Comparison of solar EUV irradiance observed by LYRA and EVE

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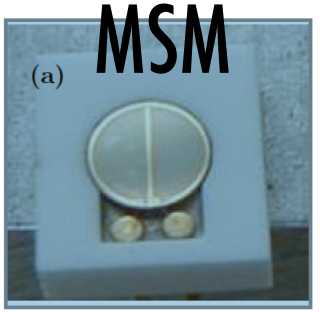
PROBA2: a technology demonstrator

- Both the S/C and its payload have true innovations:
  With LYRA, diamond detectors in space for the first time !

	Channel1	Channel2	Channel3	Channel4
	Ly	Hz	Al	Zr
Unit1	MSM	PIN	MSM	Si
Unit2	MSM	PIN	MSM	MSM
Unit3	Si	PIN	Si	Si

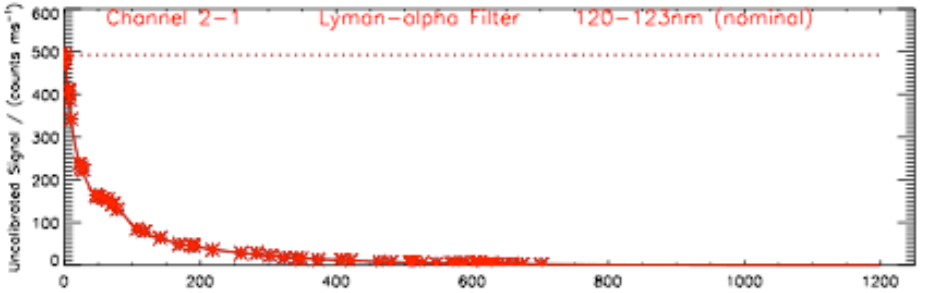
Long term calibration
Nominal
Special Campaign

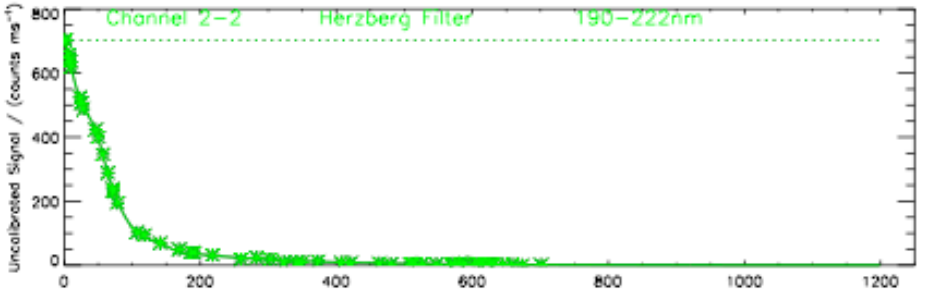


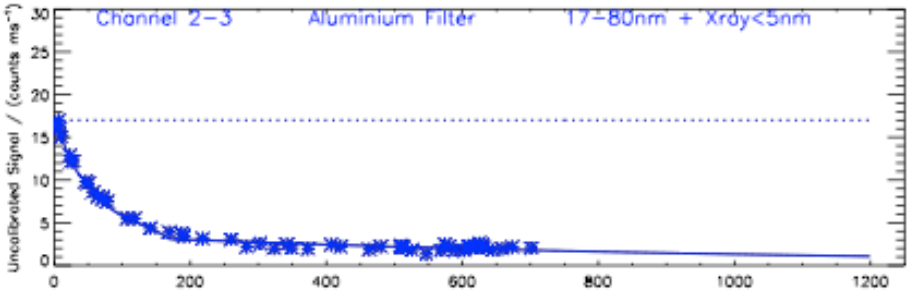
- Launched on Nov. 2 2009, LYRA first light on January 6 2010

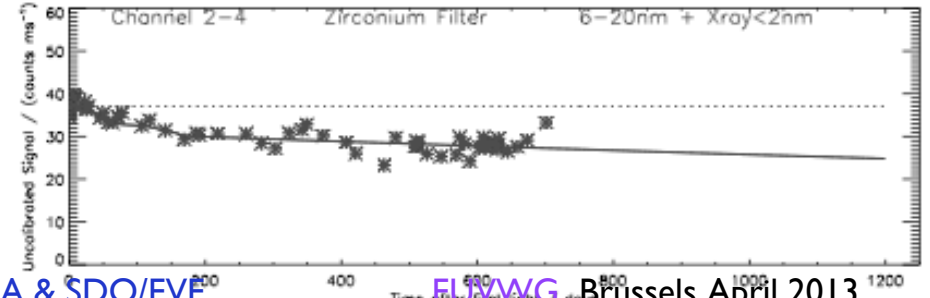
Degradation

- ✓ Huge degradation in the two first channels of the nominal unit.
- ✓ For the two other channels, back up units are used to monitor the degradation.
- ✓ which is corrected by addition.



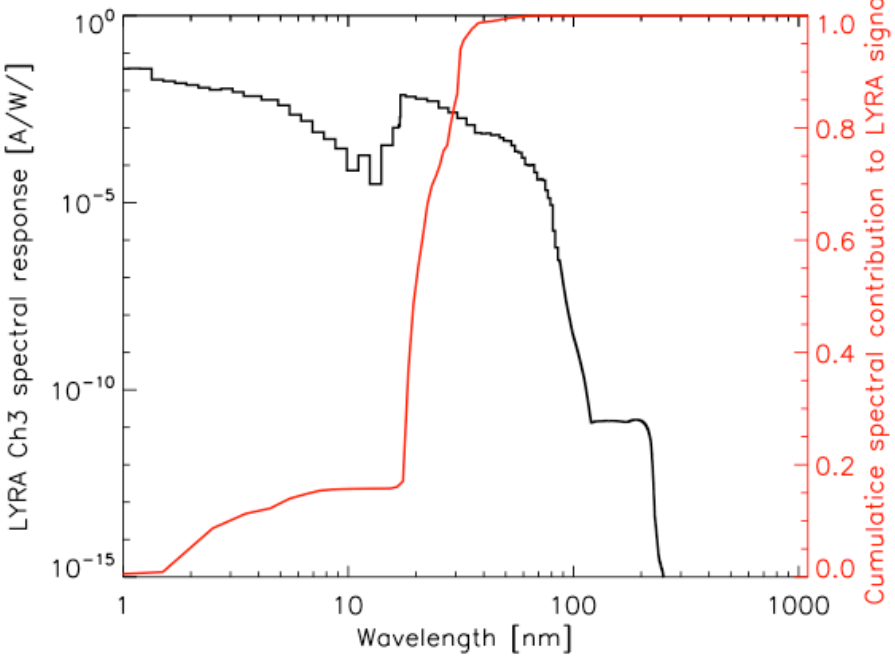






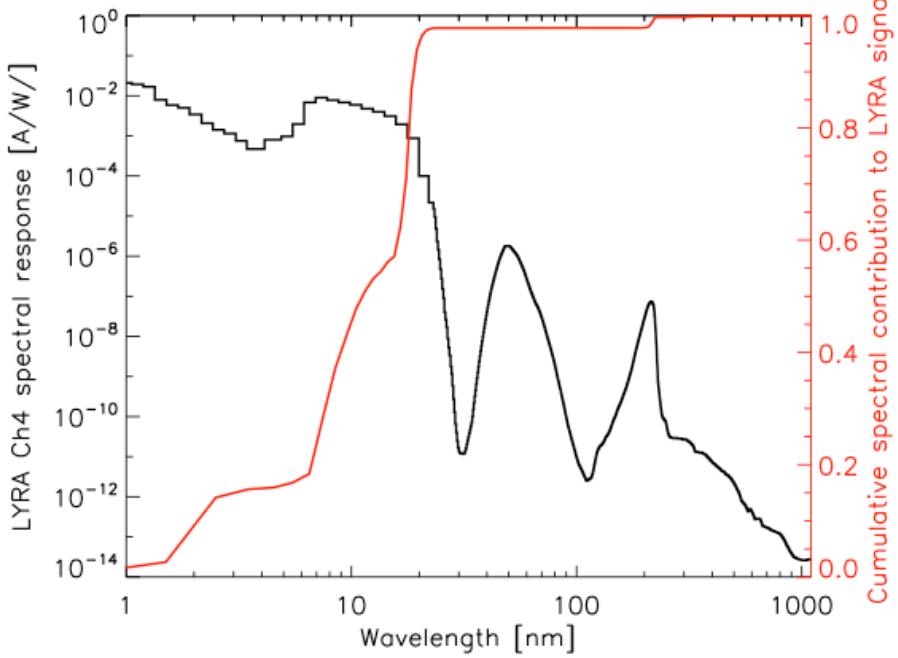
Spectral response

Ch2-3



17-80 nm + <5nm X-ray

Ch2-4

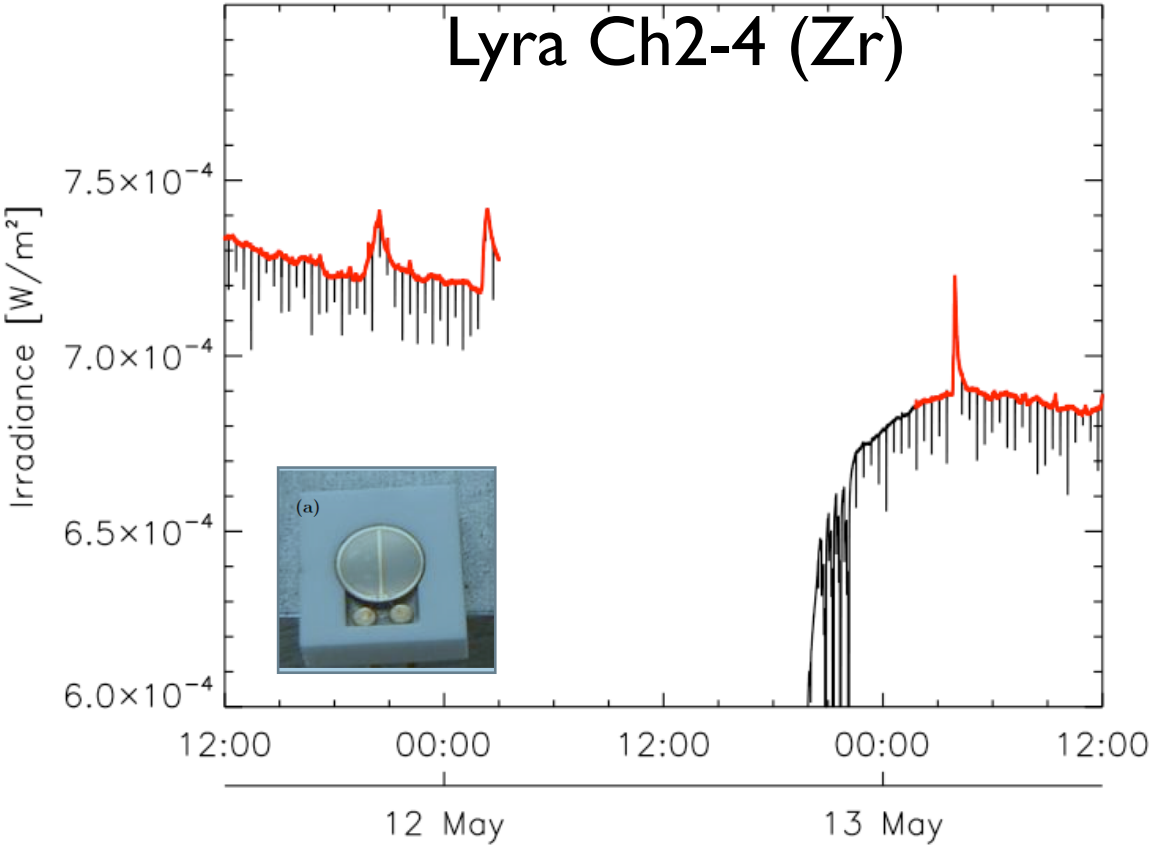


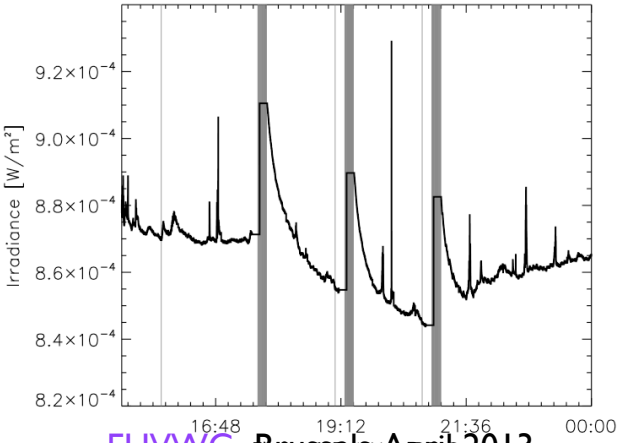
6-20 nm (+ <2nm X-ray)

✓ We use TIMED/SEE and SDO/EVE data to simulate LYRA ch2-3 and ch2-4 and compare with our results

Instrumental effects

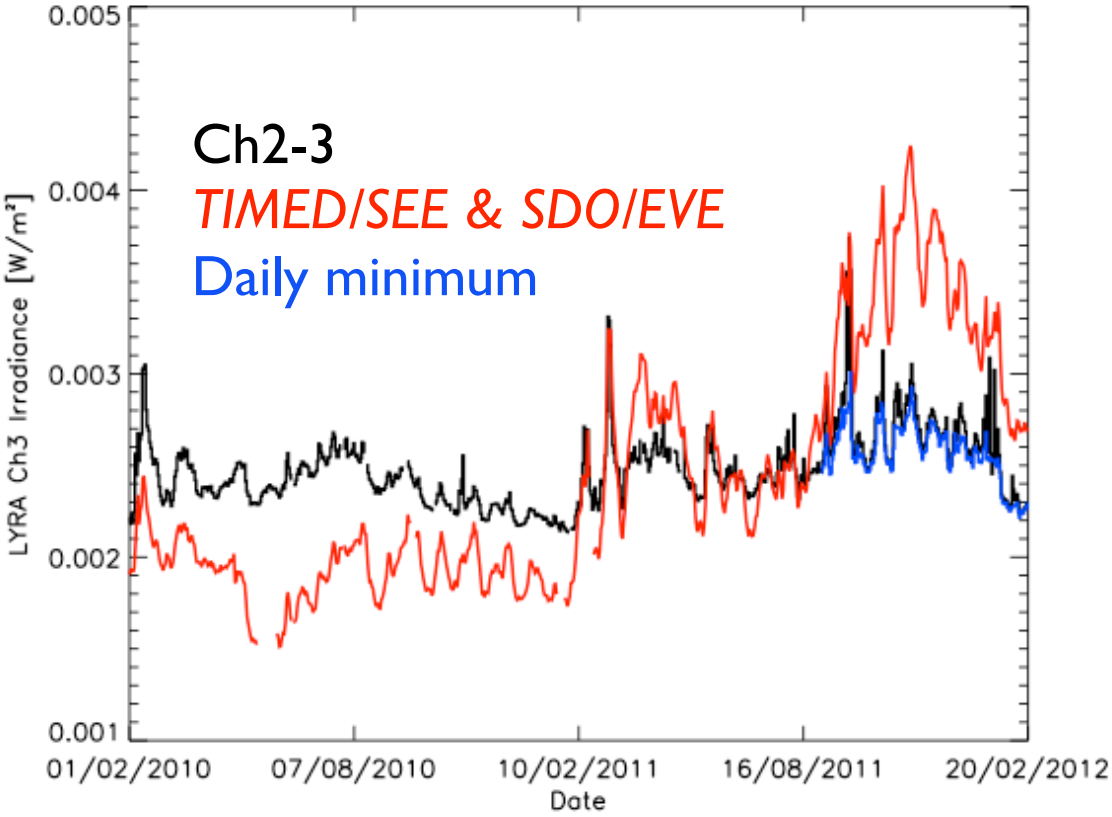
- ✓ Both LYRA and PROBA2 have innovative features that reflect themselves in the data.
- ✓ Diamond detectors + LARs
- ✓ Slow response time
- ✓ Reboots
- ✓ Eclipse and occultations
- ✓ Needed to compute daily average value.



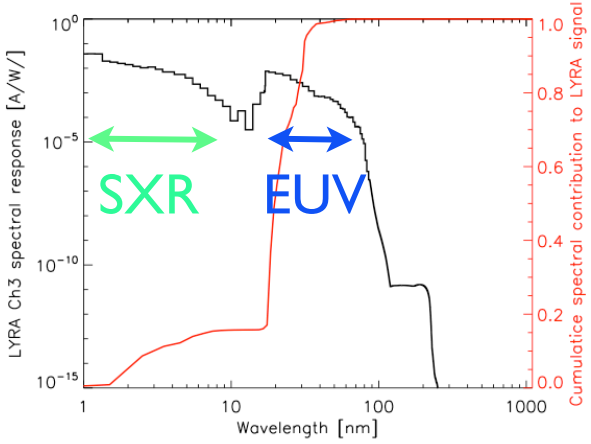


Ch2-3: long term

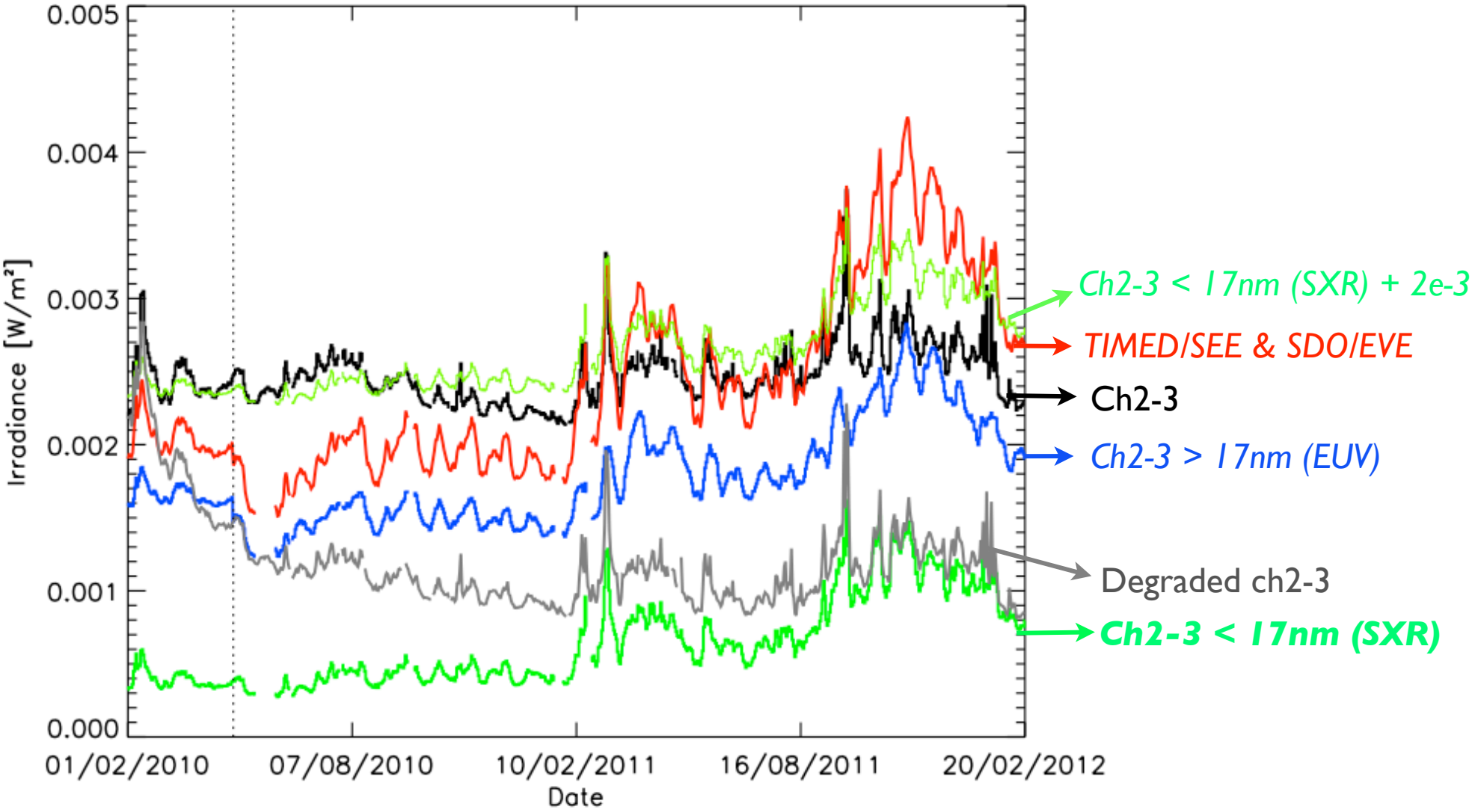
- ✓ Agrees with manual selection of daily value.
- ✓ Absolute value is ok.
- ✓ Much larger variations with solar activity for SDO/EVE.



- ✓ Use SDO/EVE to investigate the degradation of different spectral ranges.



Ch2-3: long term

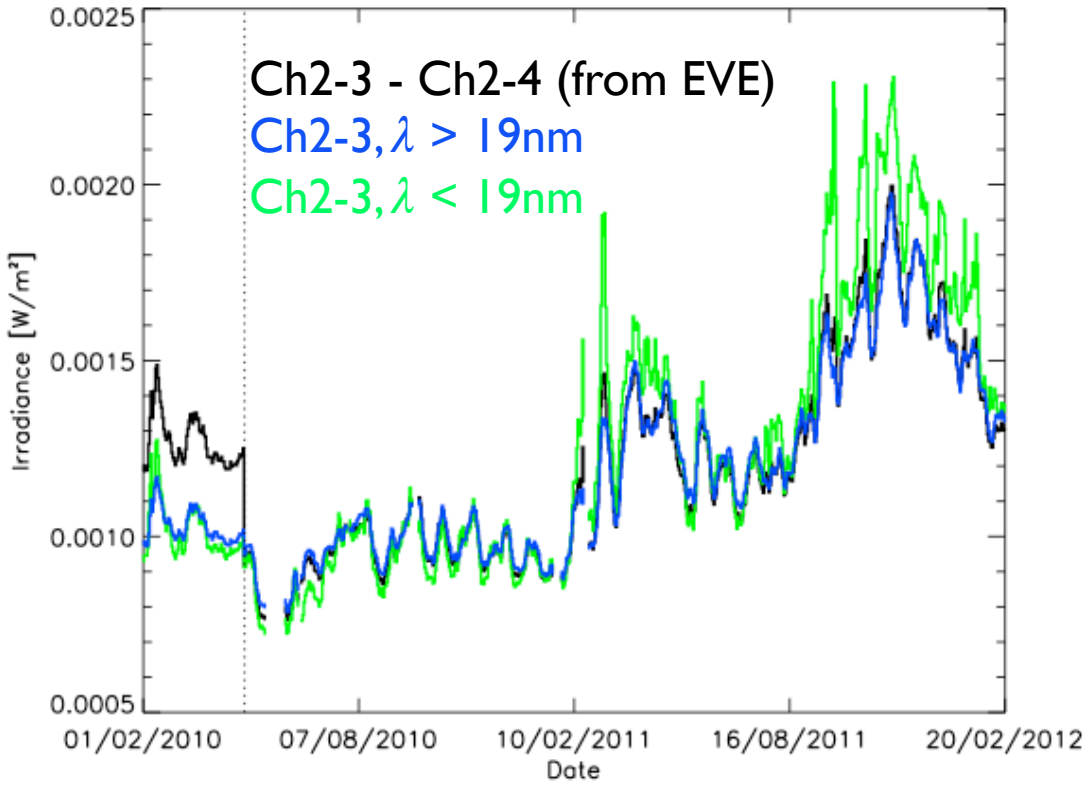


- ✓ EUV contribution to ch2-3 has strongly decreased.
- ✓ The additive correction for degradation corrects for absolute level but not for the variability.

✓ Using a multiplicative correction for degradation would artificially increase the LYRA flare flux.

✓ Can we retrieve the EUV component of ch2-3 with LYRA only ?

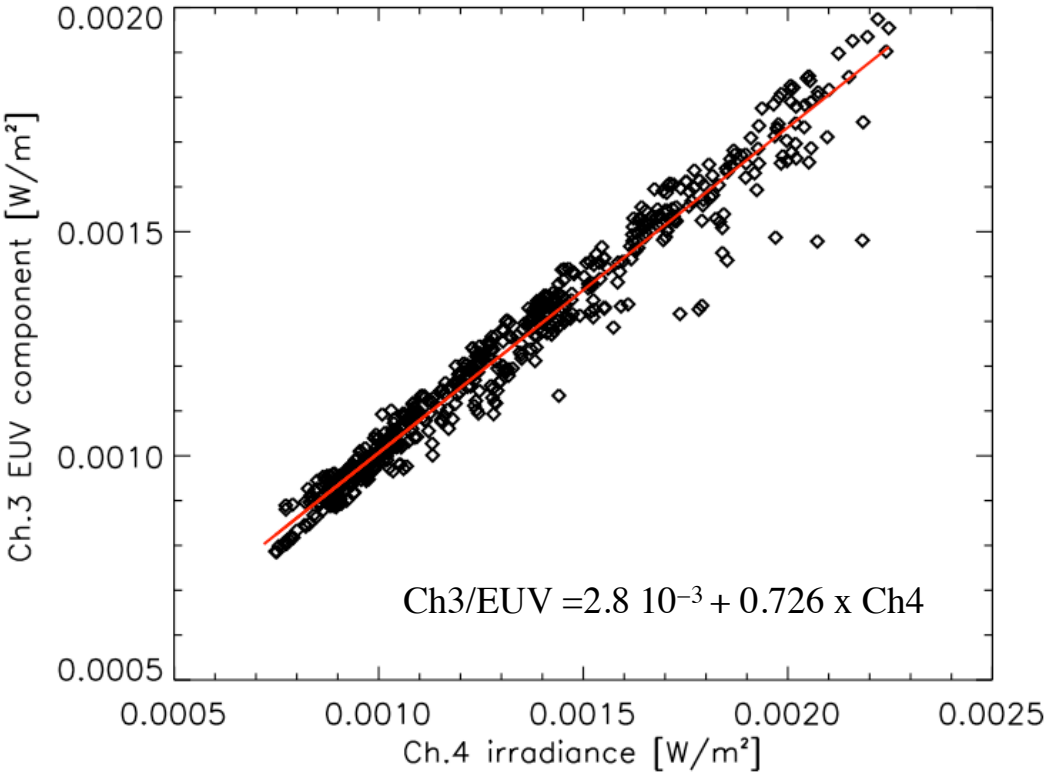
Modeling of the degradation of the EUV component of ch2-3



The difference between channel3 and channel4 matches the EUV component of ch3.

➡ $ch23^{deg}$ - ch24 = degraded EUV component of ch3

Modeling of the degradation of the EUV component of ch2-3

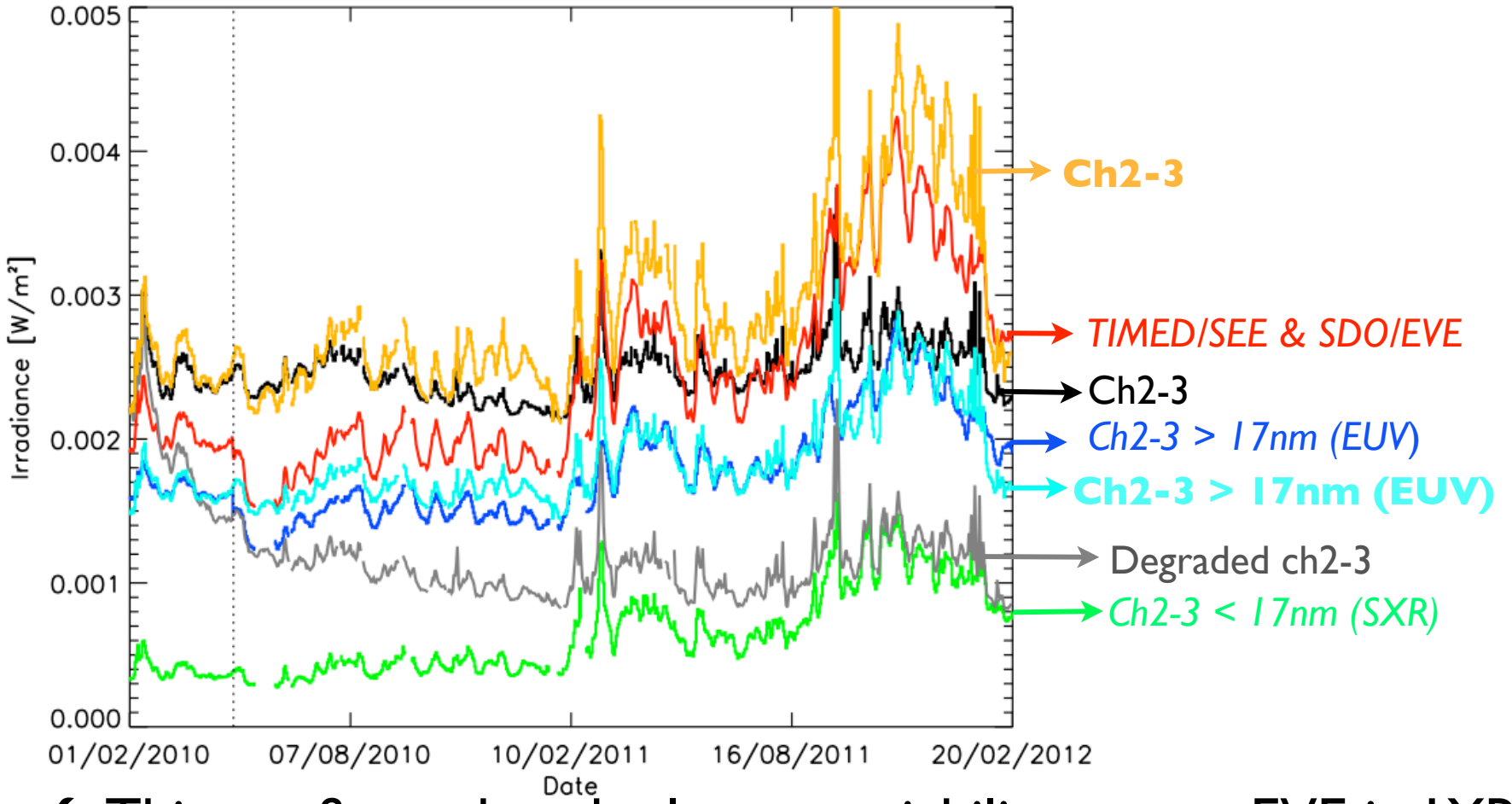


The simulated EUV component of ch3 is very well correlated with the simulated channel4

➡ $(ch23^{deg} - ch24) / (2.8\ 10^{3} + 0.726\ ch24)$ (and normalisation) = degradation curve for the EUV (DC)

➡ $(ch23^{deg} - ch24) / DC + ch24 = ch23$

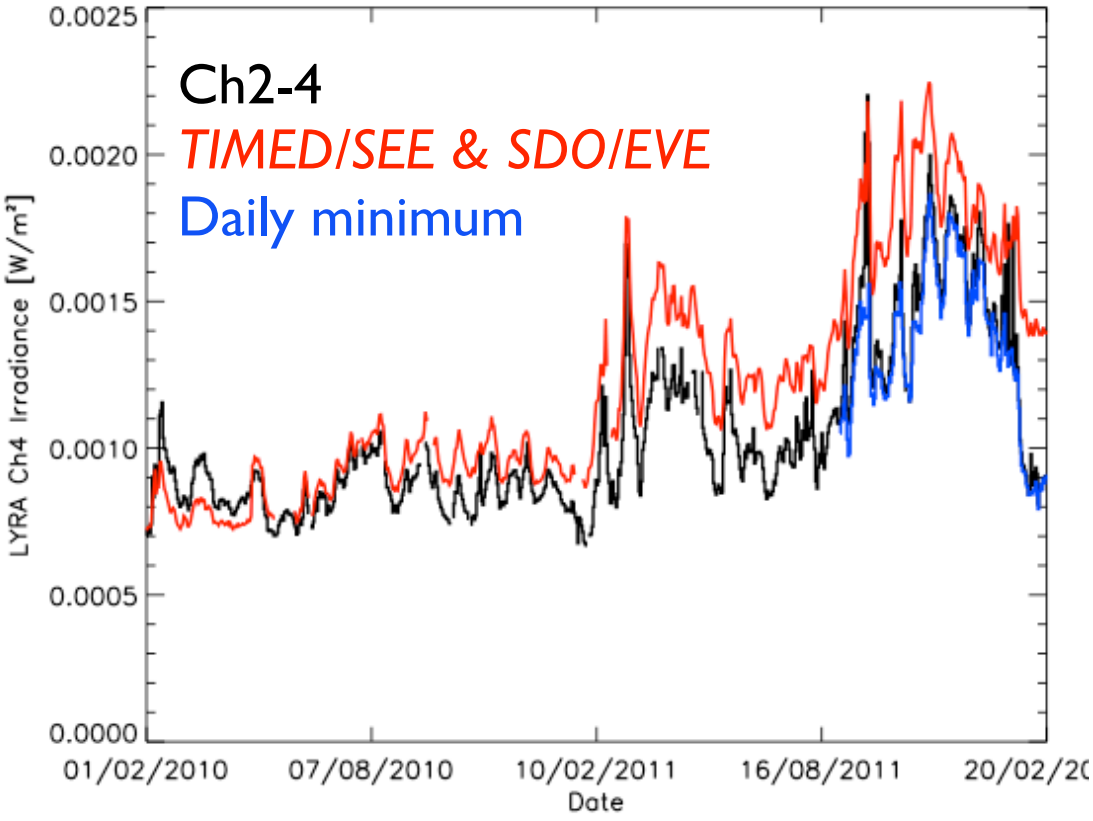
Modeling of the EUV component of ch2-3



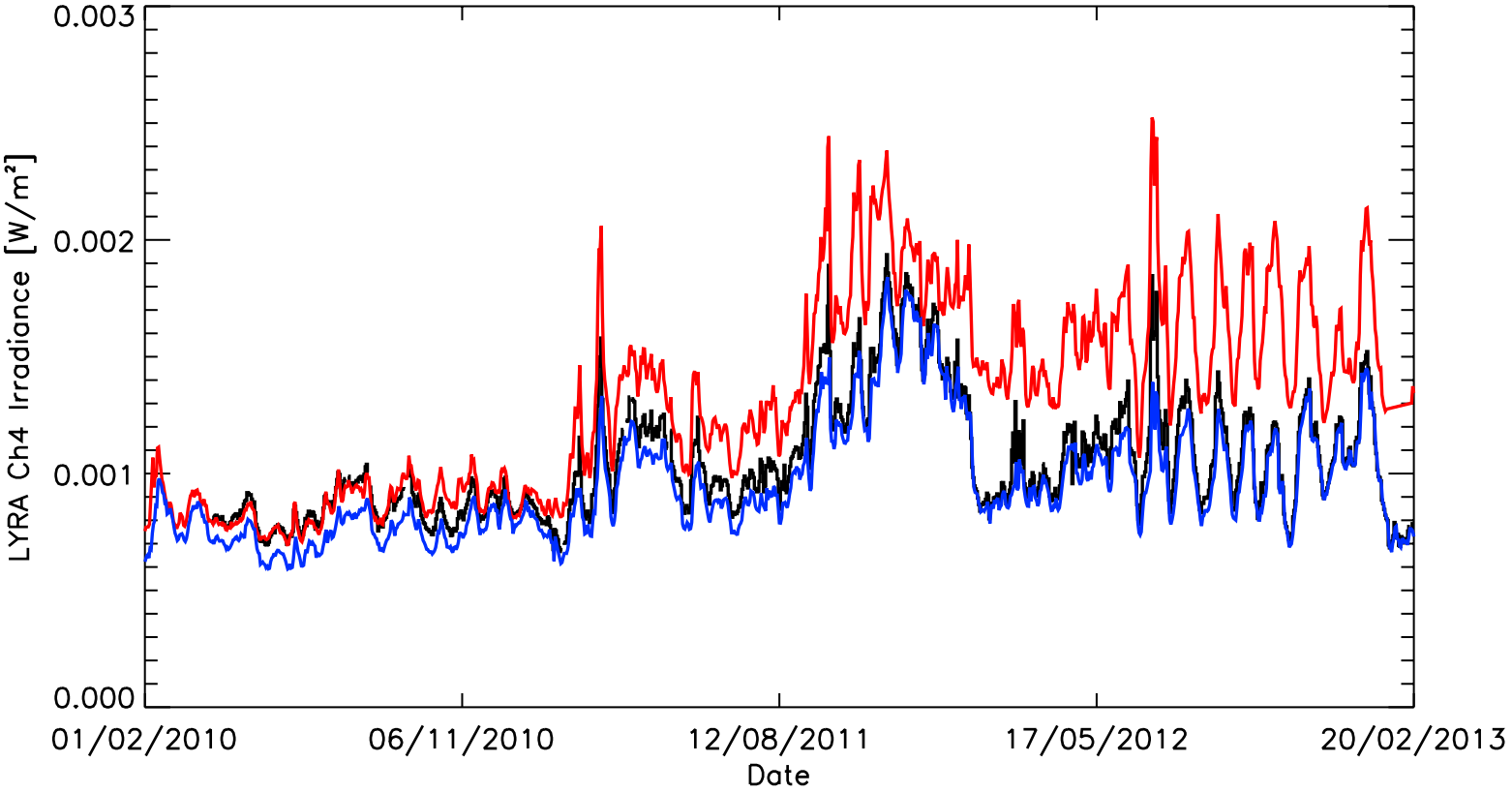
- ✓ This confirms that the lower variability wrt to EVE in LYRA ch2-3 is due to the loss of EUV sensitivity.
- ✓ This can be recover (as far as the SNR is sufficient..) by using a multiplicative correction for degradation

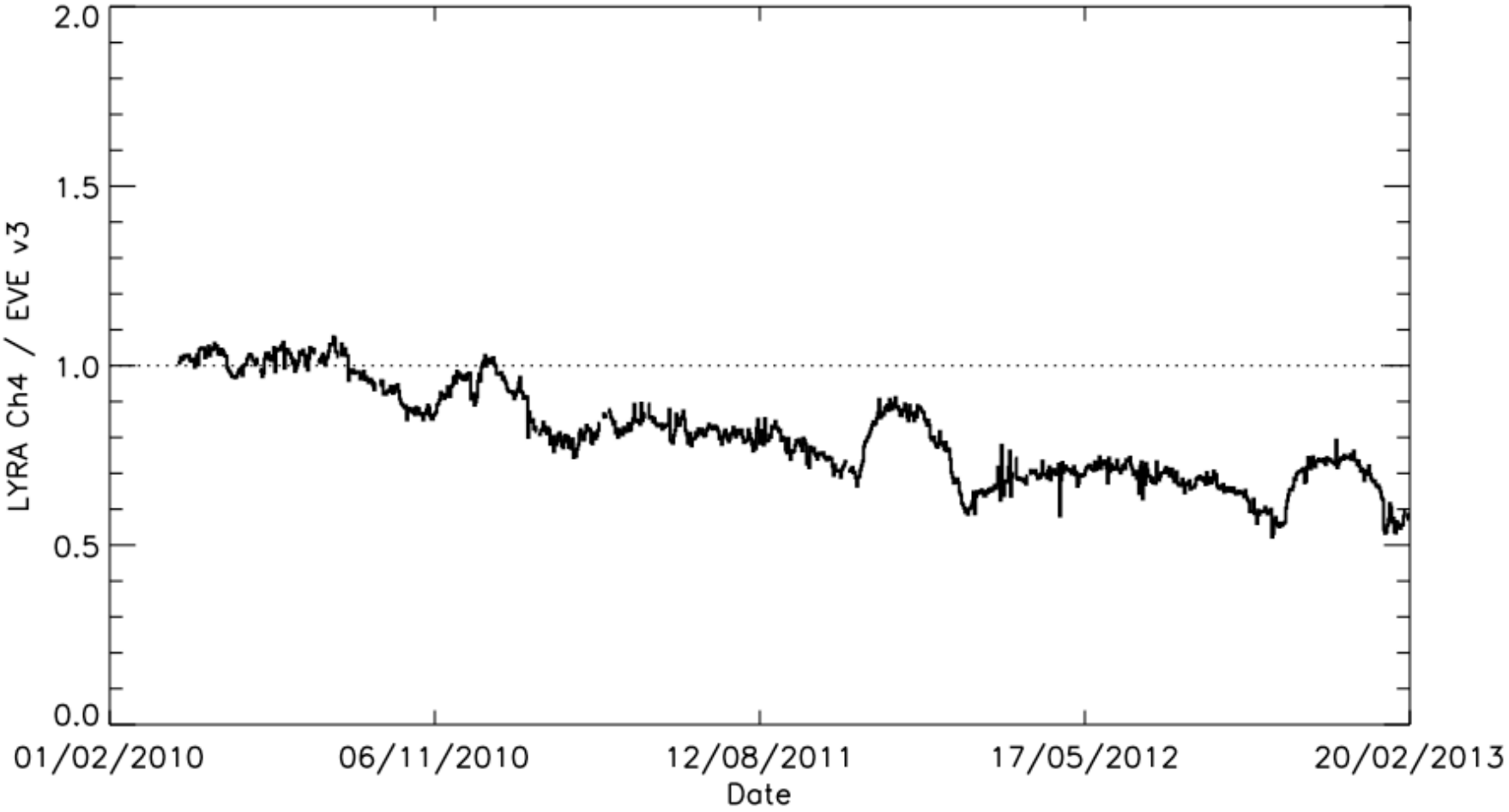
Ch2-4: long term

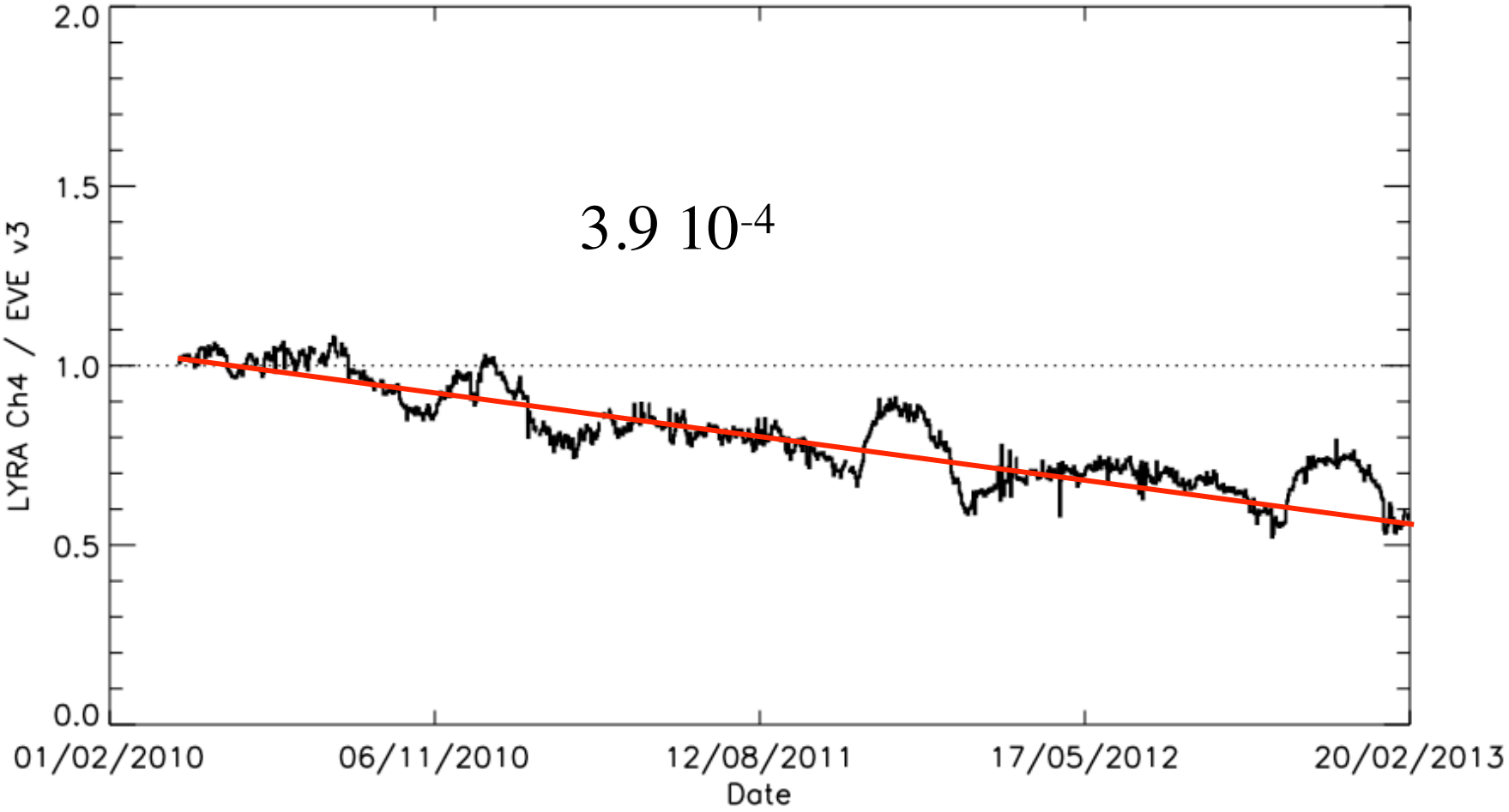
- ✓ Agrees with manual selection of daily value.
- ✓ Absolute value is good.
- ✓ slightly stronger trend with solar cycle for SDO/EVE
- ✓ but both degradation correction are version 2 only
- ✓ Up to now, increase by a factor of 2.

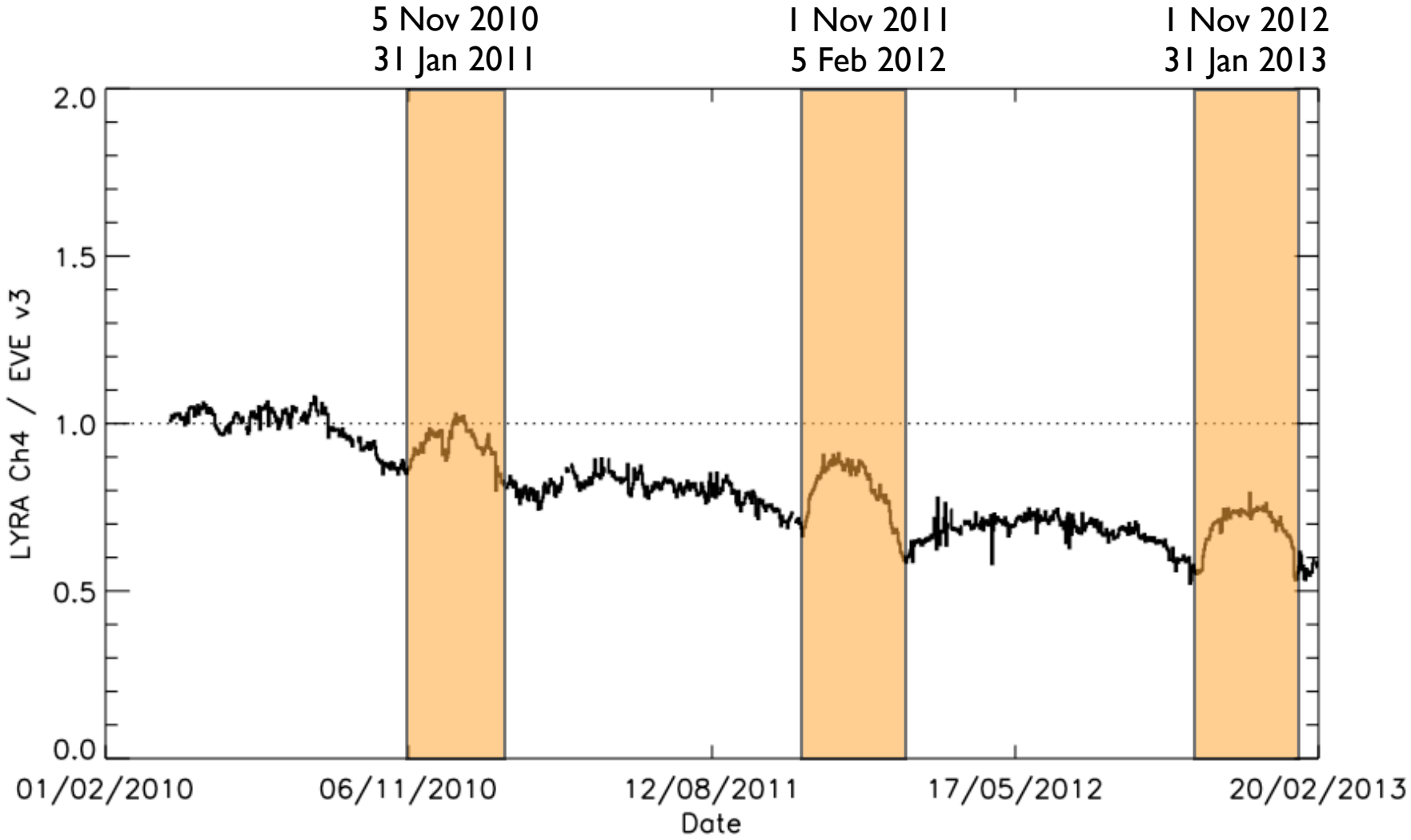


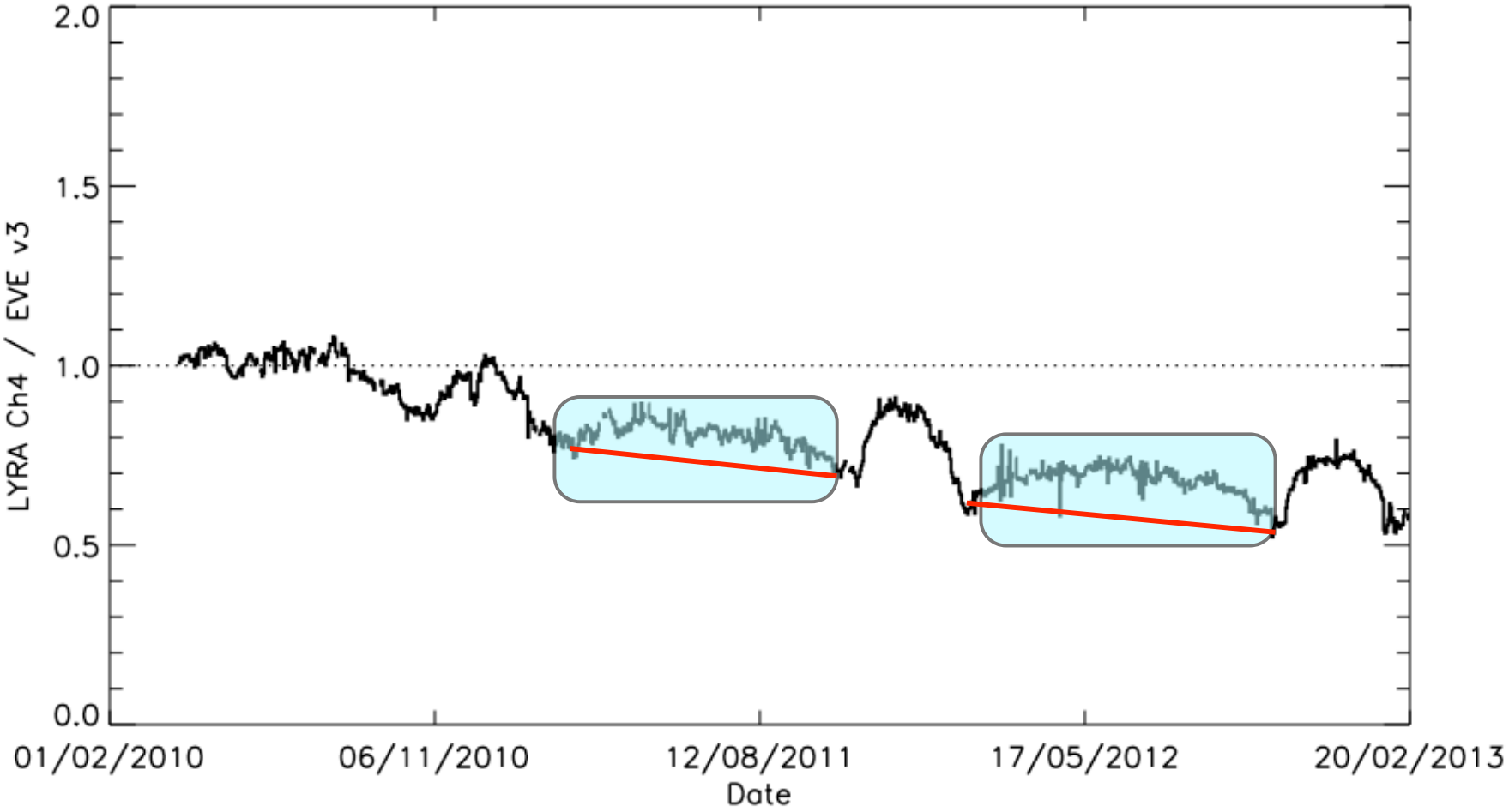
Kretzschmar et al., 2012


0.003
0.002
0.001
0.000
LYRA Ch4 Irradiance [W/m²]
01/02/2010
06/11/2010
12/08/2011
17/05/2012
20/02/2013
Date


2.0
1.5
1.0
0.5
0.0
LYRA Ch4 / EVE v3
01/02/2010
06/11/2010
12/08/2011
17/05/2012
20/02/2013
Date


3.9 10-4
LYRA Ch4 / EVE v3
2.0
1.5
1.0
0.5
0.0
01/02/2010
06/11/2010
12/08/2011
17/05/2012
20/02/2013
Date


5 Nov 2010
31 Jan 2011
1 Nov 2011
5 Feb 2012
1 Nov 2012
31 Jan 2013
2.0
1.5
1.0
0.5
0.0
LYRA Ch4 / EVE v3
01/02/2010
06/11/2010
12/08/2011
17/05/2012
20/02/2013
Date


2.0
1.5
1.0
0.5
0.0
LYRA Ch4 / EVE v3
01/02/2010
06/11/2010
12/08/2011
17/05/2012
20/02/2013
Date

Conclusion

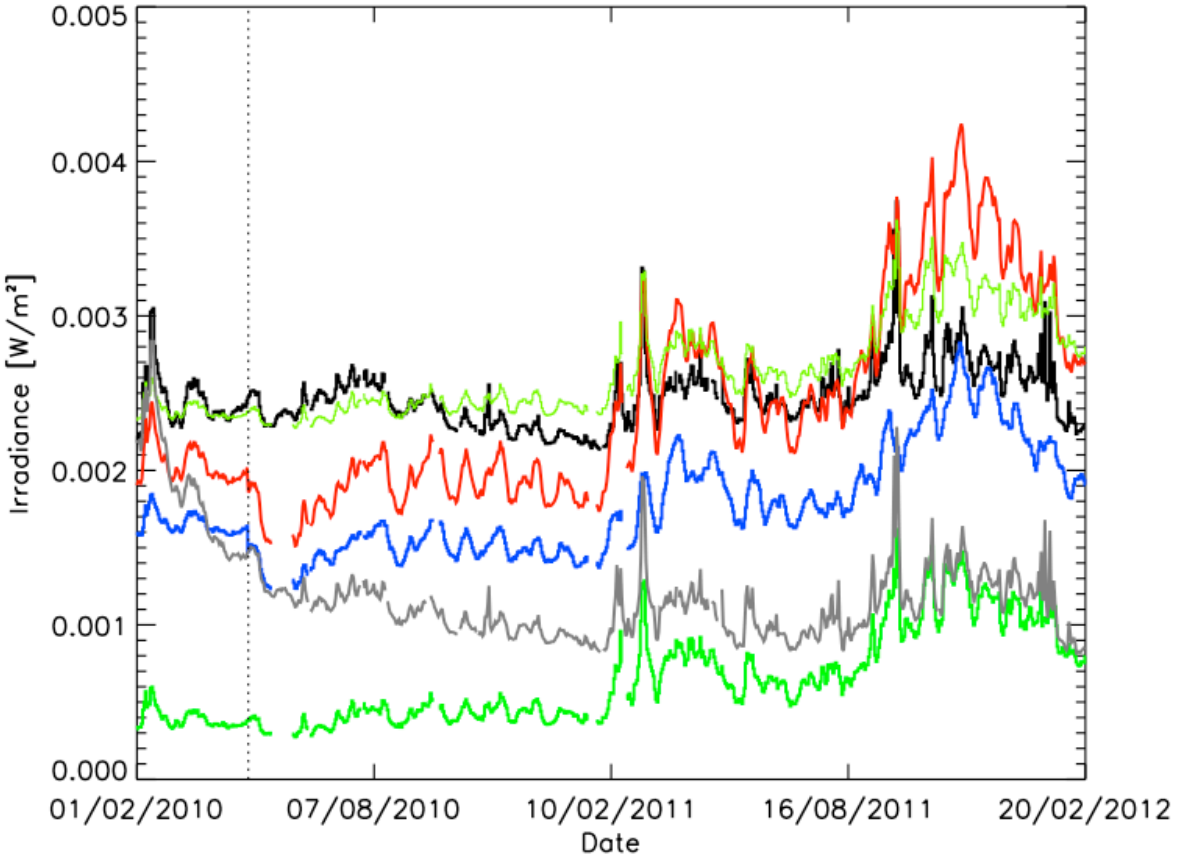
- Lyra ch2-3 has lost of its EUV signal above 17nm. It is just the SXR contribution scaled to the EUV level, does it make sens ?
- Lyra ch2-4 observes a lower increase with solar activity (-0.04% / day) wrt EVE + TIMED see.
- Other uncorrected effects appear in LYRA ch2-4, during eclipse season and annual: temperature effects ?

Now preliminary comparison of flare observations

Matthieu Kretzschmar

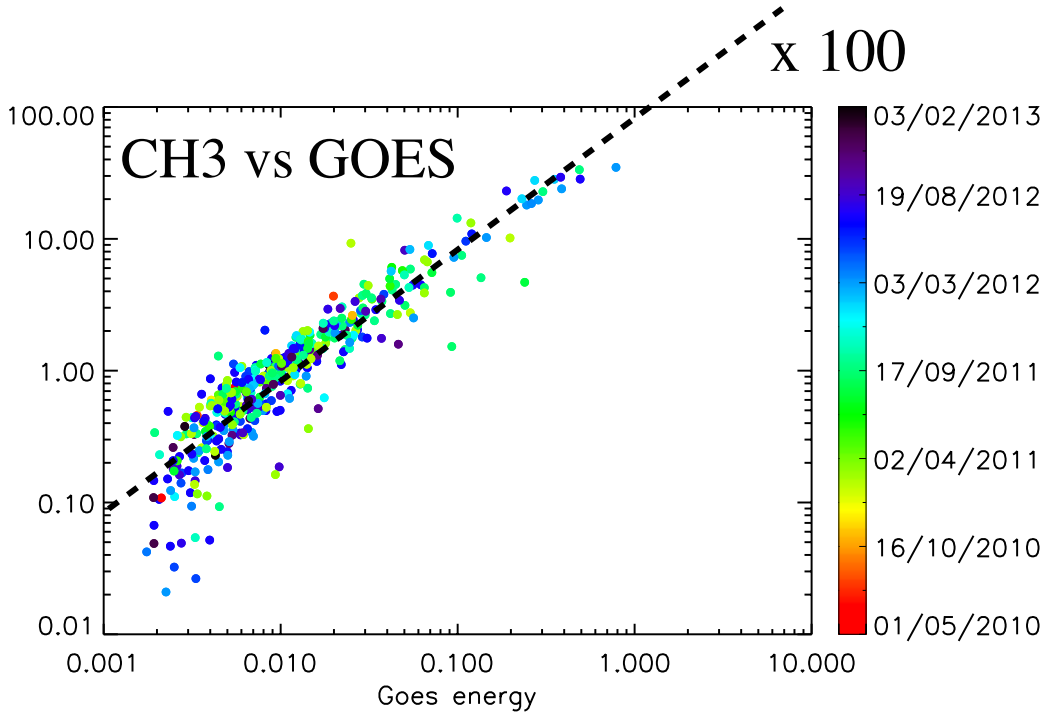
(1) LPC2E, CNRS & University of Orléans, France

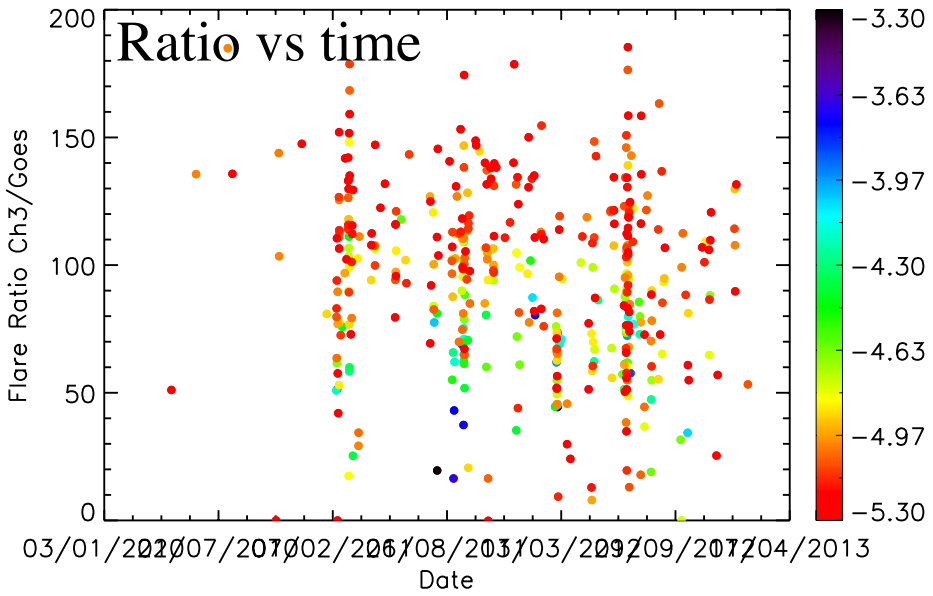
Why looking at flares and degradation ?



➡ Looking at flares might help to monitor the SXR and EUV contribution in time.

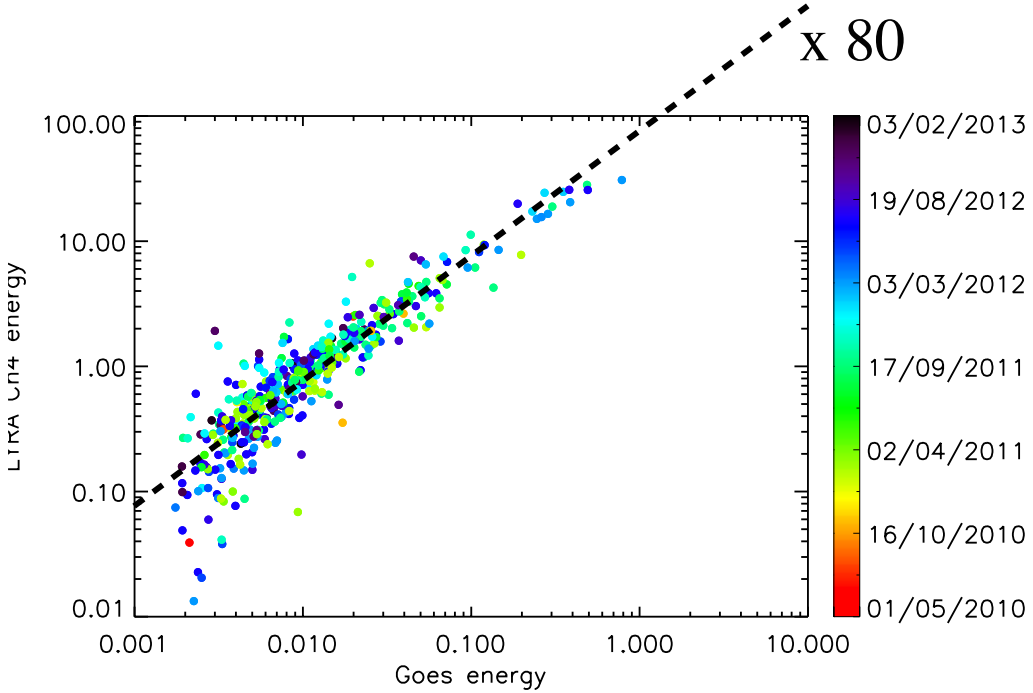
Channel 3 vs GOES

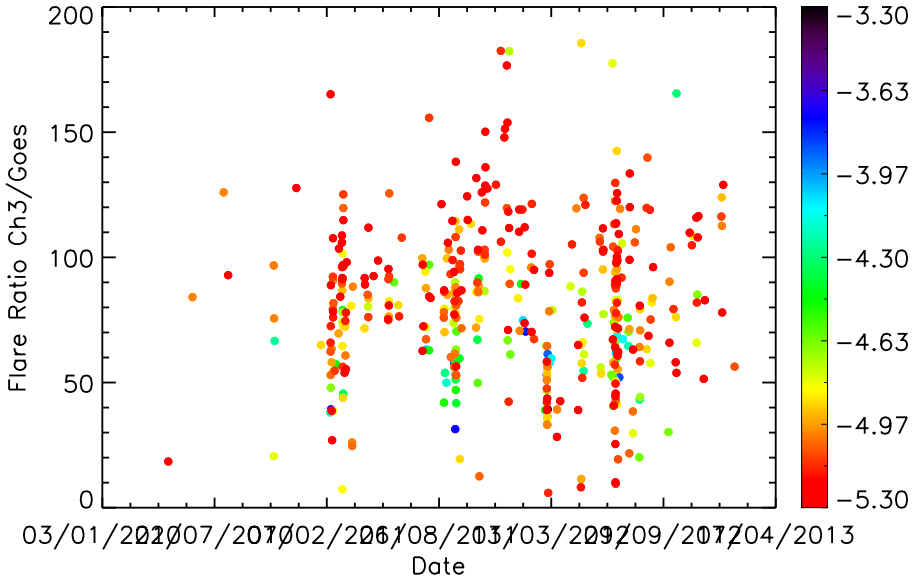




- Good correlation. Does not look dependent on time..
- Absolute value for LYRA might be OK IF background is substracted correctly.
- Ratio rather constant but larger SXR flare have relative smaller signal in LYRA. To be confirmed..

Channel 4 vs GOES





- Inconclusive for now, need more work and (good thoughts)