Emulating the small scales clustering

(Using Gaussian process)

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Abacus Summit

N-body simulations

- Base : 6912 particles in 2 Gpcs/h (95 cosmologies, 8 parameters)
- 2000 Small : 1728 in 0.5 Gpcs/h (Planck cosmology)

- Cubic boxes
- Correlation function monopole (no RSD)
- Z = 0.1
- 1800 LRG like HOD + assembly bias (9 parameters)

Gaussian process regression
(Fast recap)

$$D = \left\{(\mathsf{x}_i, y_i) \,|\, i = 1,\ldots,n\right\} \qquad\qquad y = f(\mathsf{x}) + \epsilon$$

$$p(f^* \,|\, x^*, y, X) \sim \mathcal{N}(m(x^*) + K(x^*, X)\left(K(X,X) + \sigma_n^2 I\right)^{-1}\left(y - m(X)\right),$$
$$K(x^*, x^*) - K(x^*, X)\left(K(X,X) + \sigma_n^2 I\right)^{-1} K(X, x^*))$$

Gaussian process regression

(Fast recap)

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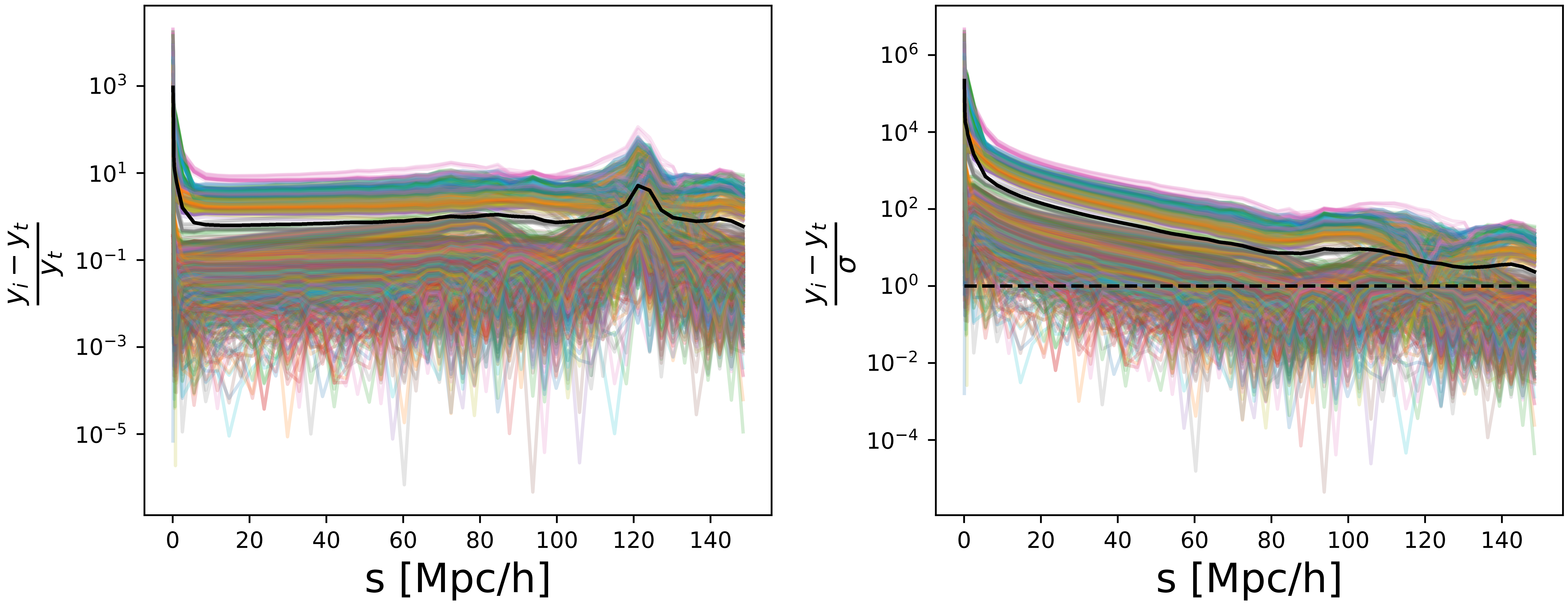
$$p(f^* \,|\, x^*, y, X) \sim \mathcal{N}\Big(m(x^*) + K(x^*, X)\left(K(X,X) + \sigma_n^2 I\right)^{-1}\left(y - m(X)\right),$$
$$K(x^*, x^*) - K(x^*, X)\left(K(X,X) + \sigma_n^2 I\right)^{-1} K(X, x^*)\Big)$$

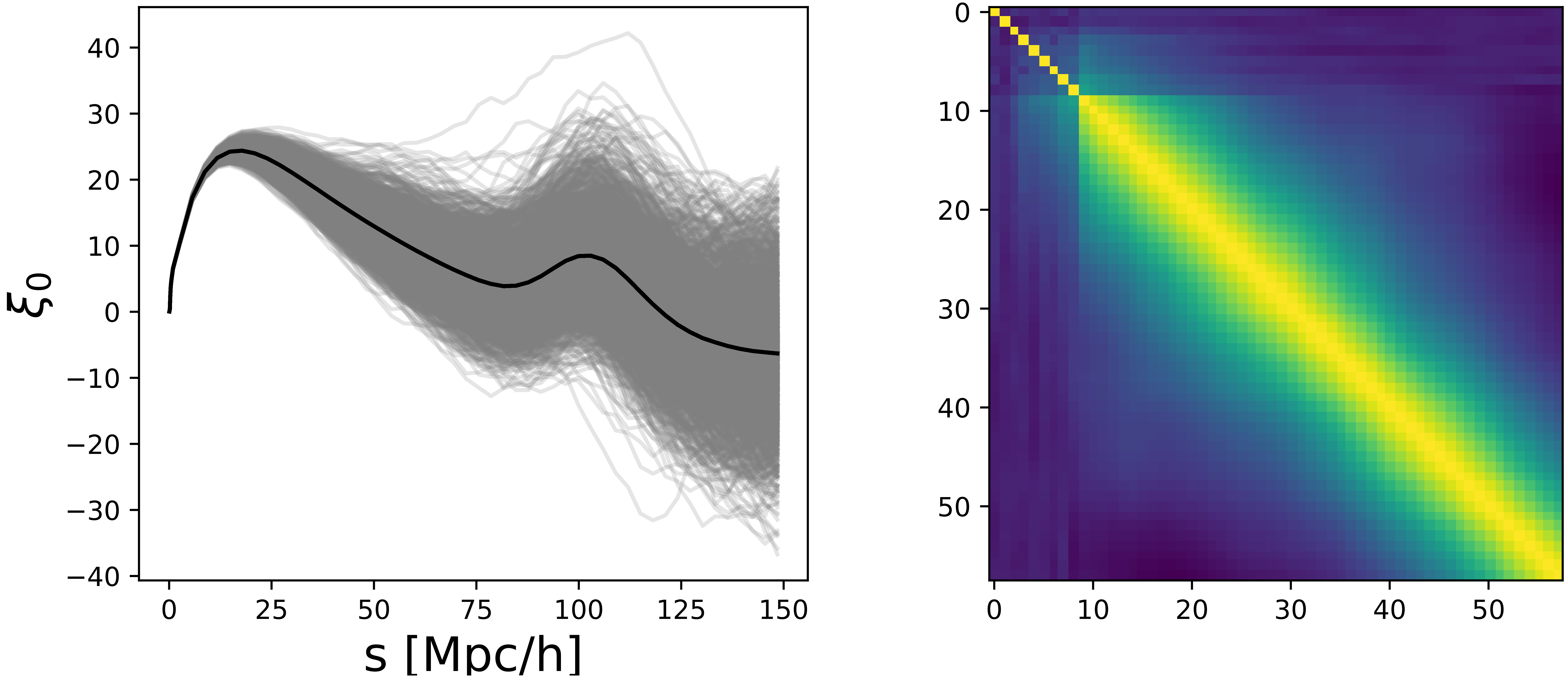
$$\Omega = \Omega_{cosmo} \otimes \Omega_{hod} \otimes \Omega_{scales} \qquad K = K_{cosmo} \otimes K_{hod} \otimes K_{scales}$$

Dataset : 9M points

(Visualisation of 1% of the points)

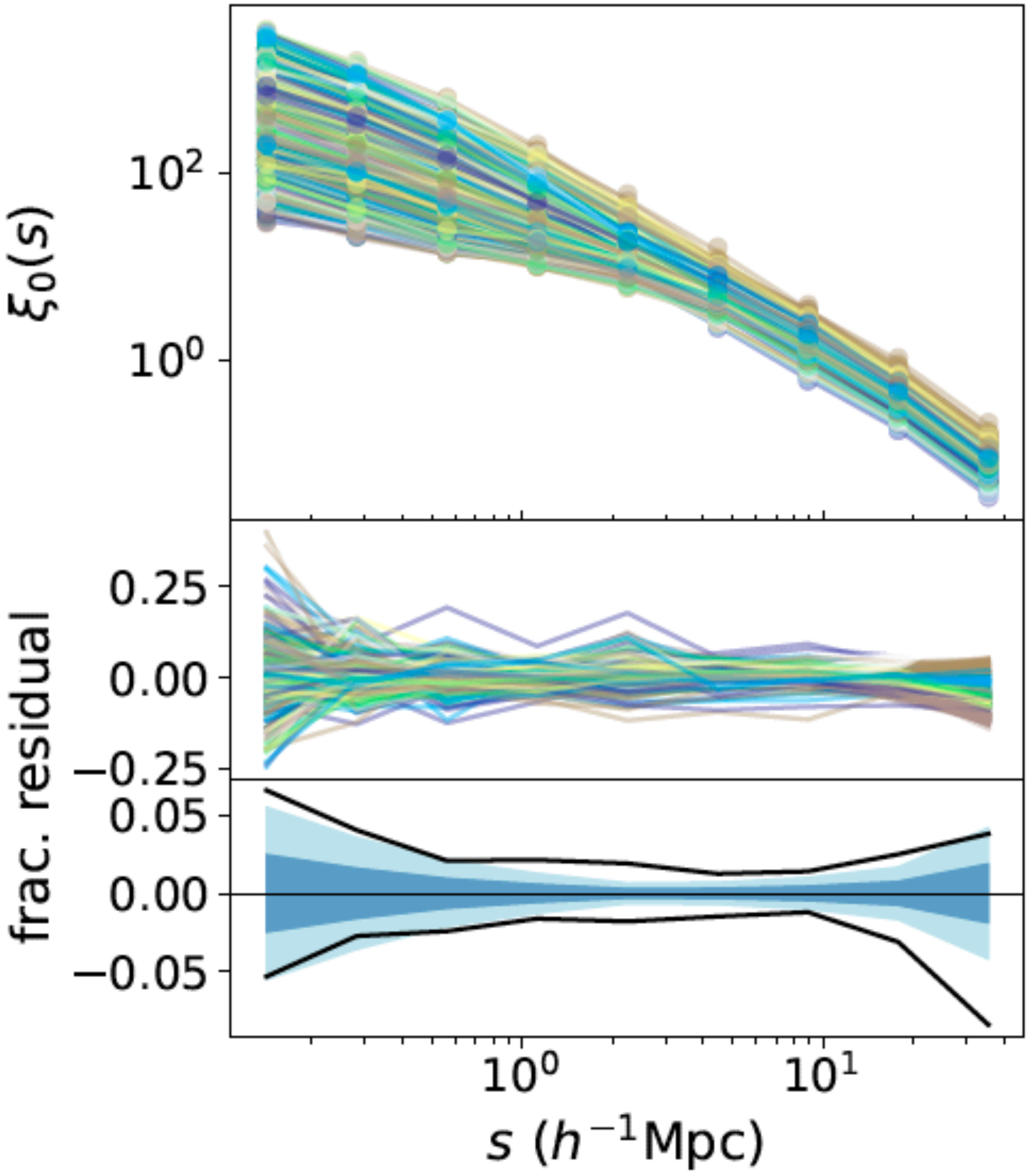


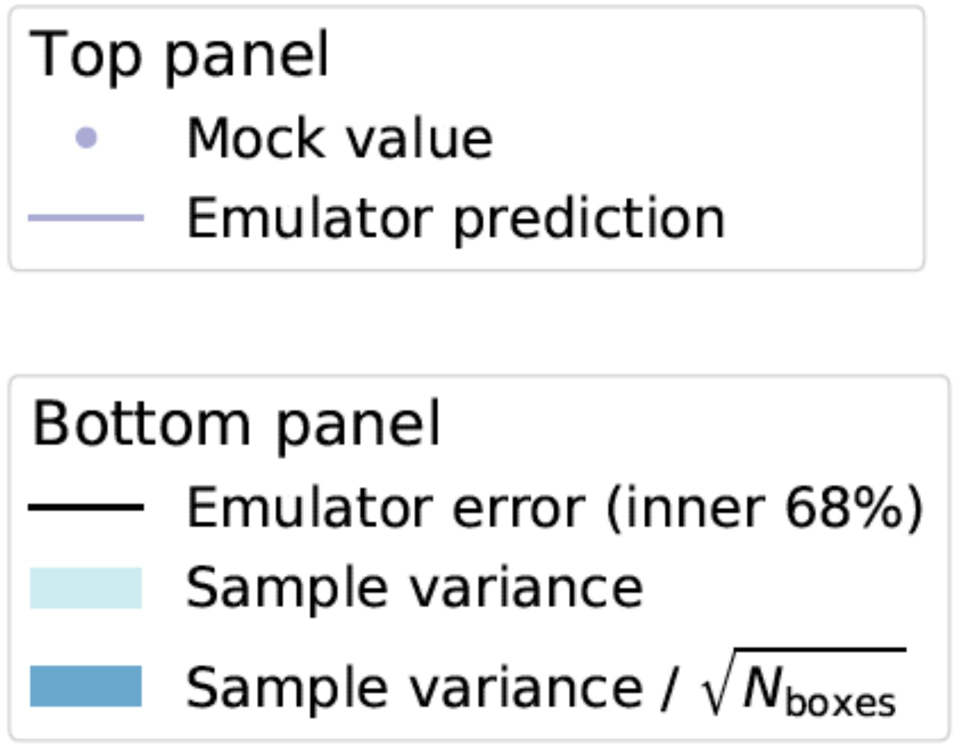
Small boxes for noise estimation



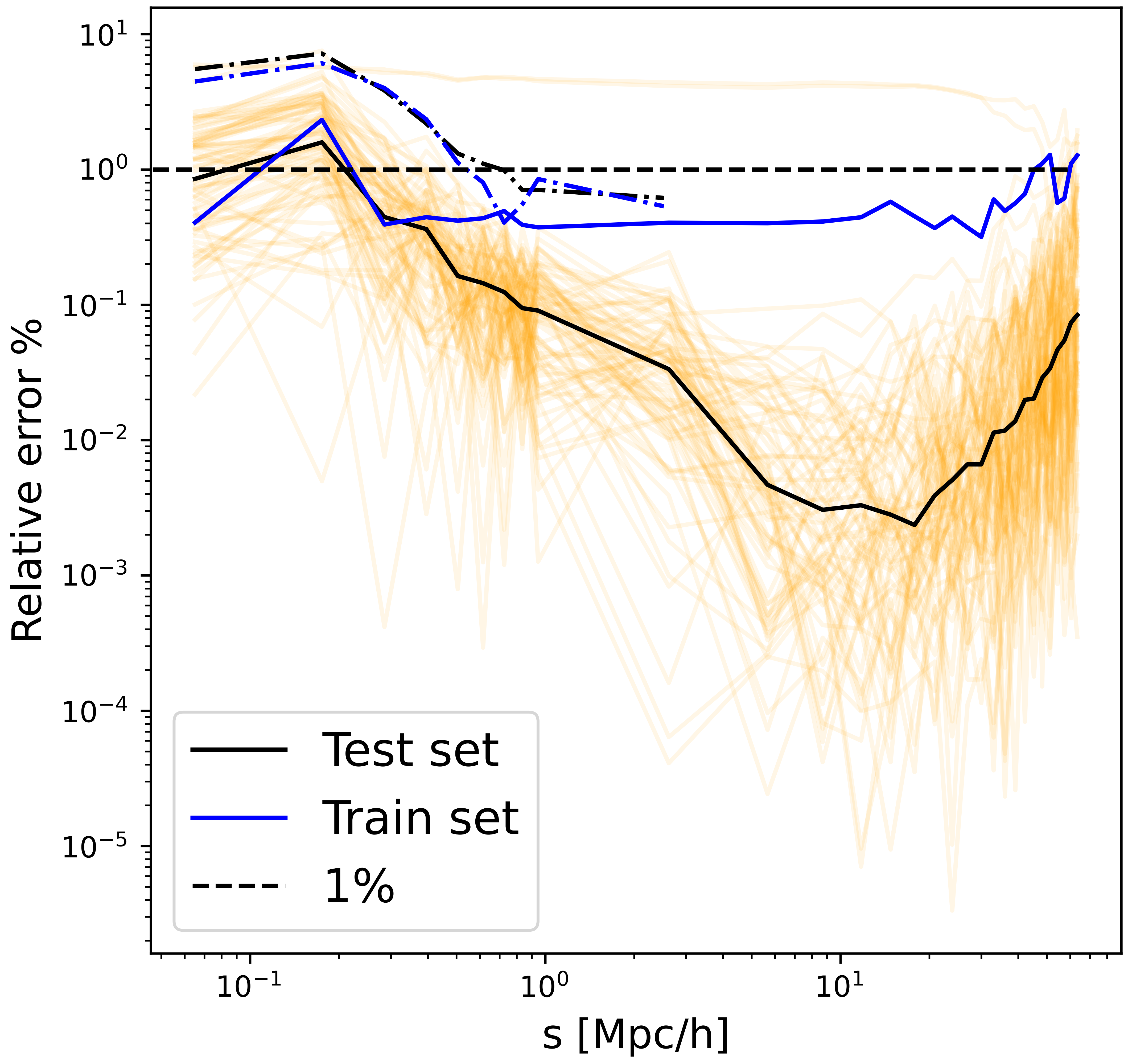
Aemulus project IV

[Kate Storey-Fisher et al 2022]



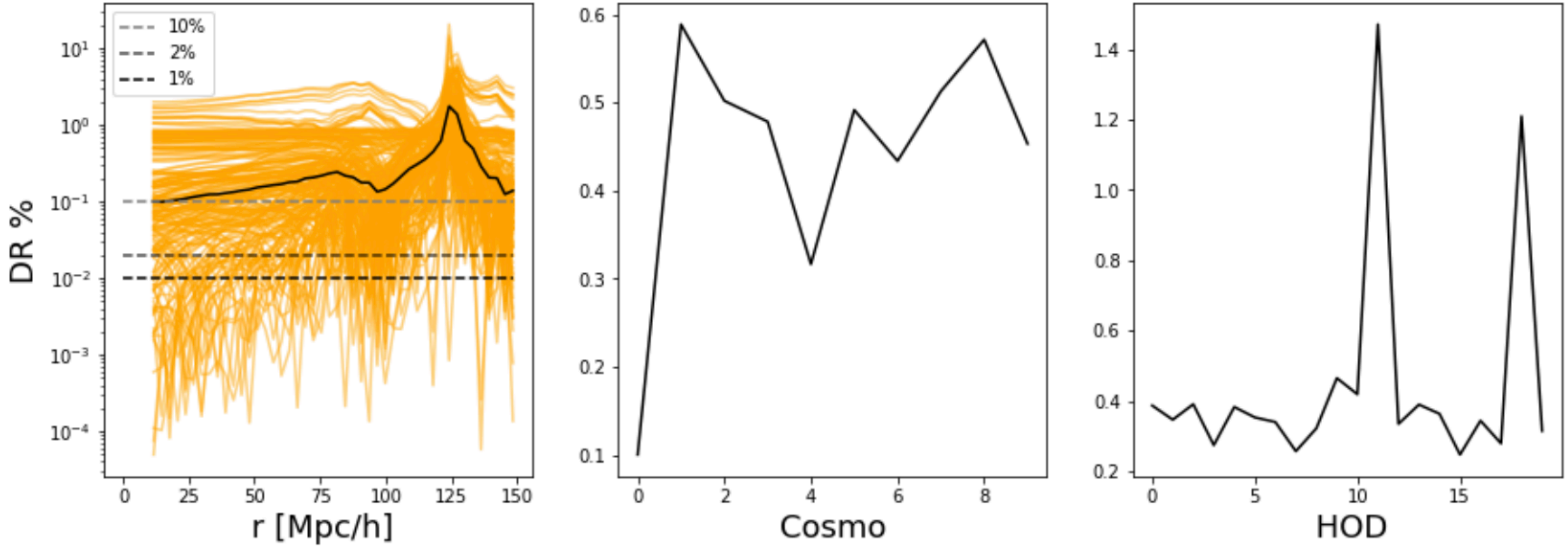


Results for 1hod



Accuracy increases when emulating the different scales together.

Results for the full dataset



Variance dependance on HOD