SPIRE Metrics: Super-resolution maps

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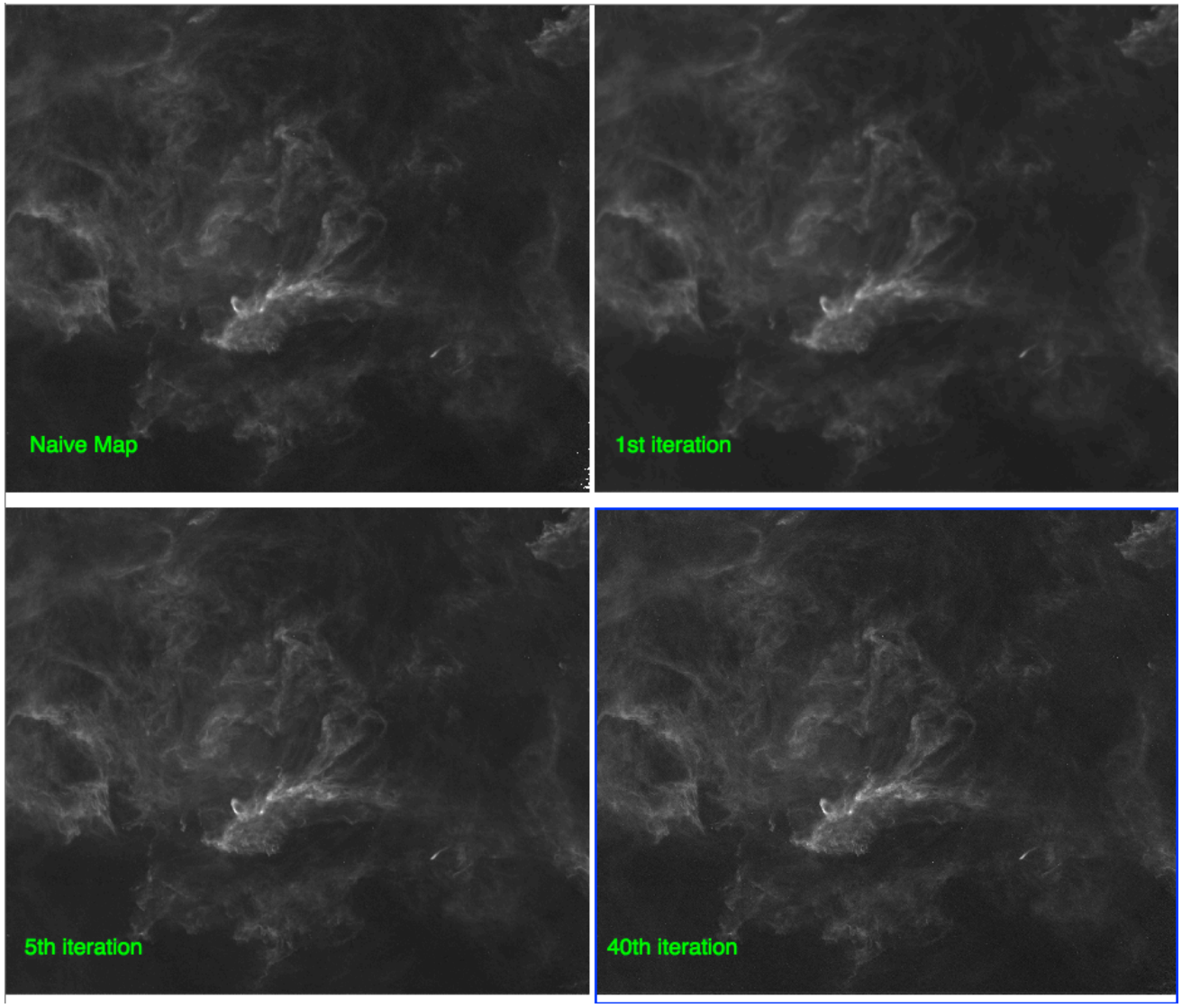
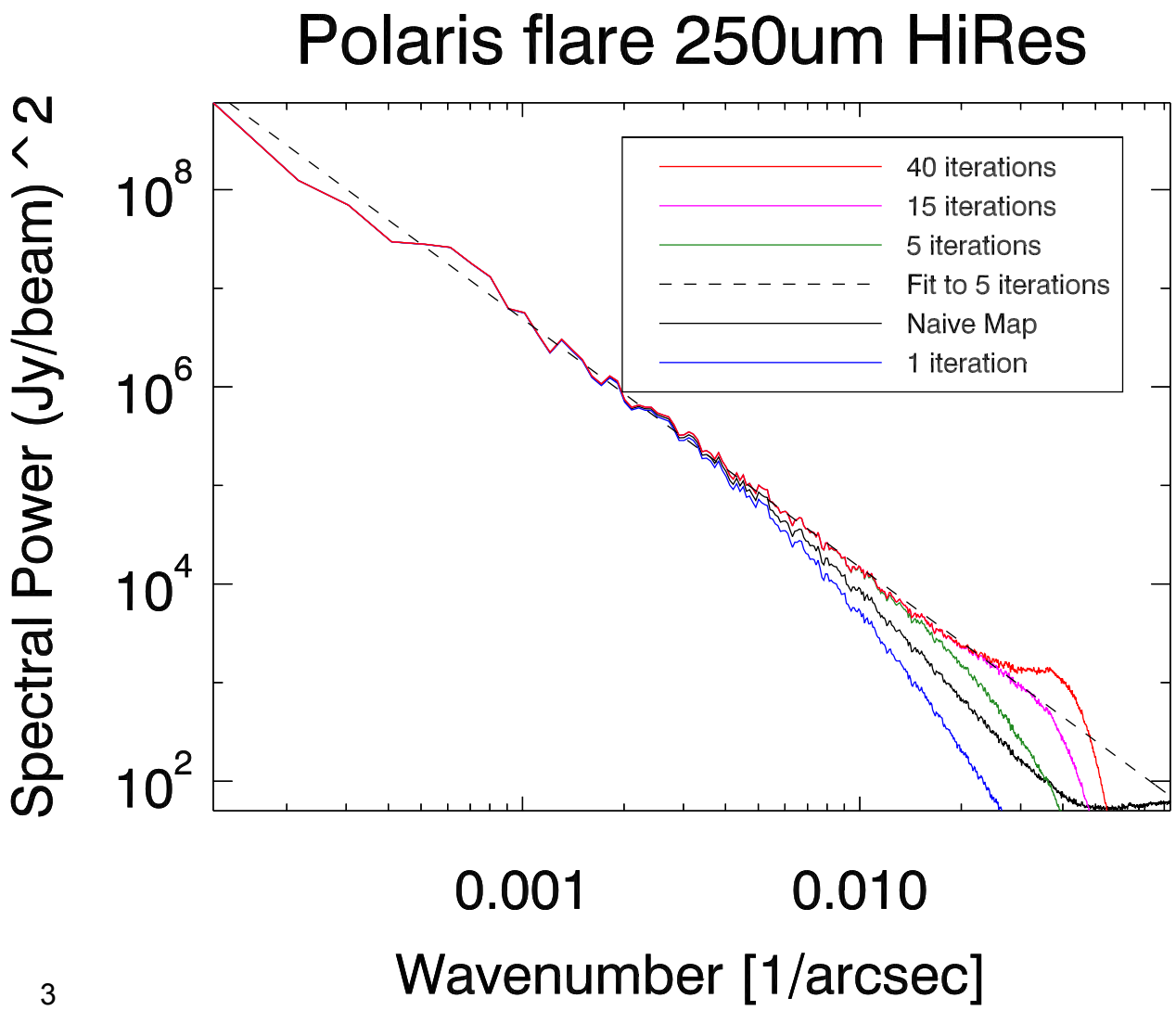
on behalf of the SPIRE mapmaking test team

HiRes run on Polaris flare at 250um



Power-law test on cirrus



- 5^{th} iteration is sharper than naïve map
- More iterations add power on small scales

Metrics have been run for SPIRE superresolution maps for three cases

- Case10 – simulated cirrus field (1.3 deg per side, 10 MJy/sr cirrus)
  - ICORE (PSW) 2”/pix rebinned to 6”/pix
  - HiRes 2”/pix
  - SUPREME (PSW) 6”/pix
  - Truthimage 2”/pix, convolved 6”/pix
- Case12 – NGC 628, real data (25 arcmin per side, 10 MJy/sr)
  - HiRes 2”/pix
- Case13 – HiGal l30 field, real data (1.8 deg per side, 2000 MJy/sr)
  - HiRes 2”/pix
  - ICORE 2”/pix

Several issues with the metrics became apparent only very recently

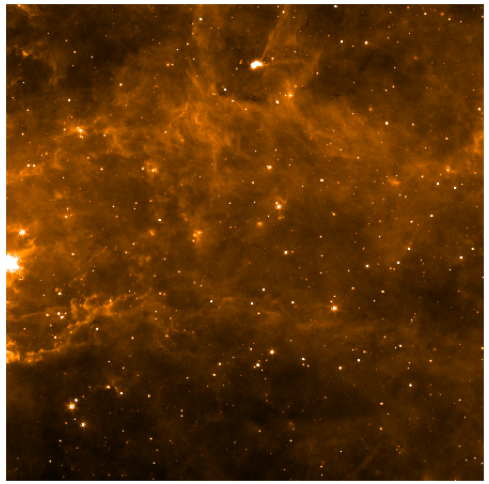
- Gaussian fits in the image domain are the wrong metric for SUPREME
- 2-arcsecond pixels for HiRes and ICORE maps are too small
  - Better: 3”, 5”, 7”
- Case 10 (parallel cirrus) is not best test
  - Extended structures are faint
  - 24um point sources are bright
  - Drift correction, WCS projection center differences for SUPREME map

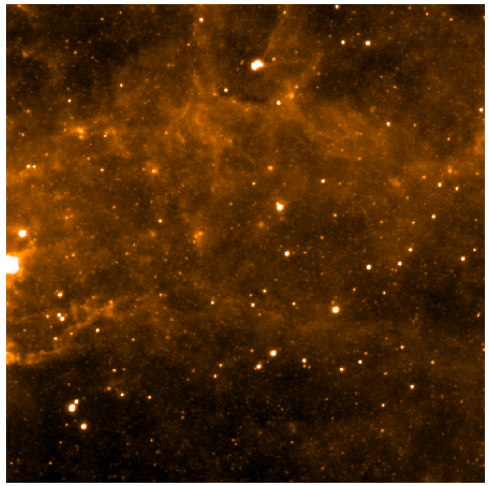
Case10 – Simulated cirrus field (PSW)

← 1.3 deg →

Cirrus brightness of 10 MJy/sr, point sources of 5 Jy

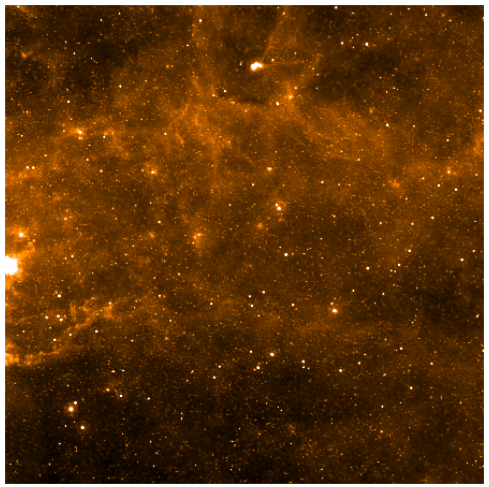
Truth (2”/pix)

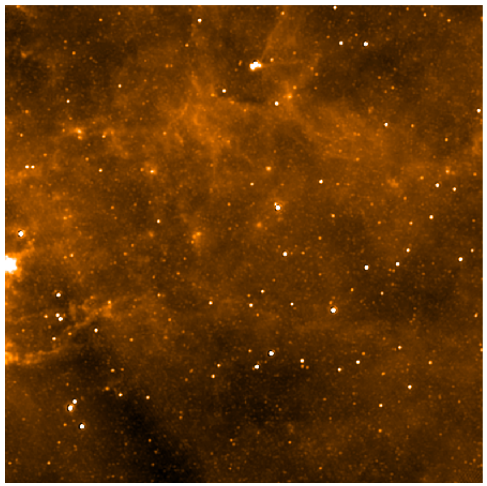




DestripedP0 (6”/pixel)

ICORE (2”/pix)





SUPREME (6”/pix)

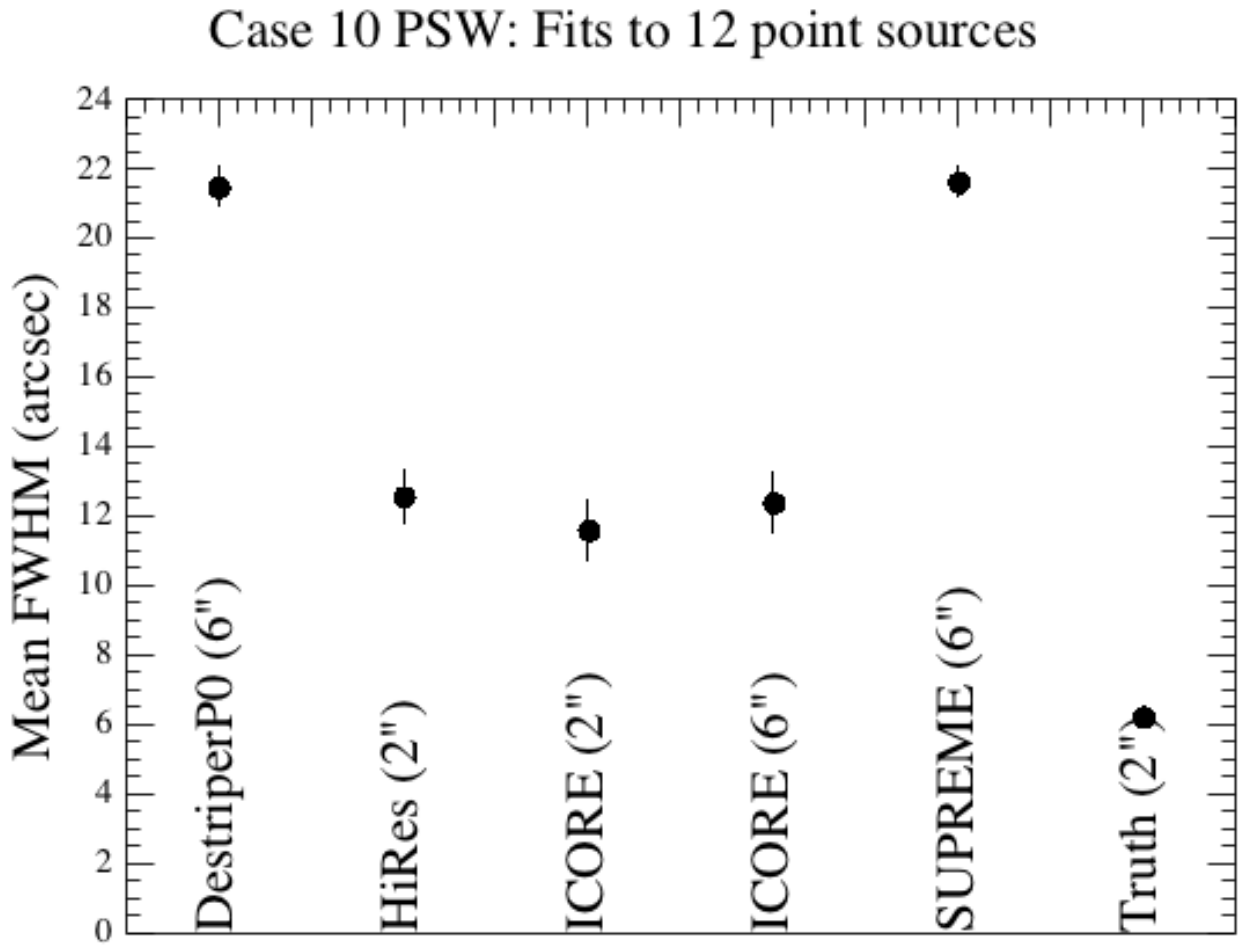
Superresolution Metrics

- Widths of point sources
- Power spectra
- ~~Spatial profiles~~

Superresolution Metrics

- Widths of point sources
  - Fitting Gaussians using sourceFitting in HIPE
- Power spectra
- ~~Spatial profiles~~

Mean and StdDev of FWHM measured on cirrus field in PSW band



The SUPREME FWHM is expected to be about the same as the destriped map.

FWHM values for PMW and PLW measured on isolated point sources

Case	Map-maker (pixel scale)	# sources	Mean FWHM (arcsec)	StdDev FWHM (arcsec)
12 PMW	HiRes (2”)	5	17.26	0.58
12 PLW	HiRes (2”)	5	26.7	3.1
10 PLW	HiRes (2”)	12	24.1	2.1
10 PLW	DestripedP0 (6”)	8	39.4	3.6

Superresolution Metrics

- Widths of point sources

- Power spectra
  - Power spectrum script kindly provided by Jim Ingalls
  - Some images for interpretation

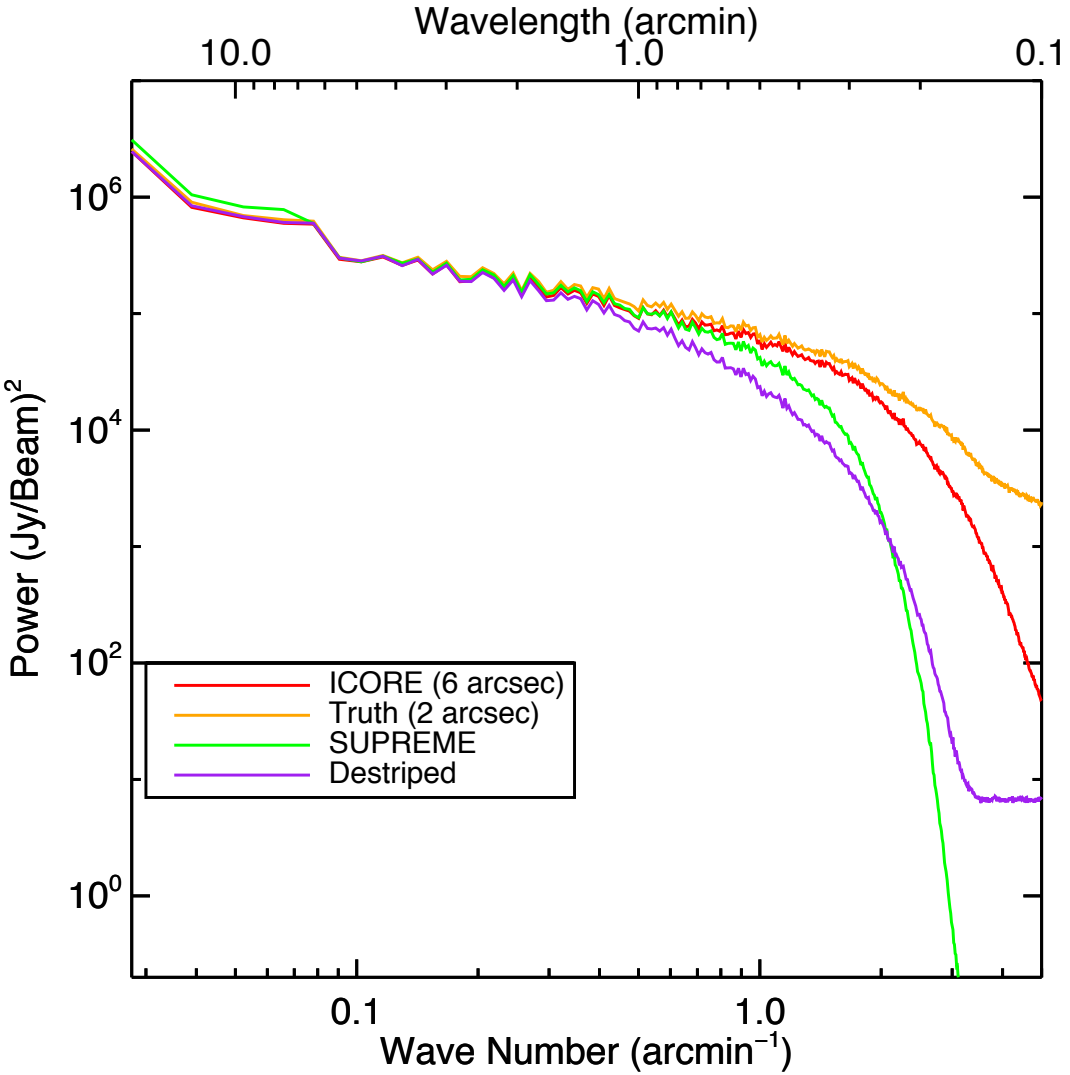
- ~~Spatial profiles~~

Accounting factors are needed to correctly normalize the power spectra

- Script normalizes to number of pixels
- Normalize to maps made with 6 arcsec pixel scale (Destriper, SUPREME)
  - HiRes and ICORE maps (2”/pix) divided by ratio of pixel areas
  - Truthimage (2”/pix) divided by half of area ratio (factor of two between 24um truthimage, and its convolution with the SPIRE beam)

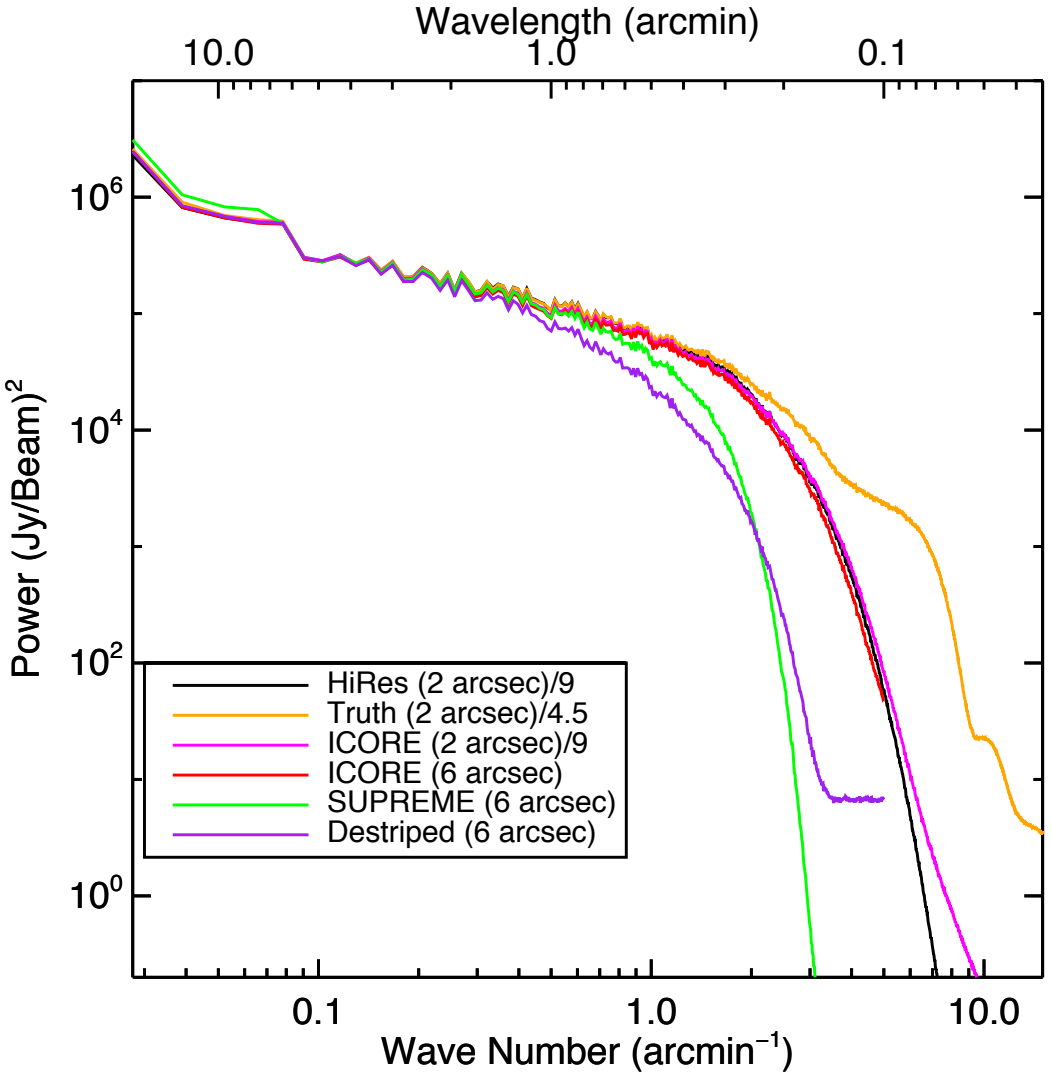
Power spectra of case10 PSW cirrus field

All maps at 6”/pixel except for truthimage (2”, before convolution with SPIRE beam).
ICORE image is rebinned.
No beam correction applied.



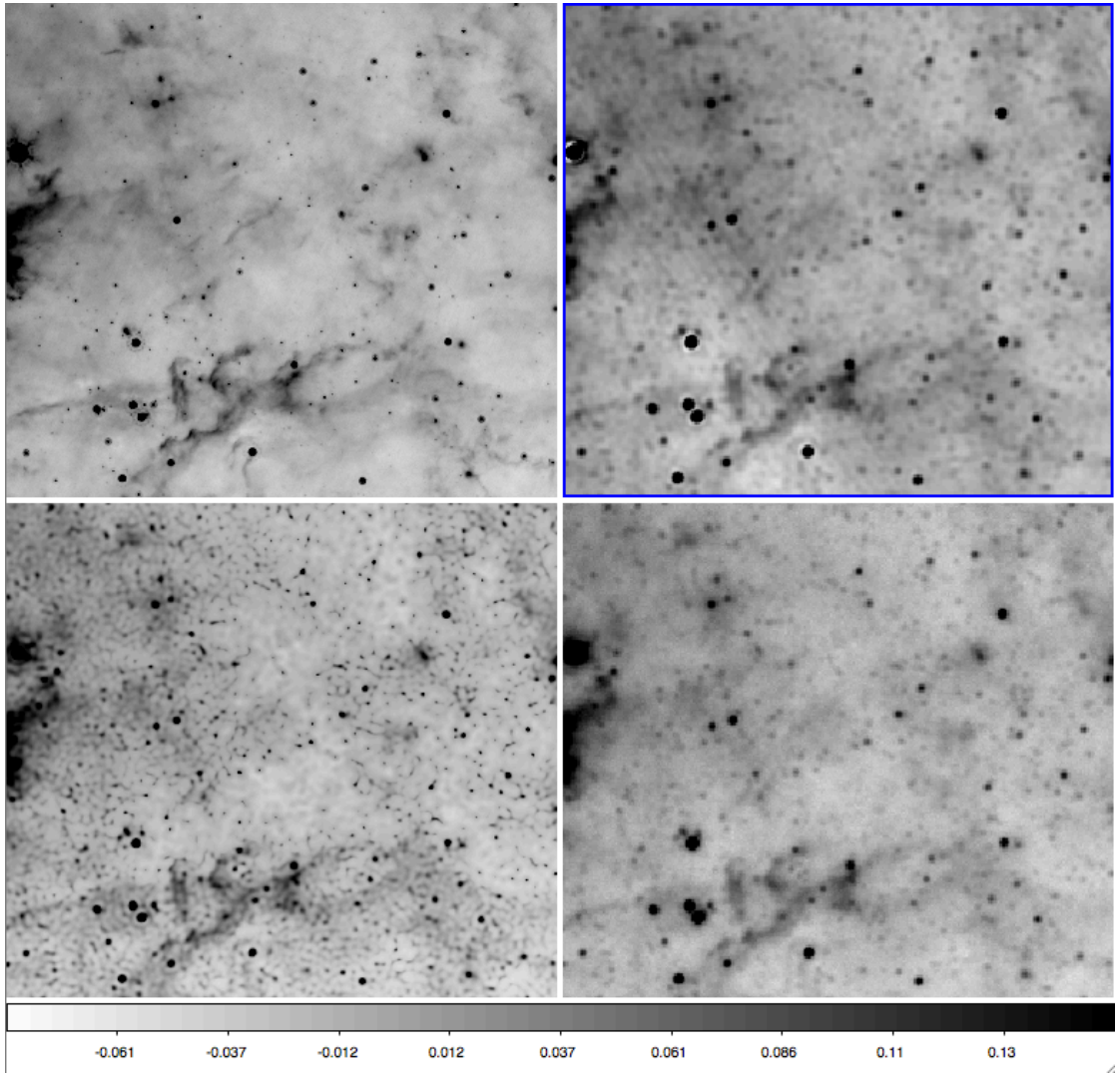
Rebinning a 2”/pix map to 6”/pix makes a small change in the power spectrum

Rebinned the ICORE image to 6”/pixel (red). The ICORE image with 2”/pixel (magenta) has a relatively small difference in the power spectra.



Zoom to left side of case10_PSW maps confirms the power spectra

Truth
2”/pix



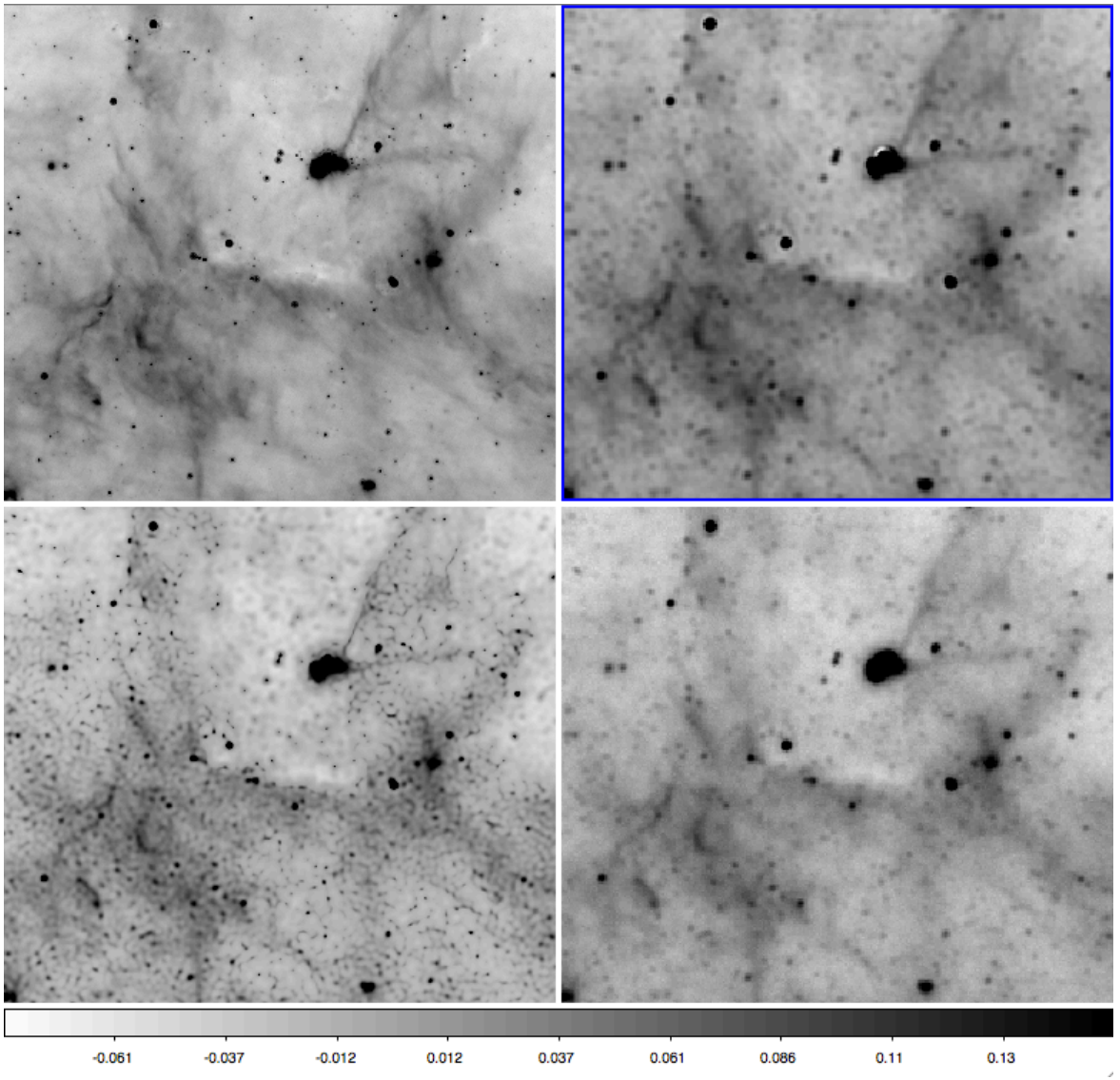
SUPREME
6”/pix

ICORE
2”/pix

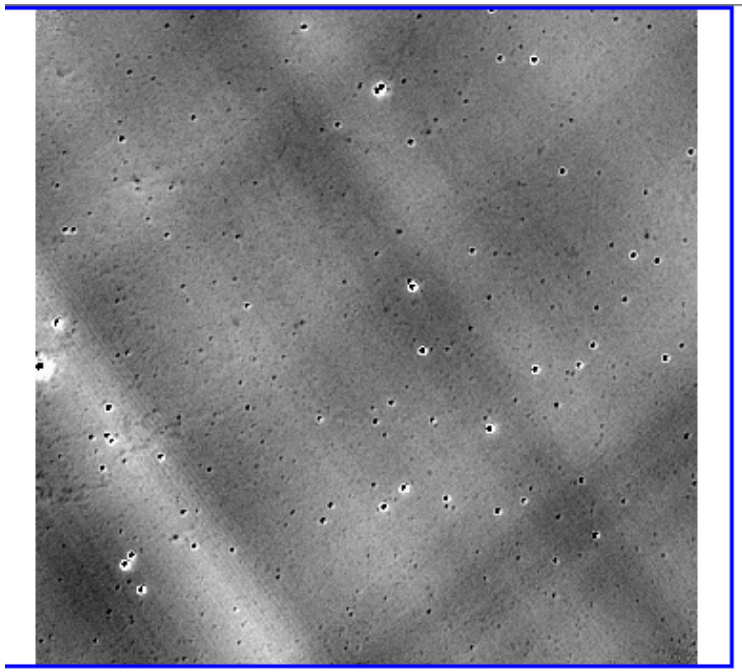
DestripedP0
6”/pix

Jy/beam

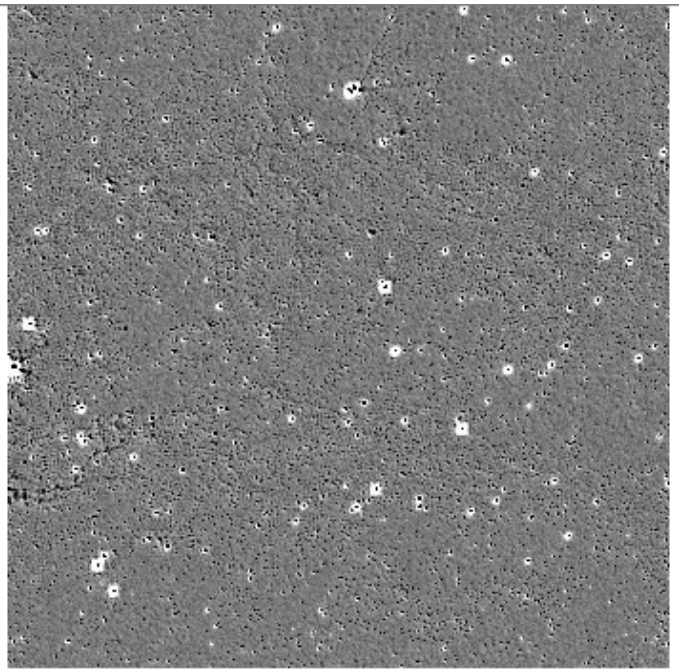
Zoom to top center of case10_PSW maps confirms the power spectra



Difference maps with destriped P0 subtracted off



SUPREME – destripedP0

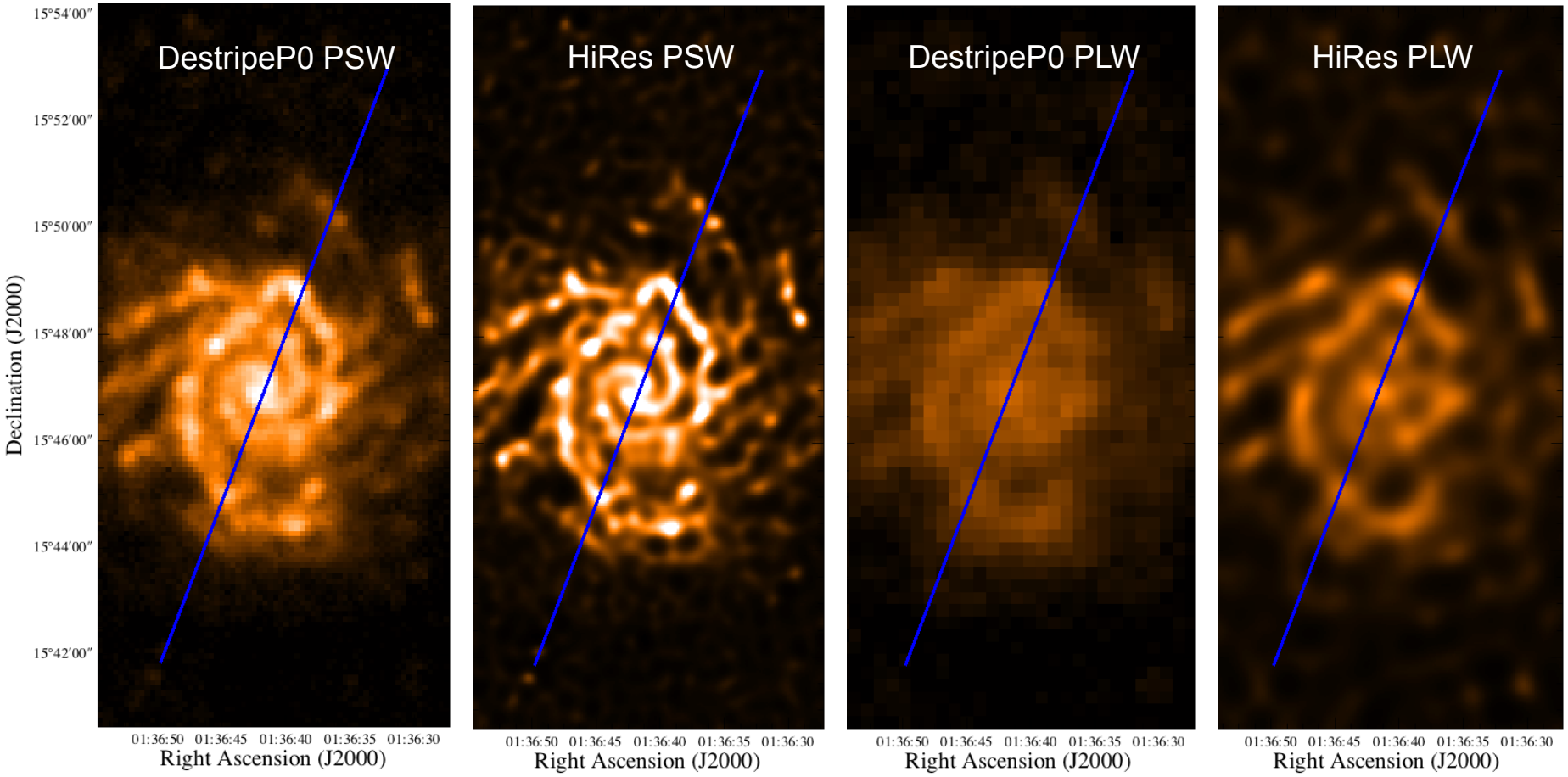


Binned ICORE - destripedP0

Note: projection center for SUPREME was about 24.2 pixels off – I trimmed the image to match DestripedP0 but didn't correct the fractional pixel. SUPREME processing used own drift correction while ICORE used SPIRE pipeline + destriper outputs.

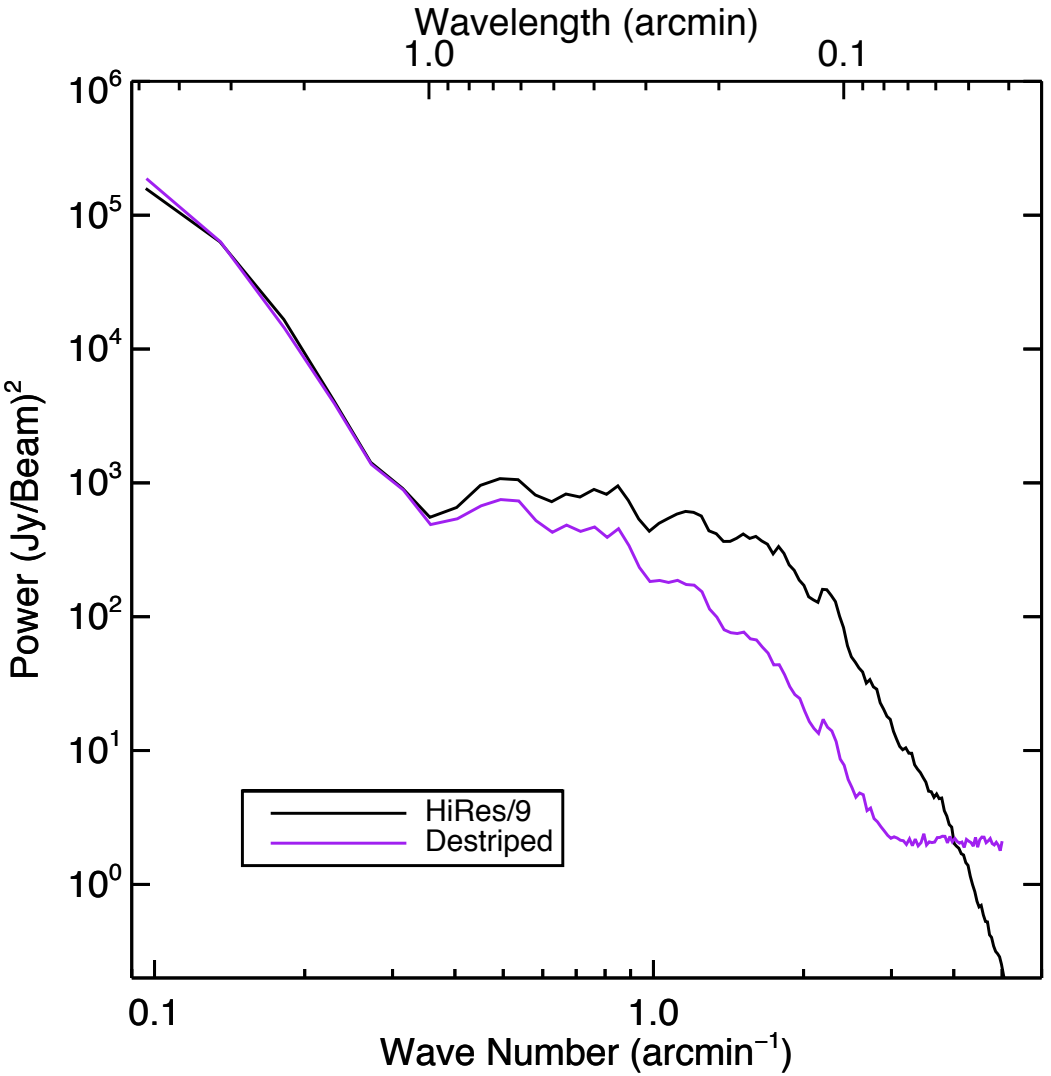
Jy/beam

Images for case 12 – NGC 628 (ignore the blue line)



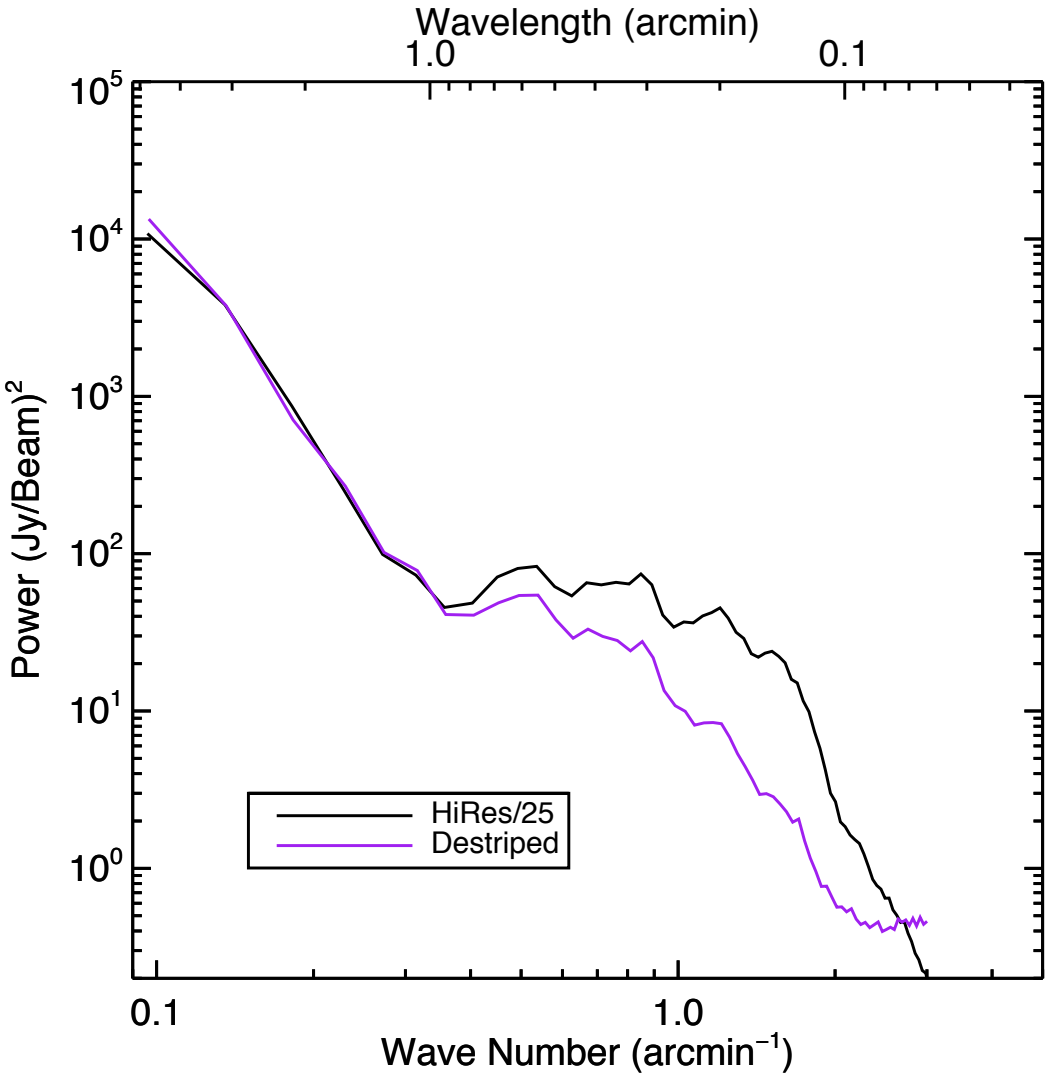
Power spectrum for case 12, NGC 628, PSW, with destriped map for comparison

HiRes image divided by 9 to account for 2" pixel size.
Destriped map at 6" per pixel.
No beam correction applied.



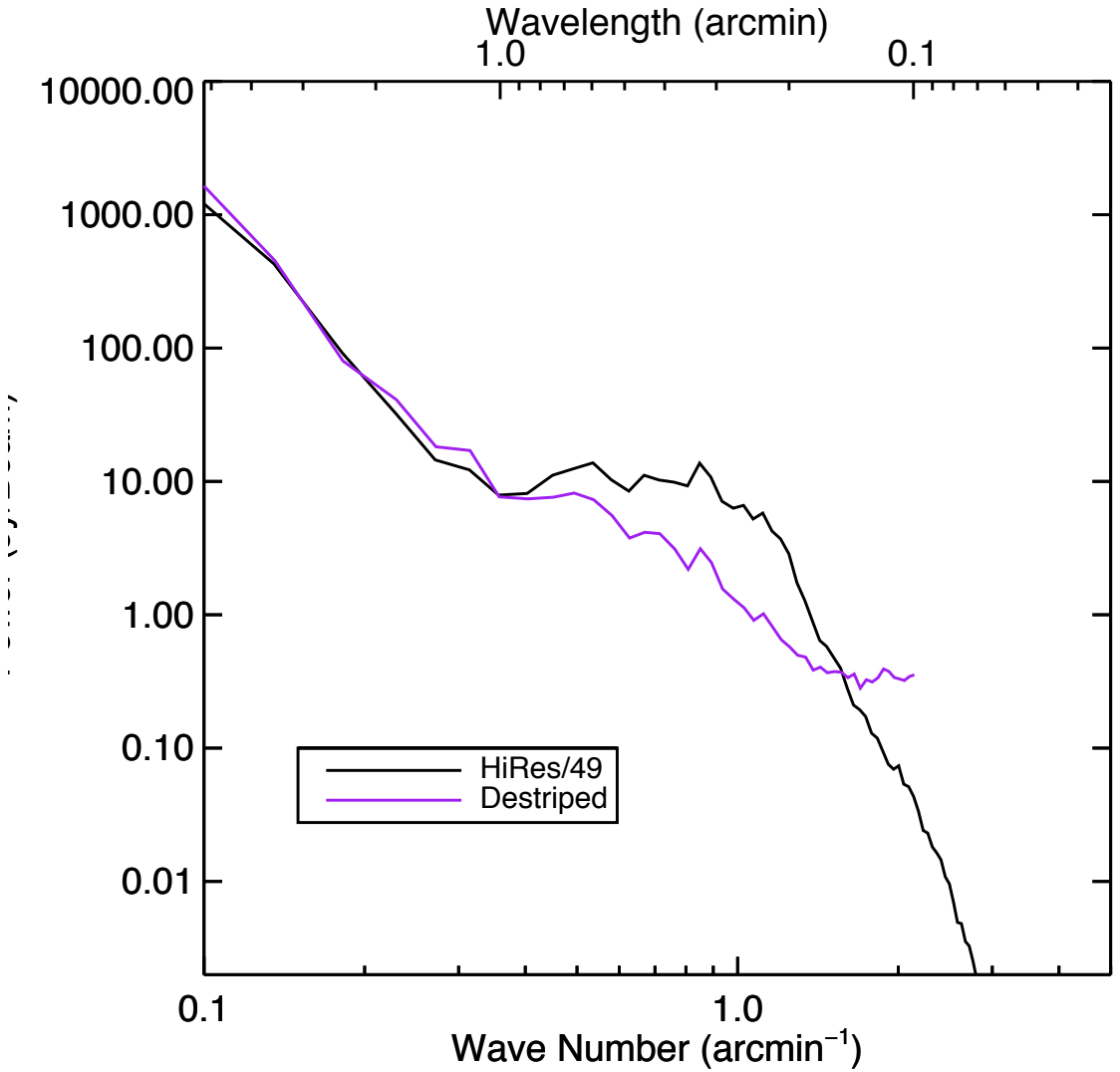
Power spectra for case 12, NGC 628, PMW, with destriped map for comparison

HiRes image divided by 25 to account for 2” pixel size.
Destriped map at 10” per pixel.
No beam correction applied.



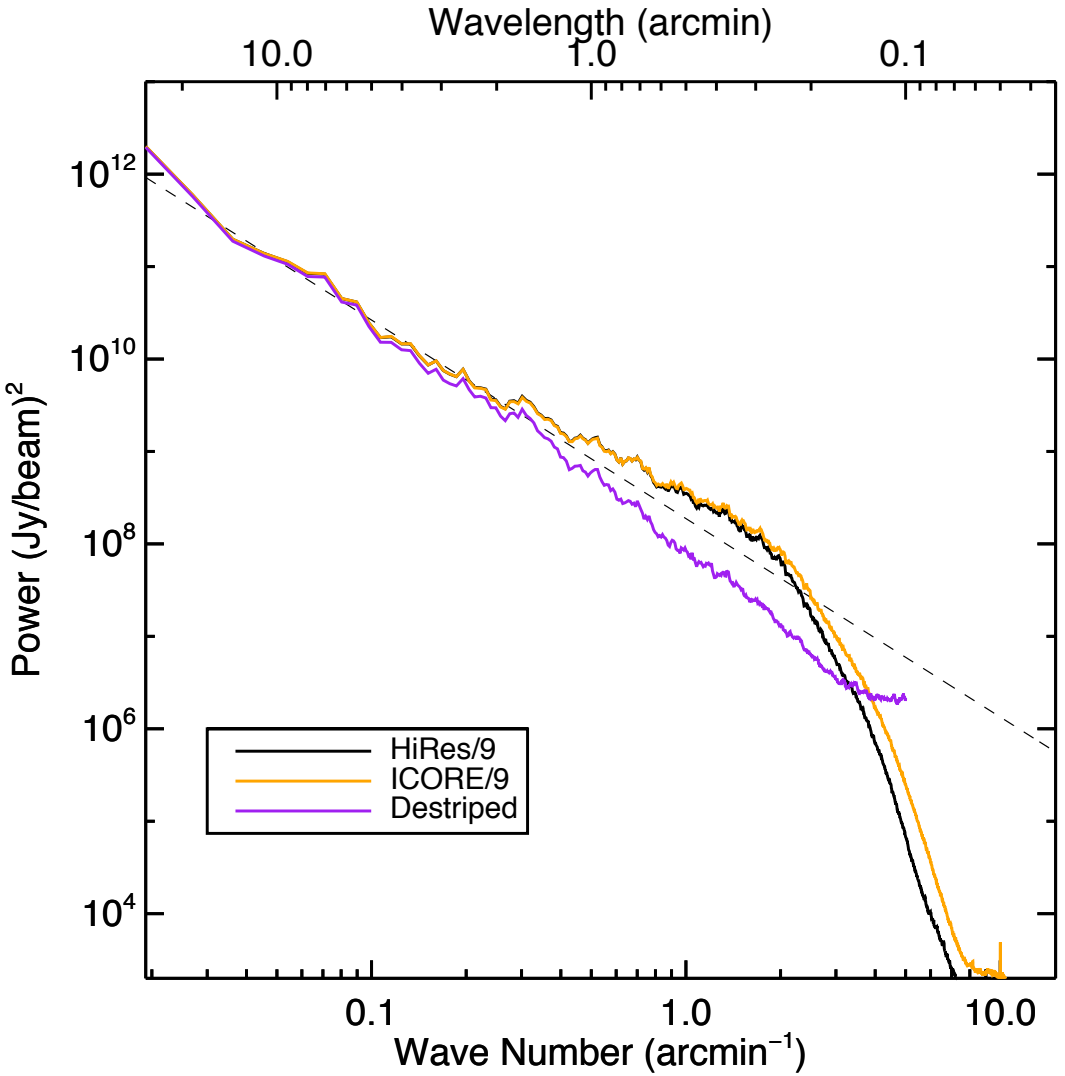
Power spectra for case 12, NGC 628, PLW, with destriped map for comparison

The HiRes image was divided by 49 to account for 2” pixel size.
No beam correction applied.



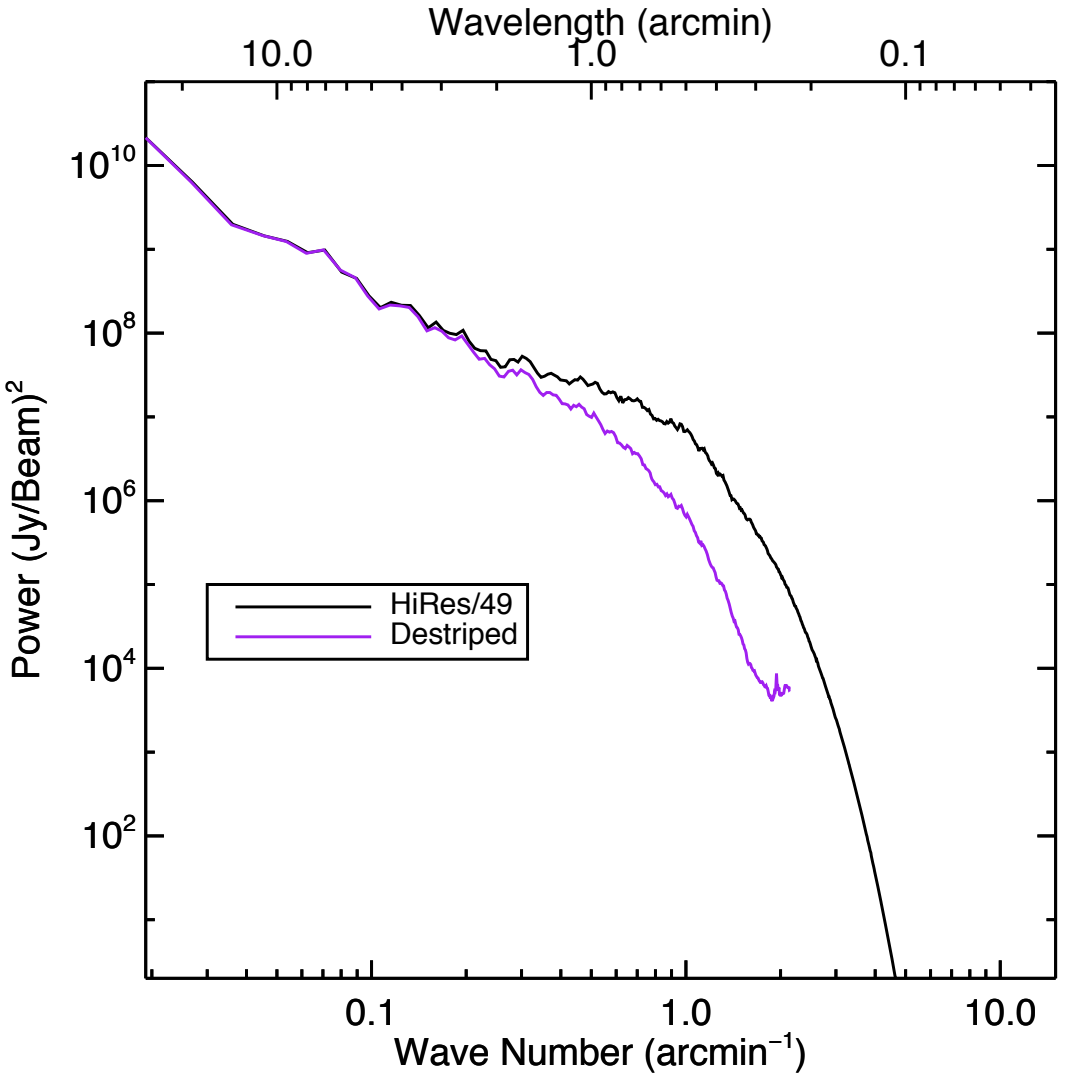
Power spectra for case 13, HiGal l30, PSW, with destriped map for comparison

HiRes and ICORE images divided by 9 to account for 2” pixel size. Destriped image at 6” per pixel. No beam correction applied.
The dashed line shows a fit to the HiRes spectrum between 0.03 and 0.3 arcmin^-1



Power spectra for case 13, PLW, with destriped map for comparison

HiRes image divided by 49 to account for 2” pixel size.
Destriped image at 14” per pixel.
No beam correction applied.



Conclusions (1)

- ***Do not worry, we're going to re-do all of this properly for the final report!***
- Gaussian fits to point sources, cuts through point sources are not the right metrics for SUPREME maps
- ICORE and HiRes give similar results for all the metrics
  - 40-45% decrease in FWHMs
  - Metrics for 6" pixels differ only slightly than for 2" pixels

Conclusions (2)

- HiRes/ICORE power spectra:
  - more power for $k > 0.2$ arcmin^{-1} than destriped map
  - Gradual falloff, extending below the beginning of the plateau in destriped map
  - track the truthimage power spec. for
    $k < \sim$ 1-2 arcmin^{-1}
- SUPREME power spectrum:
  - more power for 2 arcmin$^{-1} > k > 0.3$-0.2 arcmin^{-1} relative to destriped map
  - More frequencies could be restored (to beginning of the plateau in destriped map)