# How can PROBA2/LYRA contribute to the SOLID project (or to any other attempt to model the solar irradiance in the EUV) ?

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# Preliminary questions about SSI modeling

- Who are the users? The thermosphere/ionosphere and space weather communities? Others?
- What is the expected time resolution of the model?
  - Long-term changes => solar cycle?
  - Mid-term changes => 27-days solar rotation?
  - Short-term changes => daily evolution of solar activity?
  - Very short term (sub-daily) => solar events?
- What is the expected spectral resolution of the model? Are some spectral intervals to be known with a higher resolution?

# Preliminary questions about SSI modeling

- What's the best way to describe variability?
  - By Wavelength (partially correlated with the atmospheric region, but not completely)?
    - Several models use a set of a few carefully selected spectral bins in the EUV, or the $f_{10.7}$ flux and the Mg II K line, as a basis for a full EUV-spectrum reconstruction
  - By Source Phenomena? (QS, AR, CH, flares, filaments)
    - Magnetograms based models
    - Images segmentation

# Preliminary questions about SSI modeling

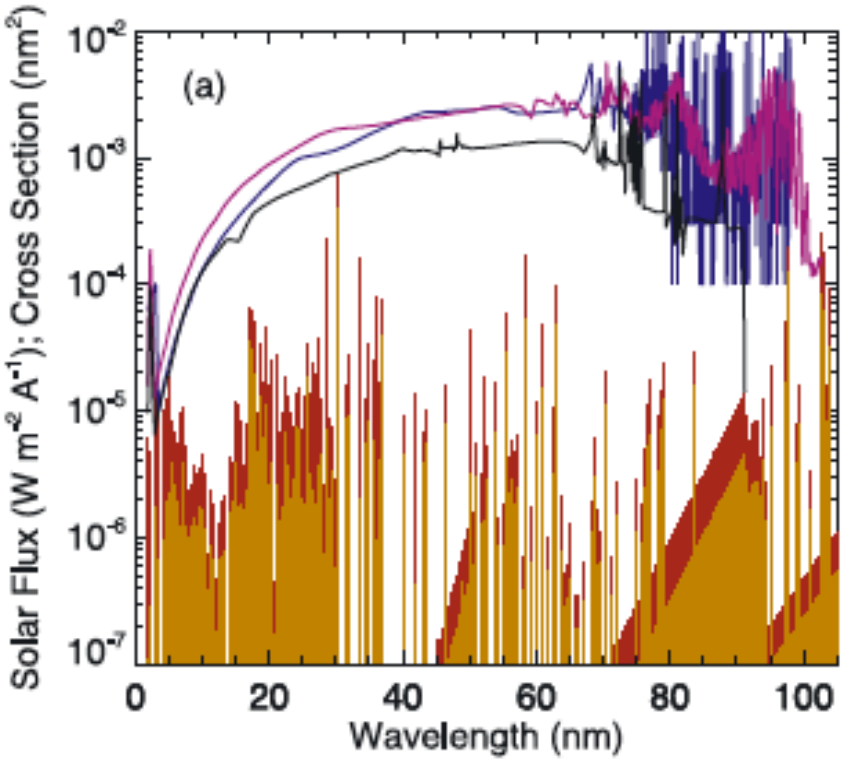
- What's the best way to describe variability?

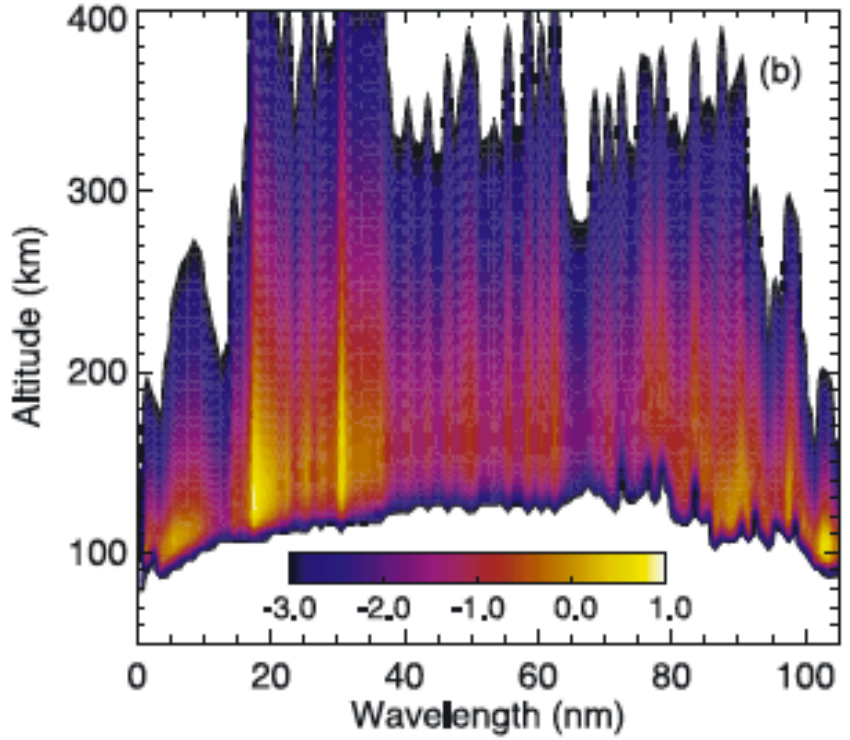
1. Depends on the expected temporal resolution
2. The quality of a reconstruction depends on the accuracy of the input data => need for well-calibrated, and cross-calibrated data

- Images segmentation

# Spectral resolution

Solomon and Qian, 2005

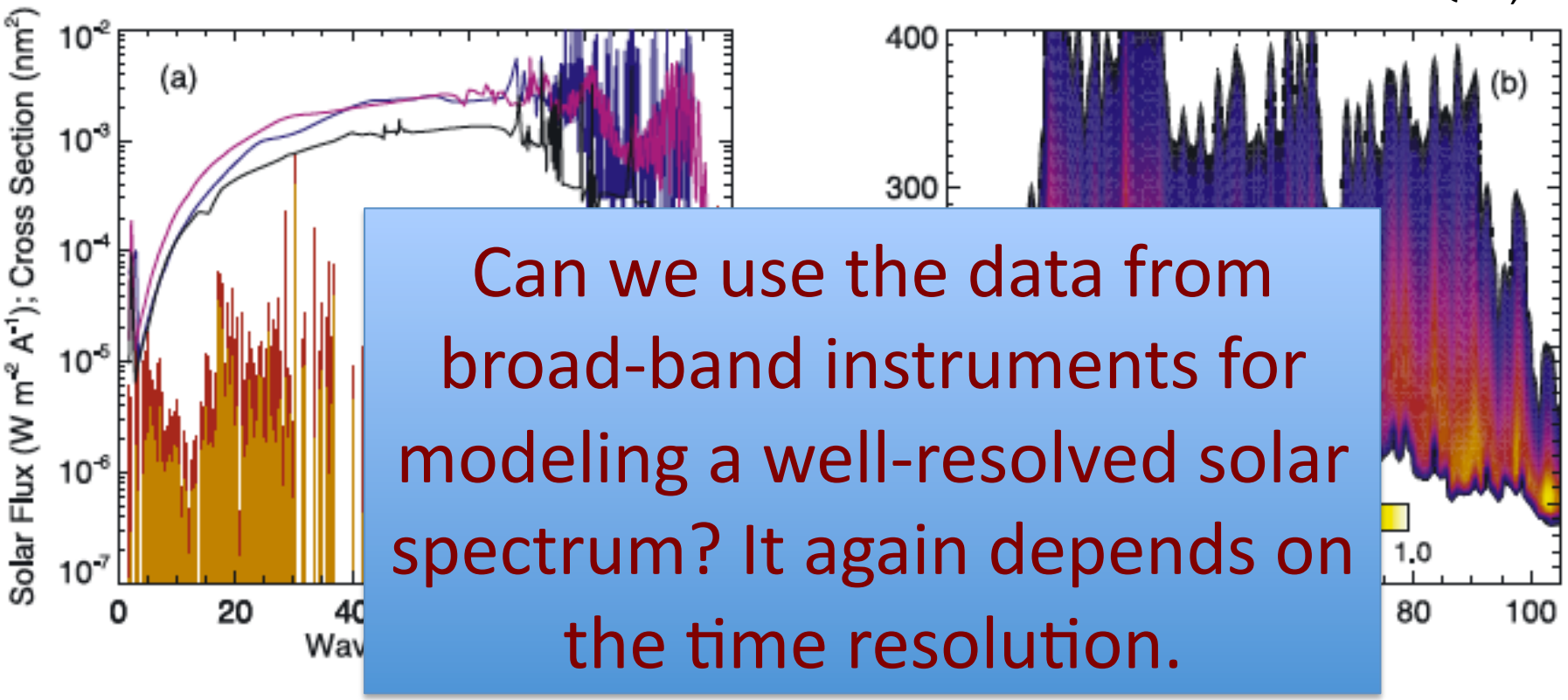



- A high resolution (< 1nm) would be ideal, but would dramatically increase the computational effort when dealing with global, time-dependant circulation models
- Are coarser resolutions such as Stan-Bands or the Torr and Torr bands sufficient?

# Spectral resolution

Solomon and Qian, 2005



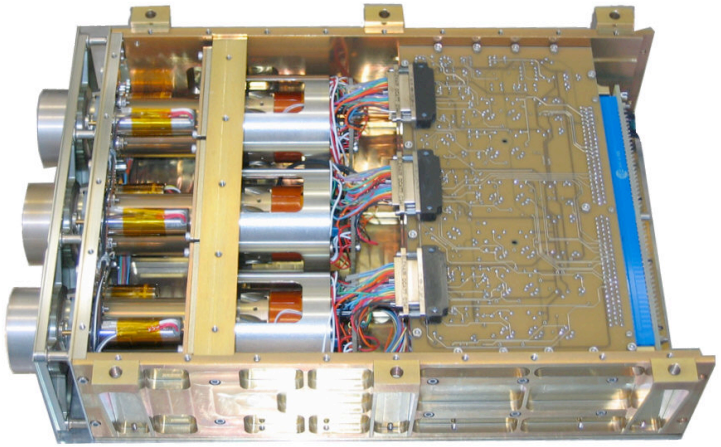

Can we use the data from broad-band instruments for modeling a well-resolved solar spectrum? It again depends on the time resolution.

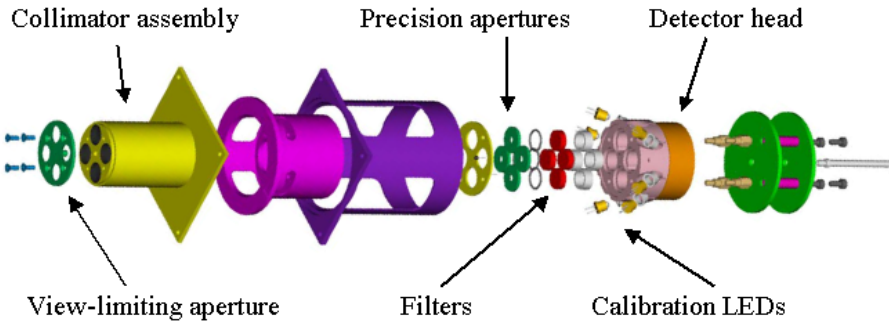
- A high resolution (< 1nm) would be ideal, but would dramatically increase the computational effort when dealing with global, time-dependant circulation models
- Are coarser resolutions such as Stan-Bands or the Torr and Torr bands sufficient?

# Time resolution

- Quite a good coherency between the various spectral ranges on long time scales.
- Daily and longer variations are usually quite well reproduced and even predicted by various models
- How to go to sub-daily variations?

# LYRA highlights

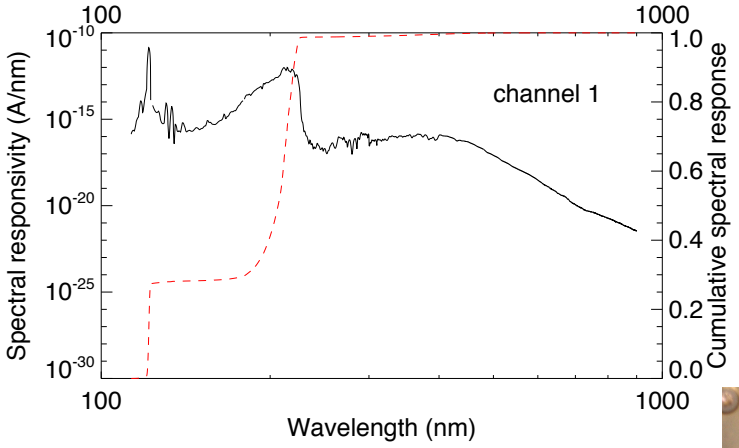




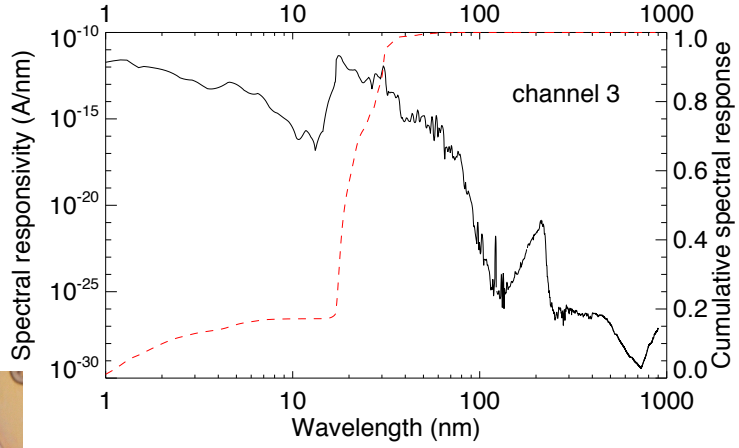

- **3 redundant units** protected by independent covers
- **4 broad-band channels**
- High acquisition cadence: **nominally 20Hz**
- 3 types of detectors:
  - standard silicon
  - 2 types of **diamond detectors**: MSM and PIN
    - radiation resistant
    - blind to radiation > 300nm
- **Calibration LEDs** with λ of 370 and 465 nm

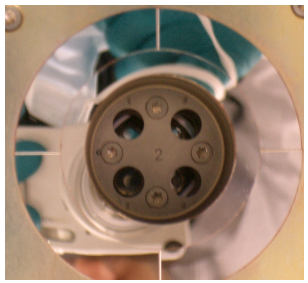
# Details of LYRA channels convolved with quiet Sun spectrum

Channel 1 – Lyman alpha
120-123 nm

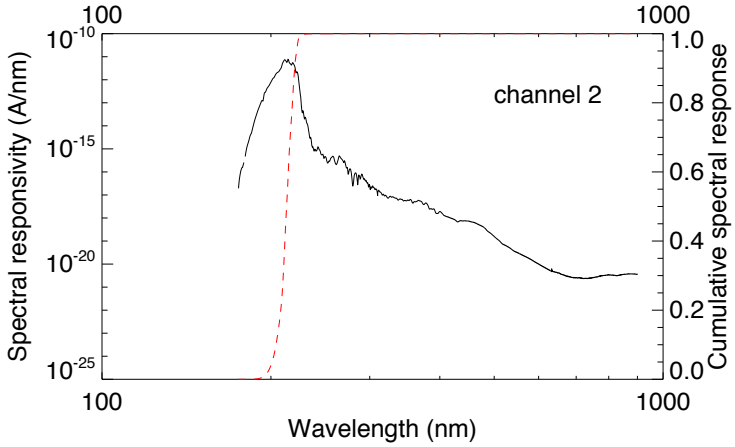



Channel 3 – Aluminium
17-80 nm + < 5nm

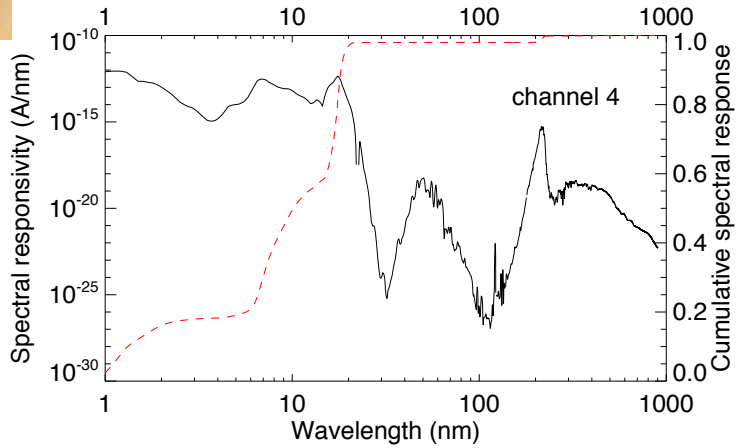


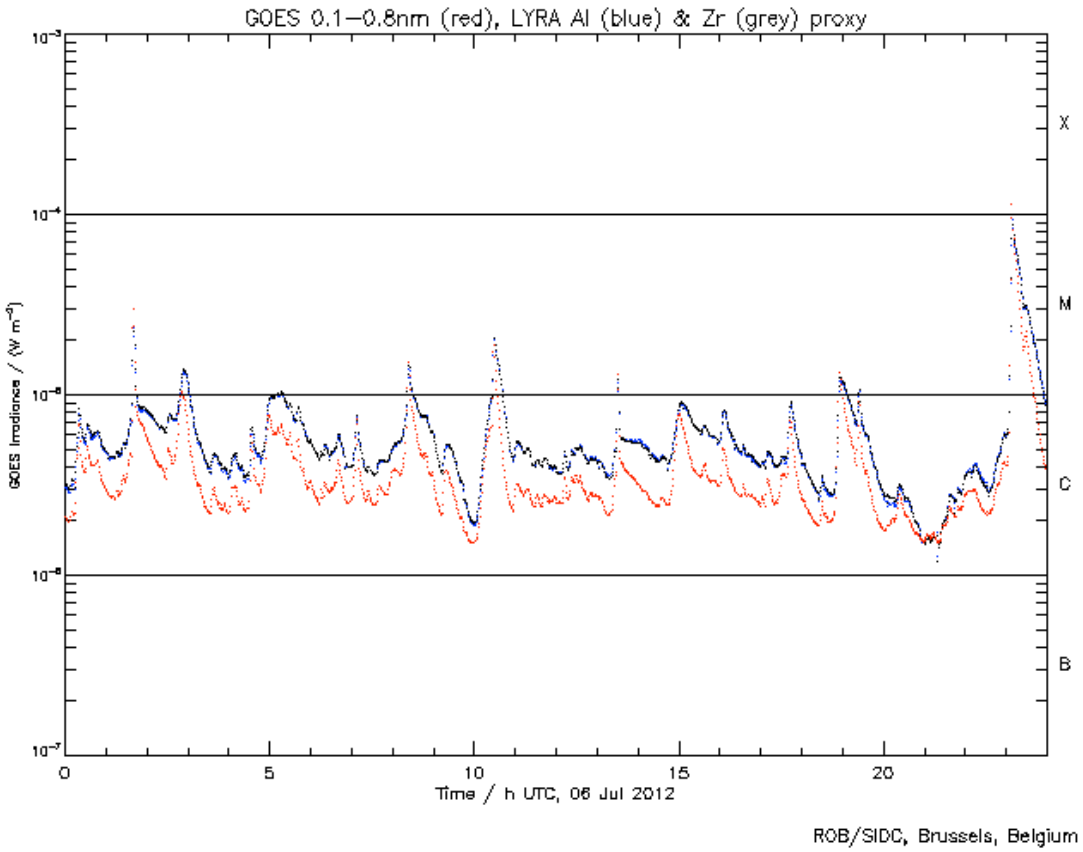
Channel 2 – Herzberg
190-222 nm




Channel 4 – Zirconium
6-20 nm + < 2nm



# Comparison to other missions : GOES




I.E. Dammasch

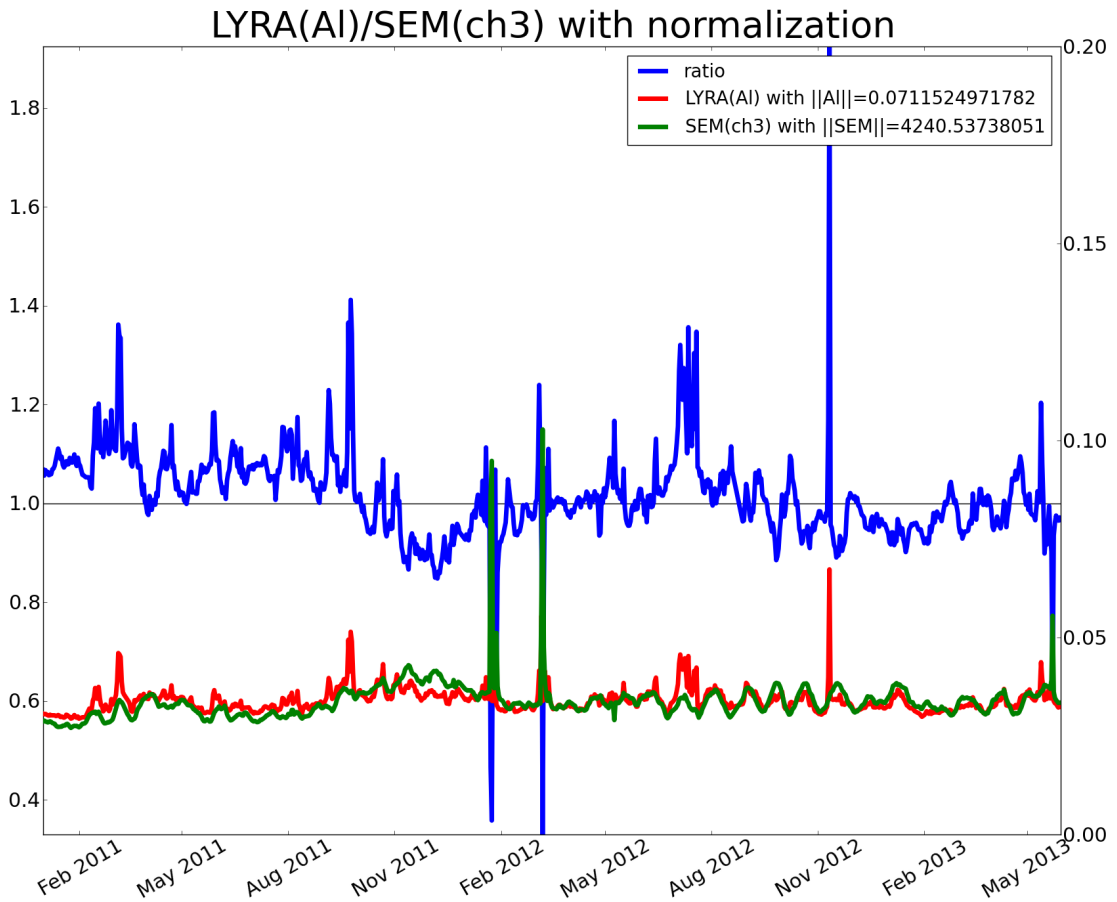
Good correlation between GOES (0.1-0.8nm) and LYRA channels 3 and 4

0.015*(ch3-min(ch3))+min(GOES)

0.018*(ch4-min(ch4))+min(GOES)

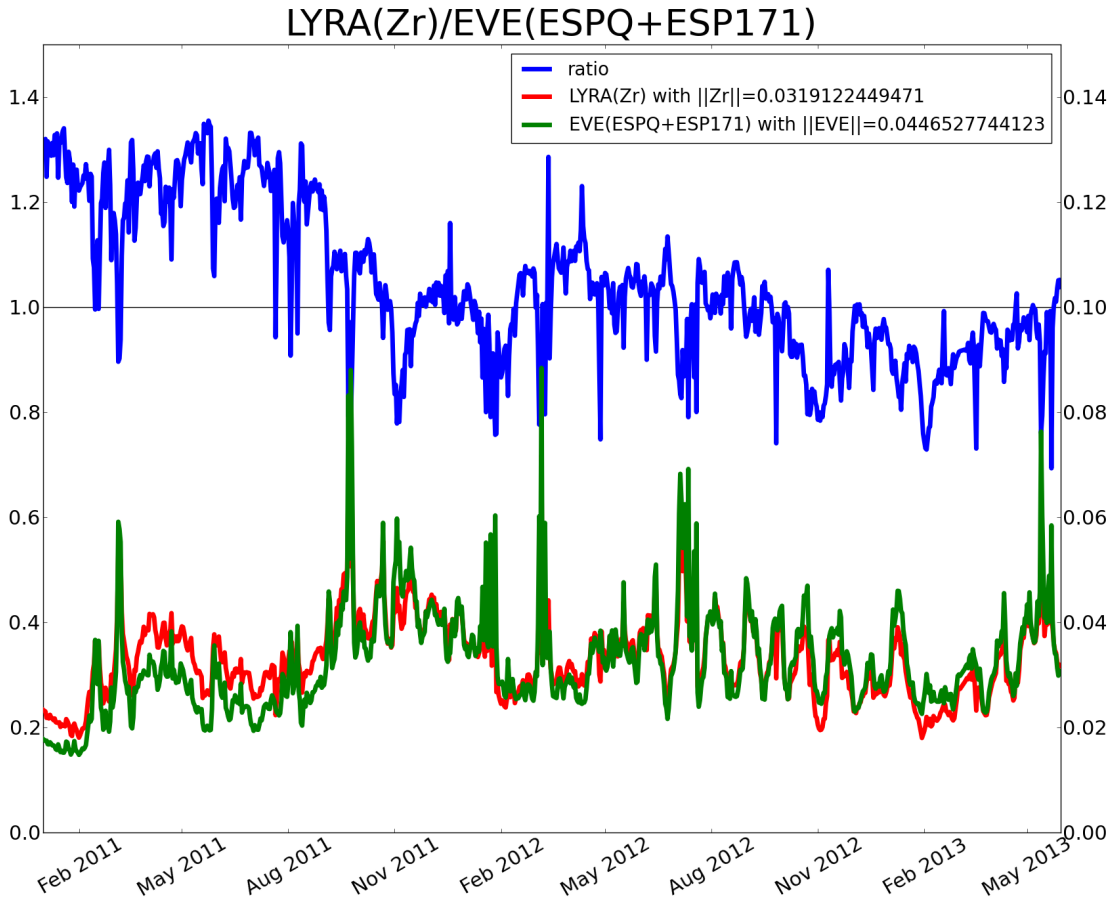
=> LYRA can constitute a proxy for estimating the amplitude of flares in GOES scale

# Comparison to other missions : SOHO/SEM channel 3 (26-34 nm)



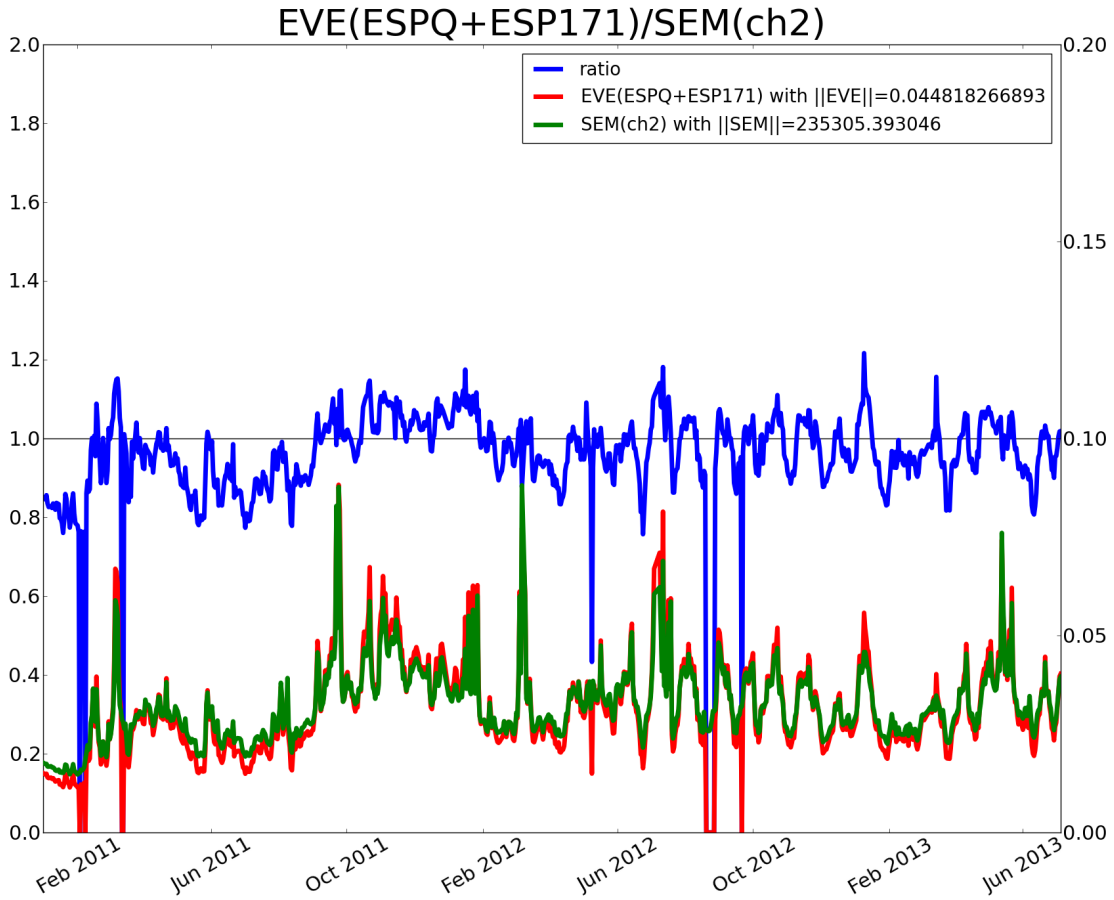

L. Wauters

# Comparison to other missions : SDO/EVE (0.1-7nm + 16.4-20.4 nm)




L. Wauters

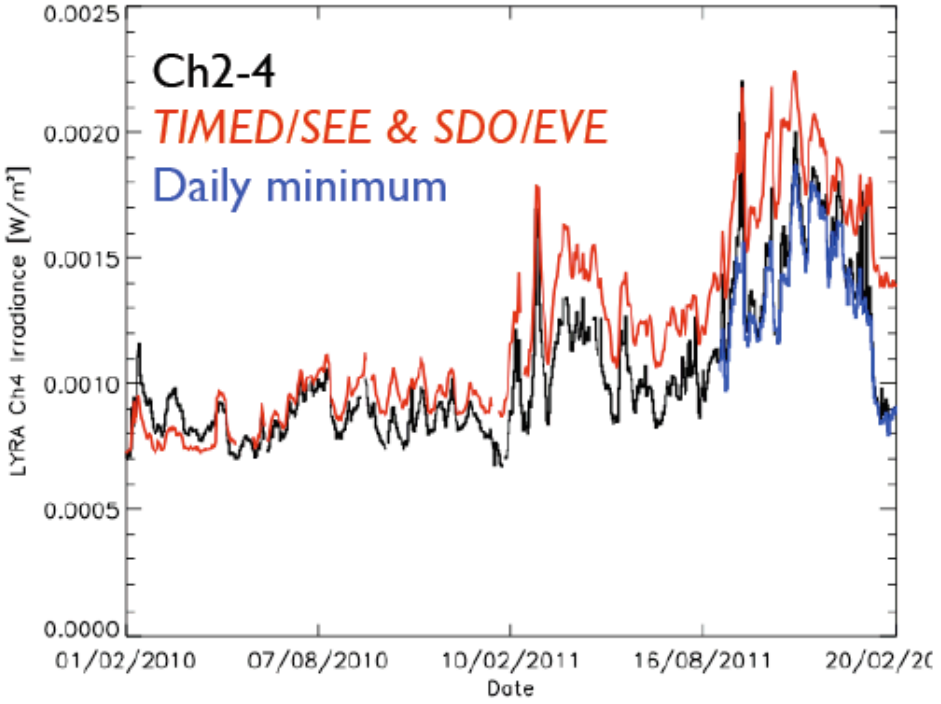
# Comparison of SDO/EVE vs SOHO/SEM




L. Wauters

# Comparison to other missions: SDO/EVE

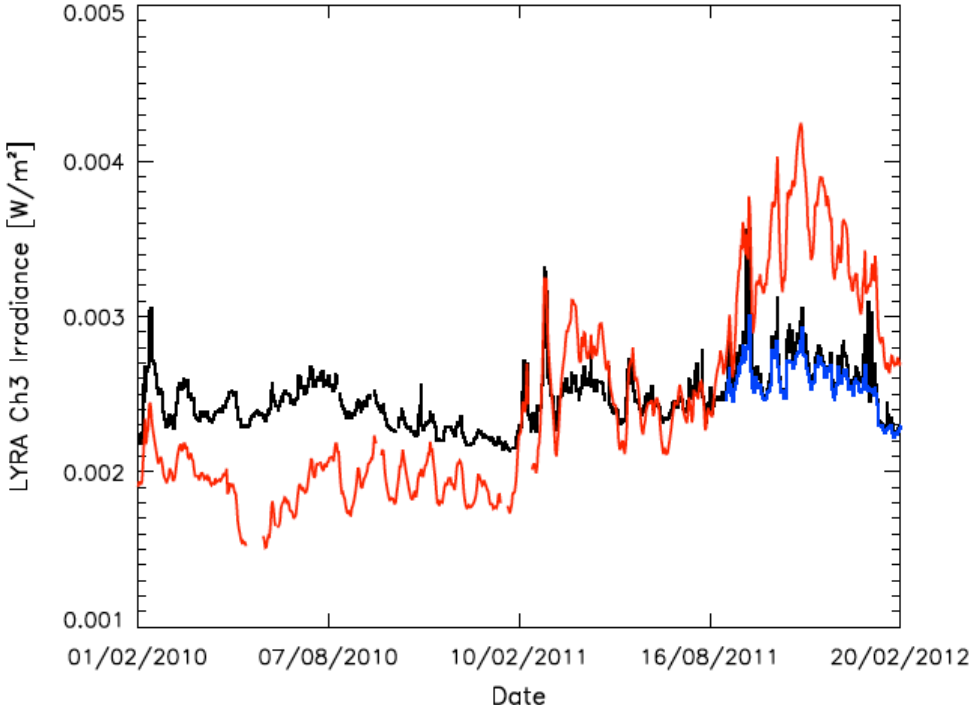
LYRA channel 4 can be reconstructed from a synthetic spectrum combining SDO/EVE and TIMED/SEE




M. Kretzschmar, 2012

# Comparison to other missions

Reconstruction of LYRA channel 3 highlights the need of a spectrally dependant correction for degradation



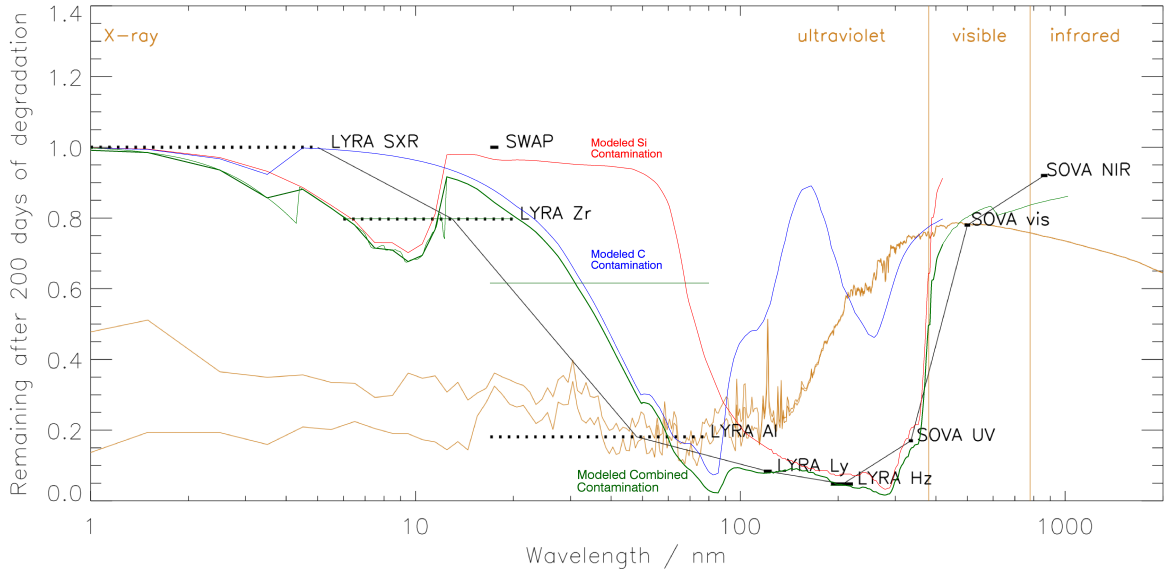

M. Kretzschmar, 2012

# Still in progress…

- Spectral degradation due to a contaminant layer. Two identified candidates, both in the front door mechanism:
  - Silicone RTV566
  - EpoxyAV138 / HV 998

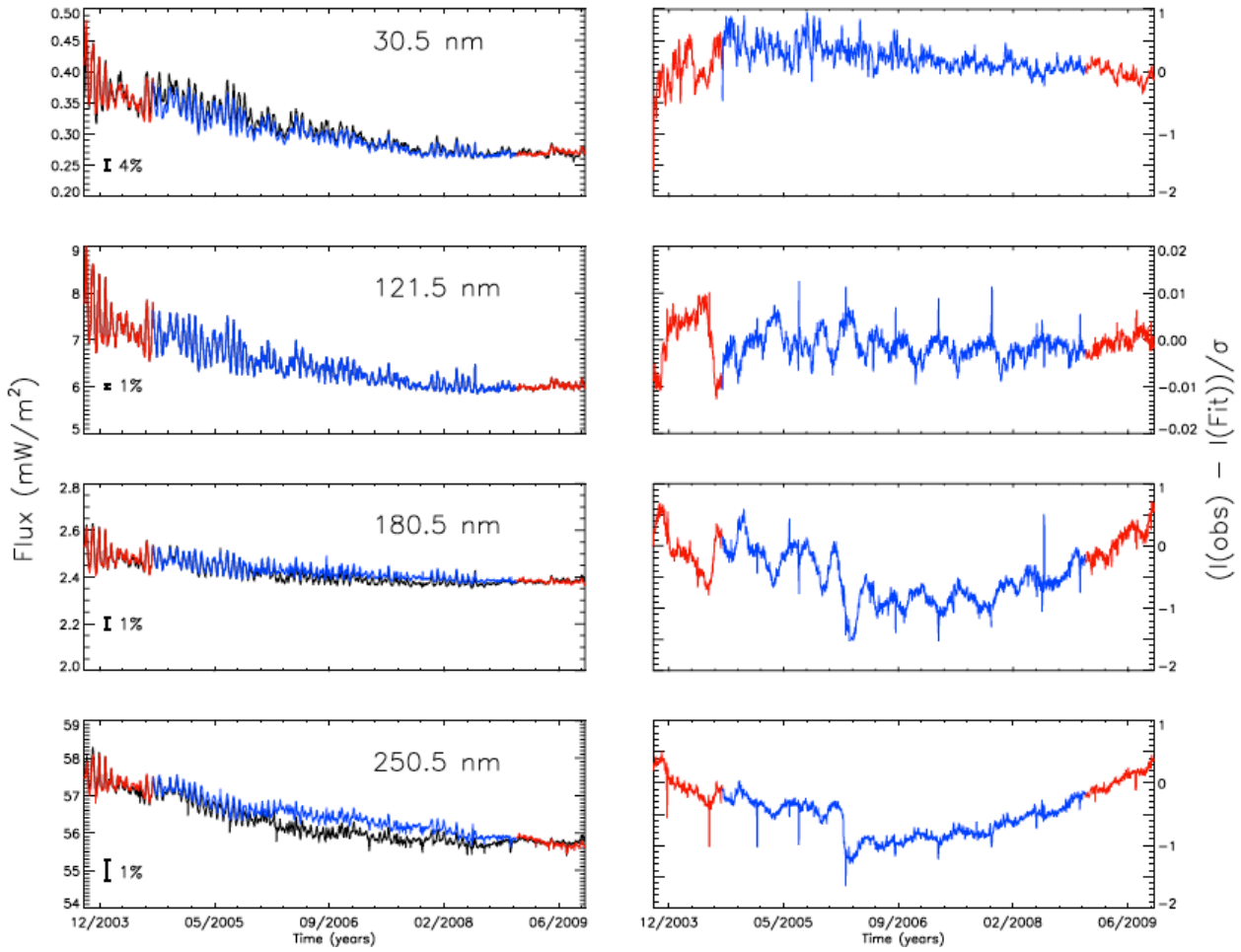
I.E. Dammasch + A. Jones

2-component Si-C model
(Si_thick = 13.33e-9,
C_thick = 12.62e-9)



# The use of LYRA in SSI reconstruction

Reconstruction of mid-term variations based on LYRA Al, LYRA Ly, LYRA Hz, and PREMOS 2 (260-270 nm)




G. Cessateur, 2011

# Conclusions

- LYRA Al and Zr channels globally agree with SDO/EVE and SOHO/SEM, except for a long term trend due to spectral degradation
- Correction for spectral degradation is under development
- LYRA can be used
  - for flare detection (as input of models for sub-daily variations)
  - for the modeling of daily scales (or longer)
  - For cross-calibration with other sources

Thank you!