

Status of iberical simulation

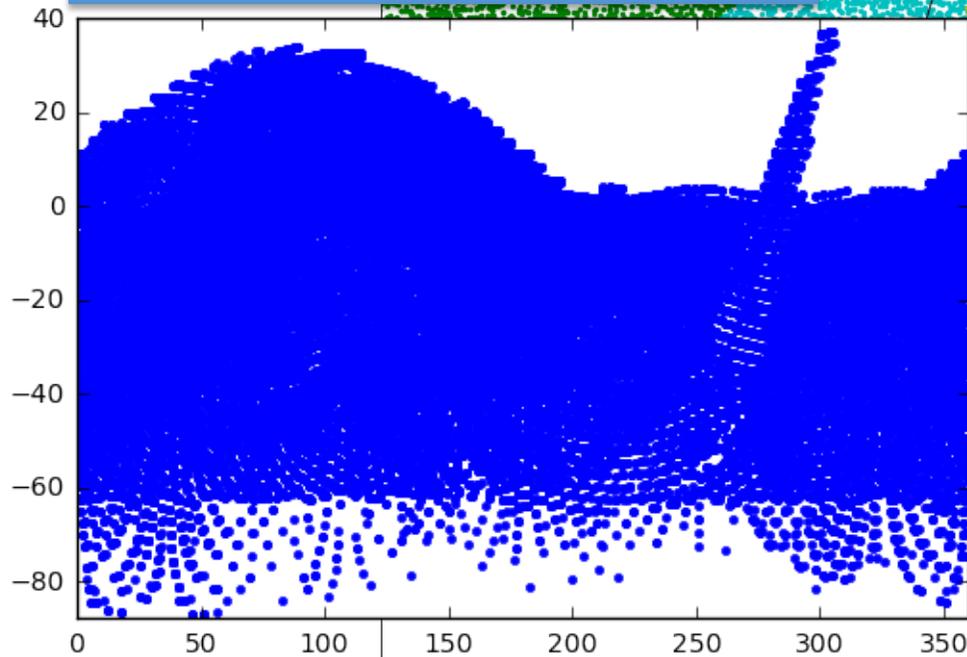
F. Feinstein, D. Fouchez, N. Lalloué, CPPM-Marseille

J. Cohen-Tanugi, LUPM-Montpellier

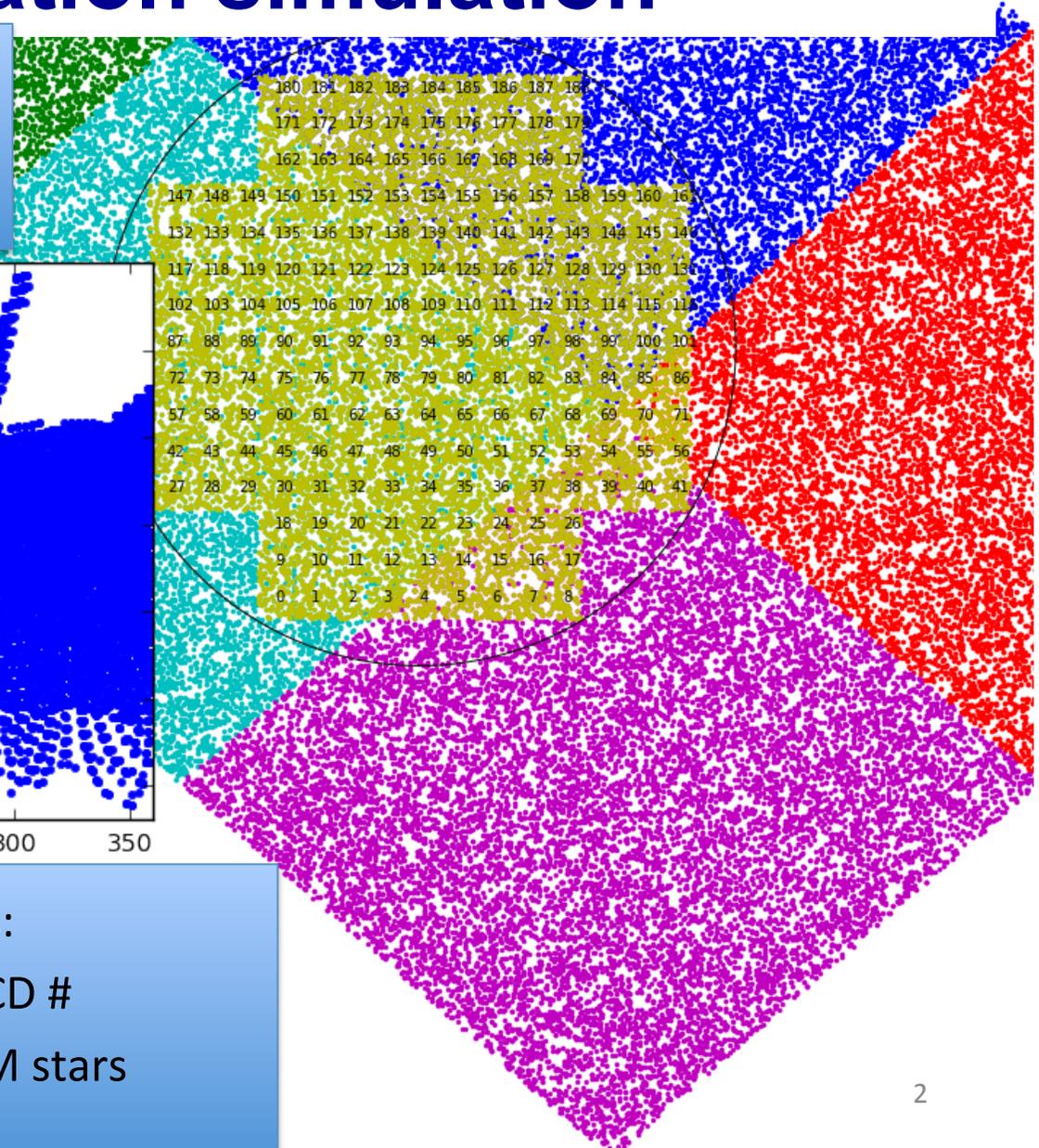
PCWG workshop, May 24th, 2018

Observation simulation

Opsim pointing, dithering
20000 deg² patch (full sky)
night #: 100 to 500, *r* filter



Simulated camera fields:
LSST focal plane with CCD #
HEALpix patches of GUM stars



Input catalog treatment

- From GUM (m_G from 16 to 19) evaluate statistics to isolated stars in crowded fields:
 - Calculate avg freq. in a circle (6 arcsec) and reduce stat. by $P(0)$
 - ⇒ negligible away from the Gal. plane, then can reduce up to 1/100
 - Reduce by ½ to account for G, K stars statistics
- Use the trick of “bright” stars to reduce test time :
 - mag – 2.5 log(reduction)
 - sky brightness – 2.5 log(reduction)
 - Here we used a reduction = 101

⇒ 1.4 M star magnitudes fitted over 28 M sources, within 55 k visits

sparse matrix 28 M x 1.5 M => fit of mag, a , k , Z_p

~ 1.5 M parameters, result in ~ 30 min on Dark Energy Centre

Fit parameters

$$f_s(\text{filter}, \text{visit}, \text{period}) = f_{\text{ToA}} \cdot K_{\text{filter}}(\text{night}) \cdot x(\text{visit}) \cdot K_{\text{CCD}}(\text{month}) \cdot \text{Grey}(\text{visit}) \cdot \text{Instr}(\text{period})$$

$$\Rightarrow m_s = m_{\text{ToA}} + kx + Zp_{\text{CCD}} + Zp_{\text{visit}} + a_{\text{Period}}$$

minion / alt_sched

~55000/58000 visits Zp → 50000 parameters for the moment

Per night, each visit is tied to the 1st visit

150 / 250 “photometric” nights → extinction : $k[\text{night}] \times x[\text{visit}]$

2 periods: throughput → $a[\text{period}]$: 2 – 1 parameters

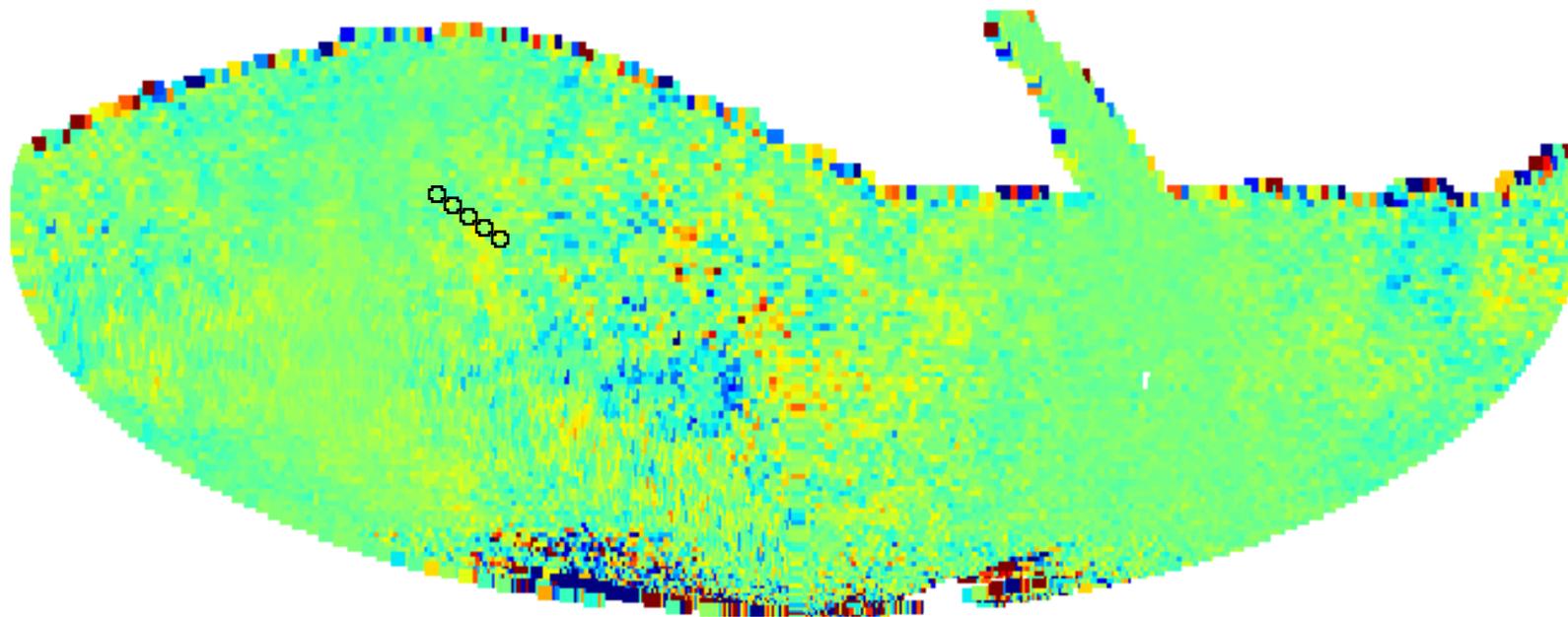
13 months : $Zp_{\text{CCD}}[\text{month}][0 \text{ to } 188]$ (focal plane response)

⇒ (13 x 189) – 1 Zp_{CCD} parameters

Minion map

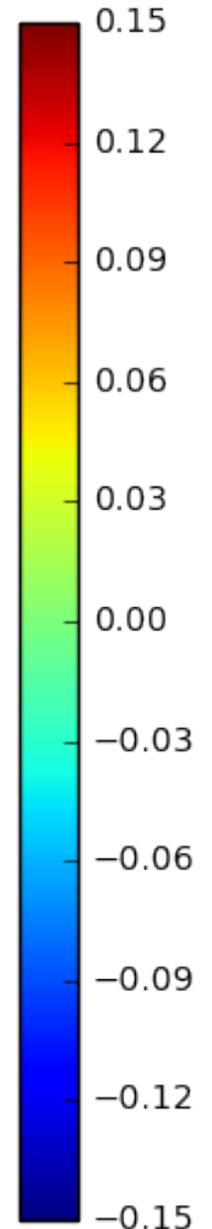
Delta mag (mmag)

- 1 year of observations, 50 000 Z_p simulated :

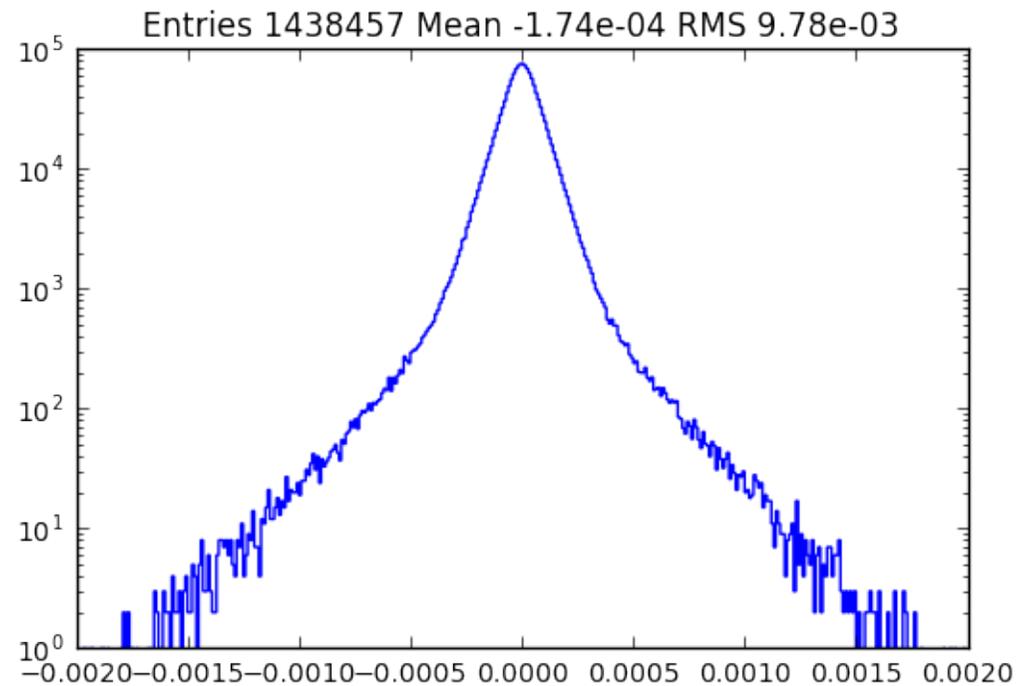


$$m_{\text{obs}} = m_{\text{true}} + \Delta a(0;1) + k(n)x + Z_p(p) + Z_p(m, \text{CCD})$$

$$m_{\text{true}} - m_{\text{fit}} (\text{mmag})$$



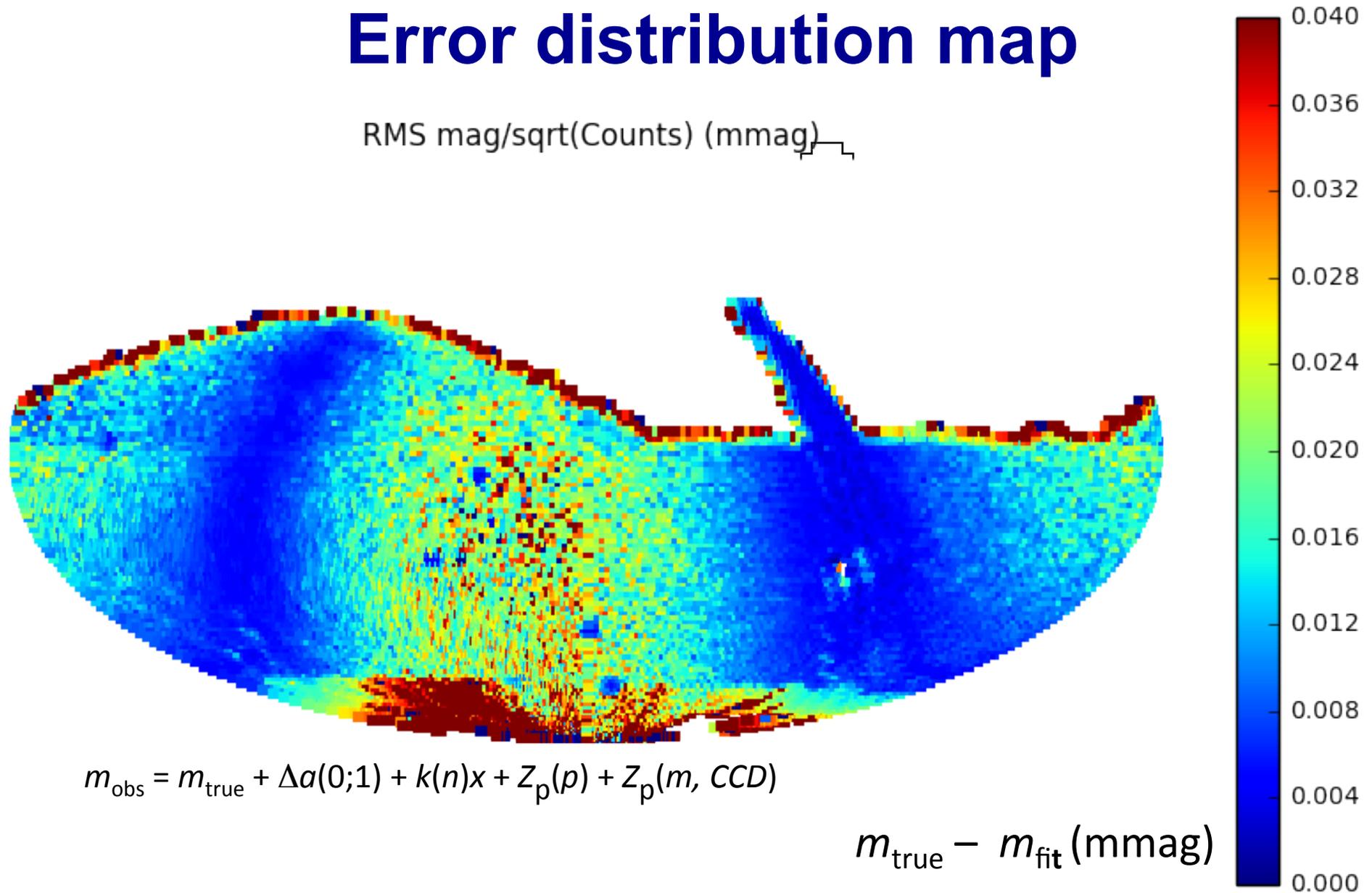
Fitted magnitudes



Gaussian if we limit to fixed nr of visits => fit error $\sim 10^{-3}$

Error distribution map

RMS mag/sqrt(Counts) (mmag)



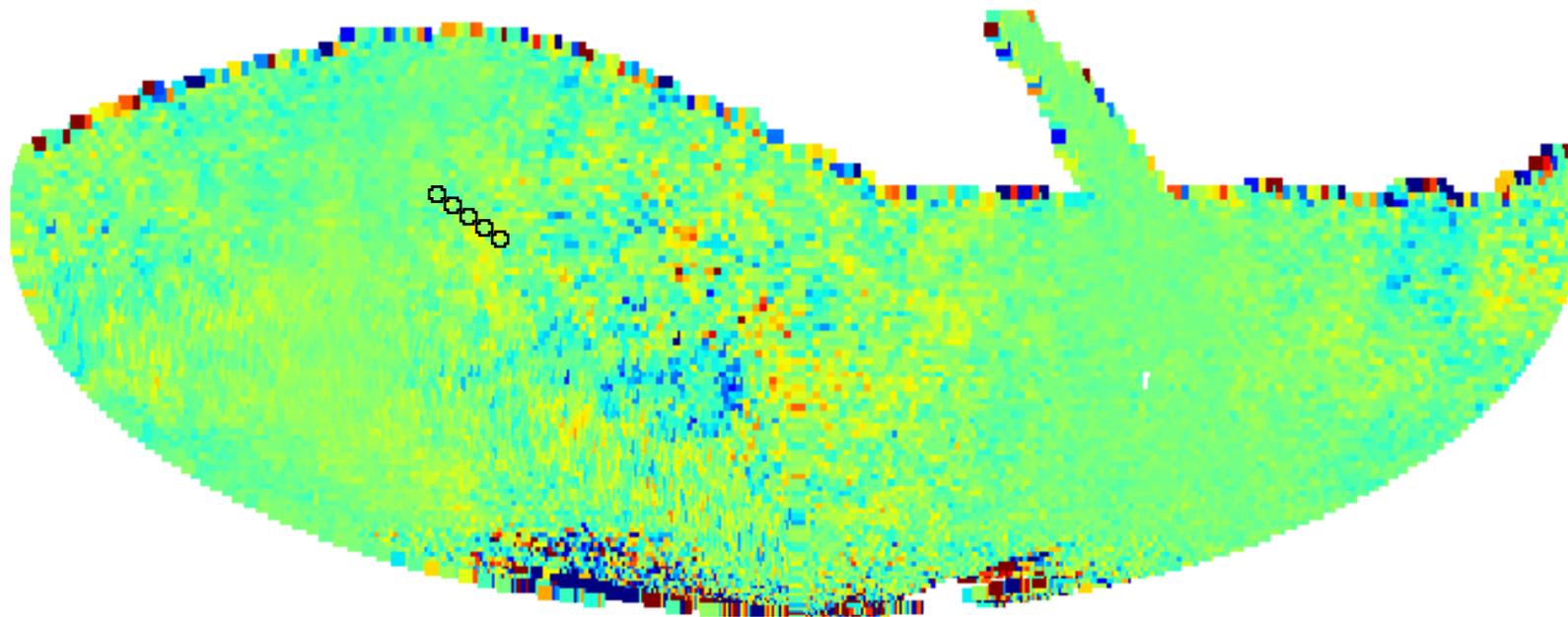
$$m_{\text{obs}} = m_{\text{true}} + \Delta a(0;1) + k(n)x + Z_p(p) + Z_p(m, \text{CCD})$$

$$m_{\text{true}} - m_{\text{fit}} \text{ (mmag)}$$

Minion map

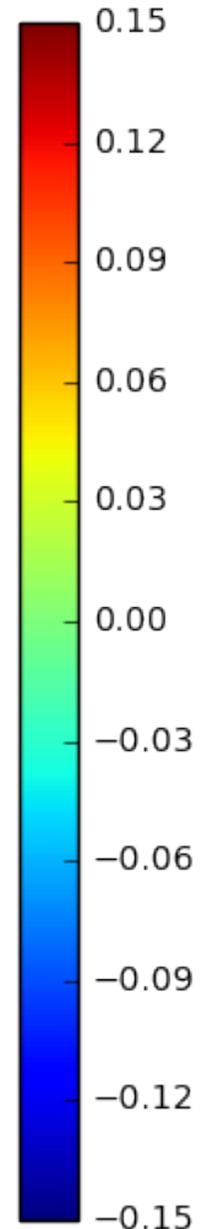
Delta mag (mmag)

- 1 year of observations, 50 000 Z_p simulated :

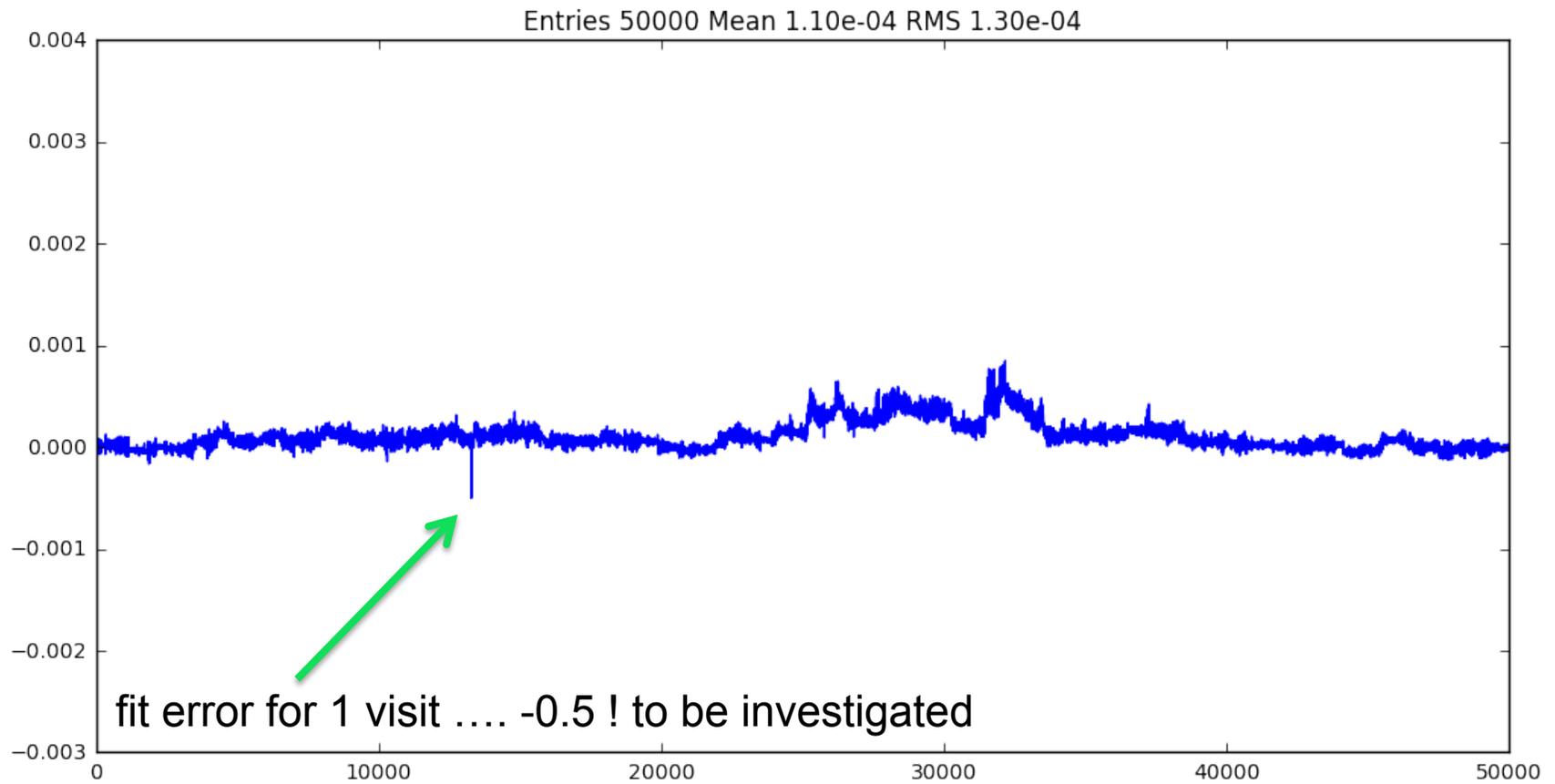


$$m_{\text{obs}} = m_{\text{true}} + \Delta a(0;1) + k(n)x + Z_p(p) + Z_p(m, \text{CCD})$$

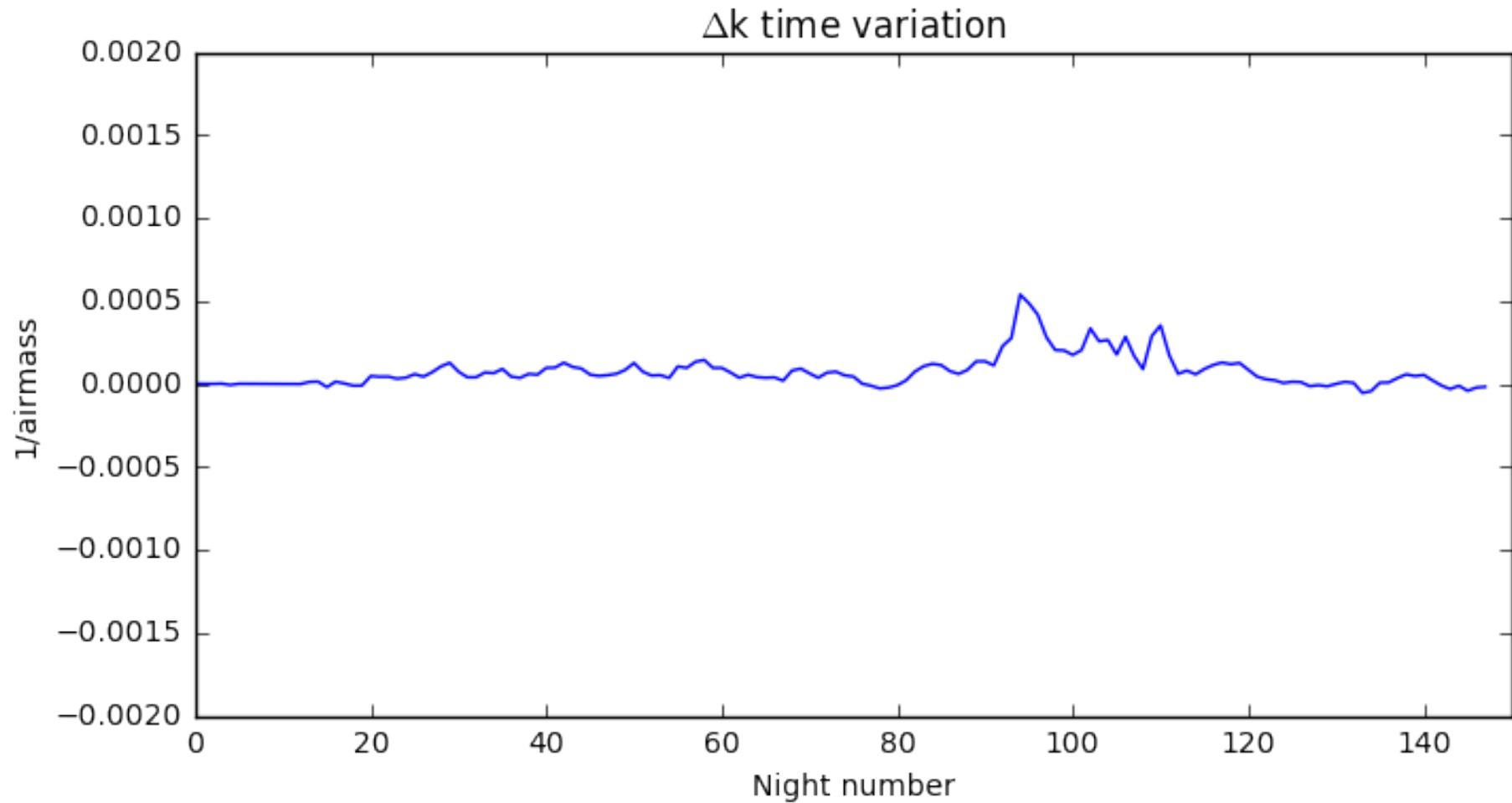
$$m_{\text{true}} - m_{\text{fit}} (\text{mmag})$$



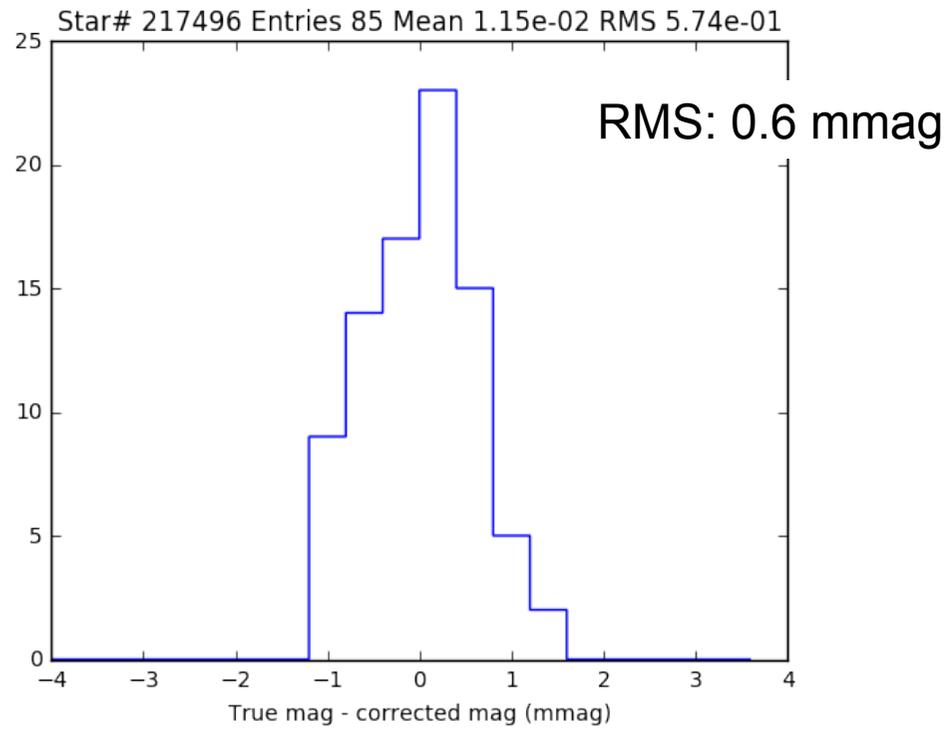
Visit Z_p variation



Δk variation



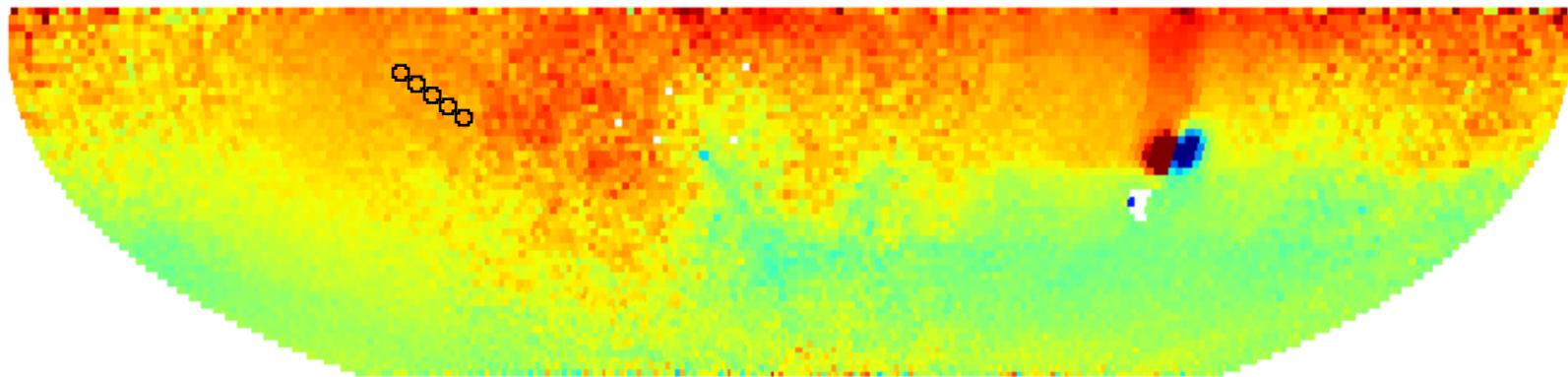
Star repeatability



Alt_sched map

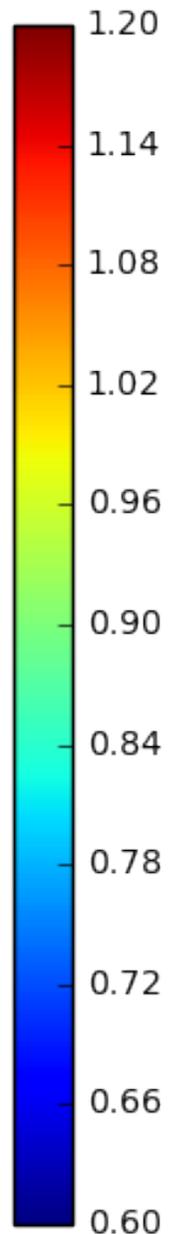
Delta mag (mmag)

- 1 year of observations, 50 000 Z_p simulated :



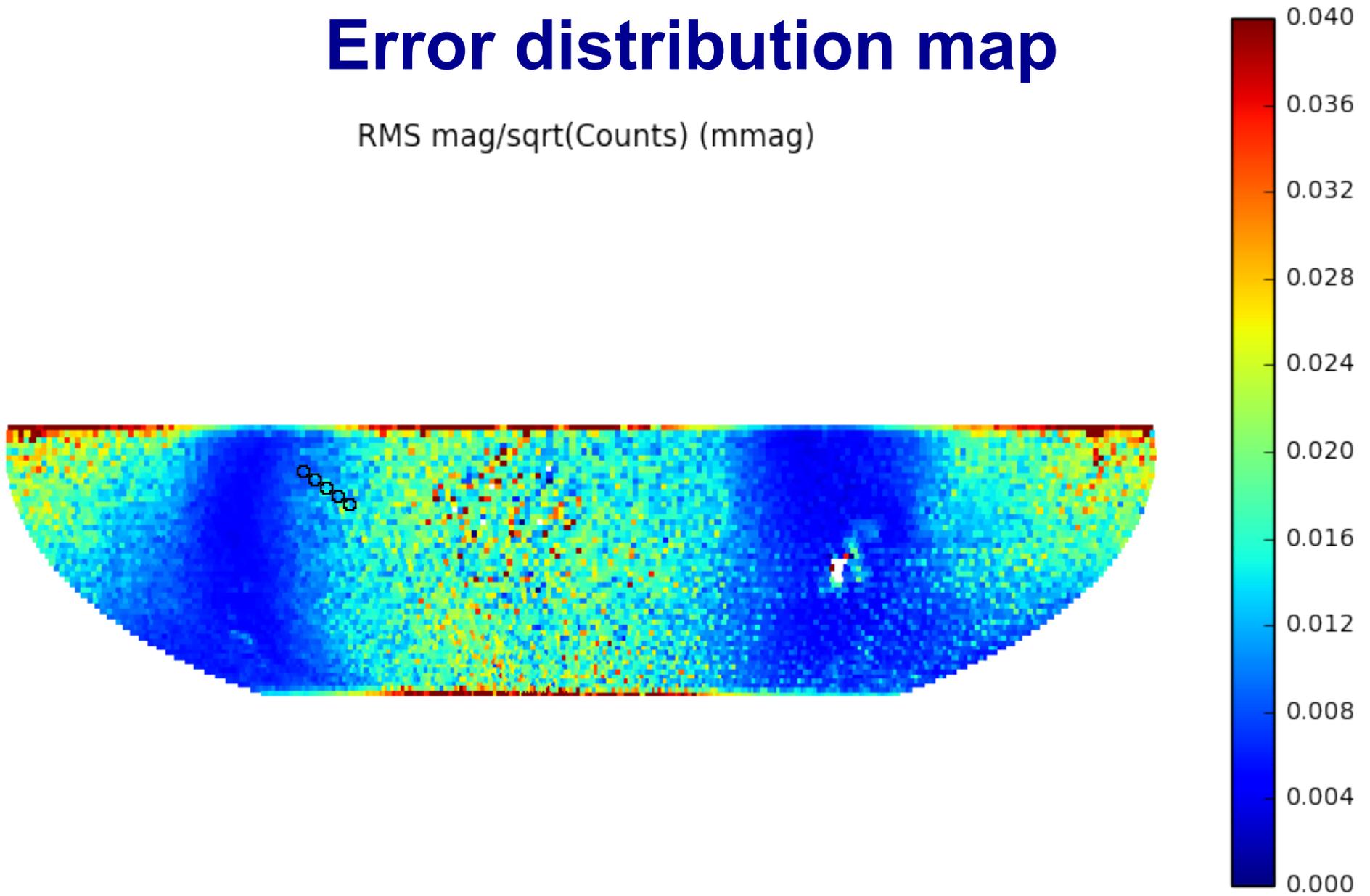
$$m_{\text{obs}} = m_{\text{true}} + \Delta a(0;1) + k(n)x + Z_p(p) + Z_p(m, \text{CCD})$$

$$m_{\text{true}} - m_{\text{fit}} \text{ (mmag)}$$



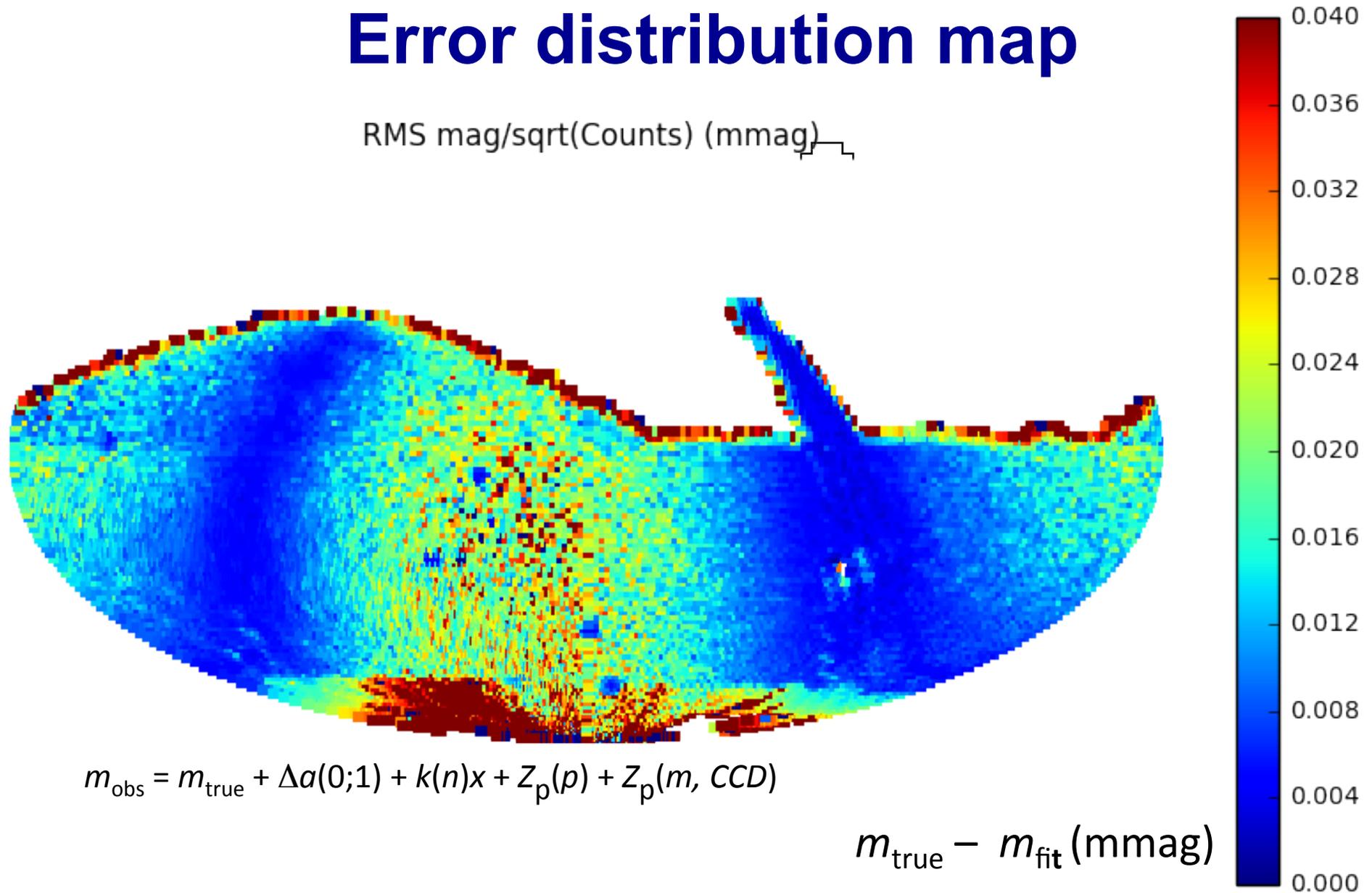
Error distribution map

RMS mag/sqrt(Counts) (mmag)



Error distribution map

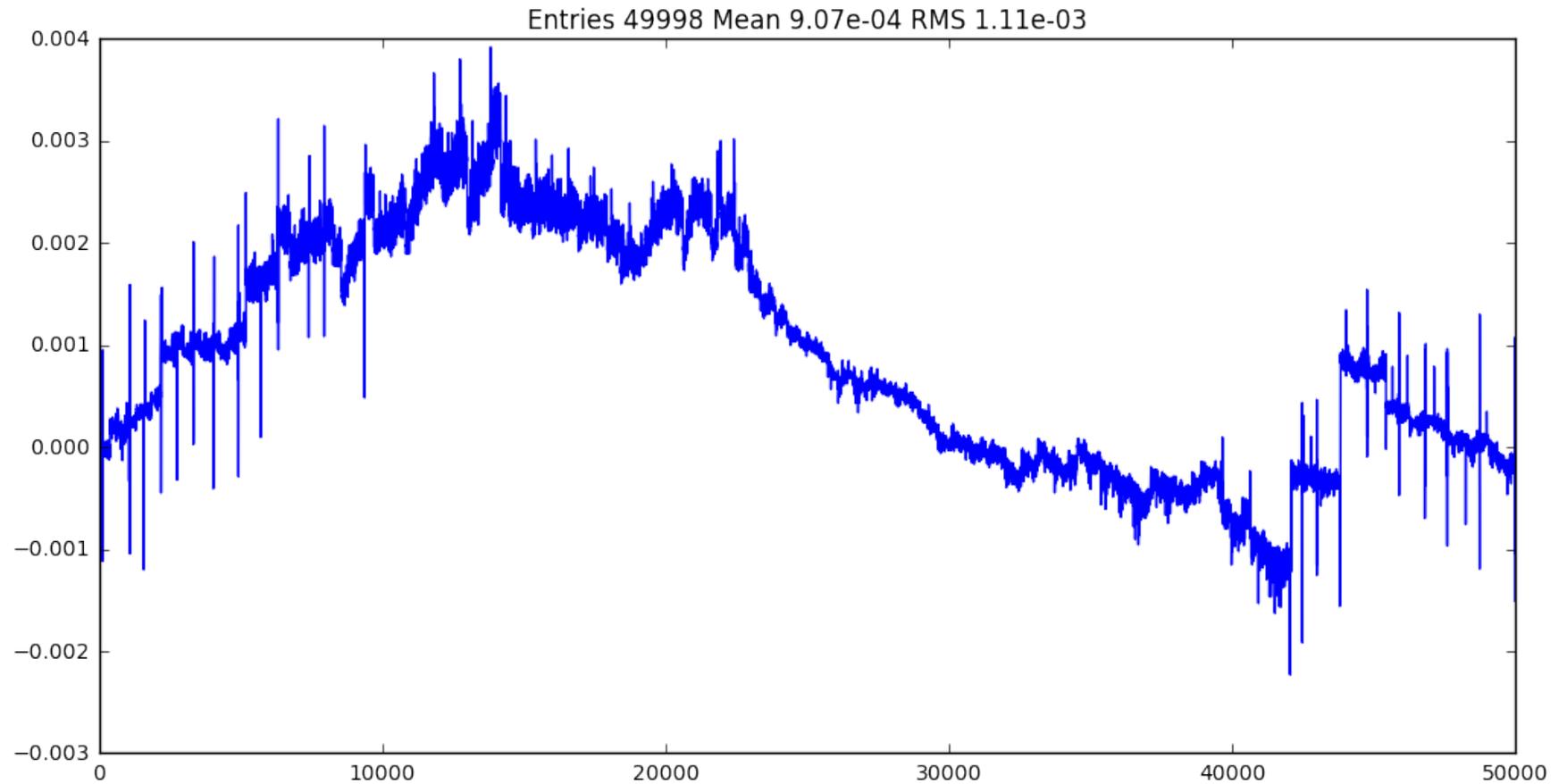
RMS mag/sqrt(Counts) (mmag)



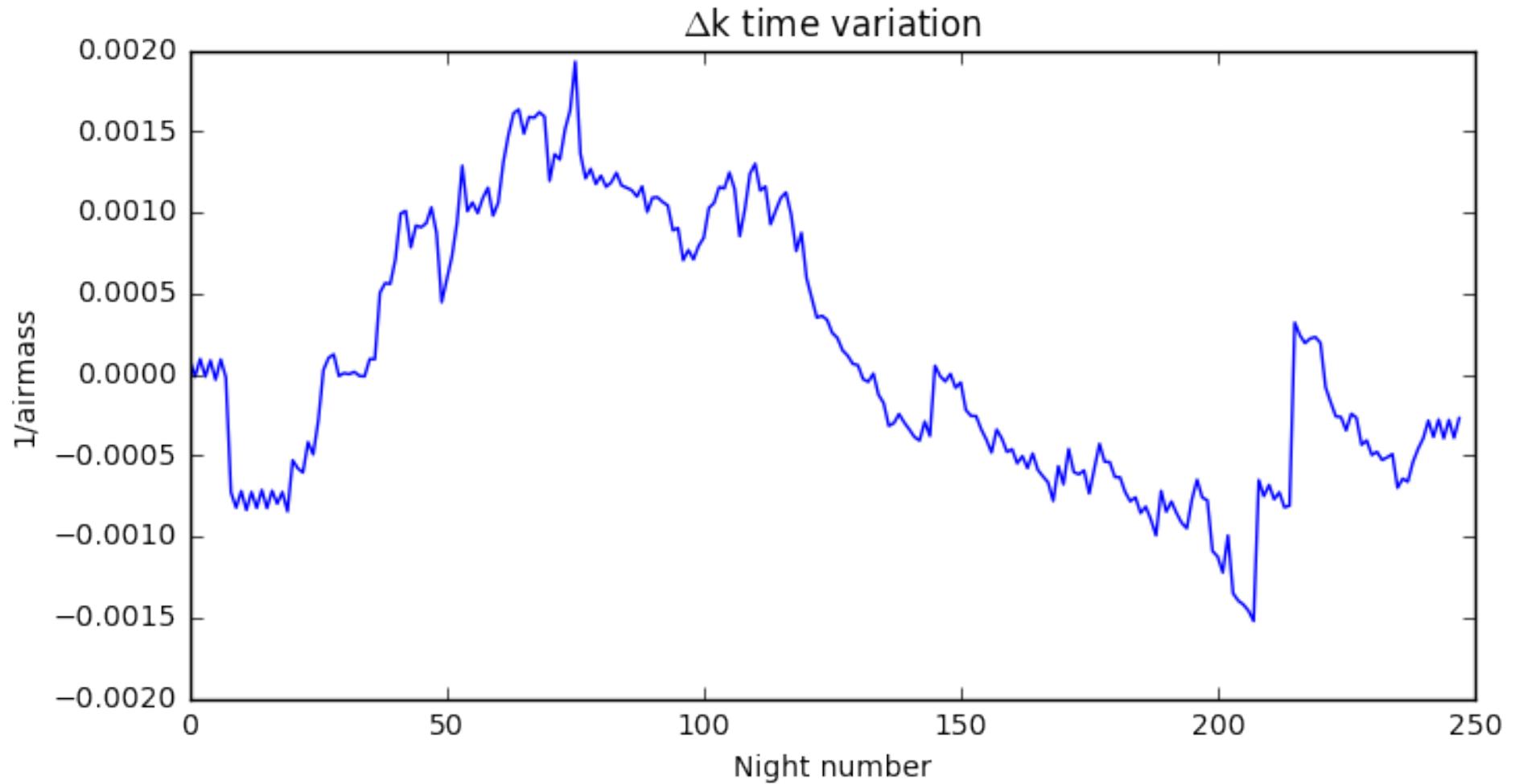
$$m_{\text{obs}} = m_{\text{true}} + \Delta a(0;1) + k(n)x + Z_p(p) + Z_p(m, \text{CCD})$$

$$m_{\text{true}} - m_{\text{fit}} \text{ (mmag)}$$

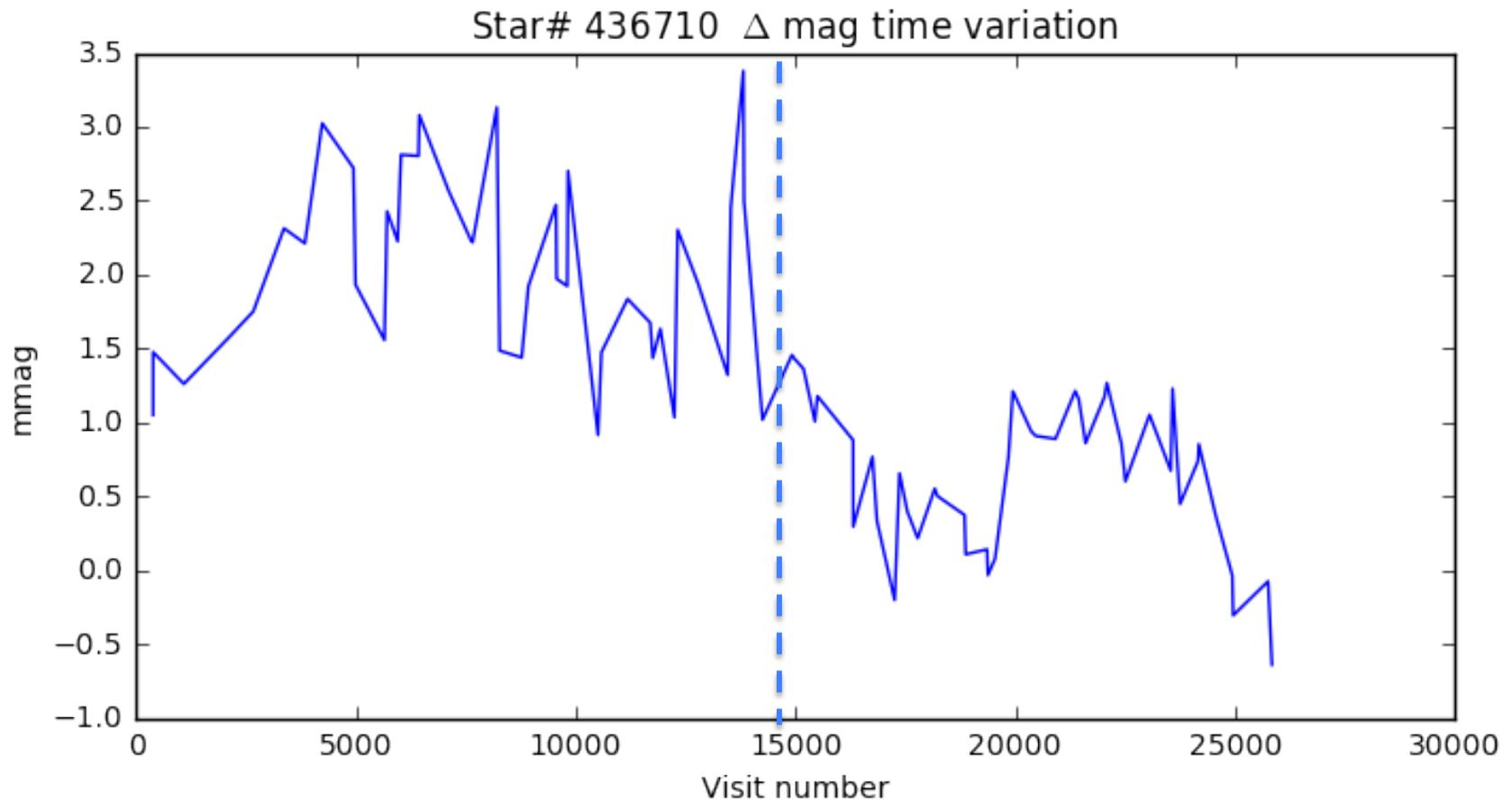
Visit Z_p variation



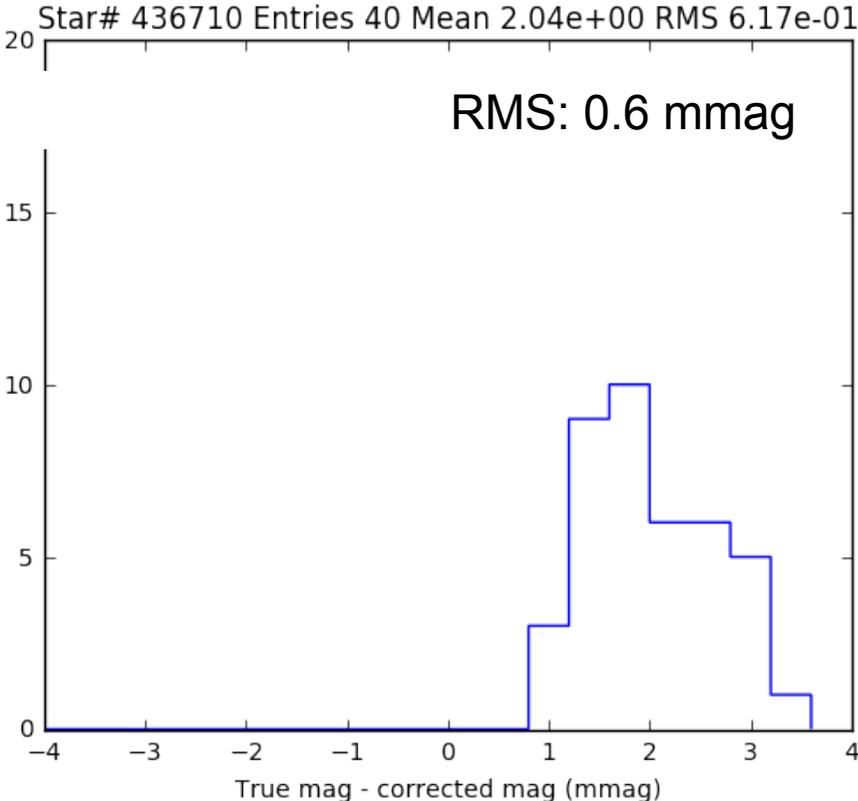
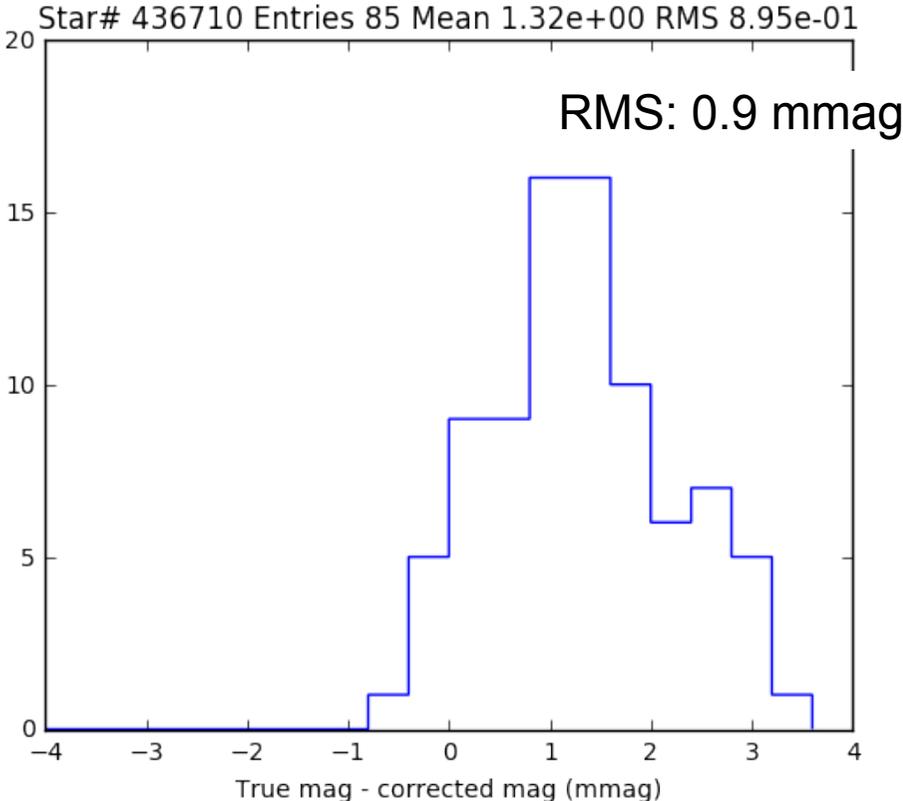
Δk variation



Star repeatability



Star repeatability



Partial conclusions

- Alt_sched biases not as self constrained as minion ones
 - However the fluctuations in mag determinations are similar:
 - star repeatability ~ 0.6 mmag
- => we need to tie our Z_p to external information/catalog
- Some improvements could be tried on alt_sched to diminish the biases

Next steps and questions

- How do we simulate and inject GAIA and Aux Tel info ?

$$f_s(\text{filt}, \nu, p) = f_{\text{ToA}} \cdot \exp\left(\int [-k(\lambda, t) SED_s(\lambda) Tr(\text{filt}) d\lambda] \cdot K_{\text{filter}}(t) \cdot x(\nu)\right) \cdot Gr(\nu, g) \cdot Instr(p, g)$$

- Is non-iterative useful wrt the FGCM ?
- Is it useful in view of our mmag goal ?