

Galaxy Evolution and Environment 2
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The colour-density relation up to $z=1.5$: observations vs semianalytical models

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Outline

- Questions we want to address
- The colour-density relation in real data (VVDS)
- The mock galaxy catalogues
 - Galaxy properties
 - The colour-density relation
- Comparison
- Conclusions

The questions

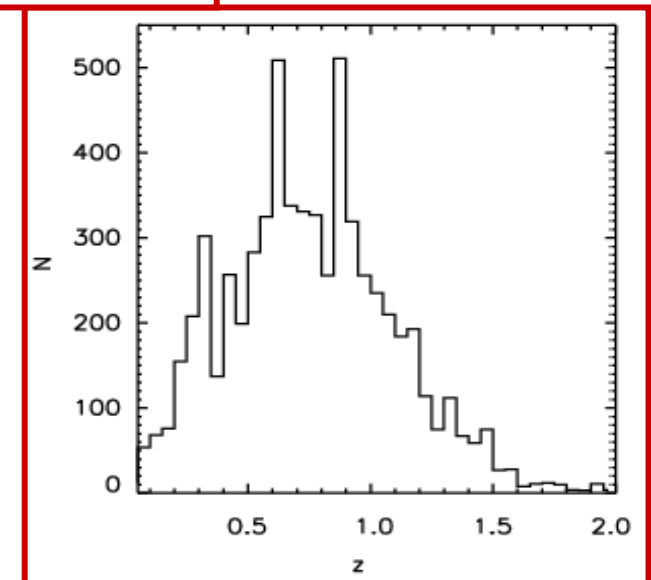
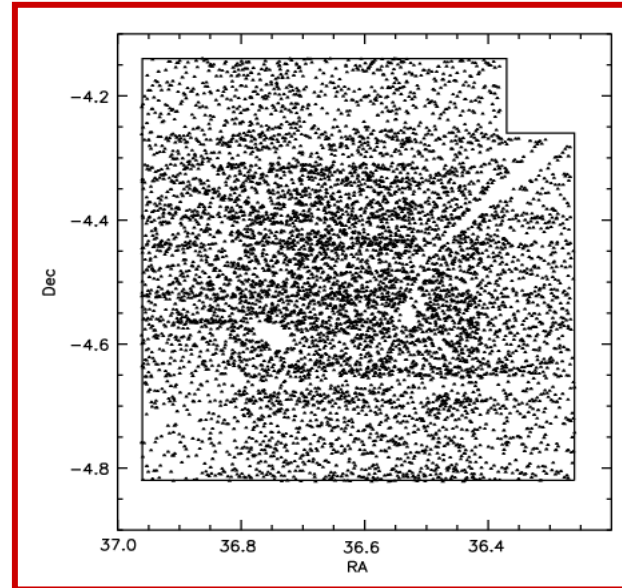
- We compute the colour-density relation in mock galaxy catalogues with the same method as in the VVDS. Our aims:
 - Quantify the cosmic variance
 - Quantify the effects of sampling rate and boundary effects on the colour-density relation
 - Give constraints on galaxy evolution in semianalytical models

Our data: The First-Epoch VVDS redshift sample



Le Fevre et al 2005

- Purely flux limited sample:
 $17.5 \leq I_{AB} \leq 24$
- **Spectroscopic catalogue**
(Le Fevre et al. 2005):
 - **~ 7000** galaxies with secure redshifts
- **Photometric catalogue**
(McCracken et al. 2003):
 - **~ 36000** objects
 - complete up to **$I_{AB} = 24$**
- **Dimensions:**
 - sky area of **$0.7 \times 0.7 \text{ deg}^2$**
 - **$\sim 40 \times 40 \text{ h}^{-1} \text{ Mpc}$**
at $z=1.5$



Environment: density contrast

Cucciati et al 2006

3D galaxy density contrast
(spherical or cylindrical volumes):

$$\delta(r,R) = \frac{\rho(r, R) - \overline{\rho(r)}}{\overline{\rho(r)}}$$

$$\rho(r) = \sum \frac{m_i W(|r-r_i|, R)}{\Phi_i}$$

$W(r,R)$ → filter

m → weighting function

Φ → selection function

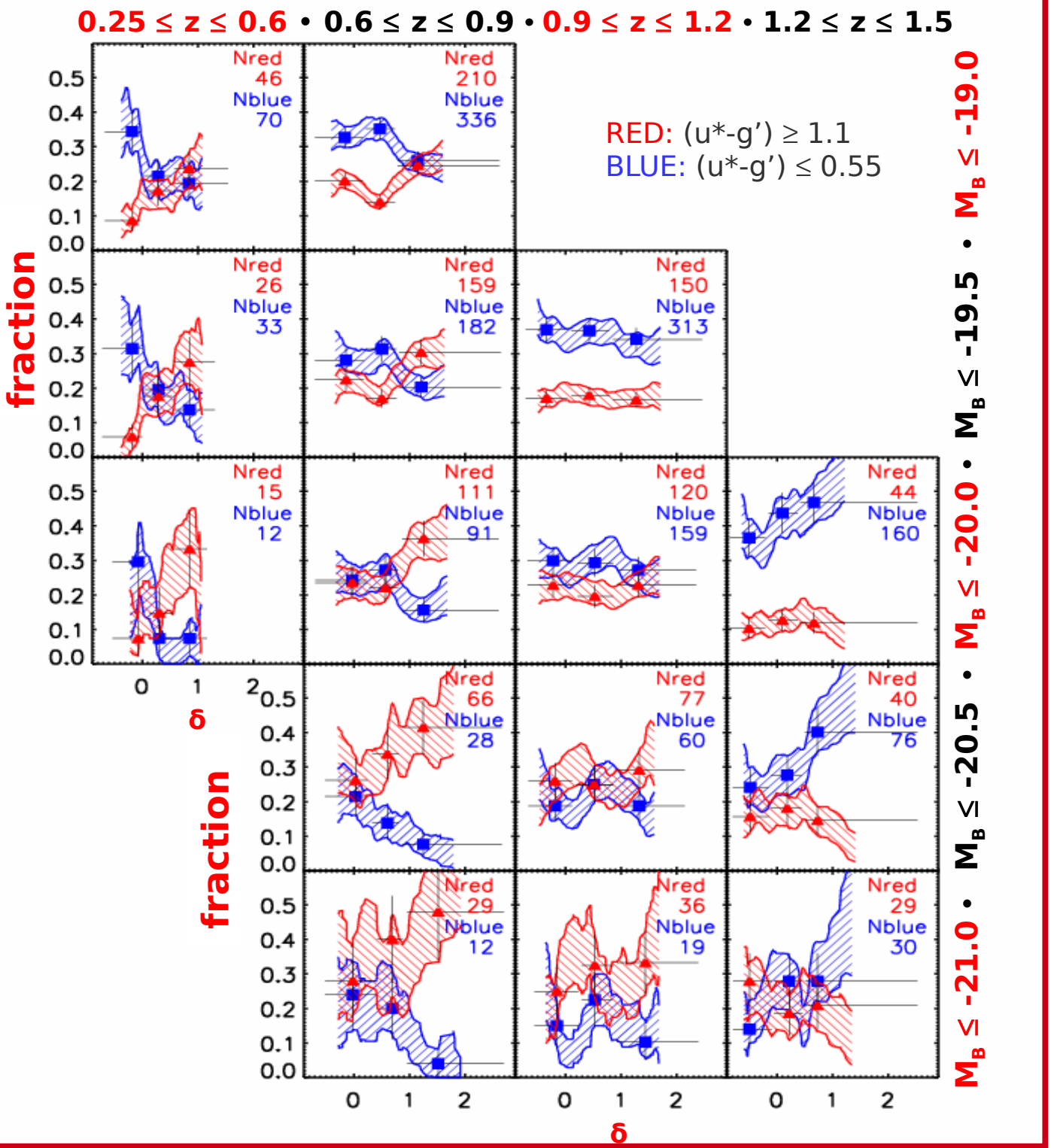
R → filter radius

**Density reconstruction reliability
tested with simulations**

VVDS data: Colour-density evolution

Cucciati et al 2006

Density has a role
to play in
determining
galaxy colours at
fixed
redshift/luminosity



Mock galaxy catalogues

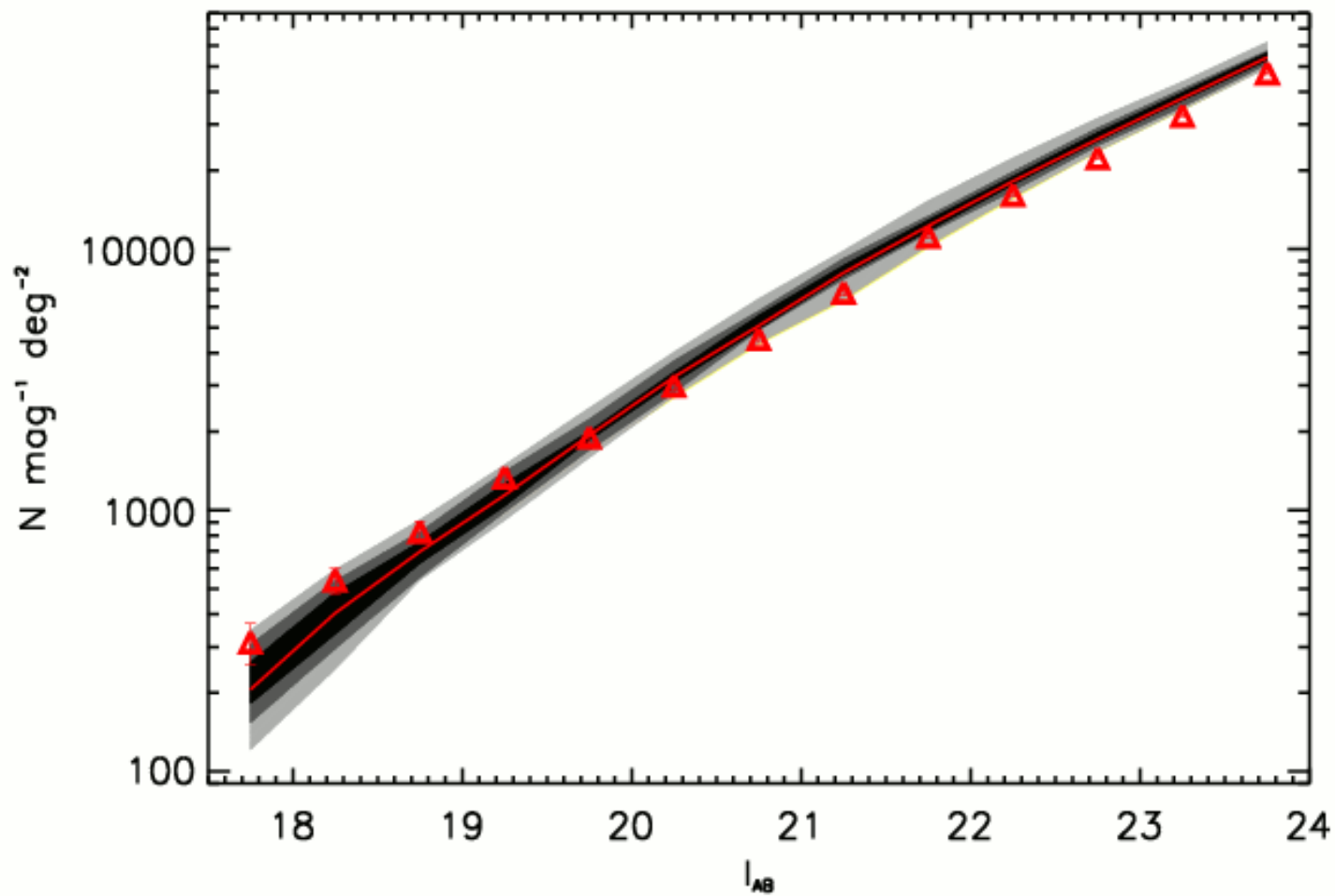
MILLENNIUM DM simulation (Springel et al 2005)

Semianalytical models of galaxy evolution from De Lucia & Blaizot 2007

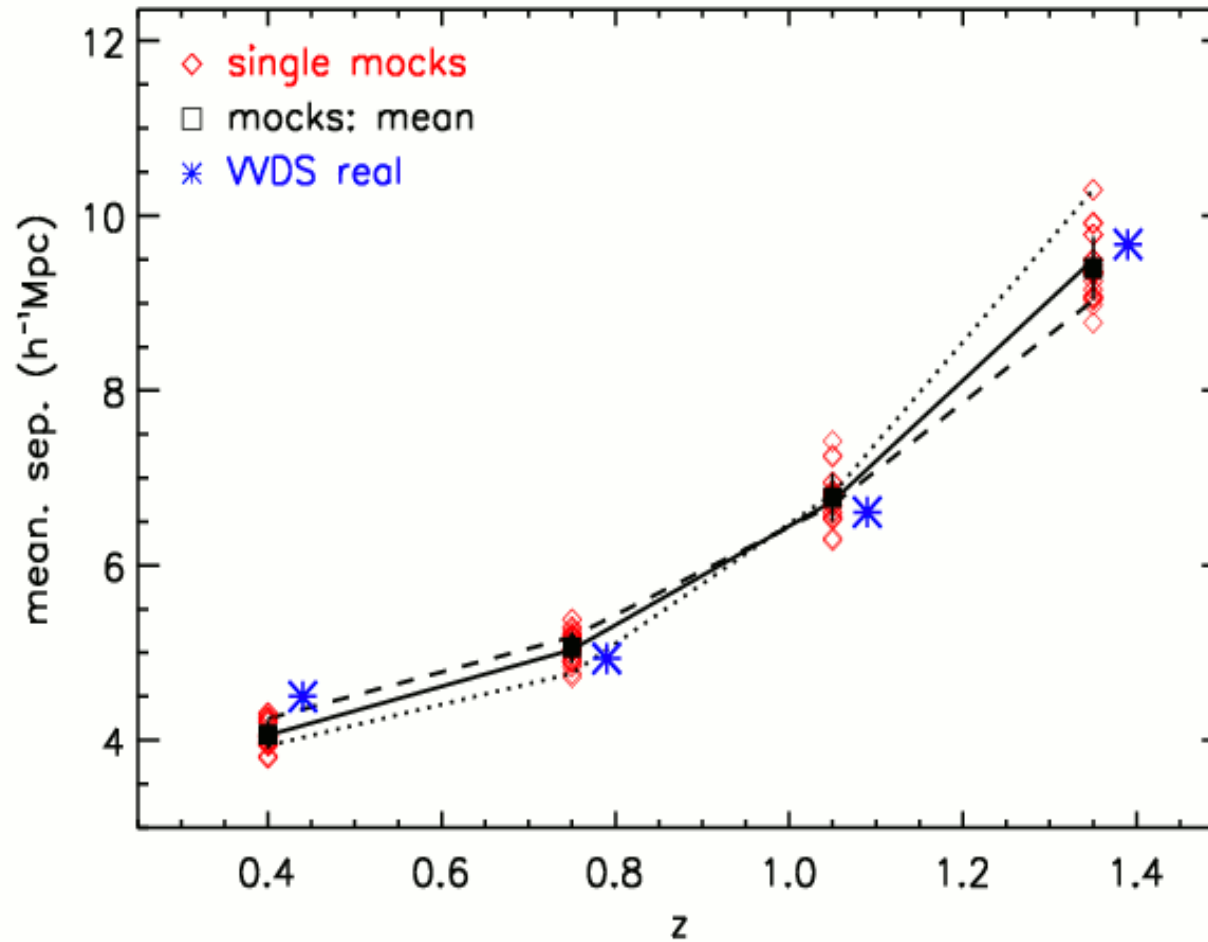
Light cones:

- 1) catalogues defined with the same limiting flux and sky area as VVDS → **full mock catalogues**
- 2) Applying the whole observational pipeline of the VVDS to the parent catalogues → **VVDS-like mock catalogues**

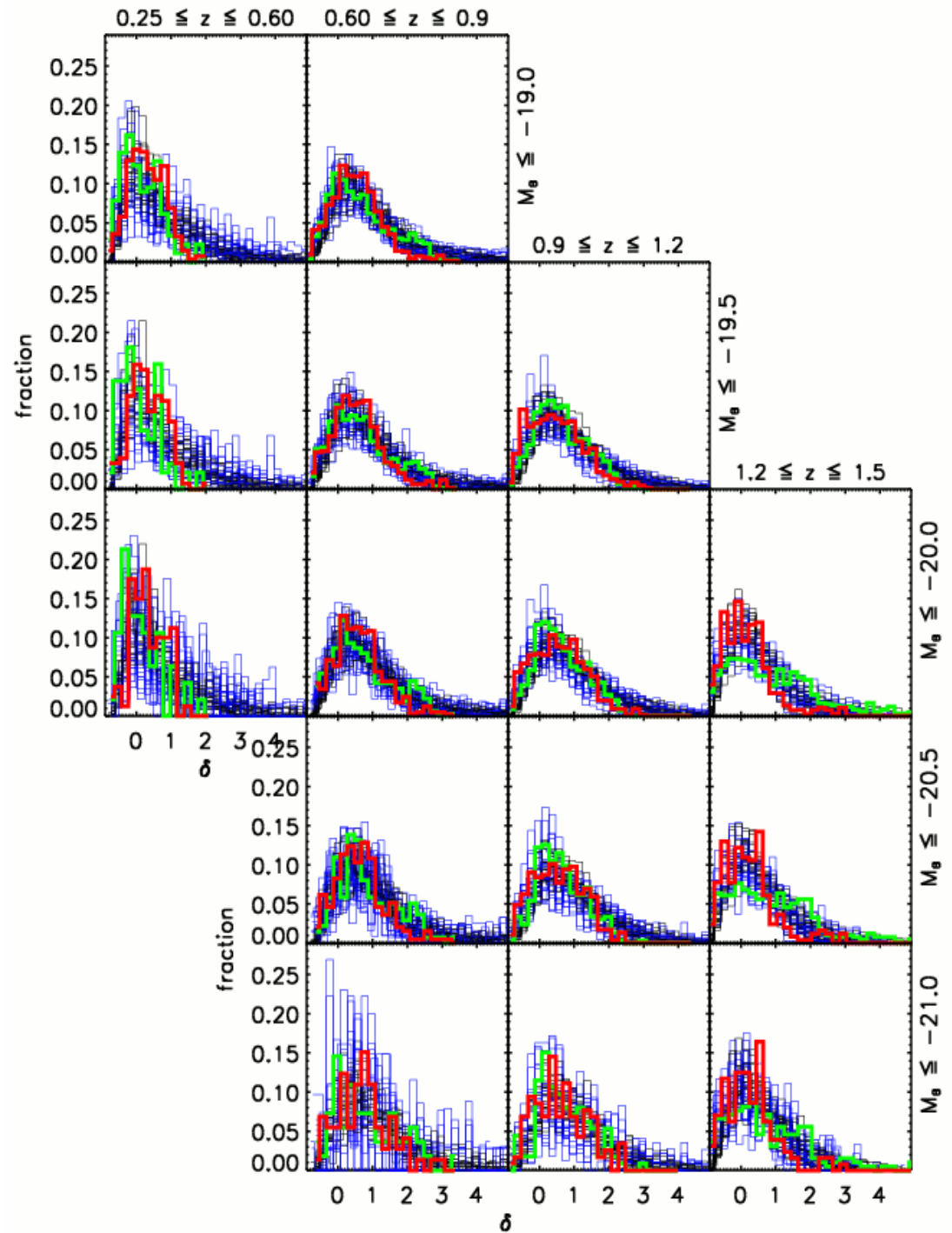
Number counts



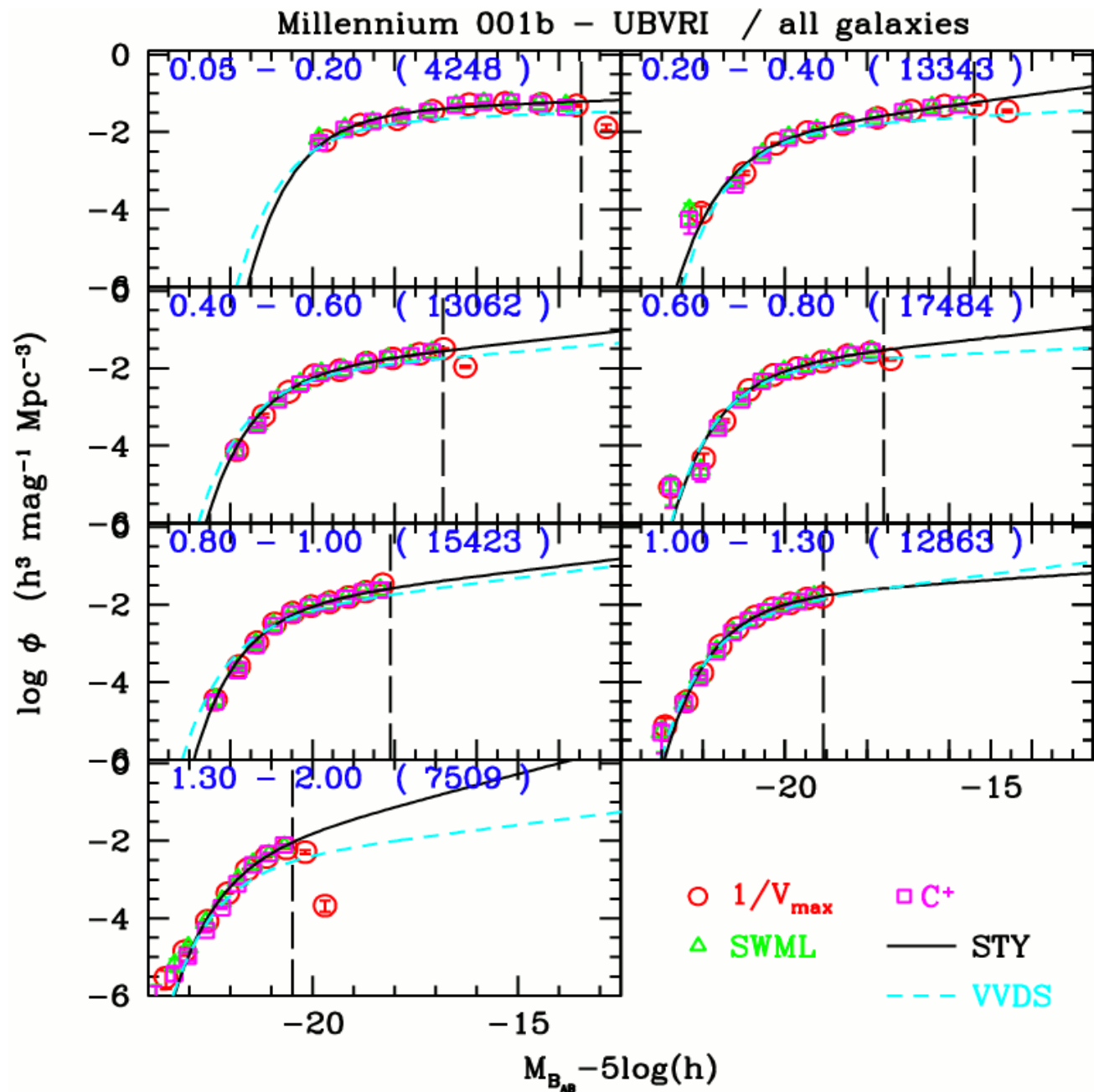
Mean inter-galaxy separation



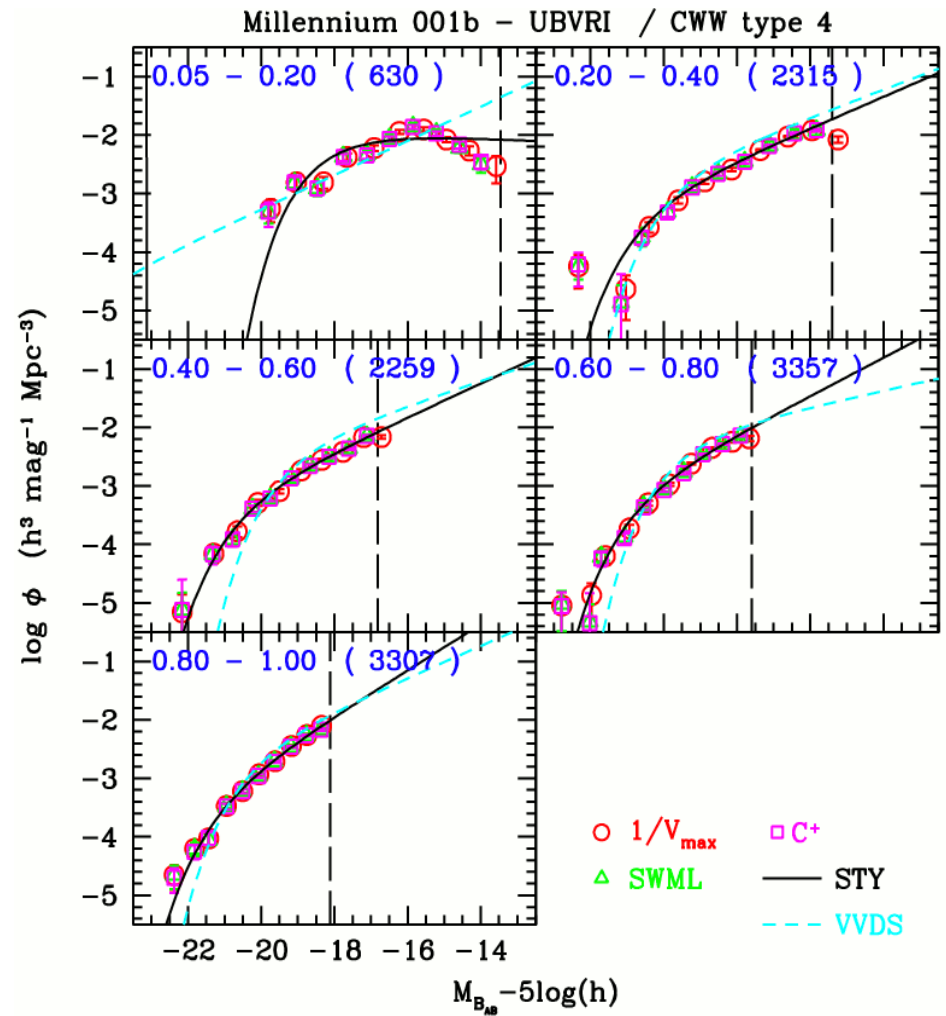
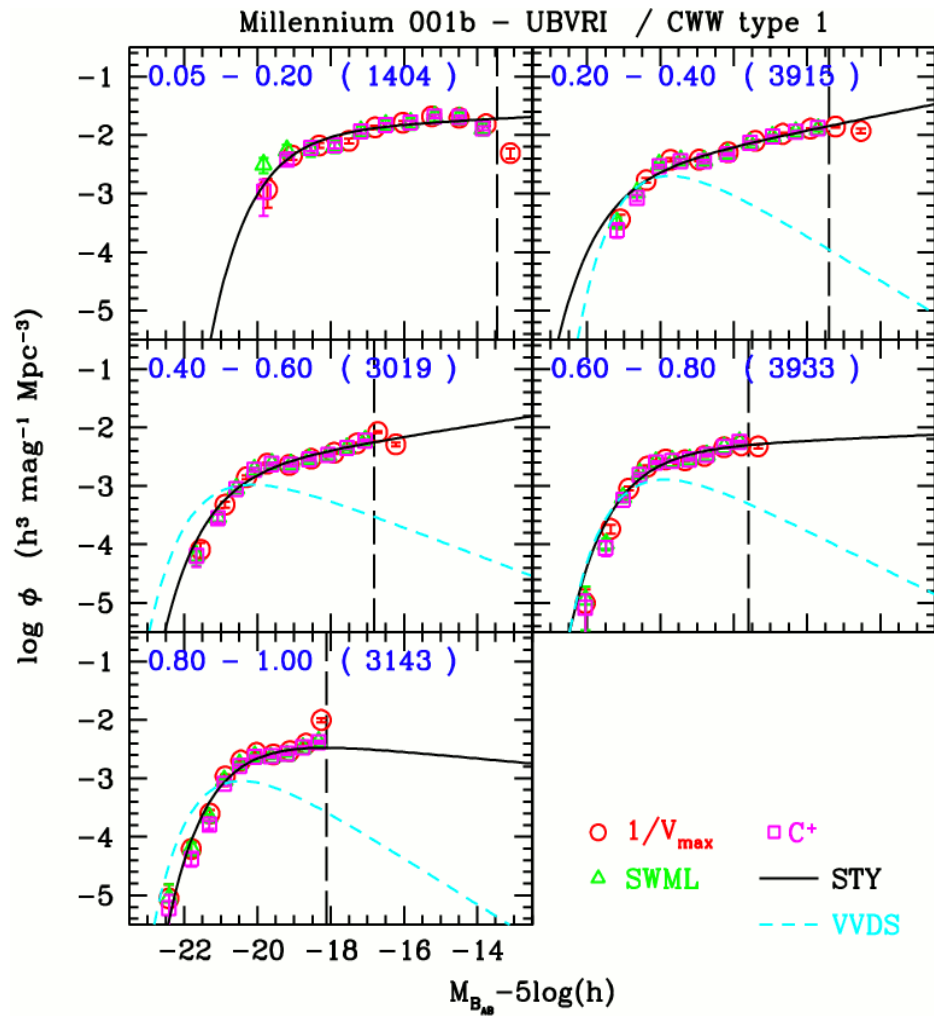
The density distribution



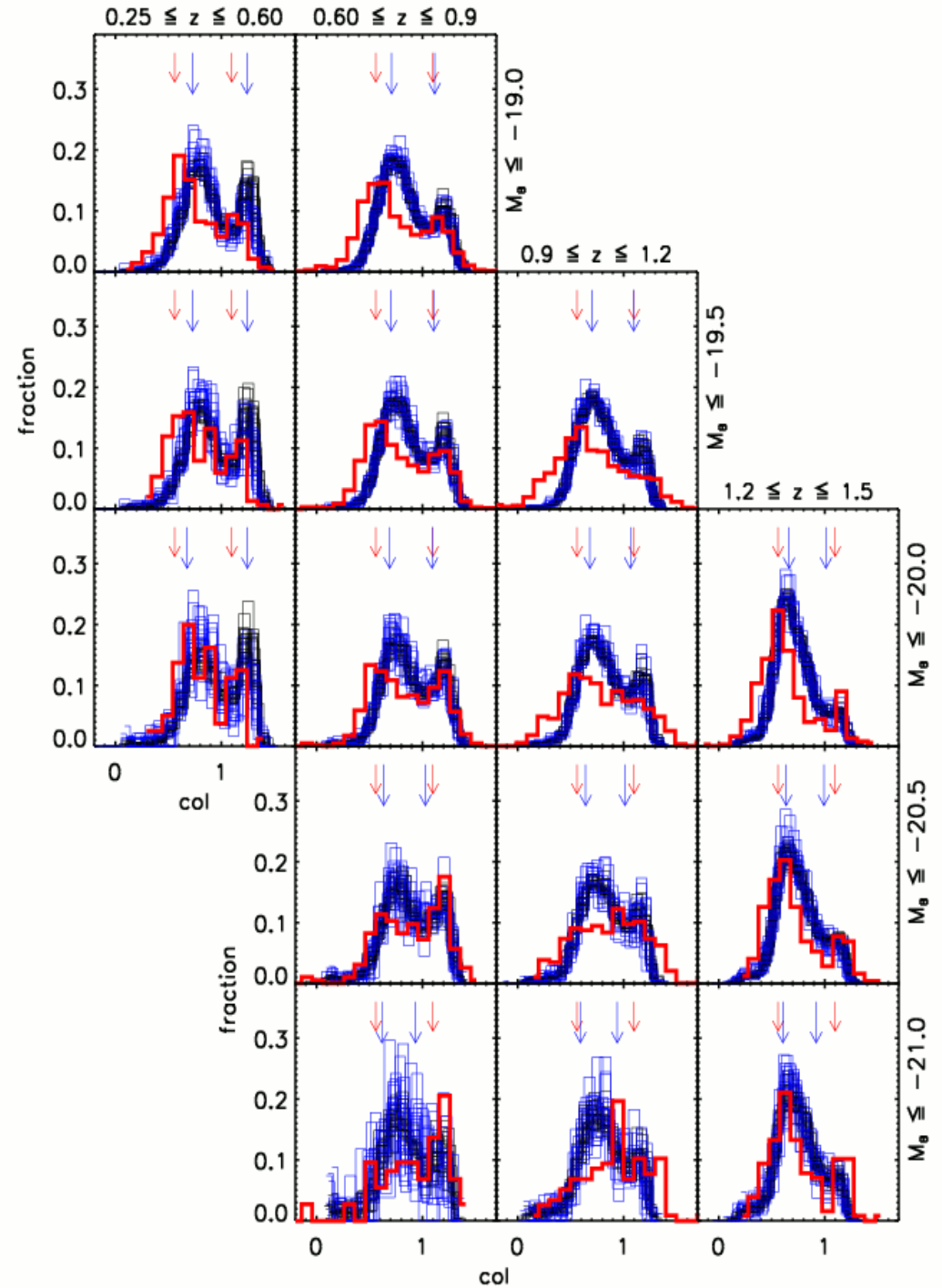
Luminosity and colours: the LF



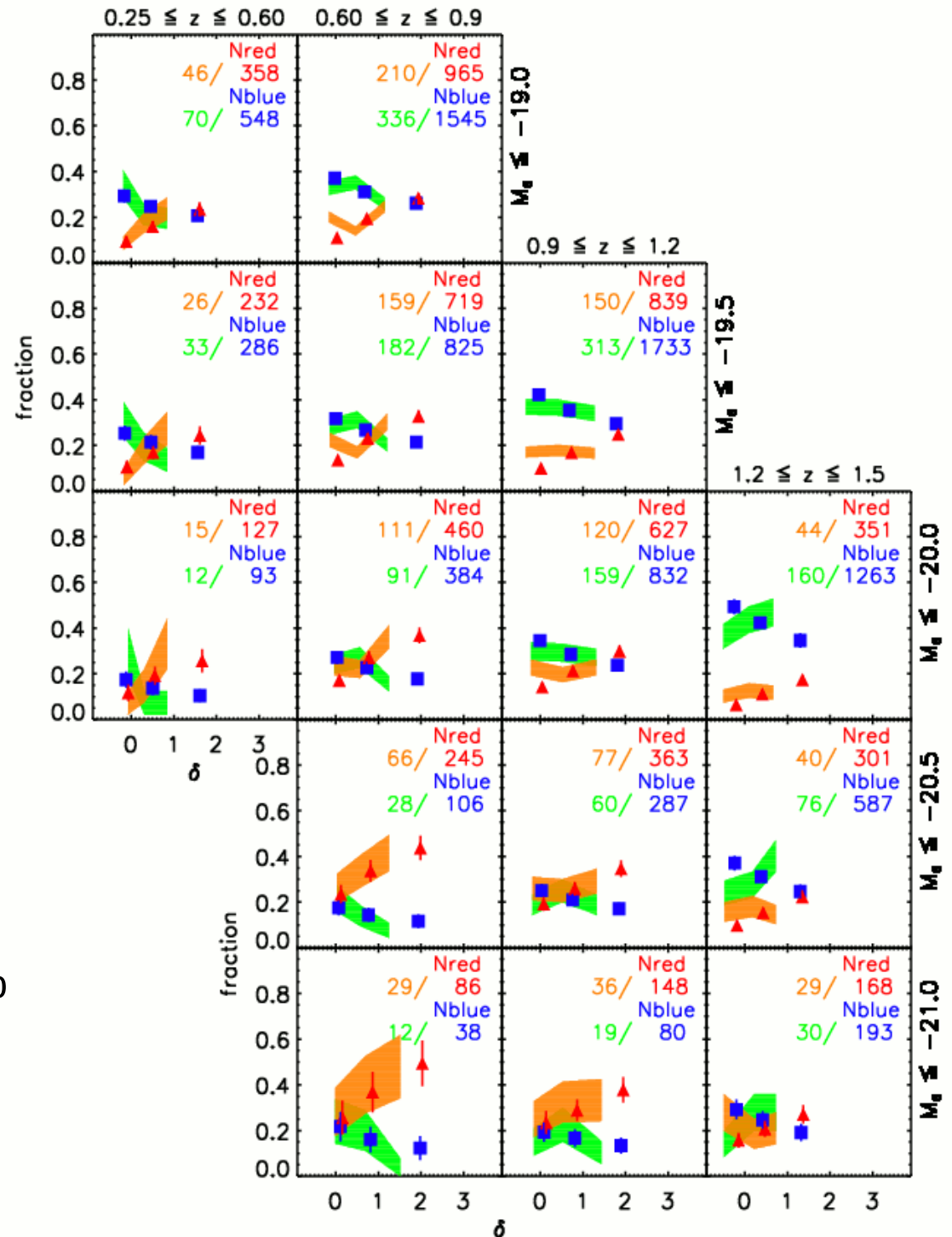
Luminosity and colours: the LF



The colour distribution



Colour-density relation in mocks

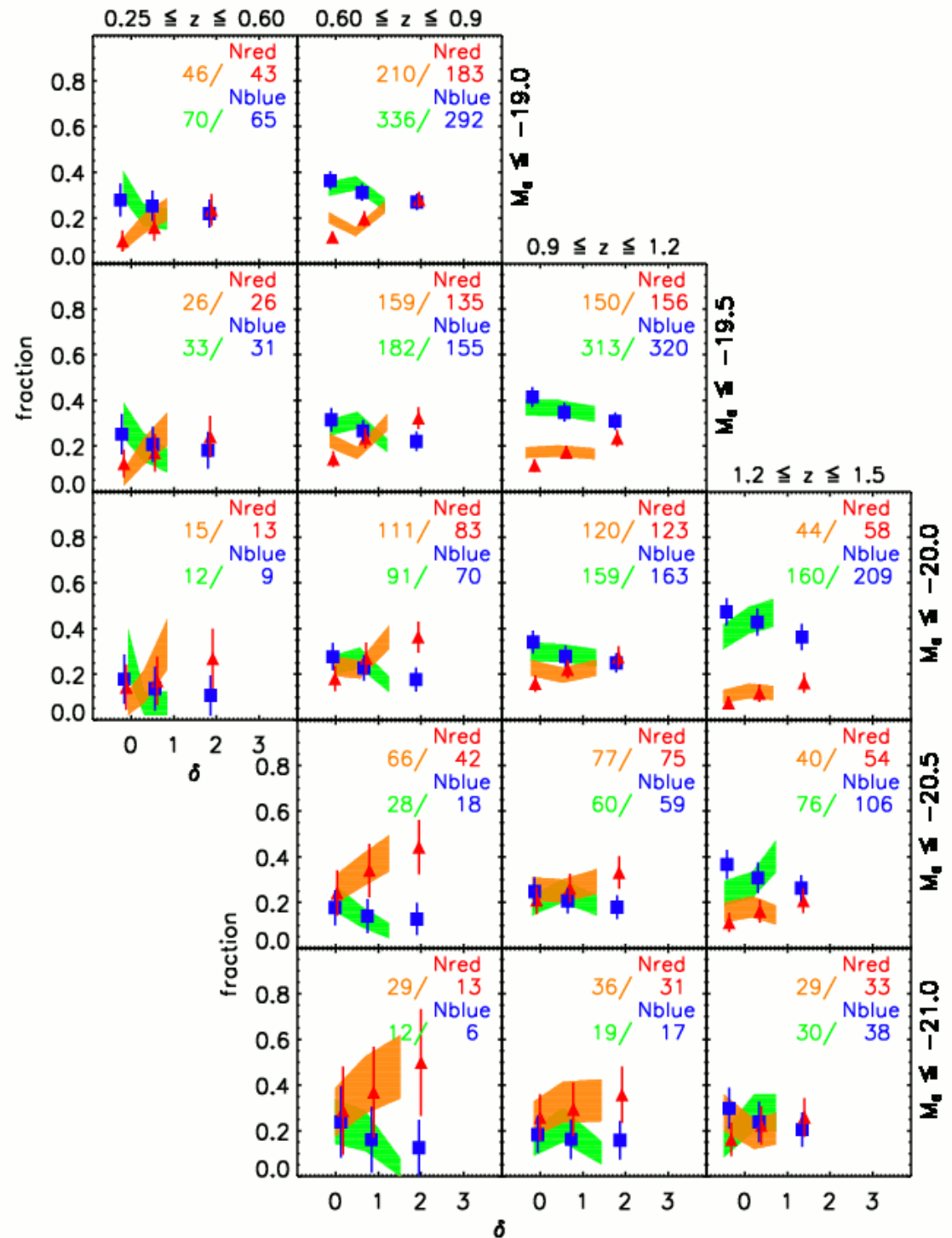


Full mock catalogues

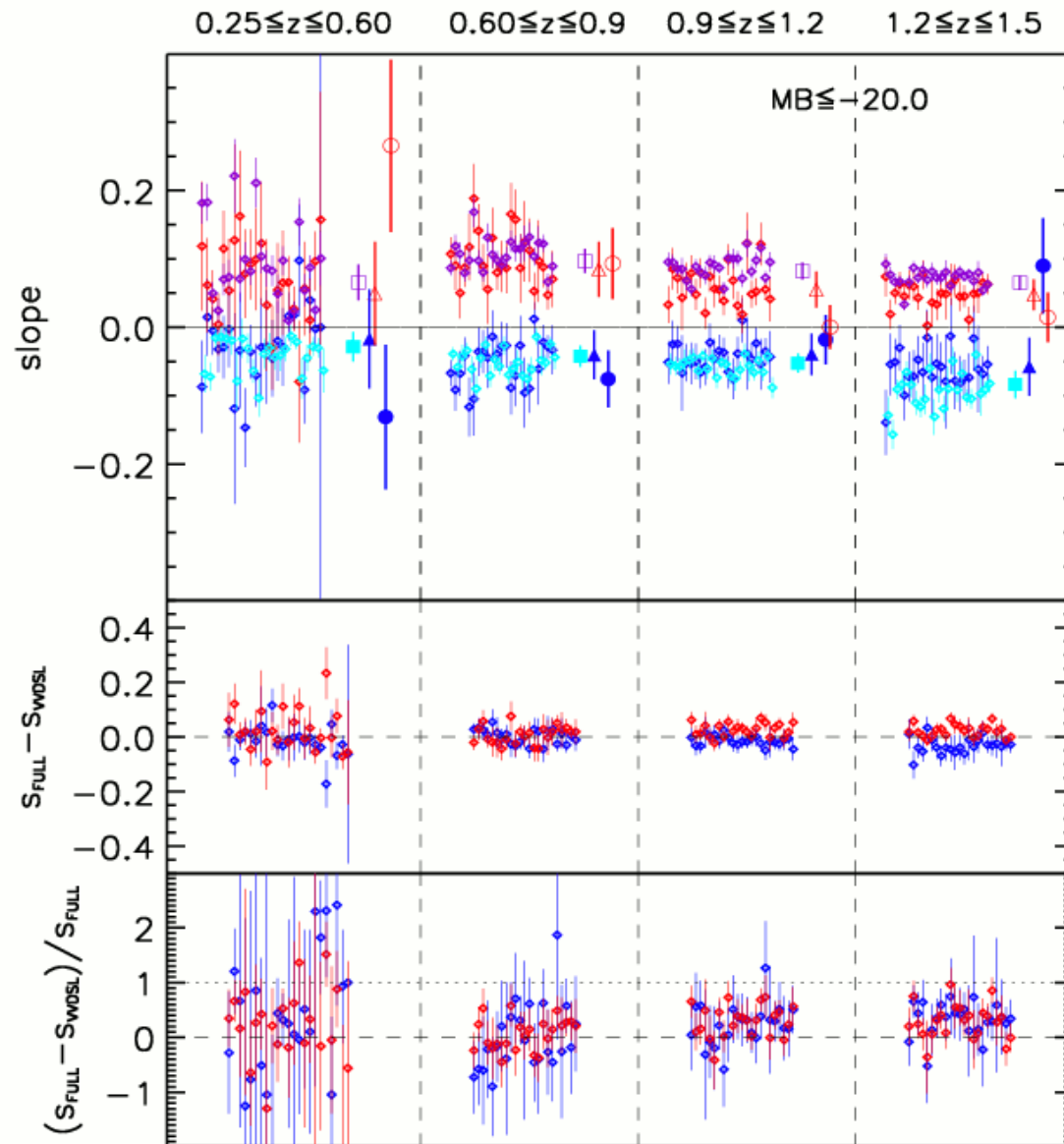
Cosmic variance: from $\sim 15\%$ at $z \sim 0.3$ to $\sim 4\%$ at $z \sim 1.3$

Colour-density relation in mocks

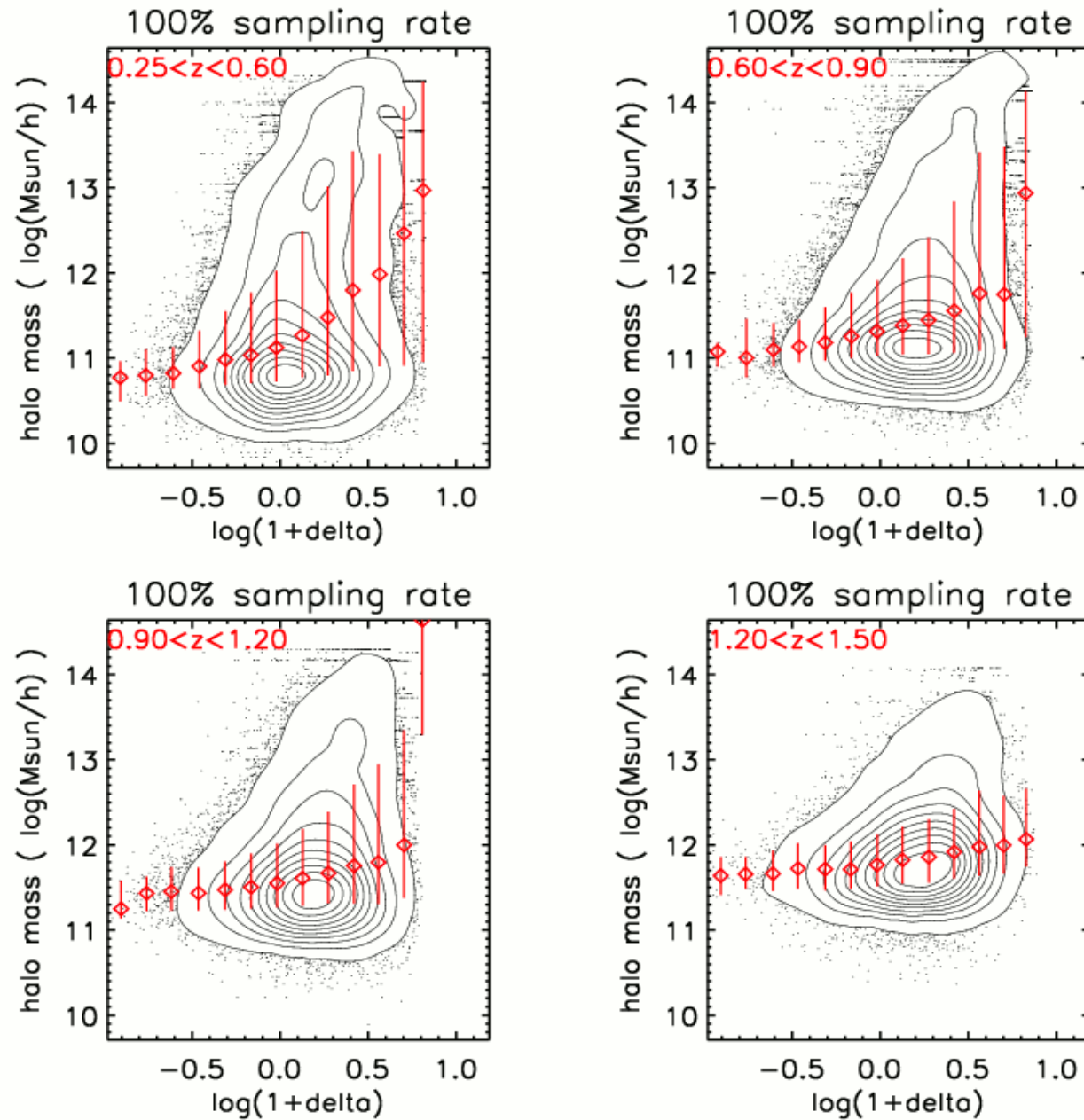
VVDS-like mock catalogues



The reliability of the trends



The density field vs halo mass



Conclusions

- Quantify cosmic variance: from $\sim 15\%$ at $z \sim 0.3$ to $\sim 4\%$ at $z \sim 1.3$
- Corrections for $< 100\%$ sampling rate and for boundaries effects do not have effects on the general dependence of the fraction of red and blue galaxies on environment (positive or negative slope)
- At $z < 1.2$, the colour-density relation in mocks is in agreement with what we find in the VVDS, but it is the opposite at $z > 1.2$ (at least for blue galaxies)
 - Next step (1): understand which galaxy population drives this trend in simulations
 - Next step (2): understand the meaning of environment on different scales
 - ...