PACS benchmarking: environment and comparison metrics

Roberta Paladini - NHSC/Caltech

Let's step a few months back….

- **Original discussion for having a Herschel mapmaking workshop started in March 2012 at the Herschel Calibration Workshop (..following a QA session with T. Marston)**

- **The developers of the mapmaking codes were contacted to agree upon organizing a Herschel mapmaking comparison exercise...**

- **the first telecon in preparation for this workshop was held in April 2012…o**
  (http://herschel.esac.esa.int/twiki/bin/view/Pacs/MapMaker2012)

PACS Benchmarking: The Philosophy

Goal of the benchmarking is to test the *performance* (→ will return on this point) of the participating mapmaking algorithms using both *real* and *simulated* Herschel data sets.

Participating codes for PACS benchmarking are:

MADmap	HIPE/Java implementation
Scanamorphos	http://www2.iap.fr/users/roussel/herschel/
JScanamorphos	HIPE/Java implementation of Scanamorphos
SANEpic	http://www.ias.u-psud.fr/sanepic/
Unimap	http://infocom.uniroma1.it/~lorenz/Unimap/
Tamasis	http://pchanial.github.com/tamasis-pacs/

PACS high-pass filtered mapping in HIPE
http://herschel.esac.esa.int/twiki/pub/Public/PacsCalibrationWeb/PDRG_Phot_May12.pdf

ALL THESE MAPMAKING PACKAGES ARE PUBLICLY AVAILABLE (OR SOON WILL BE)

PACS MapMaking Team

- Babar Ali/ Roberta Paladini → MADMap
- Helene Roussel → Scanamorphos
- Michael Wetzstein → Jscanam
- Pierre Chanial/Pasquale Panuzzo → Tamasis
- Alexandre Beelen → SANEPIC
- Lorenzo Piazzo → Unimap

PACS Benchmarking Team

- Babar Ali
- Bruno Altieri
- Vera Konyves
- Gabor Marton
- Roberta Paladini
- Lorenzo Piazzo
- Roland Vavrek
- Zoltan Balog

18 Real Data Sets: selection criteria

The selection of the data set is performed in order to allow the coverage of a parameter space as large as possible in terms of:

- **source surface brightness**
- **background surface brightness**
- **depth (i.e. # of repetitions)**
- **size of covered sky area**
- **observing mode**

18 Real Data Sets

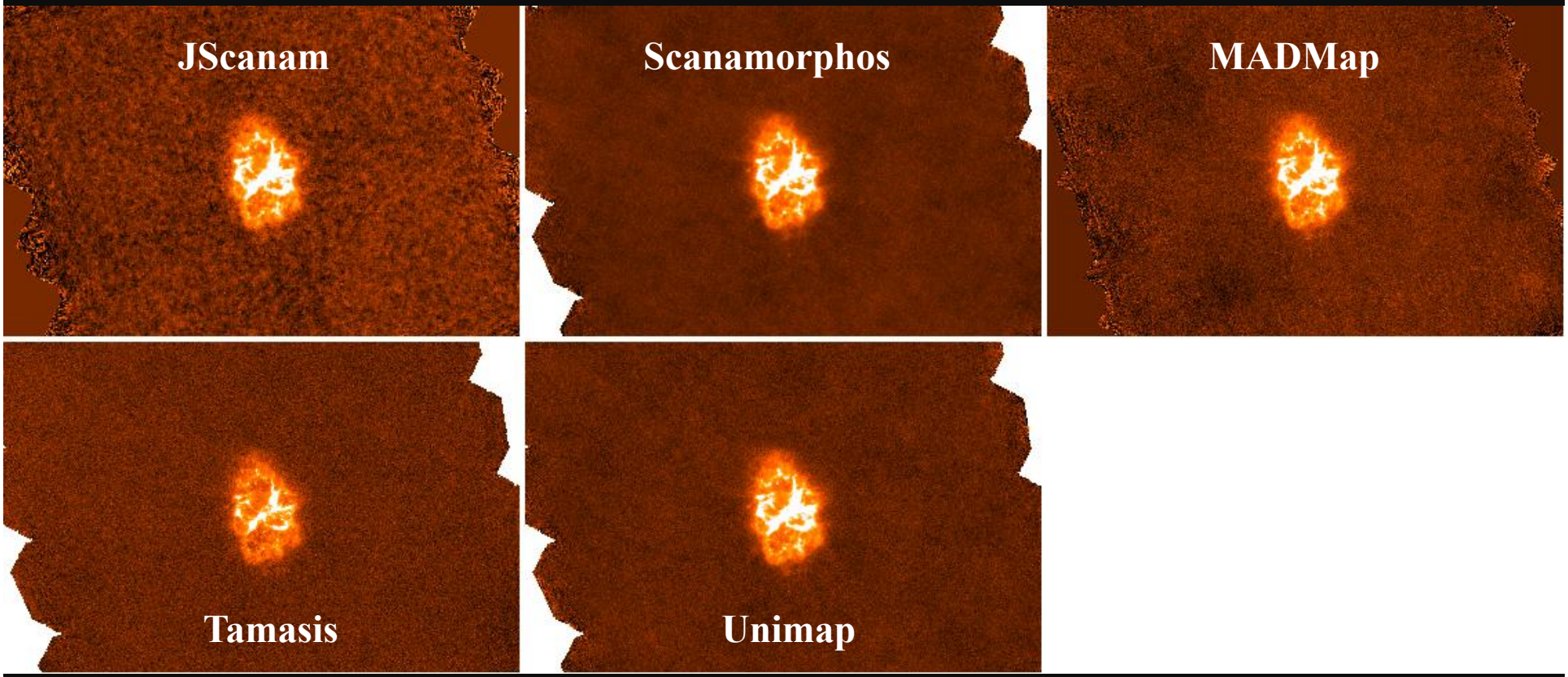
Field	Source	Background	Size	Coverage	AOT
Crab	Bright/ extended	Flat	Medium	Medium	Scan map
HiGAL l=30	Bright/fills the field	Bright	Large	Shallow	Parallel mode
GRB-110422A	Faint/point-like	Flat	Small	Deep	Scan map
IC 348	Bright/ extended (lots of point sources)	Bright/Flat	Small/ Medium	Deep	Scan map
Atlas	Faint point sources	Flat	Large	Shallow	Parallel
NGC 6946	Moderately extended	Flat	Medium	Medium	Scan map
NGC 6334	Bright/fills the field	Bright	Large	Shallow	Parallel mode
M31	extended	Flat-ish	Large	Deep	Parallel mode

18 Real Data Sets - *continued*

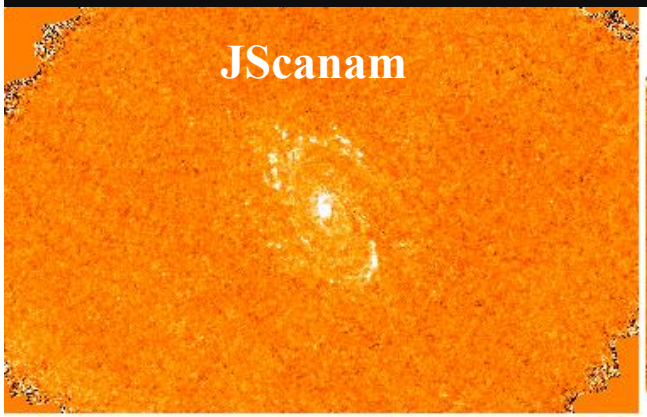
Field	Source	Background	Size	Coverage	AOT
M81	Moderately extended	Flat	Medium	Medium	Scan map
Polar Bear	Cirrus	Flat	Large	Medium/deep	Scan map
LDN1780	Faint/diffuse emission	Flat	Large	Medium	Parallel mode
HOPS Group 38	Bright/fills the field	Bright	Medium	Medium	Scan Map
Rosette	extended/fills the field	Bright	Large	Shallow	Parallel mode
HOPS Group 306	Bright/fills the field	Bright	Small	Medium	Scan map
Sa 187/188 MMS 3-5	Diffuse emission with lots of sources	Moderate	Medium	Shallow	Scan Map
HOPS Group 79	Very Bright point source	Flat-ish	Small	Medium	Scan map
Antennae	Moderately extended	Flat-ish	Medium	Medium	Scan Map

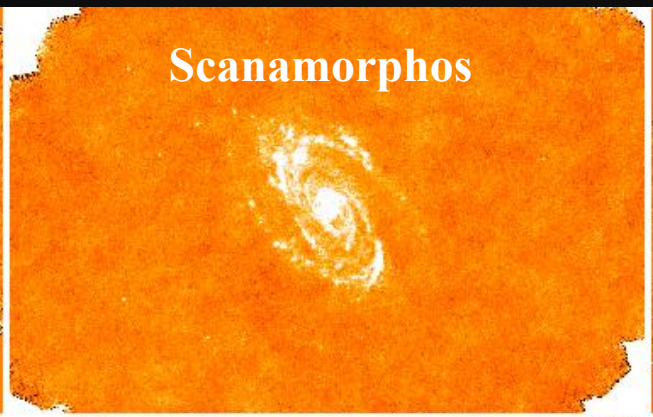
18 Real Data Sets: a few examples

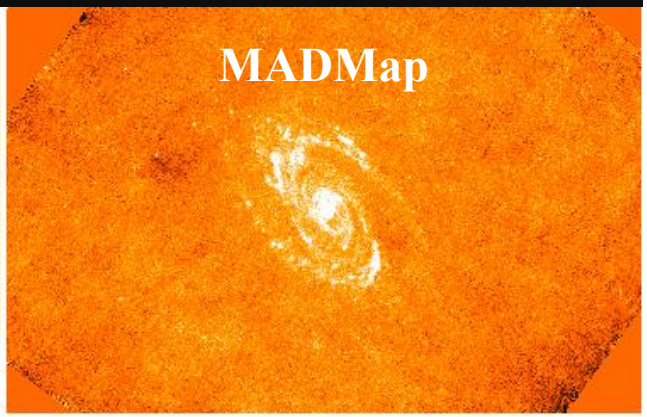
Crab

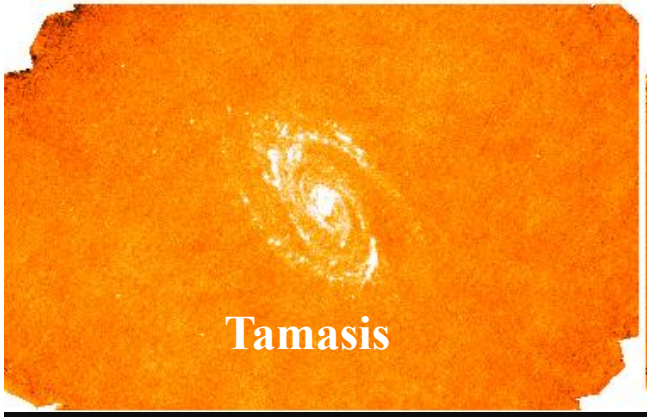


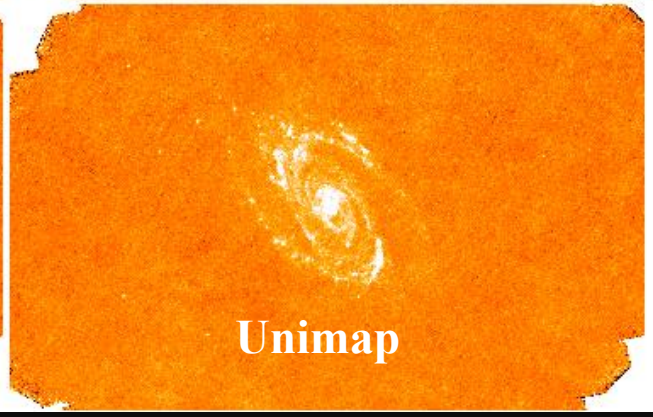
18 Real Data Sets: a few examples
M81



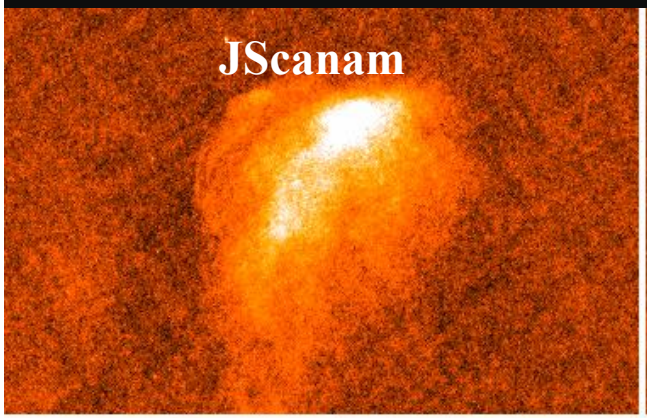


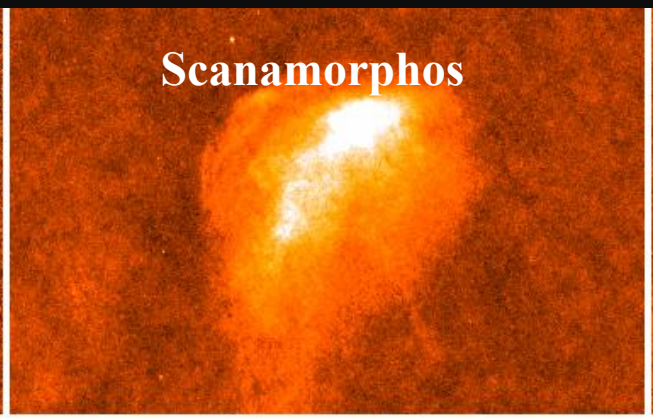


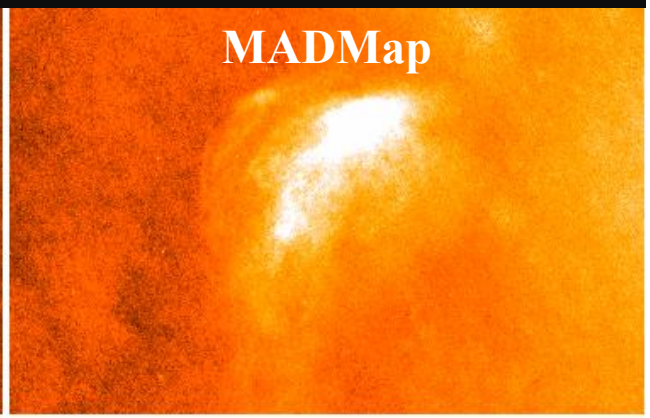


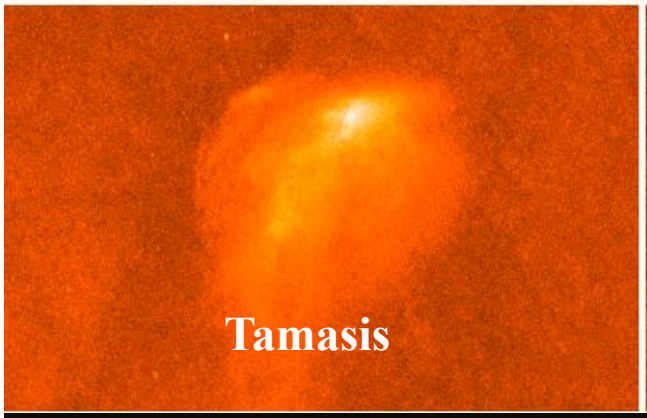


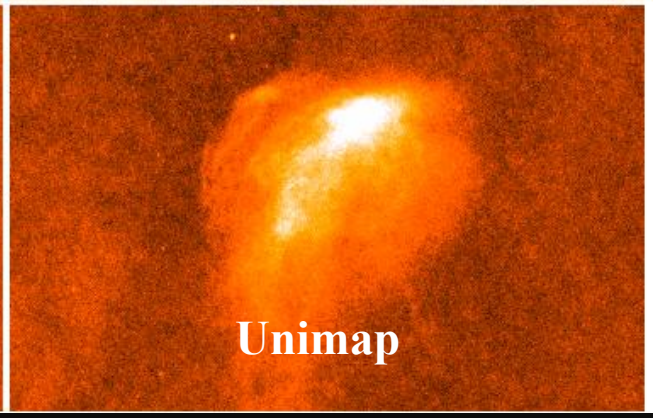
18 Real Data Sets: a few examples
LDN 1780











2 Simulated Data Sets

(R. Vavrek, L. Piazzo, P. Chanial, B. Altieri)

Simulated *hybrid* data:

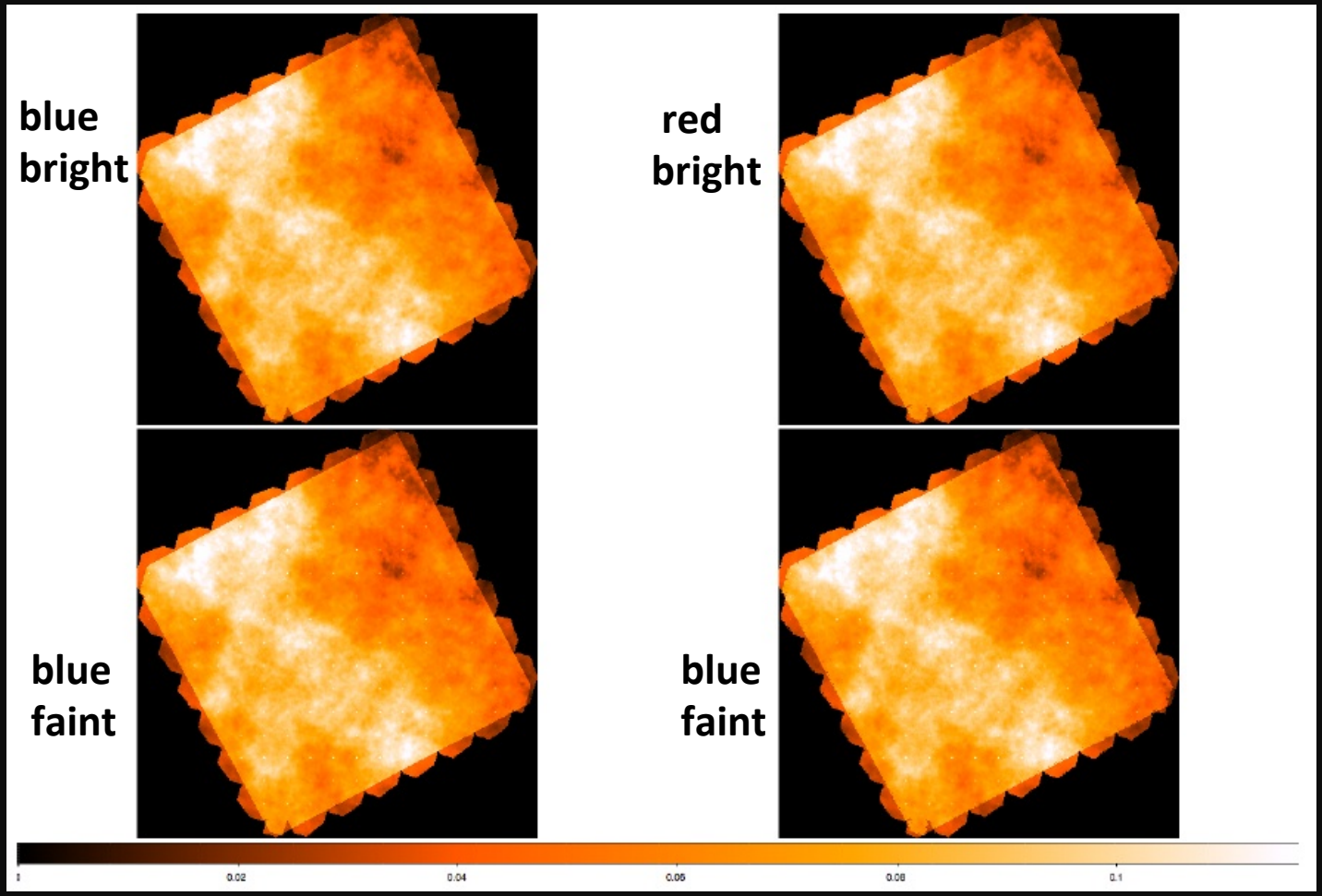
A) Simulated sky signal
(2D pink-noise)

+

B) pure instrument noise
(staring calibration observation)

Flux calibrated Level 1 detector timeline

2 Simulated Data Sets - *continued*



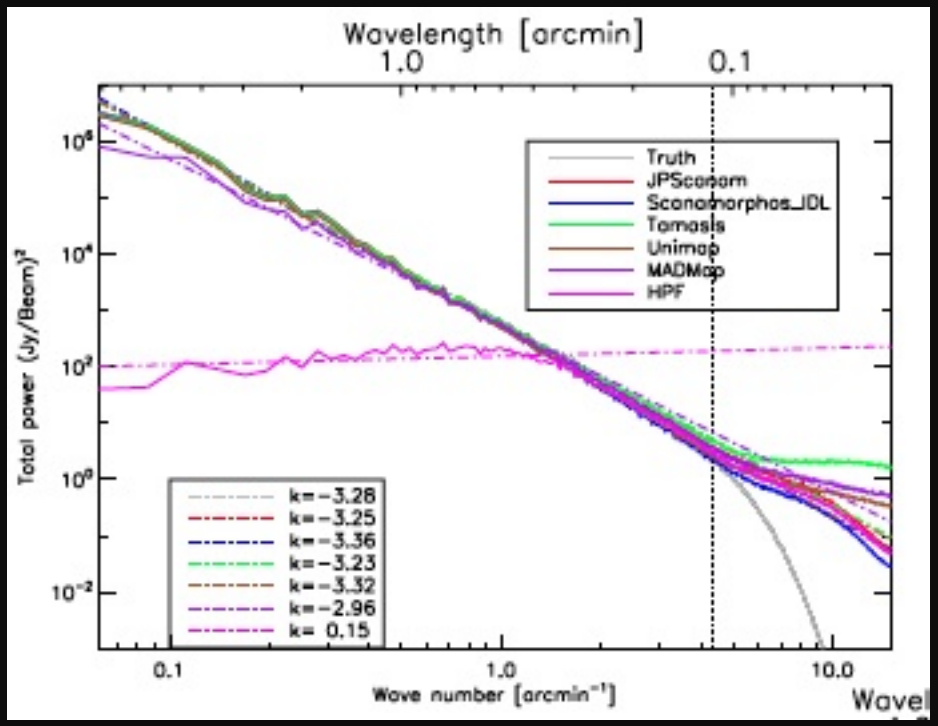
PACS benchmarking: metrics

1. Power spectrum estimation
2. Point Source photometry
3. Noise statistics
4. Difference matrix
5. Comparison with ancillary data I/II

PACS benchmarking: Power Spectrum Estimation (G. Marton)

2d-angle averaged power spectrum analysis

common tool for PACS and SPIRE



PACS benchmarking:
Point Source Photometry (Z. Balog, V. Konyves, B. Altieri)

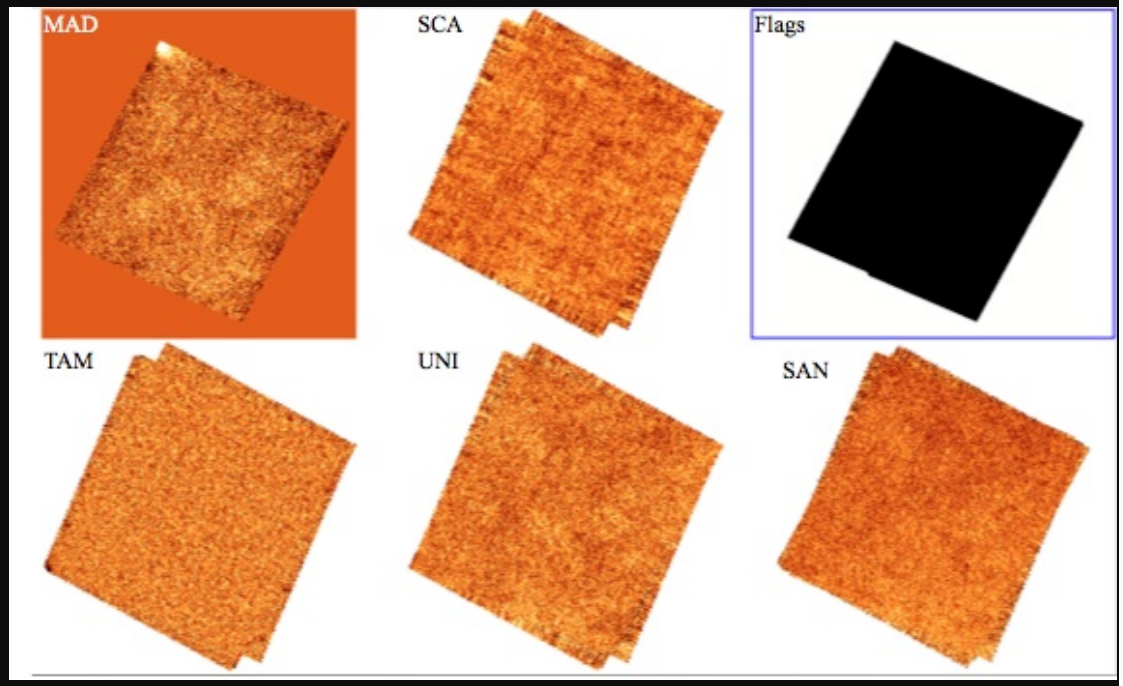
Procedure:

1. Find the mass coordinates of the sources visible in a given map;
2. Perform gaussian fitting of the source at designated coordinates;
3. Do aperture photometry at the position derived by the gaussian fitting using same source and sky apertures for each source;
4. Extract the astrometric and photometric information from the result product (flux, $fwhm_x$, $fwhm_y$, RA, DEC);
5. Compare the RA and DEC values with known 2MASS coordinates

PACS benchmarking: Noise Statistics (L. Piazzo)

Procedure:

1. Select a data set containing close to no signal (e.g. Atlas field);
2. flag out sources;
3. Obtain a sample of the noise introduced by the mapmaking codes;
4. Estimate: NOISE VARIANCE, NOISE 1D-PS, NOISE 2D-PS

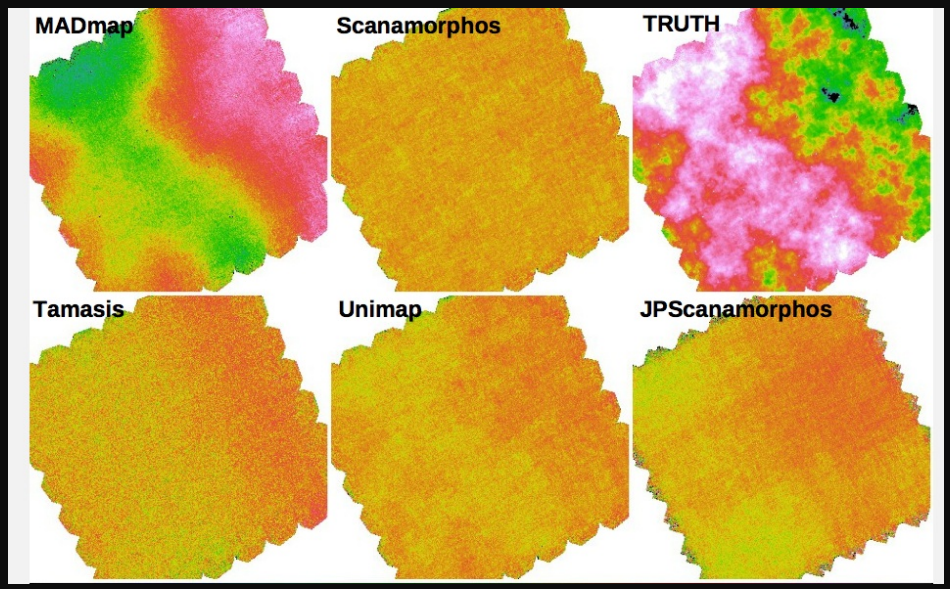


PACS benchmarking: Difference Matrix (V. Konyves)

Procedure:

1. Compare real observations processed with different mapmaking algorithms with respect to a reference (e.g Scanamorphos);

2. Compare simulated observations processed with different mapmaking algorithms with respect to true input sky → scatter plot/difference of standard deviation



PACS benchmarking: Comparison with AncillaryData – IRAS (B. Ali)

Procedure:

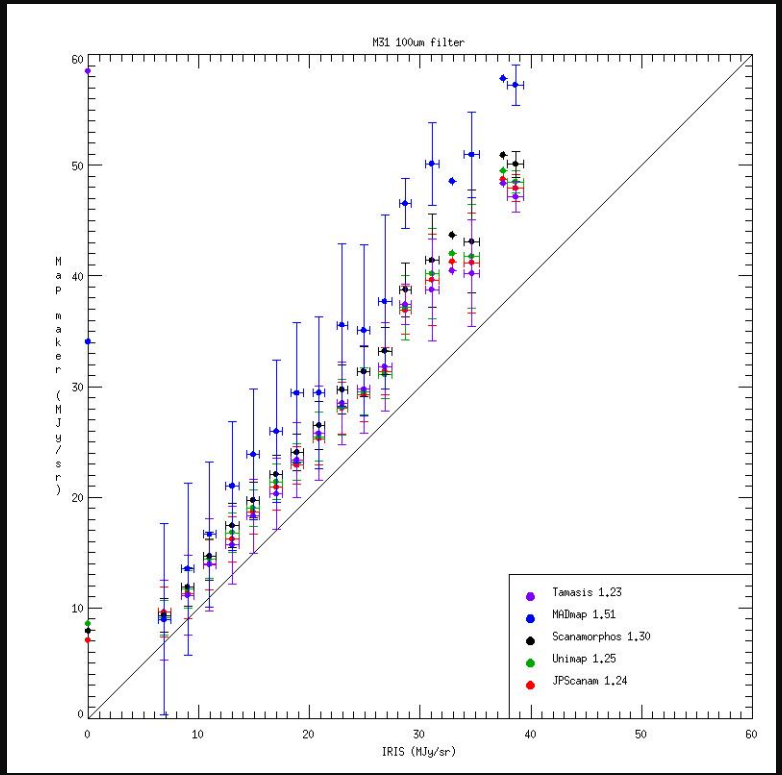
1. for every PACS data set, extract corresponding area from IRIS data;

2. PACS maps are converted into MJy/sr;

3. apply scaling relation and color corrections;

4. Convolve and rebin PACS data to IRIS resolution;

5. generate and fit scatter plot from pixel-to-pixel distribution → derive *offset* and *gain*;



PACS benchmarking: Comparison with AncillaryData – MIPS (R. Paladini)

Procedure:

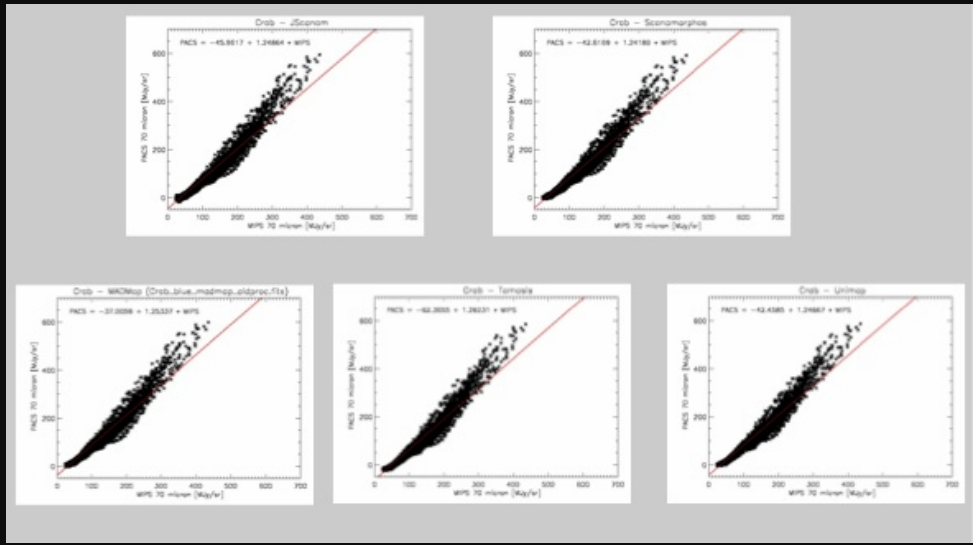
1. for every PACS data set, extract corresponding area from MIPS data;

2. PACS maps are converted into MJy/sr;

3. apply scaling relation and color corrections;

4. Convolve and rebin PACS data to MIPS resolution;

5. generate and fit scatter plot from pixel-to-pixel distribution → derive *offset* and *gain*;



…what you won't find in this benchmarking

- tests and considerations on memory consumptions and run time → fair only if individual packages run on the same type of machine
- Tests and considerations on features specific only of some map-making packages (e.g. high resolution)

Warning

A lot of this benchmarking was done with a VERY short timescale

Exact evaluation of the results will take some time and will go beyond this workshop

SO….do not jump to conclusions from what you see today and today only but…STAY TUNED !


nhsc


ipac

18 Real Data Sets: a few examples
M31