Galaxy Groups at 0.1 < z < 1 with zCOSMOS

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In collaboration with

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Millennium Workshop

Garching, December 2012

Outline

- Construction of a galaxy group catalog → Knobel et al. (2009, 2012a)
- Fraction of galaxies in groups → Knobel et al. (2012a)
- Group-galaxy cross-correlation analysis → Knobel et al. (2012b)
- Properties of central and satellite galaxies → Knobel et al. (2012c)

Millennium Simulation

We used the Millennium Simulation (COSMOS light cones) for...

- **calibration**
  - optimizing group-finding parameters
  - assigning probabilities to be a central/satellite

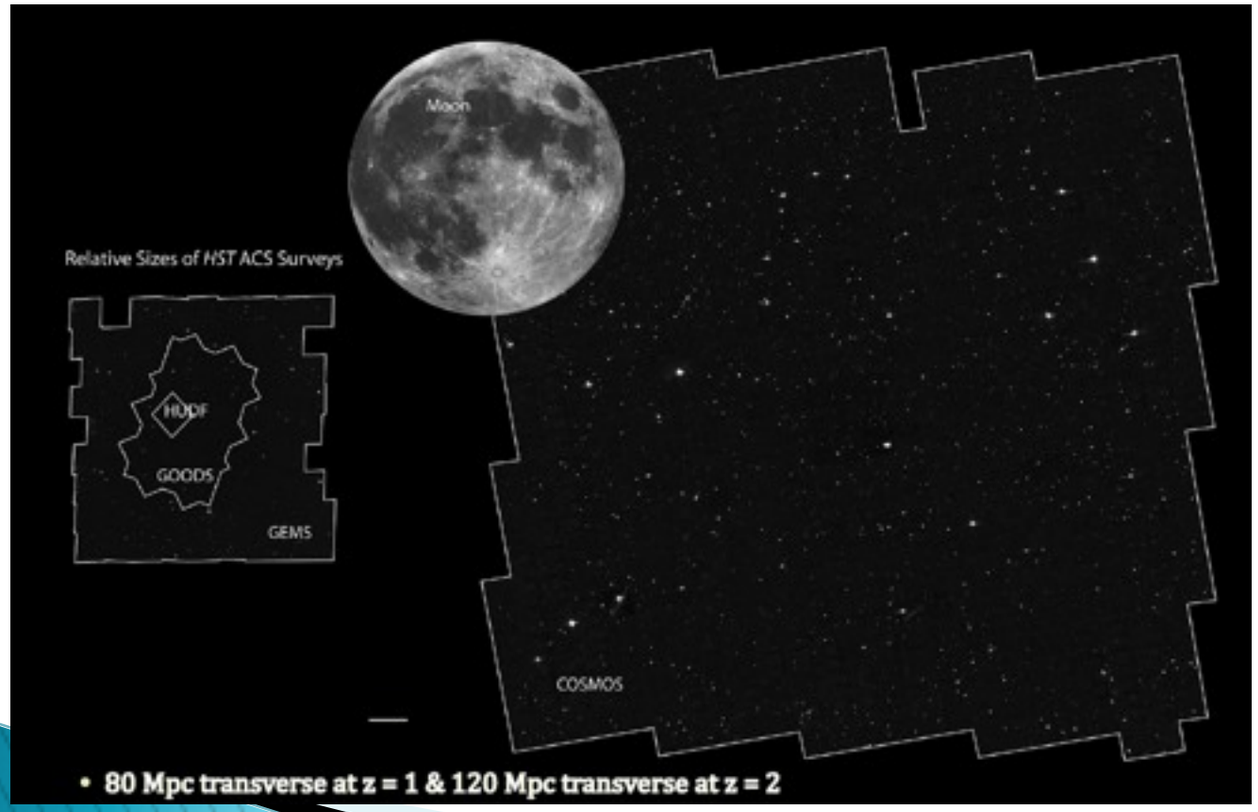
- **tests and error determination**
  - testing codes
  - exploring systematic effects
  - cosmic variance
  - correlation between data bins

- **comparison with simulations** (theoretical models)

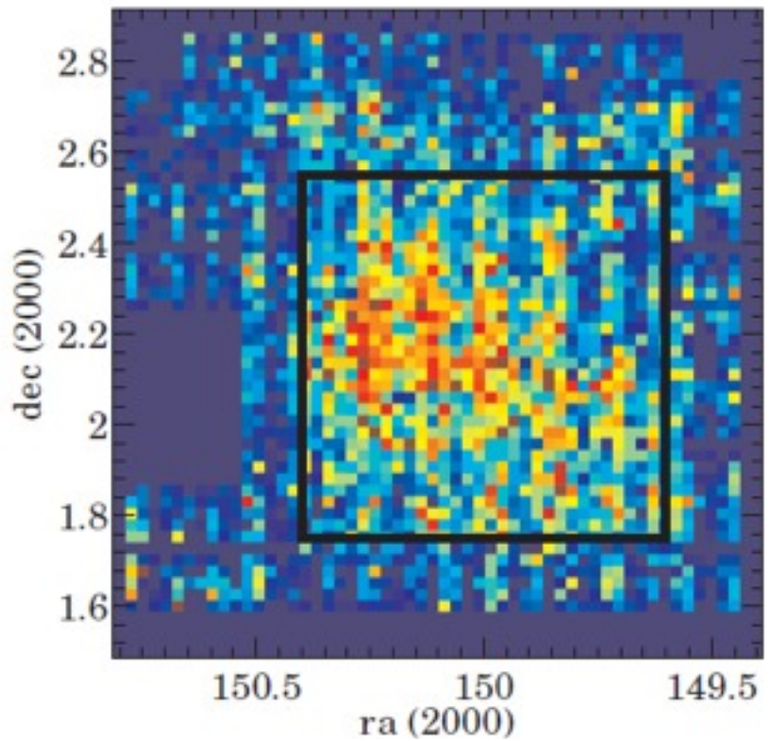
danger of circularity

zCOSMOS survey

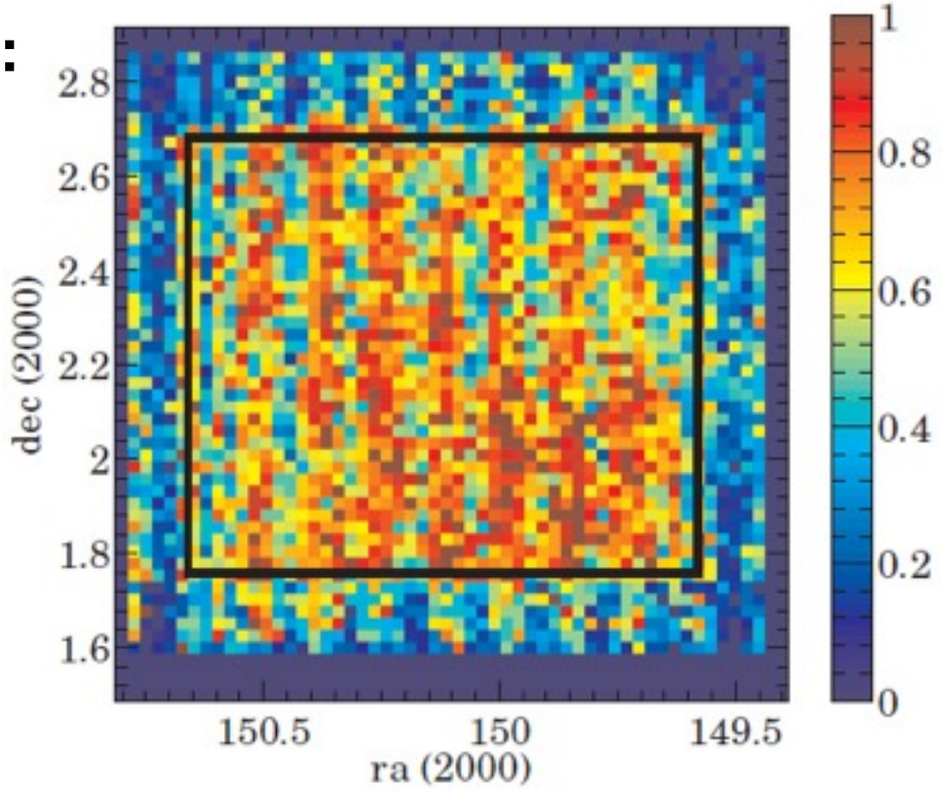
- 1.7 deg² **COSMOS field**
- magnitude limited by $\mathbf{I_{AB} < 22.5}$
- redshift range: **0.1 < z < 1.2**
- 2 released samples: 10k and 20k



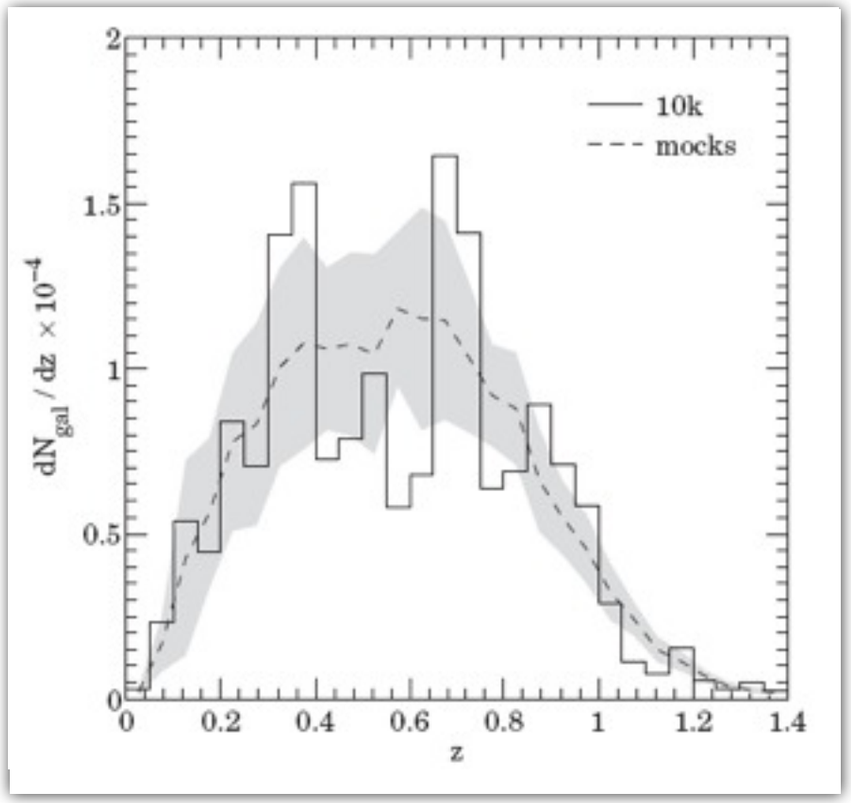
10K:



20K:

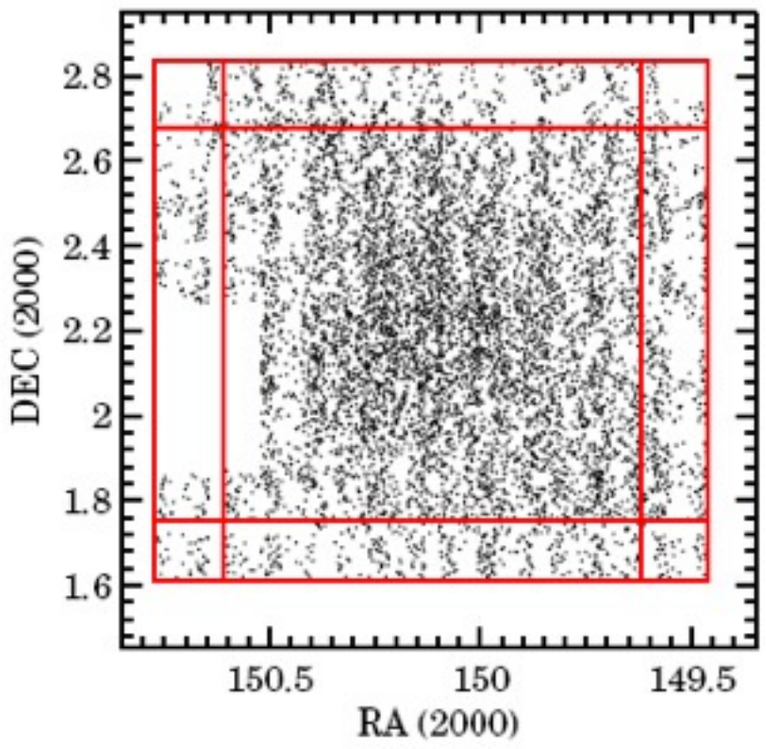


„Mocks“

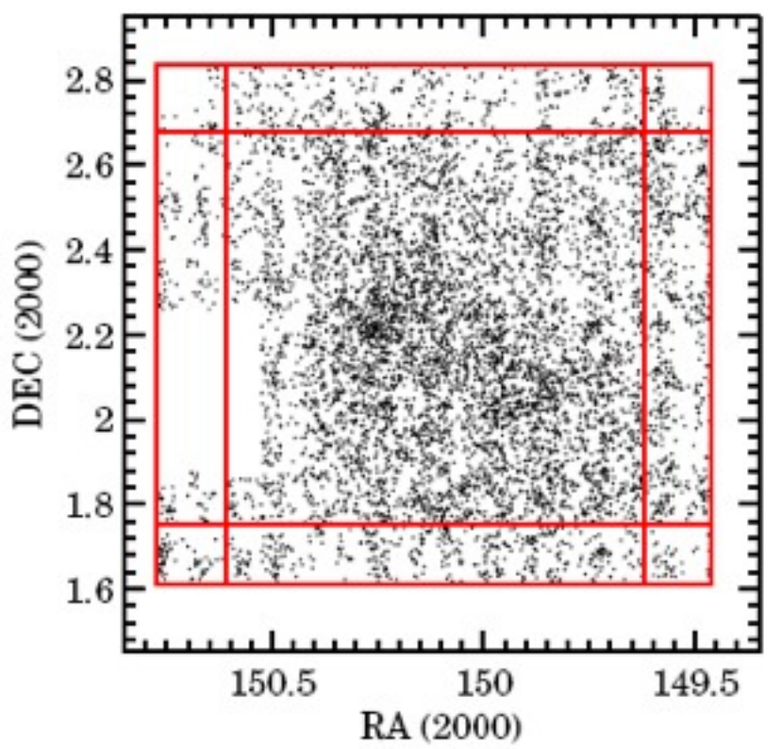


24 COSMOS light cones based on the Millennium DM simulation.

zCOSMOS 10k

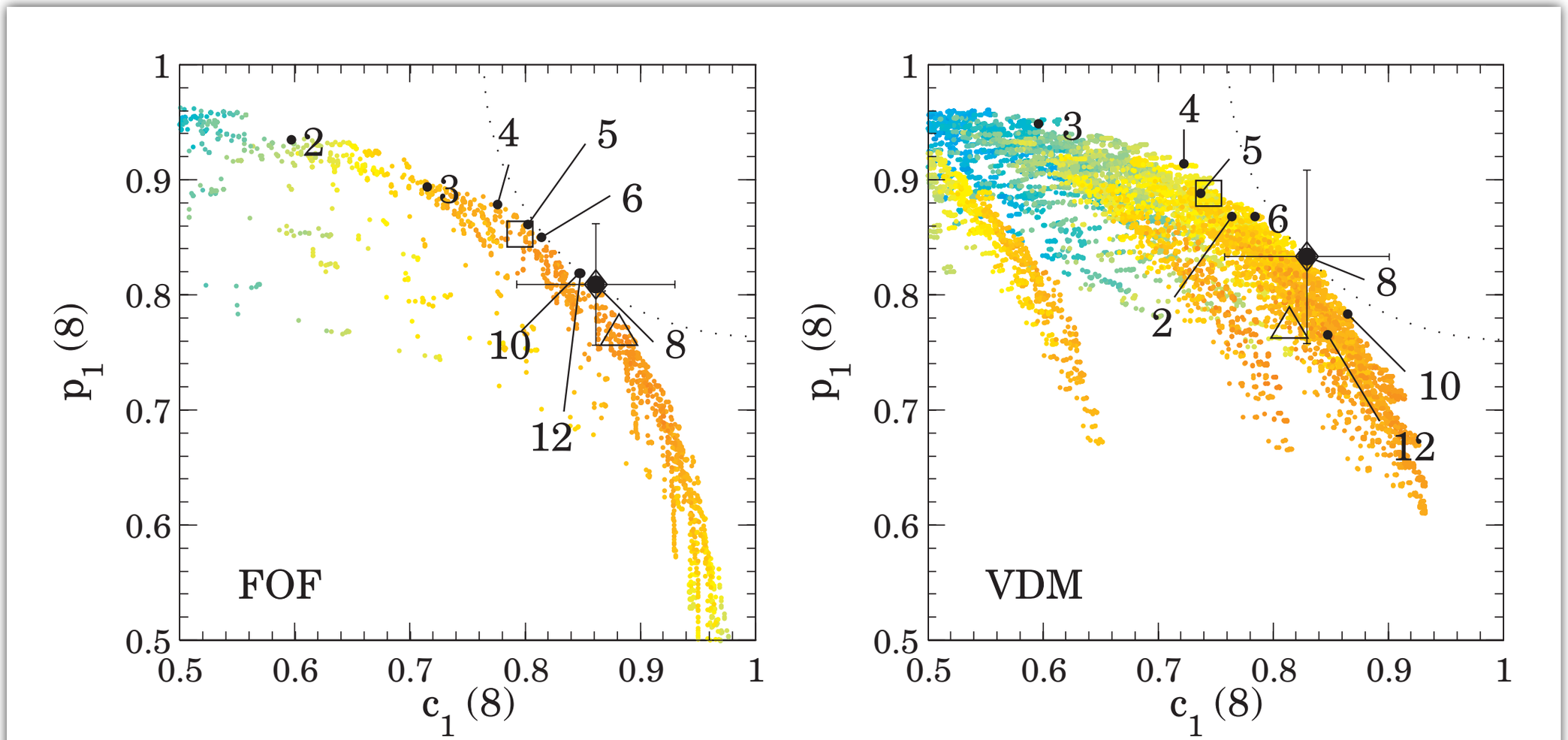


mock example



Group identification

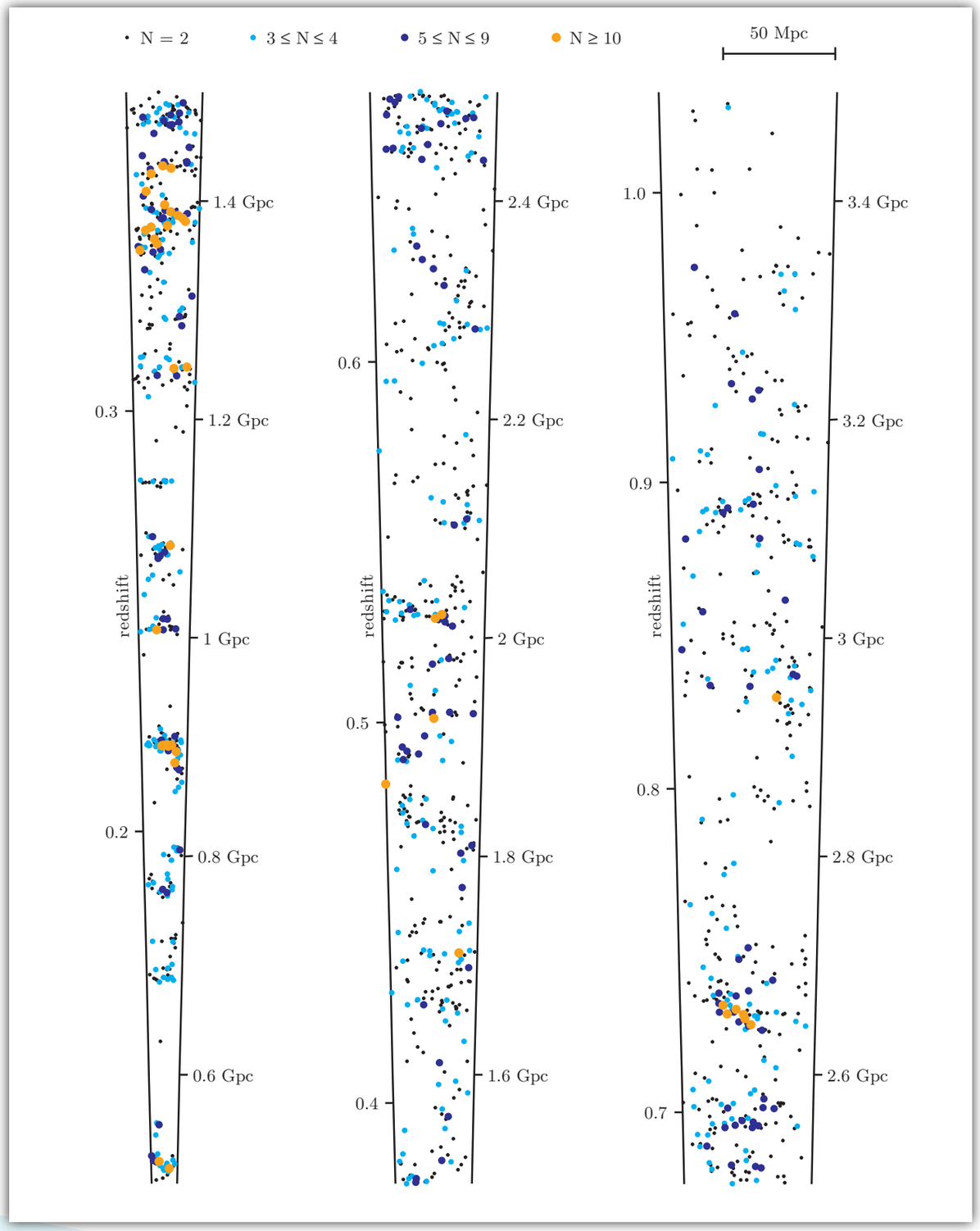
Optimizing group-finding parameters using the mocks



zCOSMOS 20k sample

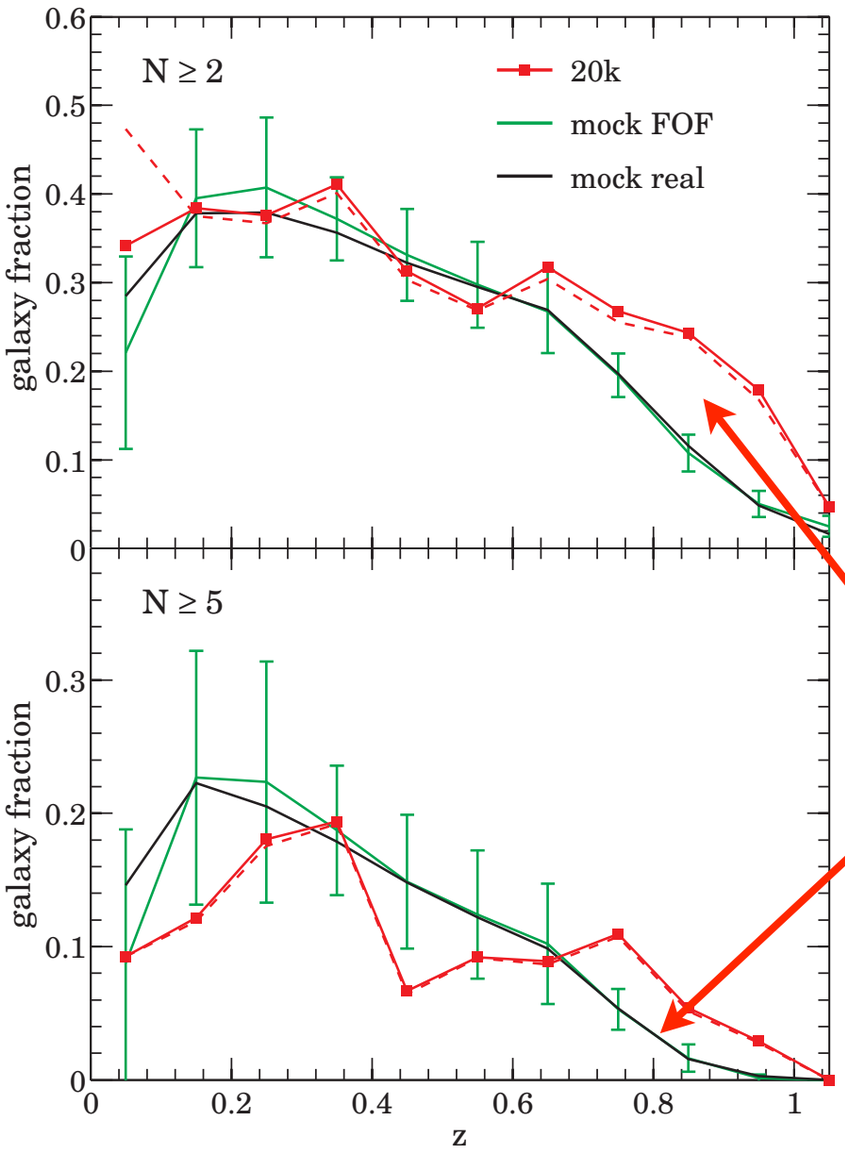
- ~ 1500 groups
- 0.1 < z < 1
- $10^{12.5} \lesssim \frac{M_{\rm halo}}{M_\odot} \lesssim 10^{14}$
- well understood systematics
- publicly available

Knobel et al. (2012a)



Fraction of galaxies in groups

Kitzbichler:

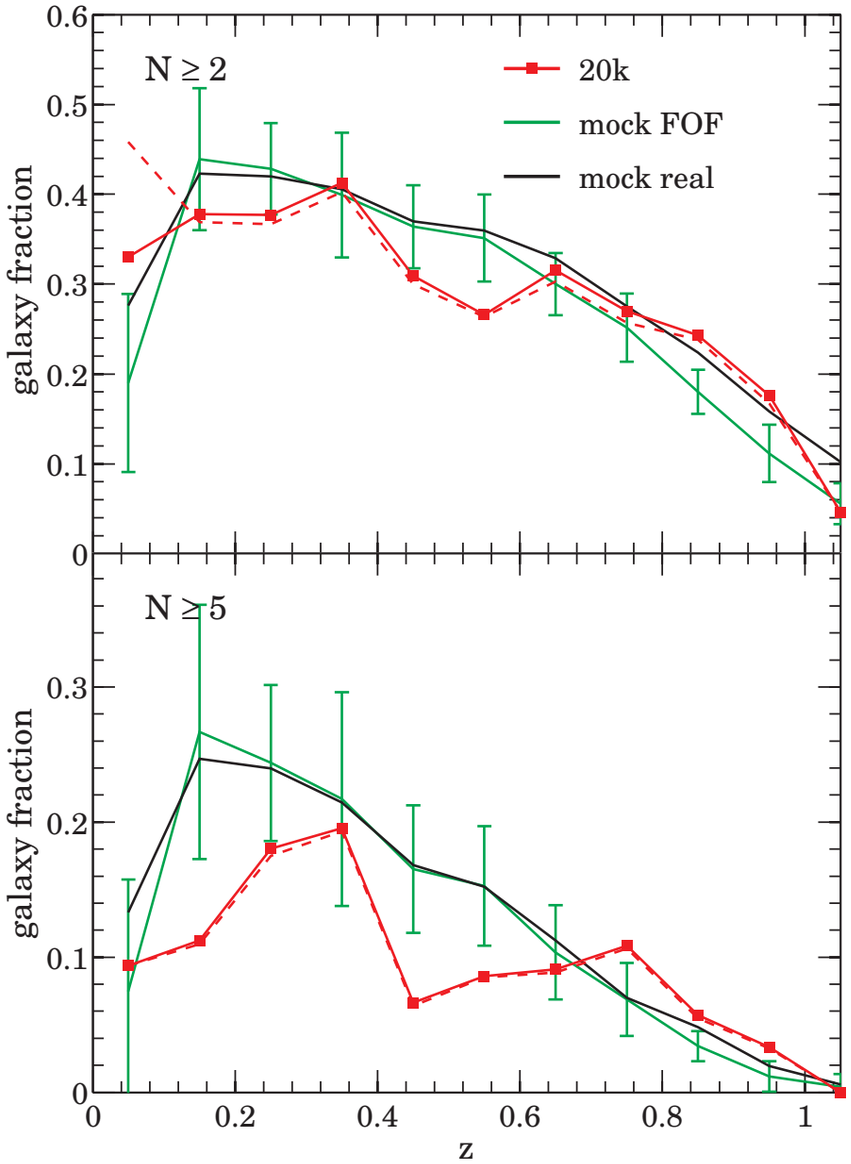


zCOSMOS

mocks

discrepancy

Henriques:

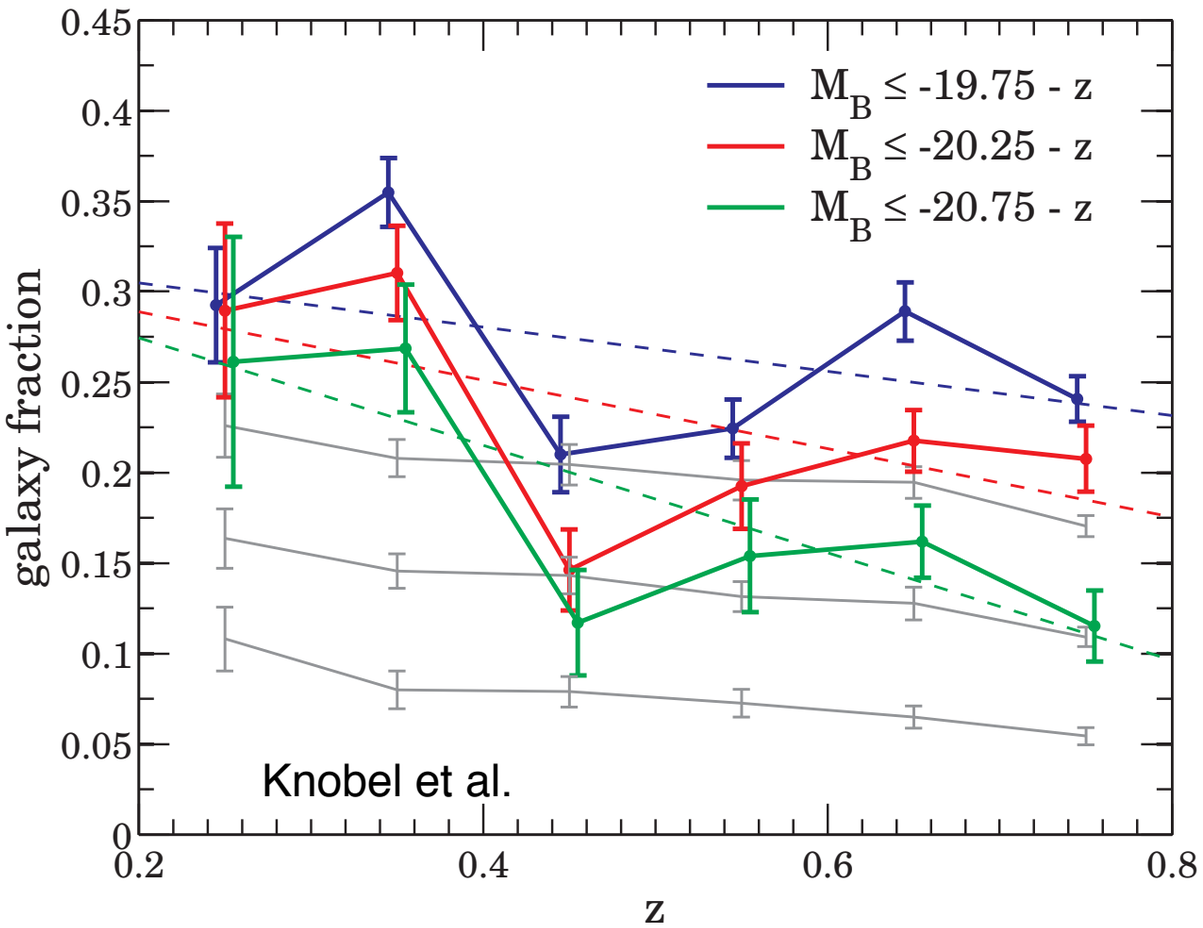


Knobel et al. (2012a)

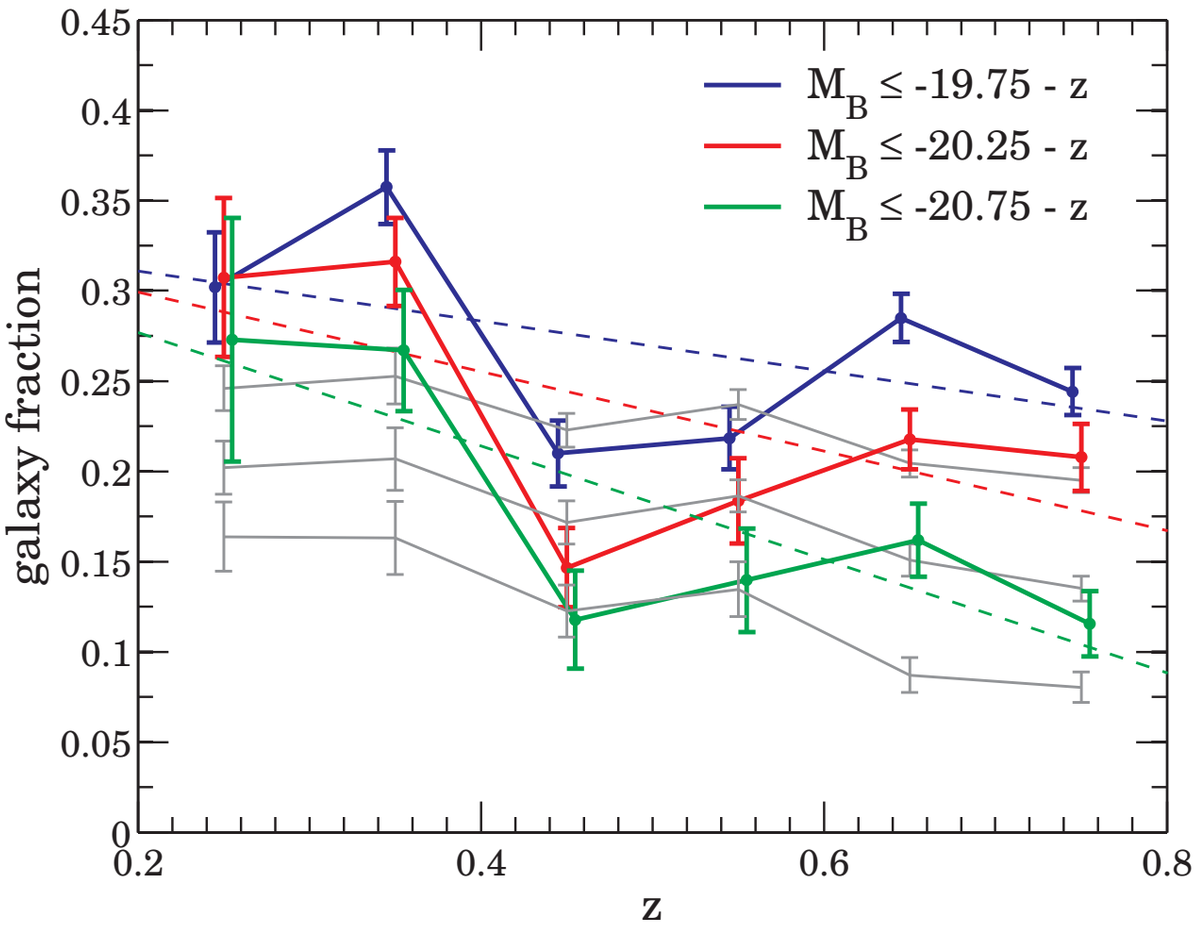
Growth of cosmic group environment

Fraction of galaxies in groups in **volume limited** galaxy and group samples

Kitzbichler:



Henriques:



→ We observe the growth of the group environment with cosmic time (as expected)

Group-galaxy cross-correlation analysis

Group-galaxy cross-correlation functions for the mocks:

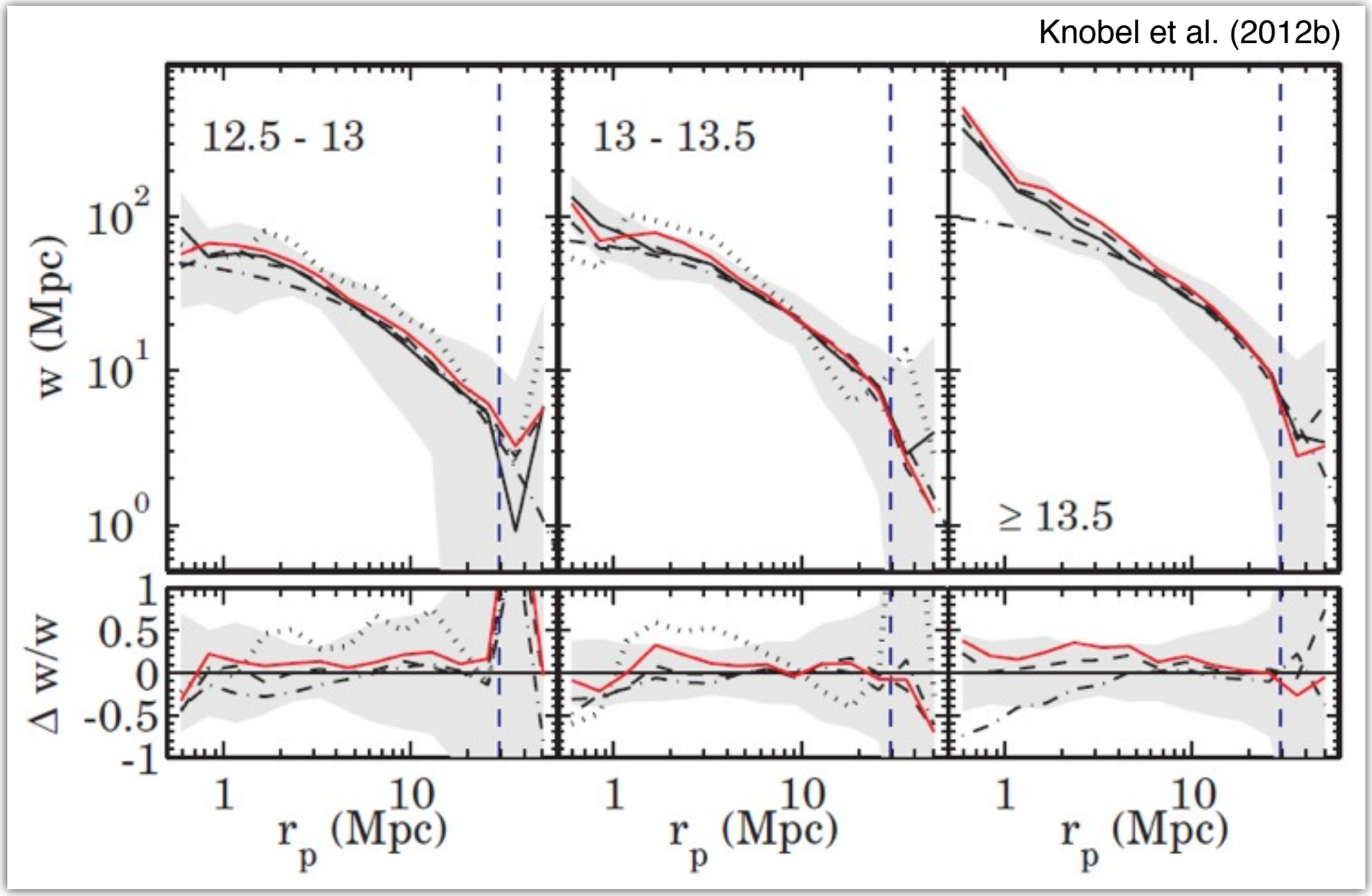
all rec gr.

real gr.

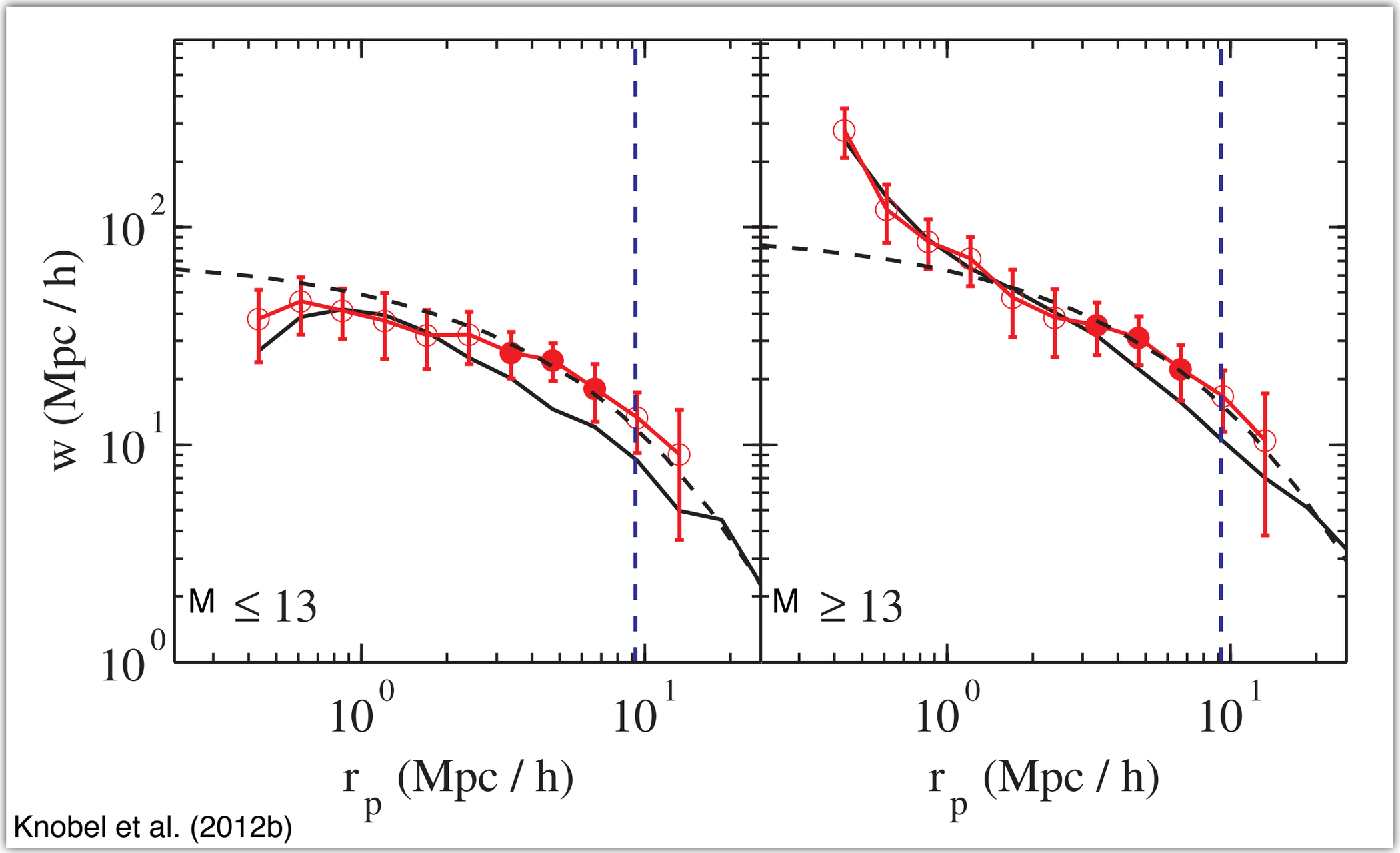
2WM assoc.

spurious gr.

$w_{\rm lin}$



Group-galaxy cross-correlation analysis



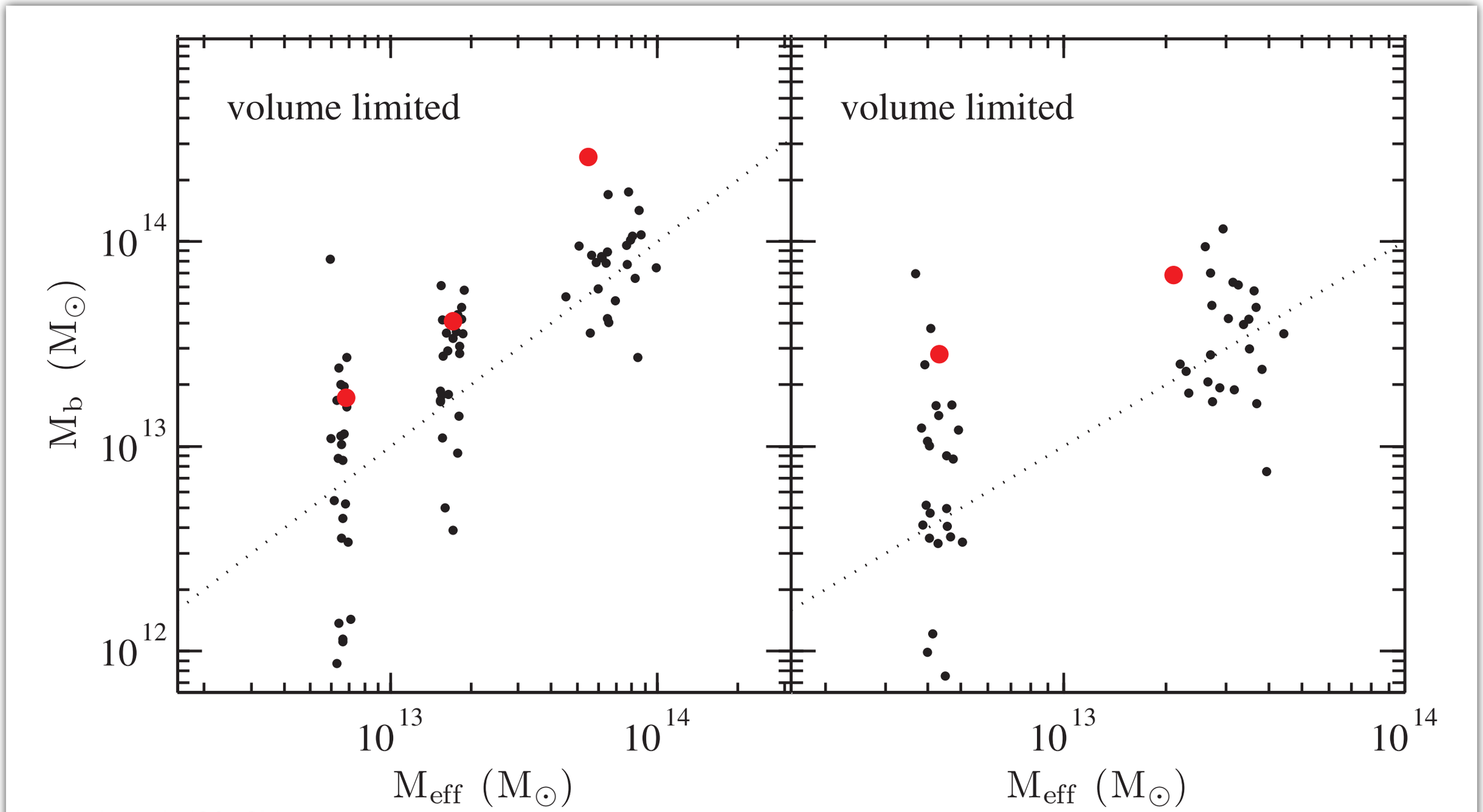
Knobel et al. (2012b)

zCOSMOS

Kitzbichler (mean of 24 mocks)

linear correlation function

Group-galaxy cross-correlation analysis



Knobel et al. (2012b)

→ The bias *b* increases with mass (as expected)

Fraction of satellites

Fraction of satellites

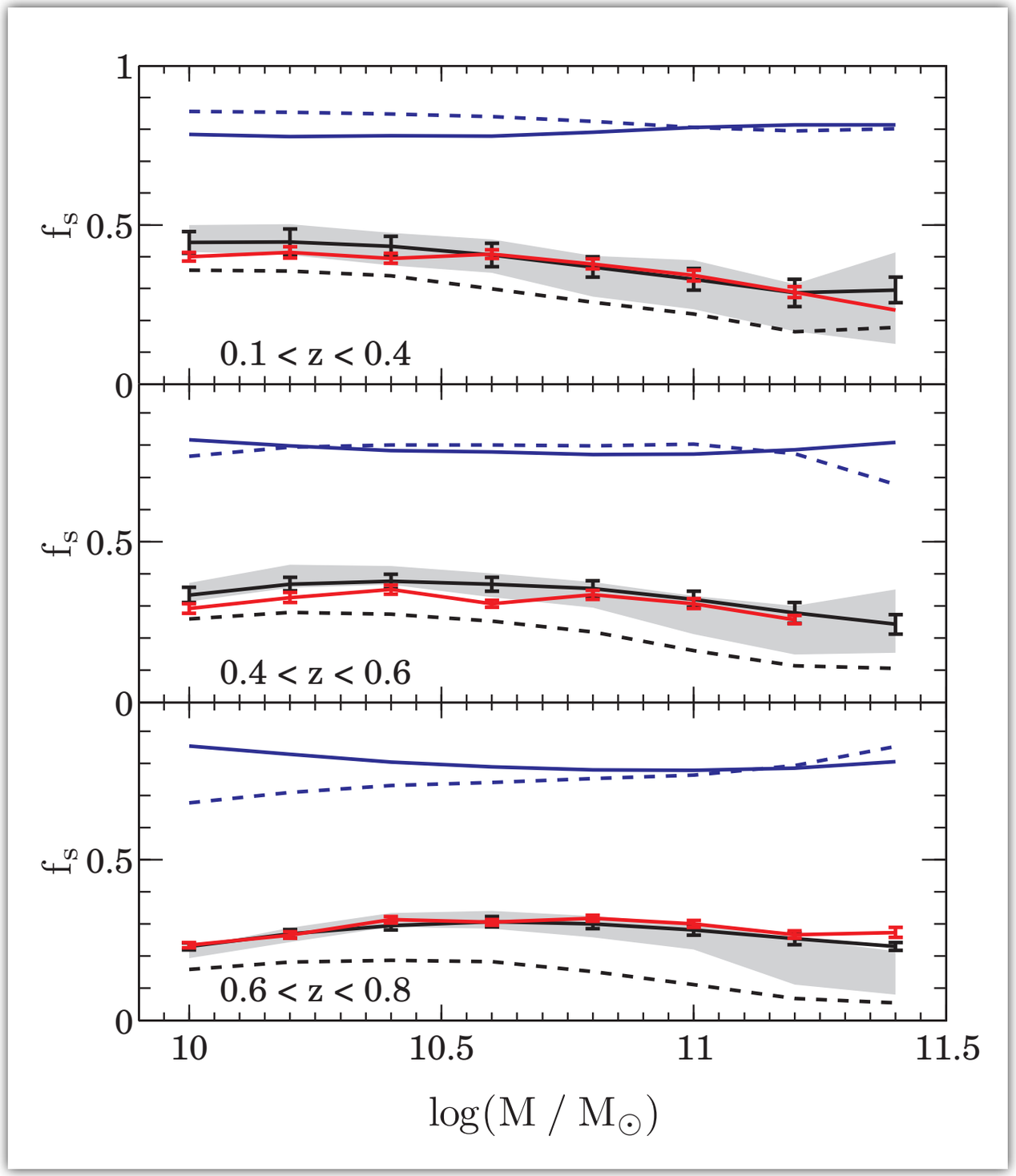
purity of centrals

purity of satellites

zCOSMOS (corrected f_s)

Henriques (corrected f_s)

Henriques (uncorrected f_s)



Knobel et al. (2012c)

Red fractions

— f_r of centrals

— f_r of satellites

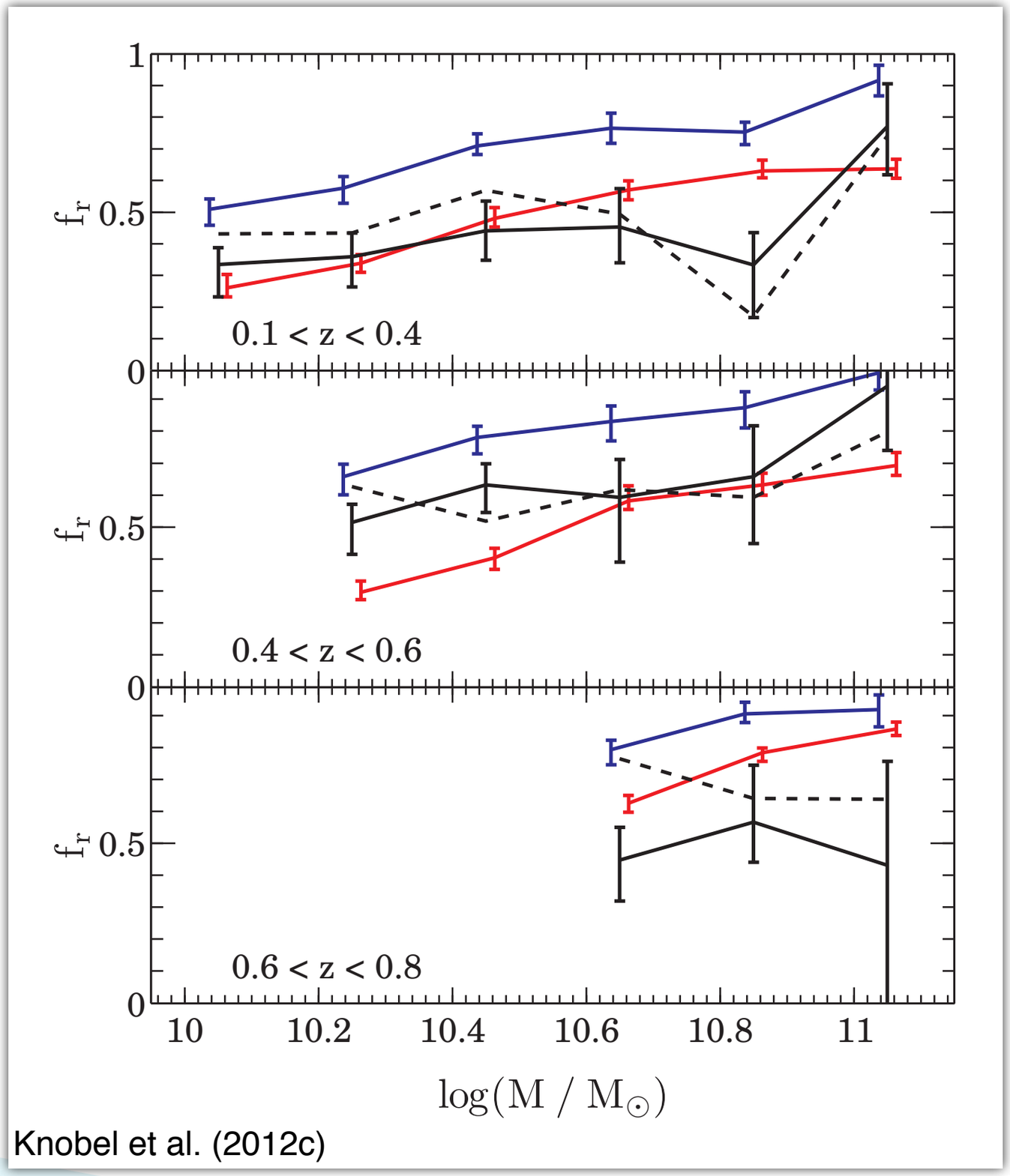
— $\epsilon_s(M)$

Satellite quenching efficiency:

$$\epsilon_s(M) = \frac{f_{r,s}(M) - f_{r,c}(M)}{f_{b,c}(M)}$$

Interpretation:

Fraction of centrals that are quenched because they are satellites



Knobel et al. (2012c)

Summary

- Milennium Simulation (COSMOS light cones) is used for calibration, exploring systematics, and comparison with observations

- New semi-analytics by Guo et al. are a better match to the observations

- We detect the growth of the group environment with cosmic time

- We detect that the bias of groups increases with halo mass

- The satellite quenching efficiency is constant with stellar mass and unaltered to z ~ 1