Astrodeep planning

Work Package 3	**Month**	**Date**
D3.1: scientific report on existing software report on source extraction tools definition of optimal technique	12	31/12/2013
D3.2: release of simulated data	24	31/12/2014
D3.3: definition of optimal technique for catalog production + release of Herschel simulated mosaics	24	31/12/2014

Work Package 4	**Month**	**Date**
D4.1: survey on available data document summarizing the list of available data	6	30/06/2013
D4.2: 1st production of public catalogs on website	18	30/06/2014
D4.3: 2nd production of public catalogs on website	30	30/06/2015
D4.4: 3rd production of public catalogs on website	42	30/06/2016

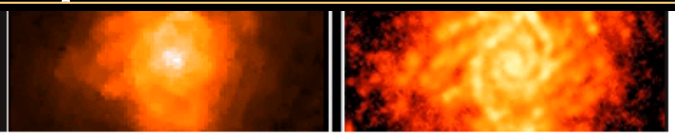
Public Herschel data releases:

GOODS-Herschel	7 September 2012 (http://hedam.oamp.fr/GOODS-Herschel/)
PEP (ext. GOODS-S)	1 March 2013 (http://www.mpe.mpg.de/ir/Research/PEP/DR1)
CANDELS-Herschel	mid-2014
HerMES DR2	3 April 2012 DR1 → DR2 ?

GOODS-*Herschel public release*

http://hedam.oamp.fr/GOODS-Herschel

HeDaM Herschel Database in Marseille



- Home page
- The survey
- Acknowledgement
- Contacts
- Publications

Data download

- GOODS-North Data
- GOODS-South Data

Search

- Cone search
- List search

CeSAM

HeDaM is operated by the Centre de donnéeS Astrophysiques de Marseille (CeSAM).

cnrs INSU Observer & comprendre

Aix*Marseille université

HeDaM Information System - GOODS-Herschel Survey

Welcome on the *Herschel Database in Marseille* section dedicated to the "*Great Observatories Origins Deep Survey*: far-infrared imaging with Herschel" (GOODS-Herschel, Elbaz *et al.*, 2011) survey.

GOODS-Herschel is an open time key programme of more than 360 hours of observation with the Herschel instruments SPIRE and PACS from 100 µm to 500 µm on the two fields of the Great Observatories Origins Deep Survey (GOODS).



GOODS-Herschel public release now open !

http://hedam.oamp.fr/GOODS-Herschel

Content	Download link
Multi-λ catalogue (VO-Table, FITS and IPAC formats)	TABLES
PACS 100 µm maps (flux, coverage, error)	100
PACS 160 µm maps (flux, coverage, error)	160
SPIRE 250 µm maps (flux, coverage, error)	250
SPIRE 350 µm maps (flux, coverage, error)	350
SPIRE 500 µm maps (flux, coverage, error)	500
Full dataset: all maps + catalogue	FULL DATA.

GOODS-South

Content	Download link
Multi-λ catalogue (VO-Table, FITS and IPAC formats)	TABLES
PACS 100 µm maps (flux, coverage, error)	100
PACS 160 µm maps (flux, coverage, error)	160
Full dataset: all maps + catalogue	FULL DATA.

GOODS-North

Cone search

From this page, you can perfom a cone search in the whole GOODS-Herschel database. You give a position (RA, Dec) and a radius and you get:

- The FITS cut-outs from the dataset flux density maps.
- The result of you cone search in VO-Table and FITS formats.
- The link to download the full dataset archive.

RA/Dec (decimal degrees): /

Radius in arc-minutes (max 180): Search

Target search

From this page, you can search for counterparts in GOODS-Herschel data to a list of targets (provided as a list of coma-separated **identifier, ra, dec** — the coordinates must be given in decimal degrees) within the provided radius. You must select the field you want to search in.

Once the search performed, you will be presented with a page summarising the results where you will be able to download the subsets of the GOODS-Herschel catalogue corresponding to your targets.

Enter the targets in a text box Upload a CSV file

PEP

- News
- Science Goals
- Fields
- Publications
- Press Releases
- Public Data Releases
- Team
- Related Links

PEP full public data release (DR1)

March 1st, 2013

The PEP Team presents the first public data release (DR1) including all PEP blank fields and clusters.

The release is organized in a set of tgz archives: one tarball for each blank field, one including all PACS data of clusters of galaxies, and finally one containing SPIRE data for two clusters. See the Fields section and the documentation for further details.

In the GOODS fields, we combine PEP and GOODS-Herschel data, thus building the deepest far-IR images so far. The accepted version of the paper describing the combined PEP/GOODS-Herschel dataset can be found below.

Documentation

- Read-Me file for PACS data
- Read-Me file for SPIRE data
- Paper (accepted for publication in A&A) describing the combined PEP/GOODS-Herschel data of the GOODS fields

Blank Fields

- COSMOS tarball [1.9 Gb]
- ECDFS tarball [278 Mb]
- EGS tarball [238 Mb]
- Lockman Hole tarball [177 Mb]
- GOODS-N combined PEP/GOODS-Herschel data tarball [102 Mb]
- GOODS-S combined PEP/GOODS-Herschel data tarball [197 Mb]

Cluster Fields

- PACS Clusters tarball (including 12 clusters) [209 Mb]
- SPIRE Clusters tarball (including 2 clusters) [3.0 Mb]

Level	AOR set	Target	Center coord. /deg	Area /deg^2	Budget /h	Dataset download			
						SPIRE 250μm	SPIRE 350μm	SPIRE 500μm	SPIRE multi-λ
Clusters deep	1	Abell 2218	16:35:54.00+66:13:00.0	0.131	9.29	250 1	350 1	500 1	xID250 1
	3	MS0451.6-0305	04:54:10.90-03:01:10.0	0.106	1.97	250 1	350 1	500 1	xID250 1
Clusters shallow	7	Abell 2219	16:40:22.10+46:42:20.0	0.107	1.97	250 1	350 1	500 1	xID250 1
Level 2	14	GOODS-N	12:36:54.90+62:14:19.0	0.629	13.51	250 1	350 1	500 1	xID250 1
	15	ECDFS	03:32:25.00-27:48:50.0	0.778	8.78	250 1	350 1	500 1	xID250 1
Level 3	17 [1]	Groth-Strip	14:19:15.20+52:53:13.4	0.813	3.54 (8.6 [1])	250 1	350 1	500 1	xID250 1
	19 [2]	Lockman-North	10:46:00.00+59:01:00.0	0.740	3.91 (7.4 [2])	250 1	350 1	500 1	xID250 1
Level 5	28	Lockman-SWIRE	10:48:00.00+58:08:00.0	18.2	13.51	250 1	350 1	500 1	xID250 1
	30+37 [3]	Boötes	14:32:26.46+33:34:00.5	11.3	48.32	250 1	350 1	500 1	xID250 1
	31	ELAIS-N1-HerMES	16:10:00.00+54:30:00.0	3.74	20.82	250 1	350 1	500 1	xID250 1
Level 6	36	XMM-LSS SWIRE	02:21:20.00-04:30:00.0	21.6	45.58	250 1	350 1	500 1	xID250 1
	38	ADFS	04:43:38.86-53:40:50.2	8.57	18.11	250 1	350 1	500 1	xID250 1
	40	FLS	17:17:00.00+59:30:00.0	7.29	17.1	250 1	350 1	500 1	xID250 1

Various source extraction techniques considered:

- **prior PSF fitting:**

  requires optimisation of prior definition

  when 2 sources are closer than Nyquist sampling (FWHM/3, ~2 pixels) the brightest is used

- **galfit:**

  list of priors even more important since galfit computes a covariance matrix that makes the noise diverge to large values when it is asked to fit 2 sources too closeby to be resolved.

  → all 24um priors to extract 500um sources leads to a list with no source !

- **starfinder:**

  blind source extraction with Herschel PSF, built from the image for PACS (assymetry of the PSF, dependance on orientation and combination of various epochs), theoretical PSF for SPIRE

- **getsources:**

  blind source extraction technique but based on a multiresolution wavelet approach that allows to account for up to 99 images altogether. In practice, we will test it using IRAC-MIPS-PACS-SPIRE on both real and mock images to study the gain on the long wavelength images from the short wavelength ones.

- **TFIT/CONVPHOT:** adapted to unresolved sources (FIR Herschel images)

Tests of source extraction + improvements

- **residual map:**

  quality of source subtraction

  search for remaining candidate distant sources

- **Monte Carlo simulations on real images:**

  inject fake sources with known flux densities iteratively

  → detection limit, completeness, % fake detections + flat background due to confusion

- **Simulations of full Herschel images:**

  quantification of confusion noise, assumes knowledge of redshift, extrapolation of flux

  identification of local confusion noise, i.e. a $\Delta S/S$ is attribued to sources based on the contribution of the field of surrounding sources

- **Subtraction of sources with extrapolated flux + work on residual images:**

  real images can be cleaned of faint sources

- **improving priors:**

  - the list of priors is crucial (galfit divergence, overdeblending,...)

- **counterparts:**

  - a given prior may be attributed various counterparts in HST images for example
  - → physical recipes to determine best candidates / participates to cleaning priors

- **clean index:**

  - systematic definition of clean sources from e.g. the local 24µm density

Distribution of work at CEA (preliminary)

Xinwen Shu: source extraction tools / search for distant galaxies

- subtraction of predicted fluxes in SPIRE bands (+ E.Daddi)
- use of galfit
- search for distant sources in residual maps
- test of getsources from S.Men'schikov on real and simulated images

Tao Wang : image simulations / quenching of star-formation, role of AGNs

- simulation of Herschel images + multiwavelength counterparts
- simulation of Herschel images from half map noise maps + FIR-MIR colors + zphot/zspecs
- application to GOODS-S → ALMA
- Identification of sources in the process of being quenched
- role of TP-AGB stars, pollution of SFR by intermediate age stellar population
- improvement of prior selection (UVJ plan to identify red/passive galaxies, improve the identification of multiple possible counterparts from z+SED+color selections).

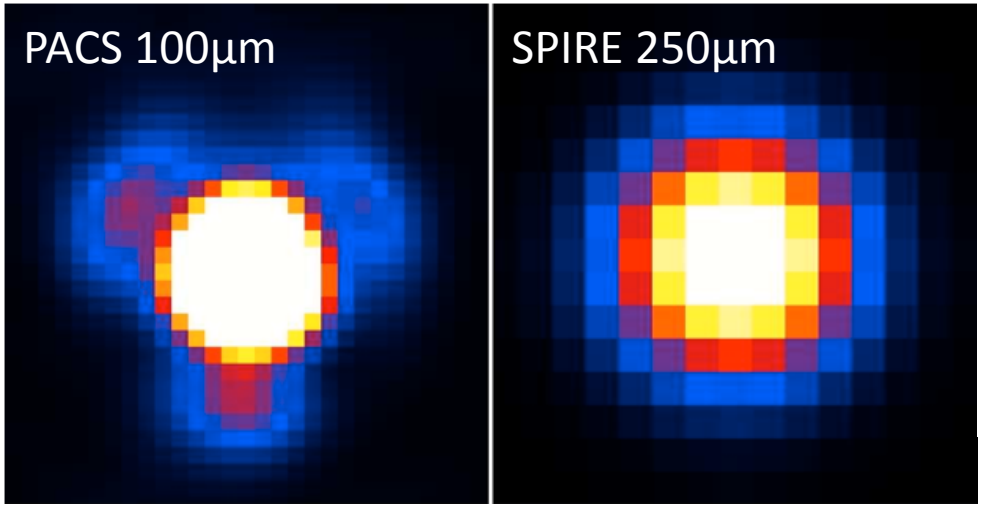
Maurilio Pannella: (postdoc ANR HUGE)

- mass selected multi-wavelength catalogs of CANDELS fields
- mass-dependent dust attenuation

Corentin Schreiber (PhD student):

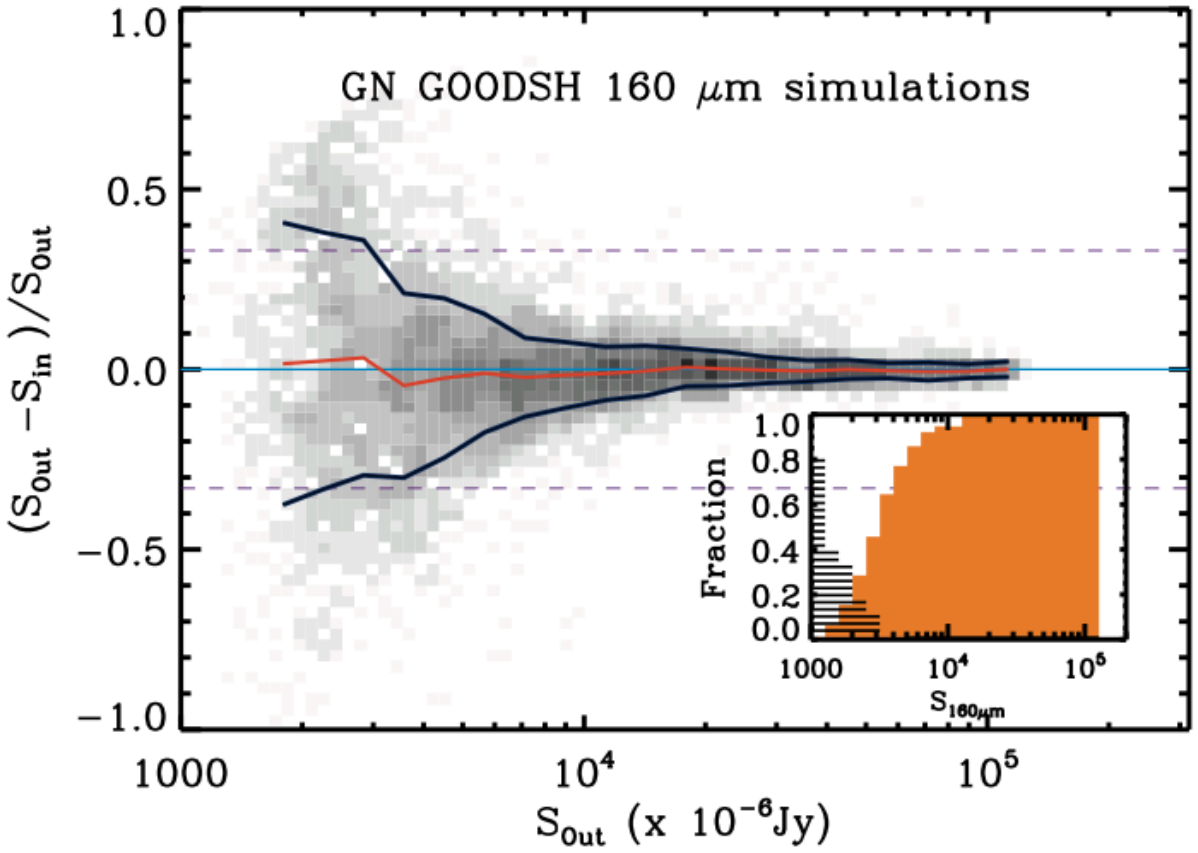
- stacks of Herschel measurements per stellar mass bins → slope and redshift evolution of Main Sequence from z=0 to 4, MS vs SB populations vs z.
- link with star-formation compactness (rest-frame UV stacks) / mergers

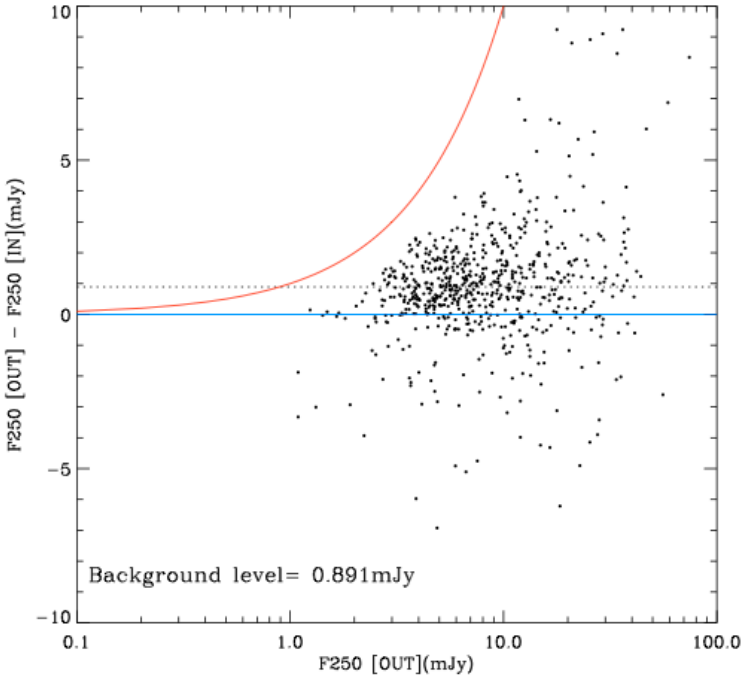
Monte Carlo simulations on real images

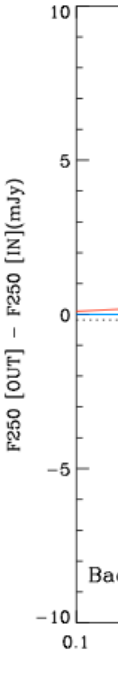


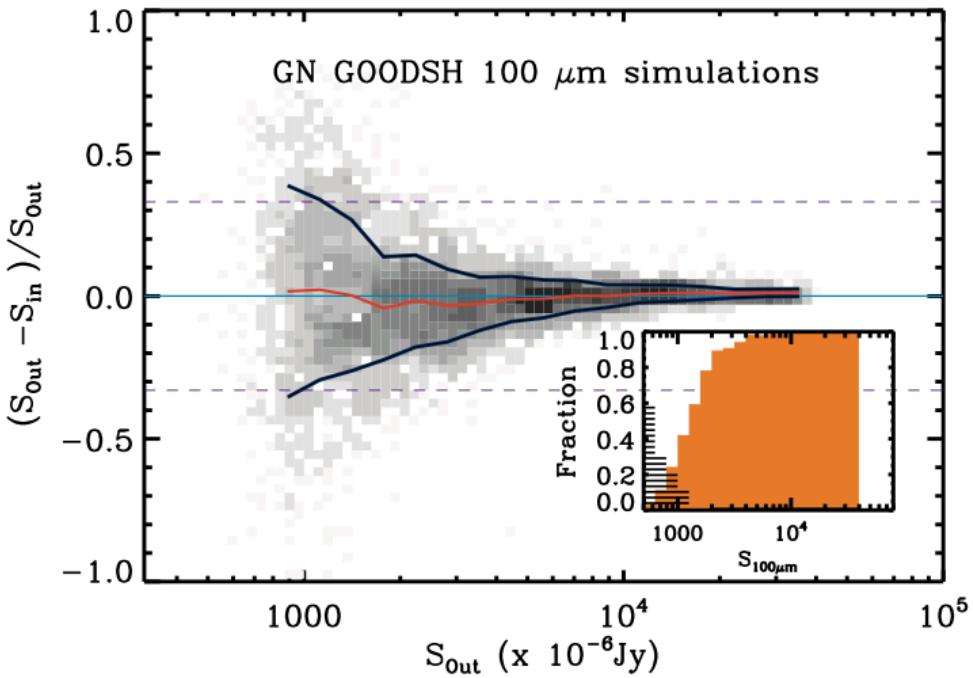
Band (mum)	FWHM (")	pixel scale ("/pixel)
100	6.7	1.2
160	11.0	2.4
250	18.1	3.6
350	24.9	4.8
500	36.9	7.2

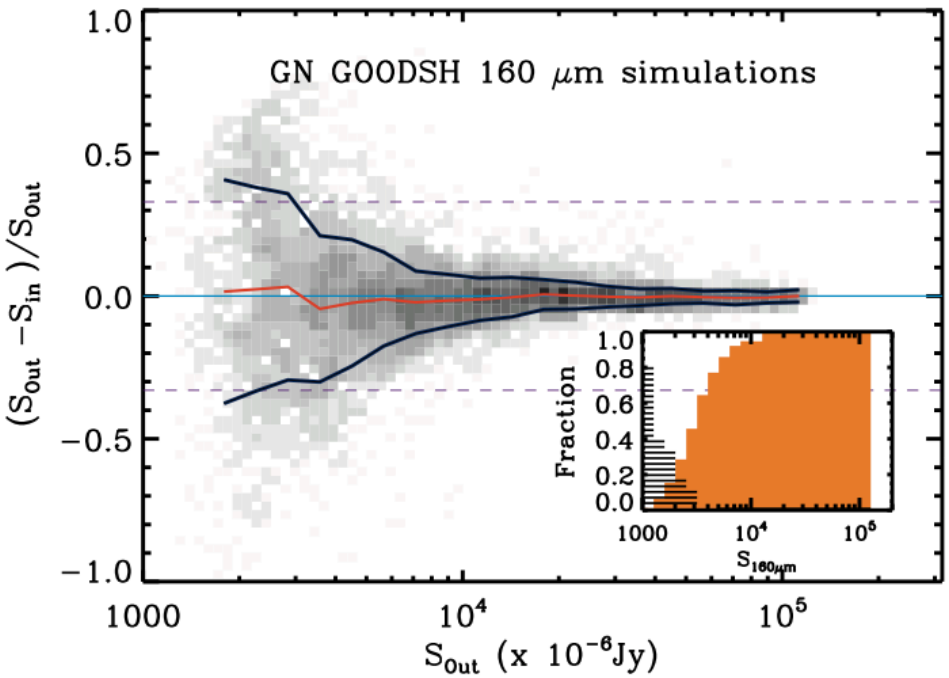
pixel size = Nyquist sampling/2
= FWHM/5
= N x IRAC-24µm pix (1.2")
= 2N x IRAC-3.6µm pix (0.6")

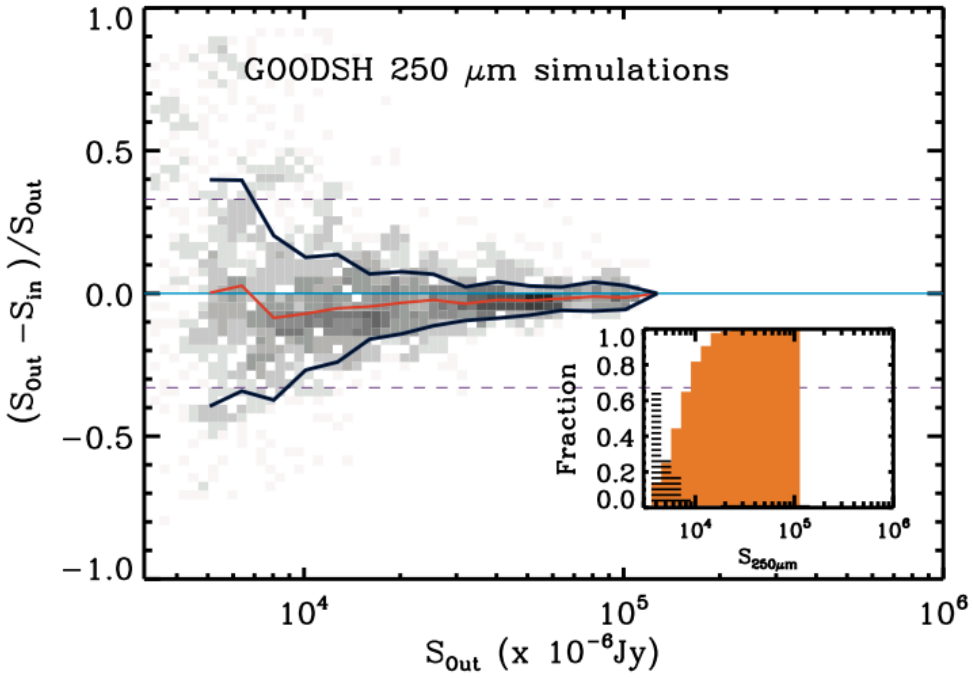


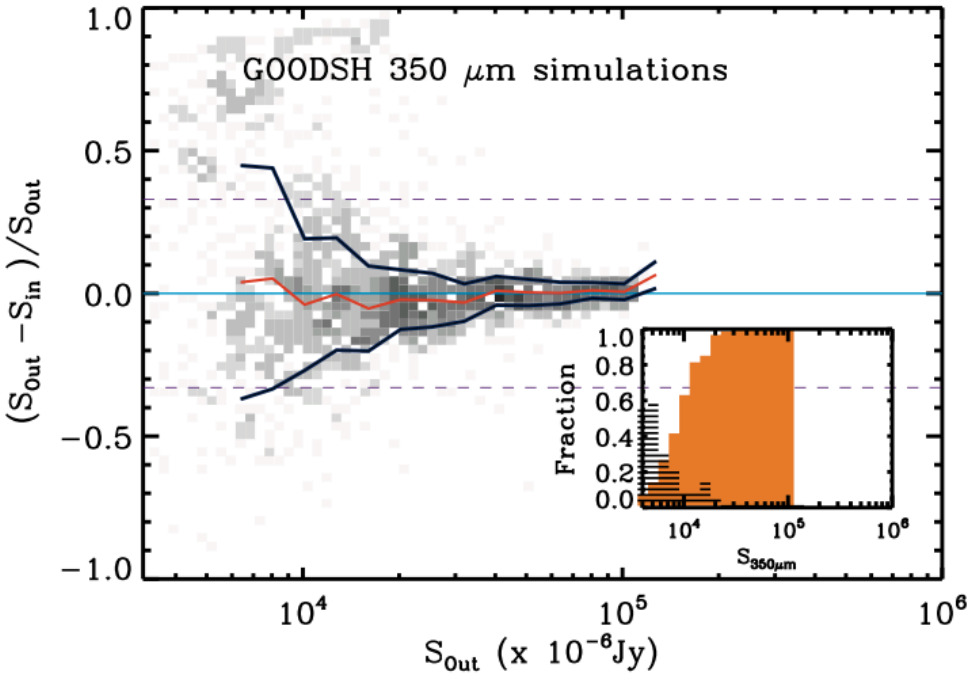


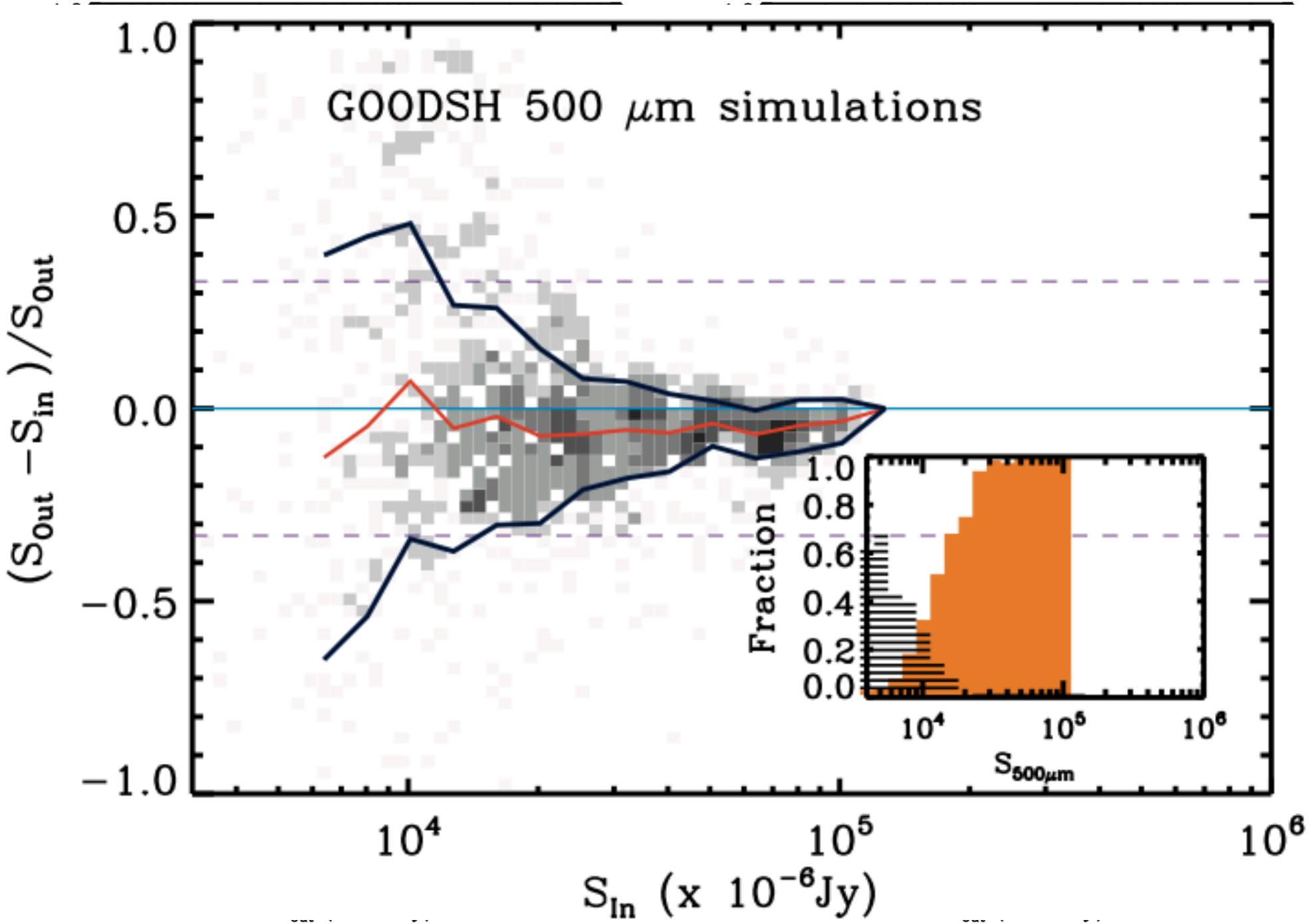



GN GOODSH 100 μm simulations
(S_Out − S_in)/S_Out
S_Out (x 10^-6 Jy)
Fraction
S_100μm

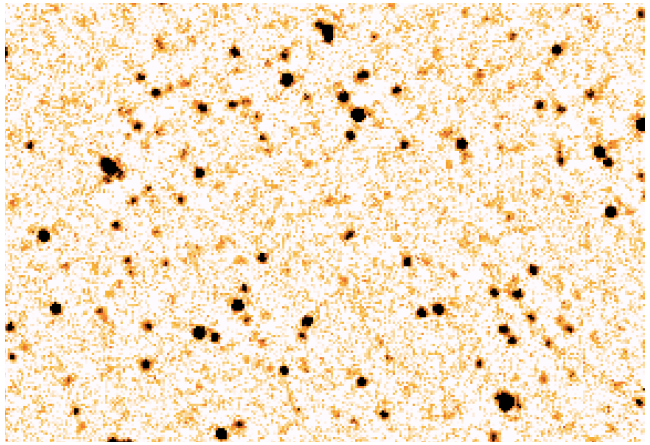

GN GOODSH 160 μm simulations
(S_Out − S_in)/S_Out
S_Out (x 10^-6 Jy)
Fraction
S_160μm


GOODSH 250 μm simulations
(S_Out − S_in)/S_Out
S_Out (x 10^-6 Jy)
Fraction
S_250μm


GOODSH 350 μm simulations
(S_Out − S_in)/S_Out
S_Out (x 10^-6 Jy)
Fraction
S_350μm

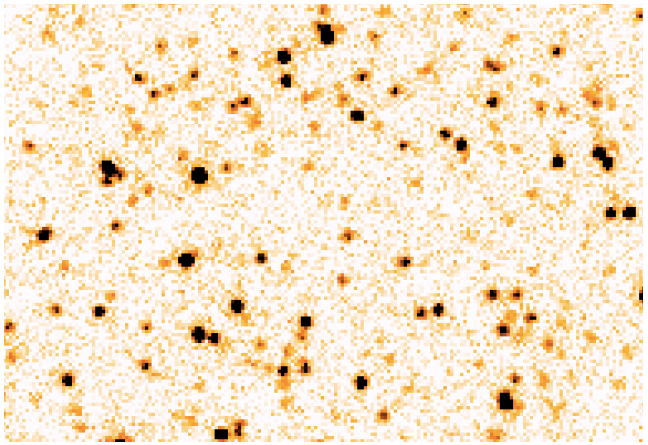

GOODSH 500 μm simulations
1.0
0.5
0.0
−0.5
−1.0
(S_Out − S_In)/S_Out
10^4
10^5
10^6
S_In (x 10^−6 Jy)
Fraction
1.0
0.8
0.6
0.4
0.2
0.0
10^4
10^5
10^6
S_500μm

GOODS South – 100um



PEP

115 hours
observation



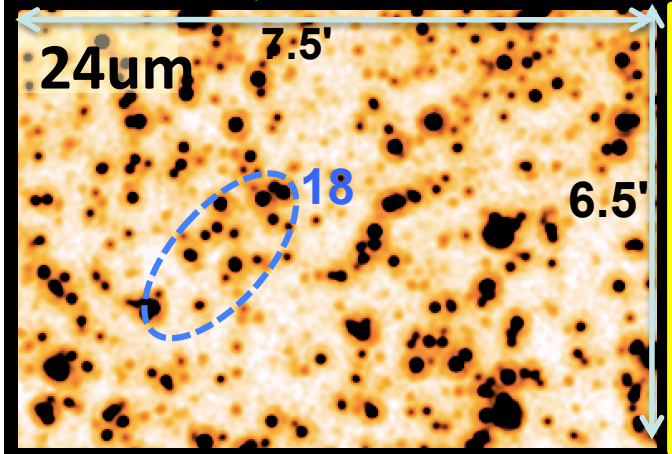
115 hours
simulation

GOODS-N 10' x 15': 44000 optical galaxies (HST)

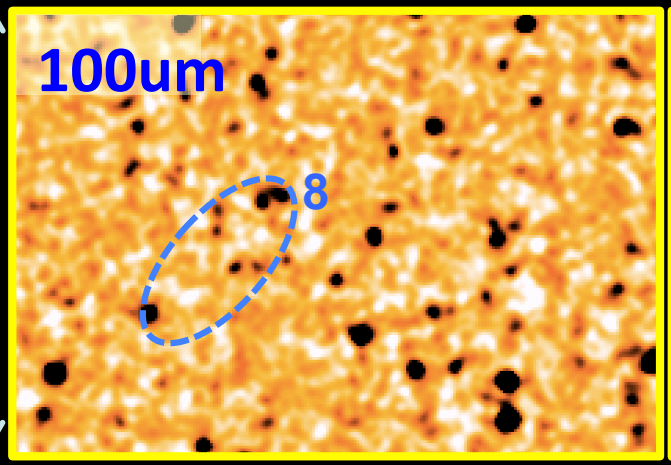
24476 Spitzer/IRAC (55% have z)
2575 MIPS24um galaxies (91% have z)
1263 ≥ 1 Herschel detection (89% have z)

FWHM=	6.7"	11"	18.1"	24.9"	36.9"
λ (μm)=	100	160	250	350	500

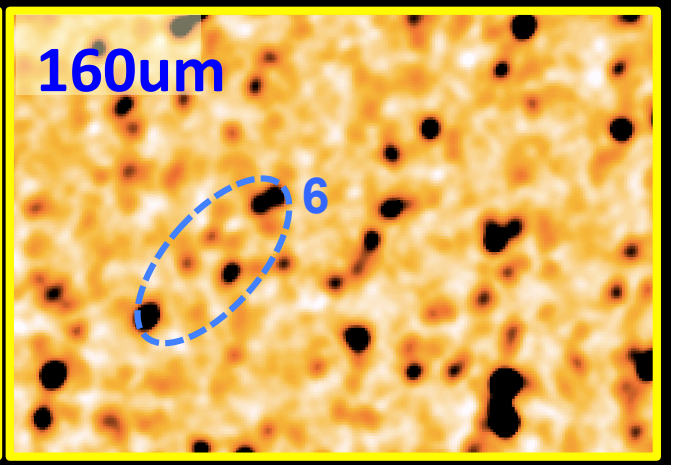
2575 (>21μJy)



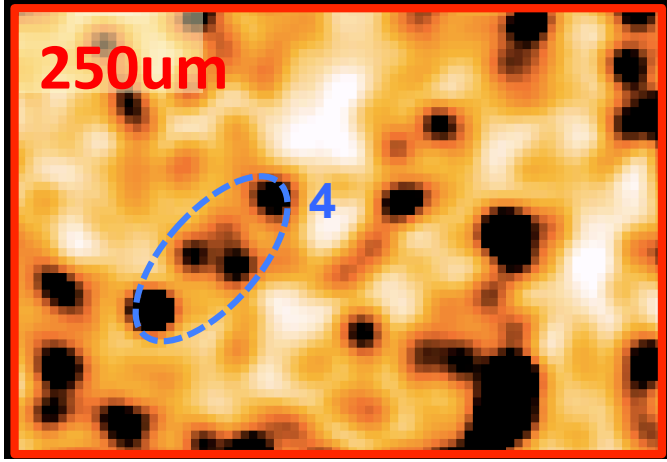
1095 src (>1.1mjy)



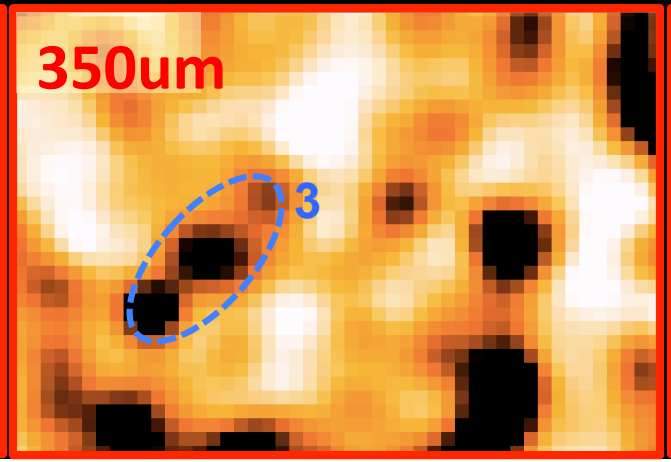
781 src (>2.7mjy)



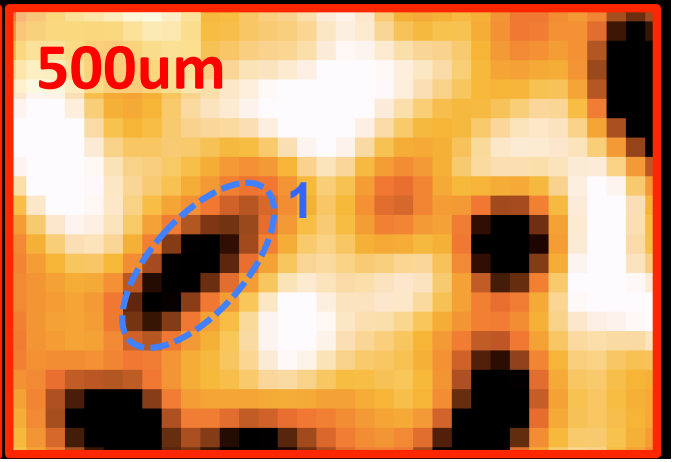
374 src (>5.7mjy)



173 src (>7.2mjy)

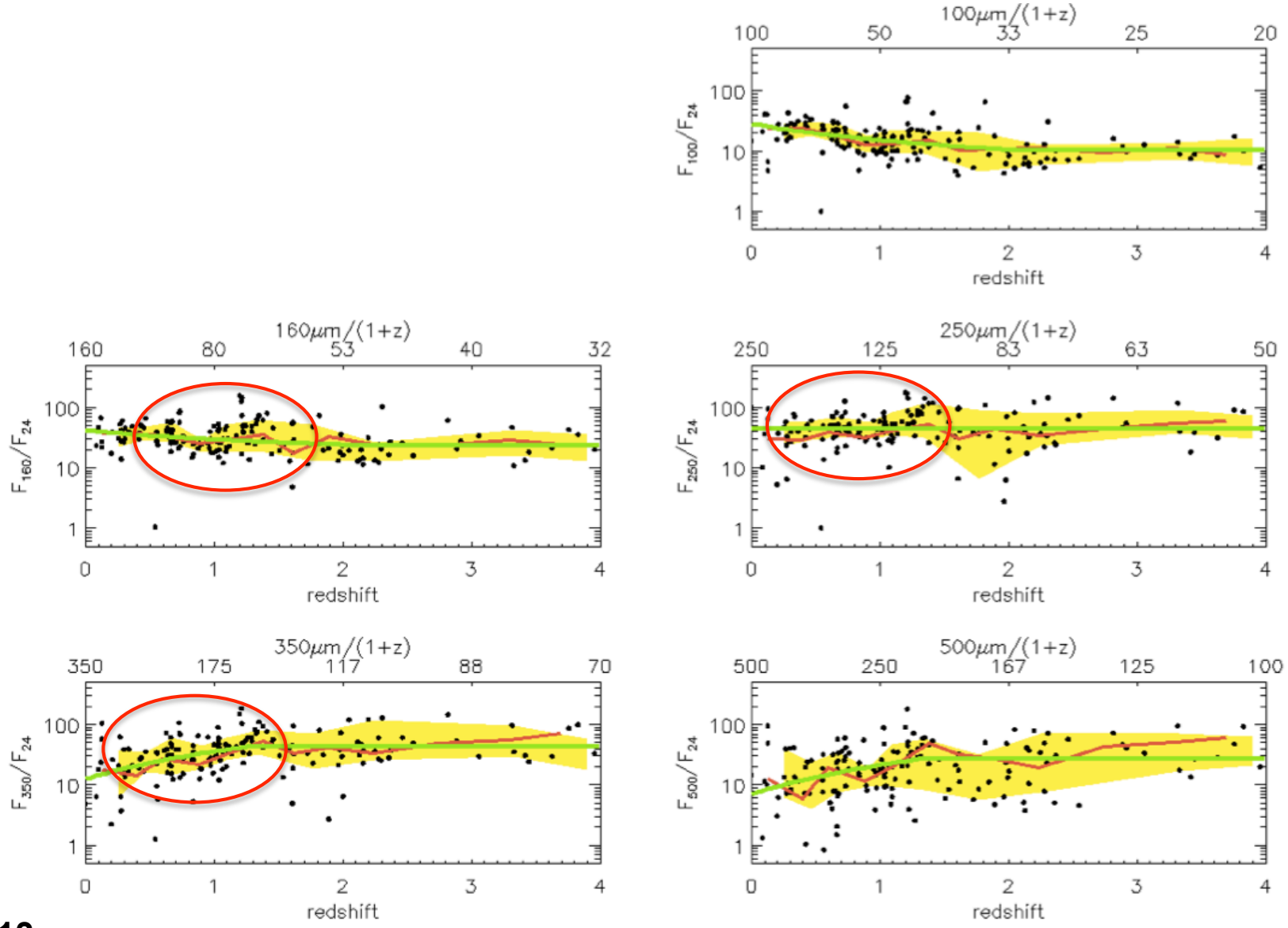


24 src (>9 mjy)



Using the universality of IR SED to dig into confusion

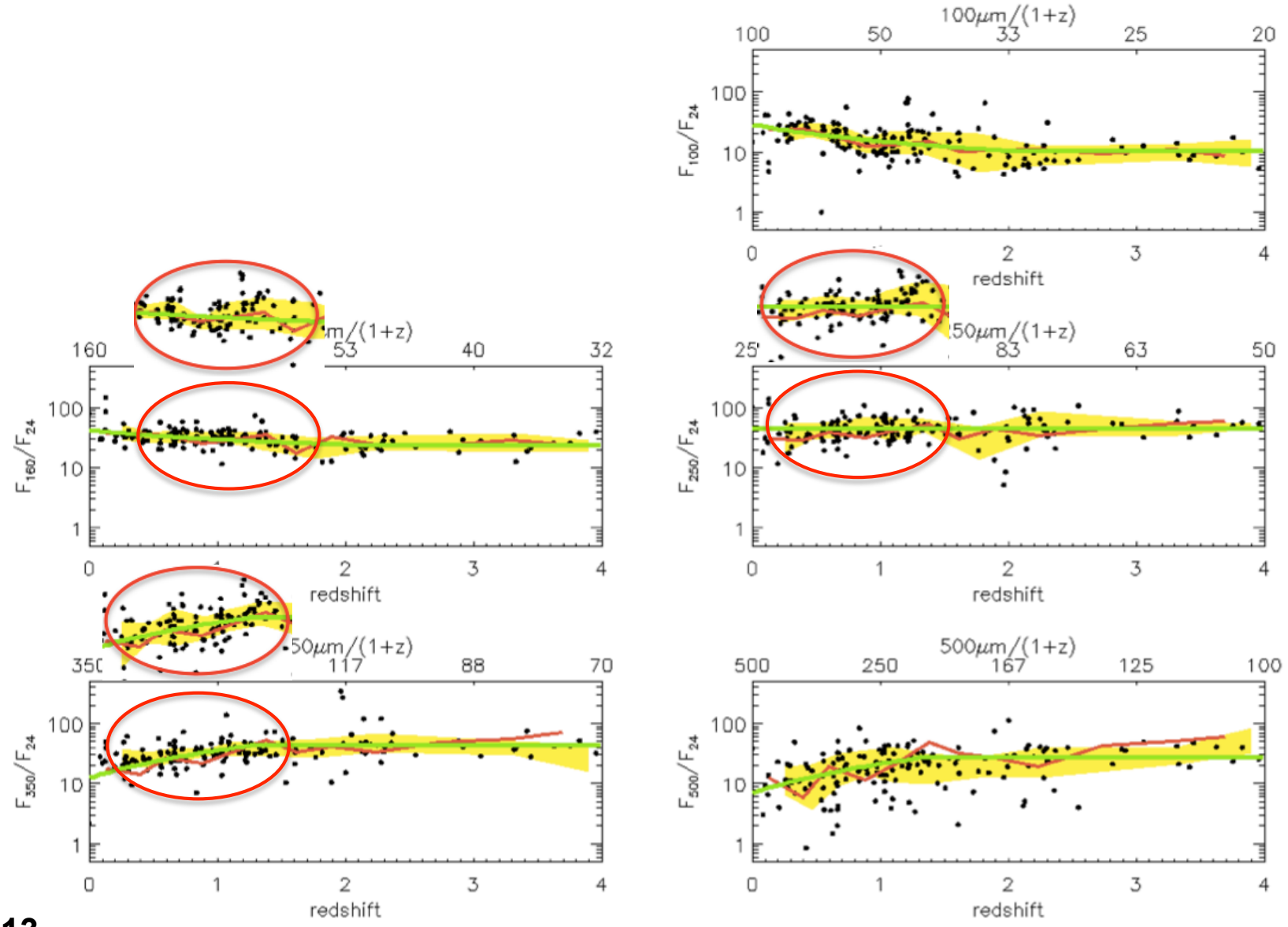
Direct Herschel / Spitzer 24 μm flux density ratio vs redshift



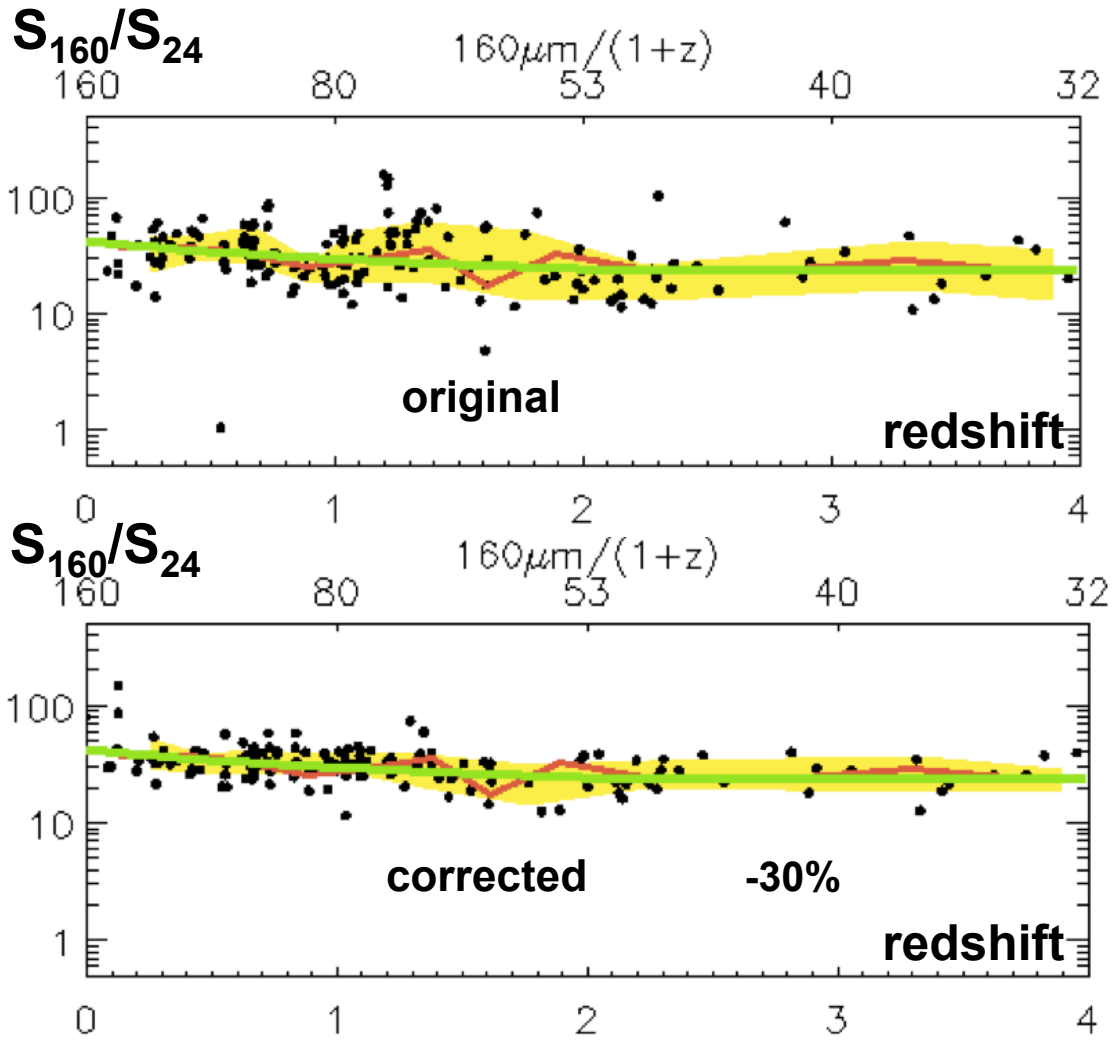
Leiton +13

Using the universality of IR SED to dig into confusion

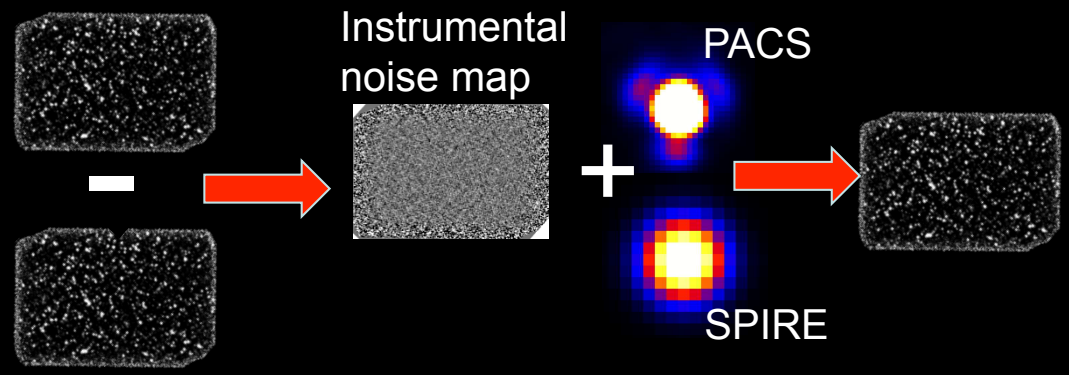
Herschel / Spitzer 24 μm flux density ratio vs redshift with iterative corrections from shorter wavelengths : when F100/F24 = 2 x (median) → F160 / 2 → used to extrapolate 160 from 24μm



Leiton +13

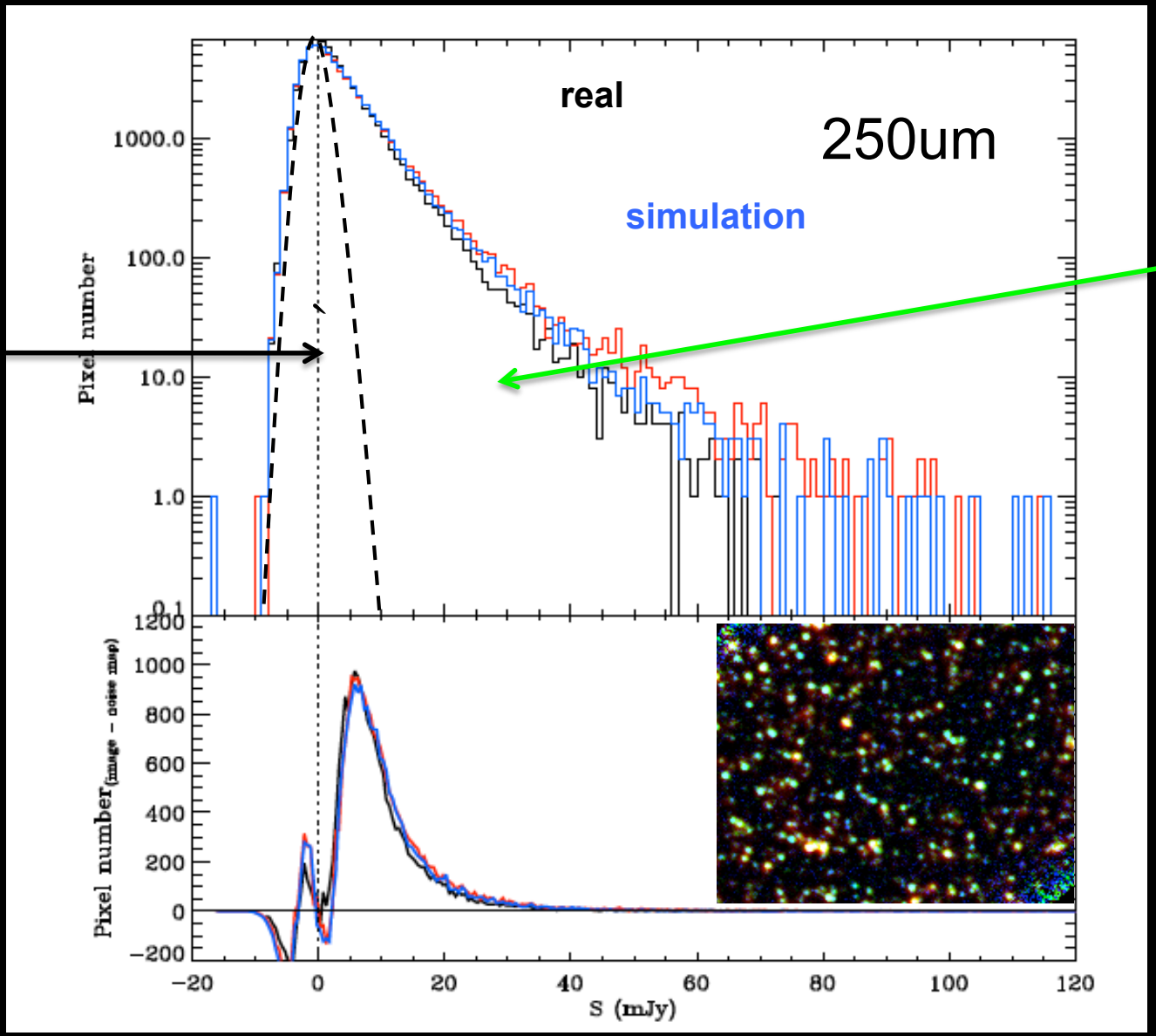

S_{160}/S_{24}
160μm/(1+z)
160
80
53
40
32
100
10
1
original
redshift
0
1
2
3
4
S_{160}/S_{24}
160μm/(1+z)
160
80
53
40
32
100
10
1
corrected
-30%
redshift
0
1
2
3
4

Leiton +13



real GOODS-North 250**μm 7.7'x7.7'** simulated

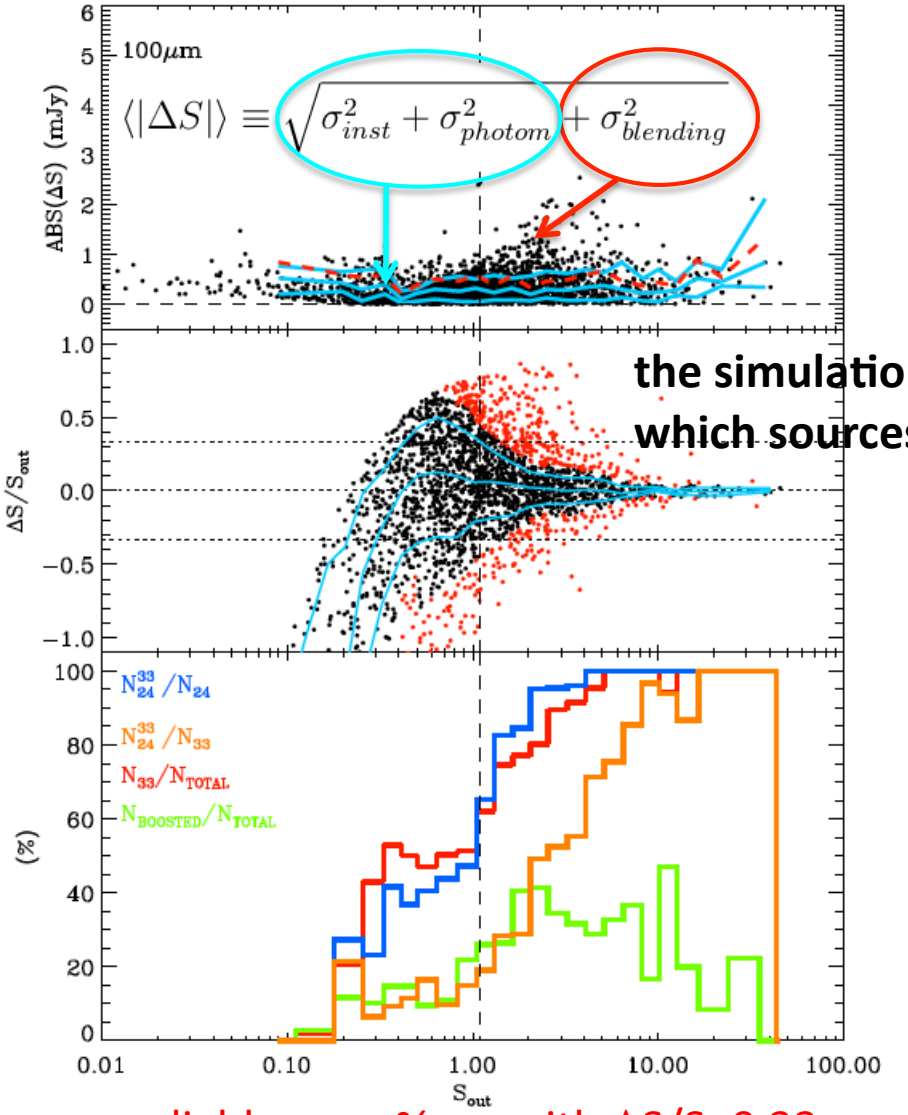
P(D), distribution pixel values, simulations ~ real images

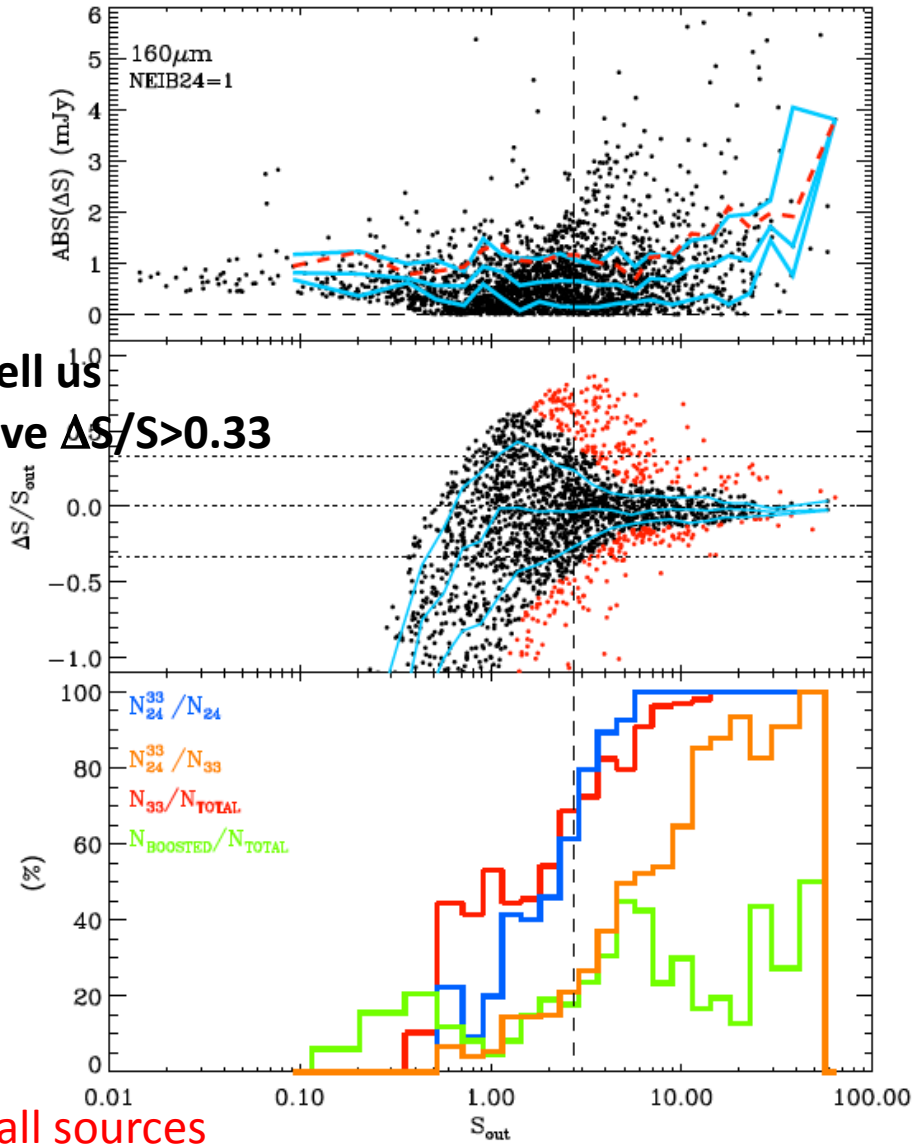


noise

Sources

"confusion" limit : >68% with a flux accuracy better than 33%





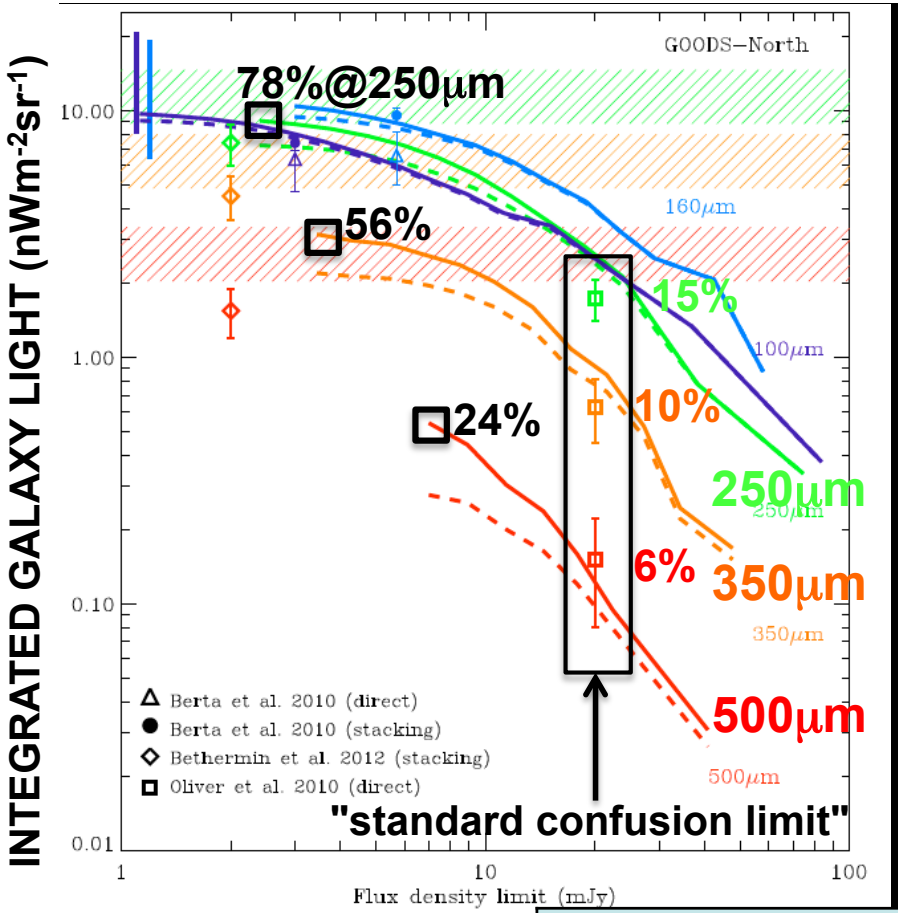
the simulations tell us which sources have ΔS/S>0.33

reliable src= % src with ΔS/S<0.33 among all sources

purity = % src with ΔS/S<0.33 among clean priors → close to red curve, so clean sources with S>1 mJy do have a flux accuracy better than 33%

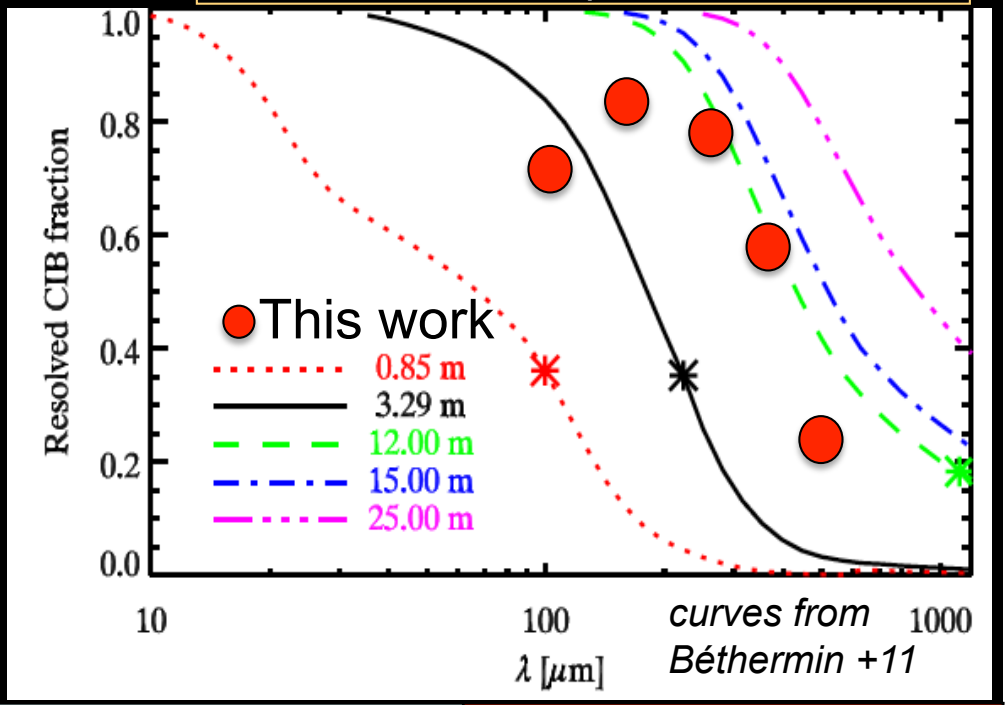
"clean" src: at most one neighbor closer than 20" with $F_{24}>F_{24}^0/2$

completeness = nb clean src with ΔS/S<0.33 / total nb src with ΔS/S<0.33



Resolution of IR background

D=3.5m ➔ 12.0m @ 250 μ m and 350 μ m



Leiton +13

	Previous direct measurements				THIS WORK		
	BAND (um)	IGL (>S_{lim}) (nWm-2sr-1)	S>S_{lim} (mJy)	% of CIRB	IGL (>S_{lim}) (nWm^{-2}sr^{-1})	S_{lim} (mJy)	% of CIRB
Berta +2010	100	6.36	3.0	44%	**10.2**	**1.1**	**71%**
Berta+2010	160	6.58	5.7	51%	**10.7**	**2.7**	**84%**
Oliver+2010	250	1.73	18.7	15%	**9.2**	**2.2**	**78%**
Oliver+2010	350	0.63	18.4	10%	**2.26**	**3.1**	**56%**
Oliver+2010	500	0.15	13.2	6%	**0.32**	**7.0**	**24%**

"A multi-scale, multi-wavelength source extraction method: getsources"
Menshchikov 12, A&A 542, 81

