Filtered vs Filterless flatfielding: impact on PSF-fit photometry

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Science Image Selection Criteria in *g* & *r* (*quadrant based*)

- 2020-06-14 <= night date <= 2020-07-08
- DIQ (median FWHM) <= 3.0 arcsec
- Airmass <= 1.2
- Moon altitude < 30°
- Photometric ZP > 26.1 mag.
- 2000 <= number PSF-fit catalog sources <= 30000
- Number of matching PS1 calibrator stars >= 200
- Exptime = 30 sec.
- Clean processing/achive quality status flags.

- Total number of quadrant images in *g*-filter = 71,368 (from 1402 exposures)
- Total number of quadrant images in *r*-filter = 94,226 (from 2102 exposures)

Procedure

- Processed each quadrant image using same-night *filterless* flats
- Benchmark: compare to *same* images from archive processed using *filter-on* flats

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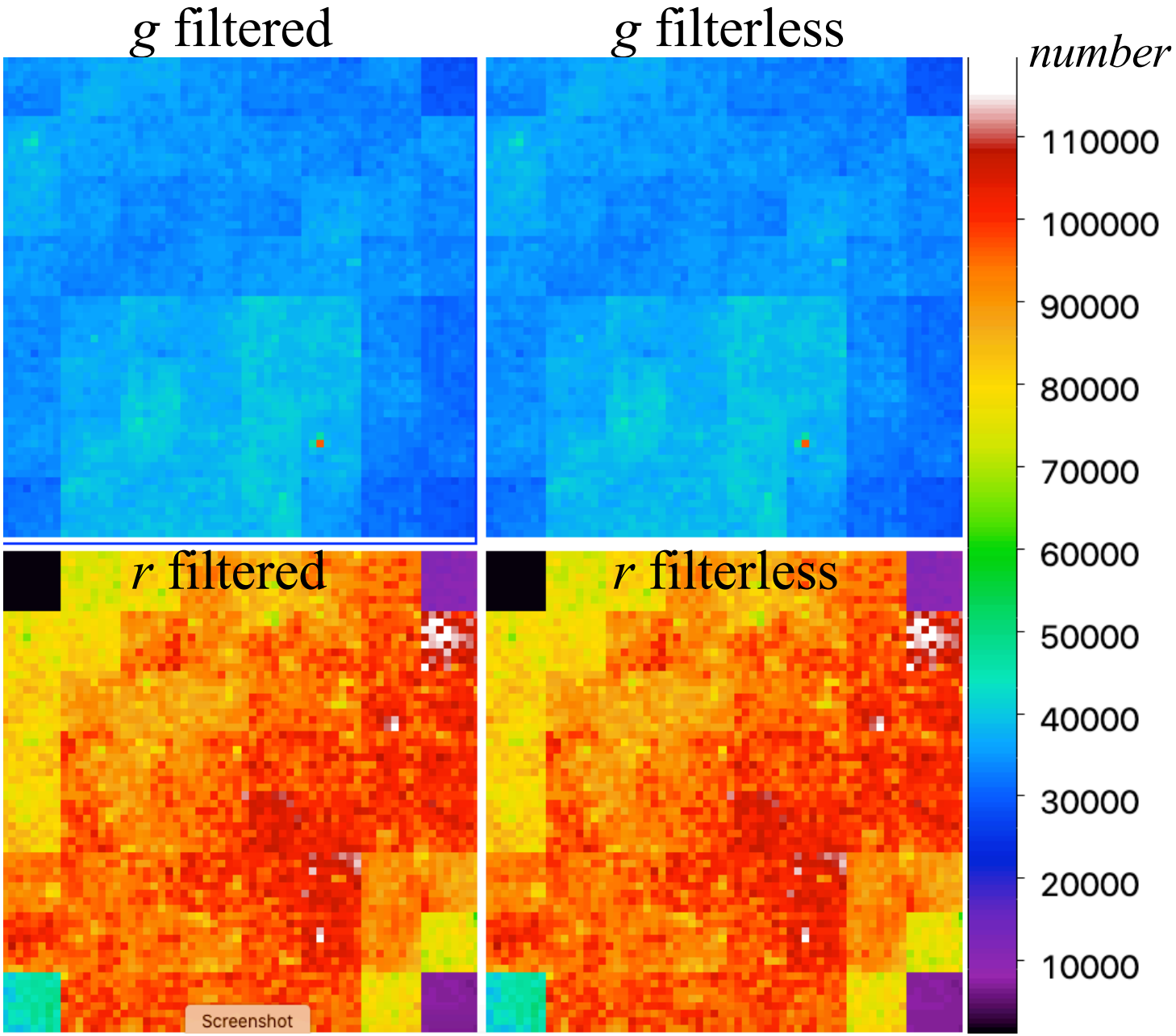
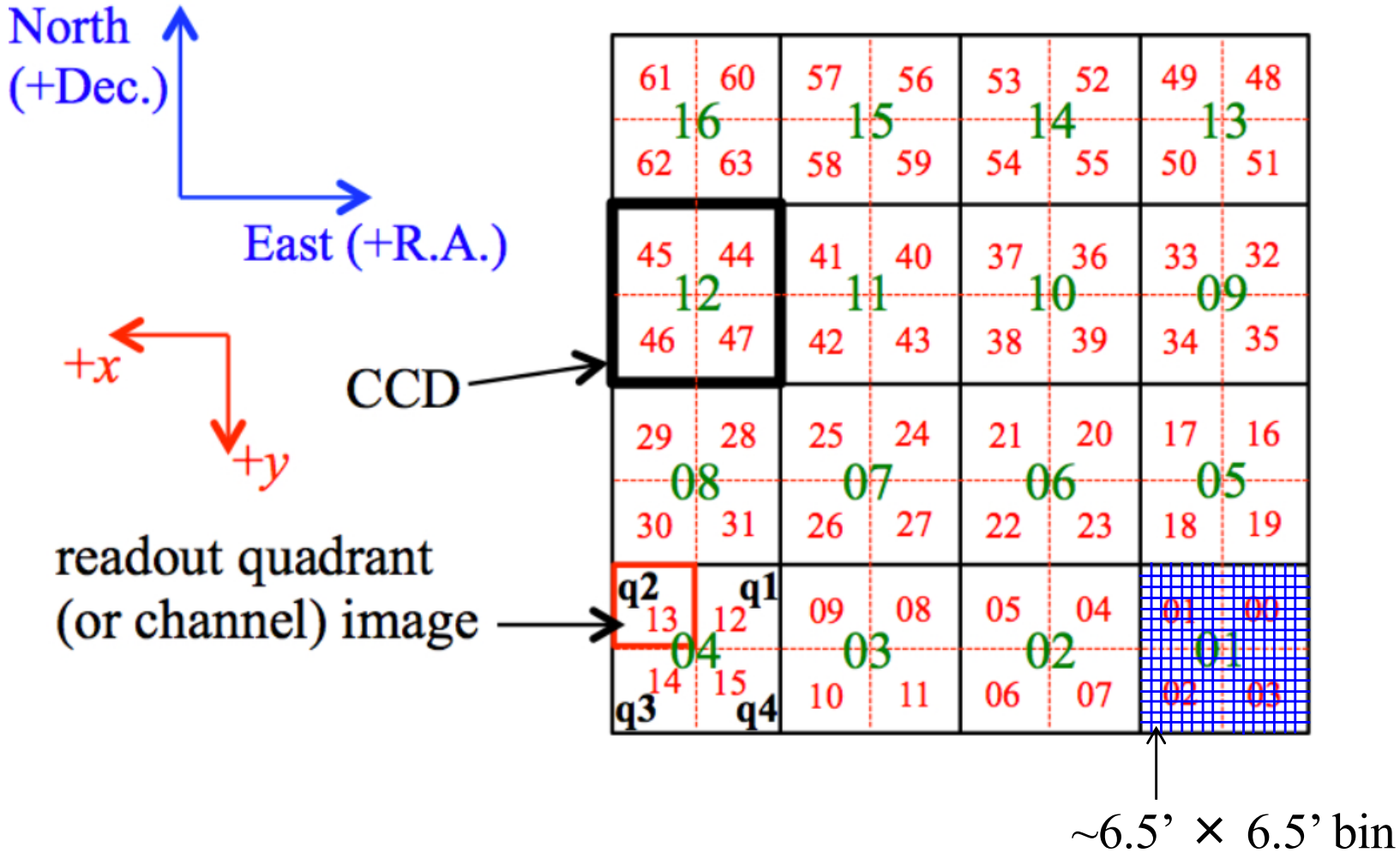
- Partitioned each quadrant image into 8 × 8 bins (~ 6.5 × 6.5 arcmin^2 bins)
- Used ZTF sources with mags: 13.5 <= mag <= 18.5
- Used *raw* catalogs with **no corrections** applied to photometry (as done to lightcurves)
- Matched to *stellar* sources in PS1 catalog per quadrant partition over 8 × 8 grid
- Calibrated ZTF mags using quadrant-based ZP, color term, and PS1 $g - r$ colors
- Computed median $DeltaMag = PS1mag - ZTFmag$ per bin
- Stitched all 8 × 8 quads × (8 × 8 partitions per quad) = 64 × 64 bins into mosaic

- Resulting number of ZTF-to-PS1 matches per bin: ~ 1,200 – 150,000 (see slide 4)

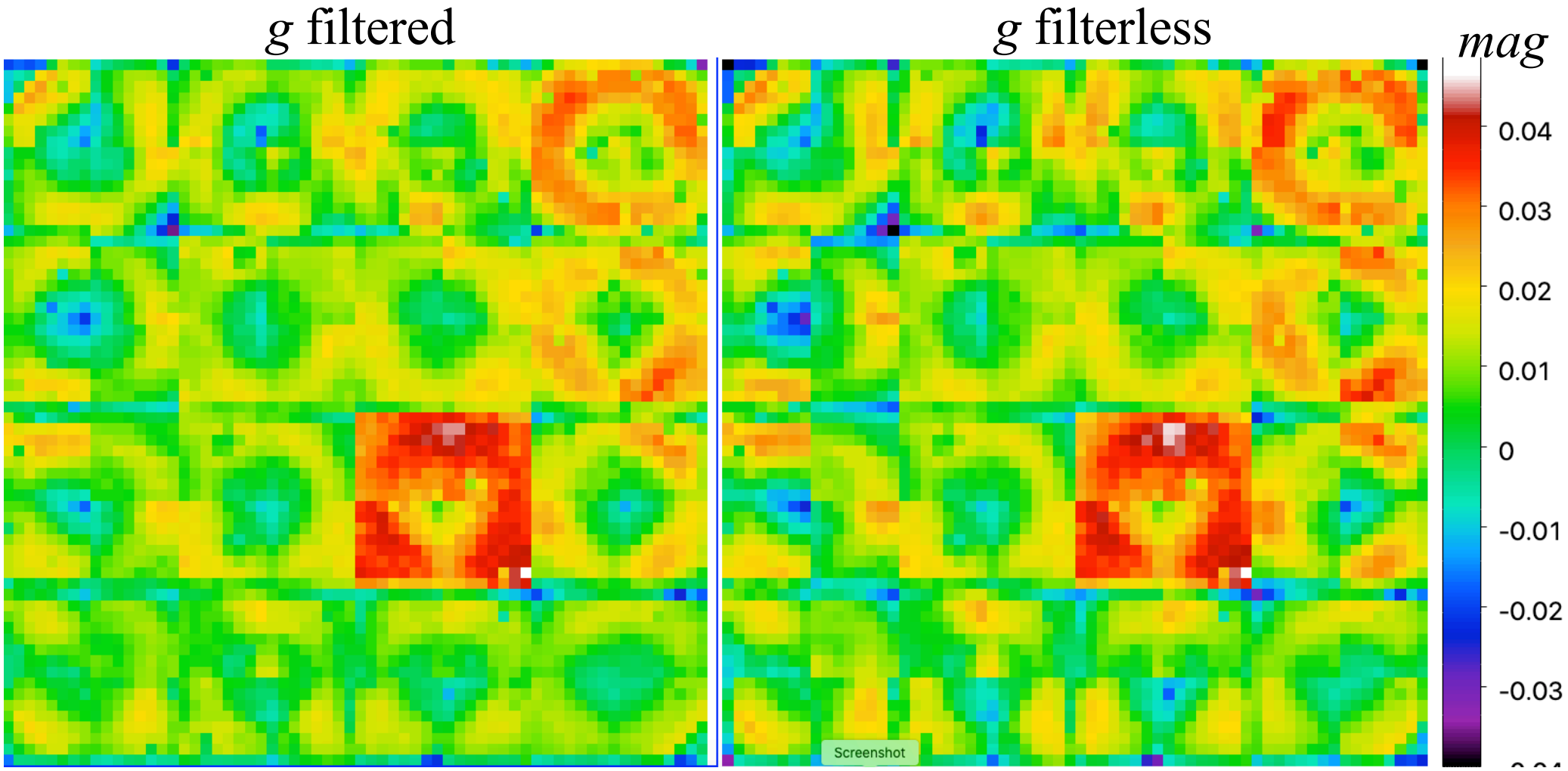
Number of ZTF-to-PS1 catalog matches per bin



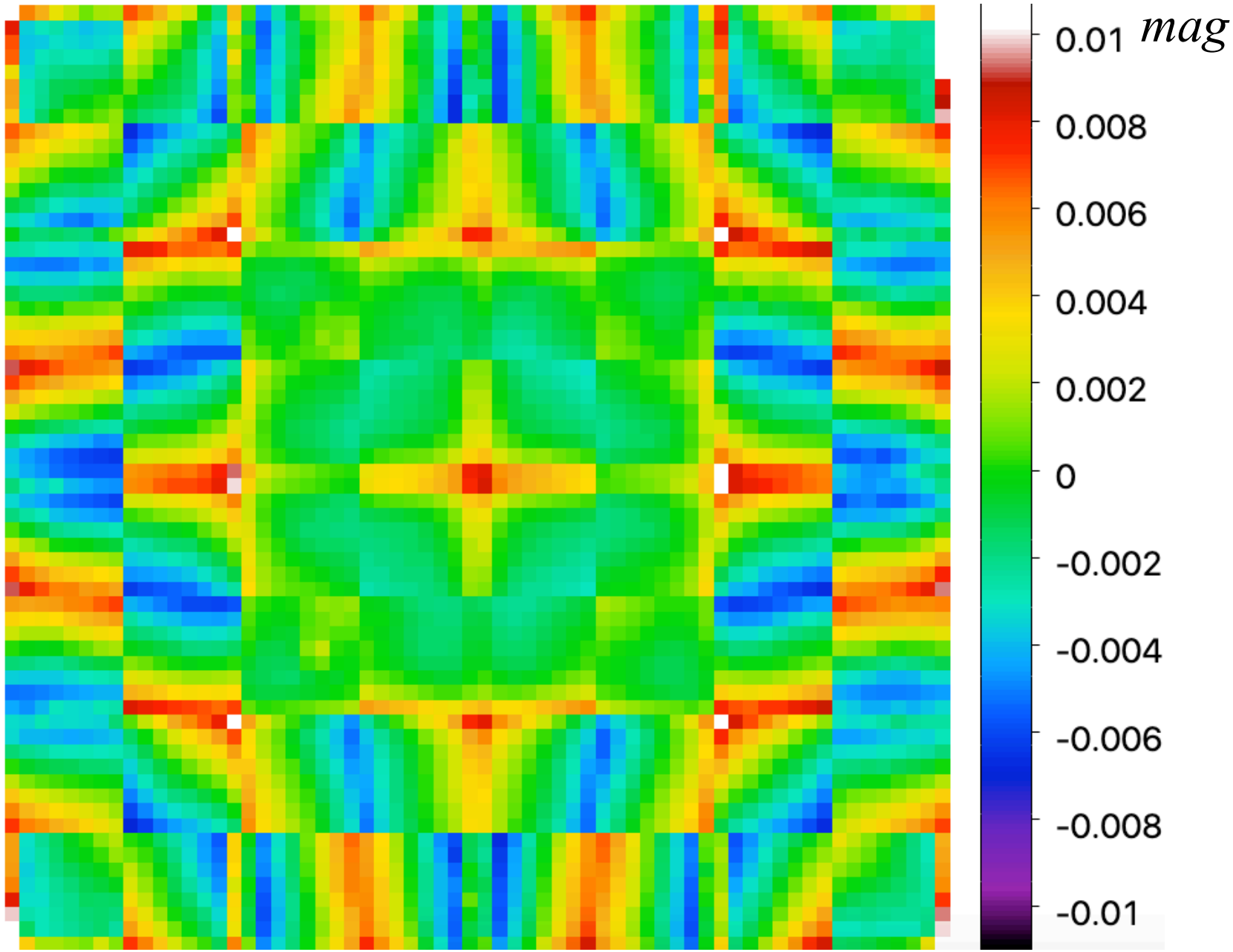
Assumed CCD / quadrant image layout



‘PS1 – PSF-fit’ photometry mag residuals (*g*)



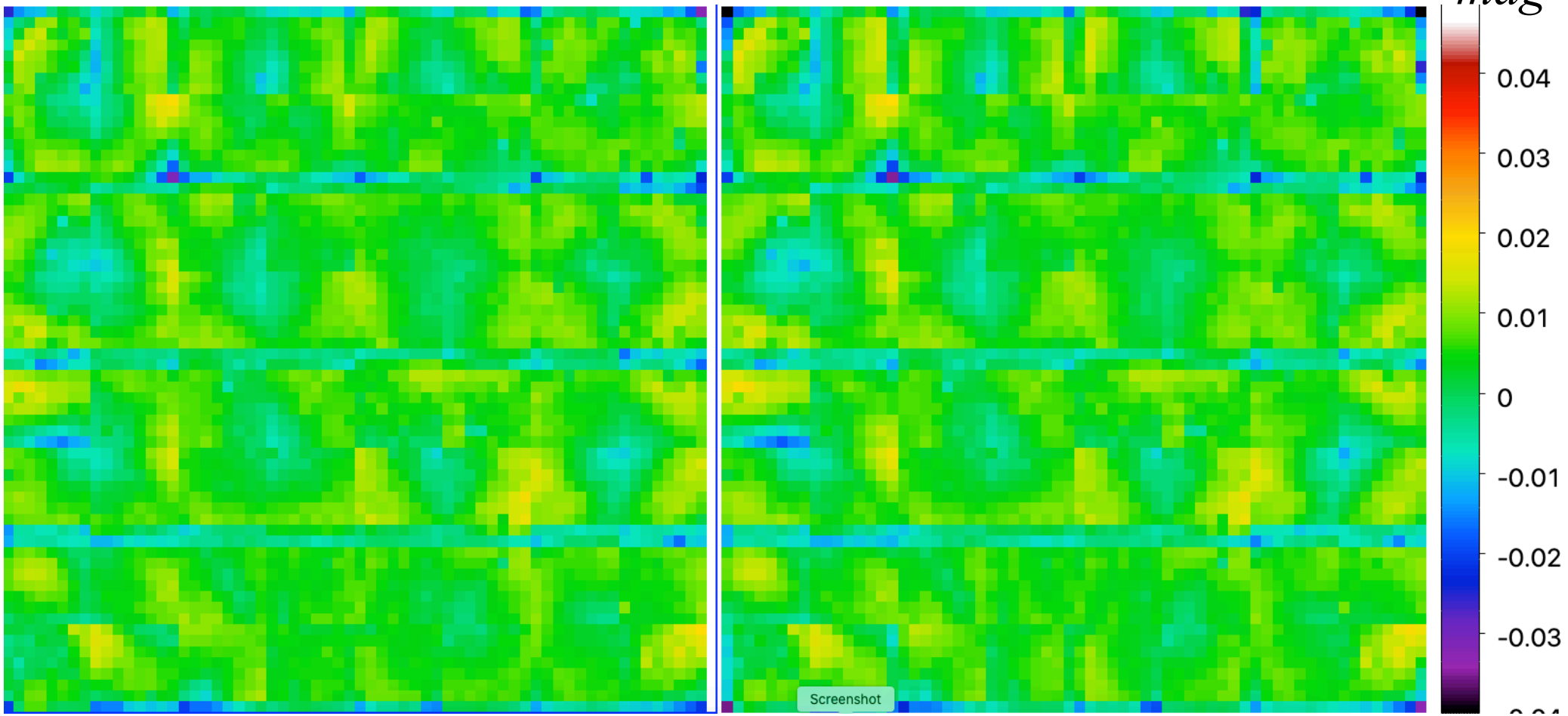
‘PS1 – PSF-fit’ photometry mag residuals
difference : *g* filtered – *g* filterless



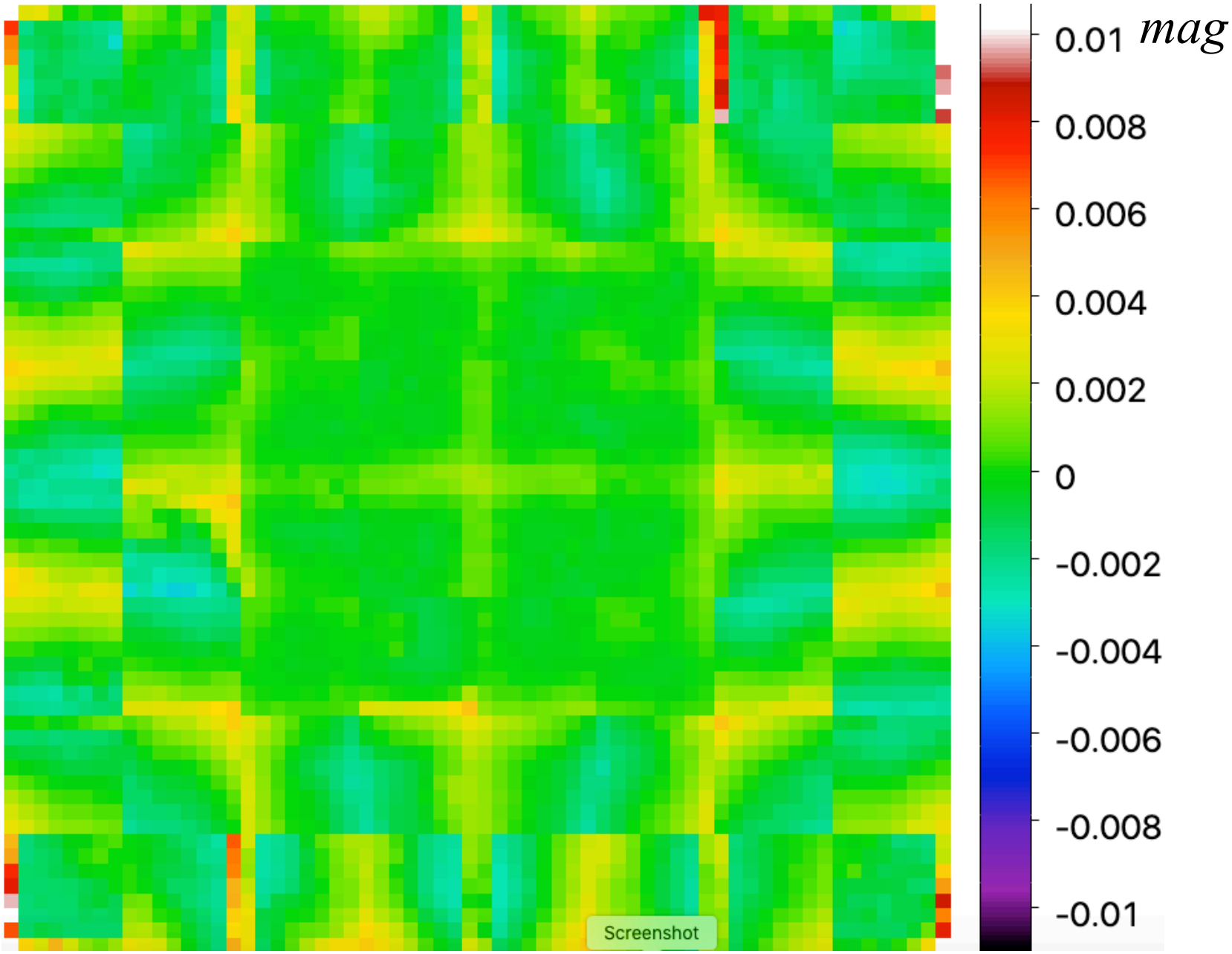
‘PS1 – PSF-fit’ photometry mag residuals (*r*)

r filtered

r filterless

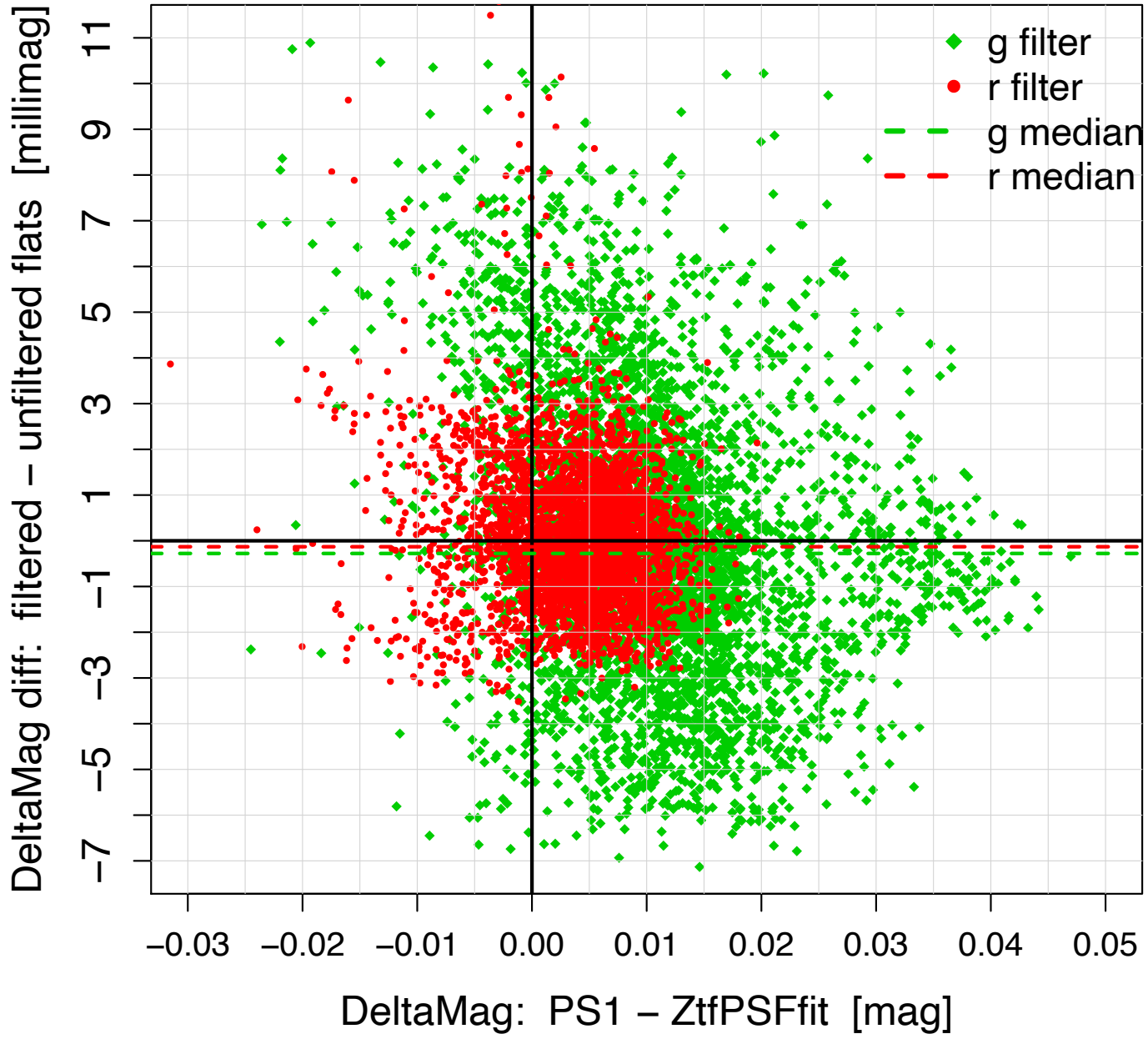


‘PS1 – PSF-fit’ photometry mag residuals
difference : *r* filtered – *r* filterless



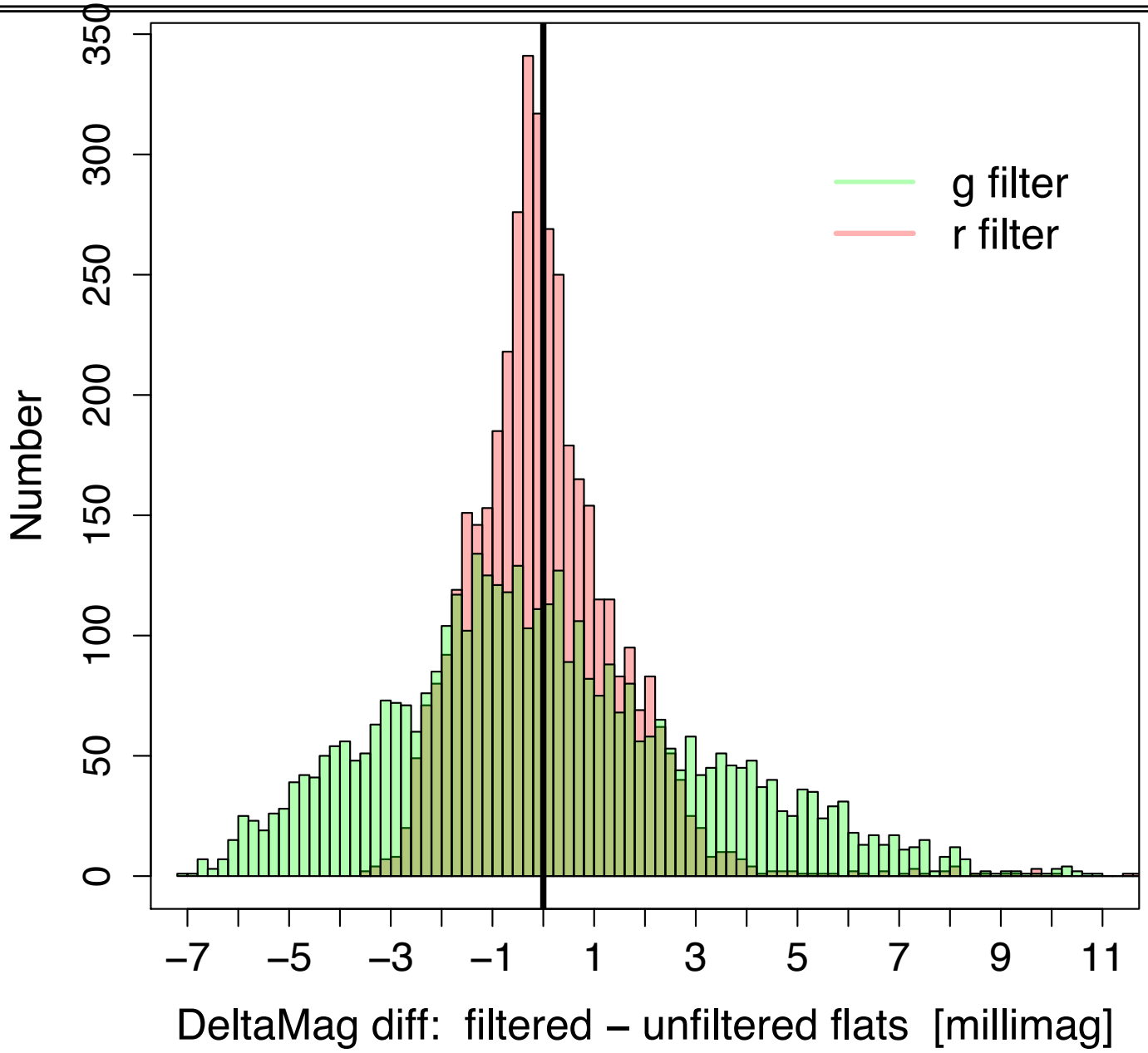
‘PS1 – PSF-fit’ photometry mag residuals

difference in residuals versus residuals per bin



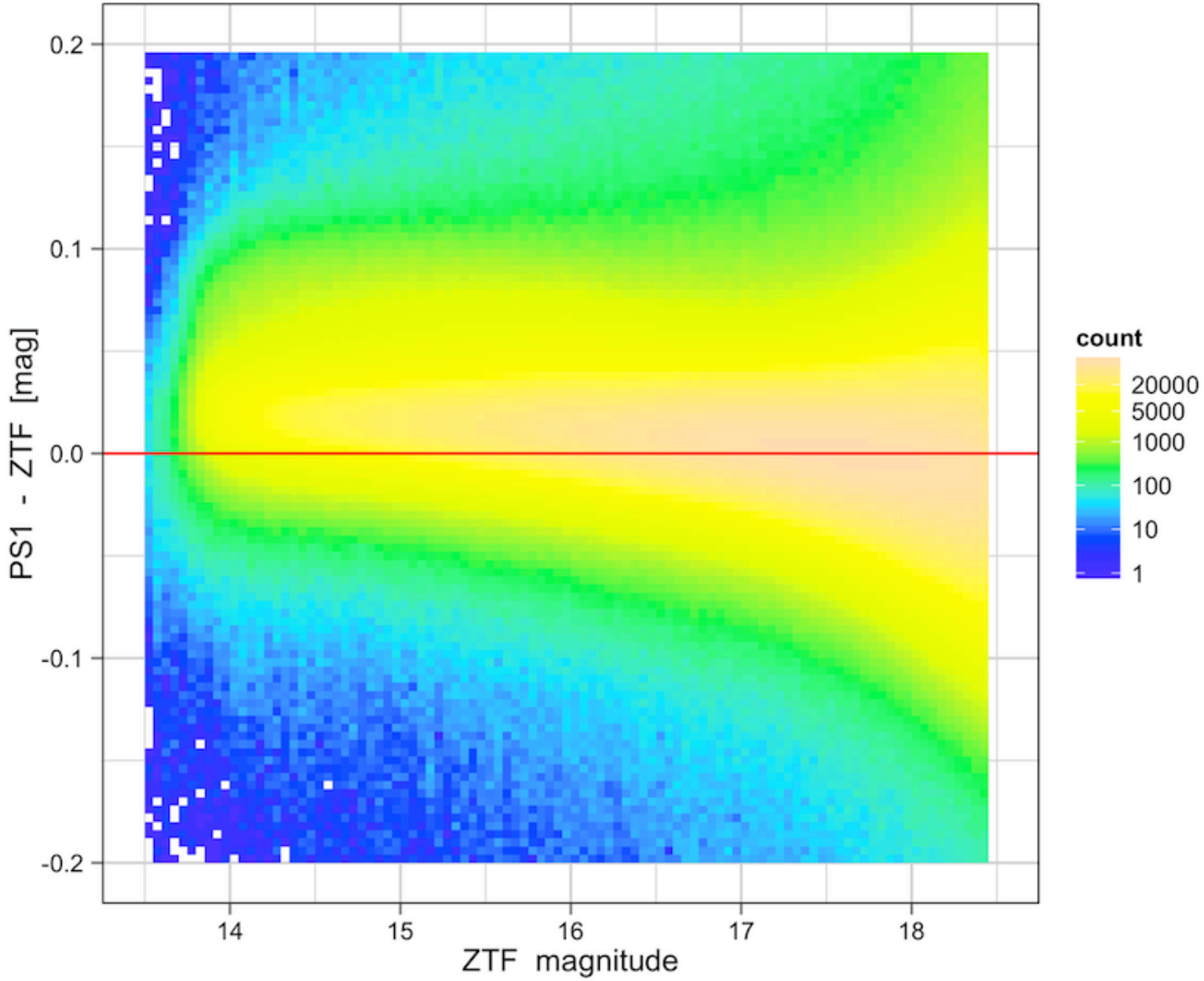
‘PS1 – PSF-fit’ photometry mag residuals

histograms of difference in residuals



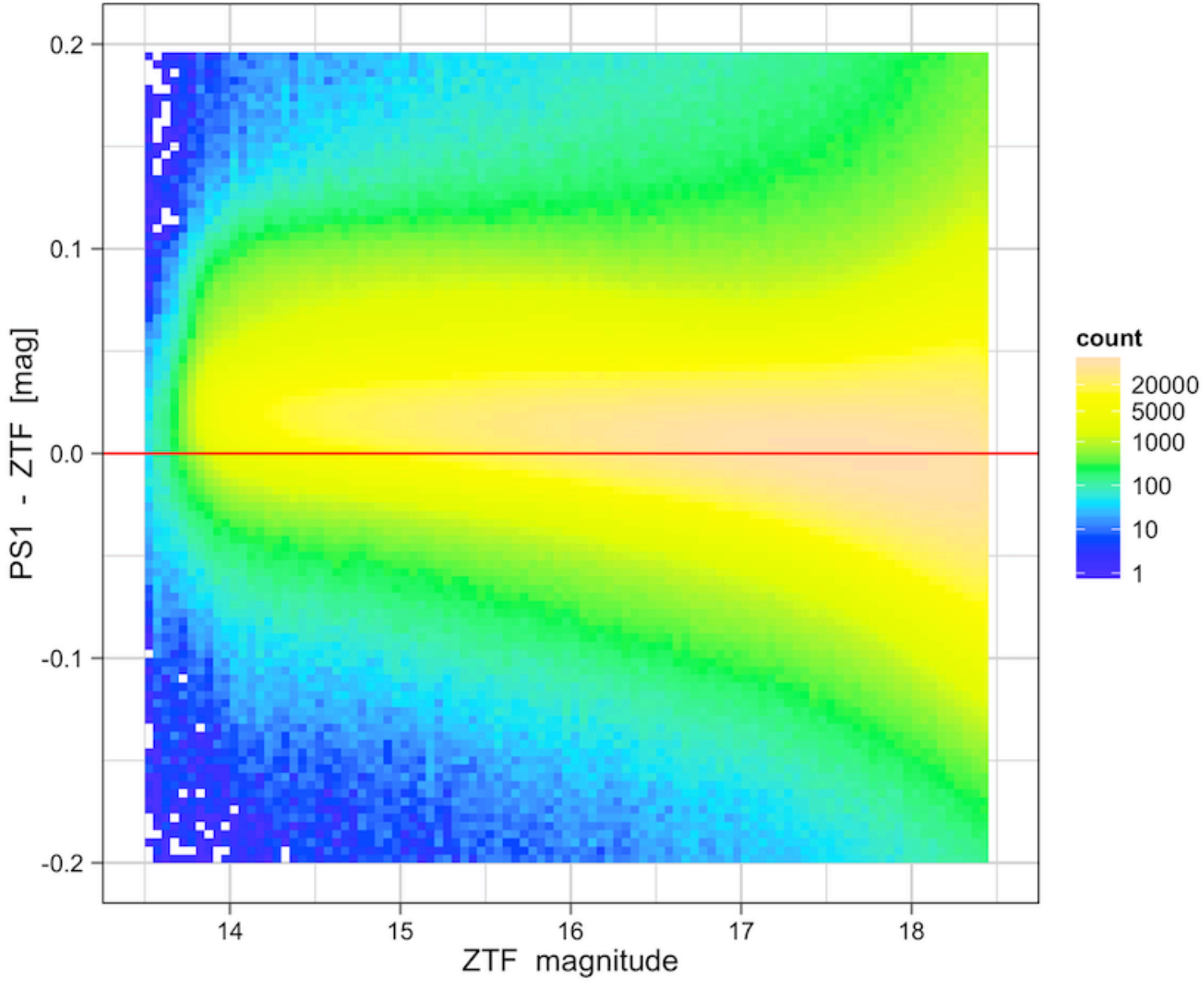
‘PS1 – PSF-fit’ photometry mag residuals

*using g-band **filtered** flats*



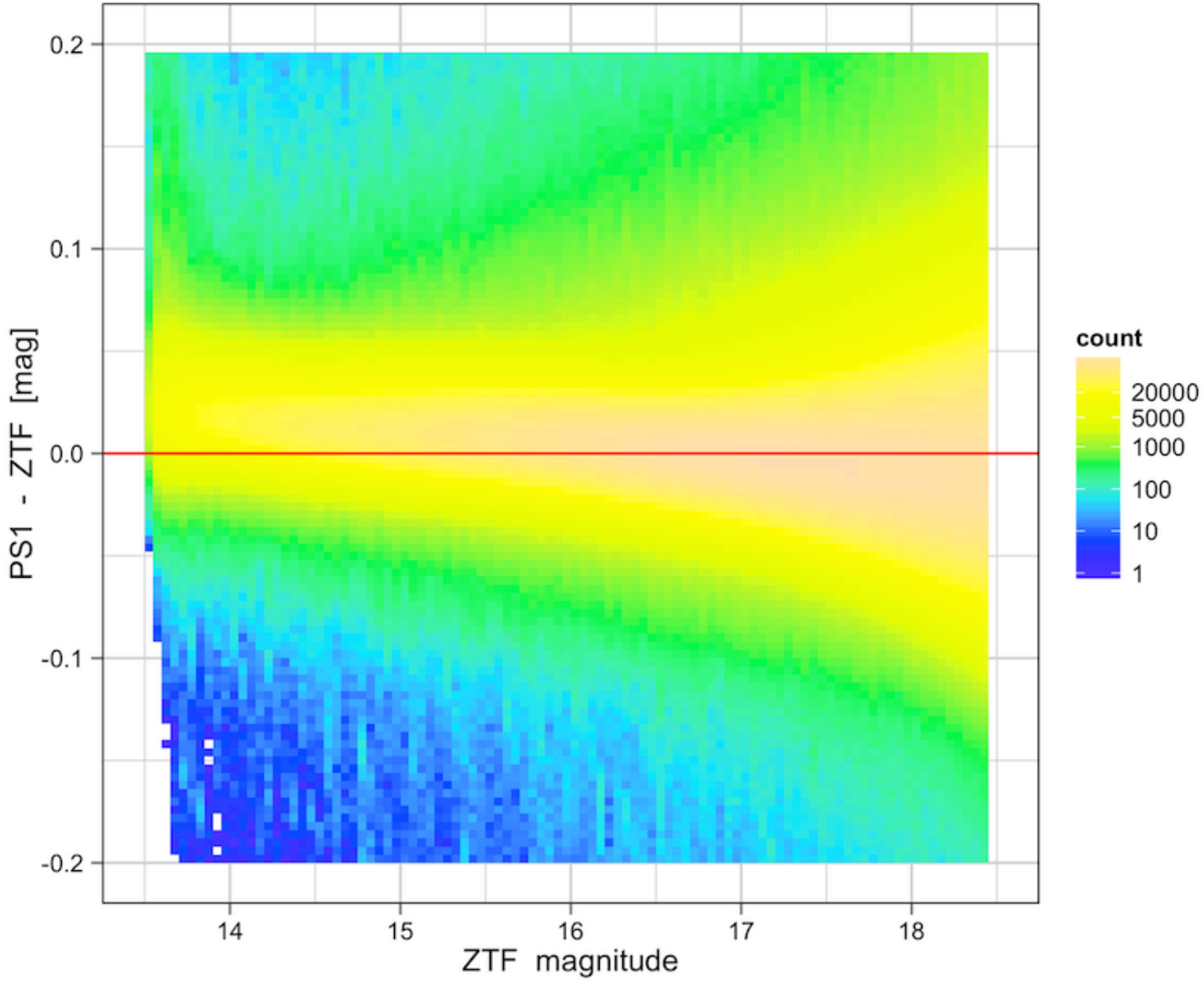
‘PS1 – PSF-fit’ photometry mag residuals

*using g-band **unfiltered** flats*



‘PS1 – PSF-fit’ photometry mag residuals

*using r-band **filtered** flats*



‘PS1 – PSF-fit’ photometry mag residuals

*using r-band **unfiltered** flats*