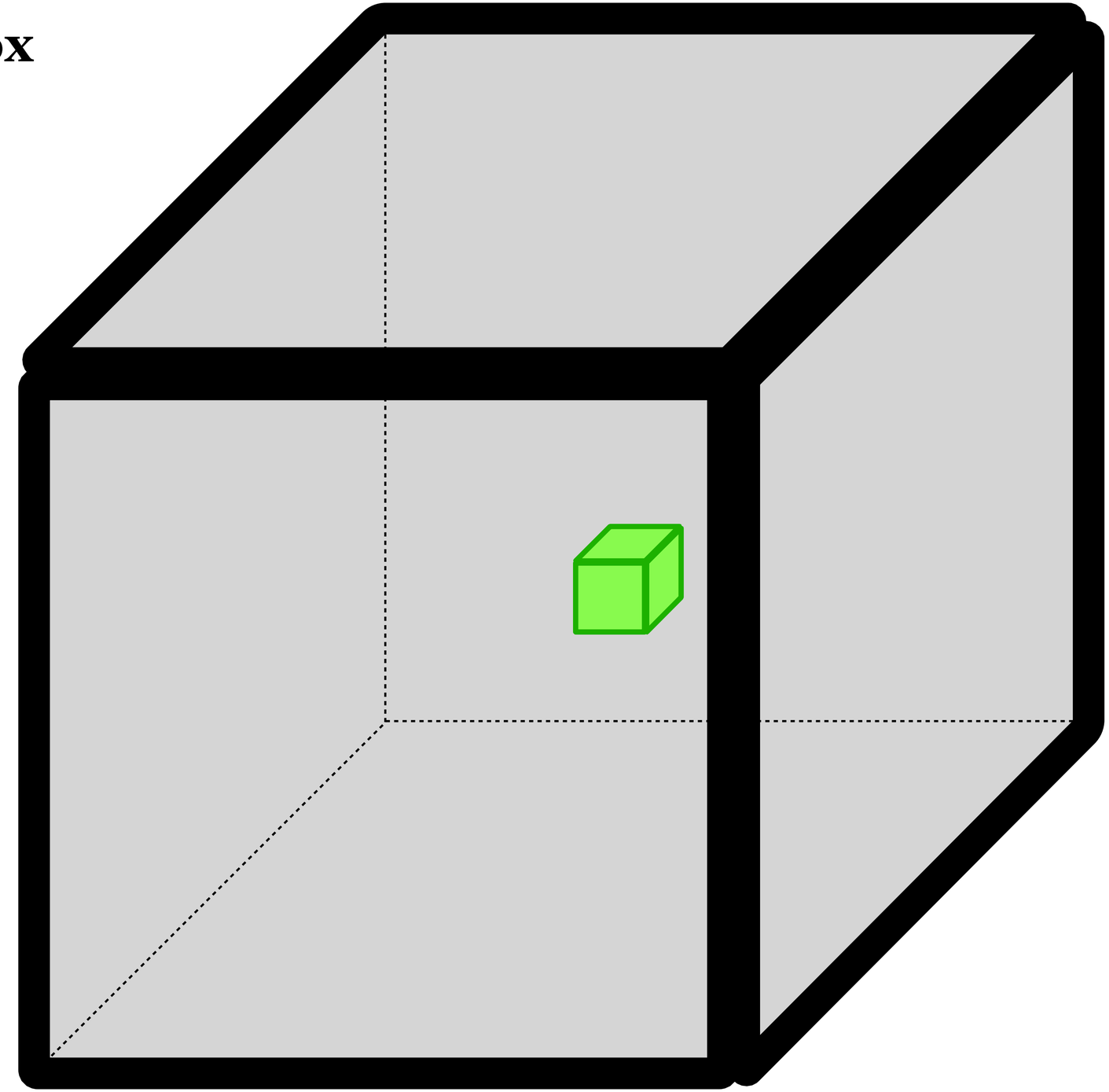
Full box: 100 snapshots over age of universe = **~140 Myr** spacing



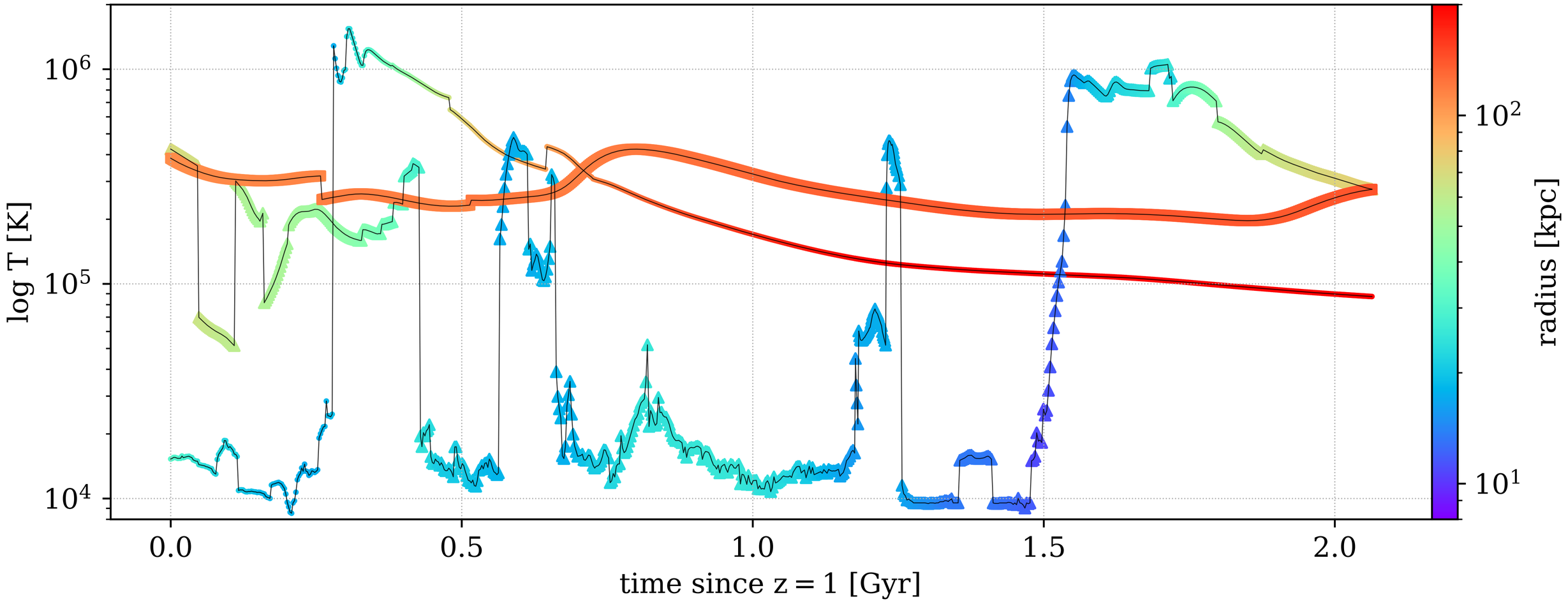
CGM Science with a TNG Subbox

Full box: 100 snapshots over age of universe = **~140 Myr** spacing

Subbox: 7908 snapshots over age of universe = **~2 Myr** spacing



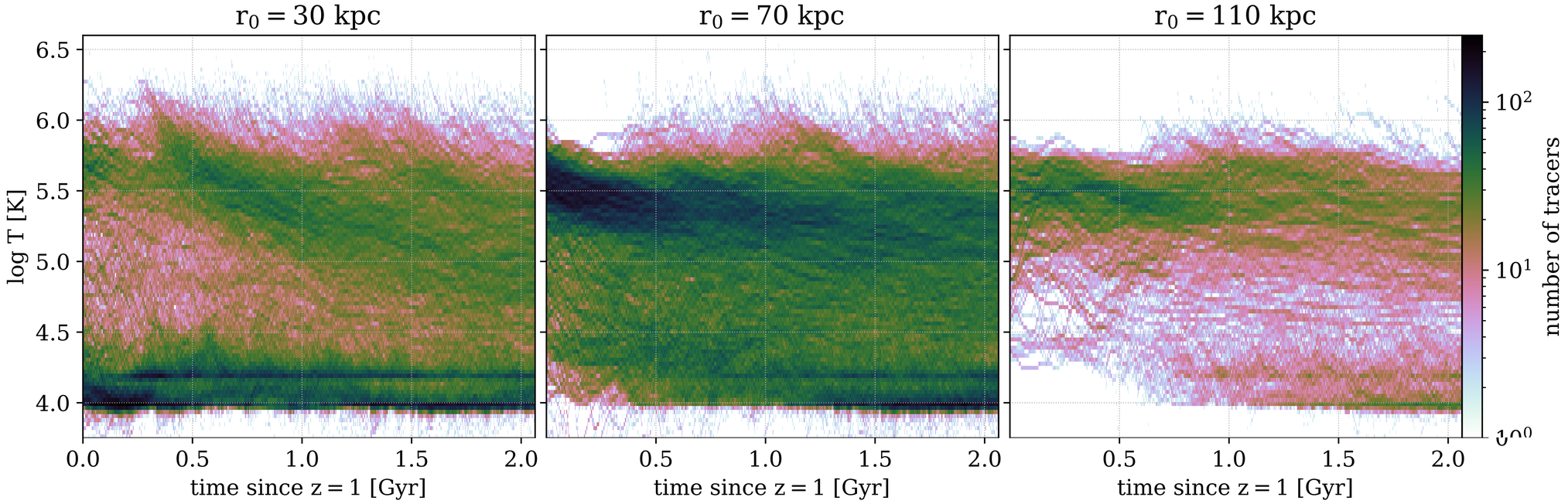
How does the CGM evolve on short timescales?



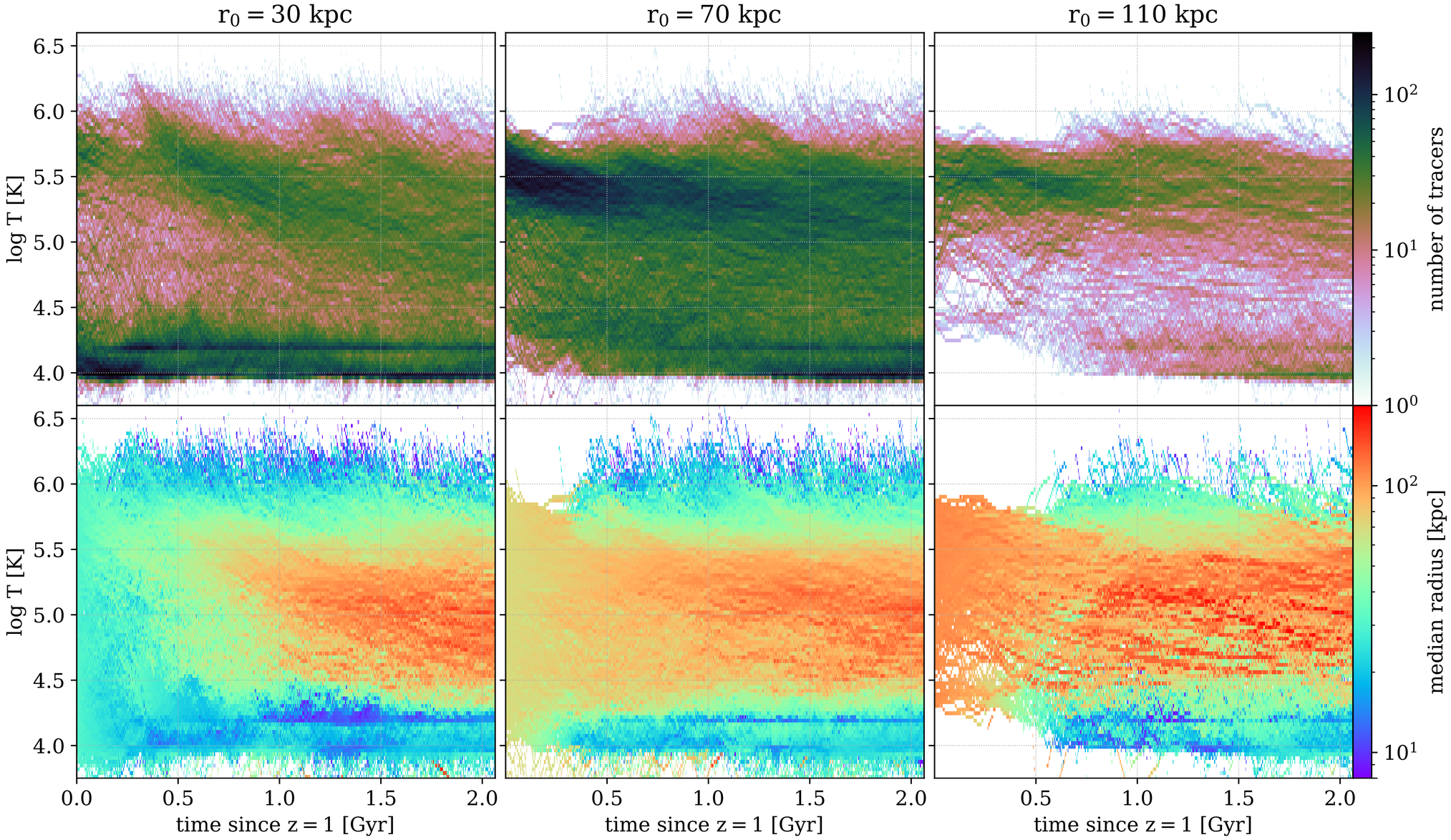
Thermal Evolution

Temperature, Density, Entropy, Pressure

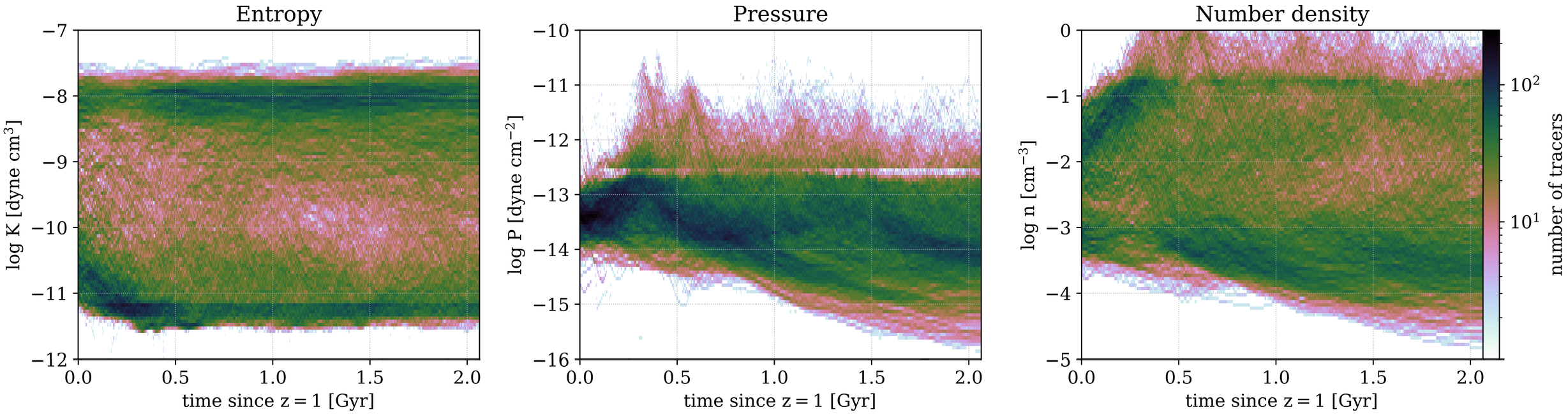
What are the cumulative effects of this short-term behavior?



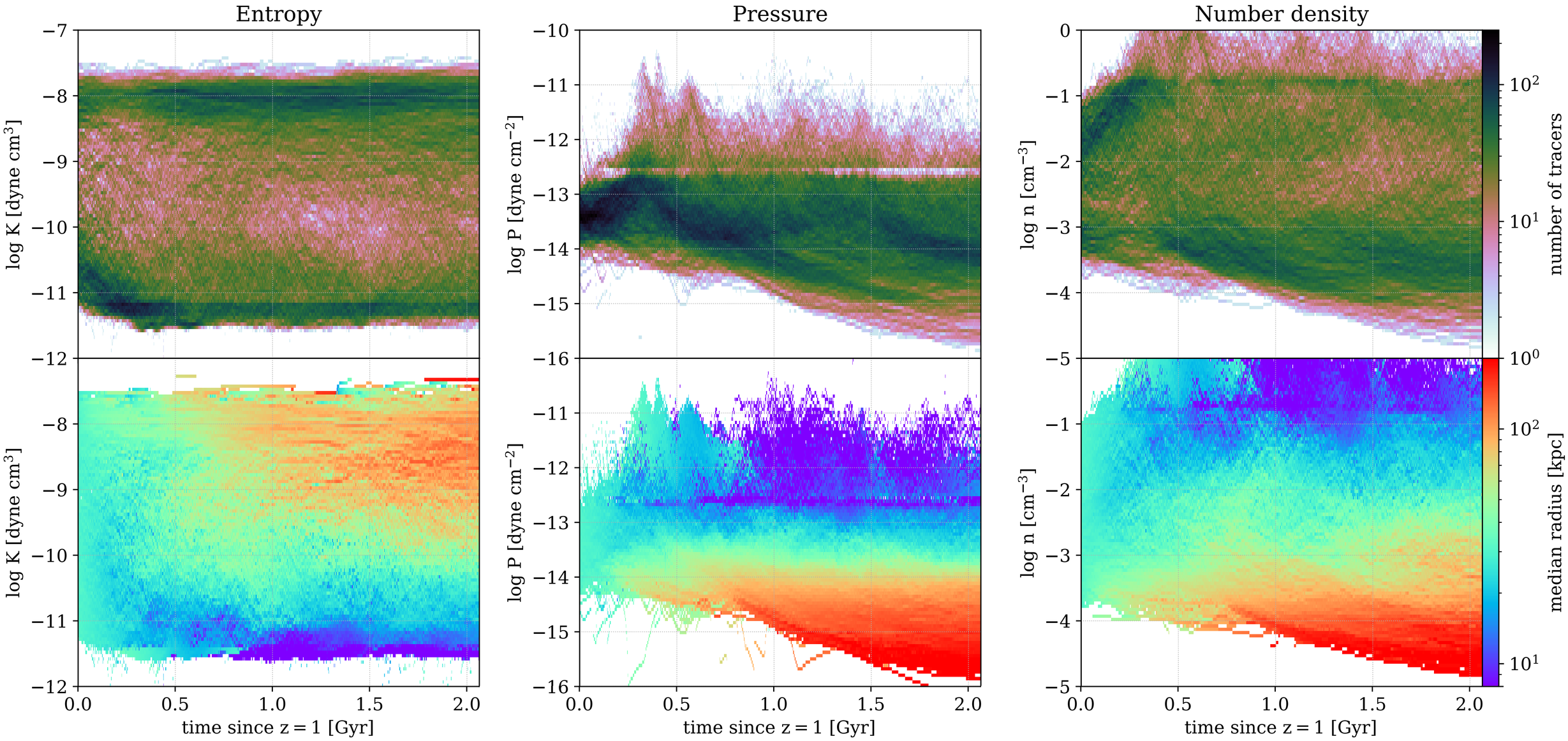
CGM gas self-segregates by temperature and becomes well-mixed after a few hundred Myr, regardless of its origin in the halo



Emergent temperature phases are reflected in emergent entropy distributions, but not pressure or density



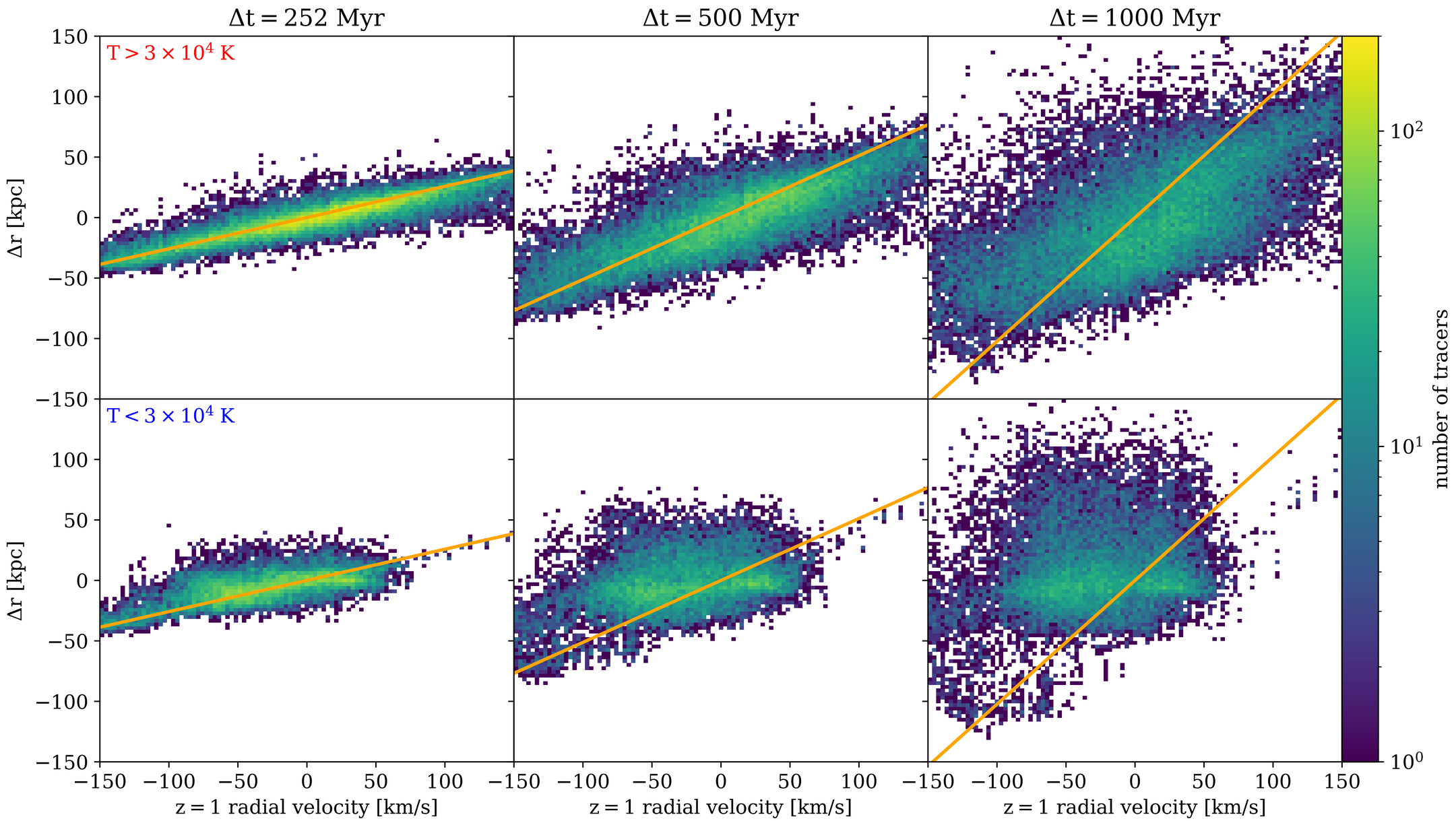
Resulting entropy, pressure, and density distributions all scale with radius within the halo



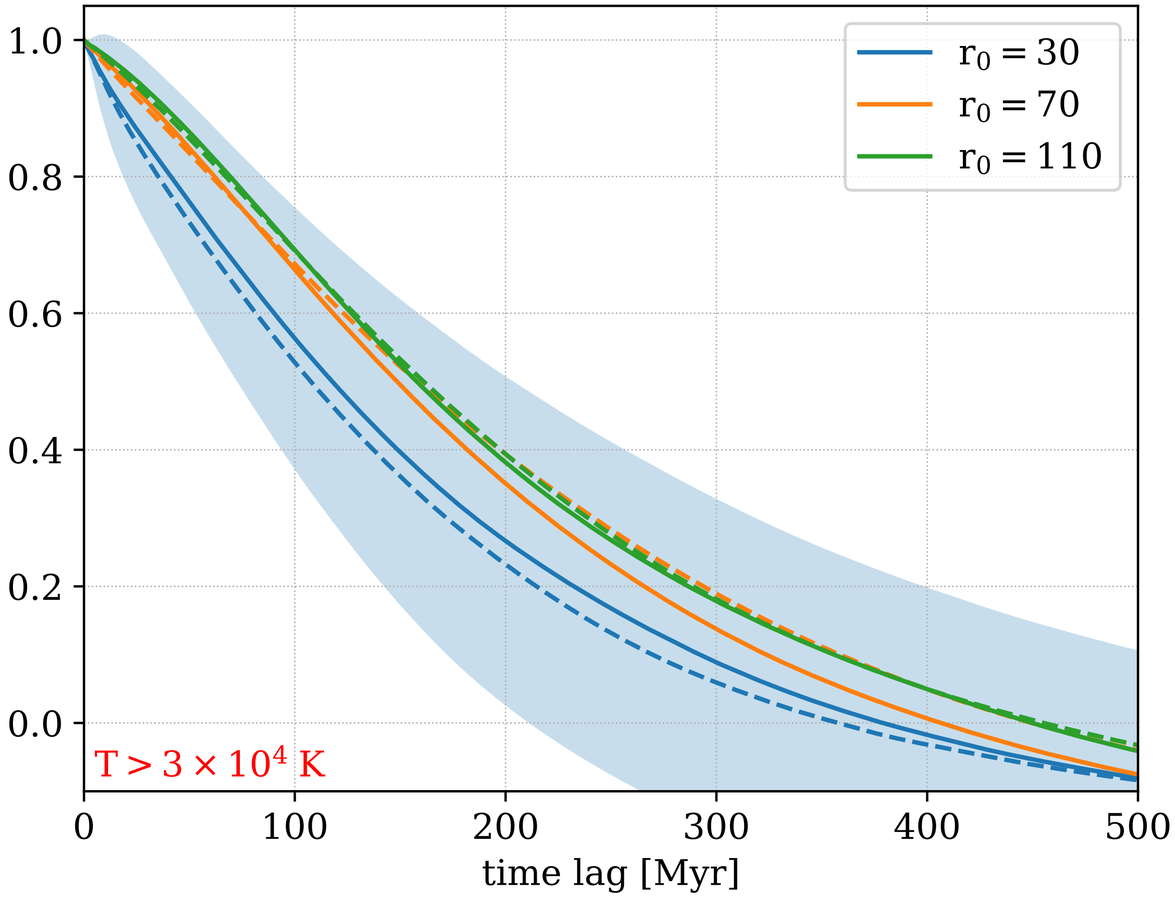
Kinematic Evolution

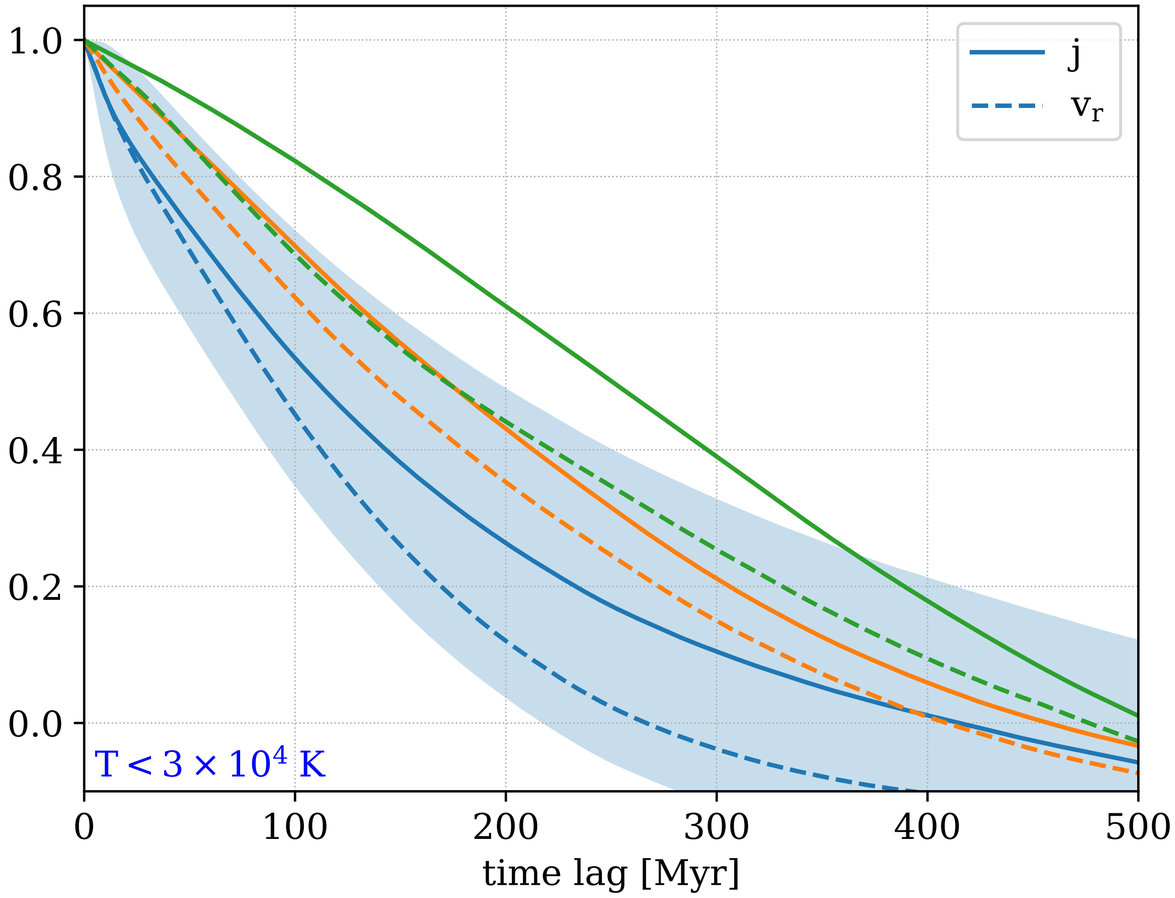
Radial velocity, angular momentum

Hot phase remembers radial velocity history for at least several hundred Myr, cold phase quickly forgets



Radial velocity and angular momentum autocorrelations reveal cold gas near the galaxy forgets its kinematic history the fastest

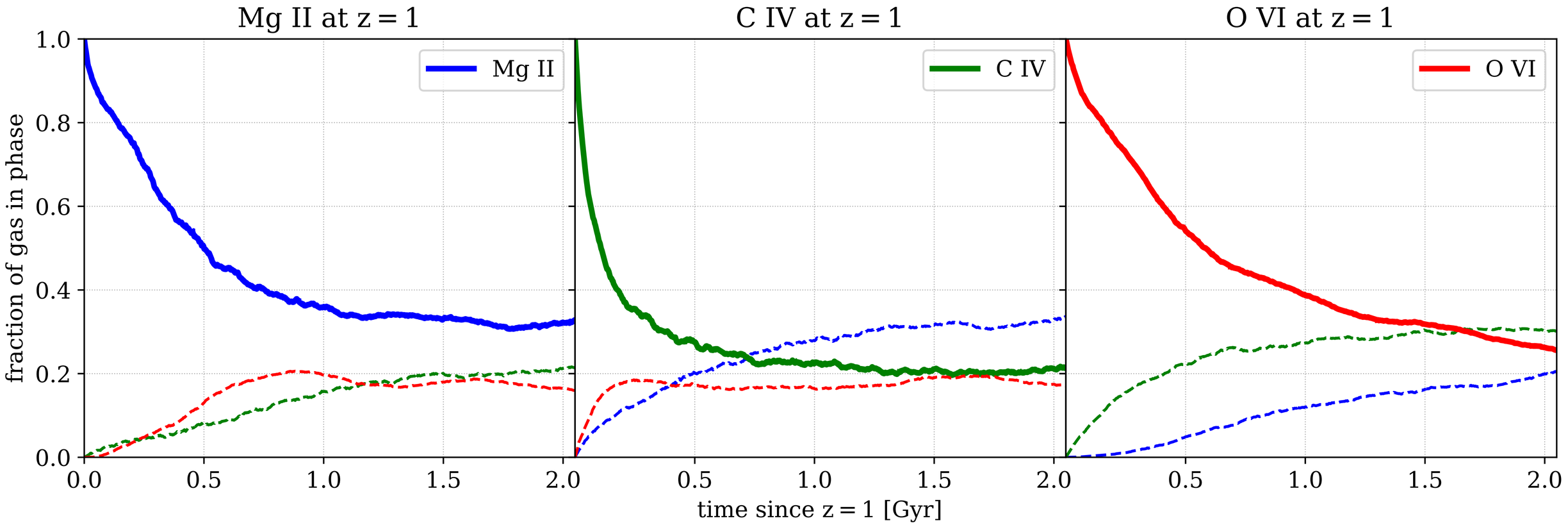




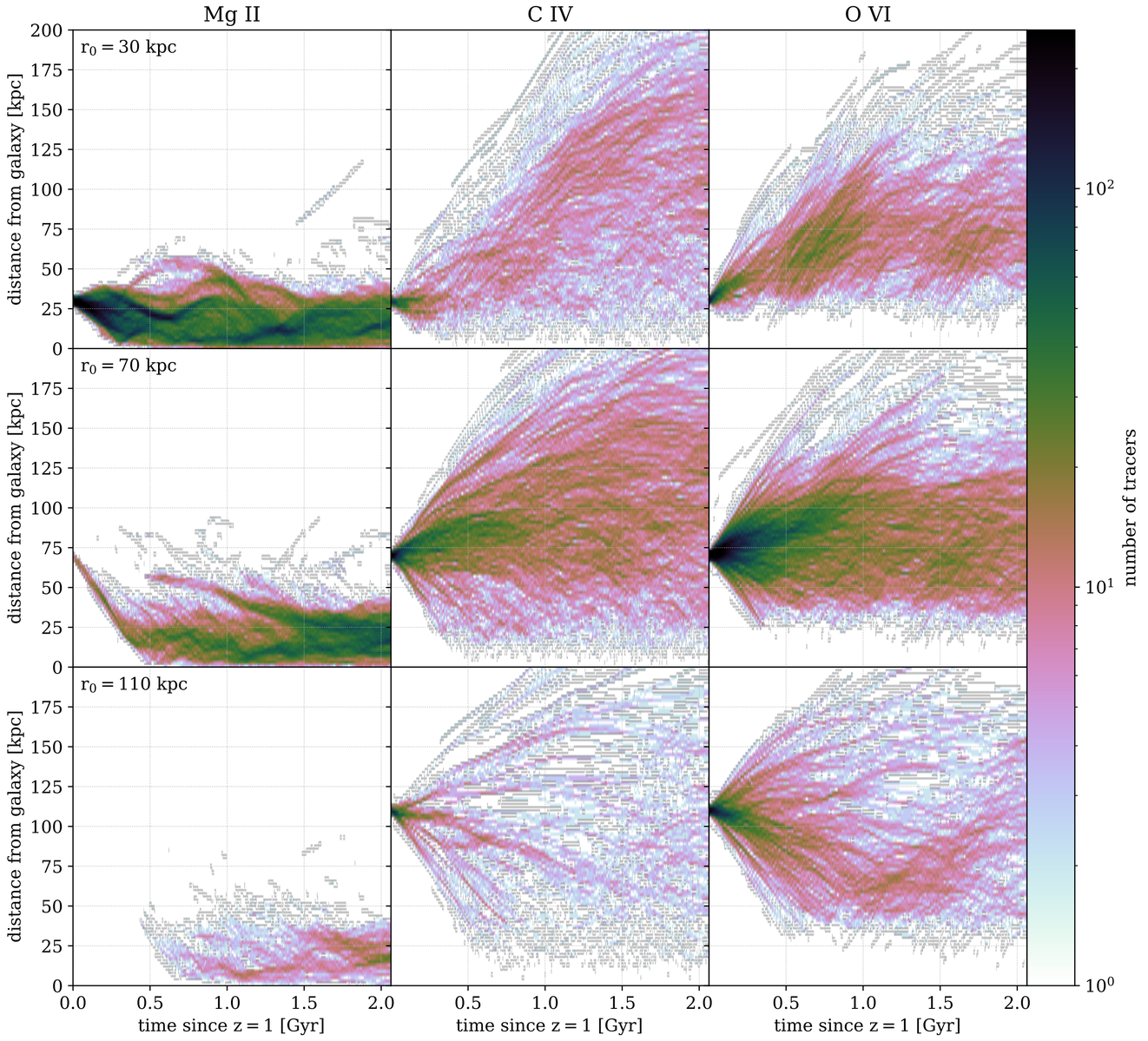
“Observed” Ion Evolution

Mg II, C IV, O VI

Gas generally moves out of “observed” z=1 phase and mixes with other phases, but at varying speeds



Mg II tends to form and remain near the galaxy, while hotter/more diffuse phases spread out over time



Summary

- Lagrangian regions in the CGM evolve into a two-phase temperature (and entropy) distribution, largely separated by radius
- Thermal properties of Lagrangian regions end up scaling with radius
- Hot gas “remembers” its journey through the baryon cycle better than cold gas
- Gas changes its “observed” phase at different speeds as it roams around the CGM
- *Future work: how do other forms/models of feedback change this behavior?*