Photometric Redshifts for the NSLS

[Northern Sky Legacy Survey]

S Arnouts (LAM)

Main Goals

- To provide an optical survey to complement the Euclid NearIR + riz photometry in the Northern Sky.

- To design a survey optimal for photometric redshifts of sources down to riz~24.5.

But with additional constraints:

- can be perform with MegaCam as is
- must fit in a "reasonable" amount of time

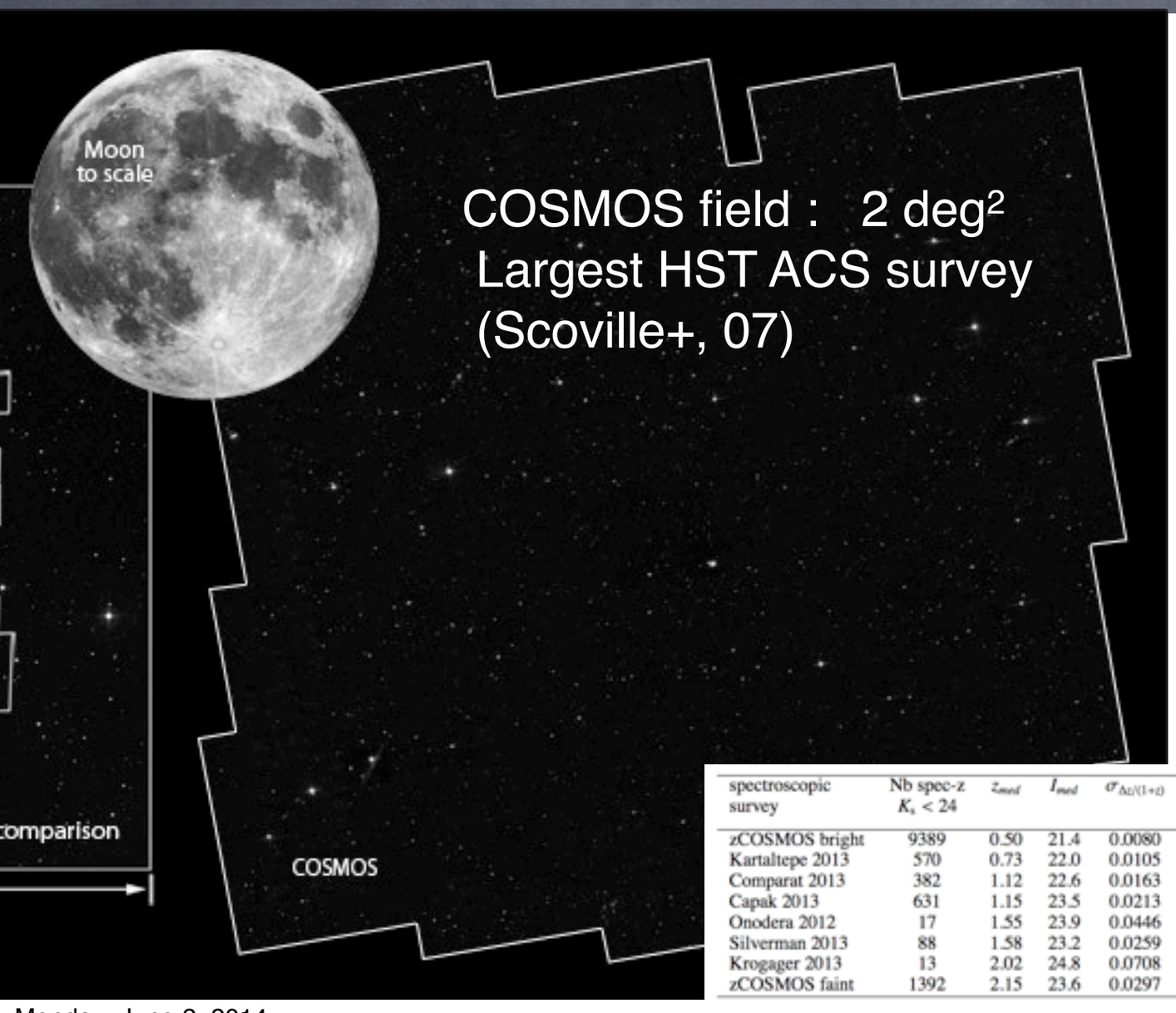
⟶ choice of filter set and depth ?

Strategy

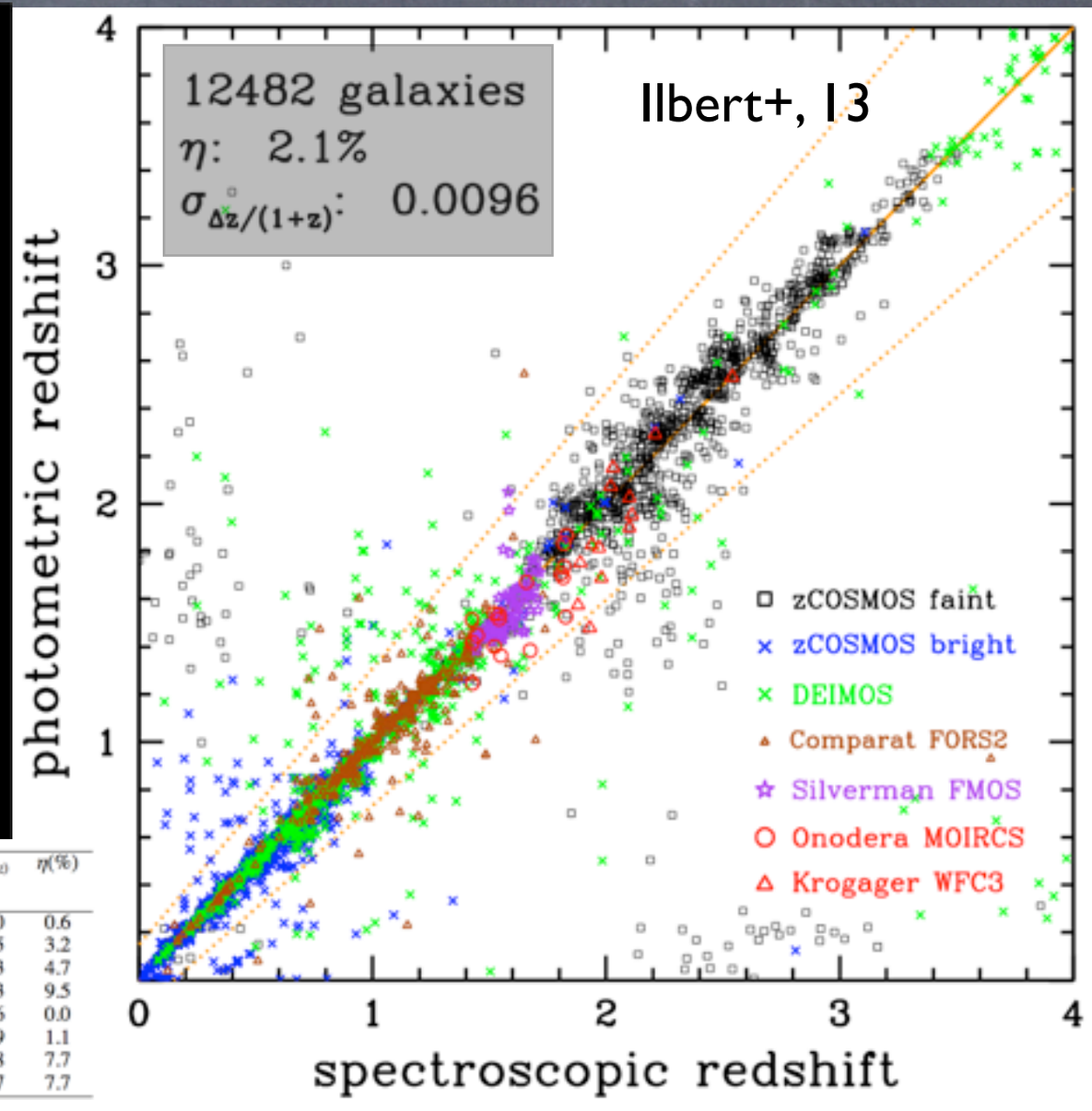
to build simulated catalogs based on the COSMOS Field (Jouvel+, 11)

- Multi-wavelength dataset with 30 filters from Far-UV to Mid-IR
- Large & Deep: diversity and representative of various environments
- Highly accurate Photometric Redshifts (Large spectroscopic sample)

⇨ It allows us to explore the population that will be seen by Euclid



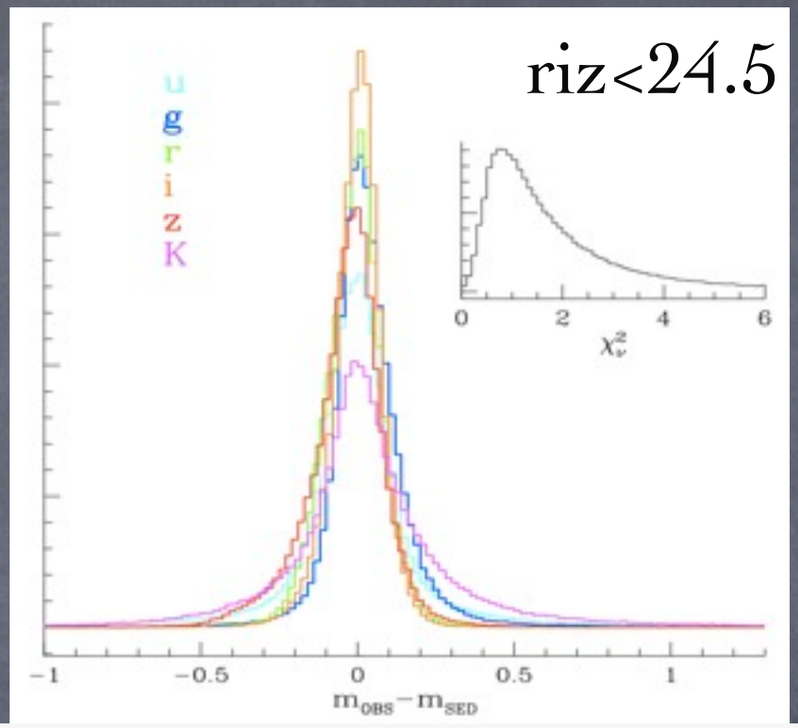
spectroscopic survey	Nb spec-z $K_s < 24$	z_{med}	I_{med}	$\sigma_{\Delta z/(1+z)}$	$\eta(\%)$
zCOSMOS bright	9389	0.50	21.4	0.0080	0.6
Kartaltepe 2013	570	0.73	22.0	0.0105	3.2
Comparat 2013	382	1.12	22.6	0.0163	4.7
Capak 2013	631	1.15	23.5	0.0213	9.5
Onodera 2012	17	1.55	23.9	0.0446	0.0
Silverman 2013	88	1.58	23.2	0.0259	1.1
Krogager 2013	13	2.02	24.8	0.0708	7.7
zCOSMOS faint	1392	2.15	23.6	0.0297	7.7

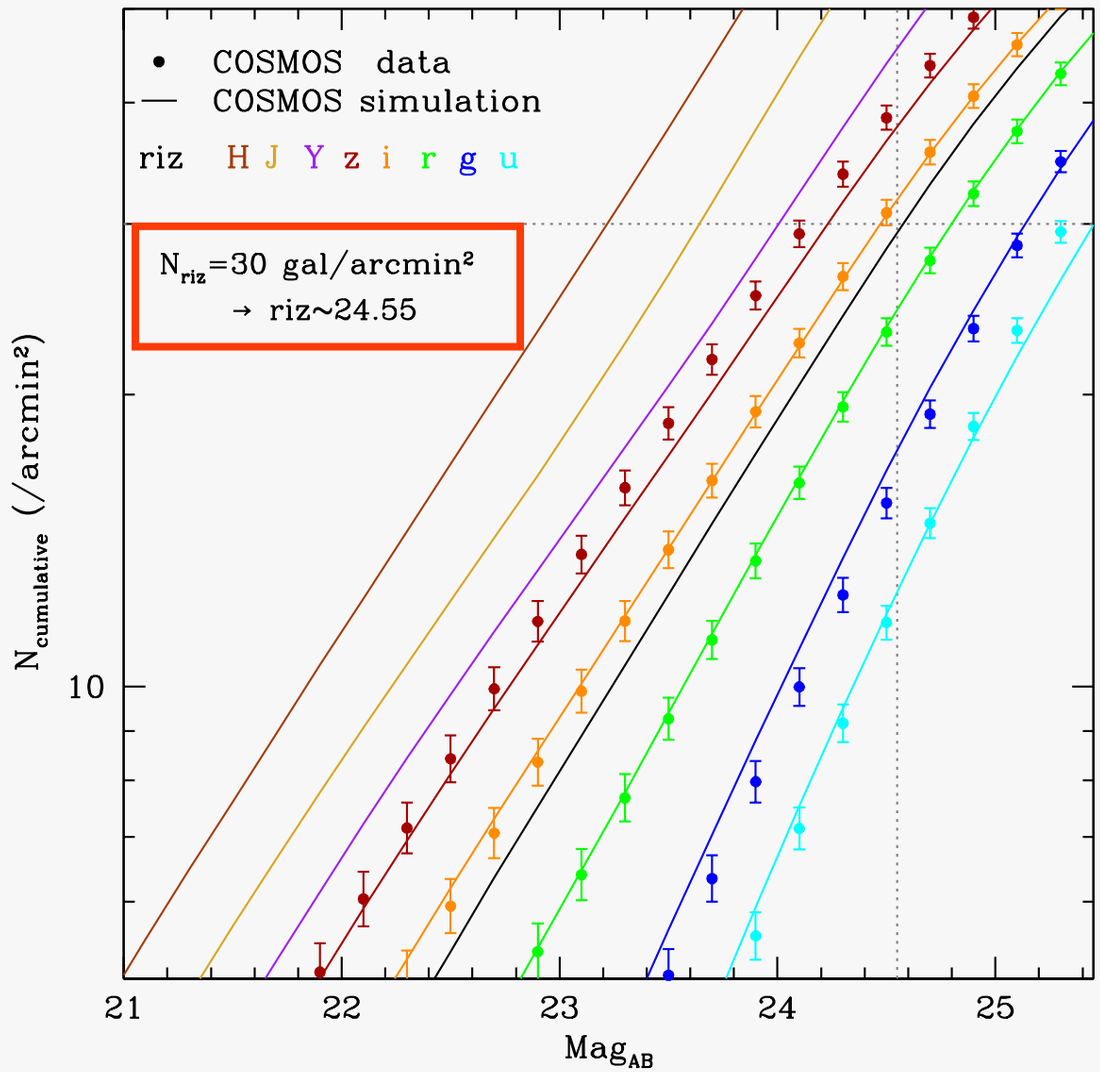


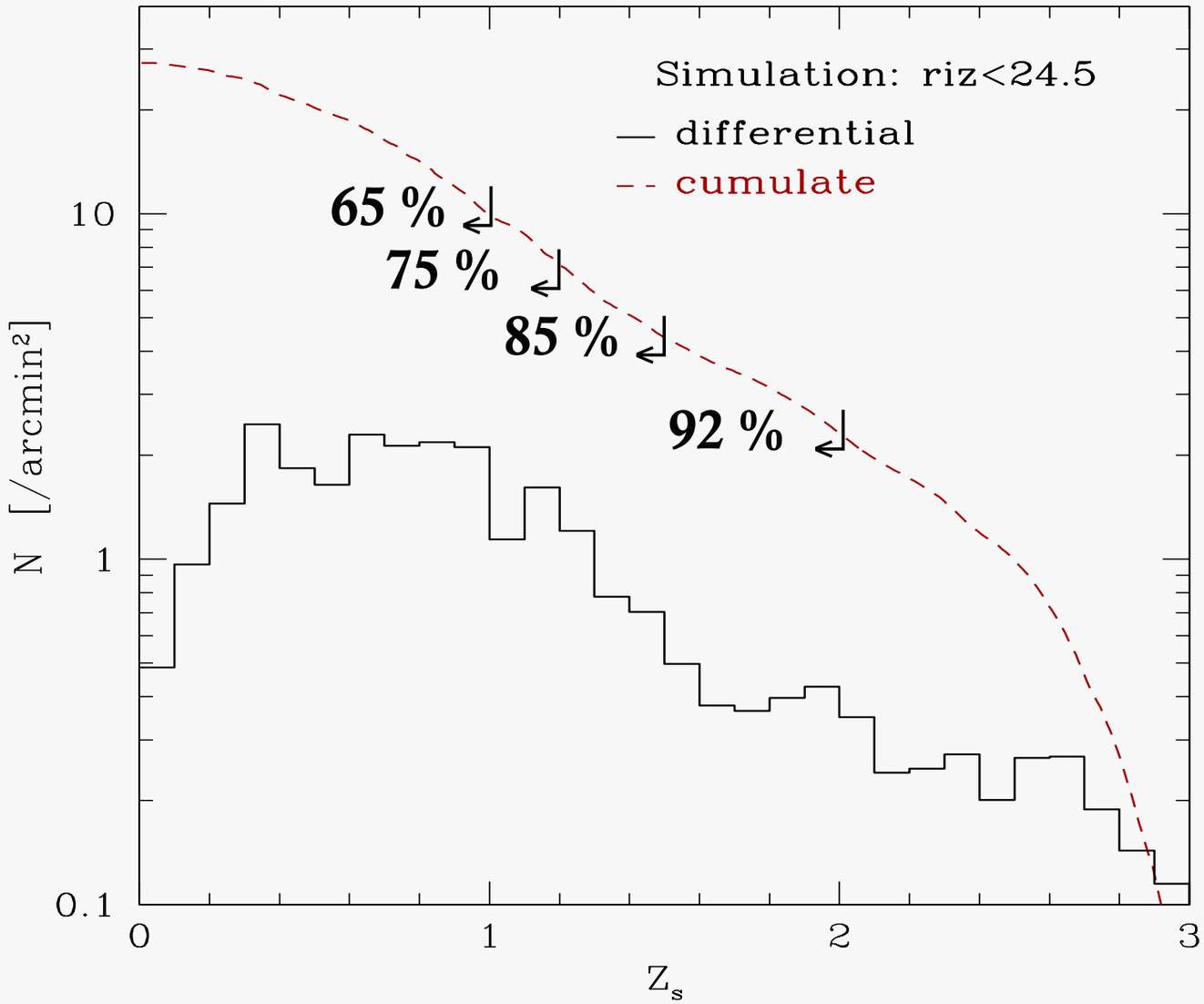
Simulated Catalogs

- Empirical SEDs with various attenuation laws are used to fit COSMOS photometry (13 broad bands) and by keeping the redshift of the sources

- Simulated catalogs generated from the modeled magnitudes in any filterset: ugriz + riz + YJH

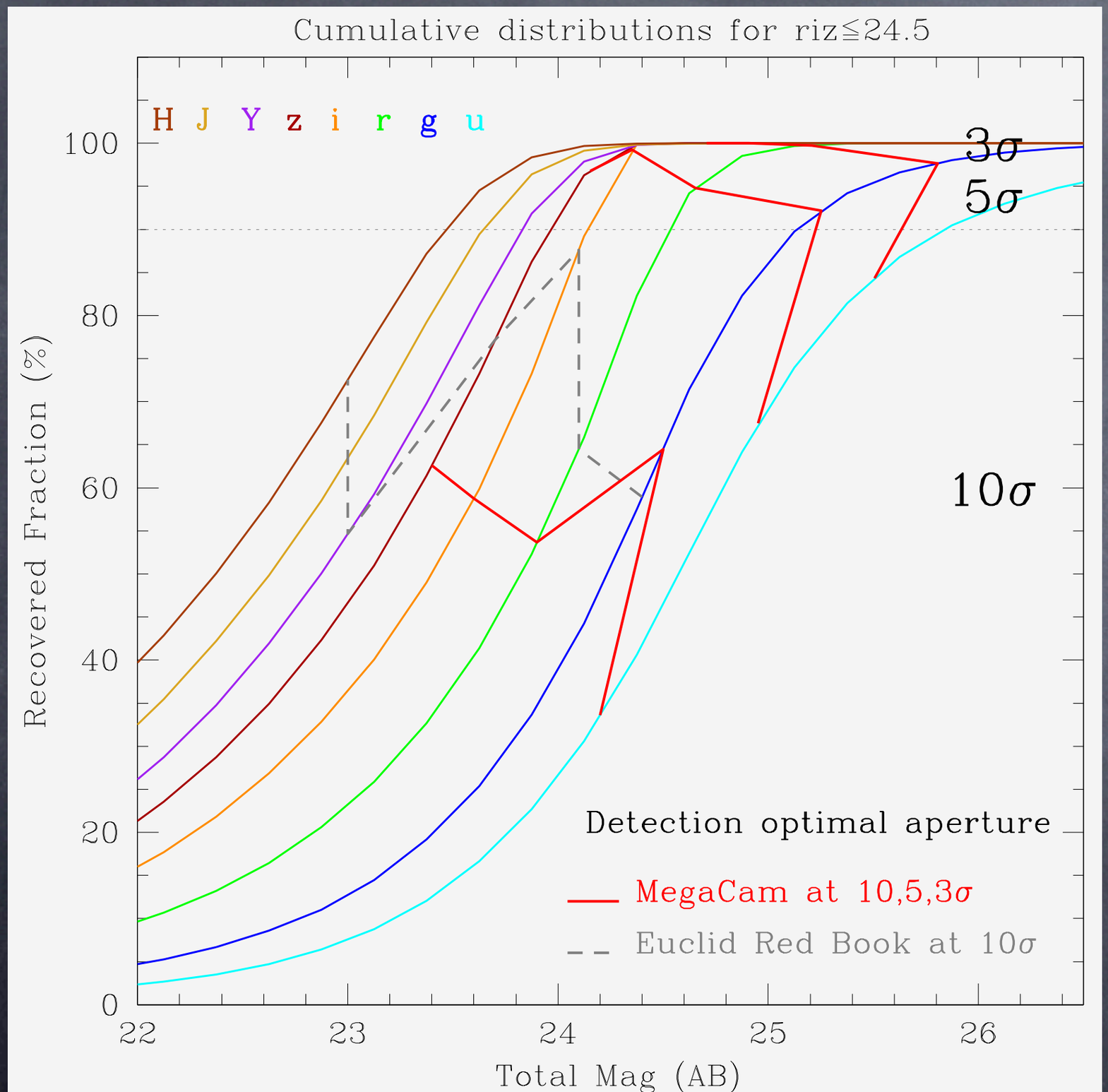






Simulated Catalogs

- **How deep do we need to go in optical ?** see JCC talk !



based on CFHT constraints we adopt this definition:

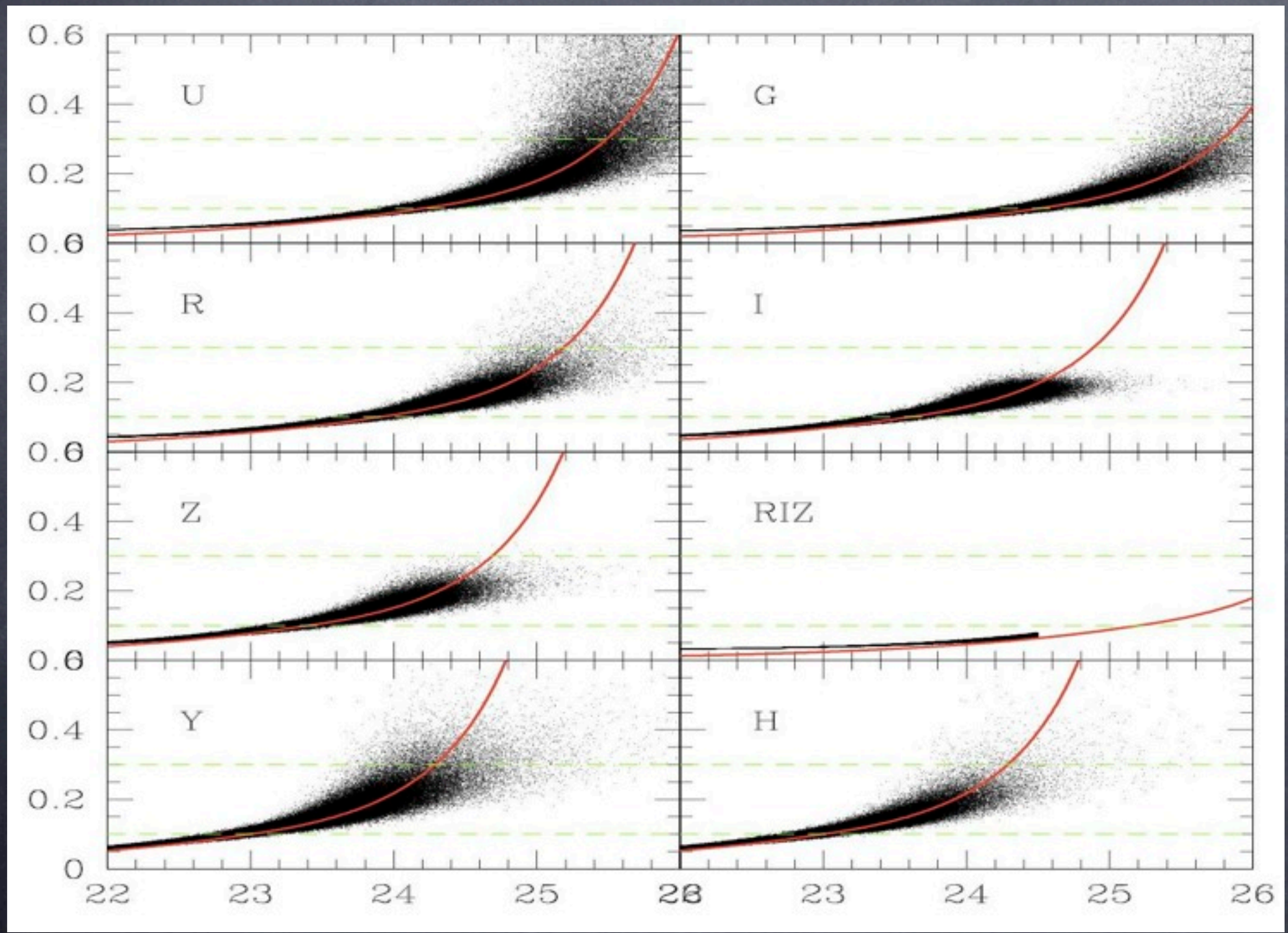
* ~60% of riz sources will be detected in griz bands with a S/N~10
  ⇨ similar to YJH !

* less than Euclid Red Book but provides a high recovery in all bands at 5 σ.

* shallower in u band (half the S/N of griz bands)

Mock Catalog

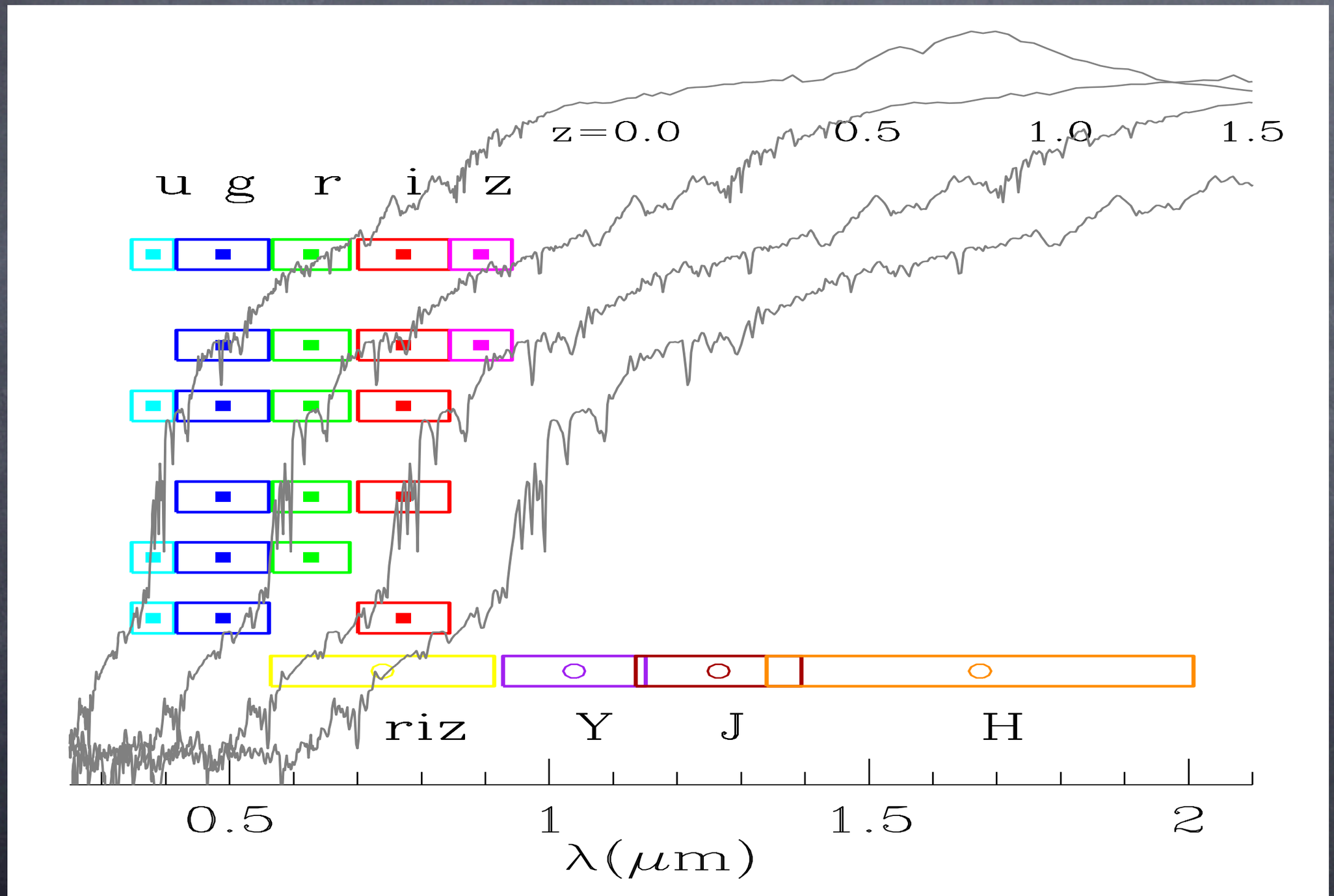
- Adopting the above constraints we generated mock catalogs with the expected S/N vs Mag
- Upper limits (defined at 5σ) are assigned for galaxies with S/N≤1



Filter	S/N~10
u	24.2
g	24.5
r	23.9
i	23.6
z	23.4
riz	25.2
Y	23
J	23
H	23

Photometric Redshifts

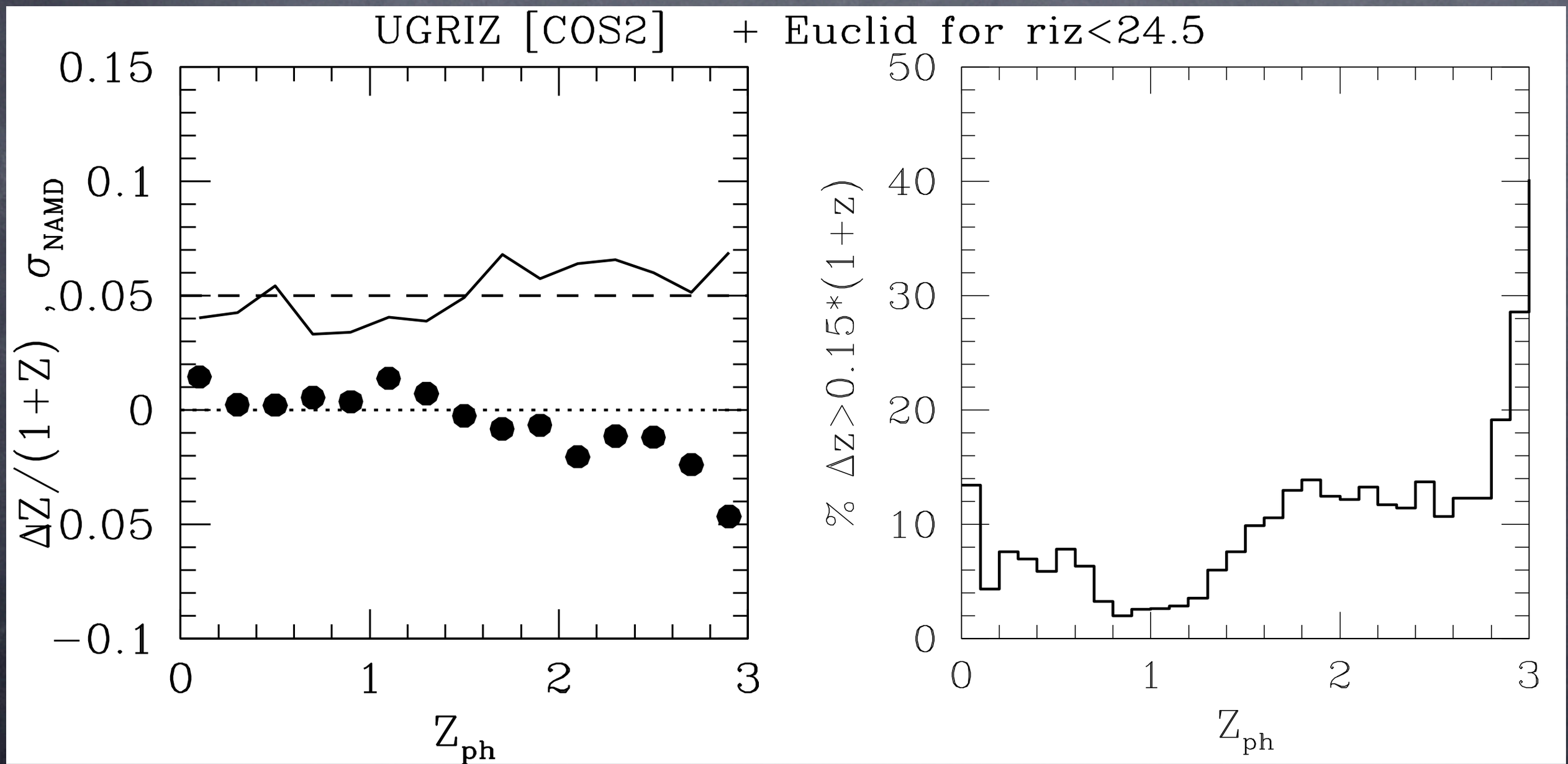
- run LePhare code with a subset of SEDs & E(B-V) reddening excess
- use Euclid configuration + different optical filter combinations



Reference catalogs : ugriz + riz + YJH

- Photo-z based on a subset of COSMOS templates (half) & less extinctions

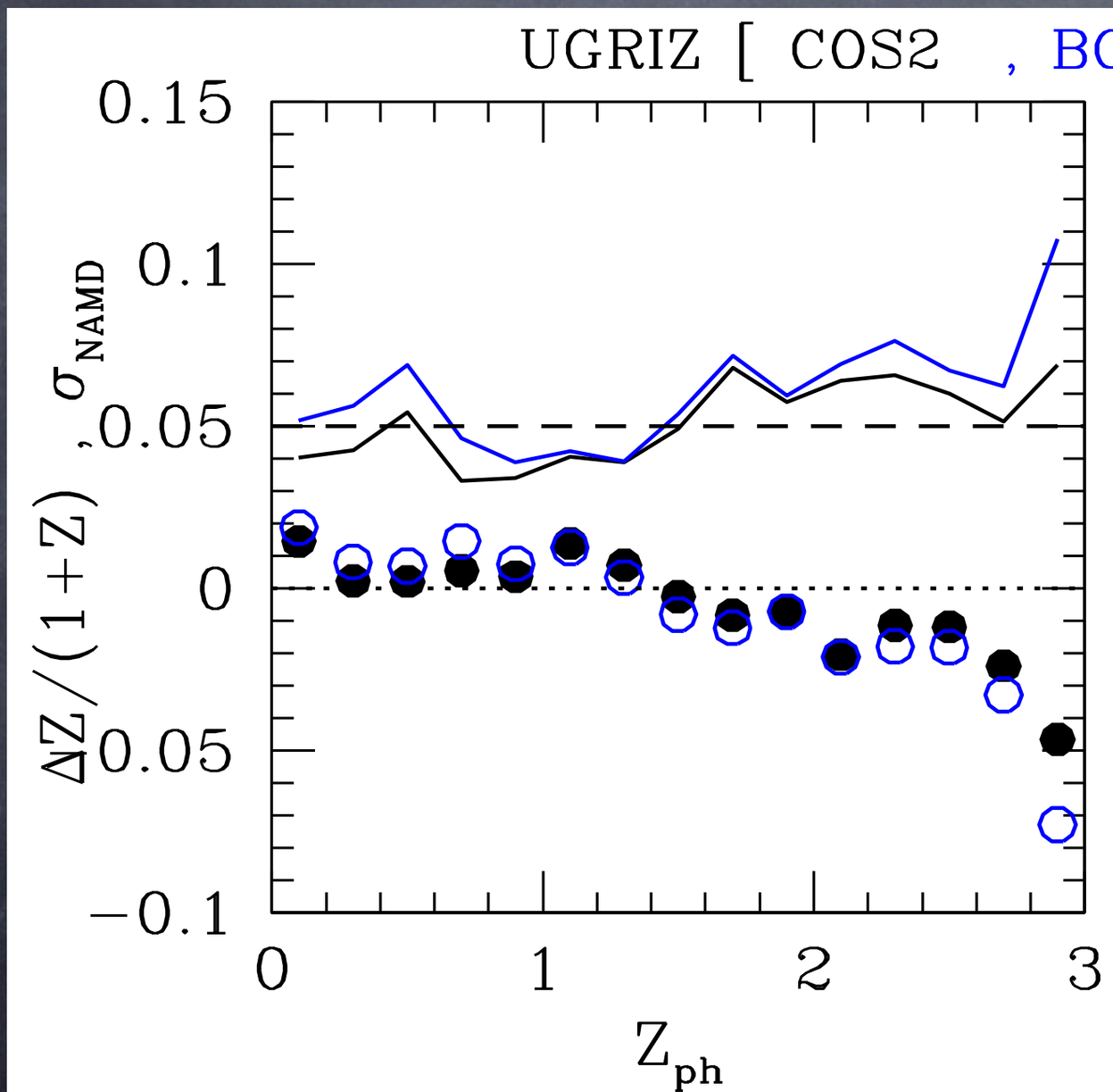
  Bias (Δz) , dispersion (σ) and fraction of catastrophic redshifts (fcat)

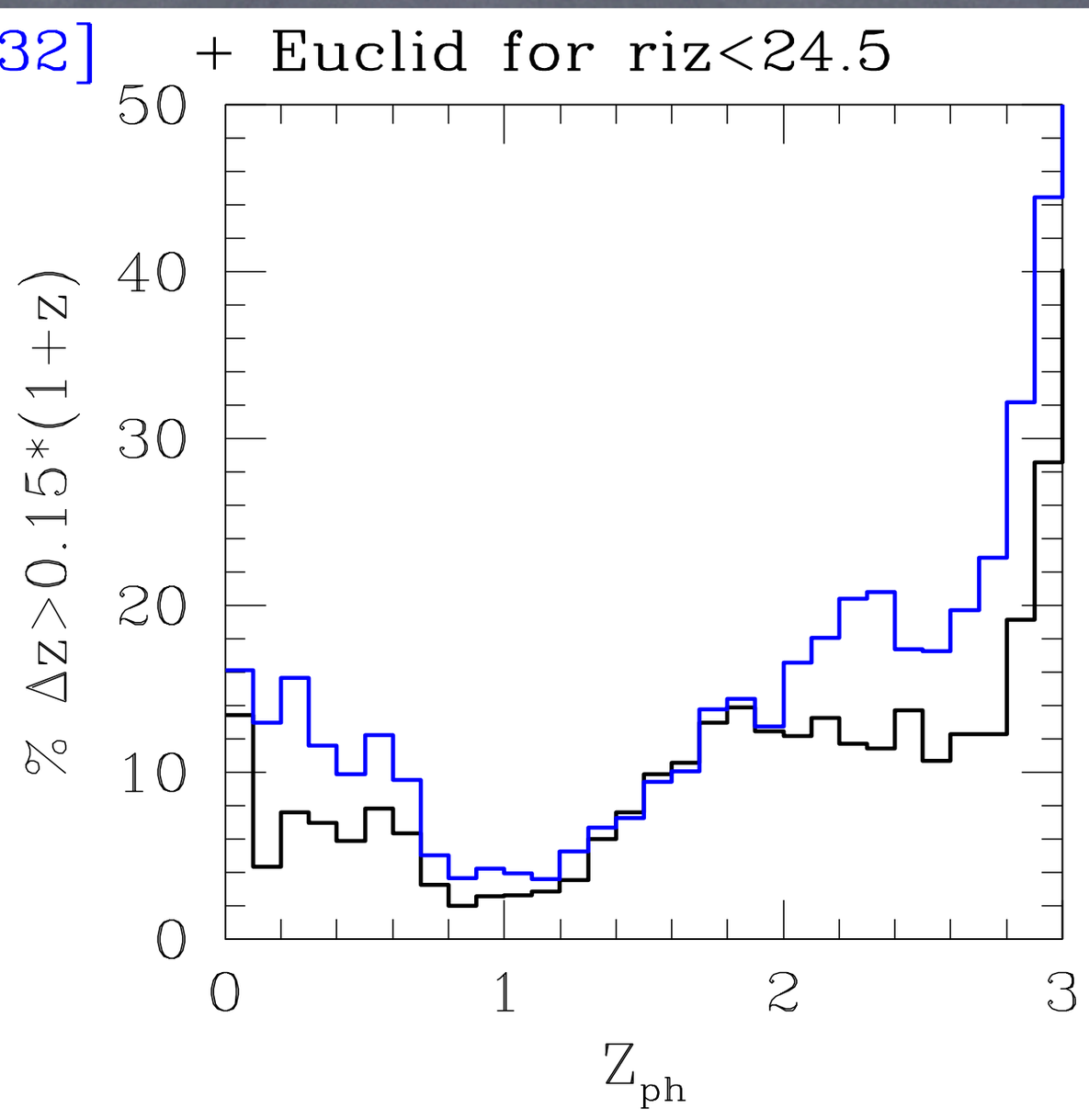


- UGRIZ + Euclid gives good results at z<1.5 (i.e. 85 % of sources) and acceptable at 1.5<z<2

Reference catalogs : impact of SEDs in Mock

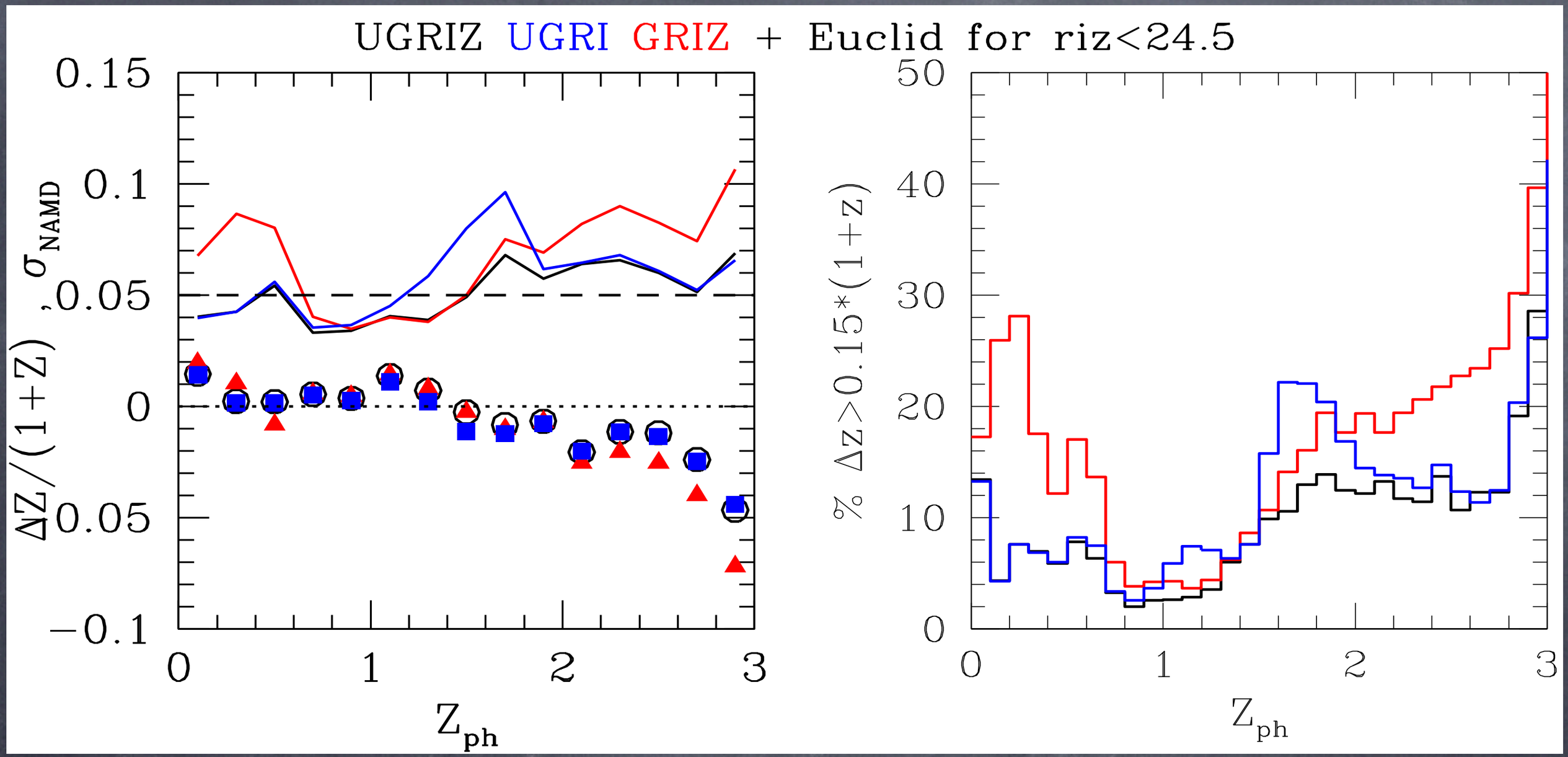
- Sensitivity of our analysis to the Input Mock Catalogs ?
  - COS SEDs based on set of empirical SEDs (Ilbert+,09)
  - BC03 SEDs from a spectro-photometric synthesis model (BC+03)





- The pessimist case still close to the Euclid requirements !

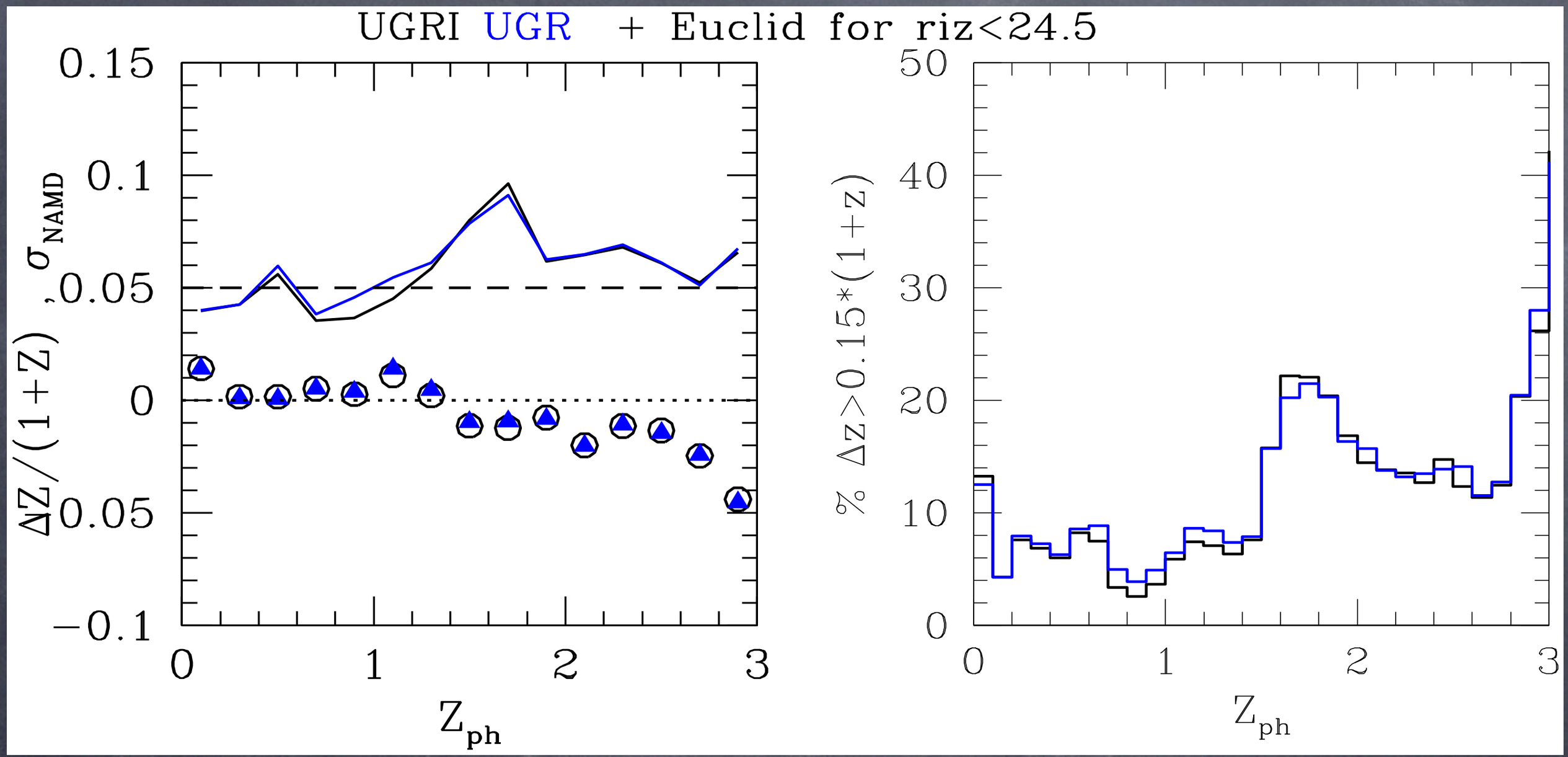
MegaCam Filterset : ugri vs griz ?



- UGRI gives excellent results at Z<1.2 (i.e. for 75% of galaxies)
  but degrades in 1.5<z<1.8 (σ>0.08, fcat>15%) before getting optimal at z>1.8

- GRIZ significantly worse at Z < 0.6 but almost optimal in 0.6 < Z < 2.0
  - High fcat. at low (Z<0.7) and high (Z>1.8) z due to the lack of u band.

MegaCam Filterset : 3 bands only ?



- UGR small increase of the scatter (σ) around z~1 but same fcat
  [(riz-r) ~ iz filter] less accurate for tracking the 4000 break

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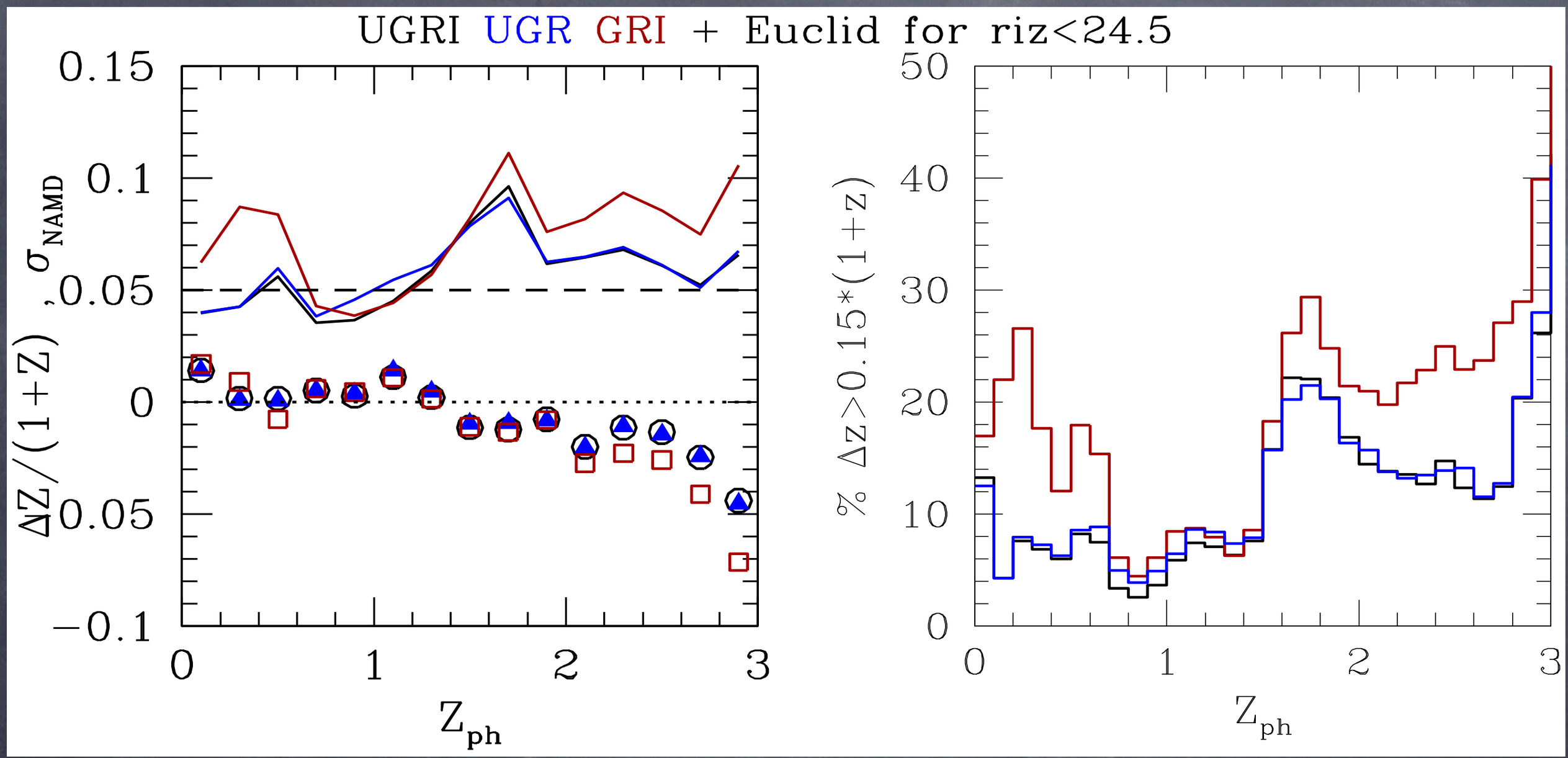

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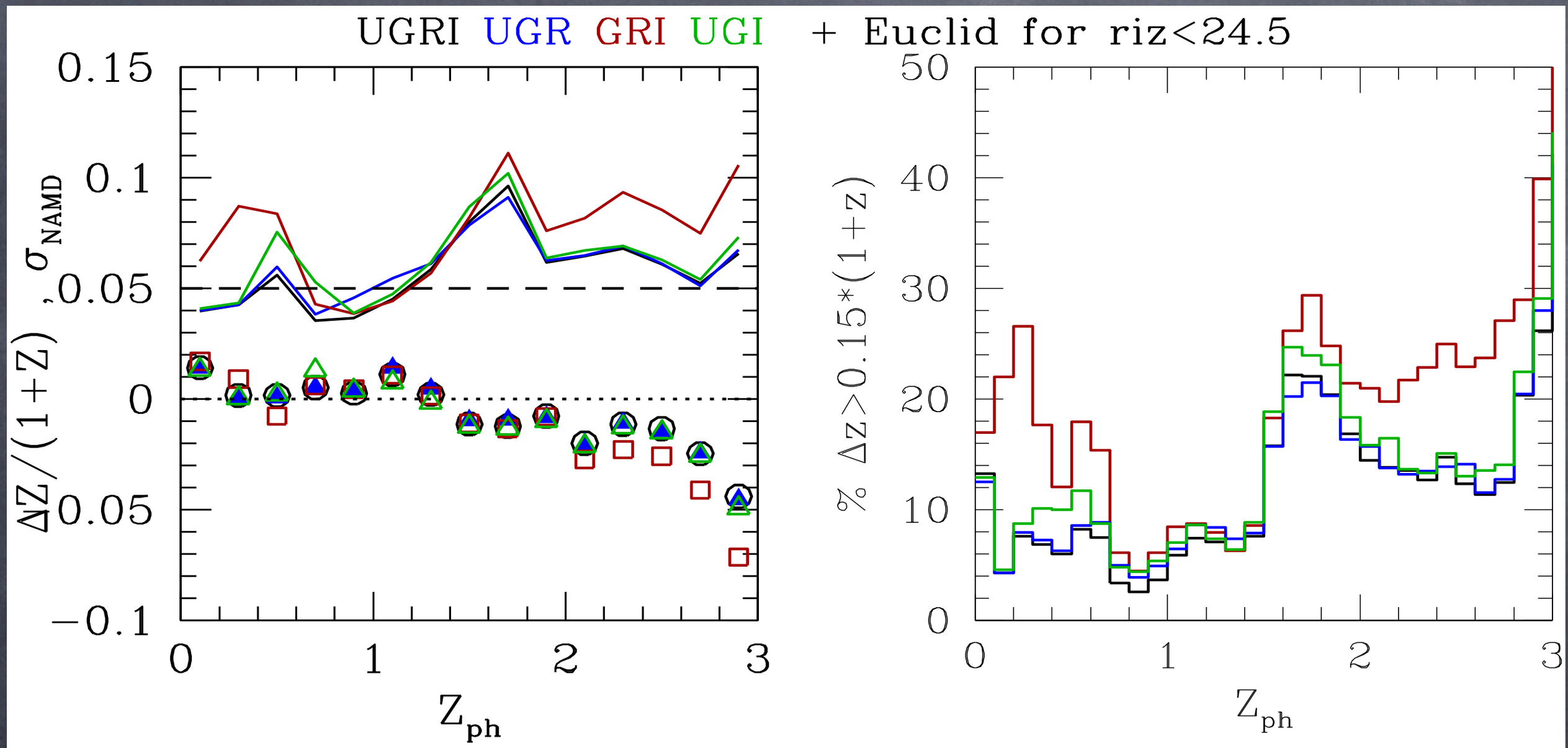

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  [(riz-r) ~ iz filter] less accurate for tracking the 4000 break
- GRI significantly worse results [lack of the u band]
- UGI close to UGR but slightly worse (σ , fcat) at low - high z (z~0.5 & 1.7)
  [(riz-i) ~ r+z filter] less meaningful information for SED

Conclusion for the NSLS

In this study we focus on the main Euclid population with riz<24.5

- GRIZ set is optimal in 0.6 < z < 2 compared to UGRIZ set.
  BUT
  - ➢ large scatter (σ) and fcat at low (z<0.6) and high z (z>2)
  - ➢ time consuming

- UGRI set is optimal at 0 < z < 1.2 and above z=1.8
  - ➢ The U band keeps the fcat low at z<1.5 (*~ 80% of the Euclid pop.*)
  - ➢ The regime 1.4<z<1.8 is more critical (*but represents <10% of the pop.*)

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- If a minimalist **3 bands** version for the NSLS is needed
  - ➢ UGR is the best (*but it will require only darkest time scheduling at CFHT*)
  - ➢ UGI as a weaker alternative (*easier to schedule*)

Conclusion for the NSLS

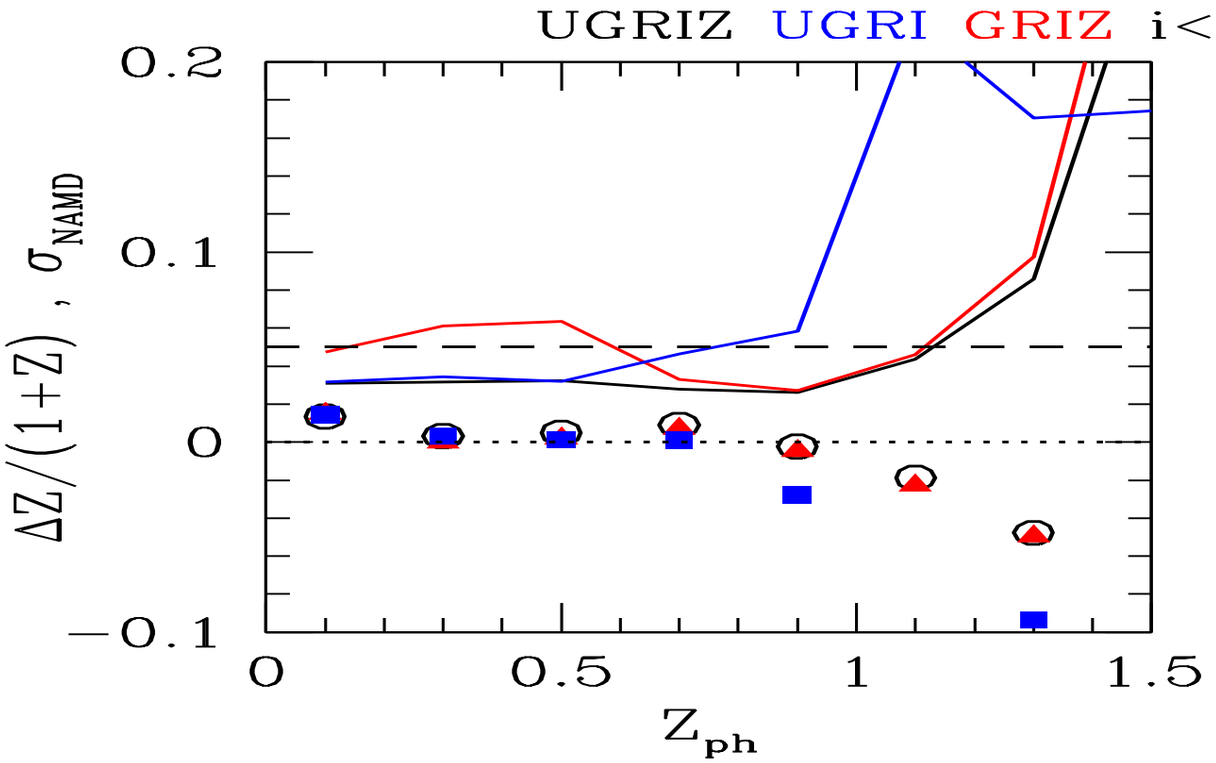
- The above results depend critically on the expected S/N in all bands

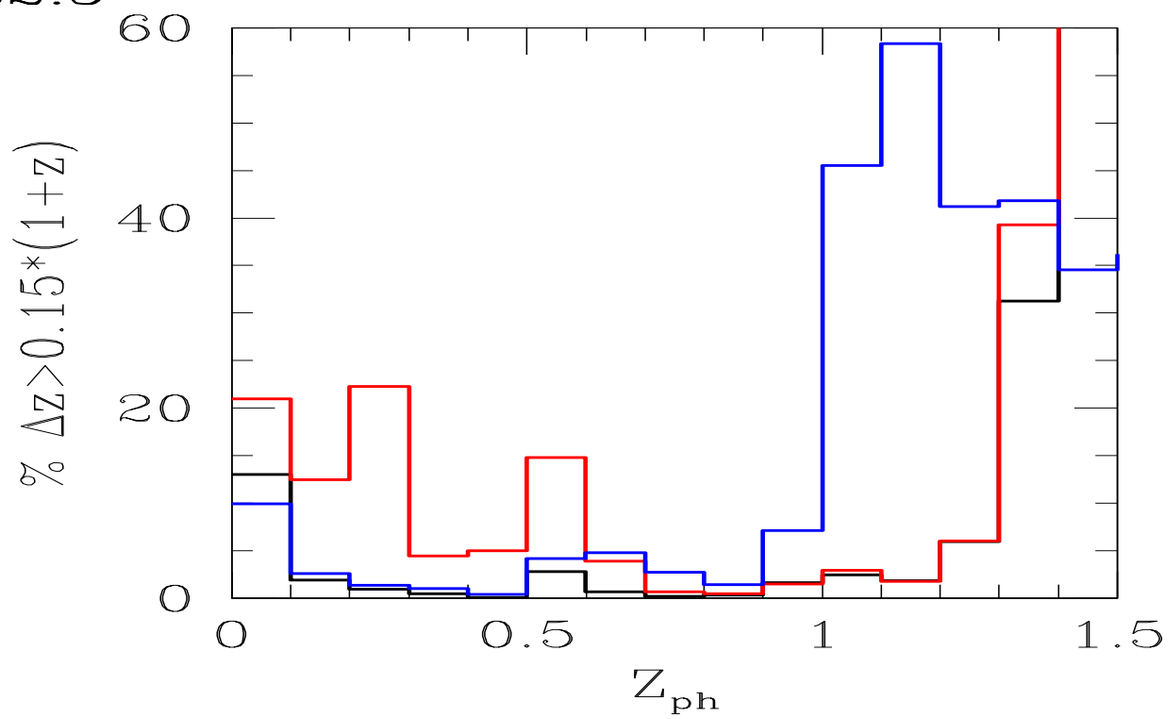
  ➢ deep NIR data are a key for the photo-z accuracy (*compare to CFHTLS*)

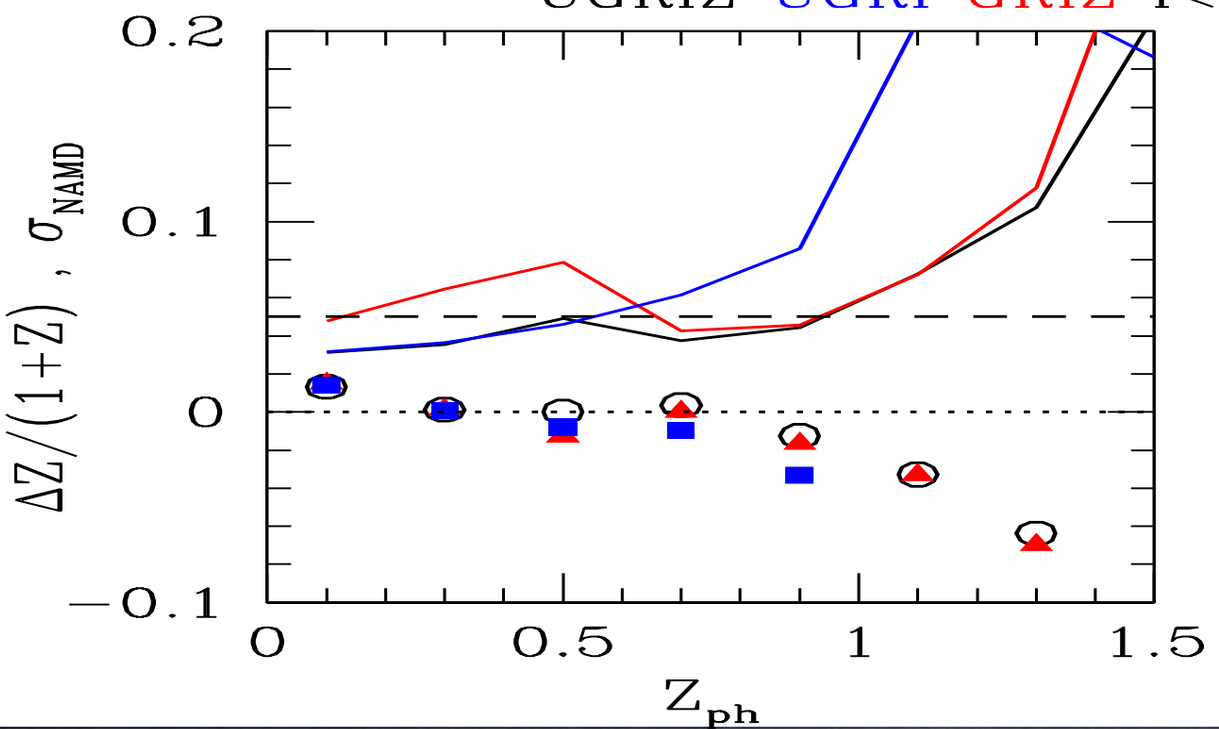
  ➢ S/N in color extraction must be tested on real data
  MegaCam/DES for optical + U-Vista in COSMOS
  to mimic Euclid photometry
  ... in progress ....

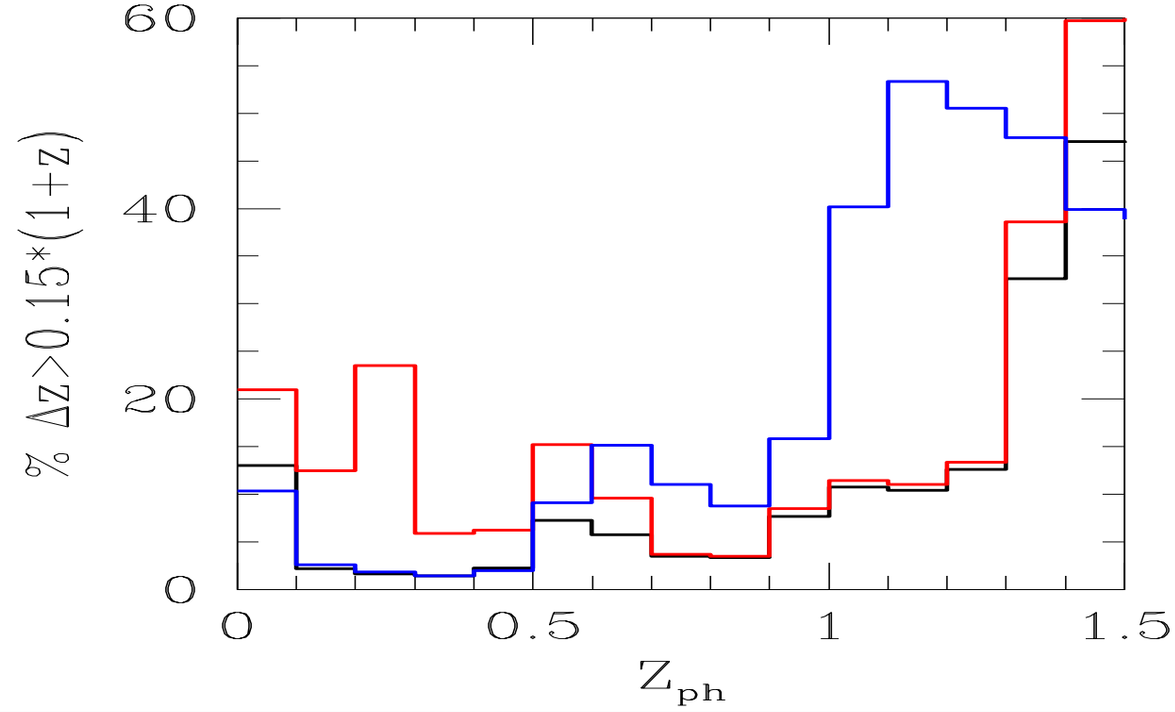
- An optimal set of SED templates for photo-z measurements is not yet available. It will depend on the available photometry and spectroscopic calibration sample.
  (*difficult to estimate now its performance*)

NSLS without Euclid









- Photo-z for UGRIZ, UGRI, GRIZ and no Euclid photometry (I<22.5, I<24) good accuracy and fcat below z=1 (UGRI) and z=1.2 (GRIZ)

NSLS with BC03-Mock catalogs