DARK ENERGY SURVEY

Photo-z's: Methods, Errors and CatSim1

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Collaborators

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Zhaoming Ma	University of Chicago
Dragan Huterer	University of Chicago
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Outline

- Photo-z Methods (Marcos)
- Error Estimators (Carlos)
- CatSim1 results (Hiro)

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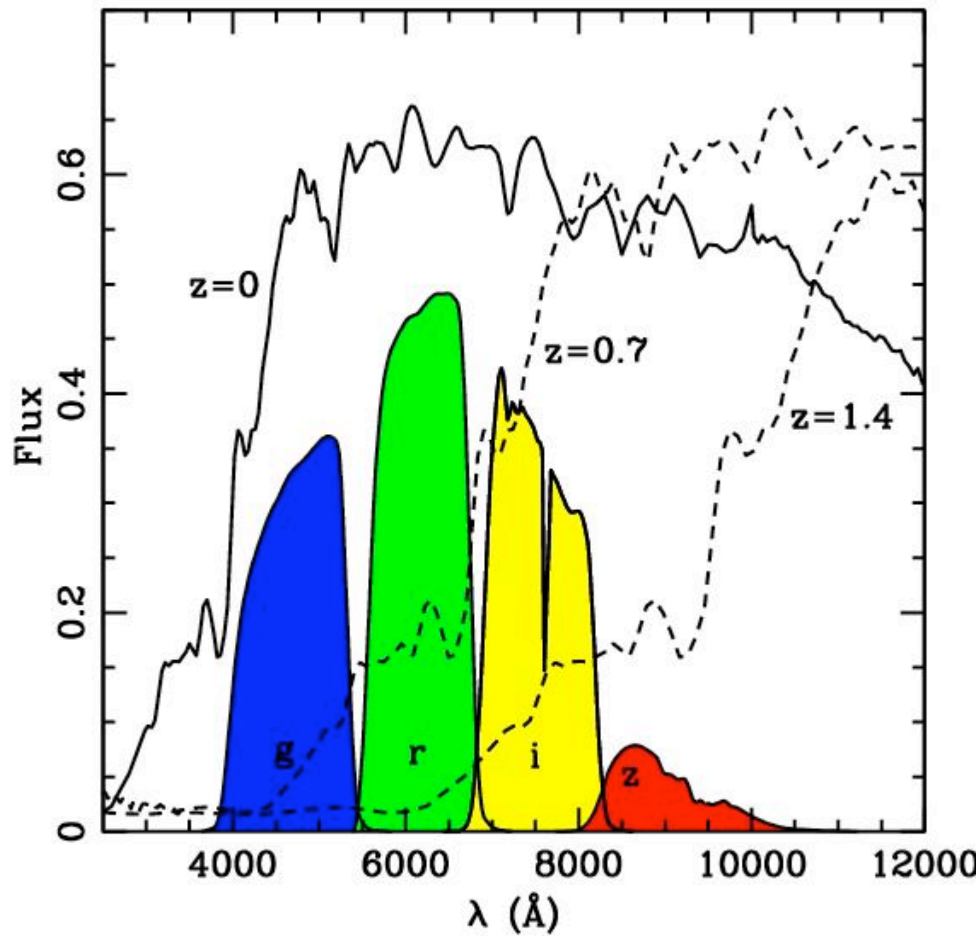
Photo-z methods

- Probe strong spectral features (4000 Å break)
- Difference in flux through filters as the galaxy is redshifted.



Template Fitting methods

- Use a set of standard SED's - templates (CWW, etc.)
- Calculate fluxes in filters of redshifted templates.
- Match object's fluxes (χ^2 minimization)
- Outputs type and redshift
- Examples

Hyper-z (Bolzonella et al. 2000)

BPZ (Benitez 2000)

Training Set Methods

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- Determine functional relation between m and z_{phot} using a training set

$$z_{phot} = z_{phot}(m,c)$$

- Examples

Nearest Neighbors
(Csabai et al. 2003)

Polynomial
(Connolly et al. 1995)

} Polynomial Nearest Neighbors
(Cunha et al. in prep. 2005)

Neural Network
(Firth et al. 2003, Collister & Lahav 2004)

DES5YR (Huan Lin)

Cunha et al. in prep. 2005.

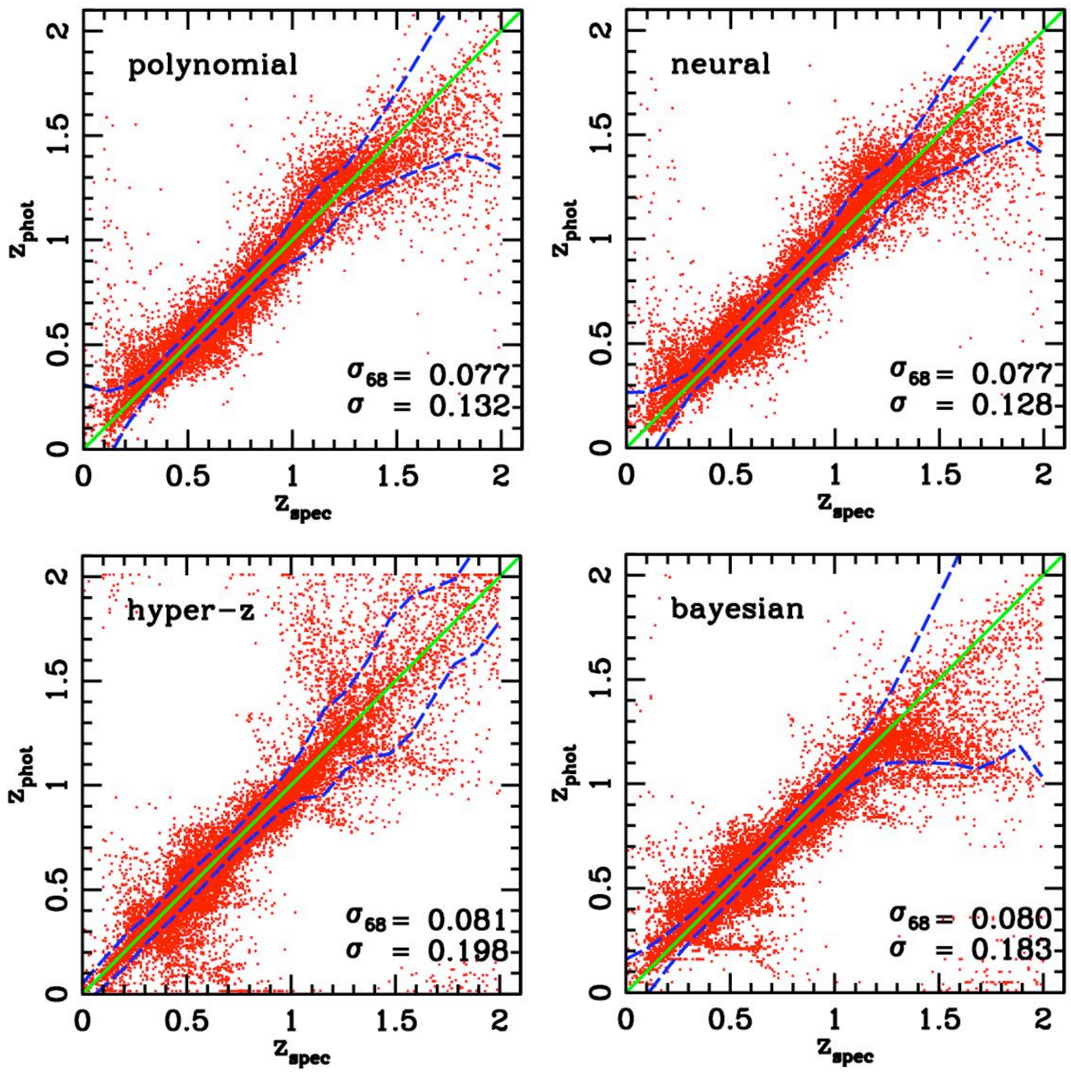
DES
griz filters

$$\sigma = \frac{1}{N}\sum_{i=1}^{N}\left(z_{phot}^{i} - z_{spec}^{i}\right)^{2}$$

$\sigma_{68} = 68\%$ limit region

Limiting Magnitudes

g	24.6
r	24.1
i	24.0
z	23.65



DES+IR

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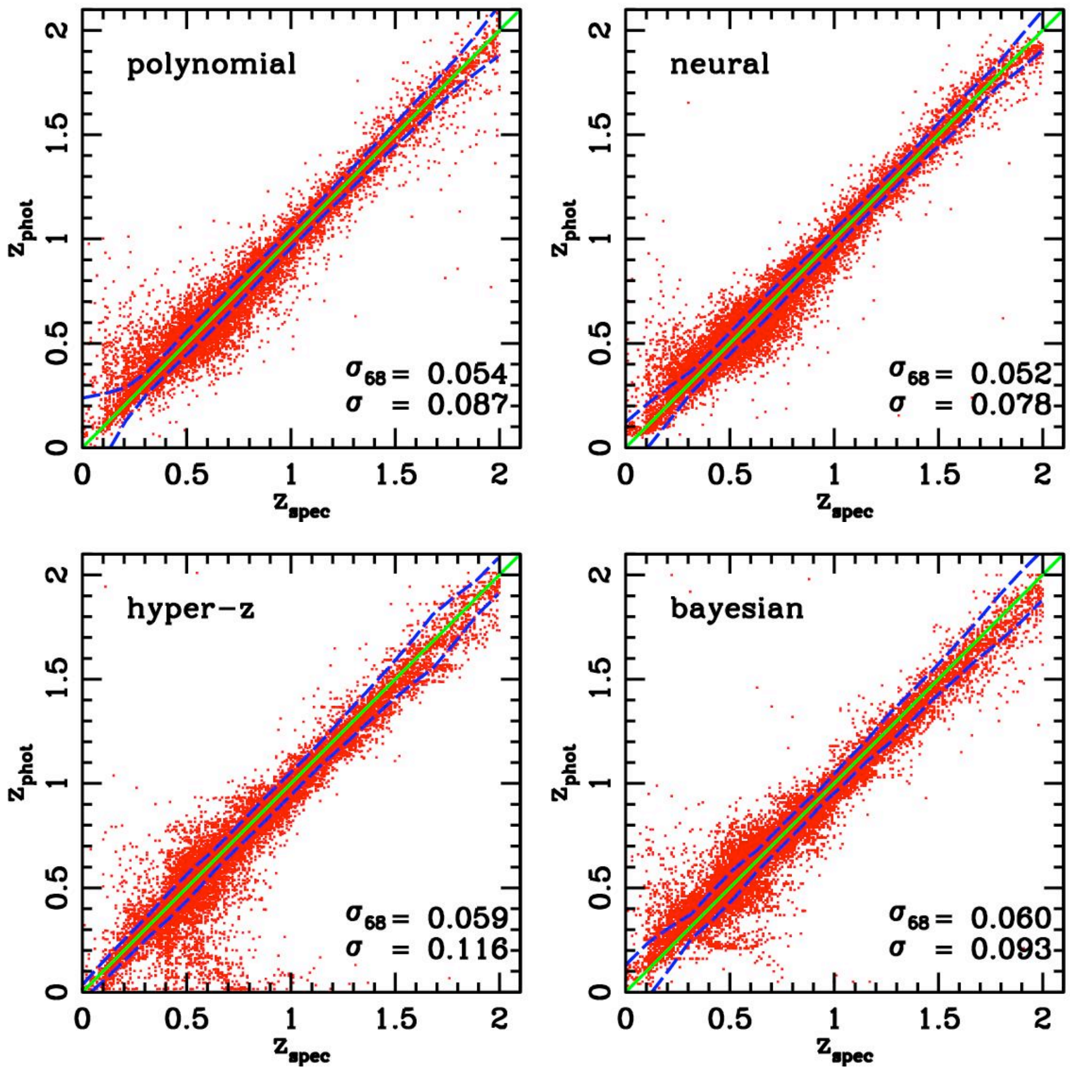
Cunha et al. in prep. 2005.

DES + VISTA grizYJHKs filters

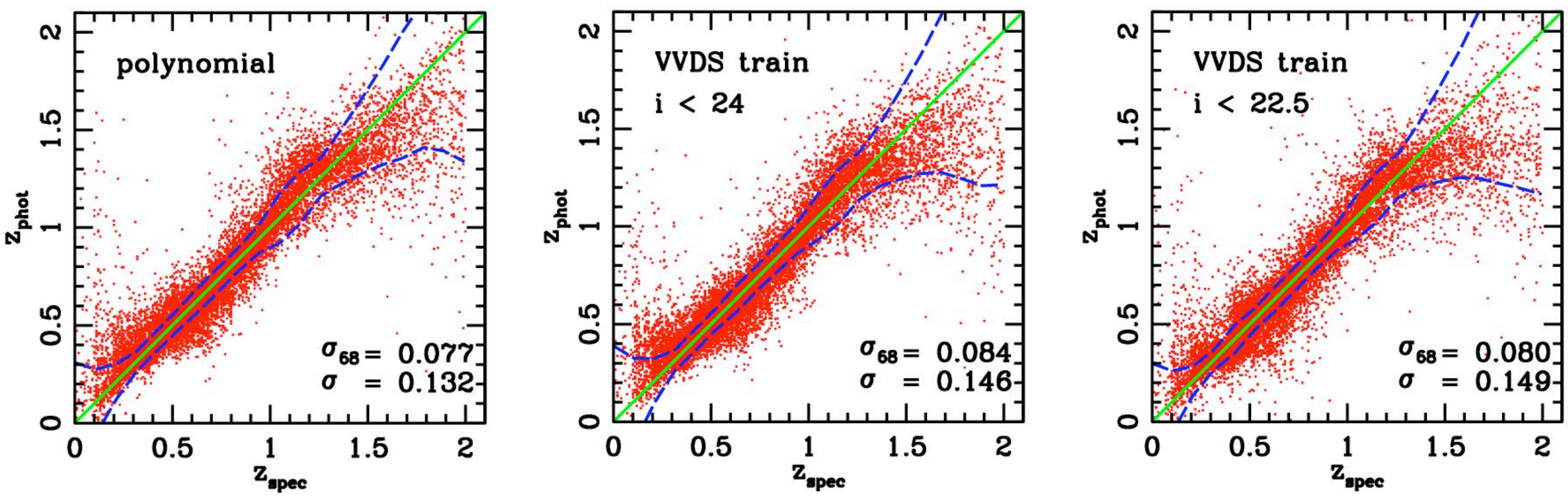


Similar improvements by adding one single filter if it is J or redder.

Extrapolations

- VIMOS VLT Deep Survey (VVDS) Le Fevre et al. 2005
- Training set: VVDS i magnitude distribution

  i < 24 and i < 22.5



Cunha et al. in prep. 2005.

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Photometric Redshift Errors

Error Estimators

- Don't require training set:
  - χ^2 based methods
  - Propagation of magnitude differentials
  - Monte Carlo magnitude resampling (MCMR)

- Require training set:
  - Nearest Neighbor (NNE)
  - Kd - Tree

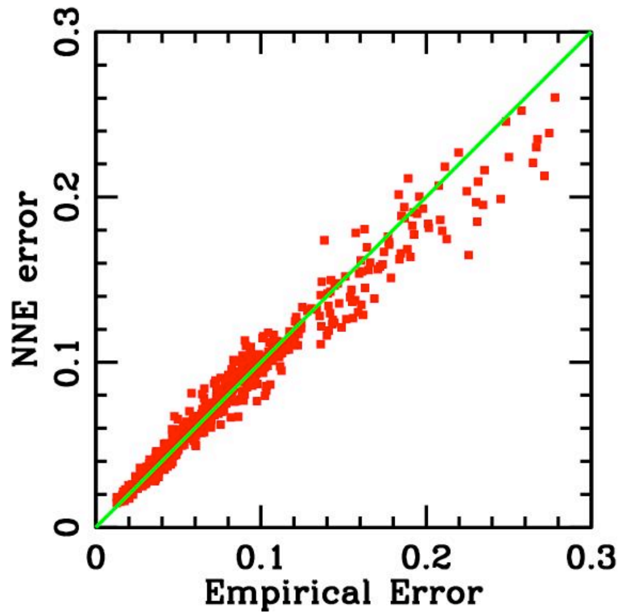
Nearest Neighbors Error

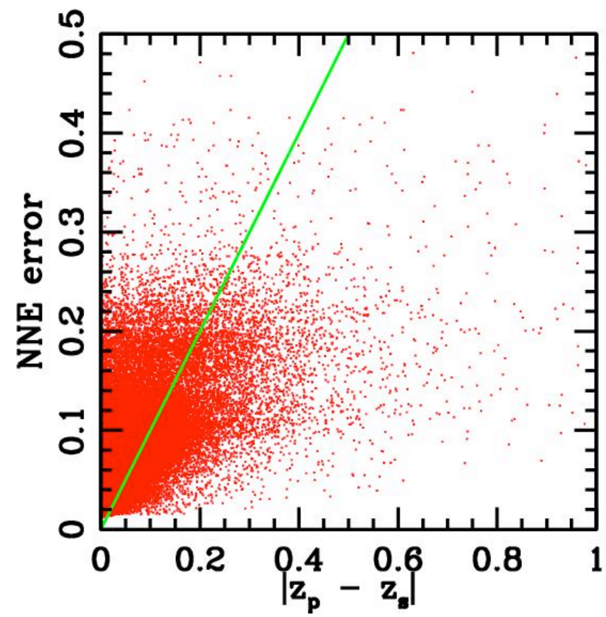
- Nearest Neighbor Error is the width (σ_{68}) of the (z_{phot} - z_{spec}) distribution of 100 nearest training set objects in magnitude space
- Assumption is that nearby objects in magnitude space have similar error characteristics

Nearest Neighbors Error

- We prefer NNE, because:
  - It works better (and we need a training set anyways).
  - Does not require knowledge of magnitude errors and magnitude error correlations

NNE at work

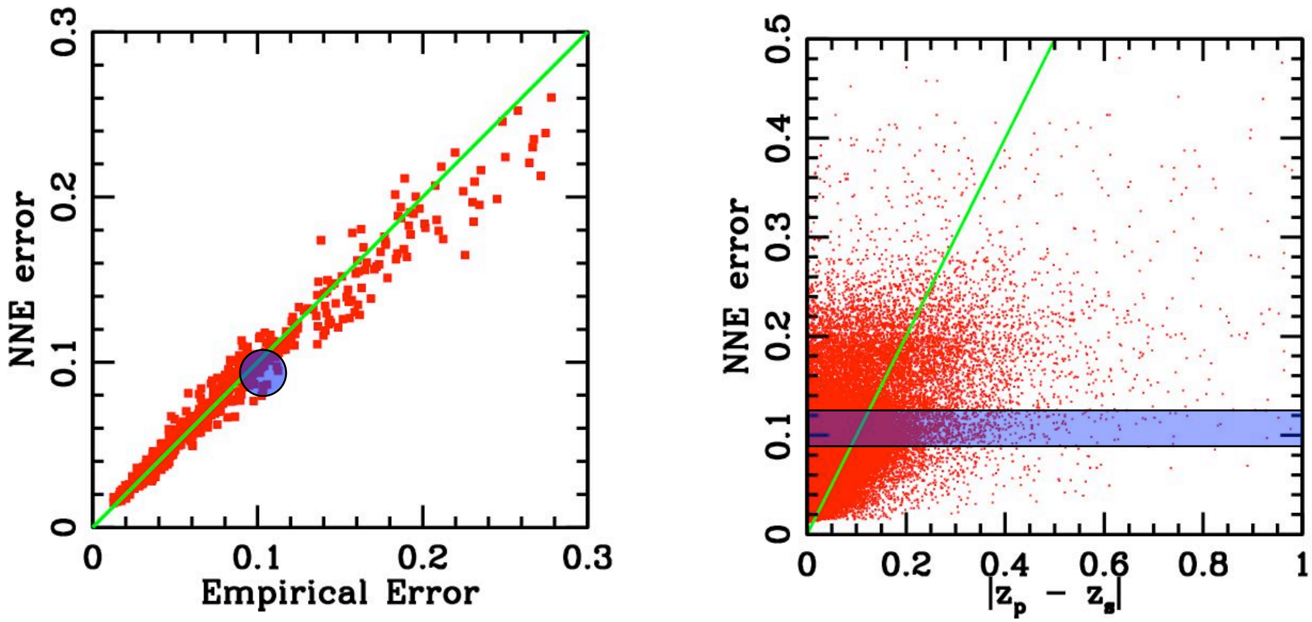




Oyaizu et al. in prep. 2005.

- $z_p - z_s =$ wrongness
- Errors can only be statistically

NNE at work

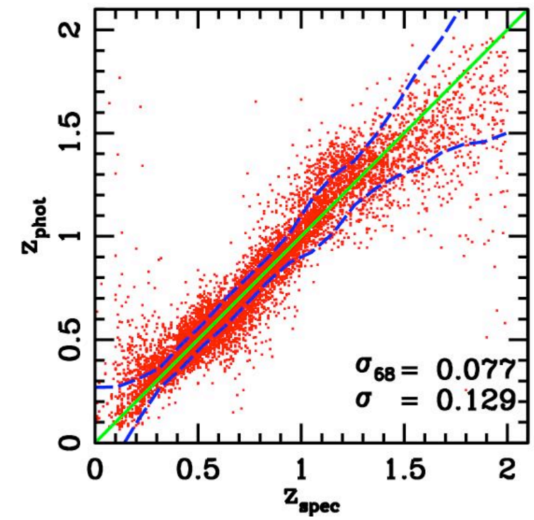


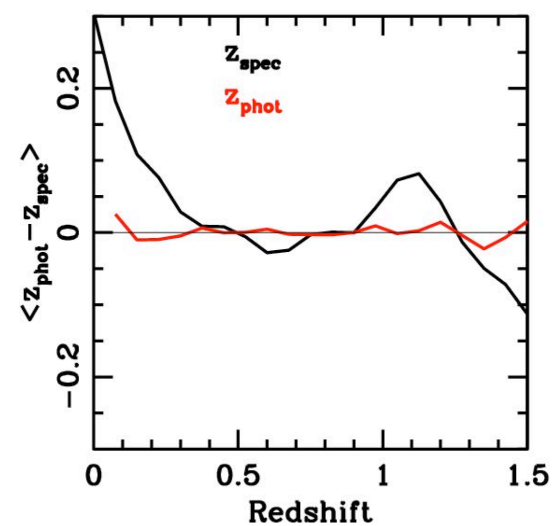
Oyaizu et al. in prep. 2005.

- $z_p - z_s =$ wrongness
- Errors can only be tested statistically

Can the bias be removed?

- What bias?
  - in z_{phot} bins
  - in z_{spec} bins
- Can only remove bias caused by catastrophics





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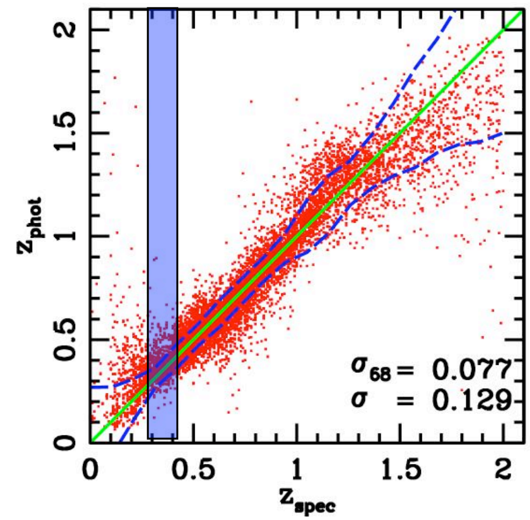

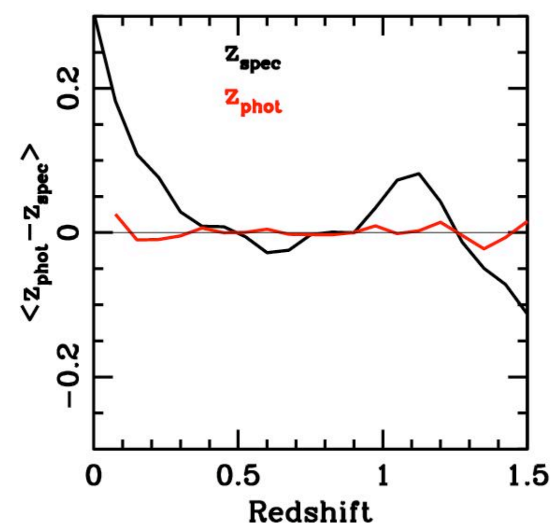

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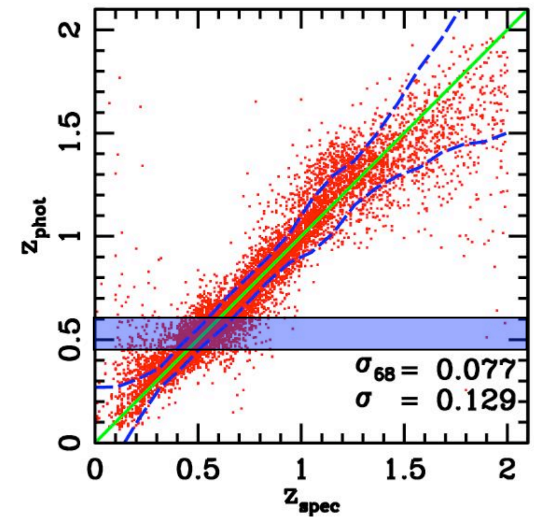
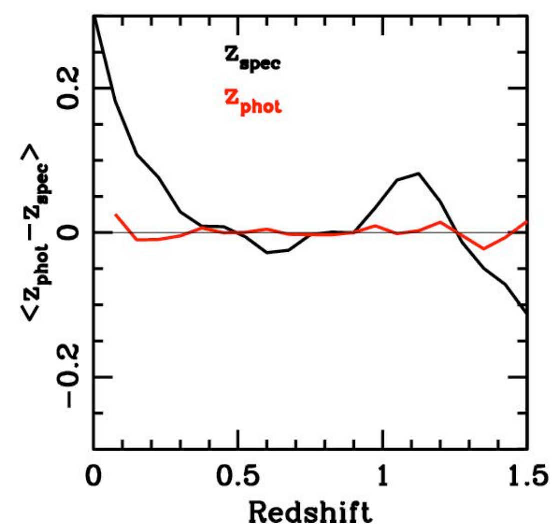
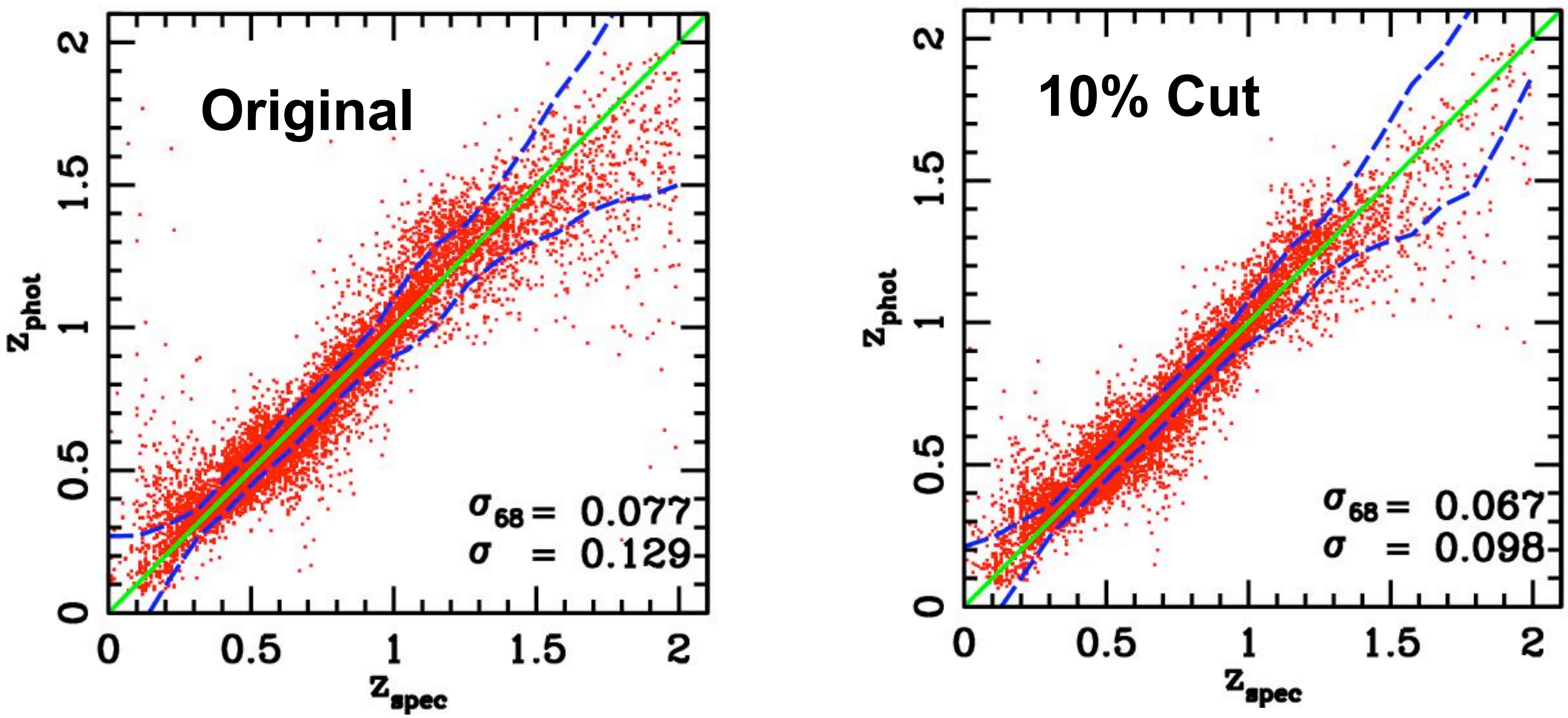




Removing Objects



10% objects removed ⇒ 30% improvement in dispersion

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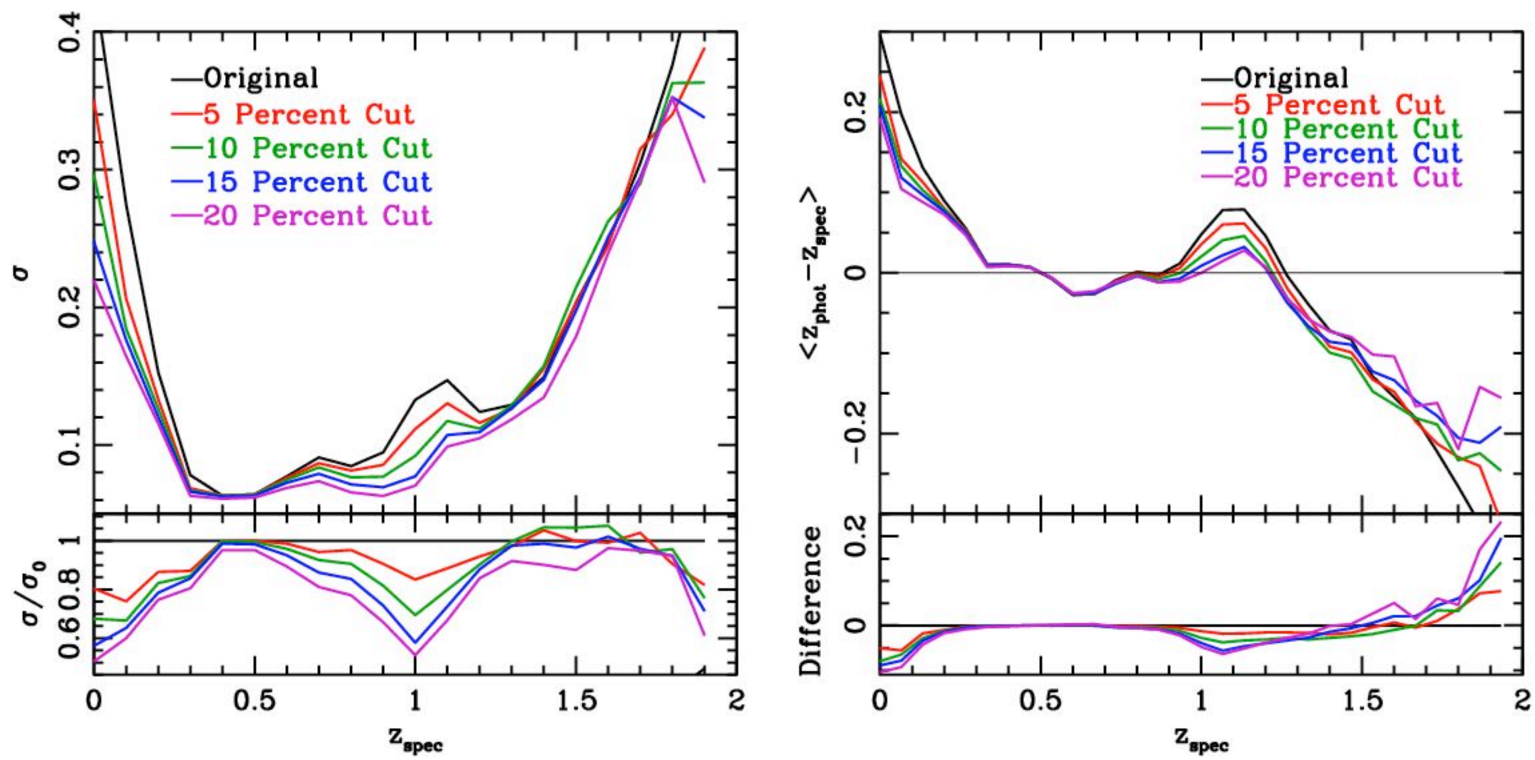
Removing Objects



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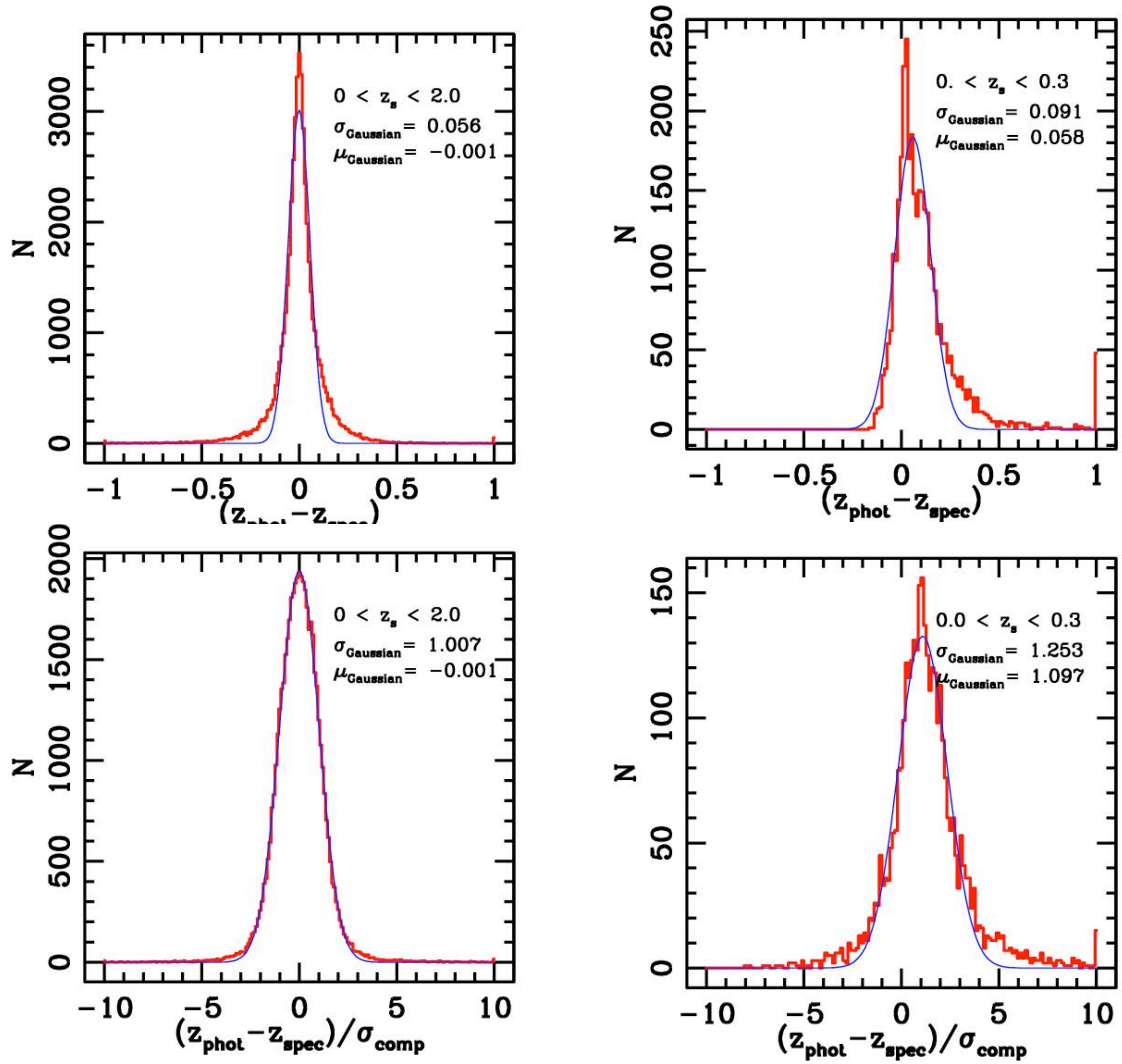
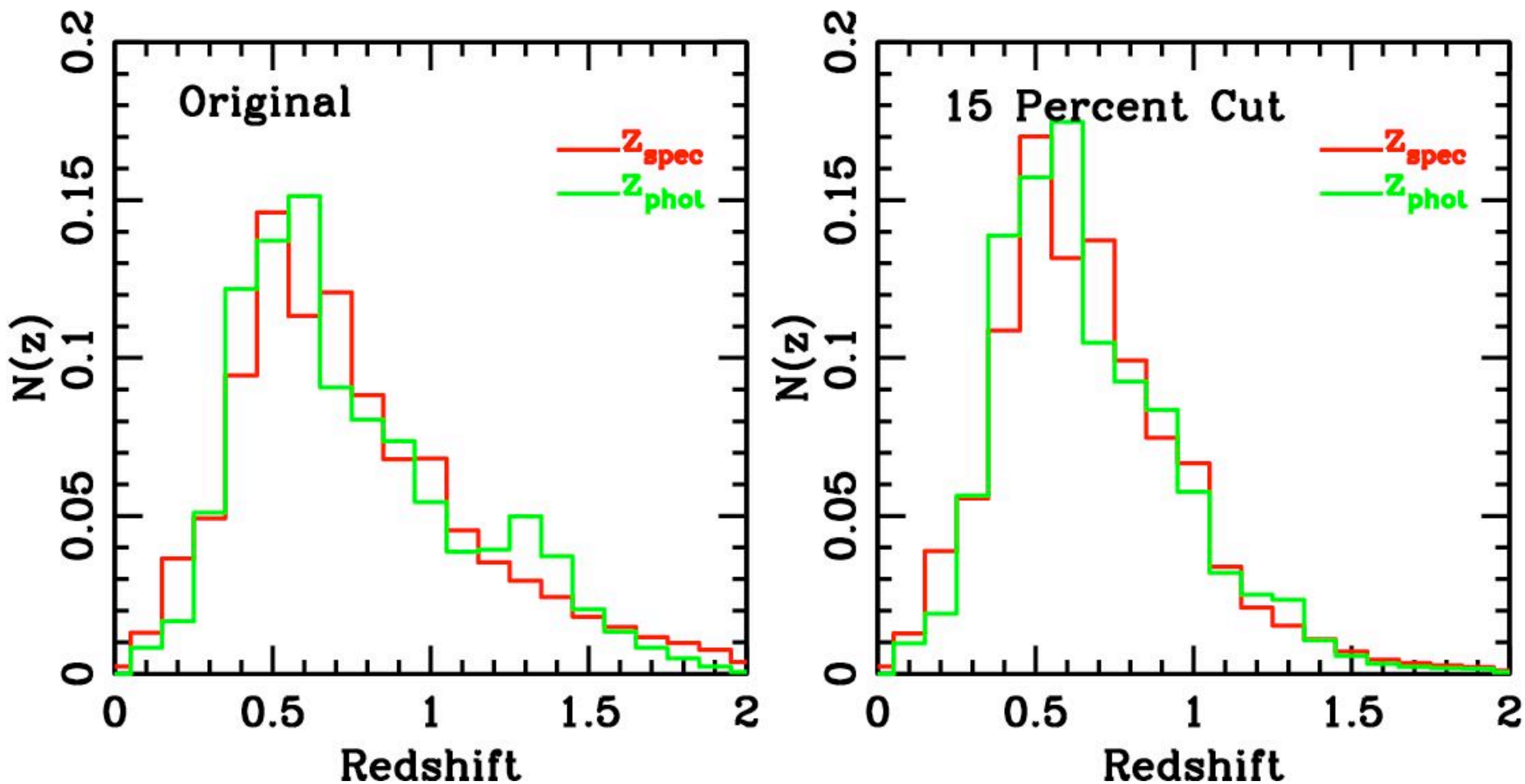
Error distributions

Rescaled distributions have:

- Smaller tails
- Less skewness
- Same bias



Redshift Distributions



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CatSim1 Results

CatSim1 Results

- Galaxies from the N-body based bright object catalog and the faint object catalog
  - Mixed with 1:3 ratio, i.e., 1 bright catalog object for every 3 faint object catalog
- Training Size: 50,000 galaxies
- Photometric size: 50,000 galaxies

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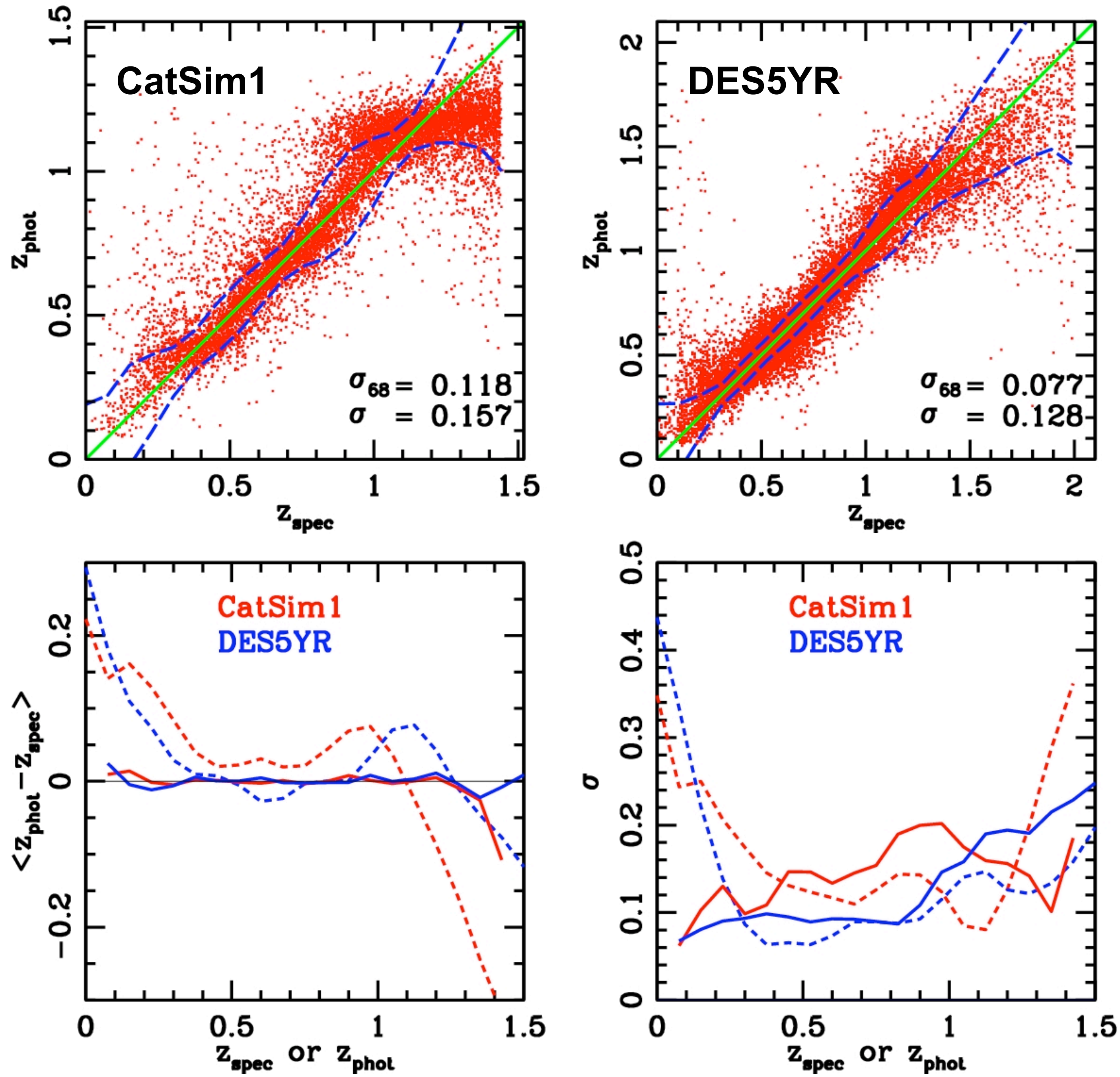

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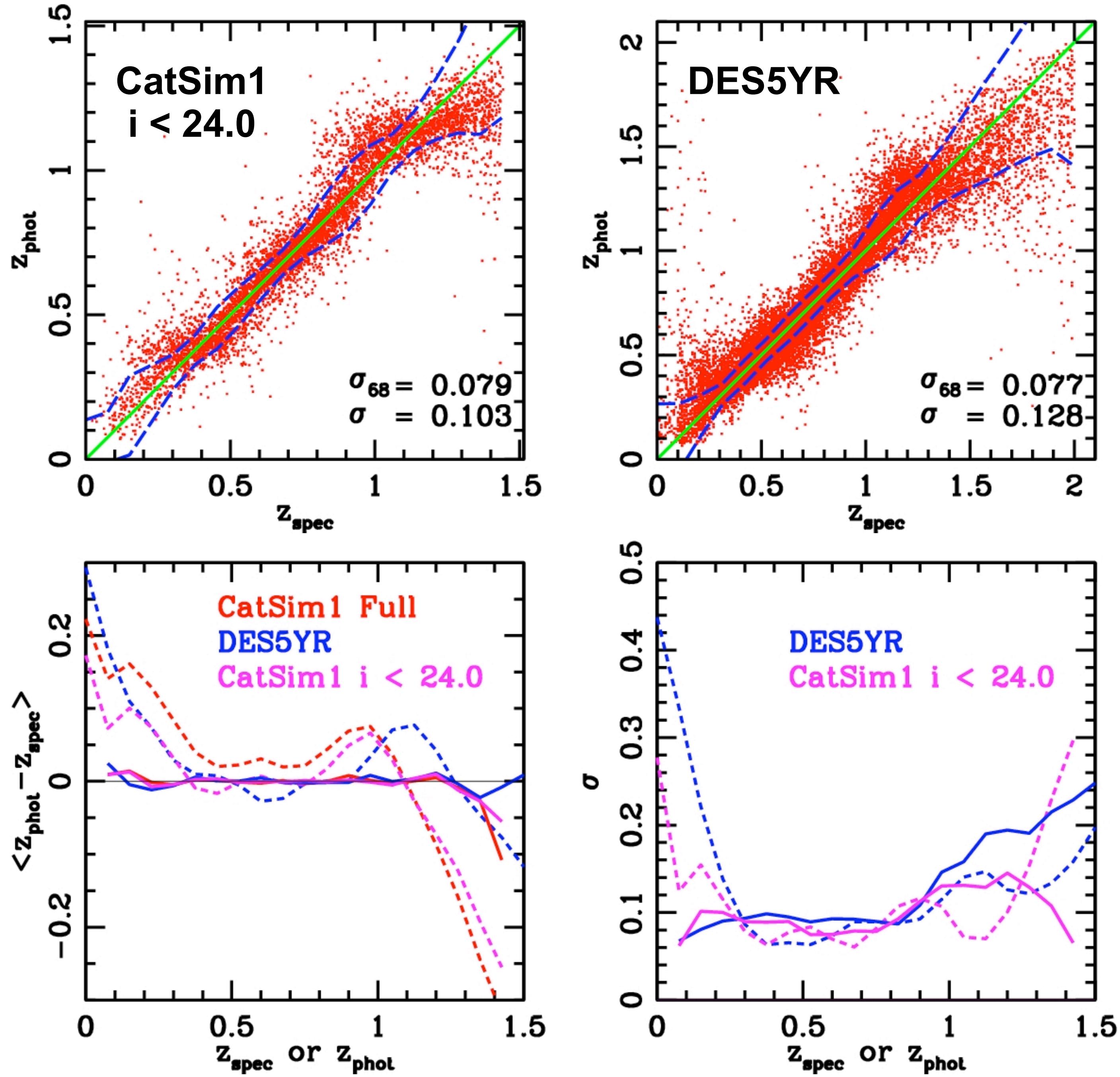
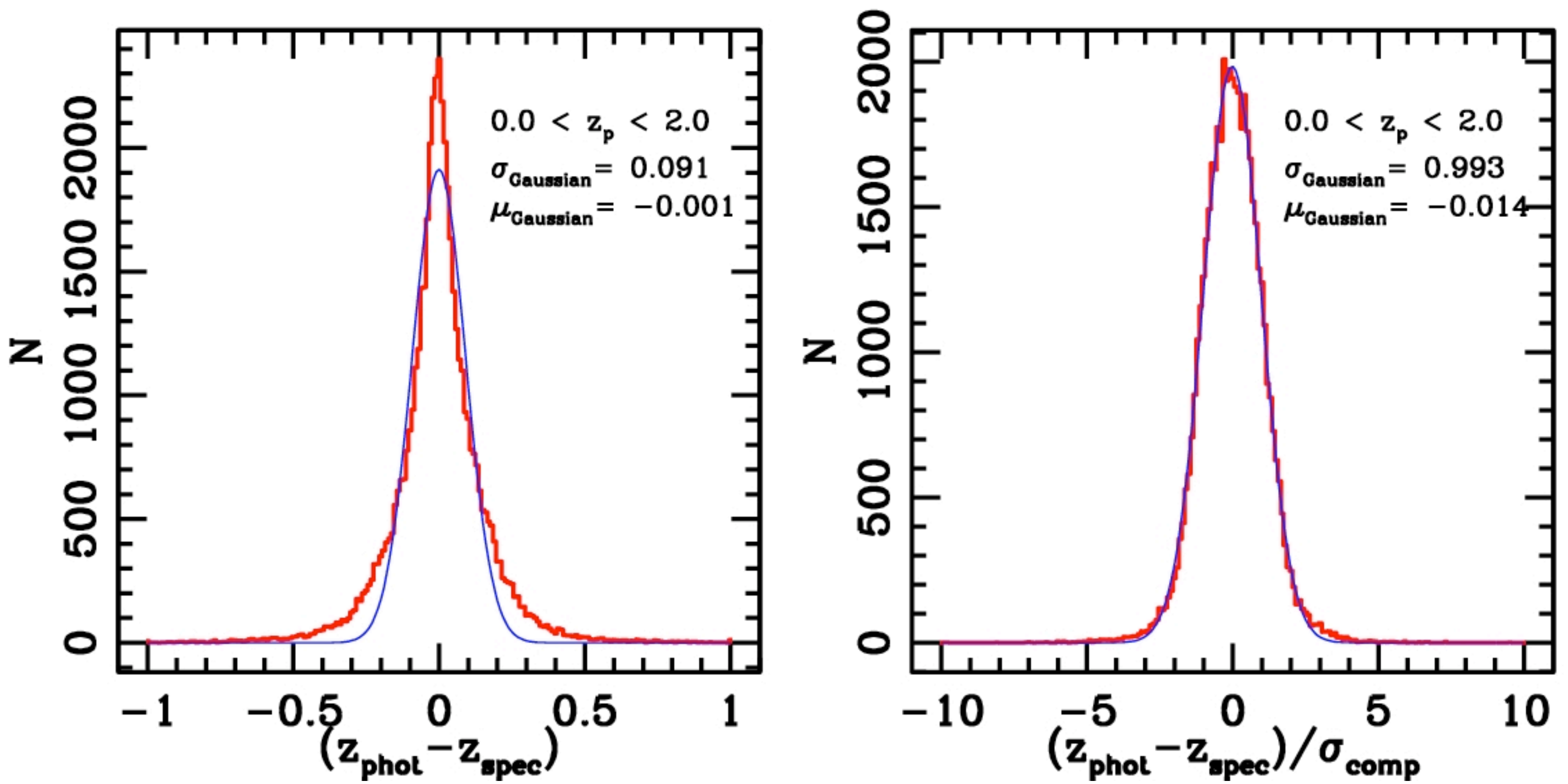
i < 24



CatSim1 Error Distribution



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CatSim1: Summary

- RMS scatter ~ 0.1 for $i < 24$
- Results are comparable to (if not better than) the original DES catalog simulation by Huan Lin
- NNE error estimates are good
- Further testing on cluster galaxies may be necessary

Conclusions

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- Training set methods are better suited for DES
- NNE estimator works like a charm
- Most catastrophic objects can be removed

- CatSim1 results look good