Scanamorphos map-making

Presenter: Babar Ali (NHSC)

Scanamorphos Author: Helene Roussel

Outline

I. Basics
   - What is Scanamorphos?
   - Why use Scanamorphos?
   - Where to get Scanamorphos
   - Where to find help

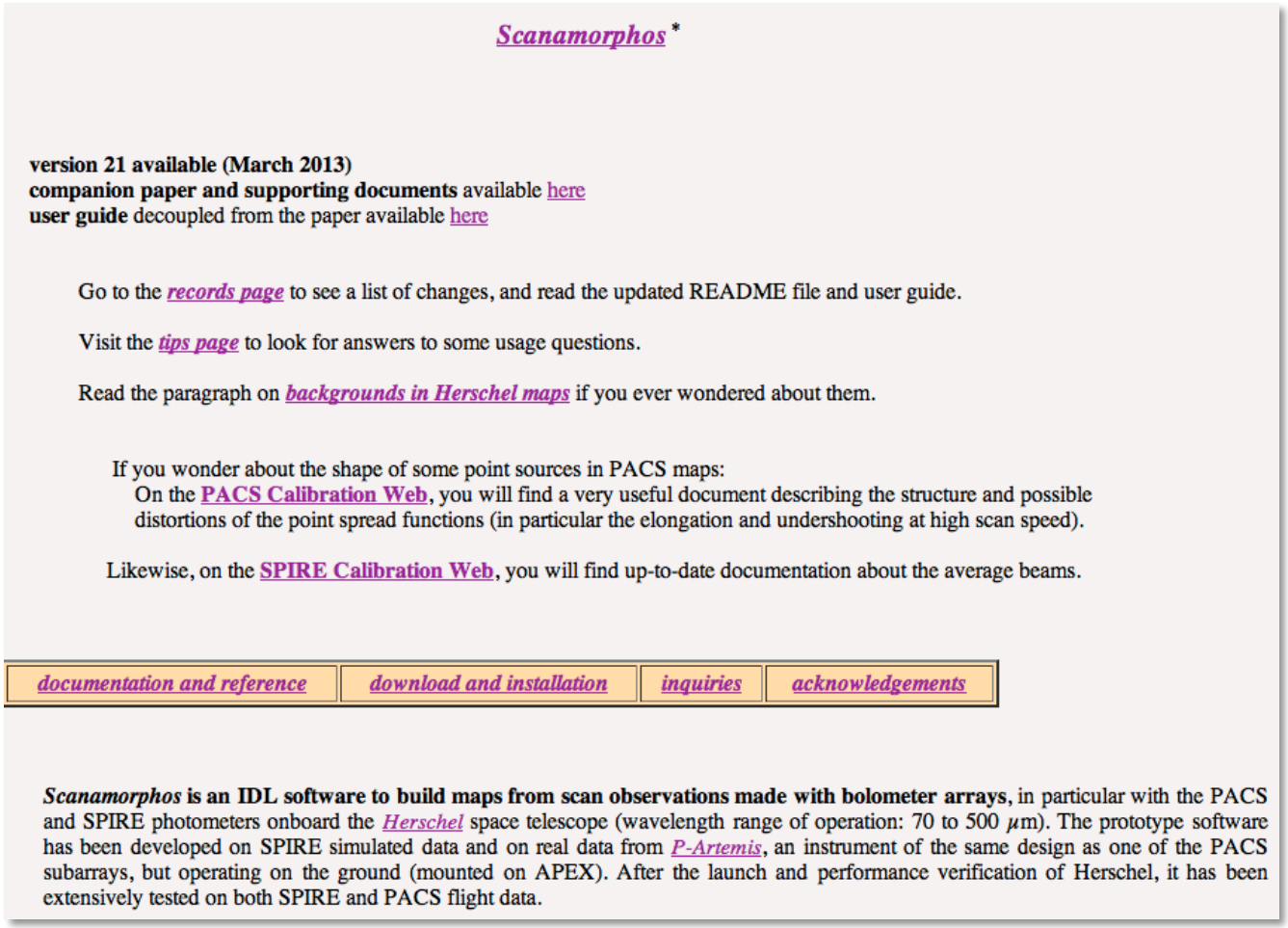
II. Scanamorphos Internals
   - *Taken from M. Wetzstein*

III. Using Scanamorphos

Part I

THE BASICS

What is Scanamorphos?



Scanamorphos *

version 21 available (March 2013)
companion paper and supporting documents available here
user guide decoupled from the paper available here

Go to the *records page* to see a list of changes, and read the updated README file and user guide.

Visit the *tips page* to look for answers to some usage questions.

Read the paragraph on *backgrounds in Herschel maps* if you ever wondered about them.

If you wonder about the shape of some point sources in PACS maps:
On the PACS Calibration Web, you will find a very useful document describing the structure and possible distortions of the point spread functions (in particular the elongation and undershooting at high scan speed).

Likewise, on the SPIRE Calibration Web, you will find up-to-date documentation about the average beams.

documentation and reference	*download and installation*	*inquiries*	*acknowledgements*

***Scanamorphos* is an IDL software to build maps from scan observations made with bolometer arrays**, in particular with the PACS and SPIRE photometers onboard the *Herschel* space telescope (wavelength range of operation: 70 to 500 μm). The prototype software has been developed on SPIRE simulated data and on real data from *P-Artemis*, an instrument of the same design as one of the PACS subarrays, but operating on the ground (mounted on APEX). After the launch and performance verification of Herschel, it has been extensively tested on both SPIRE and PACS flight data.

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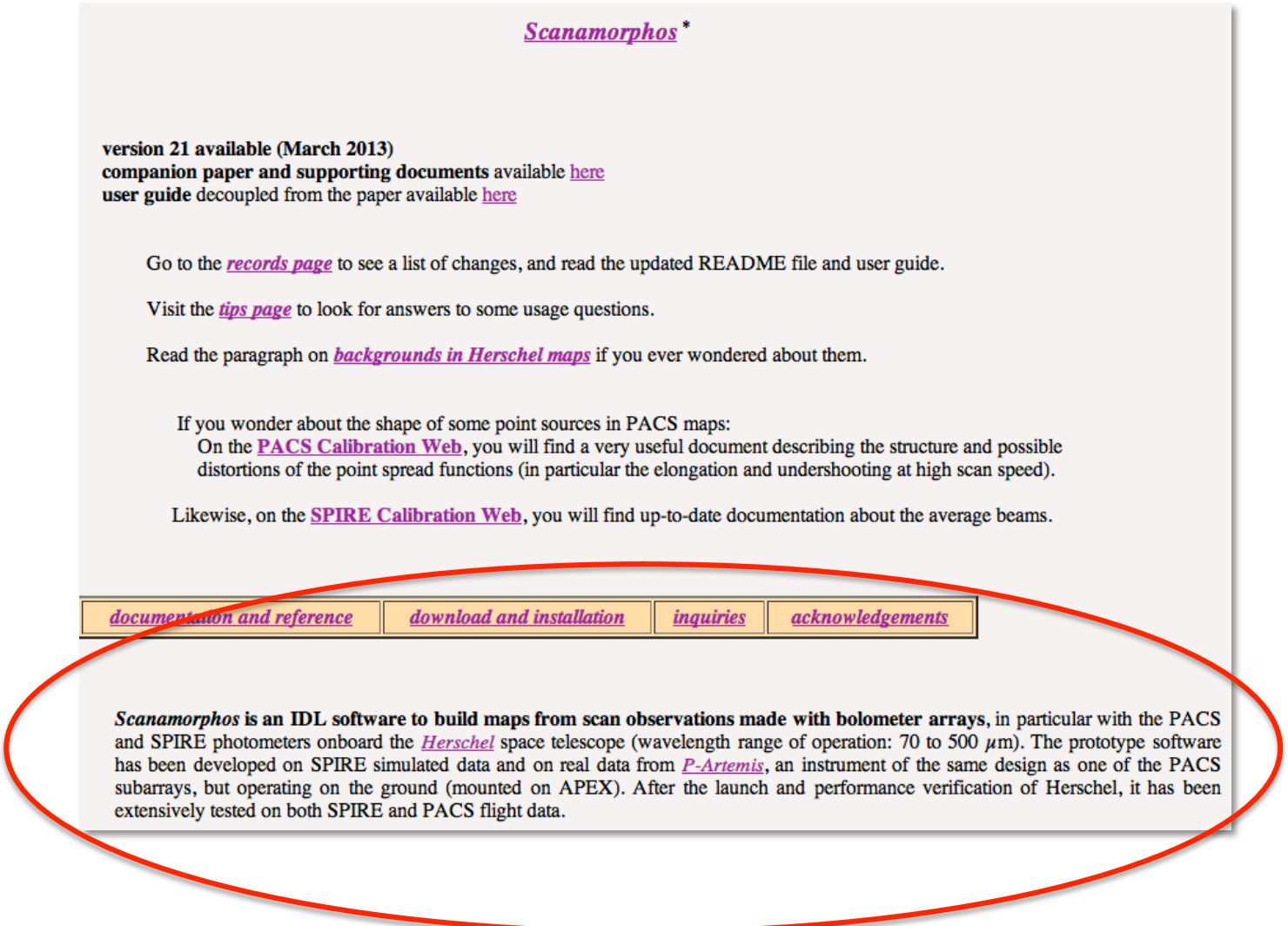

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Written in IDL

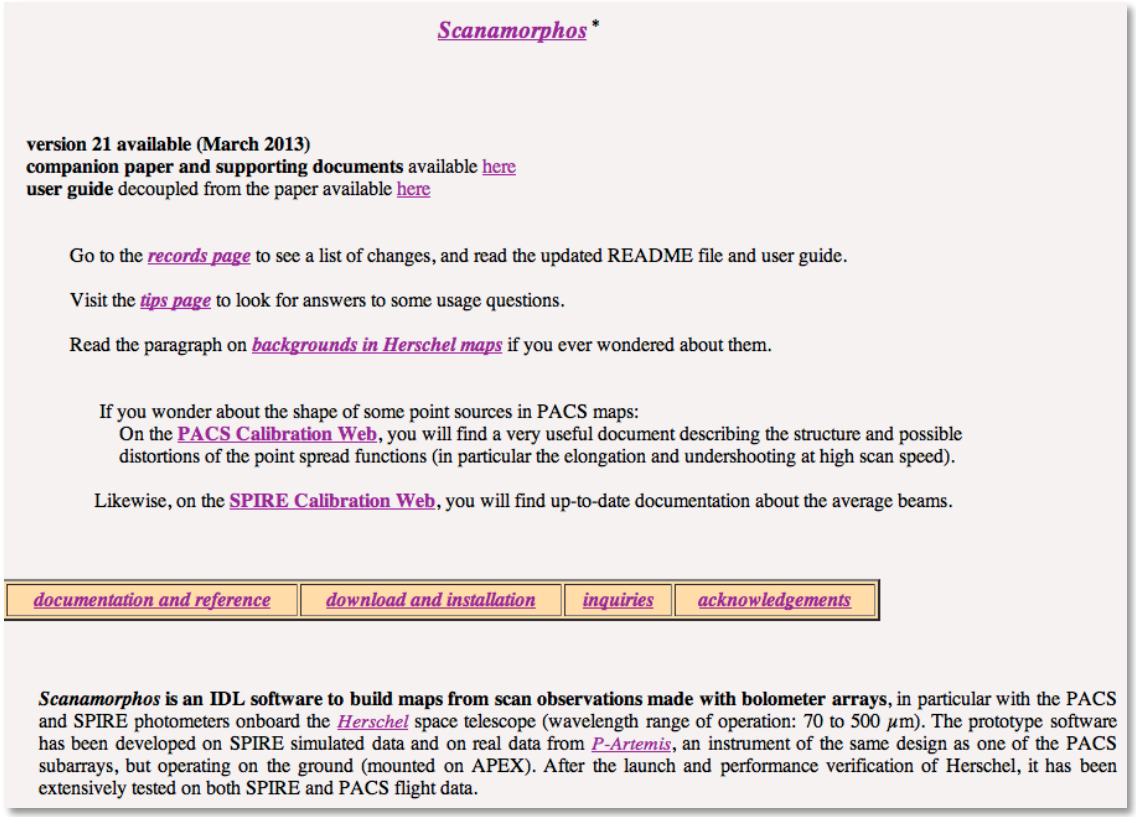
Standalone code that works from Level 1 processed PACS data

Why Use Scanamorphos?

- Stable and robust package, which produces scientifically validated images.
- Performed very well in metric evaluation for the recent map-making workshop
- Easy to use.
- Conserves flux.
- Low memory requirements compared to Java/ HIPE.
- Good response and support from Scanamorphos author.

Download & Documentation

http://www2.iap.fr/users/roussel/herschel/



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Where to get help?

- HSC and NHSC helpdesks
- Scanamorphos documentation
- Scanamorphos author
- Scanamorphos user community

Other tutorials and help

- HSC workshop/webinar presentations
- Michael Wetzstein

http://herschel.esac.esa.int/2013MapmakingWorkshop/presentations/JPScanam_MWetzstein_MapMaking2013_DPWS.pdf

- Zoltan Balog

http://herschel.esac.esa.int/twiki/pub/Public/DataProcessingWorkshop2012/scanam_tutor.pdf

- Youtube video of Zoltan's talk

  http://www.youtube.com/watch?v=MIYE31fSBTc

Part II

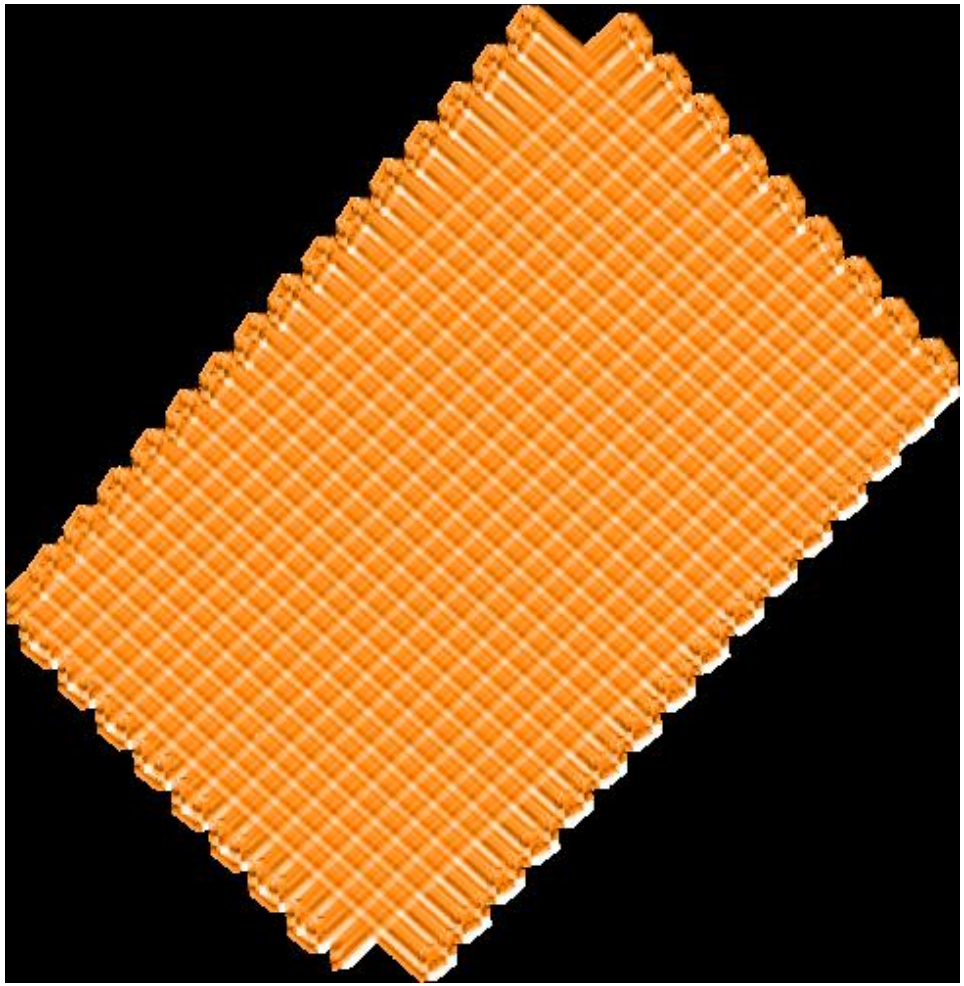
SCANAMORPHOS INTERNALS

Slides taken from M. Wetzstein

Scanamorphos port to JAVA

Michael Wetzstein

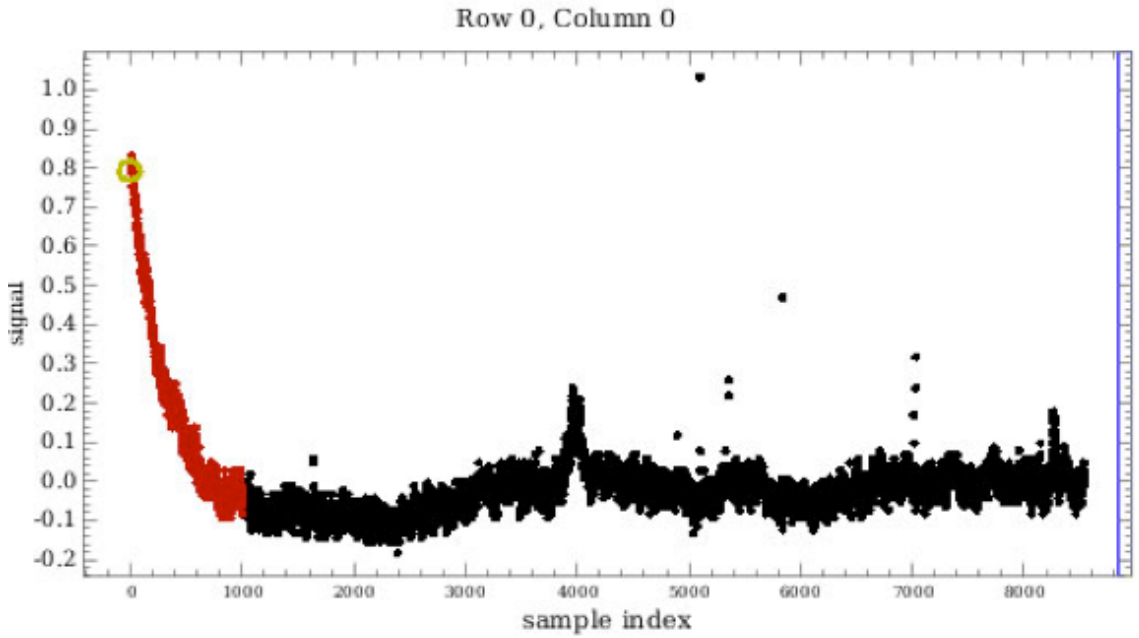
Level 1 of obsid 1342204362 + -63



Map dominated by noise artifacts at Level 1.

Scanamorphos will:
Measure and remove correlated and uncorrelated signal drift noise on different scales.

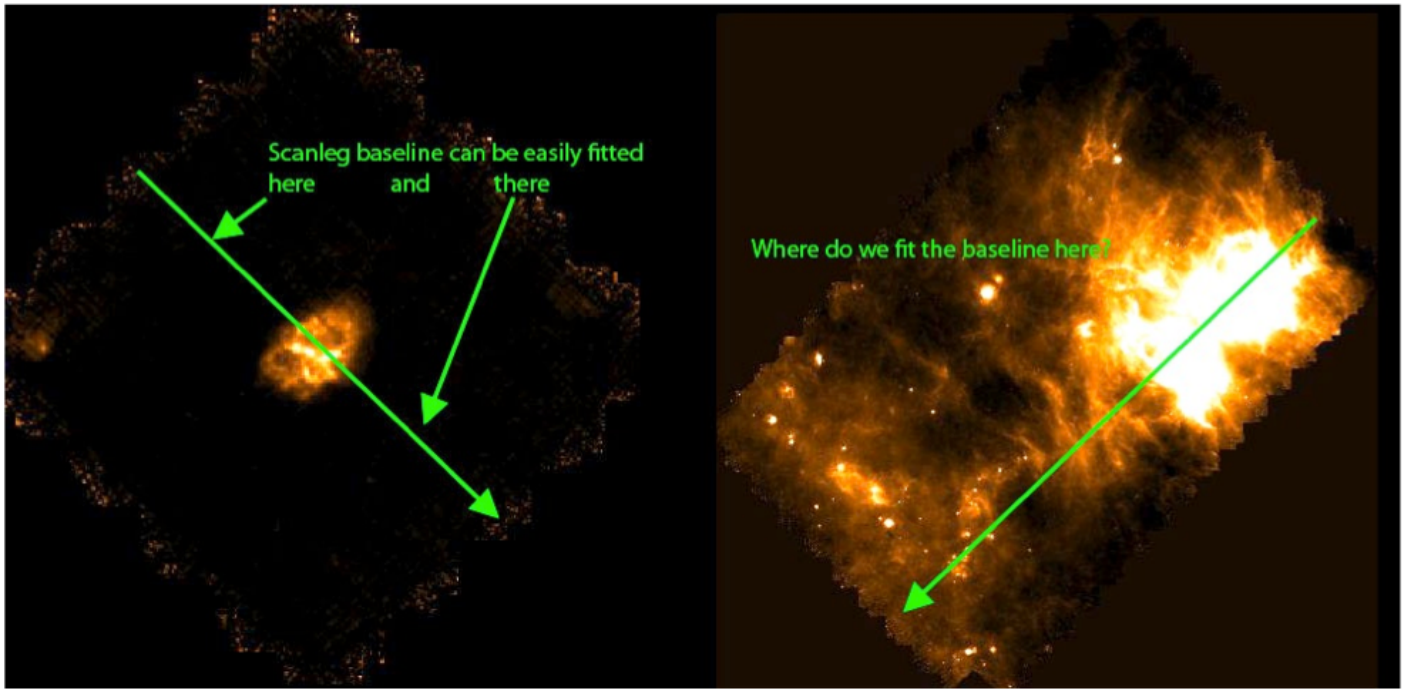
Preprocessing



Mask calibration block transients

Baseline removal: galactic or not?

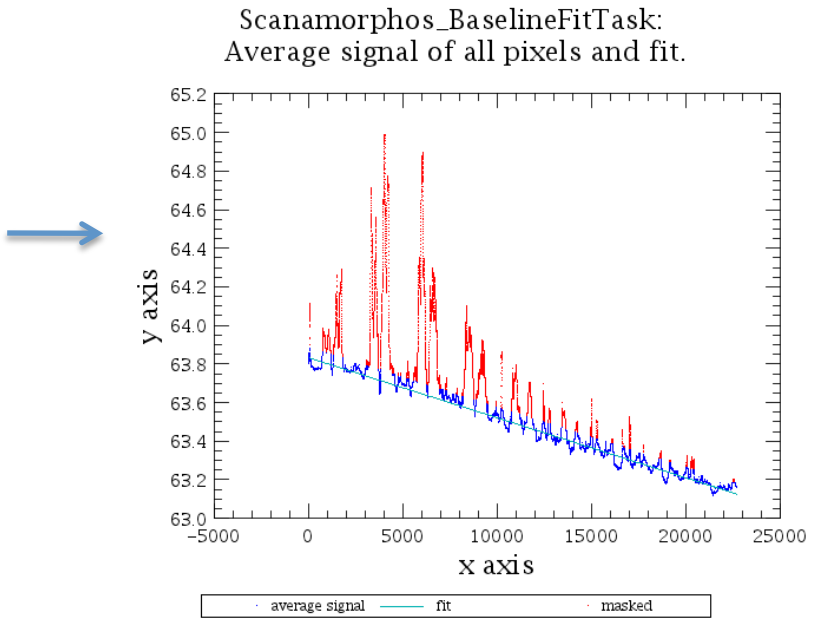
There is a difference between bright compact sources and bright distributed emission:



Baseline removal

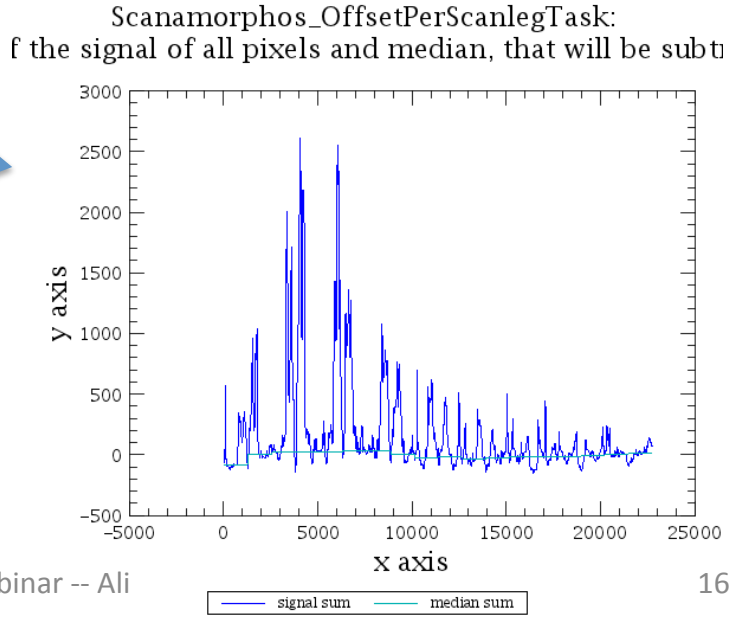
Non-Galactic

1. baseline fit of average signal, complete timeline. 3-sigma masking
2. subtract the median of all unmasked values per scanleg
3. repeat 1 and 2
4. repeat 1
5. Fit scanlegs per detector pixel, 2-sigma masking



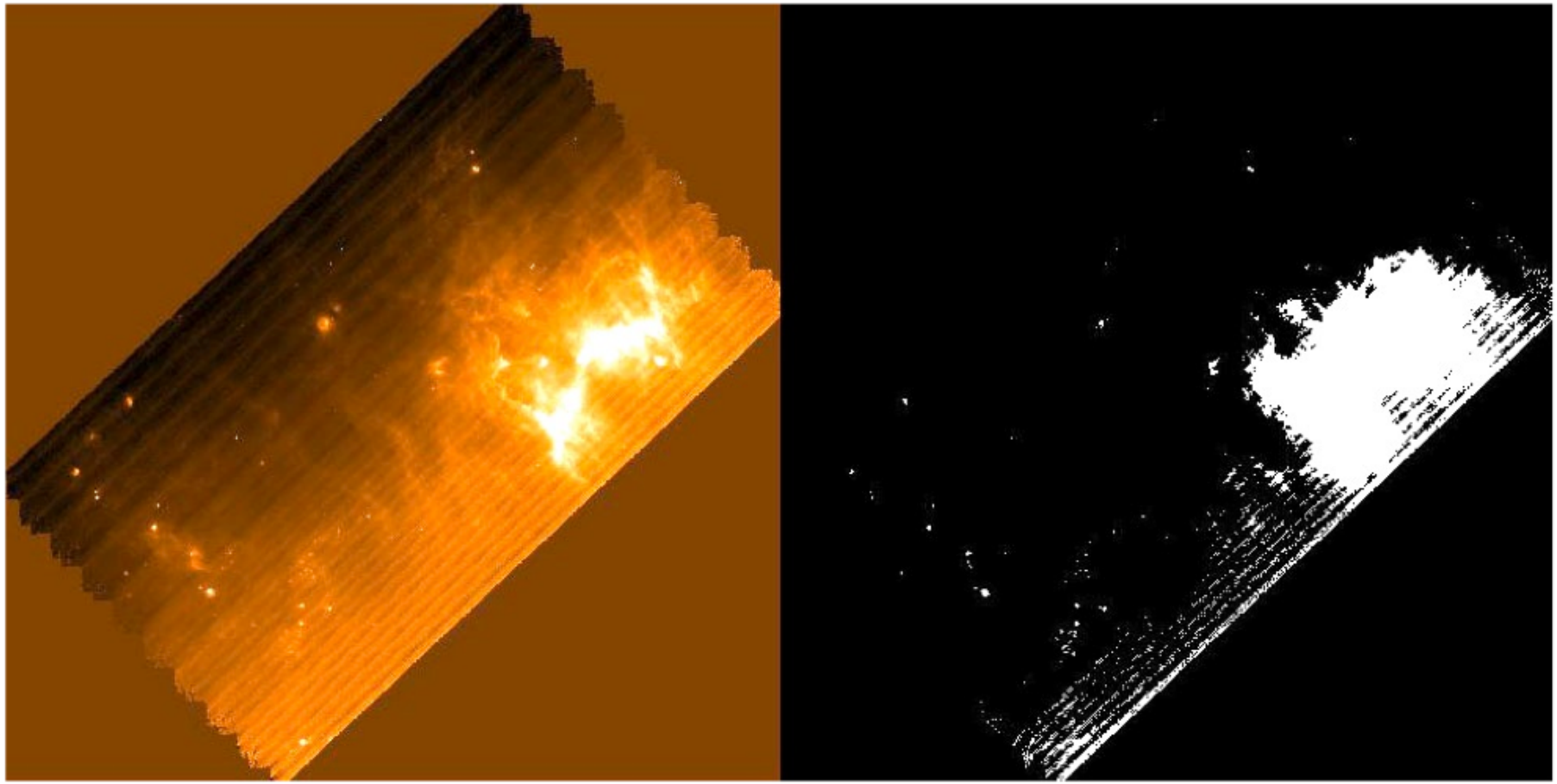
Galactic

1. Only the median recentering is done.
2. A threshold source mask is calculated.
3. Median recentering is repeated.

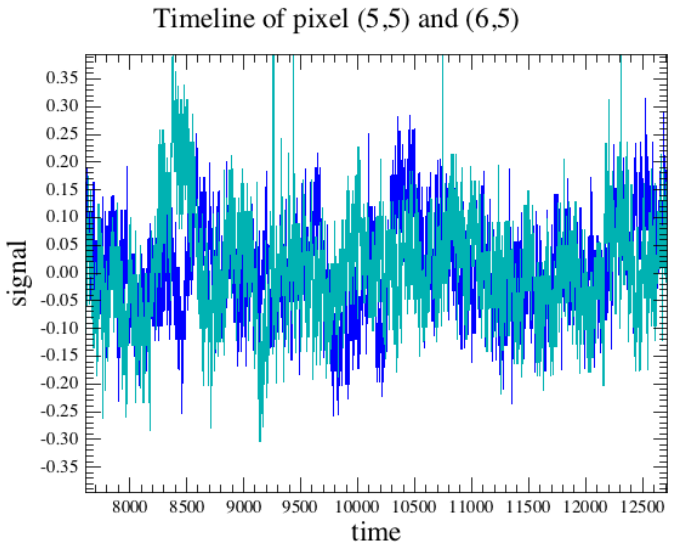


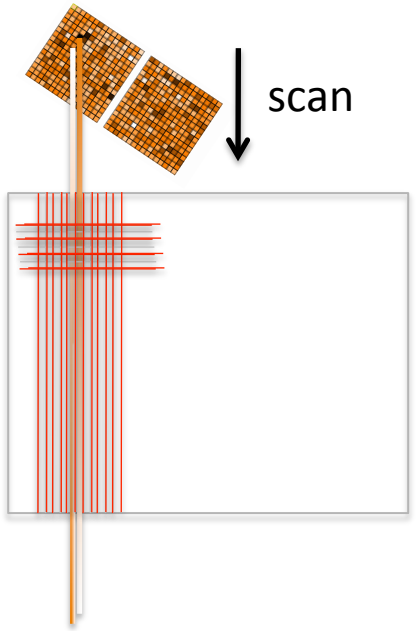
Baseline removal - result

Galactic case: map and threshold (source) mask



Destriping

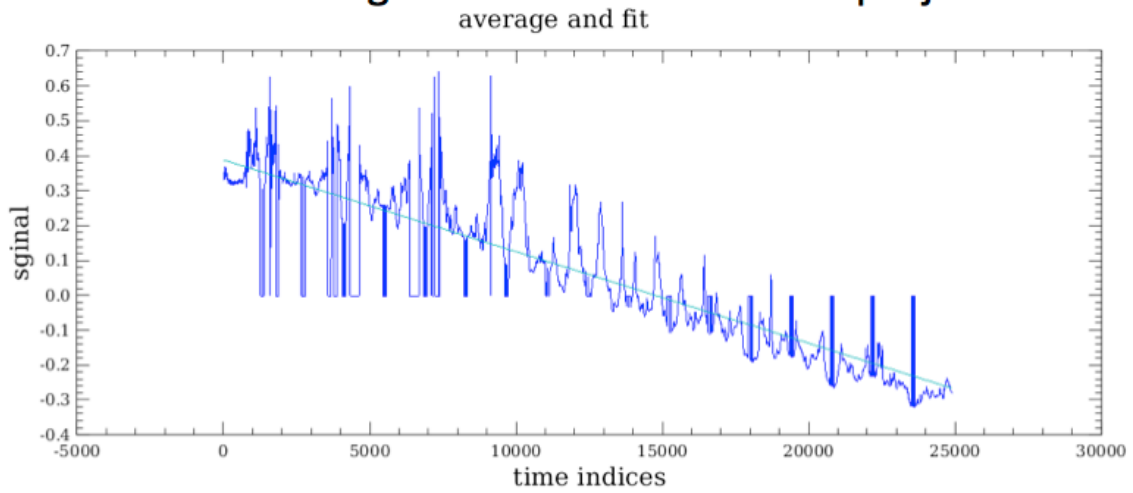




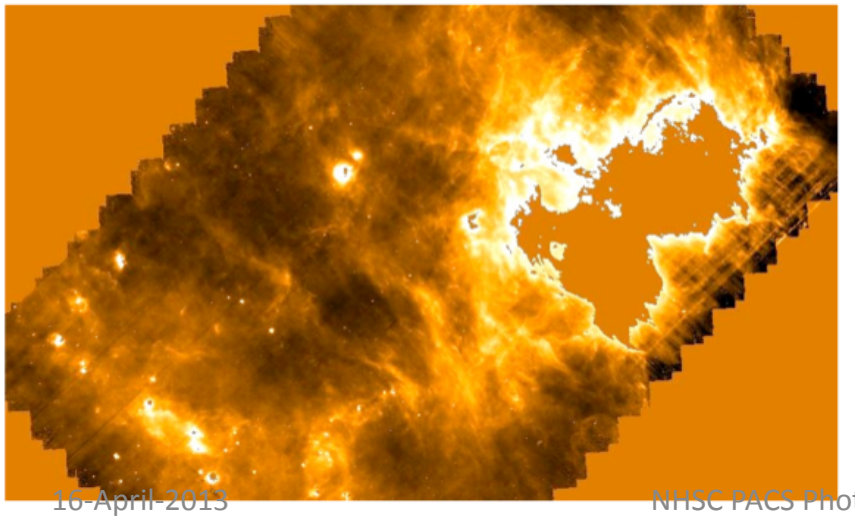
- Takes a Map and backprojects it into a Signal cube
  this should average out drifts
- subract this simulated cube from the real one
- fit the difference
- subtract fit from the signal
- Map
- iterate

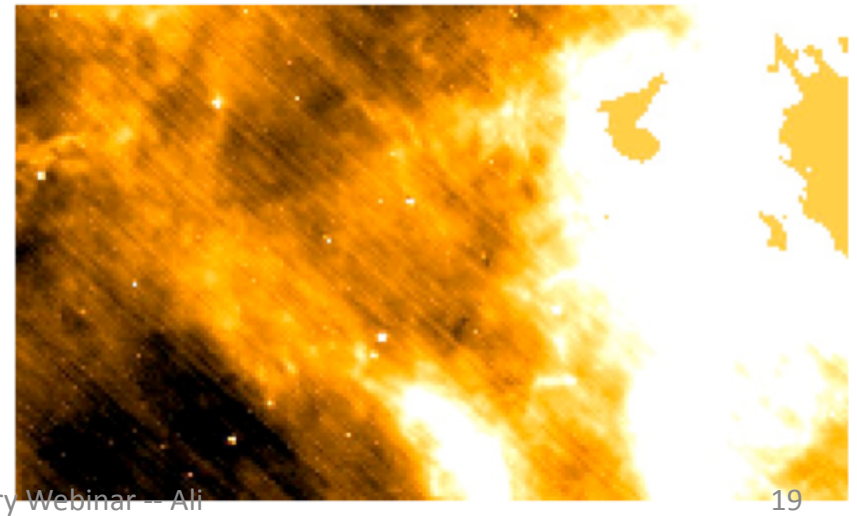
Destriping Results

Fit of the average timeline with the backprojected cross-scan



Detail with short time drifts



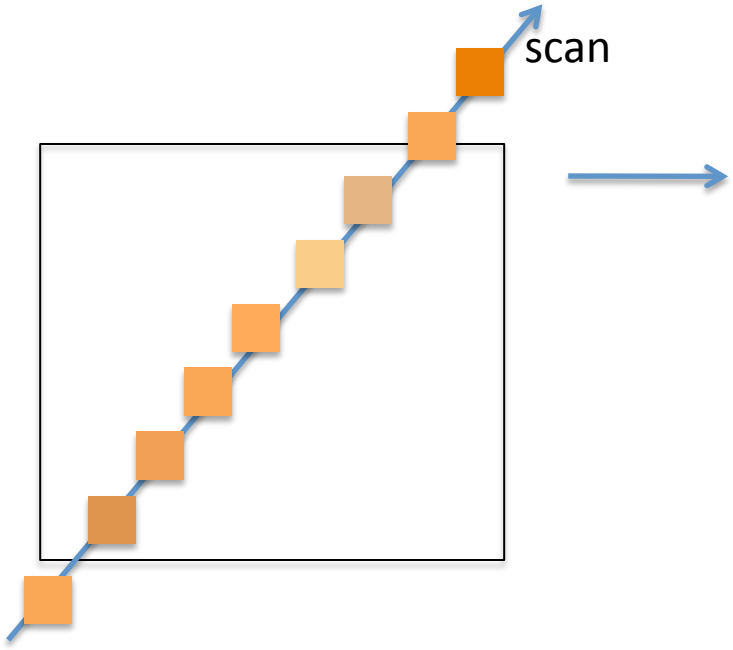


Average Drifts

Goal: remove the drift that is common to all detector pixels

Approach:

Collect crossings of Detectors over a Map pixel



For every Map Pixel:

$\overline{Flux}_i, \sigma_i, \overline{time}_i$

Build drift matrix: Put $Flux_i, \sigma_i$ at $time_i$

Assign $\overline{Flux}(time_{k)} = 0$

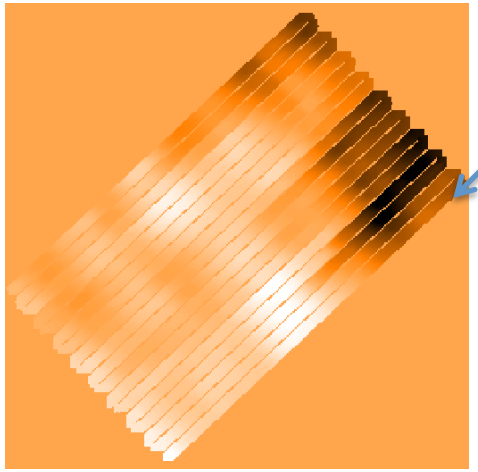
Find difference: $\overline{drift}_{ki} = \overline{Flux}_k - \overline{Flux}_i$

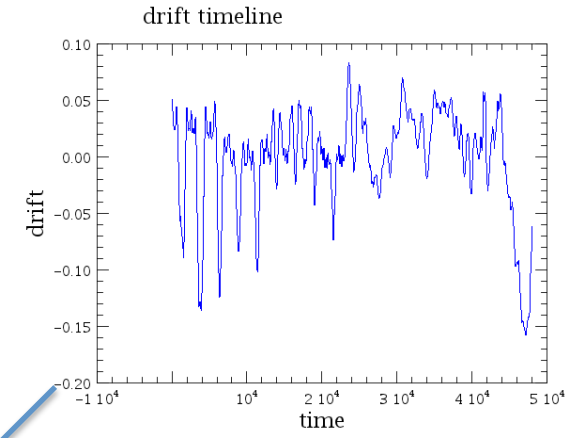
Assign $\overline{Flux}_i$

Iterate over the matrix

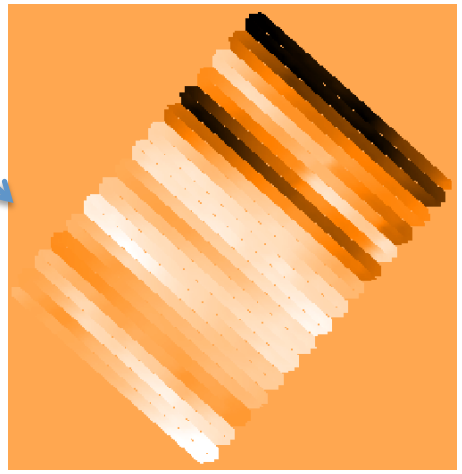
Average Drifts 2

scan

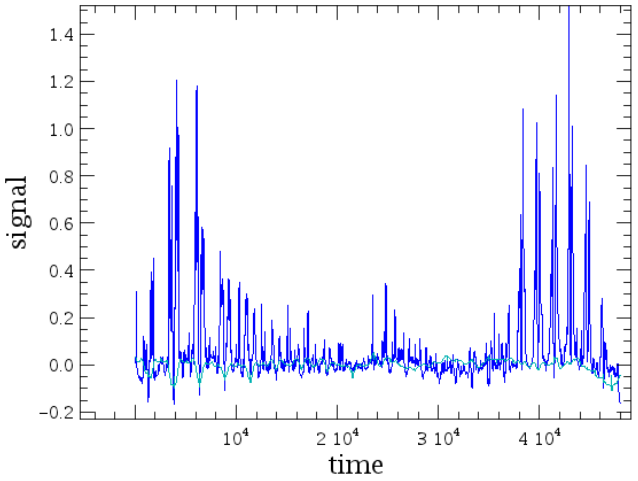




cross-scan



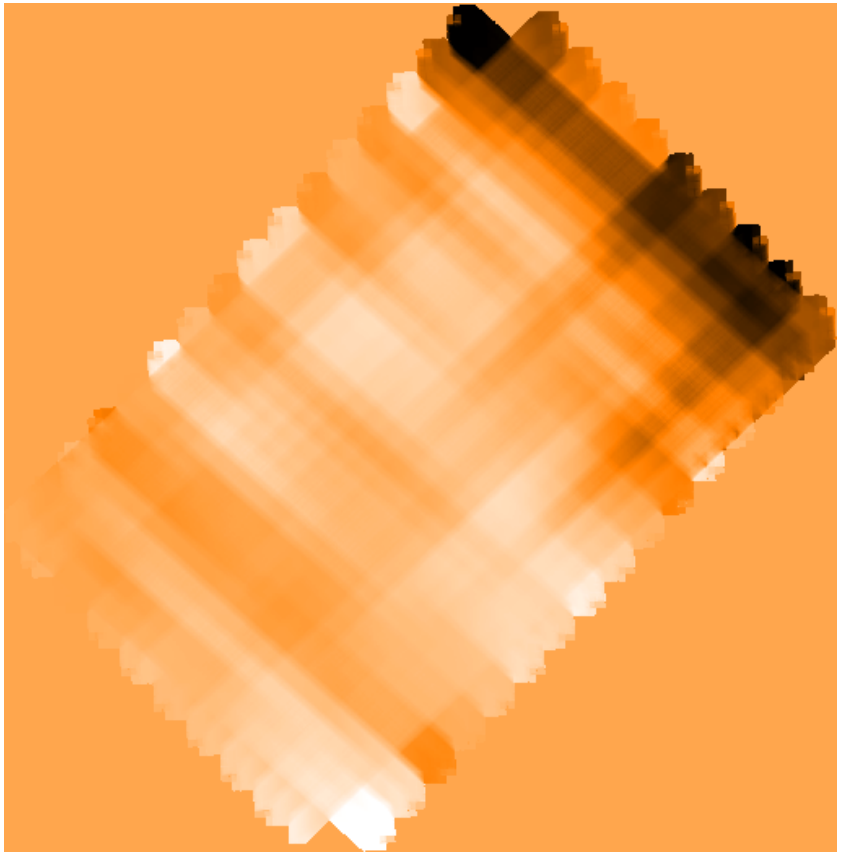
σ-map



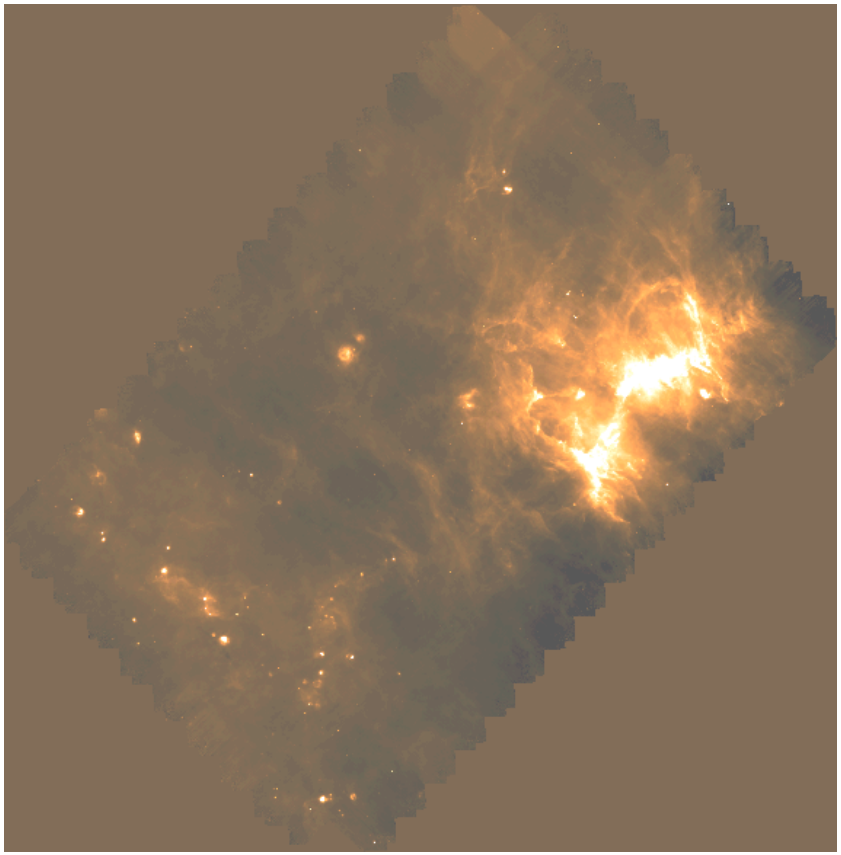
σ-map

Average - result

Destriped Map

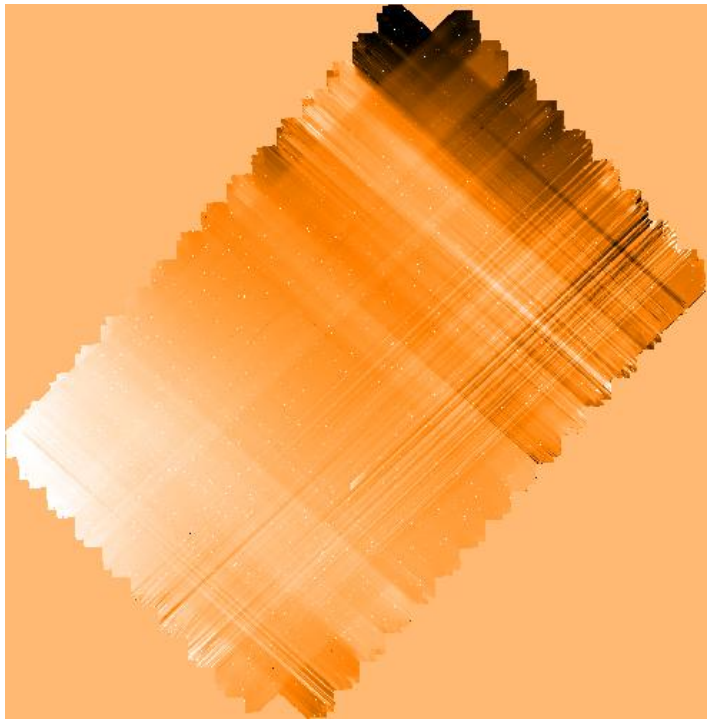


Map after average Drift removal

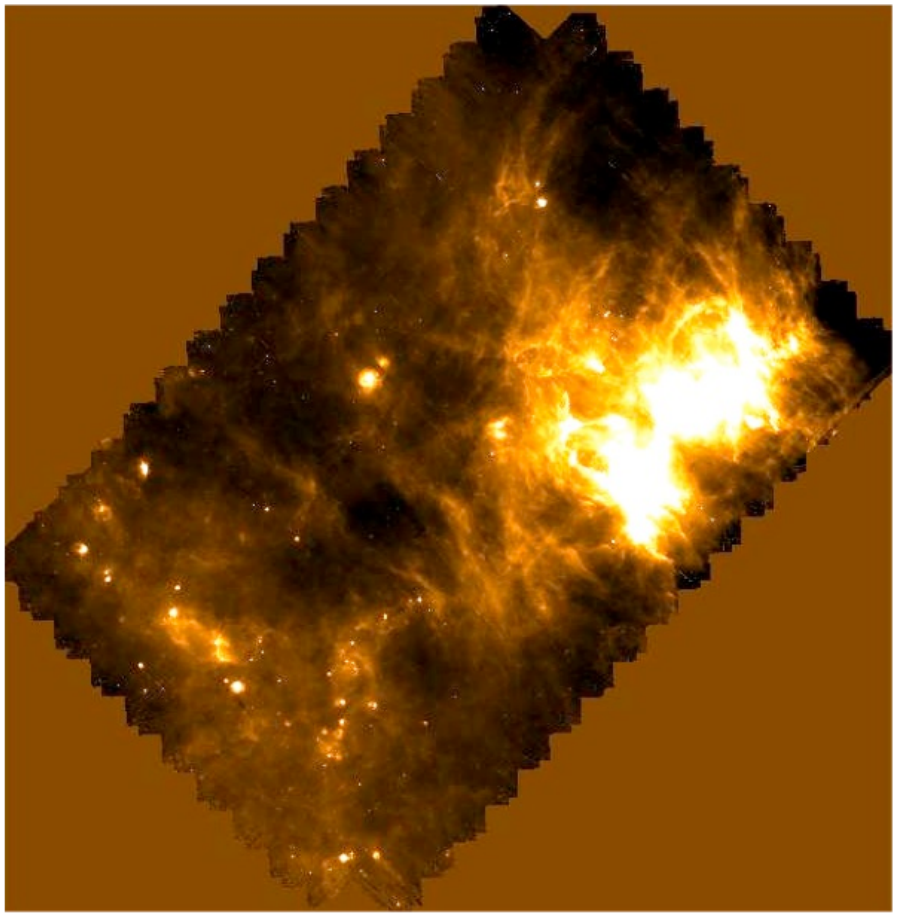


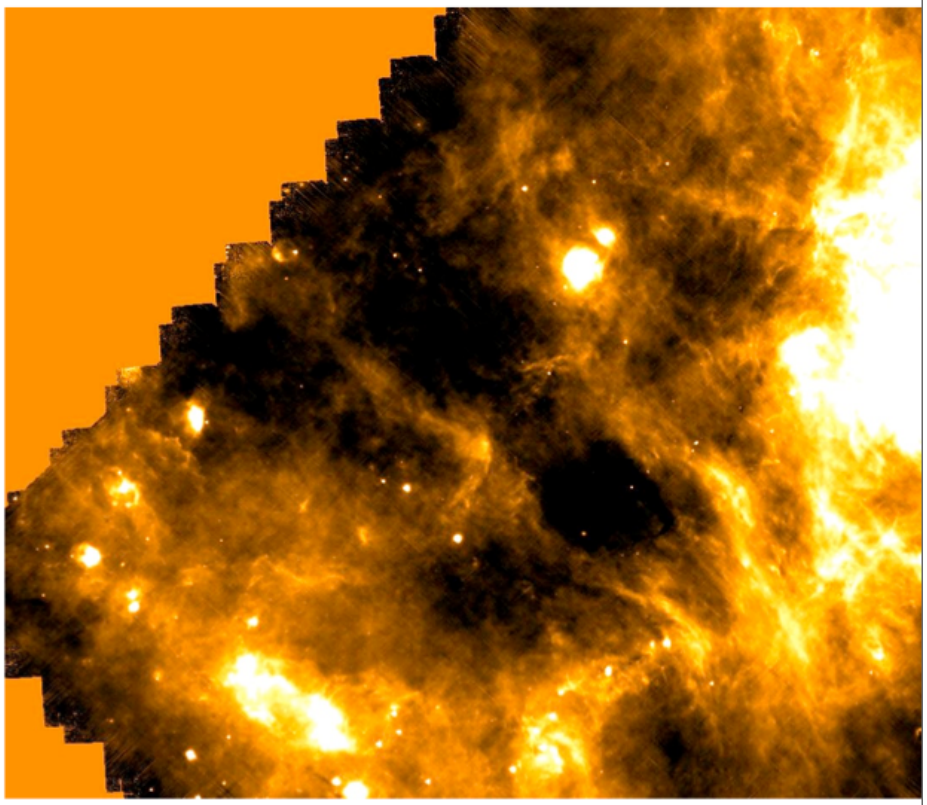
Individual Drifts

- Calculate the crossings again (like for the average drift)
- Calculate the average flux of all crossings for one Mappixel
- take the difference as drift and assign it to the timeline, this time for every detector pixel
- subtract the drift cube from the signal cube
- iterate



Final Result





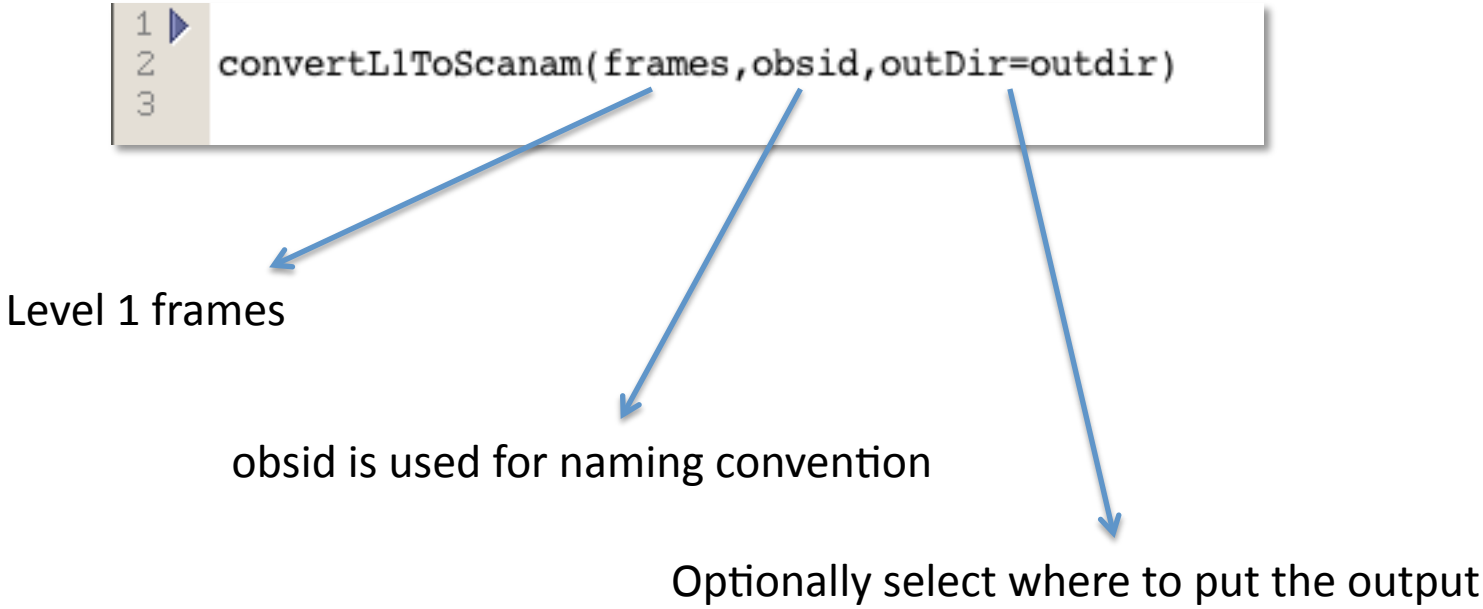
Part III

USING SCANAMORPHOS

Level 1 conversion

- Use HIPE to export level-1 frames to Scanamorphos format

```
1
2  convertL1ToScanam(frames,obsid,outDir=outdir)
3
```



Level 1 conversion

- Complete conversion with IDL tools included in distribution

convert_hcssfits_pacs.pro

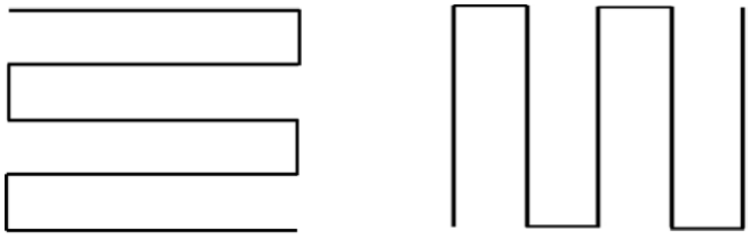
input IDL structures (1 .xdr file per repetition per obsid)
(non-nominal frames and slews between scans discarded)

```
nobs = 2
obsid = ['1342187067', '1342187069']
for i = 0, nobs - 1 do convert_hcssfits_pacs, $
dir_in='/data/pacs/n4559/processed_obsid/', $
dir_out='/data/pacs/n4559/input_scans/', $
root=obsid(i)+'_blue', color='blue'
```

Example and text from Zoltan Balog

ordering of input scans

input scans must alternate their orientation on the sky



scan cross-scan

The .xdr files for each input scans must be put into the file called **scanlist_pacs**
The first line of this file **must** contain the directory where the files are

example: observation with 2 obsids and 1 **scans** and 1 **cross-scans, rep=2**

stru_obsid1_cam_scan1.xdr
stru_obsid2_cam_scan1.xdr
stru_obsid1_cam_scan2.xdr
stru_obsid4_cam_scan2.xdr

If there are more than one repetition:

typically for PACS : n × **scan**, then n × **cross-scan**

The same structure must be repeated for each of them

Slide taken from Zoltan Balog

Processing Parameters

Parameter	Description
Mandatory	
/pacs	Defines PACS as instrument.
nobs = n	Number of distinct OBSIDs
Debugging info.	Usually very, very verbose; Handle with care
/visu	Shows the result of each intermediate step
/debug	Shows even more plots than /visu

Processing Parameters

Parameter	Description
/parallel	For observations taken in parallel mode.
/galactic	To preserve sky gradients in regions where spatially extended emission dominates the map
/minimap	For observations taken with “mini scan map” parameters
/nocross	Specifies that only one scan direction observation is available.
/jumps_pacs	Detect and mask brightness discontinuities due to pixel, row, or module dropouts or similar electronic effects.
/nothermal	Skip short timescale average drift subtraction
/noglitch	Skip Scanamorphos’ internal deglitching
nblocks=nbl	Force slicing of field into nbl sub-fields.

Processing Parameters

Parameter	Description
pixsize=	Pixel size of the final map in arc-seconds.
orient=	'astro' for astronomical (North up, East to the left) 'scan' for optimizing along the scan direction
/frame_framallscans	Use all scans to compute the final WCS for the map, not just the first two scans.
hdr_ref=hdr	Use the reference header in 'hdr' for map projection.
/one_plane_fits	To produce separate FITS format file for each plane instead of a single cube.

A complete list of parameters is available from the Scanamorphos website maintained by H. Roussel