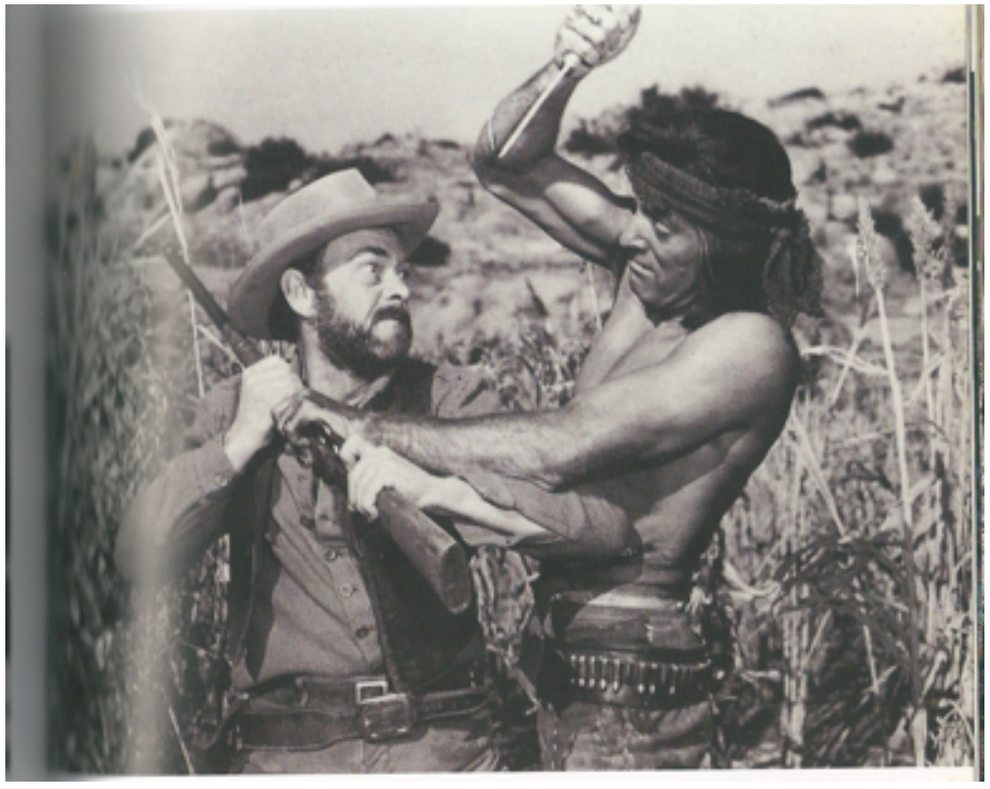
Comparing SATIRE and NRLSSI2: an external view

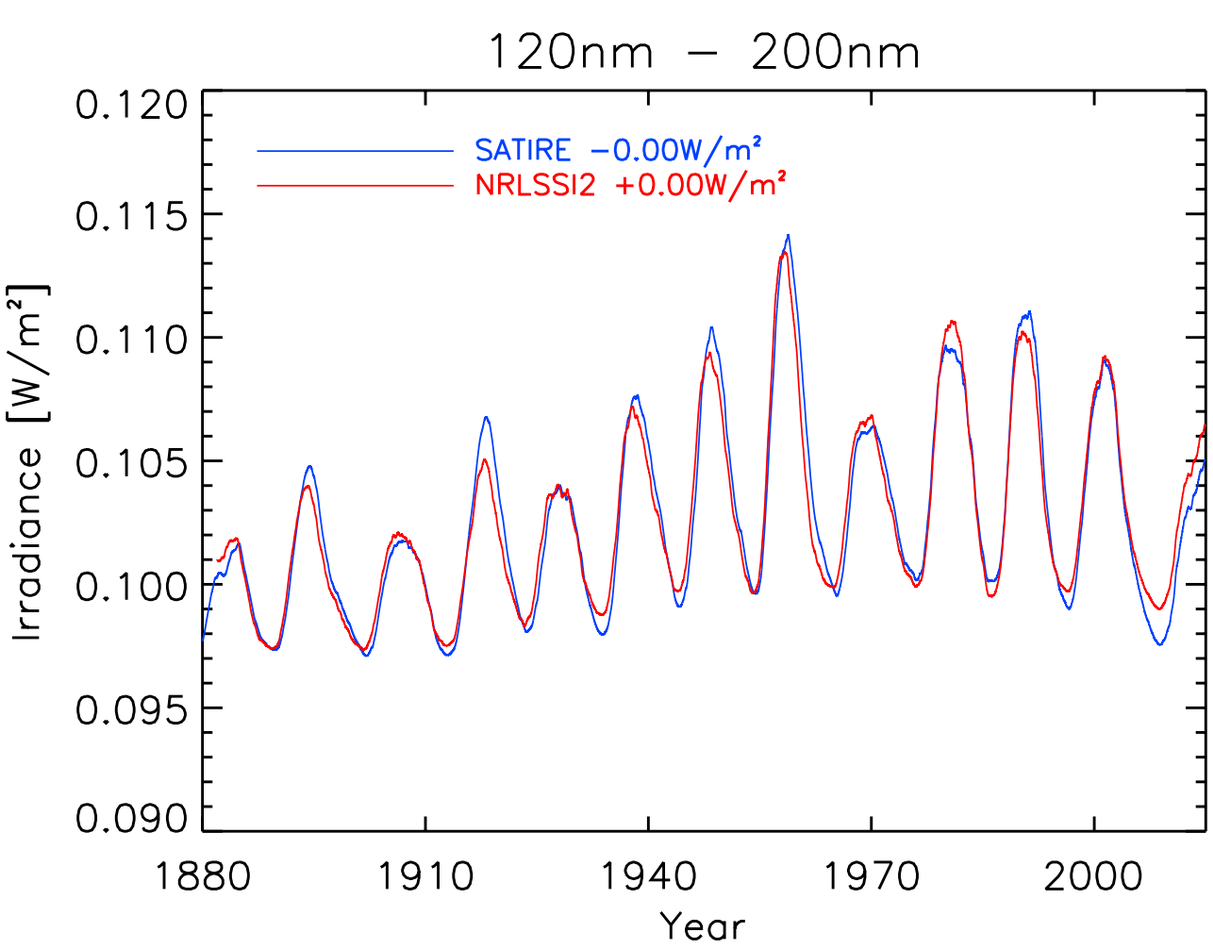
M. Kretzschmar
LPC2E, CNRS &University of Orléans.

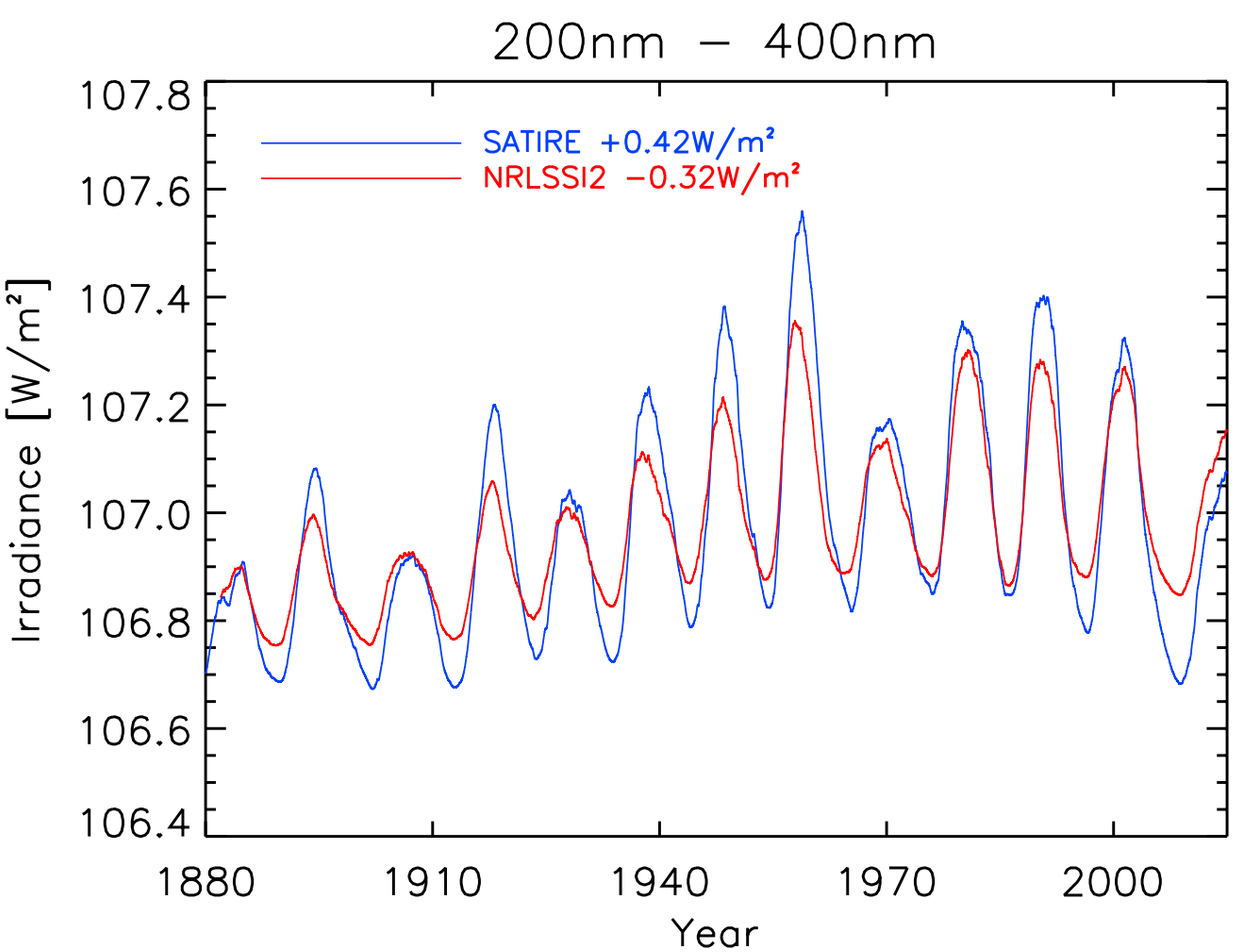
J. Francis White & Joy N. Houck present **"KENTUCKY RIFLE"** in Pathe COLOR Starring CHILL WILLS, LANCE FULLER, CATHY DOWNS, JESS BARKER, JEANNE CAGNEY, STERLING HOLLOWAY and HENRY HULL. With Clyde Houck and John Picard. Produced and Directed by Carl K. Hittleman. A Howco Production.

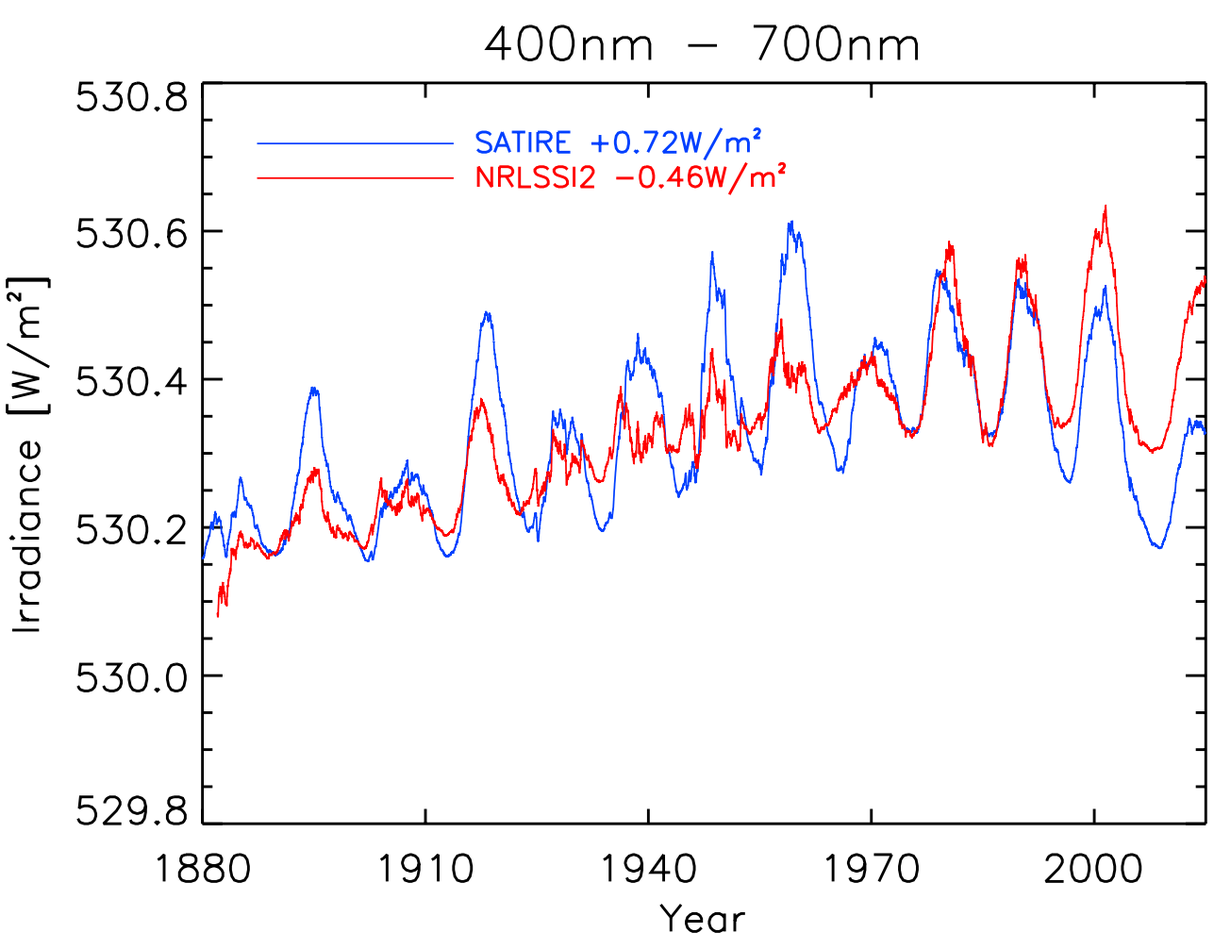
55/182

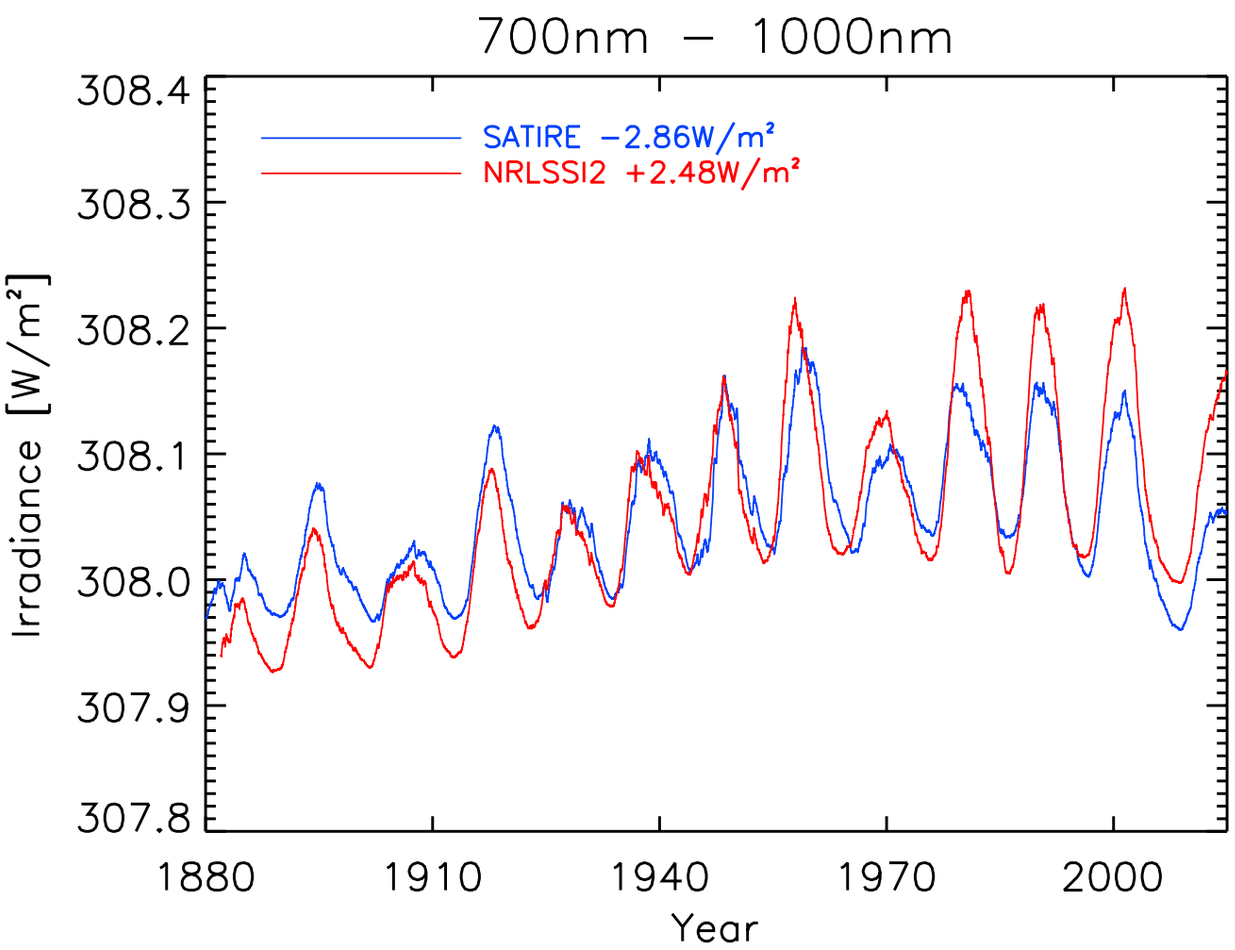
Team objectives:




120nm – 200nm
SATIRE −0.00W/m²
NRLSSI2 +0.00W/m²
Irradiance [W/m²]
0.120
0.115
0.110
0.105
0.100
0.095
0.090
1880
1910
1940
1970
2000
Year


200nm – 400nm
SATIRE +0.42W/m²
NRLSSI2 −0.32W/m²
Irradiance [W/m²]
107.8
107.6
107.4
107.2
107.0
106.8
106.6
106.4
1880
1910
1940
1970
2000
Year


400nm – 700nm
SATIRE +0.72W/m²
NRLSSI2 −0.46W/m²
Irradiance [W/m²]
530.8
530.6
530.4
530.2
530.0
529.8
1880
1910
1940
1970
2000
Year


700nm – 1000nm
SATIRE −2.86W/m²
NRLSSI2 +2.48W/m²
Irradiance [W/m²]
308.4
308.3
308.2
308.1
308.0
307.9
307.8
1880
1910
1940
1970
2000
Year

125_ 150

125nm-150nm

Satire
NRLSSI
Usol_m
Usus_m
Ssol_m
Ssim_m
Satires_m
Nrlssi_m

Irradiance [W/m²]

0.0020
0.0018
0.0016
0.0014
0.0012

19790506198410261990041819951009200103312006092120120313

125_ 150

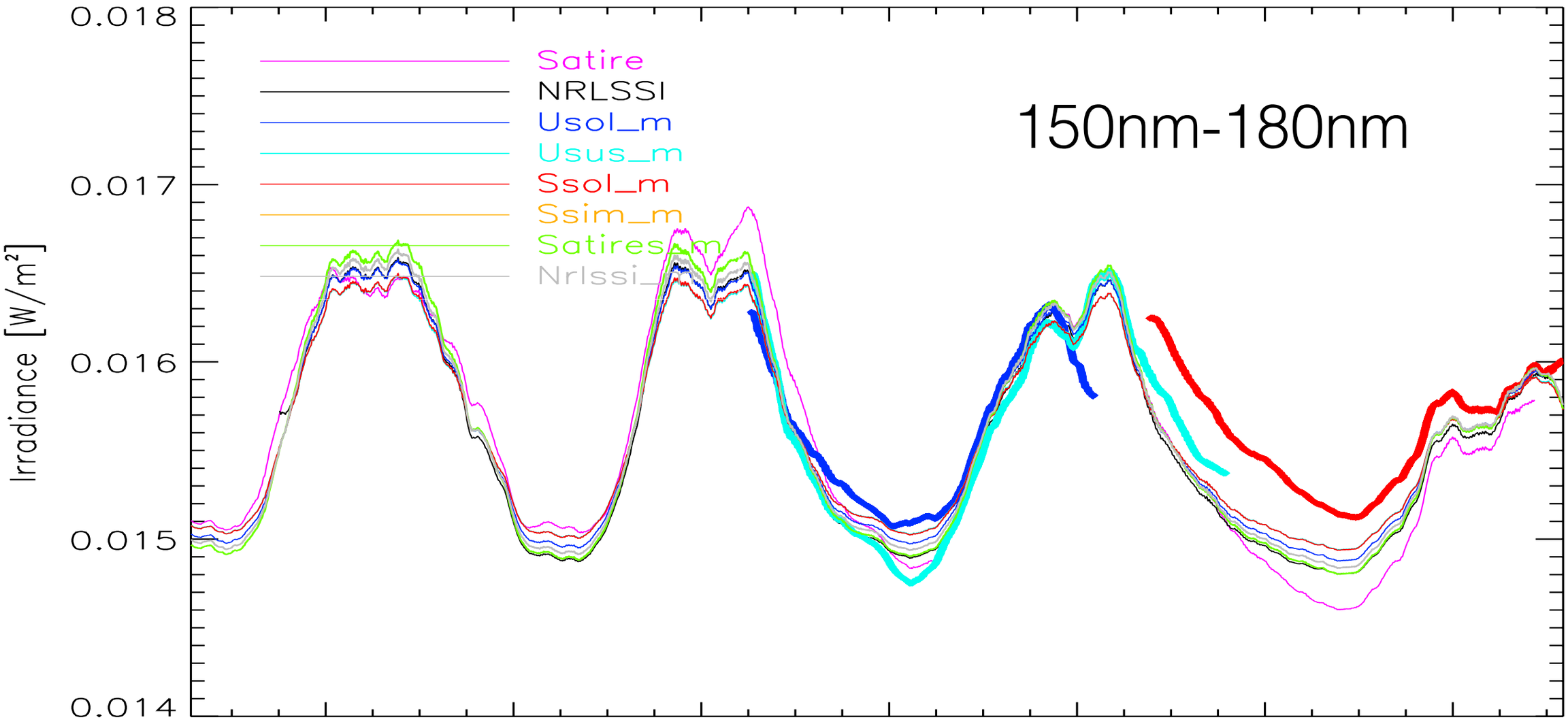
Satire
NRLSSI
Usol_m
Usus_m
Ssol_m
Ssim_m

Irradiance change [W/m²]

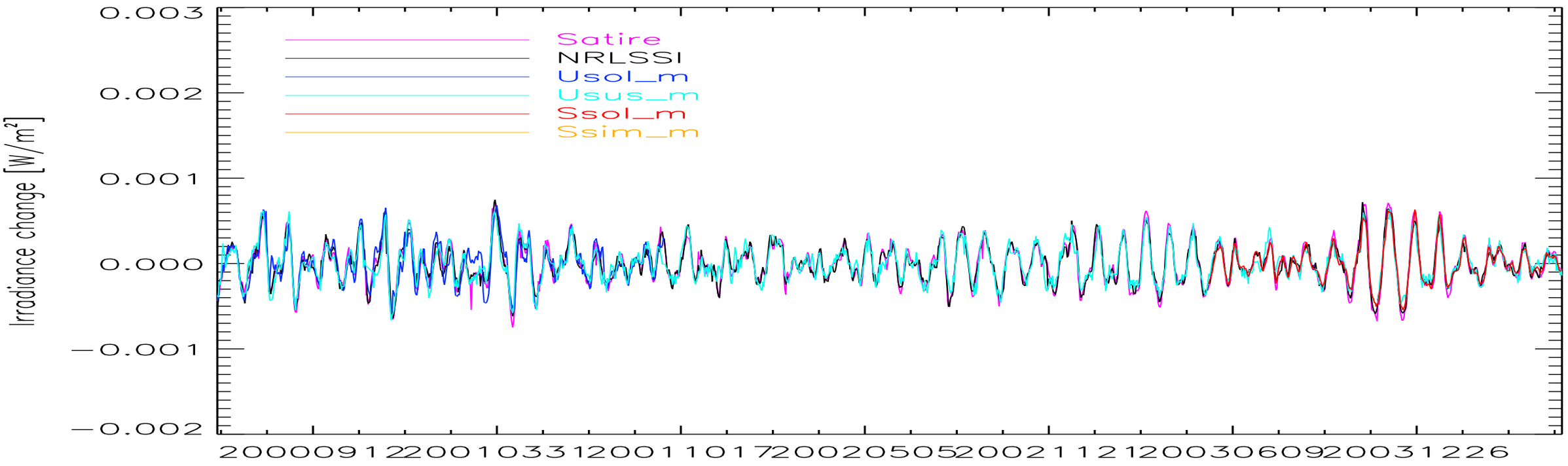
0.0006
0.0004
0.0002
0.0000
−0.0002
−0.0004

20000912200103312001101720020505200211212003060920031226

150_ 180



150_ 180



241_ 260

241nm-260nm

Satire
NRLSSI
Usol_m
Usus_m
Ssol_m
Ssim_m
Satires_m
Nrlssi_m

Irradiance [W/m²]

1.25
1.24
1.23
1.22
1.21
1.20
1.19

19790506198410261990041819951009200103312006092120120313

241_ 260

Satire
NRLSSI
Usol_m
Usus_m
Ssol_m
Ssim_m

Irradiance change [W/m²]

0.08
0.06
0.04
0.02
0.00
−0.02
−0.04

20000912200103312001101720020505200211212003060920031226

241_ 260

SFO fac
+DSA

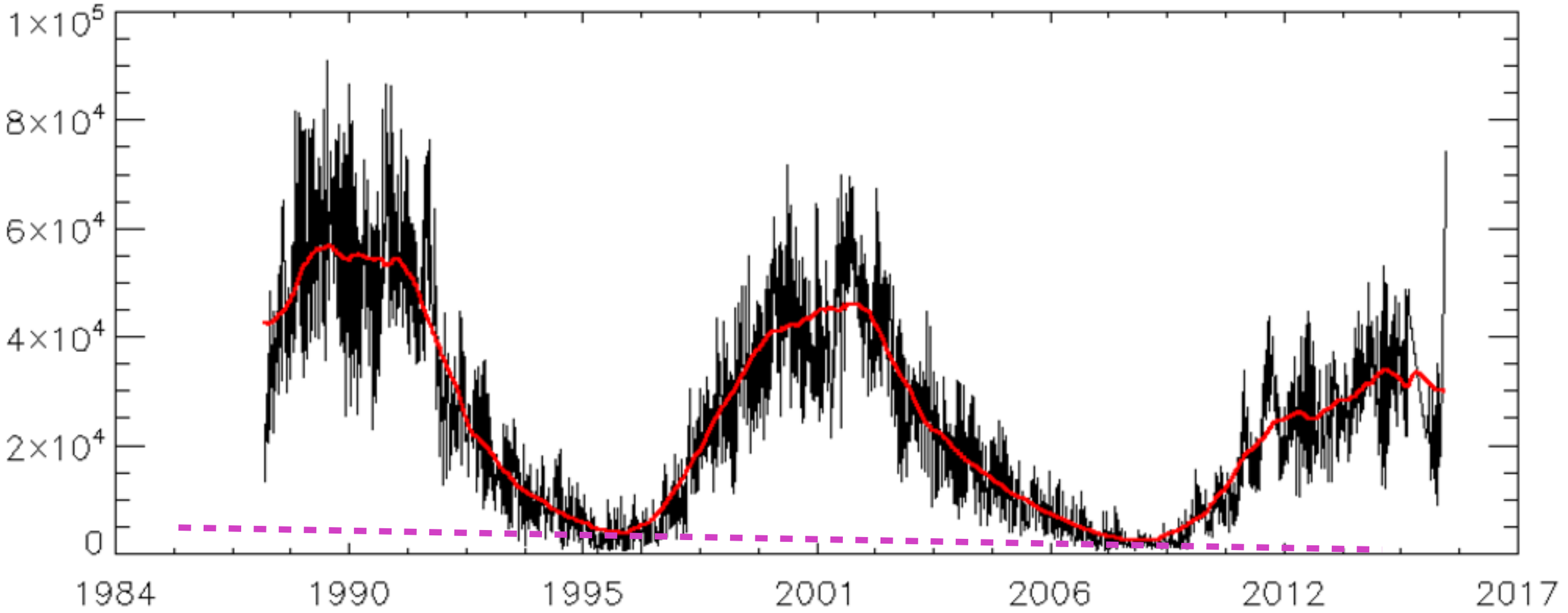
Satire
NRLSSI
Usol_m
Usus_m
Ssol_m
Ssim_m
Satires_m
Nrlssi_m

Irradiance [W/m²]

1.25
1.24
1.23
1.22
1.21
1.20
1.19

19790506 19841026 19900418 19951009 20010331 20060921 20120313

SFO Solar indices



Main Differences

- SATIRE downward trend in the last 3 minima (all λ)

  ➡ Attributed to less faculae. Amplitude discussed.

- Smaller cycle and rotational amplitude in NRLSSI2

  ➡ Solar rotation hard to fit **and/or** other reasons

- ‘noisy like’ cycle in NRLSSI2 in the visible (before 1978)

  ➡ Being corrected in the new coming version

Ingredients in NRLSSI2

- proportionnal « contrasts » (but not constant with B) and CLV.
- Proxies
  - MgII, assumed representative of faculae for all
  - Sunspot blocking: depends on station and CLV of sunspot contrast (in visible ?)

$$S(t) = 0.32 \sum_{1}^{N_{spot}} A_S \left(\frac{3\mu+2}{2}\right)\mu$$

- Mid-term trend from TSI and proxies.
- Fitting method and interval
- Unperfect proxies (or fitting) are corrected with empirical correction to match TSI variations.

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- Mid-term trend from TSI and proxies.
- **Fitting method and interval**
- Unperfect proxies (or fitting) are corrected with empirical correction to match TSI variations.

Ingredients in SATIRE

$$I(\lambda, t) = \Sigma_i S_i I_i(\lambda, \theta) \quad = \Sigma_i S_i I_i(\lambda) \phi_i(\lambda, \theta)$$

- Constant contrast over time.
- Number of structures and/or one contrast value per structure (but faculae filling factor).
- Magnetograms and images: responsible for long term (cycle to cycle)
- Long term: ephemeral regions.
- Same B_sat for all wavelengths.
- B_cut=800G
- Spectrum computation
  - 1D radiative transfert (impact for CLV ?)
  - NLTE effects
  - Atomic parameters uncertainty
- **More physics**: more clear assumptions and more easy to check.

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- **More physics**: more easy to understand and hypothesis more easy to check.

Pixel contrast

QS

$B<B_{thresh}$

U

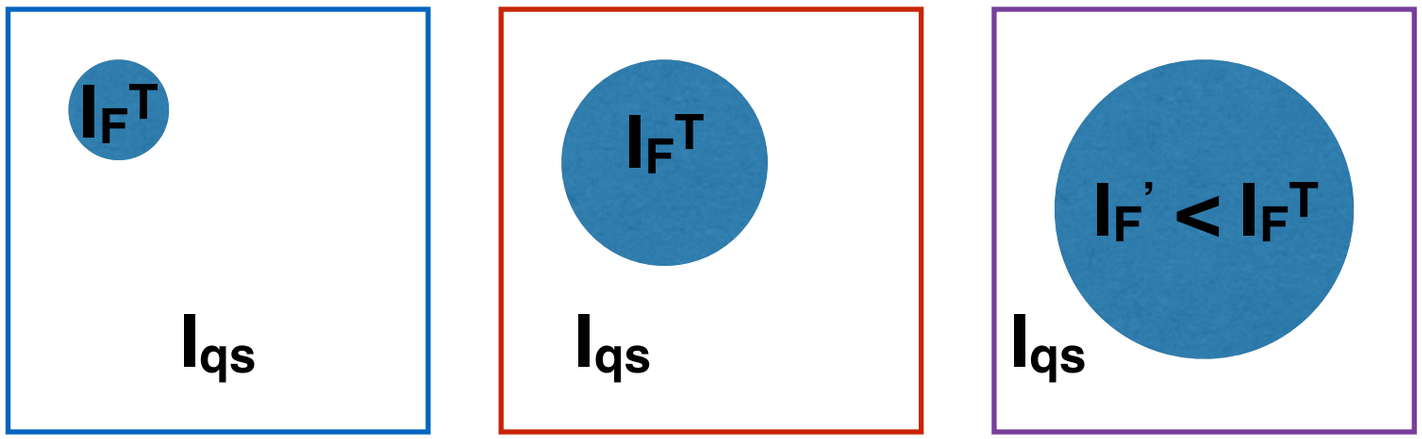
$I<I_{thresh}$

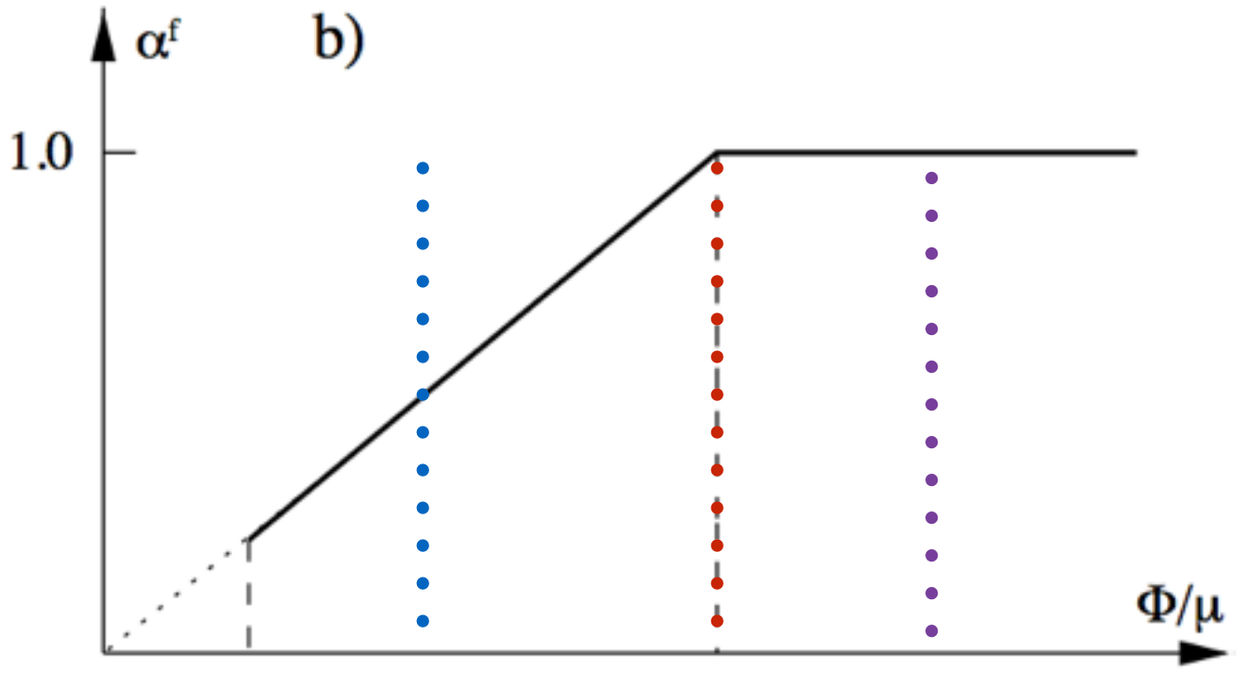
Faculae

$B>B_{thresh}$

I_f increases because of larger flux tube (and B ?)

less radiation from the walls compensate size increase (or ?)





B_{thresh} B_{sat} ~ 260G

Pixel contrast

QS

$B<B_{thresh}$

U

$I<I_{thresh}$

Faculae

$B>B_{thresh}$

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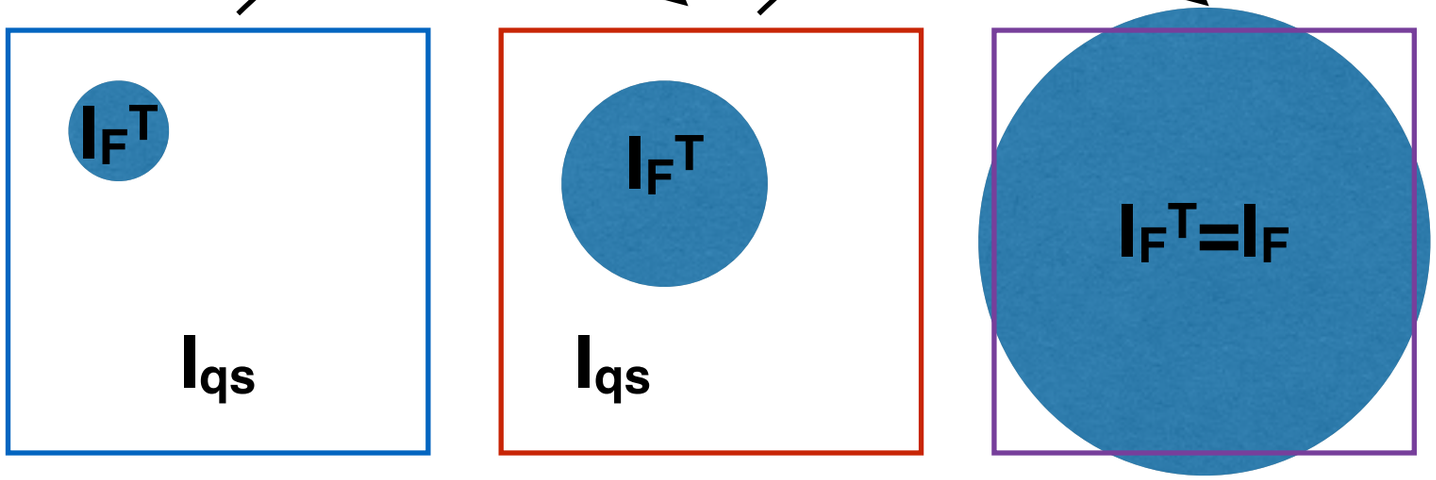
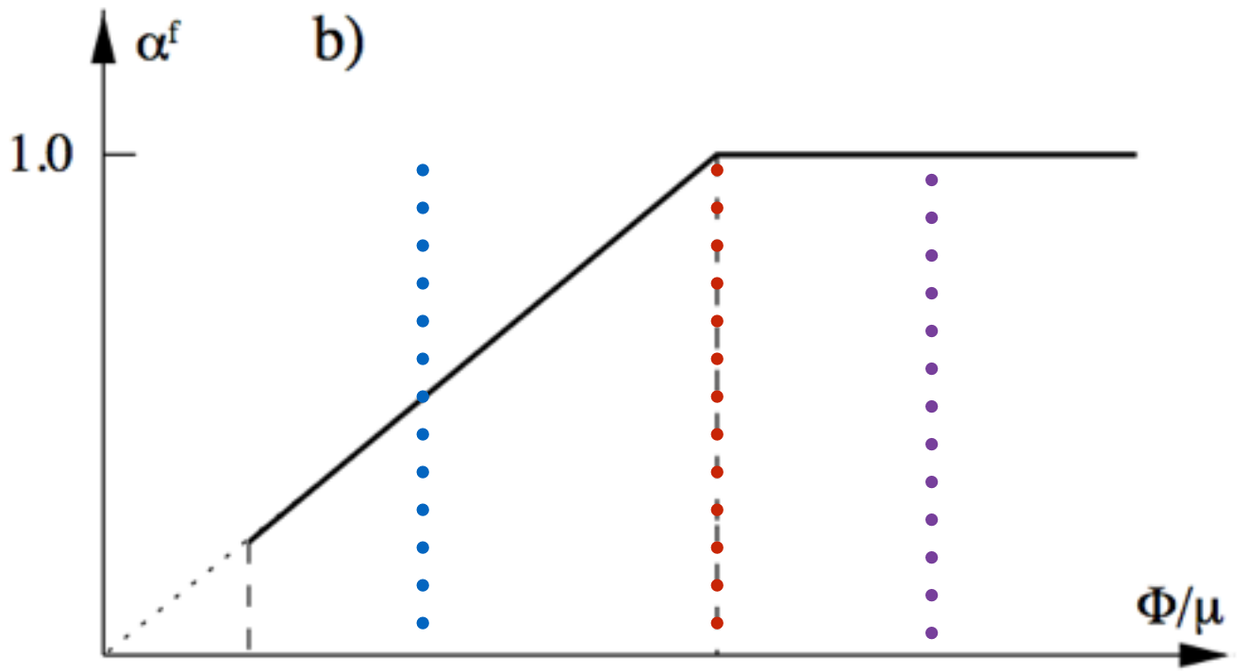
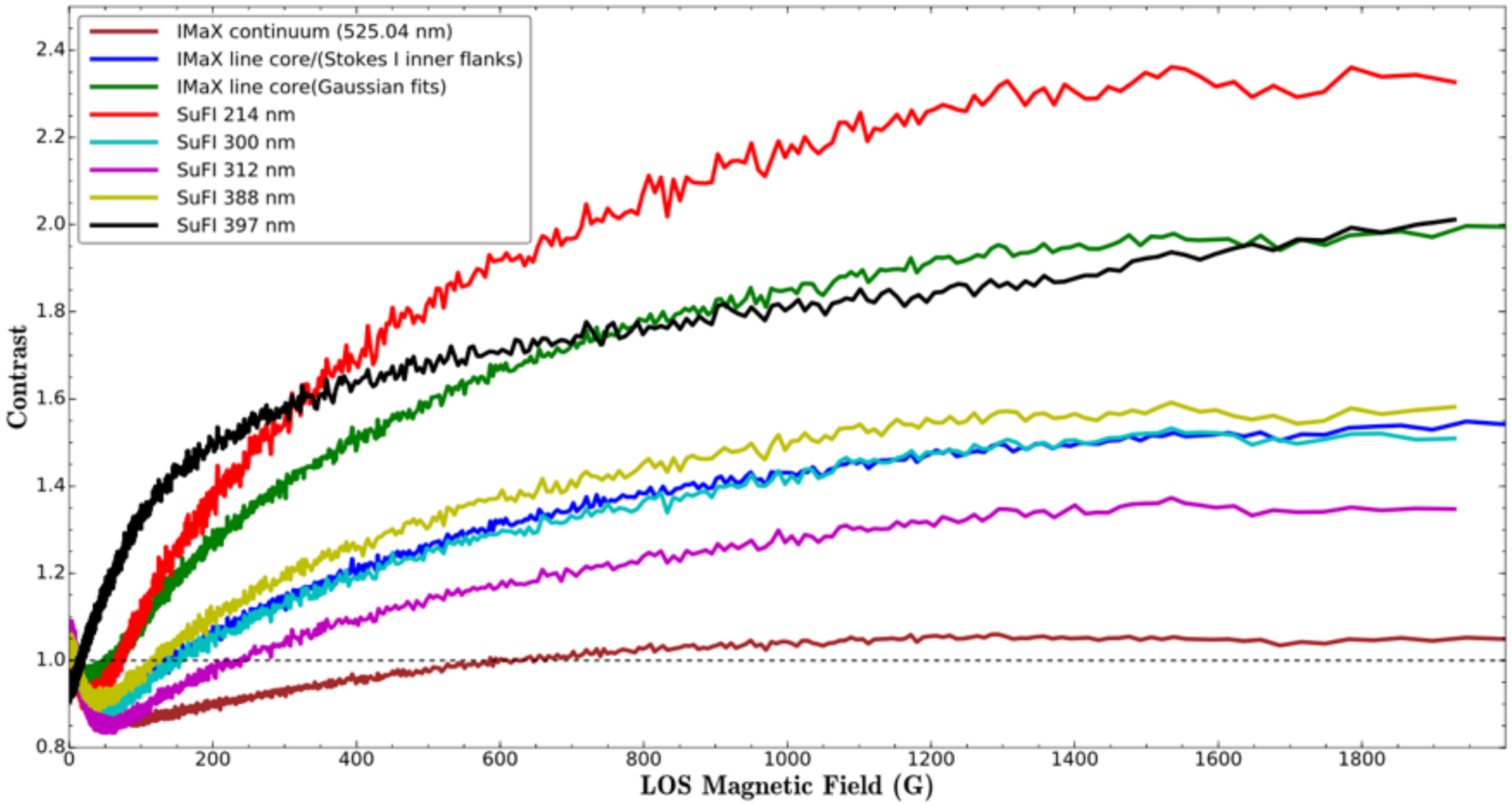




B_{thresh} B_{sat} ~ 260G

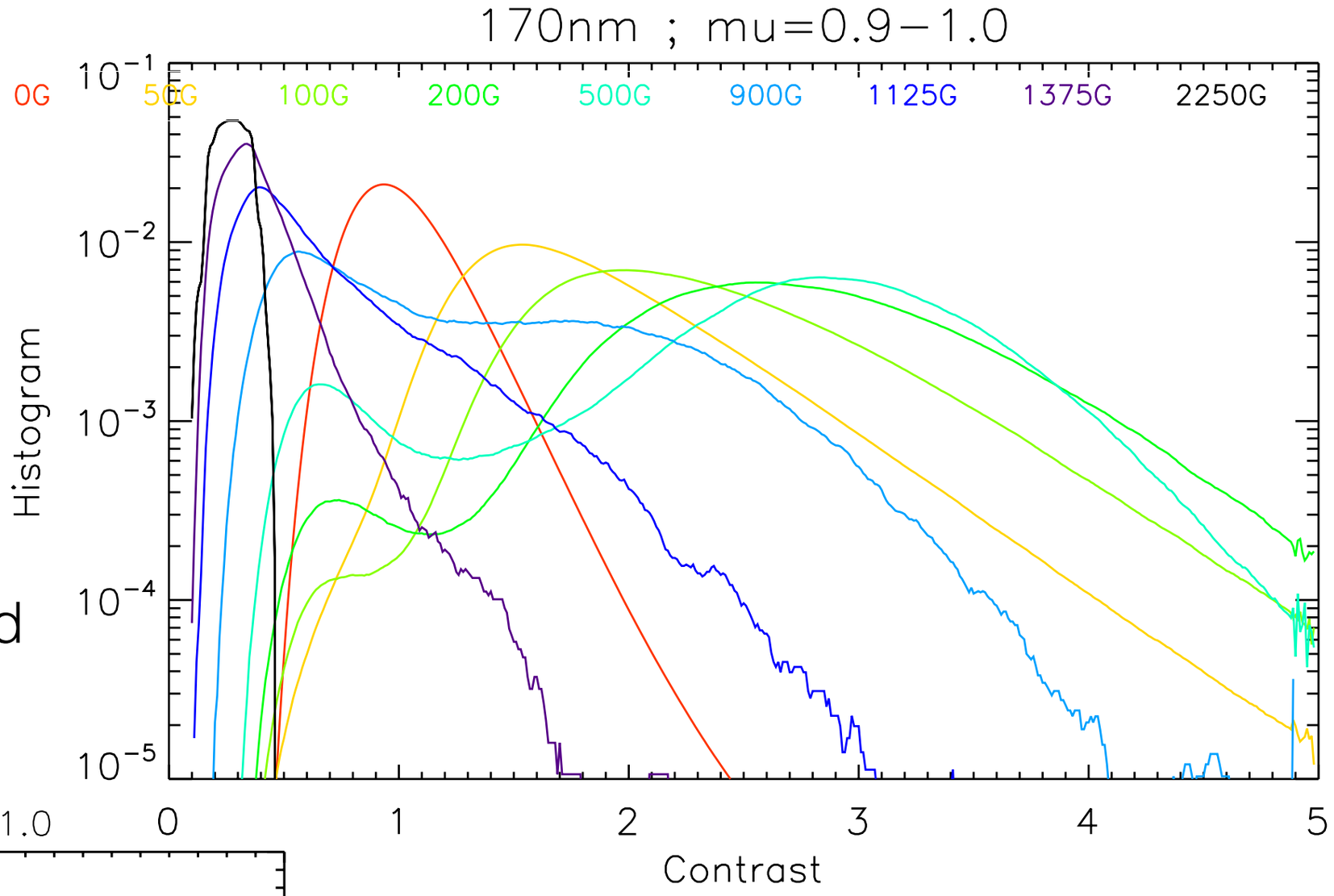


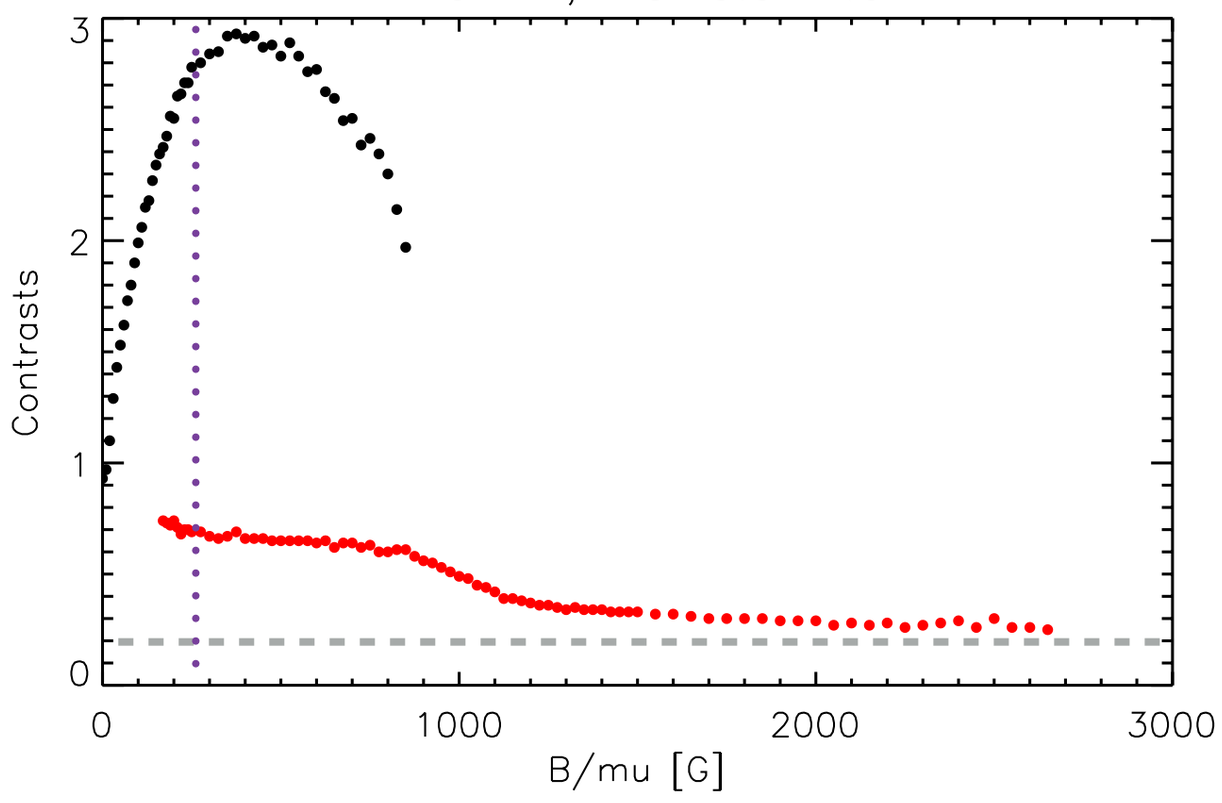
Kahil+ 2017

B_{sat} may depend on λ. Value hard to compare because of resolution.

Contrast @ 170nm @ 0.5”

~25G bins in magnetic field

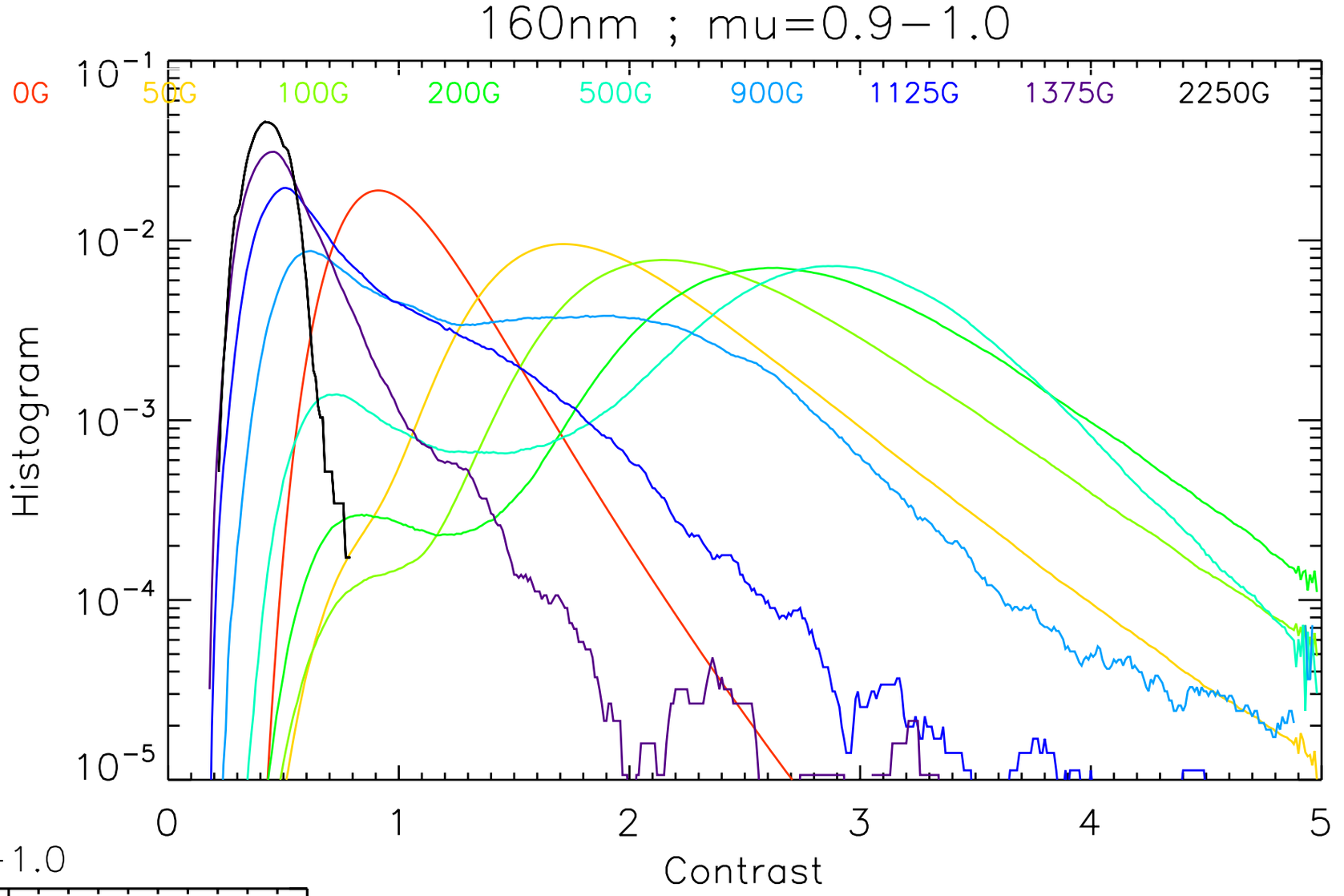


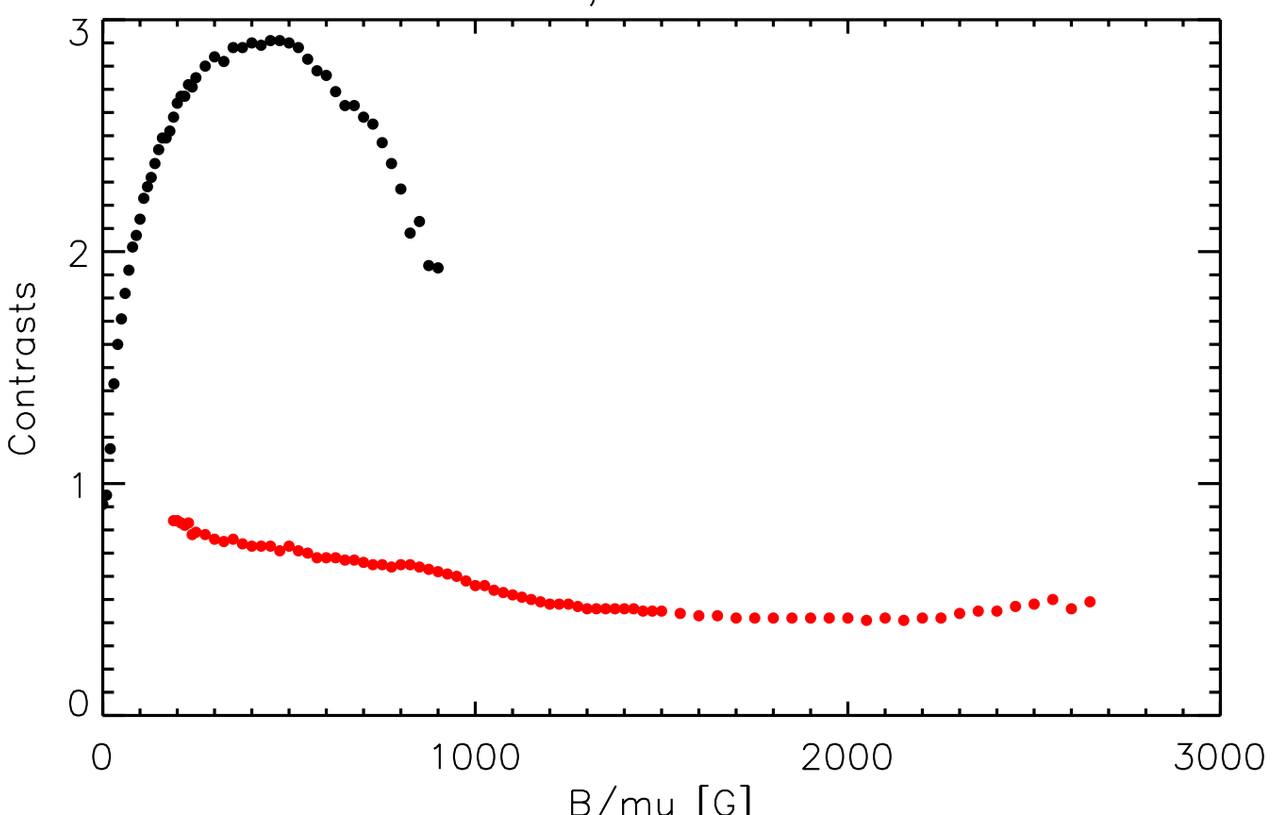


- Contrast are distributed with B at magnetogram’s resolution.
- Distribution moves with B
- 1 structure = 1 contrast ?

Gravet et al., in prep

Contrast @ 160nm @ 0.5”





Gravet et al., in prep

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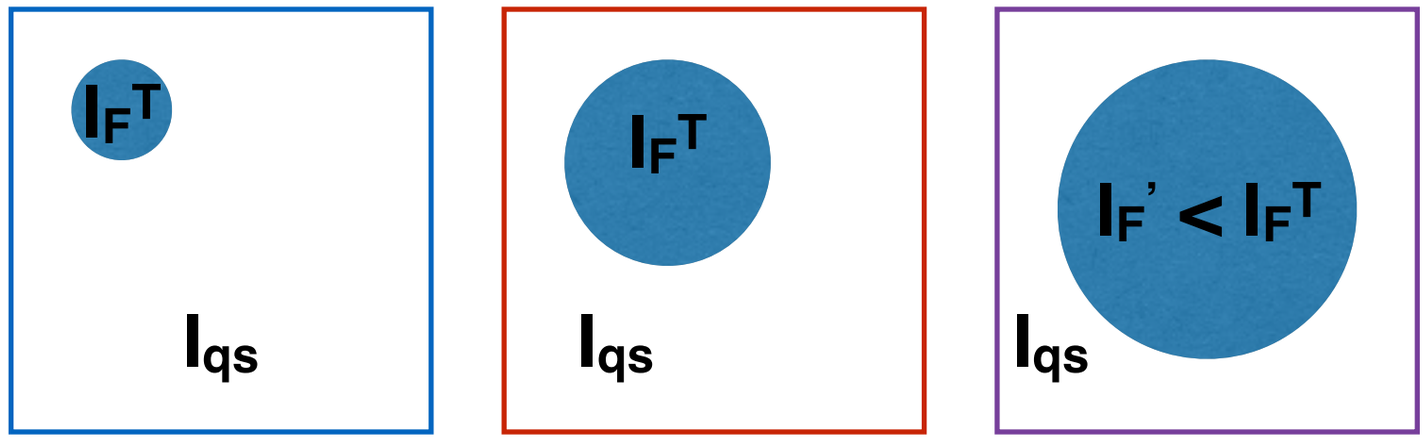
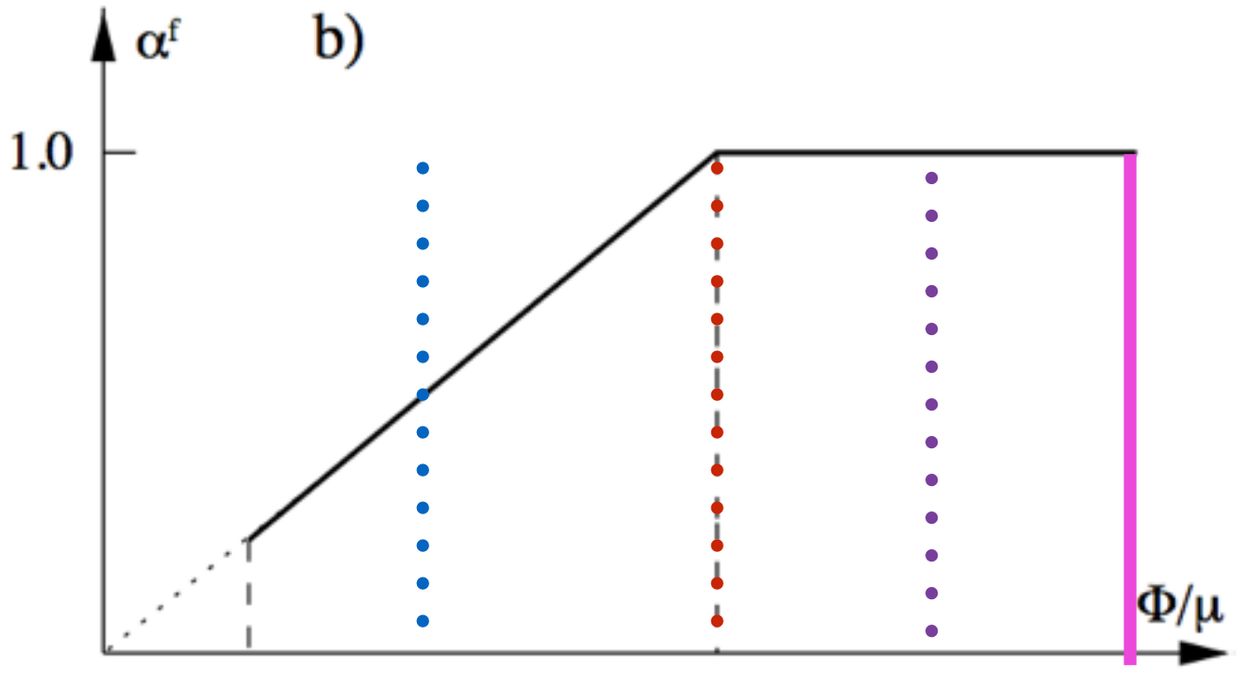
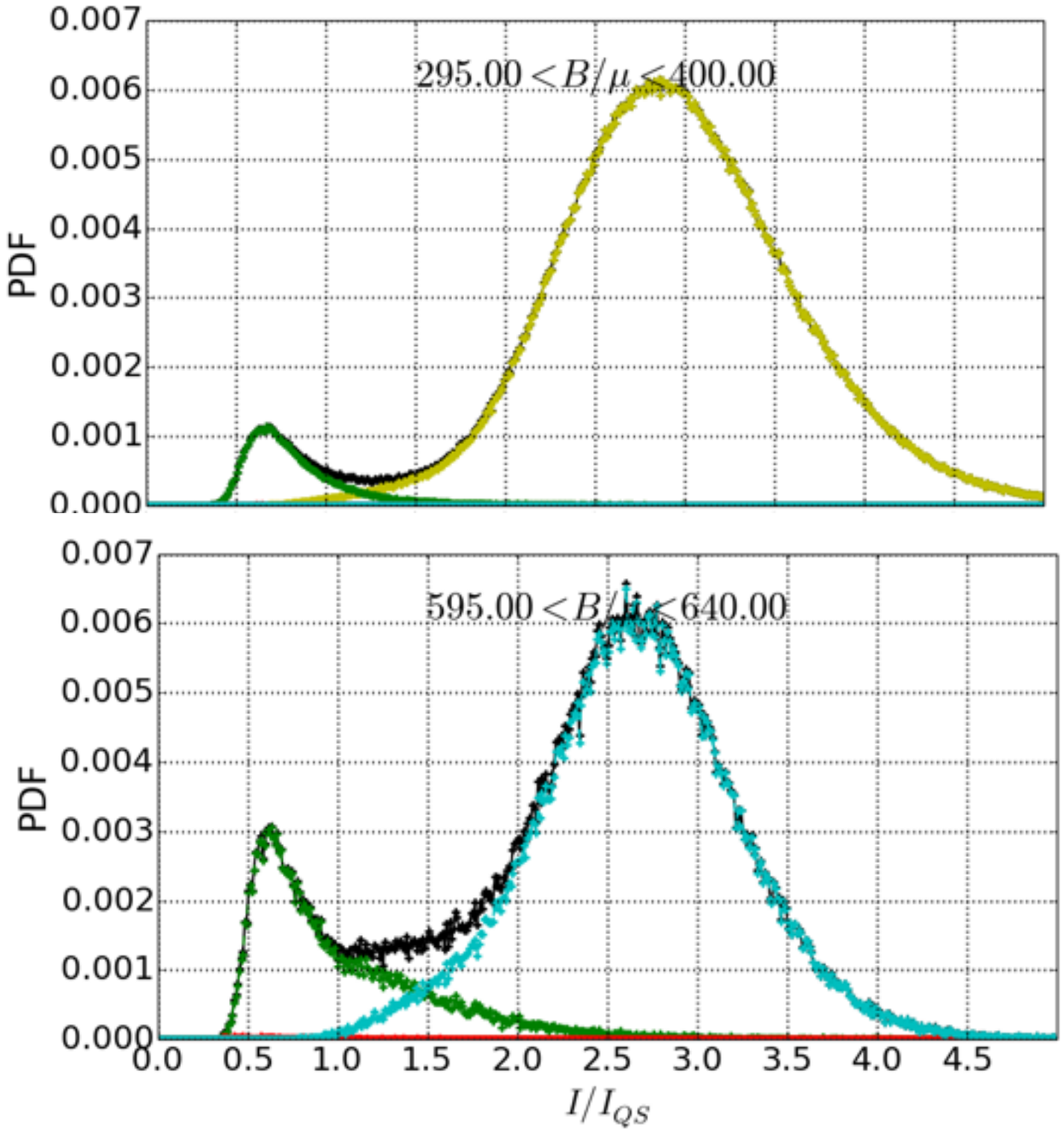




B_{thresh} B_{sat} ~ 260G B_{cut} = 600G

Effects of B_cut

Contraste @ 170nm



- Bright UV pixels are assimilated to quiet Sun.
- How many are they ?

Gravet et al., in prep

A <u>possible</u> scenario for a too large downward trend ?

- Miss some bright pixels because of B_cut

- underestimating B_Sat (more bright faculae and network) would compensate, in order to reproduce cycle variability.

- Network contrast is overestimated

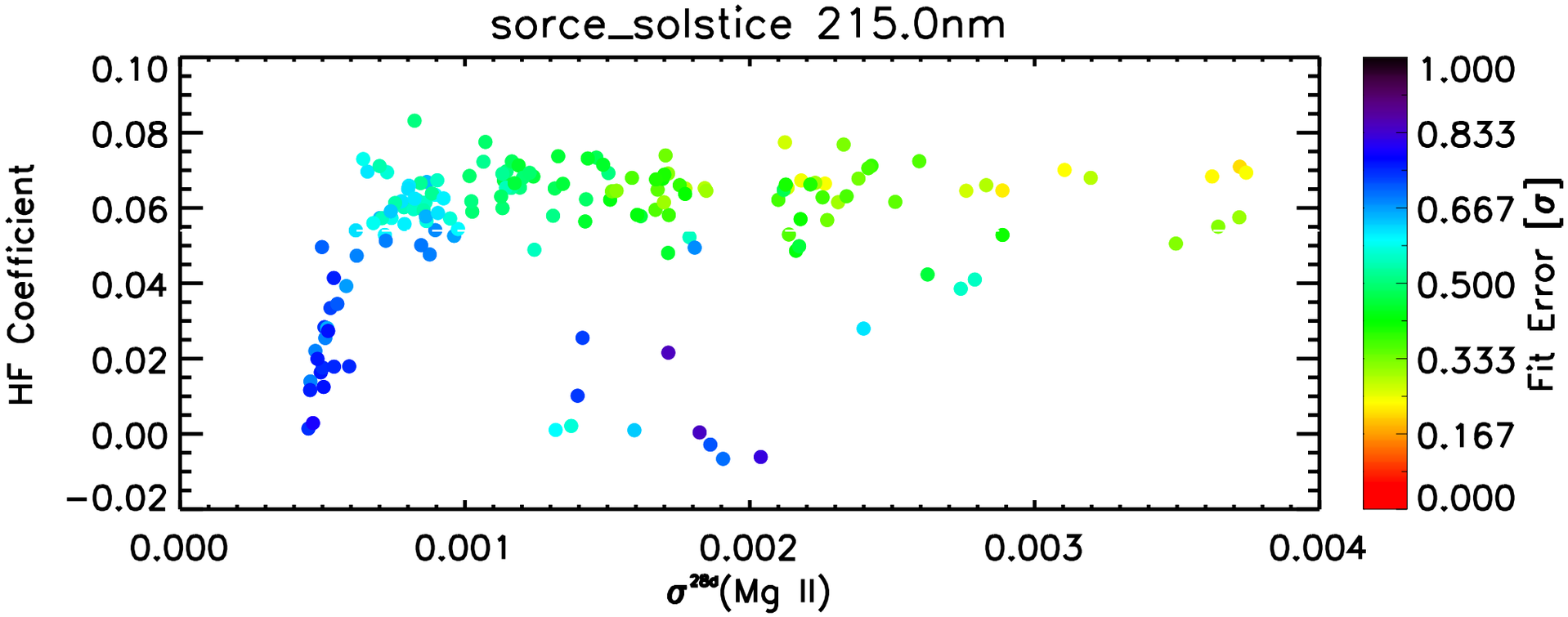
- Variations from minimum to minimum, caused by network contribution, is enhanced.

This probably can be checked with the recent simulations: brightness of pixels above B_{cut} ?

Empirical modeling

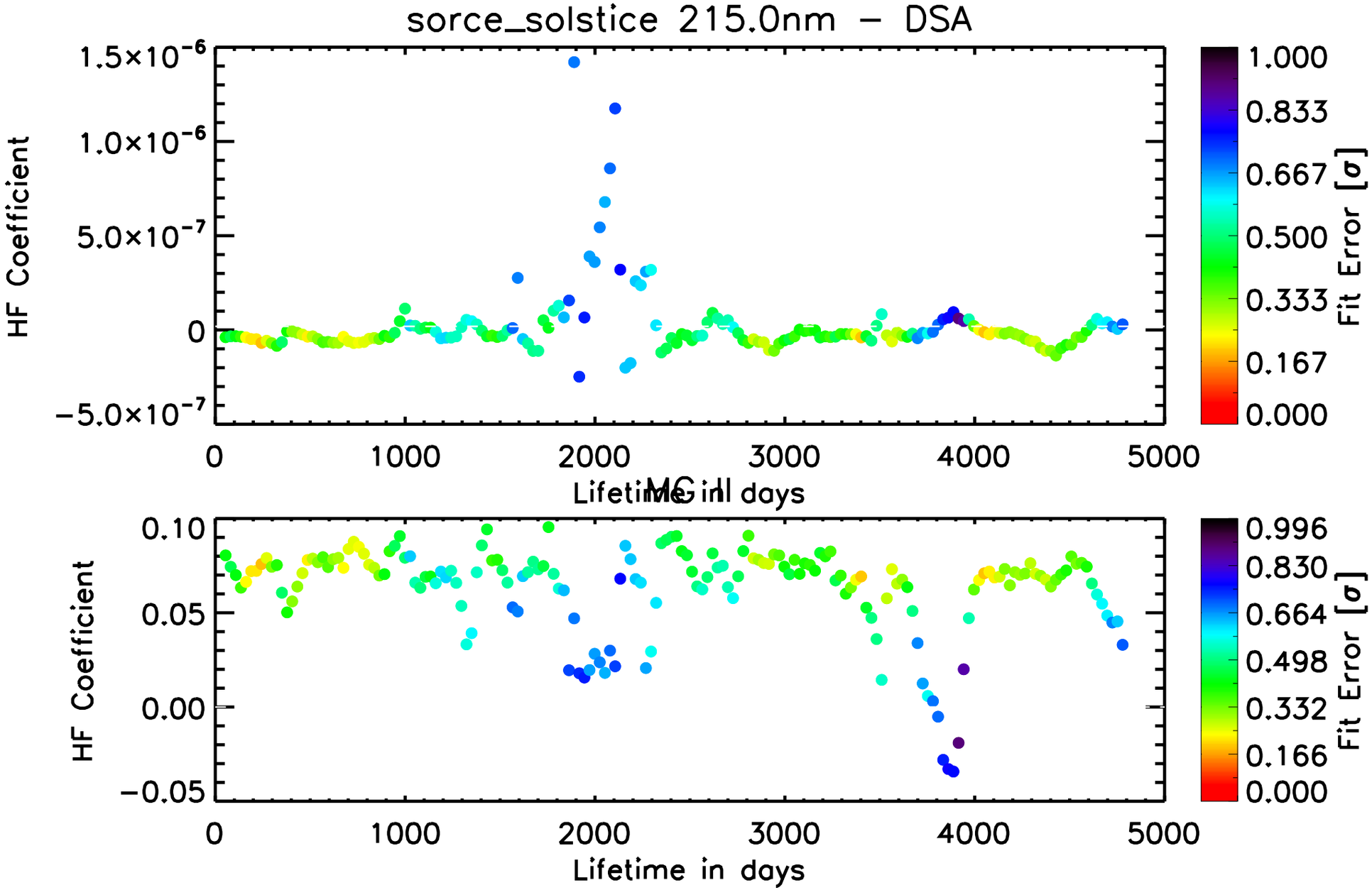
- On the fitting of solar rotation variability

Determining rotational coef



- Each coefficient is determined from 4 solar rotation
- One coefficient each 27 days.

Determining rotational coef



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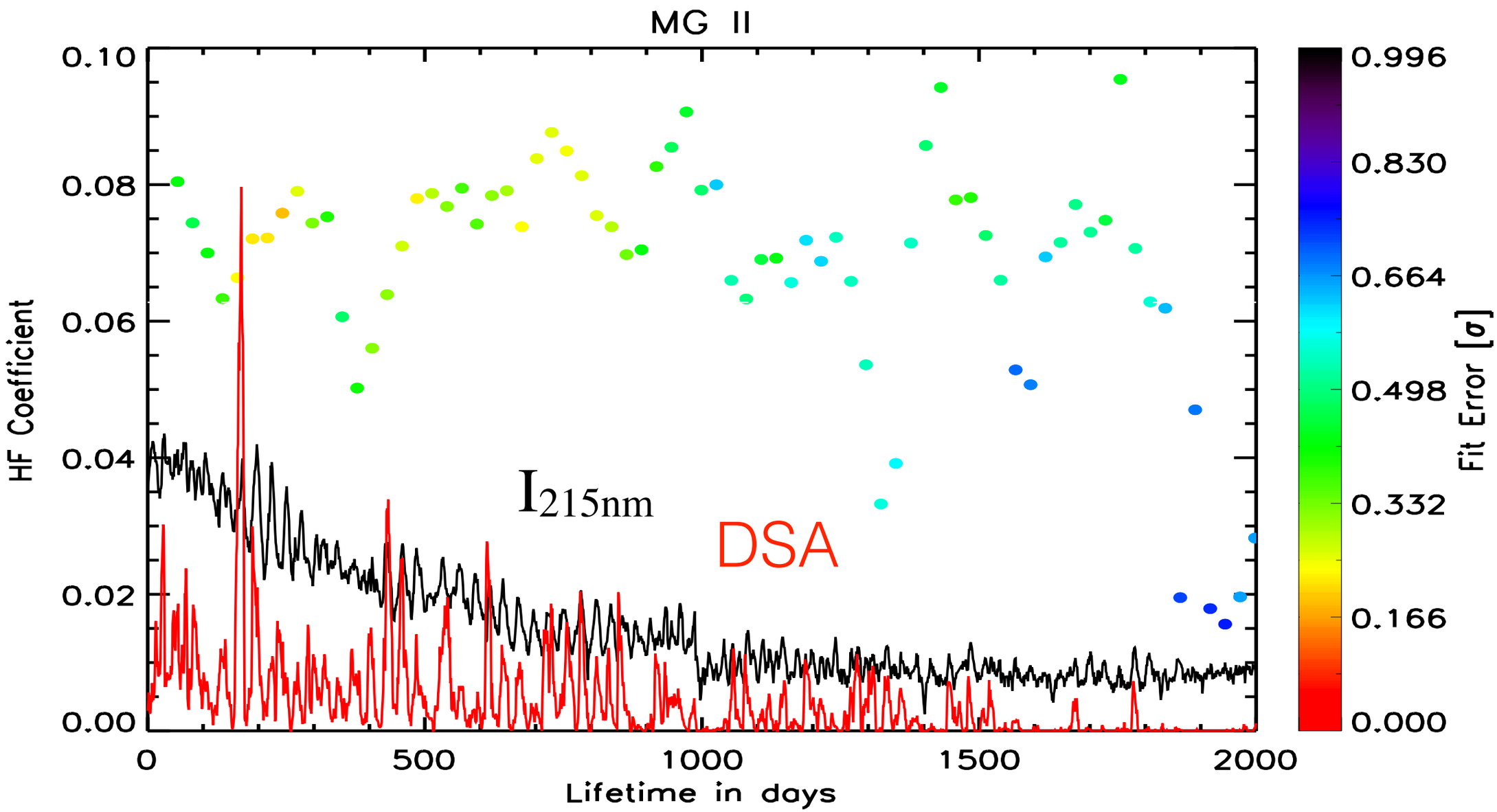
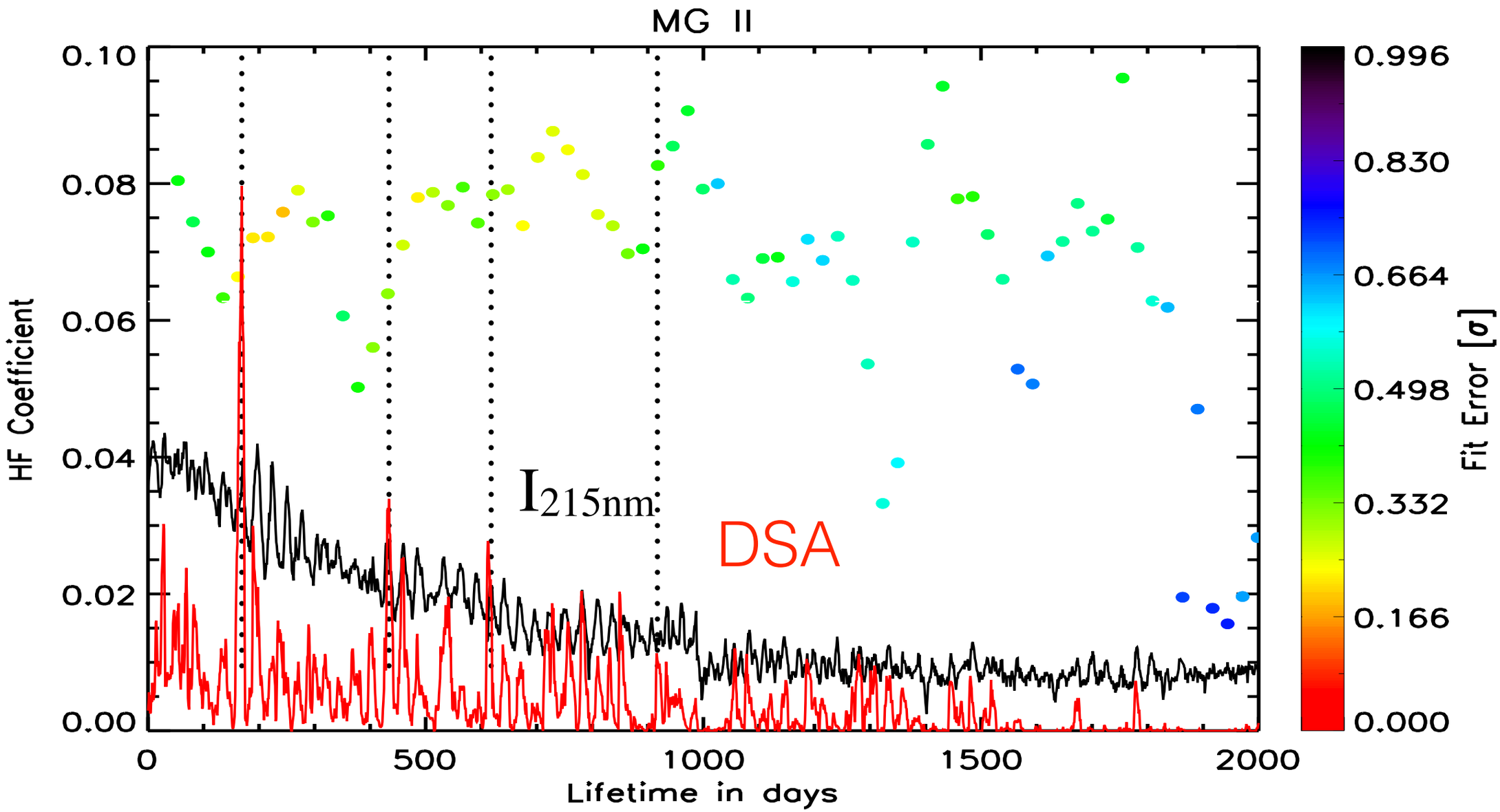
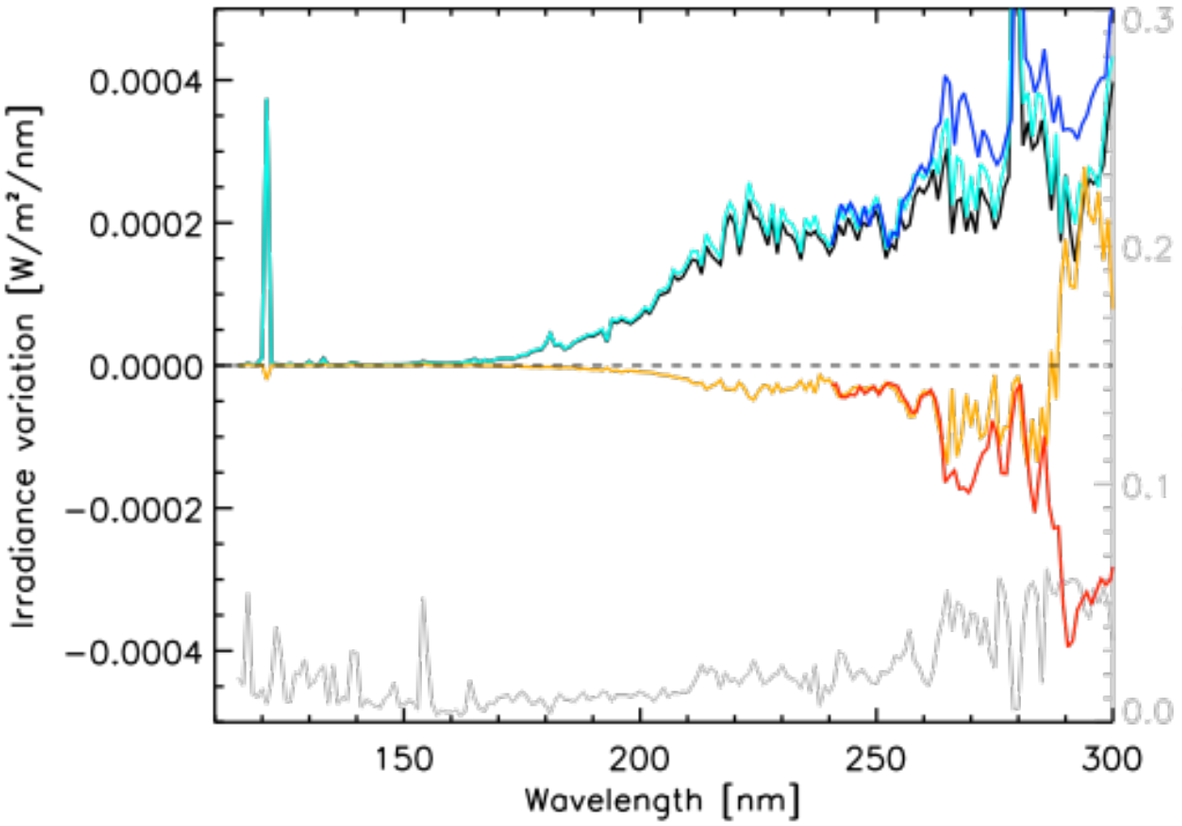
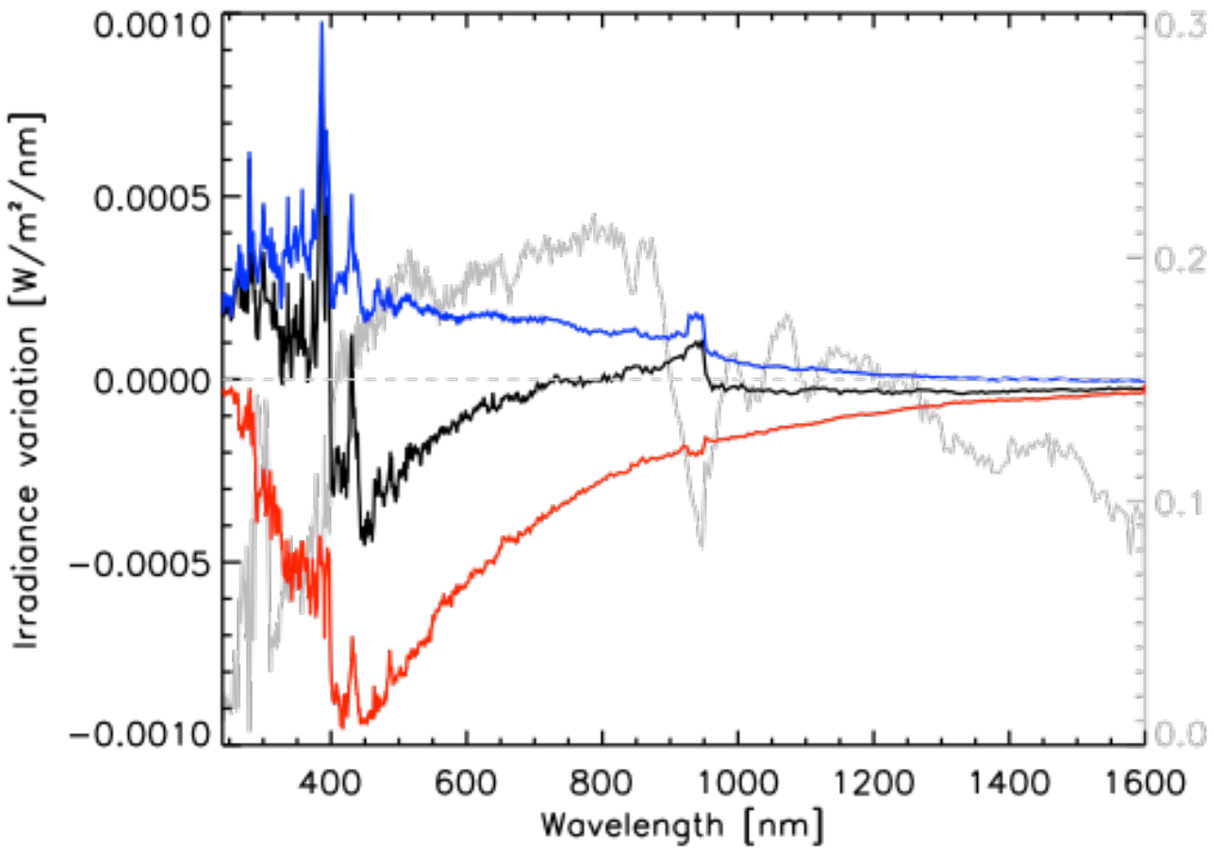

MG II
0.10
0.08
0.06
0.04
0.02
0.00
HF Coefficient
0
500
1000
1500
2000
Lifetime in days
I215nm
DSA
0.996
0.830
0.664
0.498
0.332
0.166
0.000
Fit Error [σ]



- Coefficients are time/activity dependent (locally, no correlation with SC)

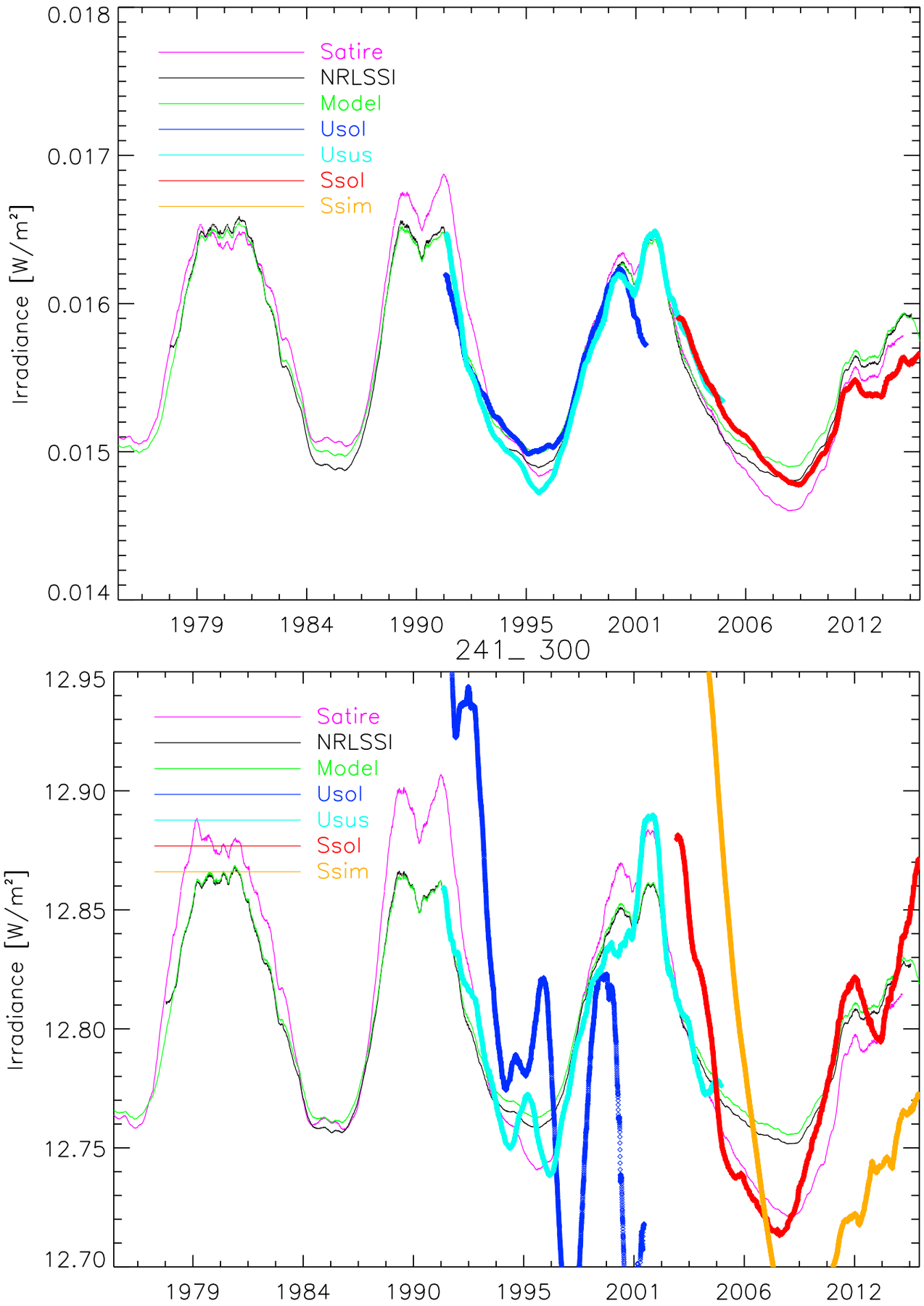
Contribution to rotational variability from SORCE





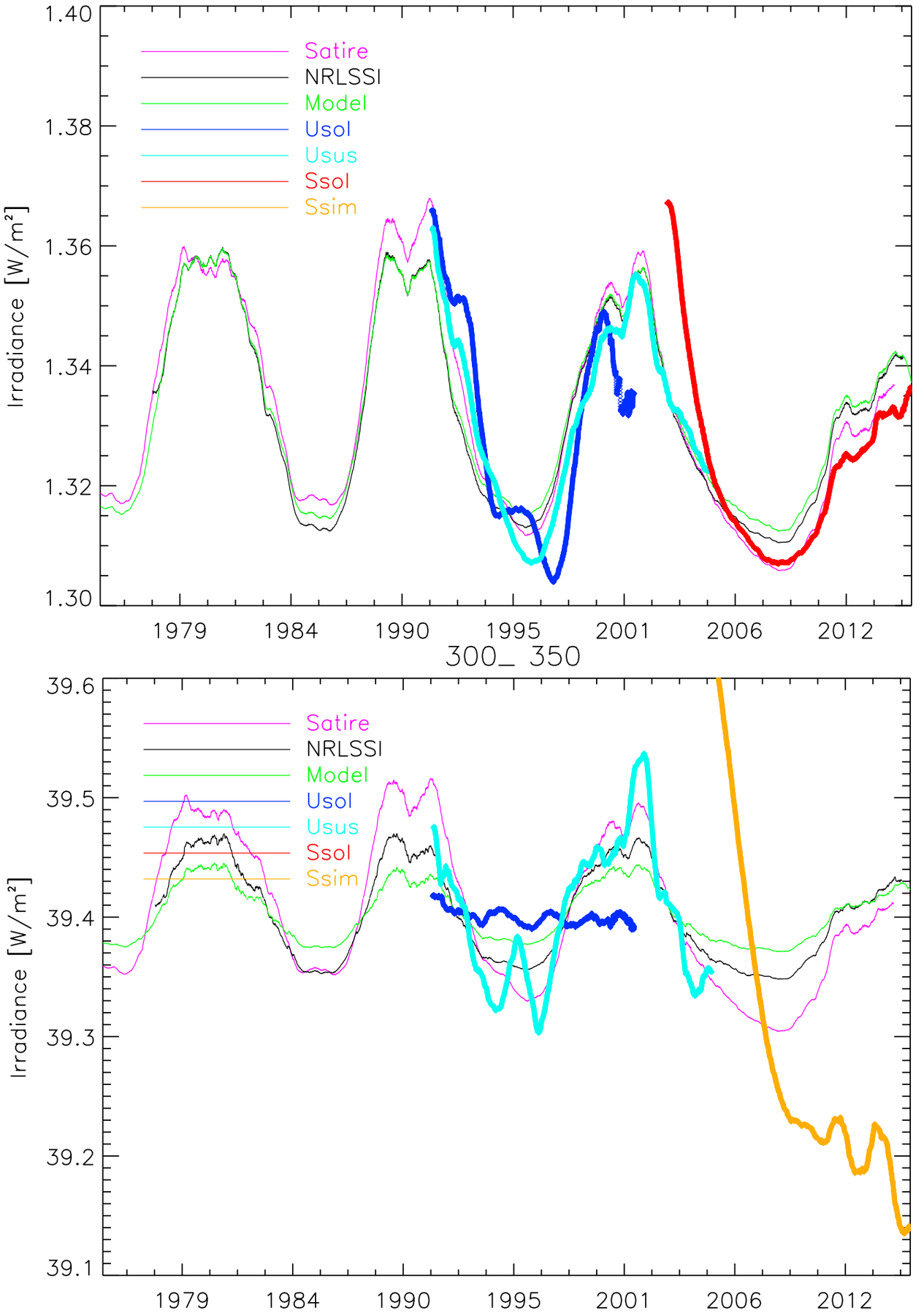
- **Mg II only** (black)
- **MgII [blue]** and **DSA [red]**and both the Mg II (blue) and DSA indices (red)
- **Grey**: improvement by using 2 proxy.

150_ 180



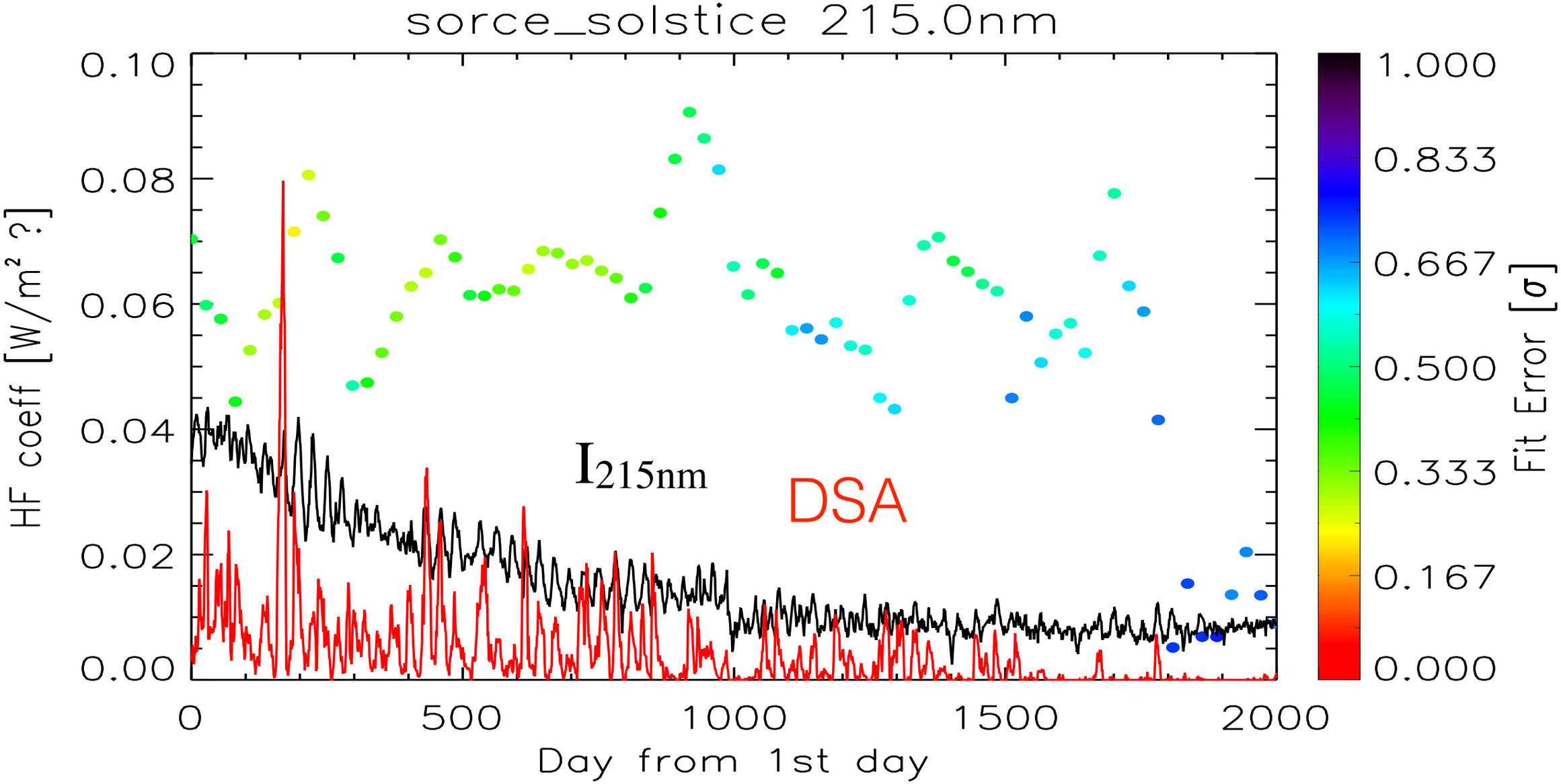
241_ 300

200_ 240

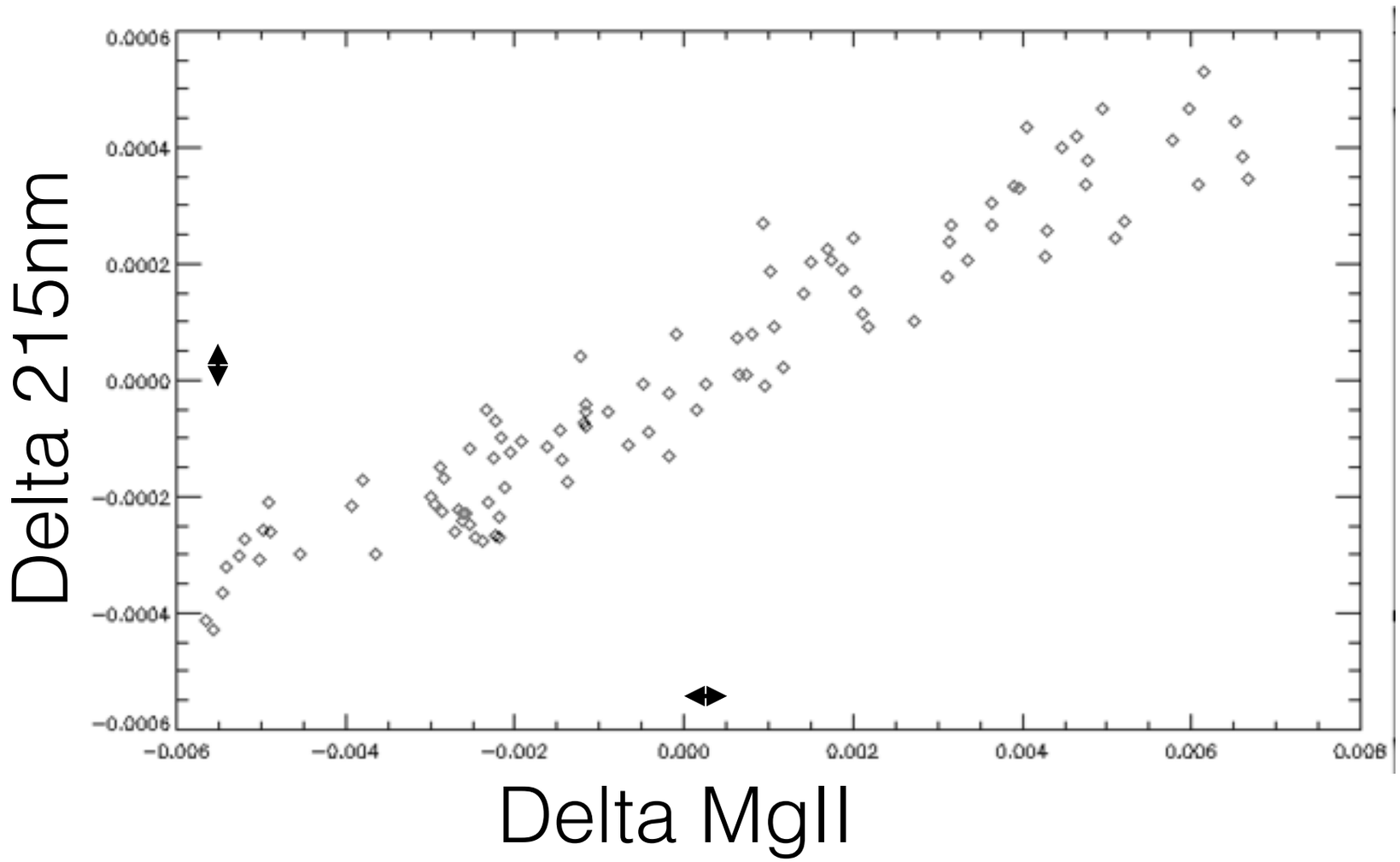


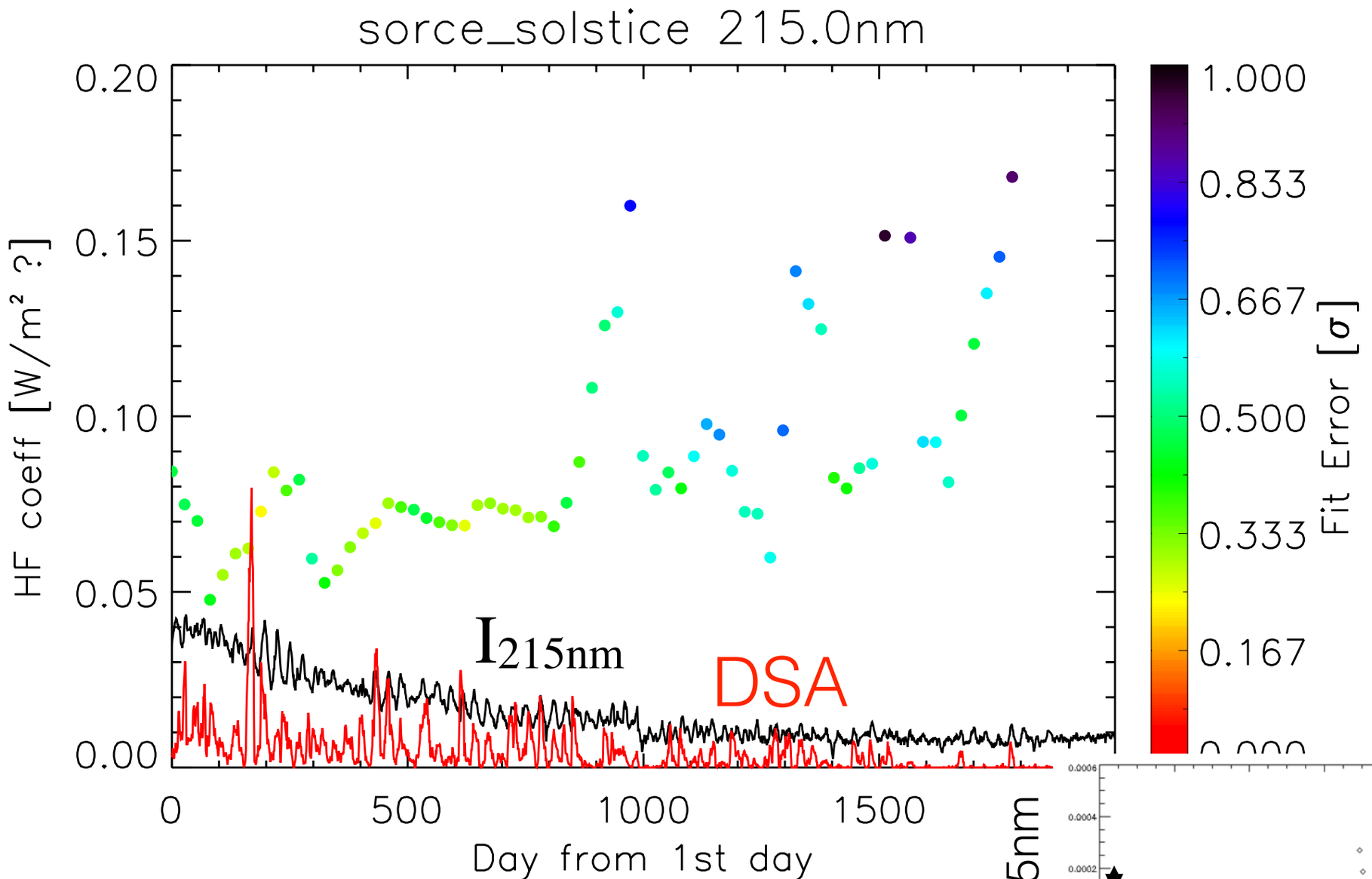
300_ 350

Fitting method.

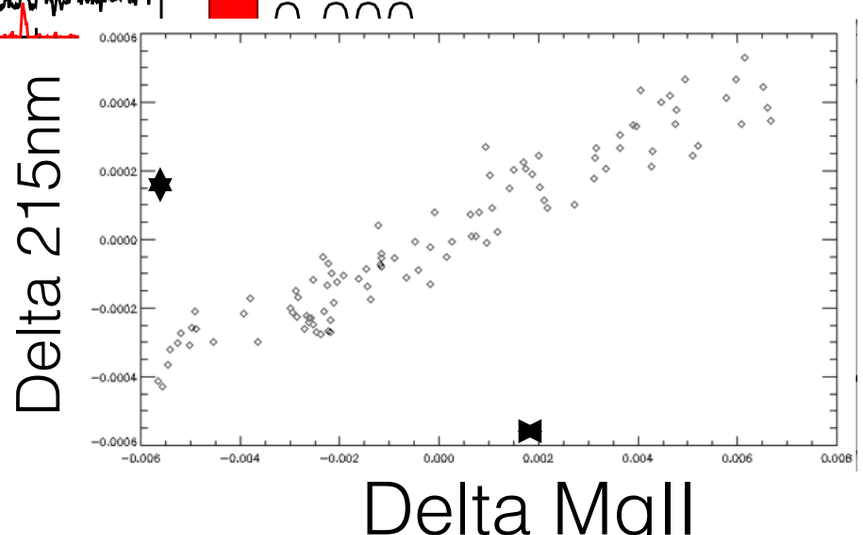


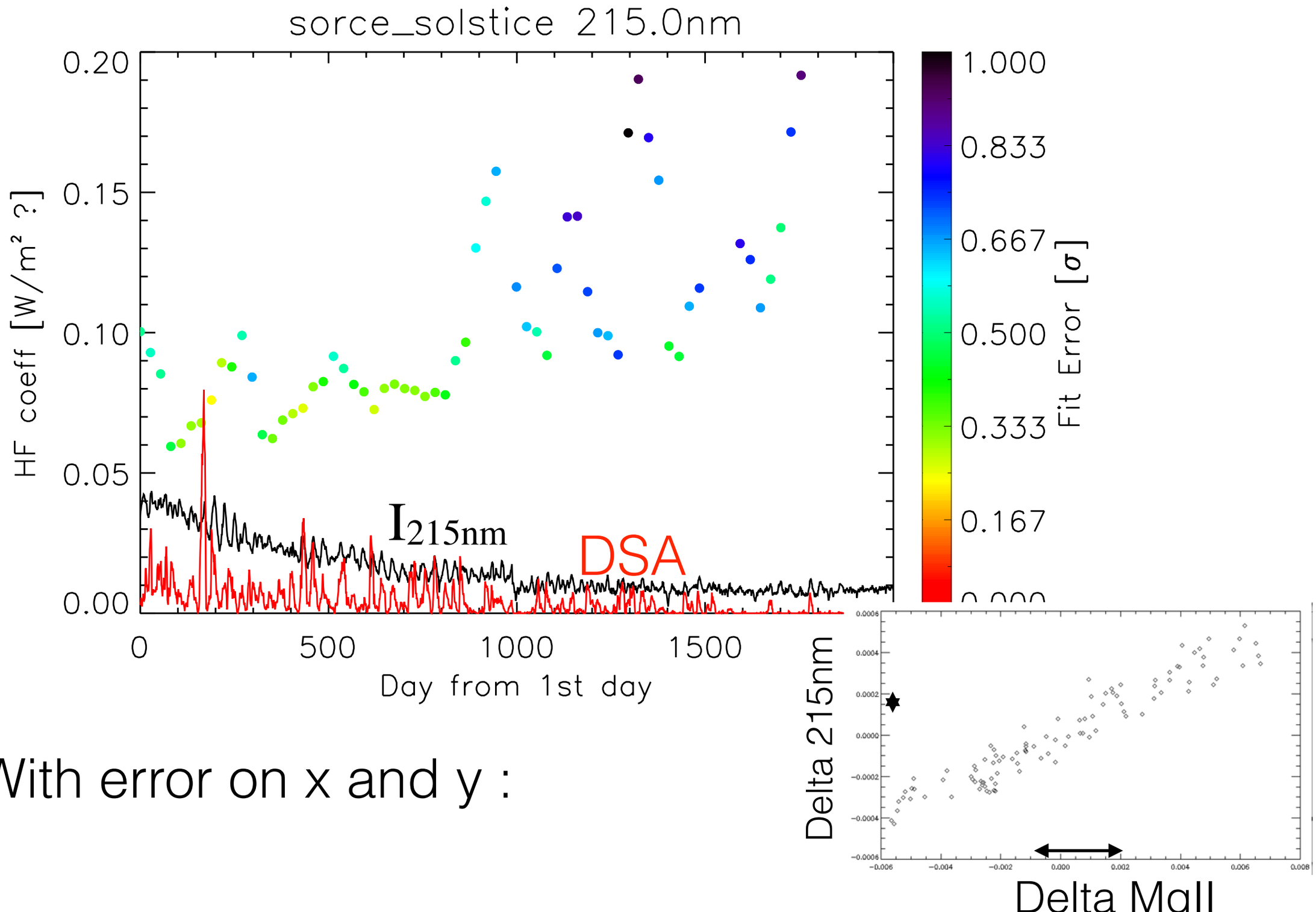
- No error on x assumed.


Delta 2150nm
Delta MgII
0.0006
0.0004
0.0002
0.0000
−0.0002
−0.0004
−0.0006
−0.006
−0.004
−0.002
0.000
0.002
0.004
0.006
0.008

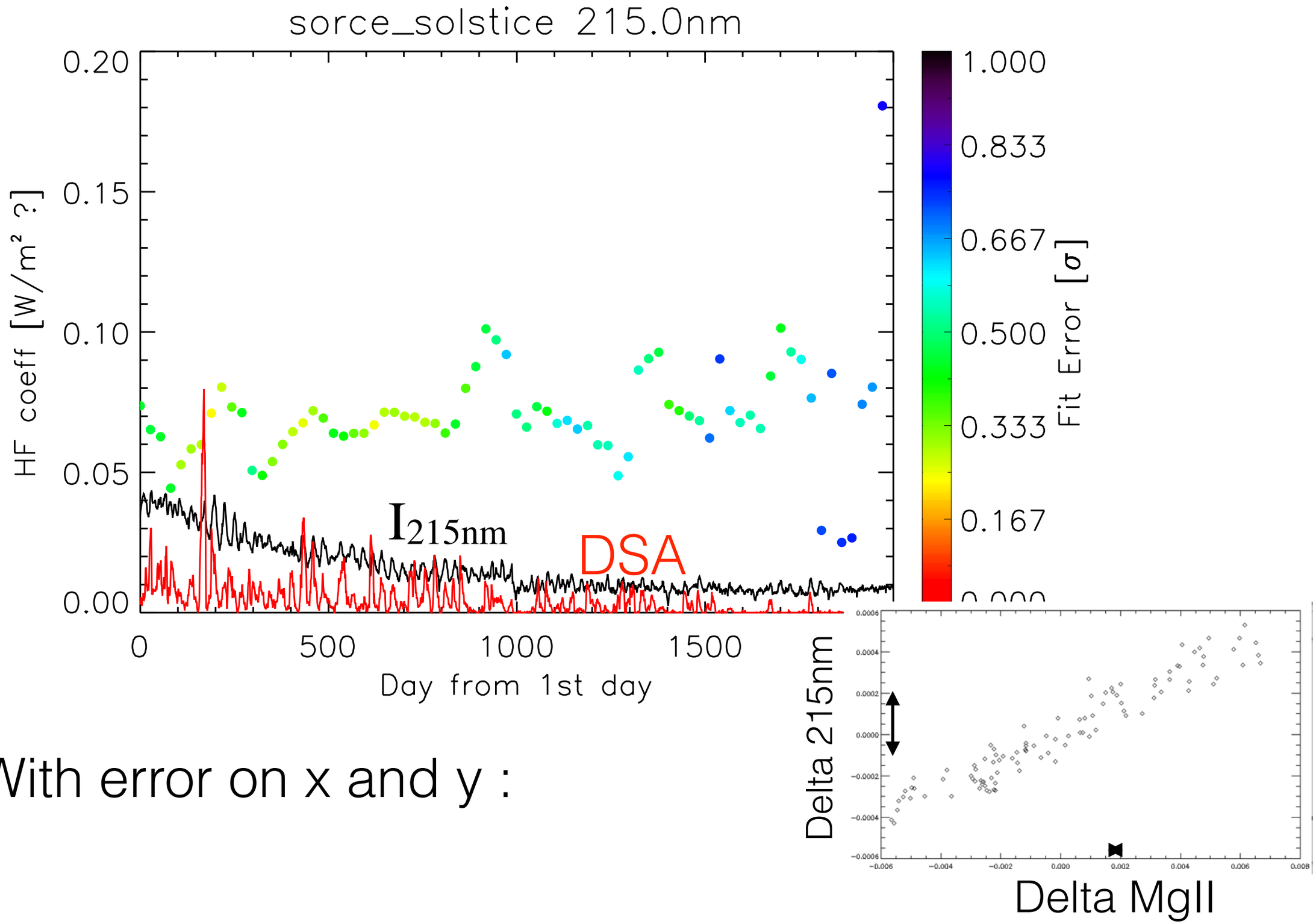


- With error on x and y :





- With error on x and y :



- With error on x and y :

Thank you