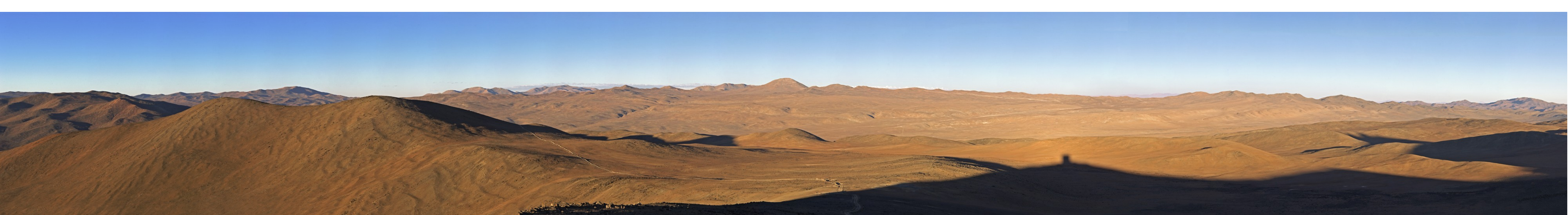
A global calibration of ATLAS:

A progress report

Joe Findlay

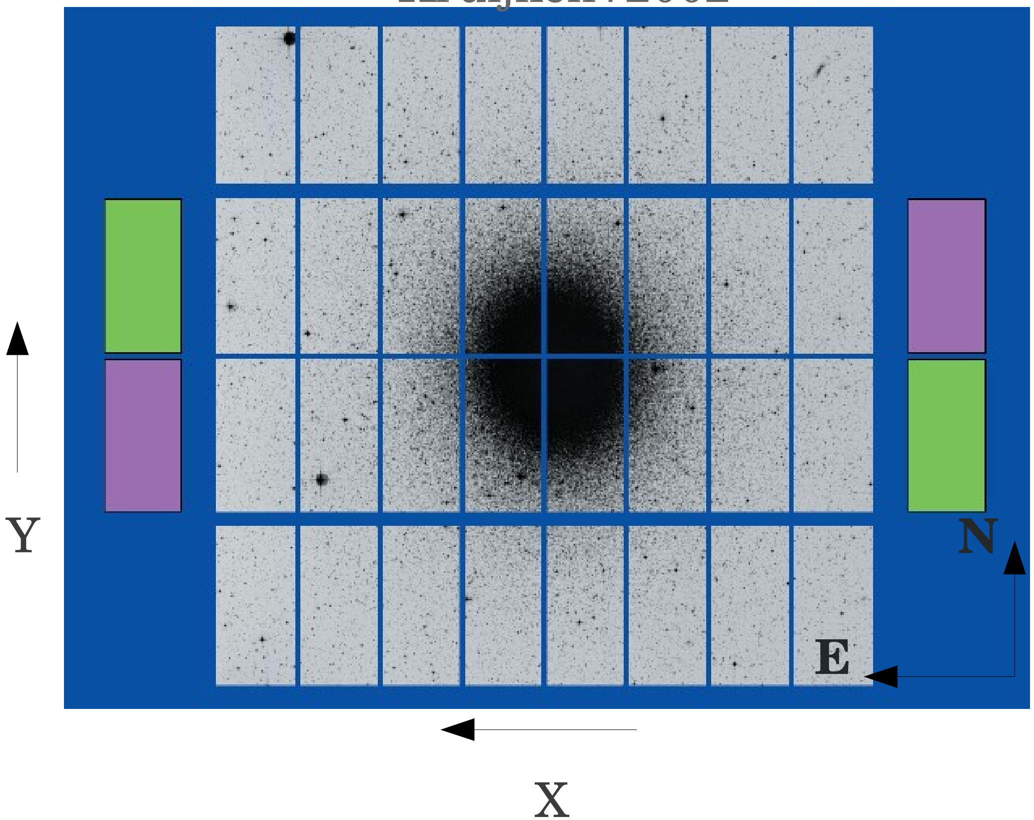
+

Durham: T. Shanks, N. Metcalfe, B. Chehade.
CASU M. Irwin, E. Gonzalez Solares, J. Lewis, A. Kupcu Yoldas

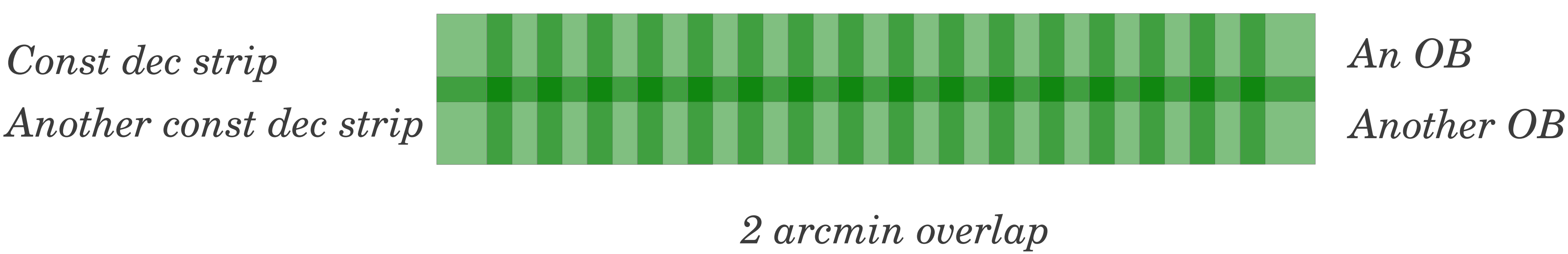


ATLAS observing strategy.

OmegaCAM: layout of focal plane
Kruijken+2002



- Detector array covers 1x1 sq.deg.
- Gaps between chips translate to 25'' and 85''.
- ATLAS fills gaps between detectors with a 2-point dither per field.
- OBs are carried in 17 pointings of constant declination.
- Each field retains 2' overlap between adjacent fields.

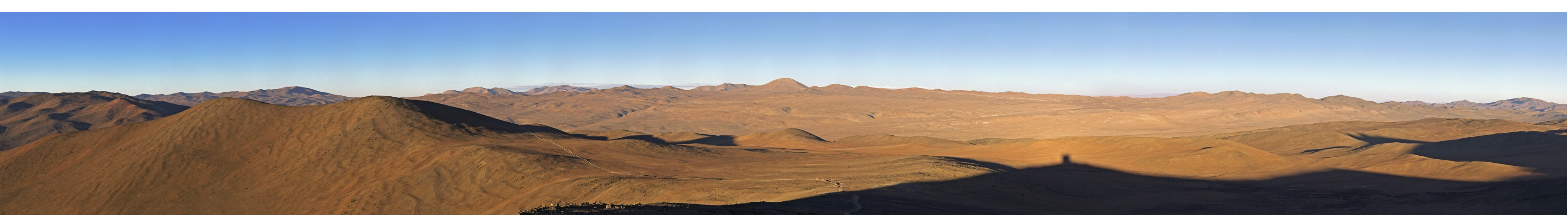


Photometric Calibration

- Currently 2 different calibration methods:

  1) ESO Standards.

- Photometric calibration based on a limited number of standard fields observed by VST each night.
- Each detector has its own nightly zero point.
- Short time scale effects such as passing cloud unaccounted for.

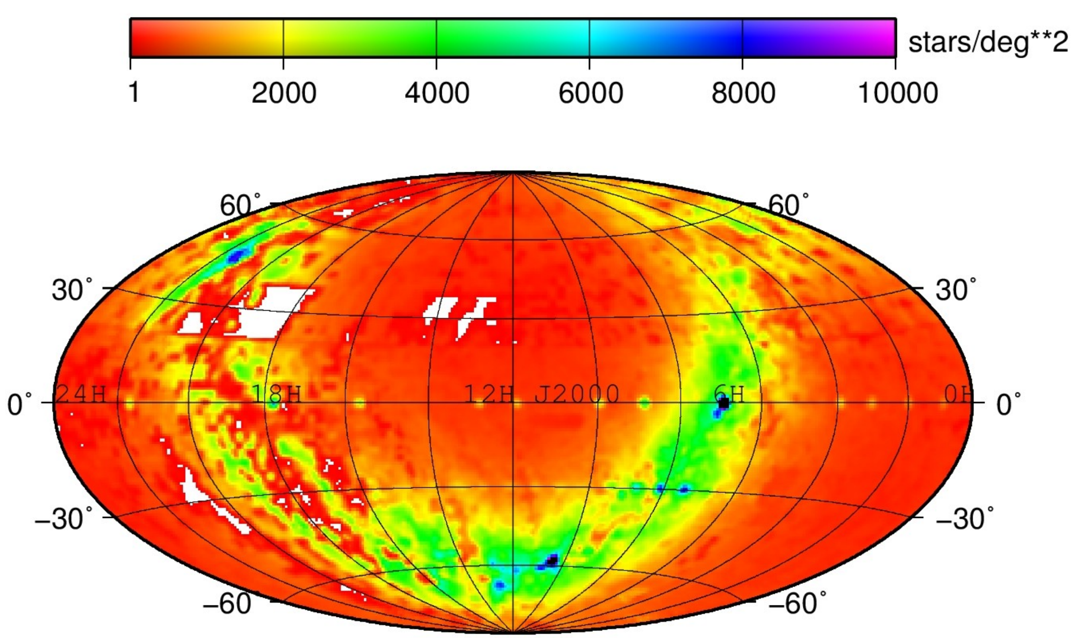


Photometric Calibration

- Currently 2 different calibration methods:

- 2) CASU have recently tied calibration to APASS.
  American association of variable star observers (AAVSO) **A**ll **S**ky **S**urvey

APASS DR6 Sky coverage map.
Edward Los+2012



- All sky photometric survey in Johnson B, V and Sloan *gri*.

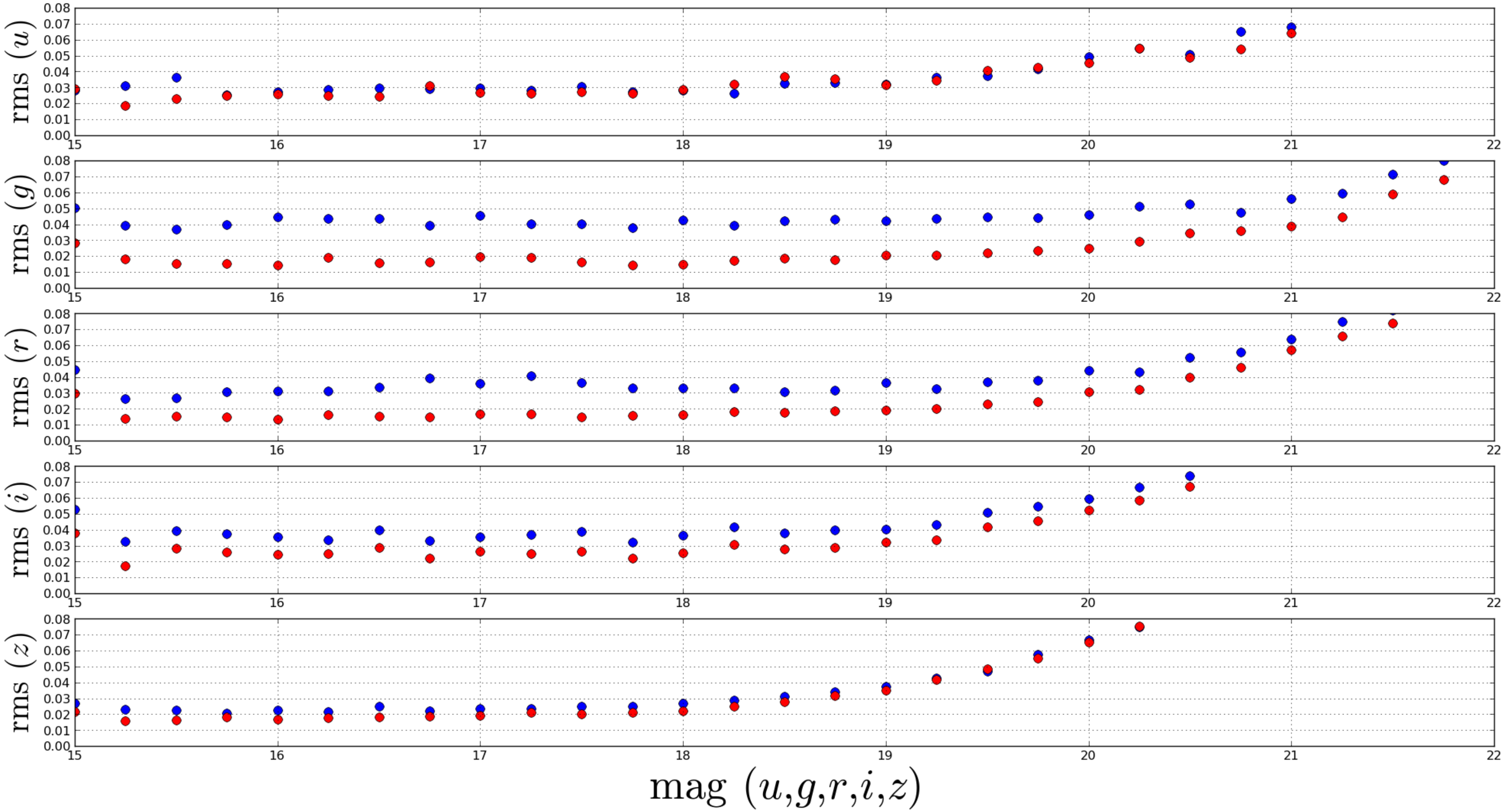
- 5-sigma limiting mags are ~16 in V and ~ 15 in *i*.

- DR7 contains 50M objects over 97% of the sky

Comparison of methods

Residuals between pairs of observations in magnitude bins

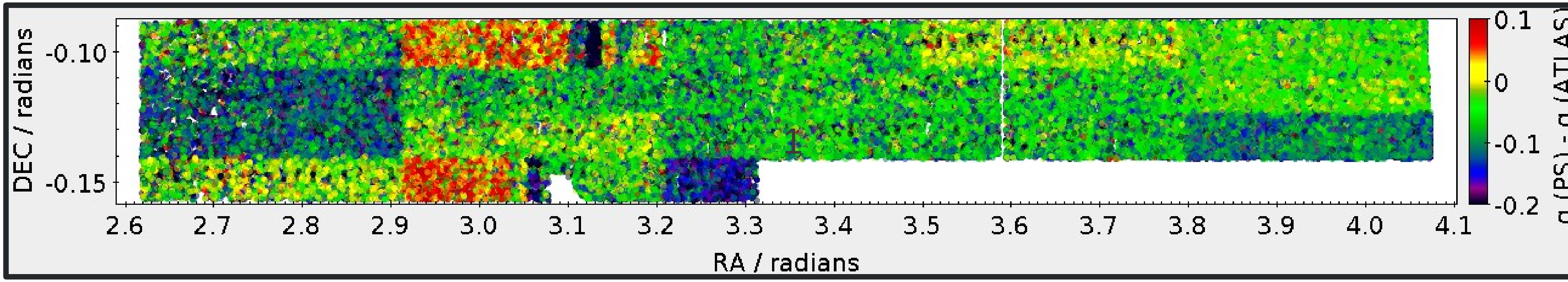
- On local scales:
- • Standard star calibration good to ~0.05.
- •APASS calibration ~0.02



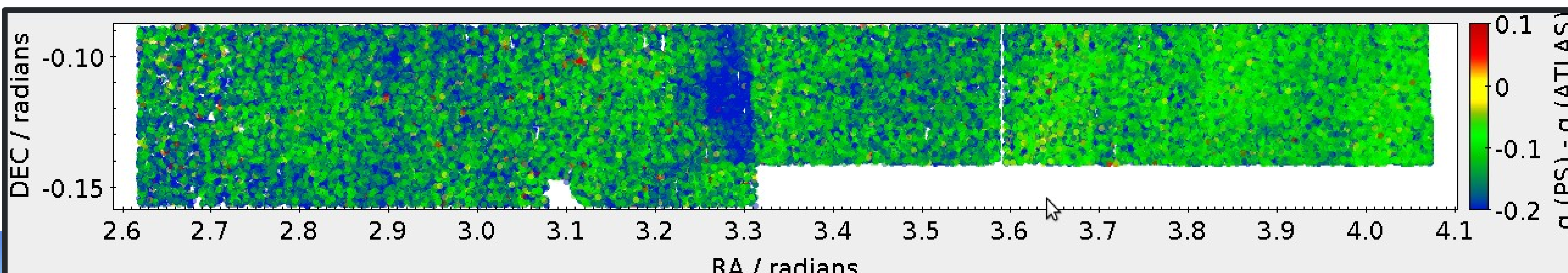
Comparison of methods

Pan-STARRS photometry over large regions of the ATLAS provides a test bed of comparison.

g-band ESO-Standards calibration vs. Pan-STARRS

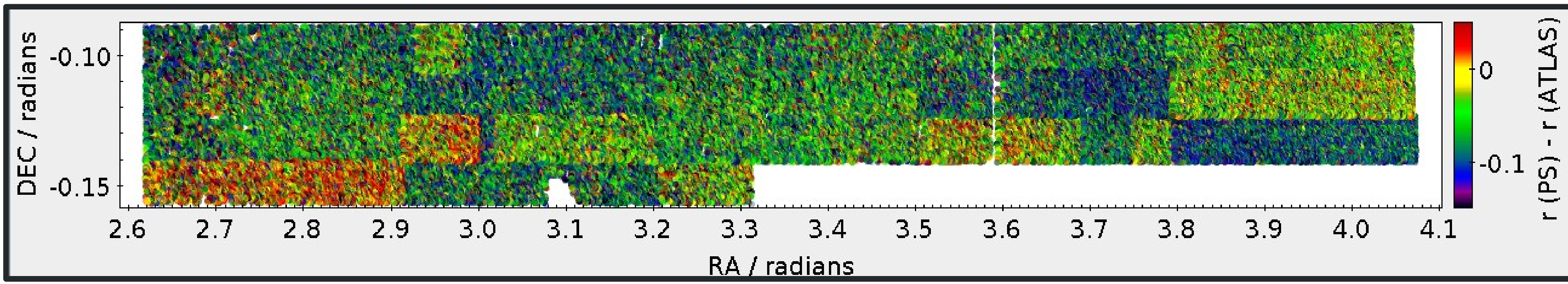


APASS calibration vs. Pan-STARRS

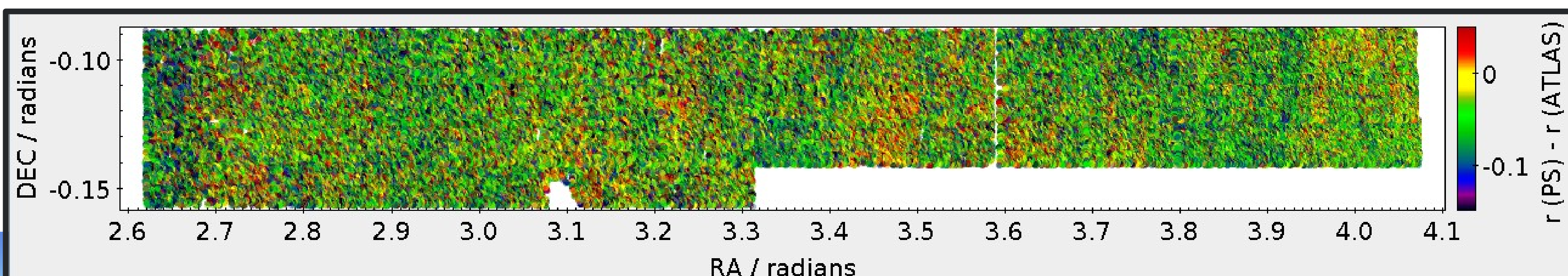


Comparison of methods

r-band ESO-Standards calibration vs. Pan-STARRS

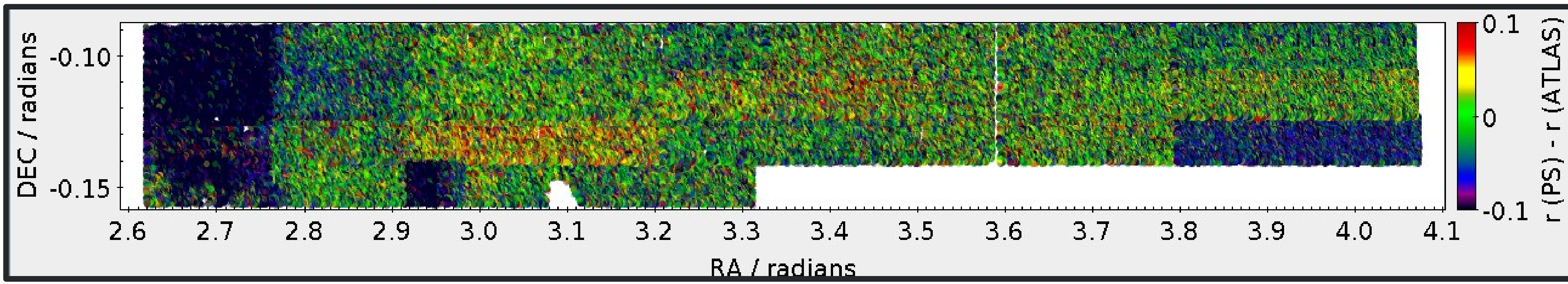


APASS calibration vs. Pan-STARRS

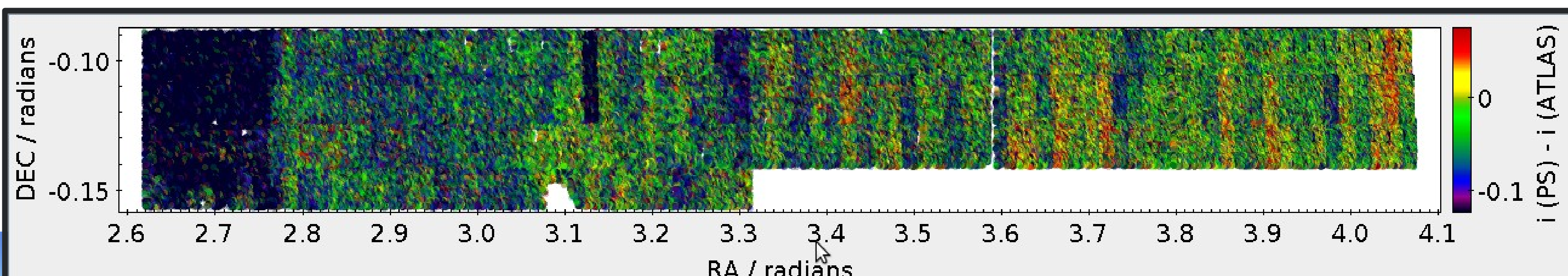


Comparison of methods

i-band ESO-Standards calibration vs. Pan-STARRS

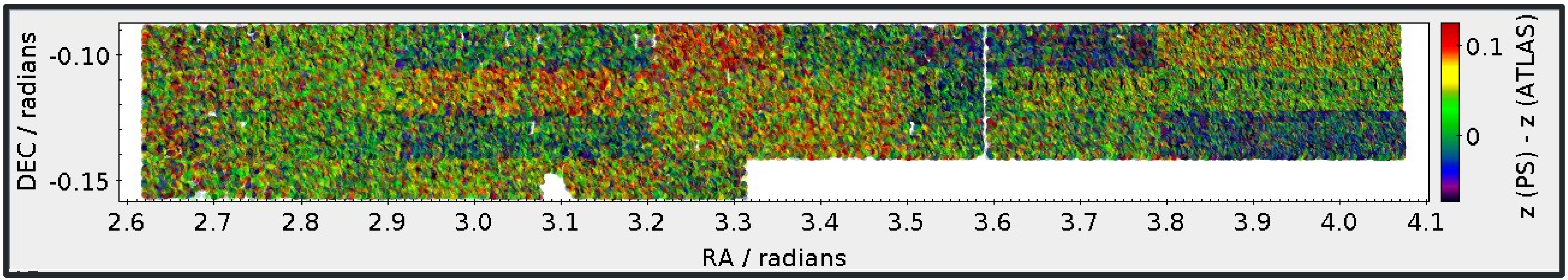


APASS calibration vs. Pan-STARRS

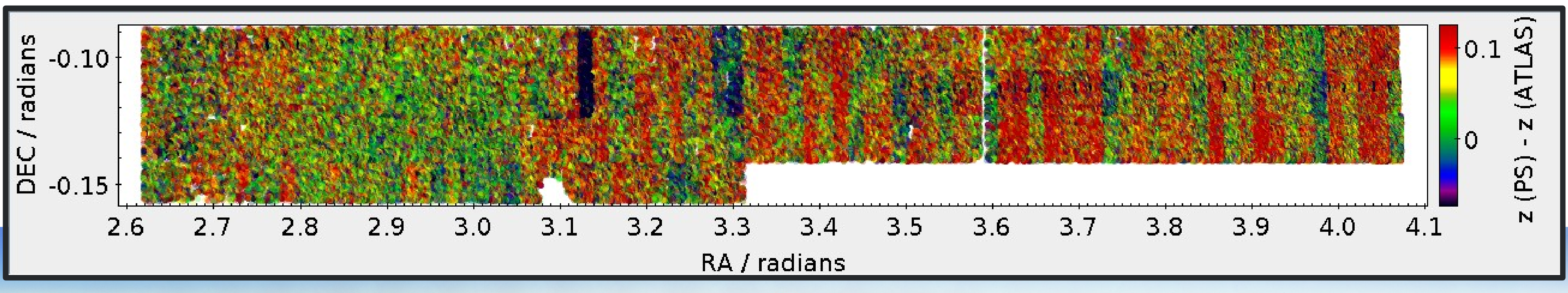


Comparison of methods

z-band ESO-Standards calibration vs. Pan-STARRS

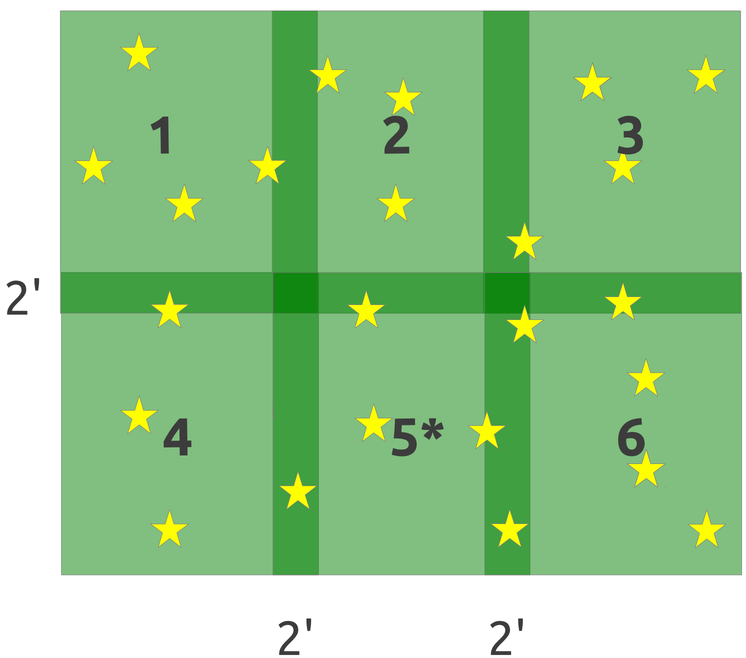


APASS calibration vs. Pan-STARRS



Overlap calibration

Allow zero points of all non-photometric frames to vary and find a least squares solution that minimises overlap residuals.



N frames where *(1...m)* are ucalibrated *(m+1...n)* calibrated.

$$\Delta_{ij} = \langle \mathrm{Mag}_i - \mathrm{Mag}_j \rangle_{\mathrm{pairs}}$$

a_i is the floating zero-point of frame i where a_i=0 for calibrated frames.

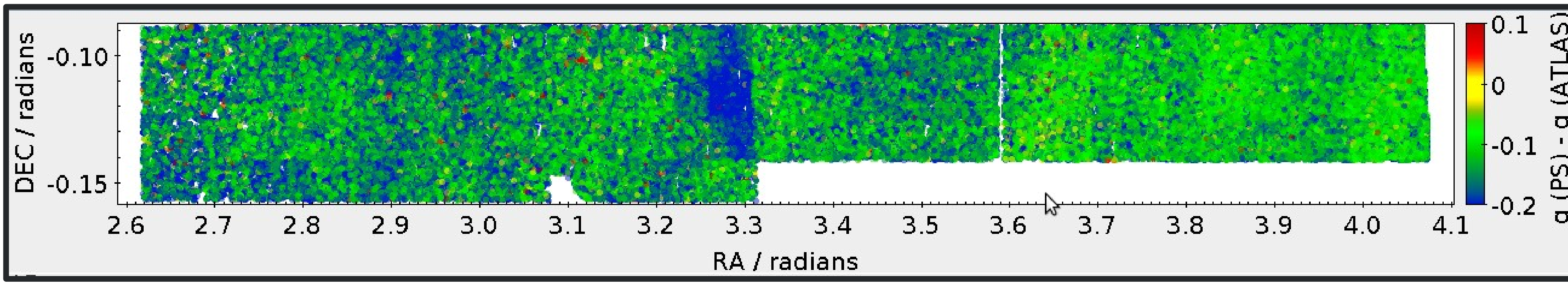
$$\theta_{ij} = \begin{cases} = 1 & \text{if frames } i \text{ and } j \text{ overlap,} \\ = 0 & \text{if no overlap,} \\ = 1 & \text{if } i = j. \end{cases}$$

Glazebrook+1994

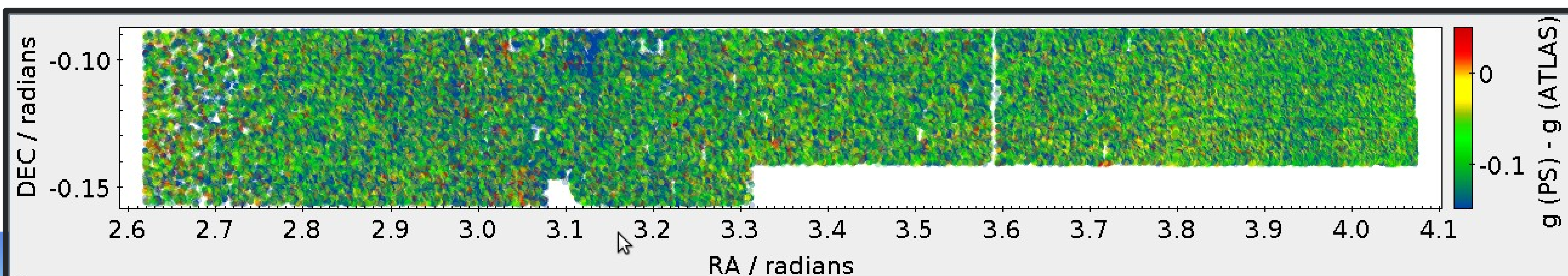
$$S = \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} \theta_{ij} (\Delta_{ij} + a_i - a_j)^2,$$

Comparison of methods

g-band APASS calibration vs. Pan-STARRS

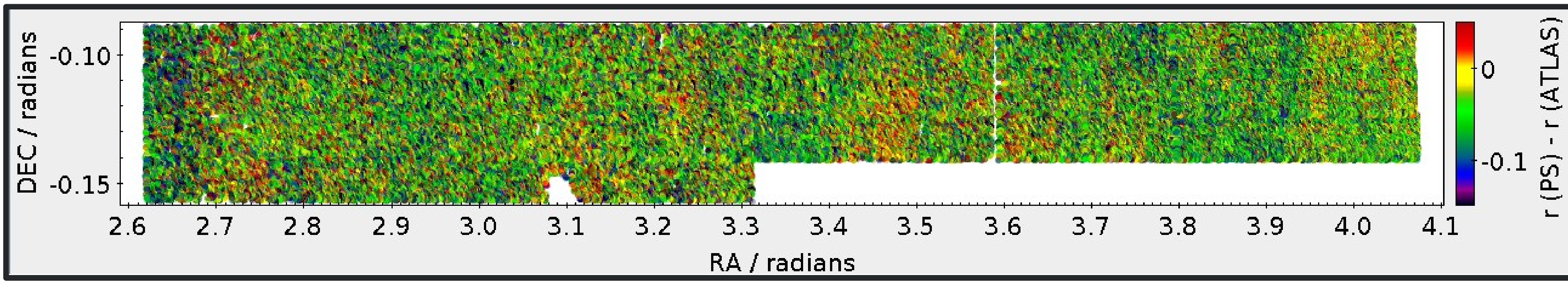


Matrix inversion vs. Pan-STARRS

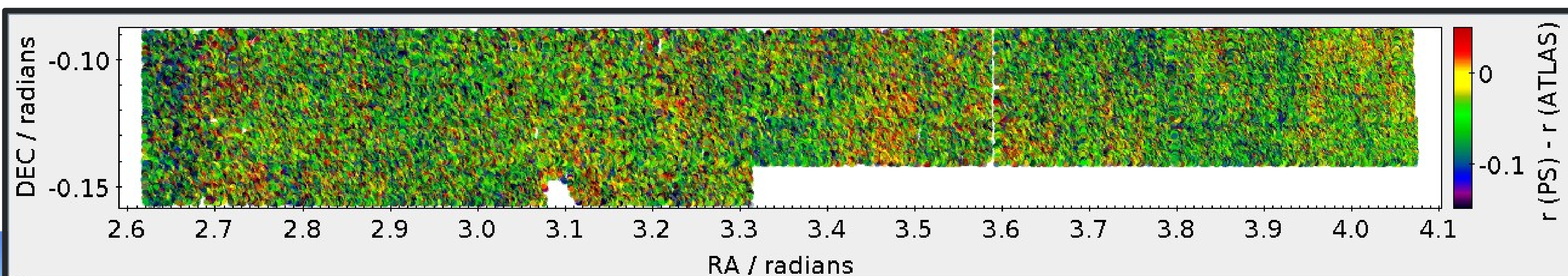


Comparison of methods

r-band APASS calibration vs. Pan-STARRS

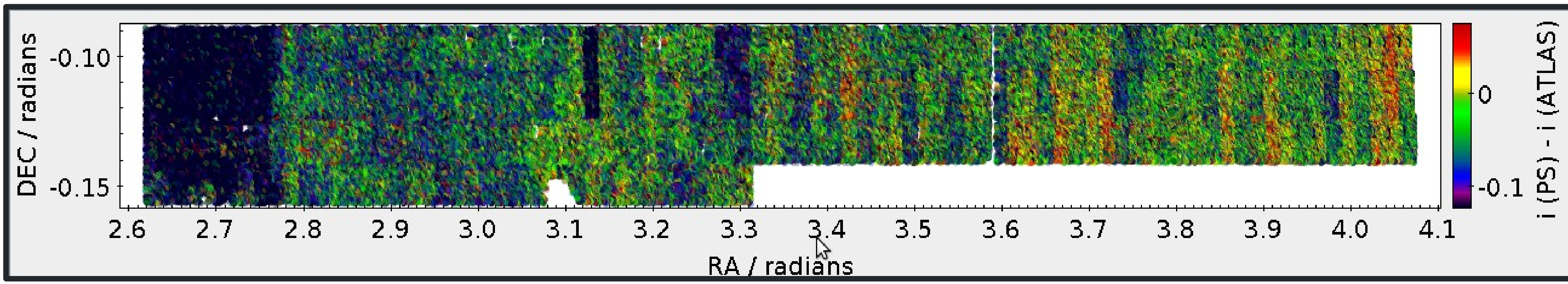


Matrix inversion vs. Pan-STARRS

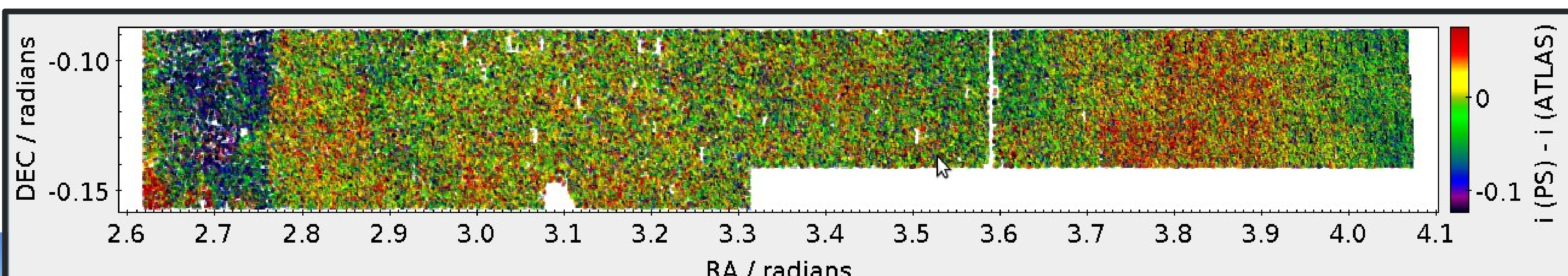


Comparison of methods

i-band APASS calibration vs. Pan-STARRS

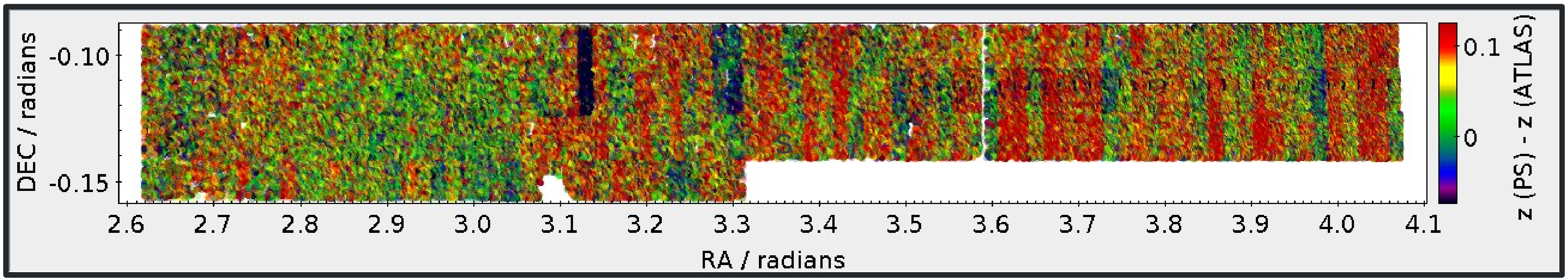


Matrix inversion vs. Pan-STARRS

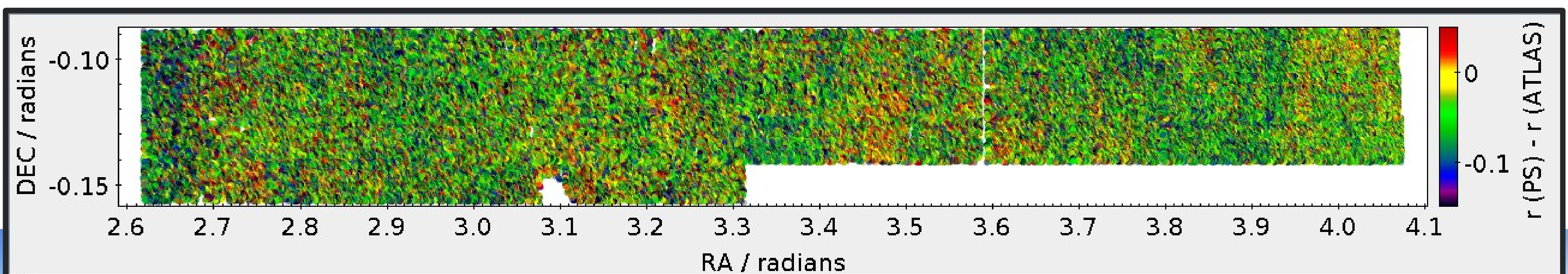


Comparison of methods

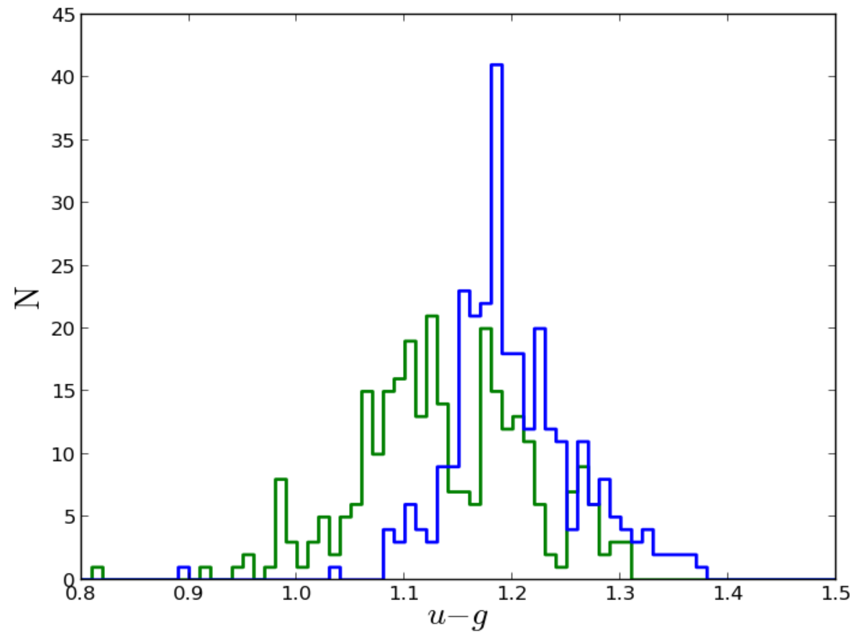
z-band APASS calibration vs. Pan-STARRS



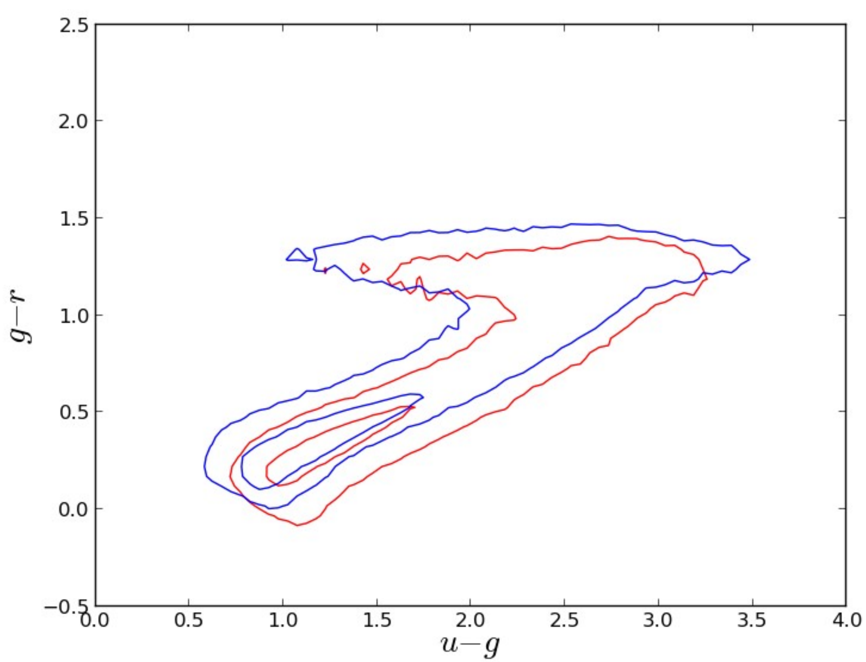
Matrix inversion vs. Pan-STARRS

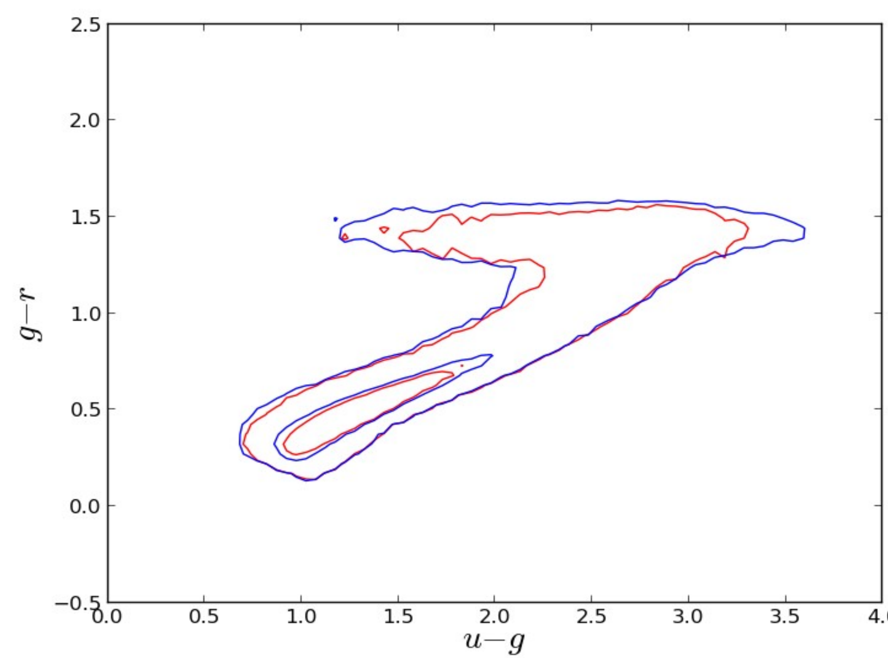


Colour plots



- Left: Histogram of median u-g positions of stellar loci in ATLAS fields over 300 sq.deg
- Bottom left: ug:gr showing two streams evident in histogram before calibration.
- Bottom right: Two streams after calibration.

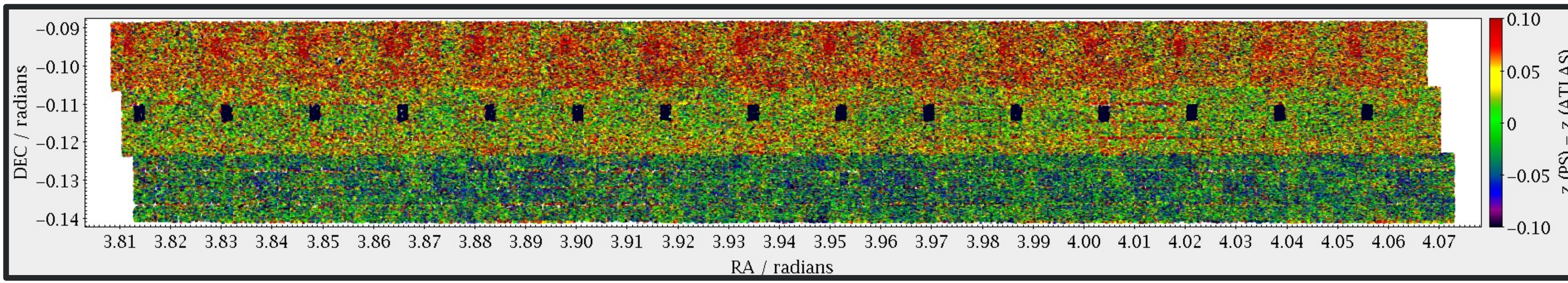




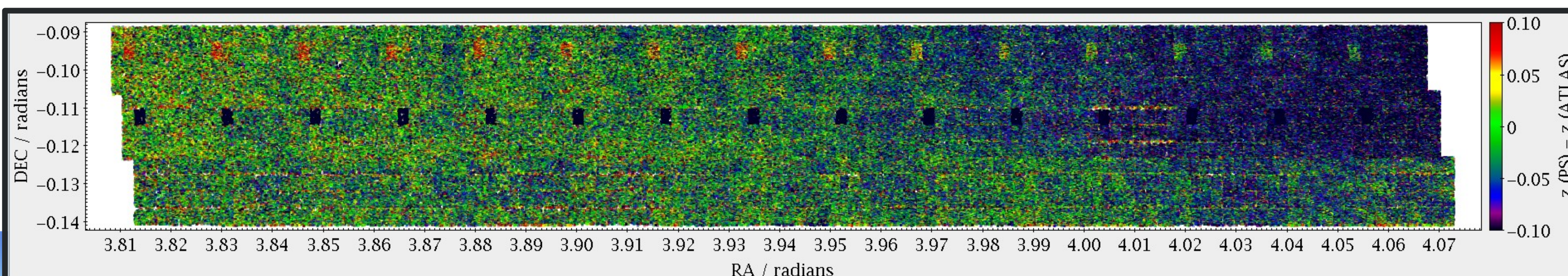
Gradients

Choose your anchor fields wisely: Gradients across fields can have propagate.

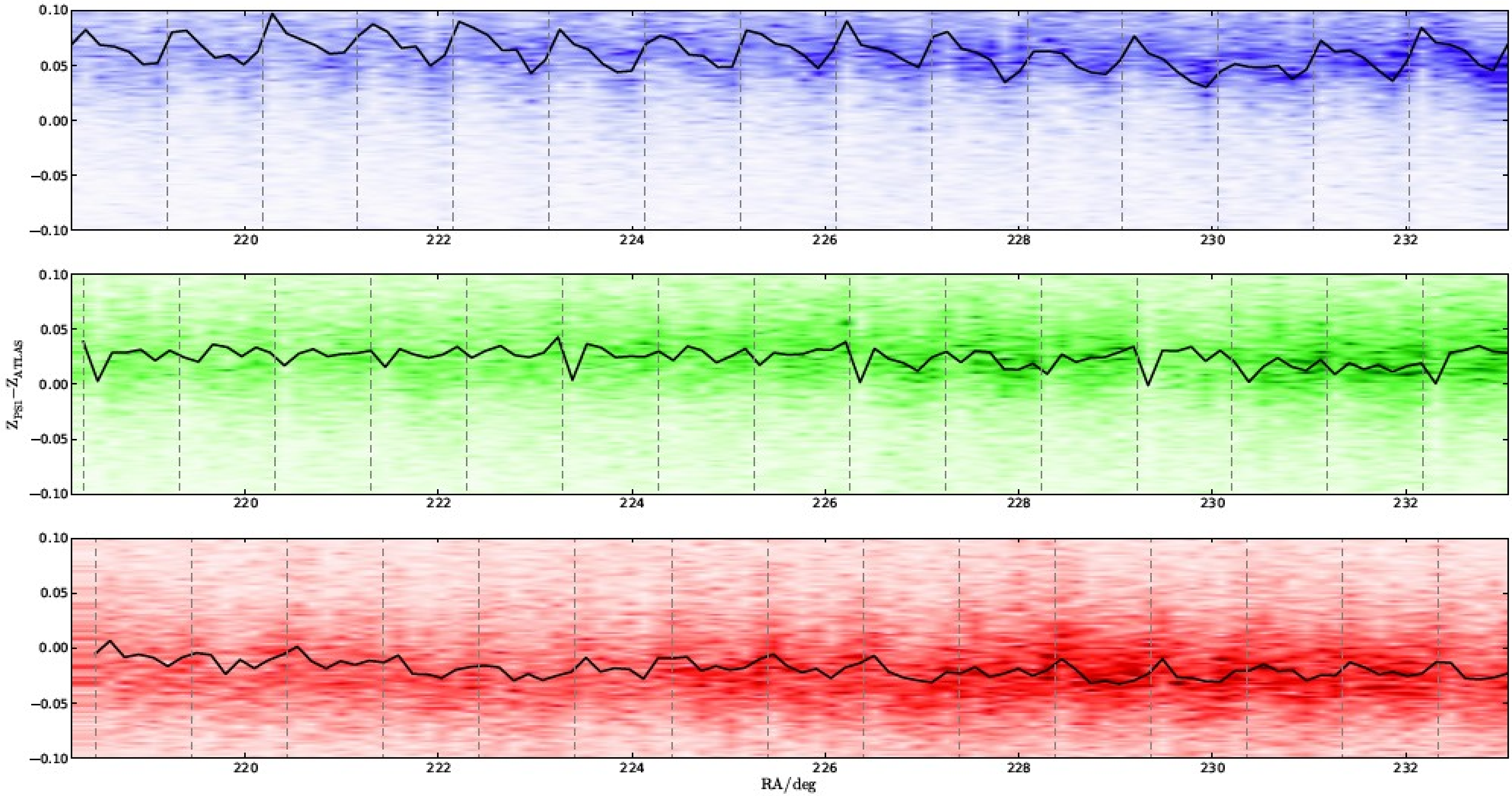
z-band standard calibration vs. Pan-STARRS



Matrix inversion vs. Pan-STARRS



Gradients


0.10
0.05
0.00
−0.05
−0.10
220
222
224
226
228
230
232
$Z_{PS1} - Z_{ATLAS}$
RA/deg

To Do List

Define a set of ATLAS anchors with the overall aim of calibrating to the "natural" VST system.

Try the method with various apertures; what is the best aperture to work with

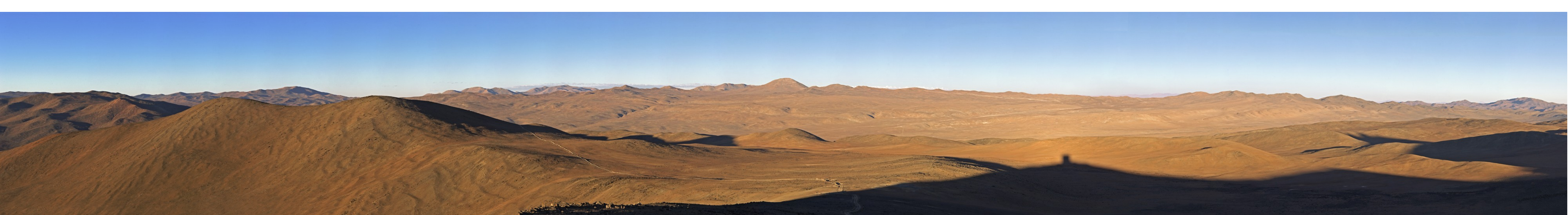
Quantify the gain in photometric precision.

Illumination correction. Are there nightly variations in scattered light and what is the effect of using an average illumination correction.

Science experiments.

e.g. Galaxy clustering.

e.g. Galaxy counts.



Summary

- ATLAS is currently calibrated by 1) ESO standard star observations and 2) tying to APASS.

- These methods give ~0.05 and ~0.02 mag scatter between adjacent fields.

- On wider scales as shown here both methods vary over ranges of ~0.2 mags up to 0.4 mag!

- The Matrix inversion method shows promising results in reducing large zero point variations over wide scales.

- More to be done to quantify the gain in photometric precision.