LYRA

the **L**arge-**Y**ield **Ra**diometer onboard PROBA2

# Solar flux variations observed by LYRA: From Space Weather to Space Climate

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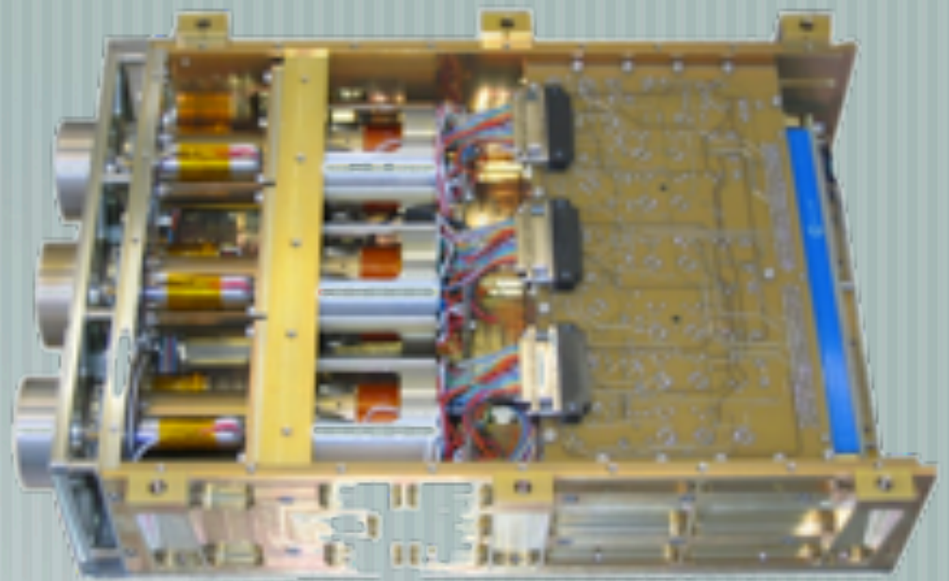
# The LYRA radiometer

➡ 3 instrument units (redundancy)



➡ 4 spectral channels per head

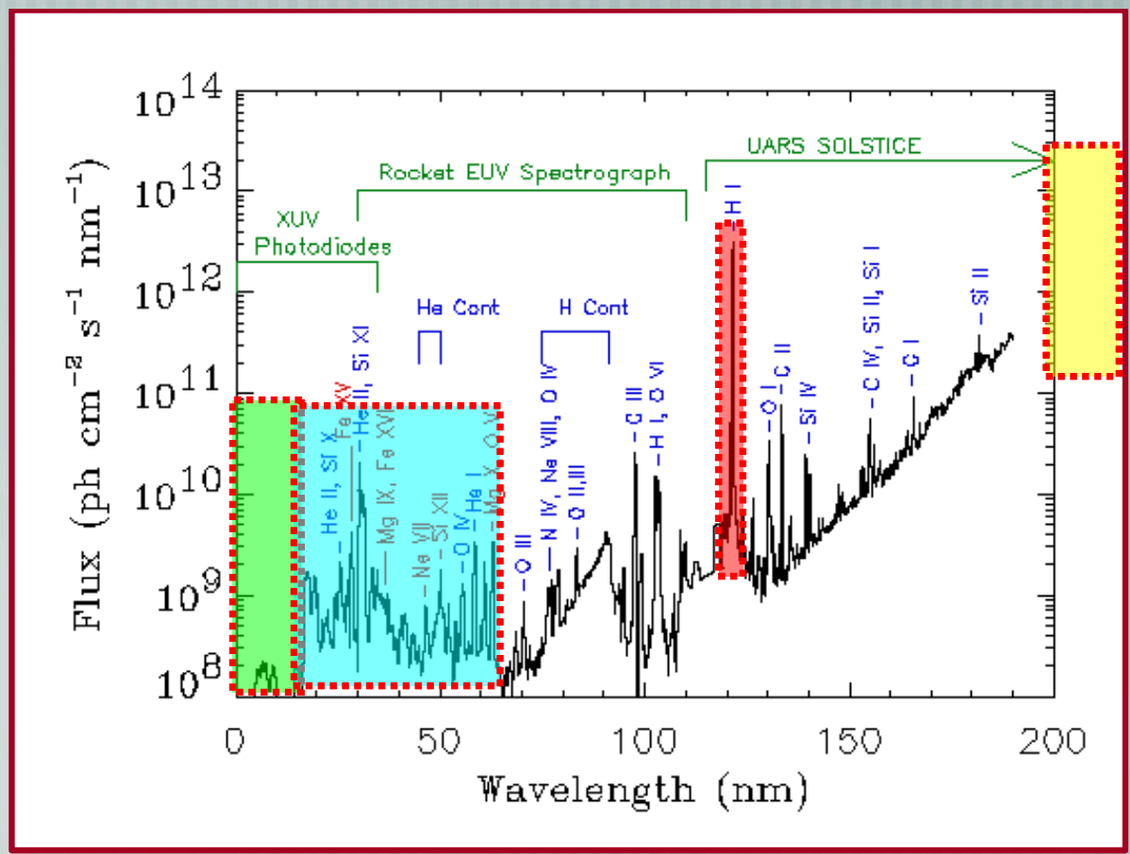
Ch1 121.6nm | Ch2 200-220nm

Ch3 17-80nm | Ch4 6-20nm

➡ 3 types of detectors, Silicon + 2 types of diamond detectors (MSM, PIN):

- radiation resistant
- insensitive to visible light compared to Si detectors

➡ High cadence up to 100 Hz



# 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 |


- Onboard companions: SWAP & two plasma instruments.
- Launched on Nov. 2 2009, LYRA first light on January 6 2010 !

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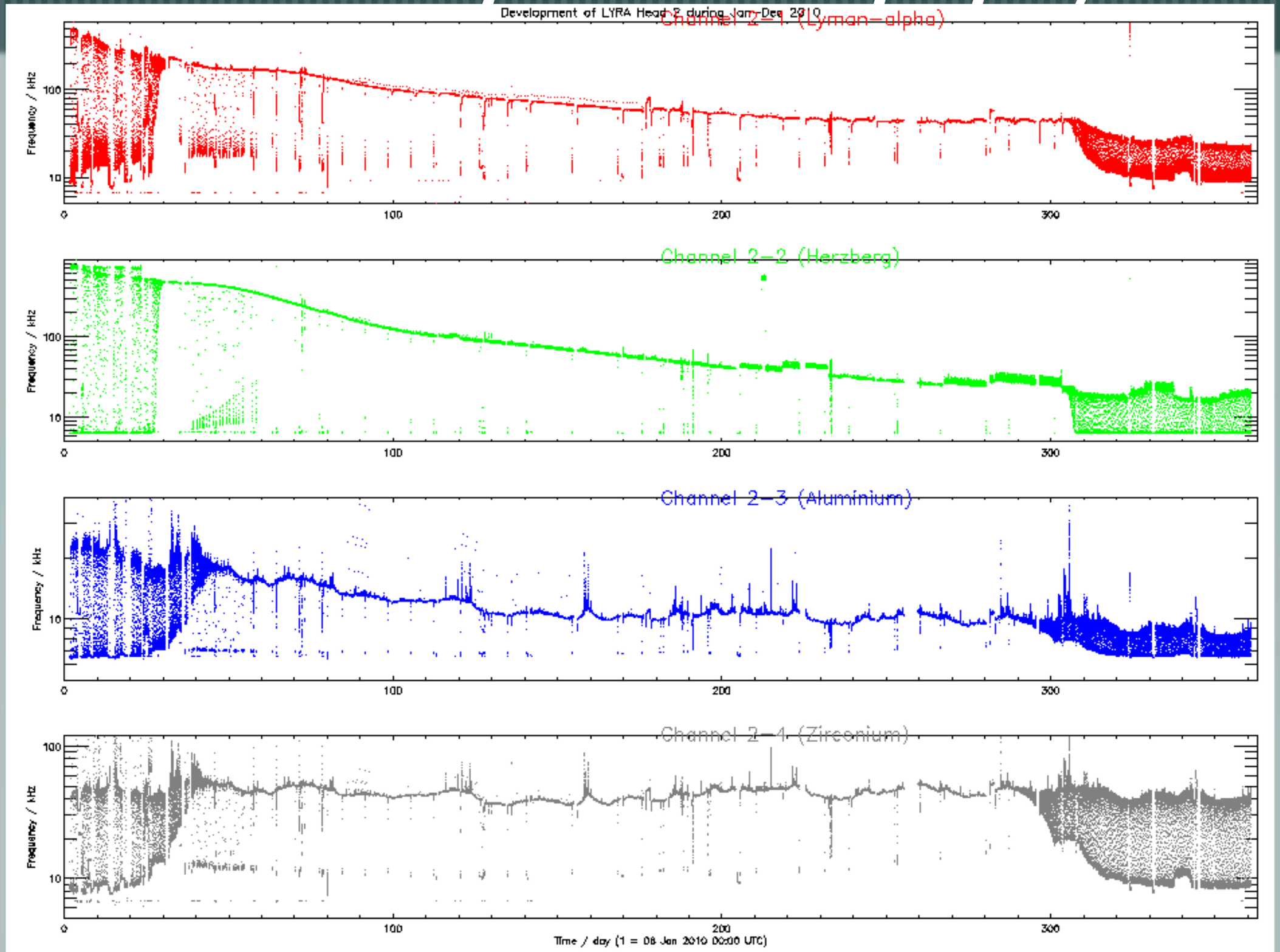
- The payload has to deal with the non 100% optimisation of the S/C for science; situation similar to small SW payload. Suitable for space climate ?

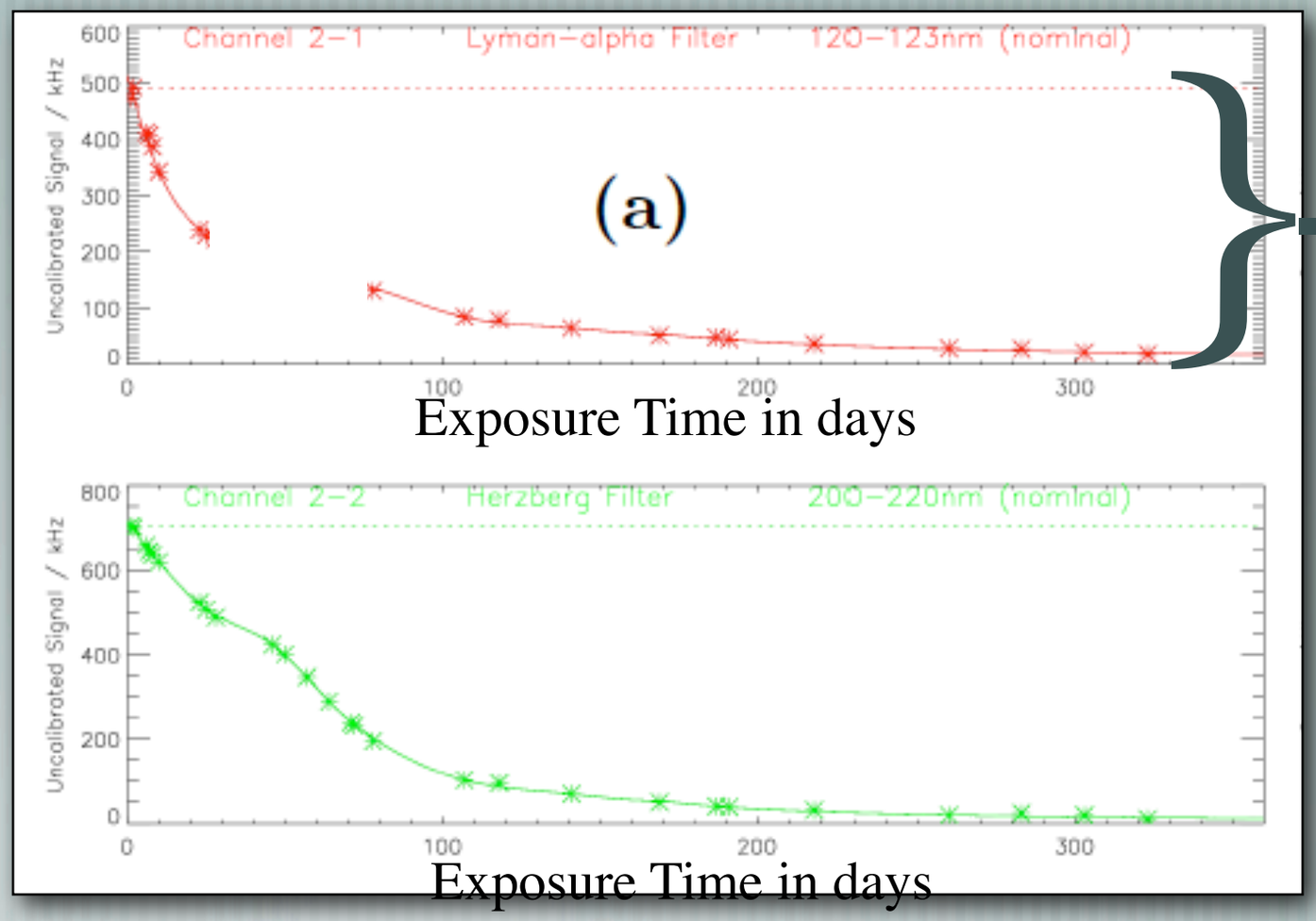
# Solar variability as seen by Lyra/level1



# Degradation

- Can be somehow modelled, but sensitivity loss is definitive.

Ch1: Ly a




**- 99% !**

Ch2: Hz

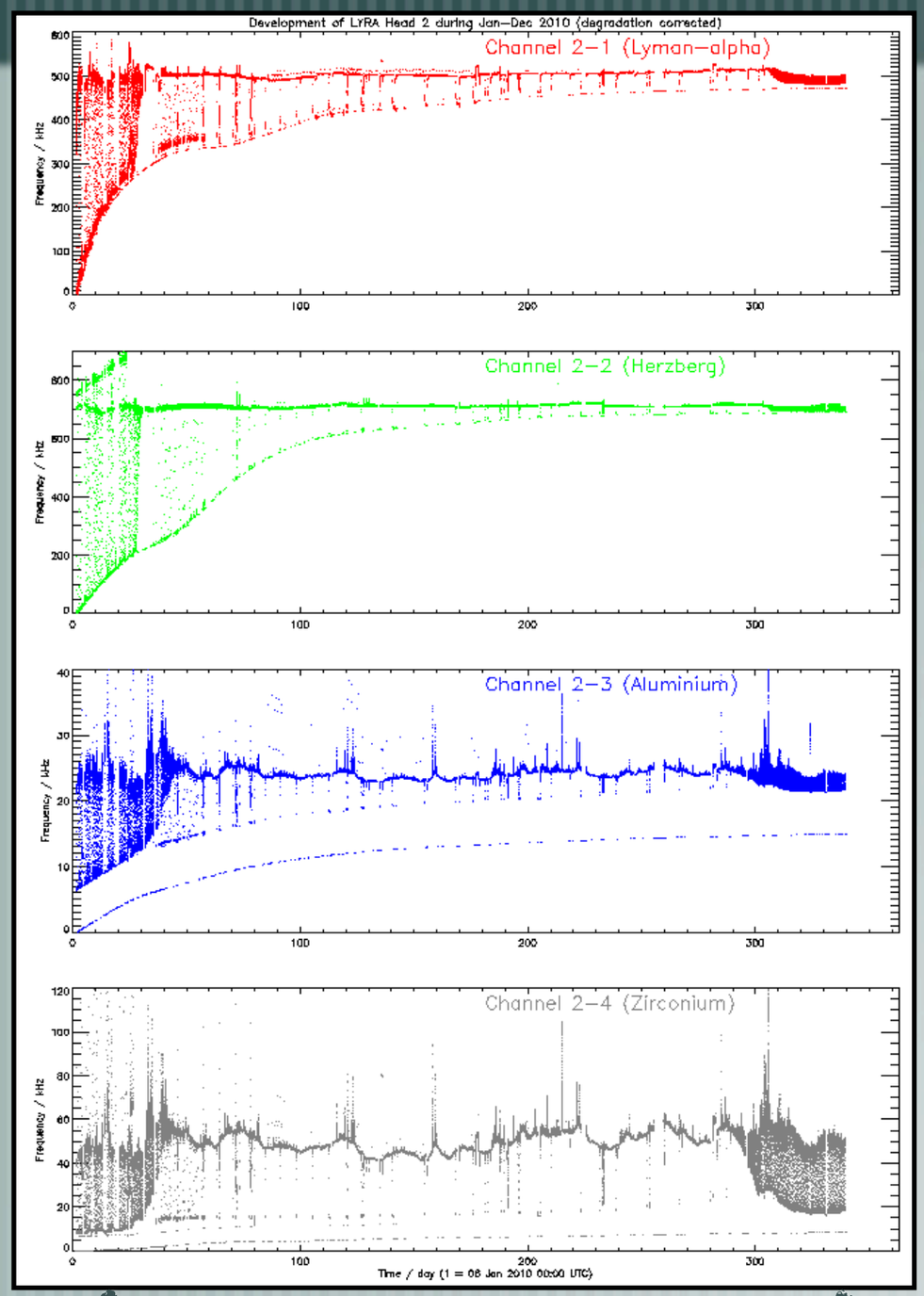
- Determination of long term variability for this channel will rely on backup units observations

# Degradation

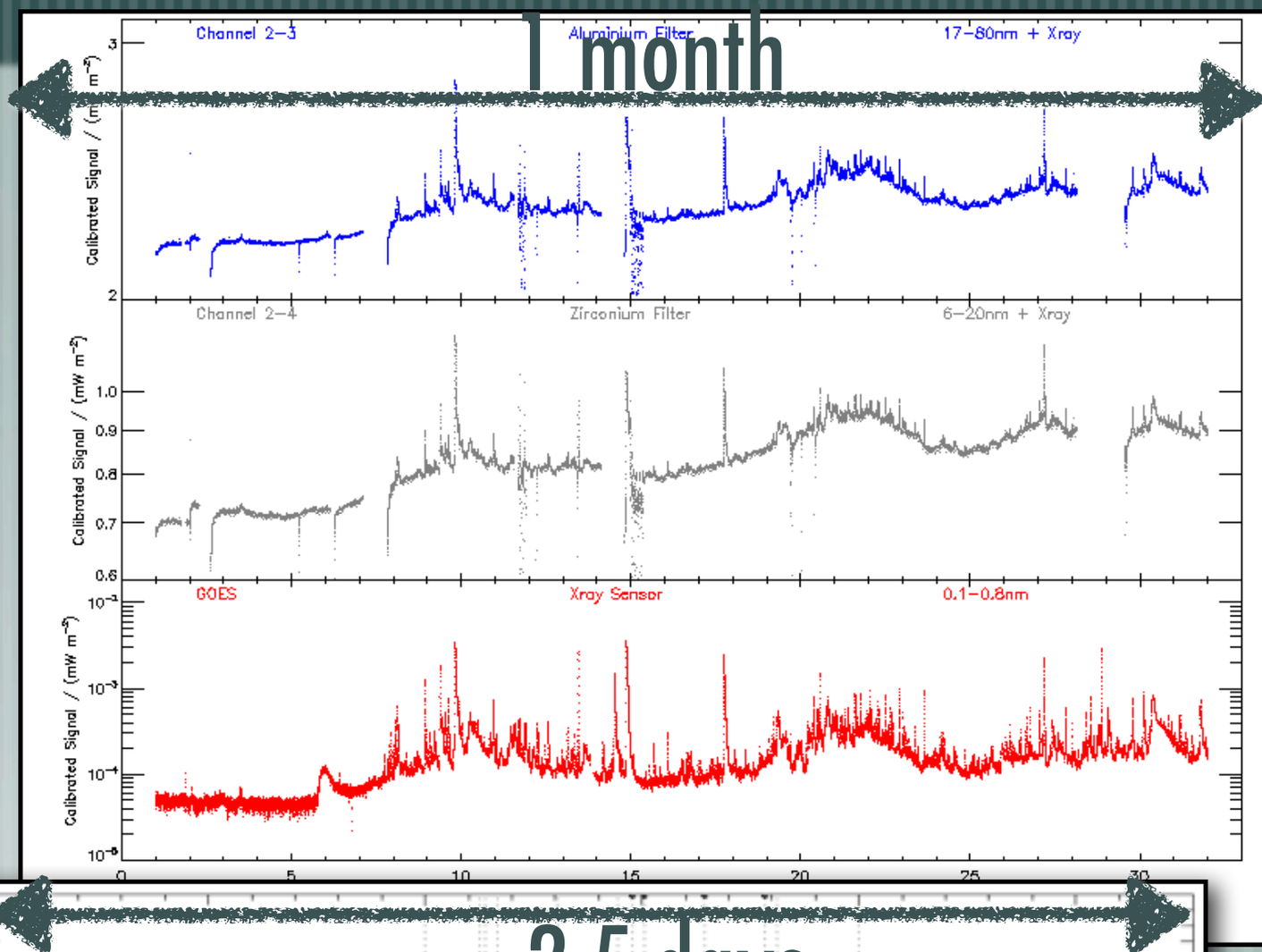
- Channel 2-3 and 2-4 are still ok.
- Not LYRA specific: SDO/EVE and PICARD/PREMOS experienced larger than expected degradation too.
- Filter degradation caused by the outgassing of hydrocarbons by S/C components.

*Degradation is … terrible for Space Weather and … dramatic for Space Climate !*

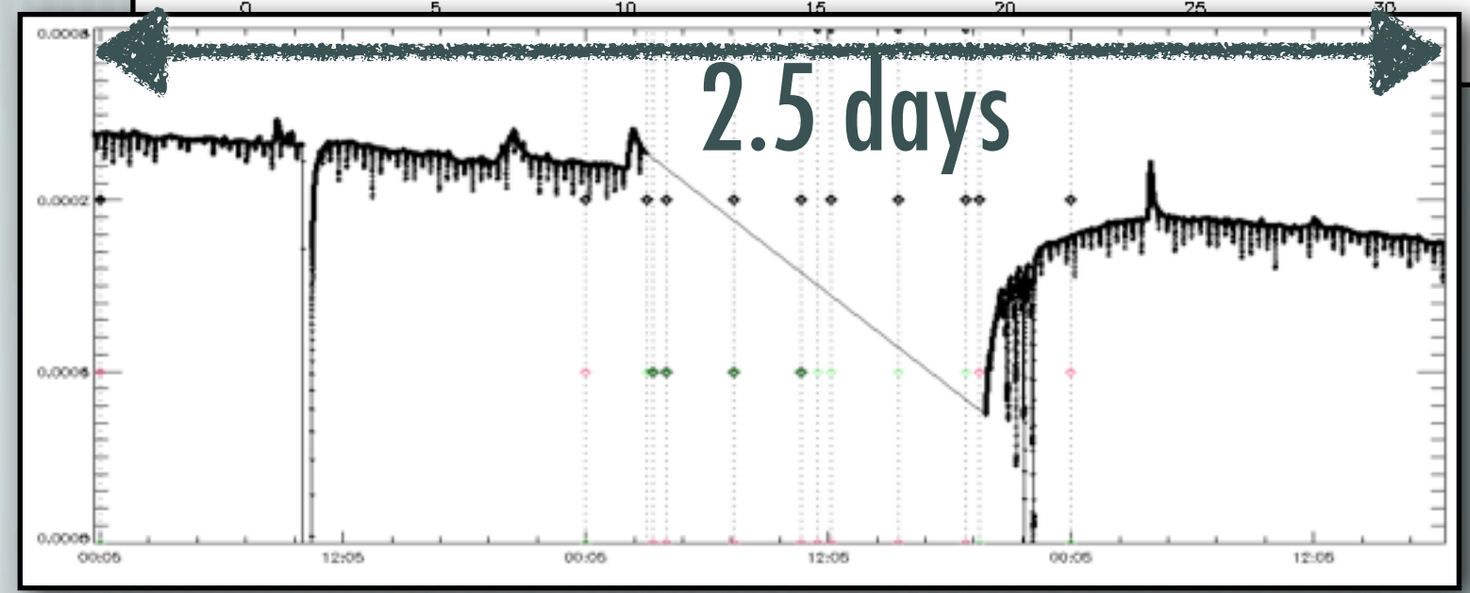
# Solar variability as seen by Lyra/level2




1 year



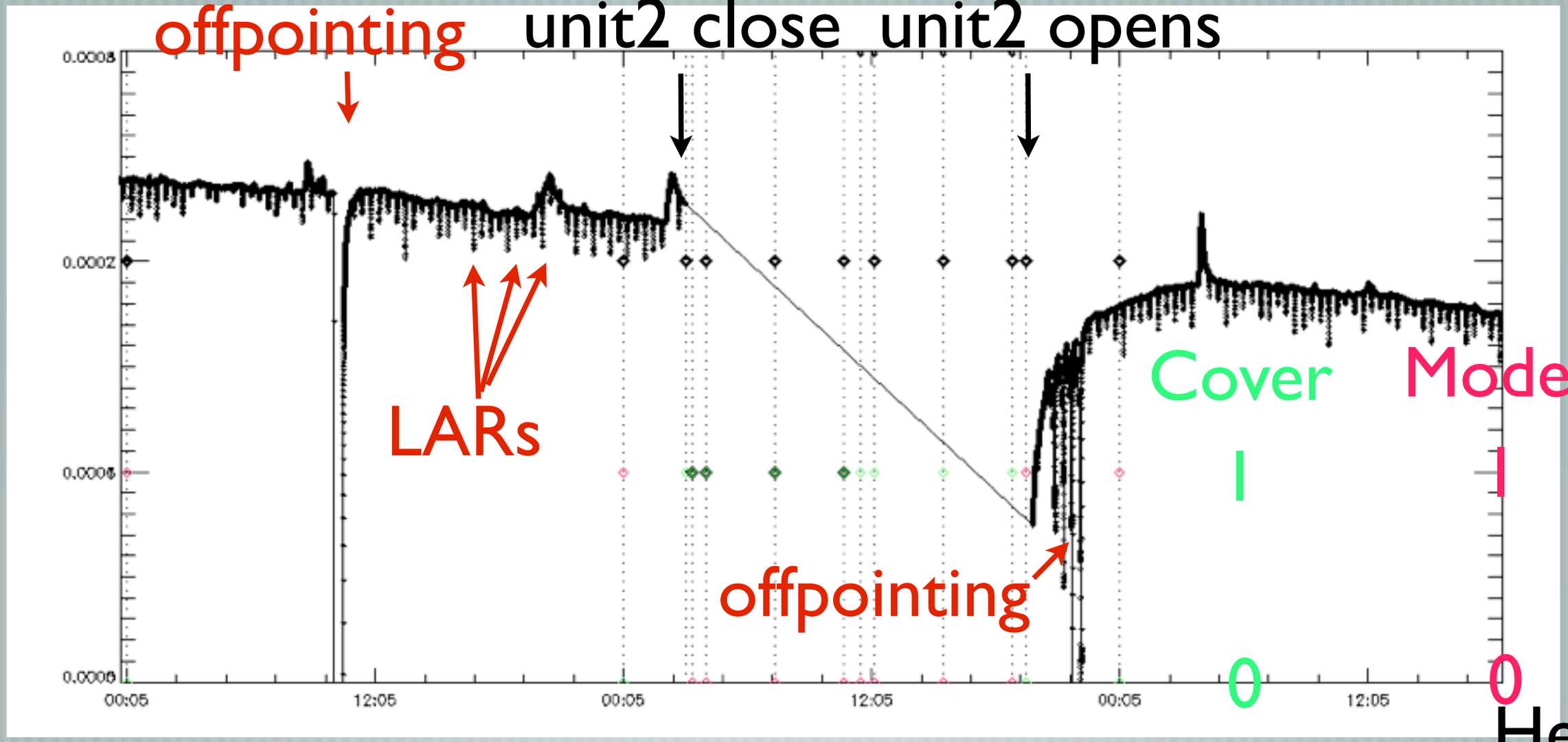

1 month




2.5 days

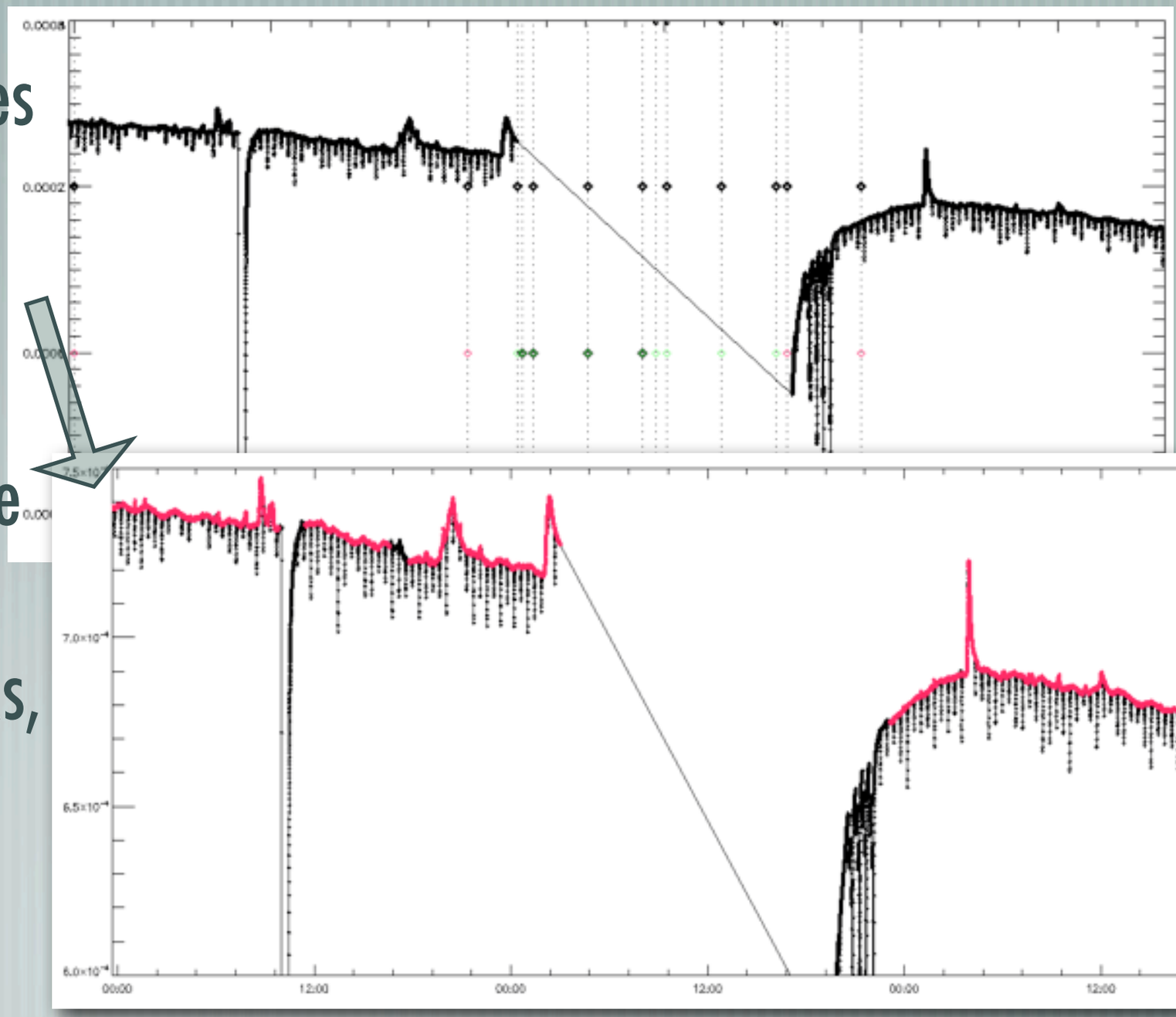
# LYRA «instrumental» features

## A conjugation of S/C operations and LYRA specific (innovative) properties

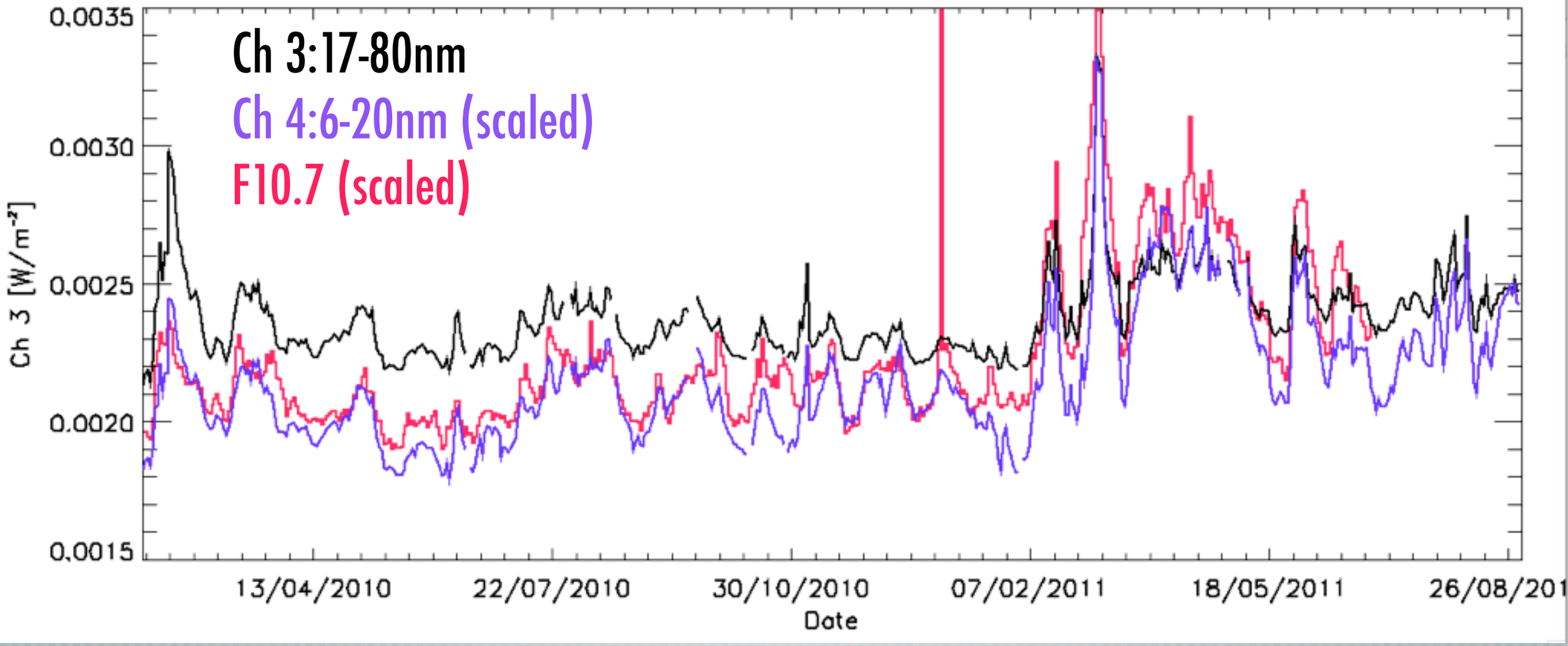


# Toward daily values ....

- ✓ Be careful when deducing mid & long term variabilities from level3 data.
- ✓ Daily value is defined as the median or mean of correct measurements (i.e. NO LARs, off-pointing, occultations, cover opening, ...) over the day

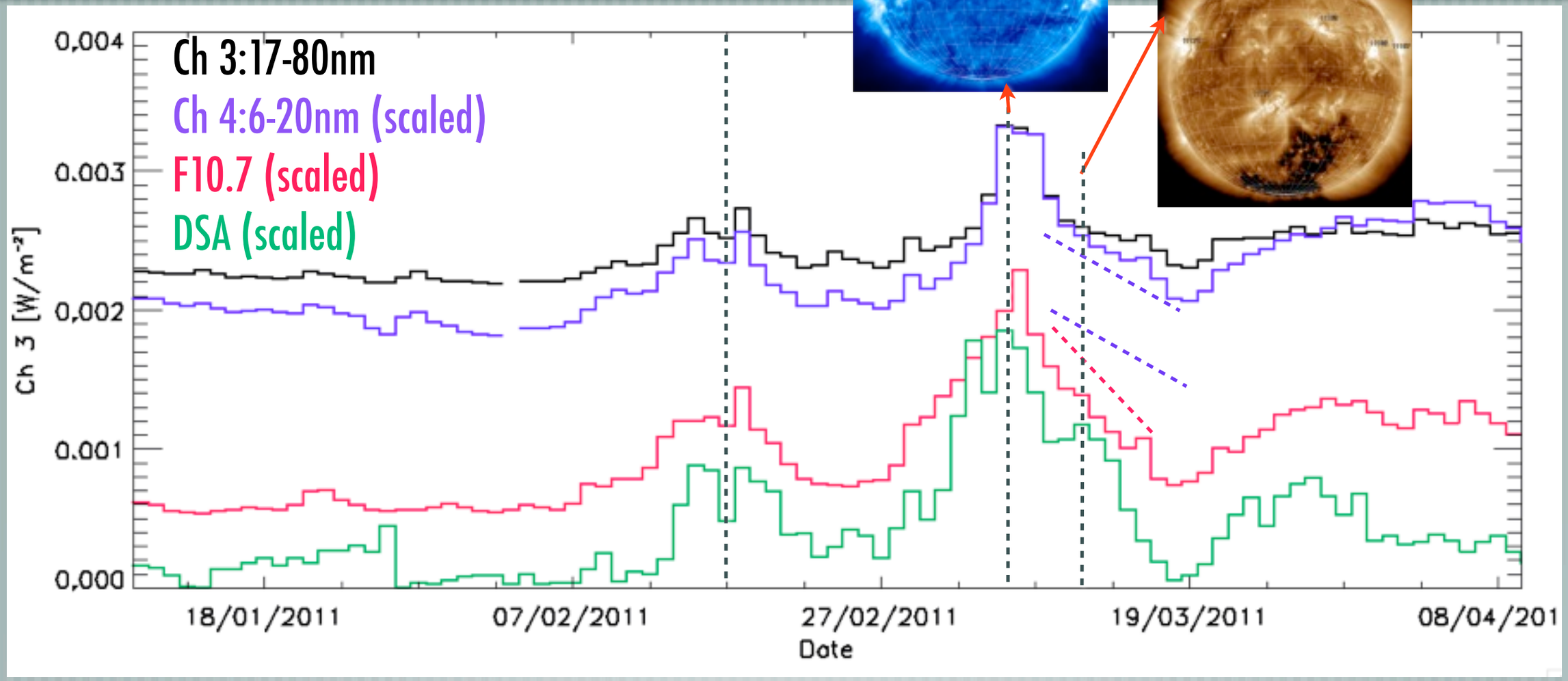


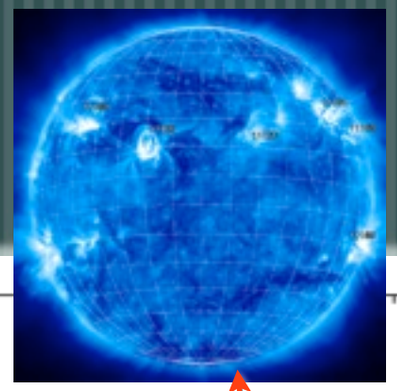
# Results

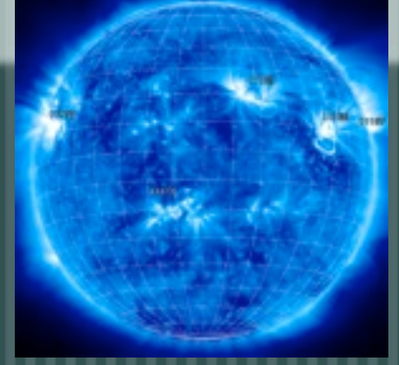



- Very good overall agreement ! Rotational and long term time scale.
- Wait for new degradation correctionto be implemented.

# Results



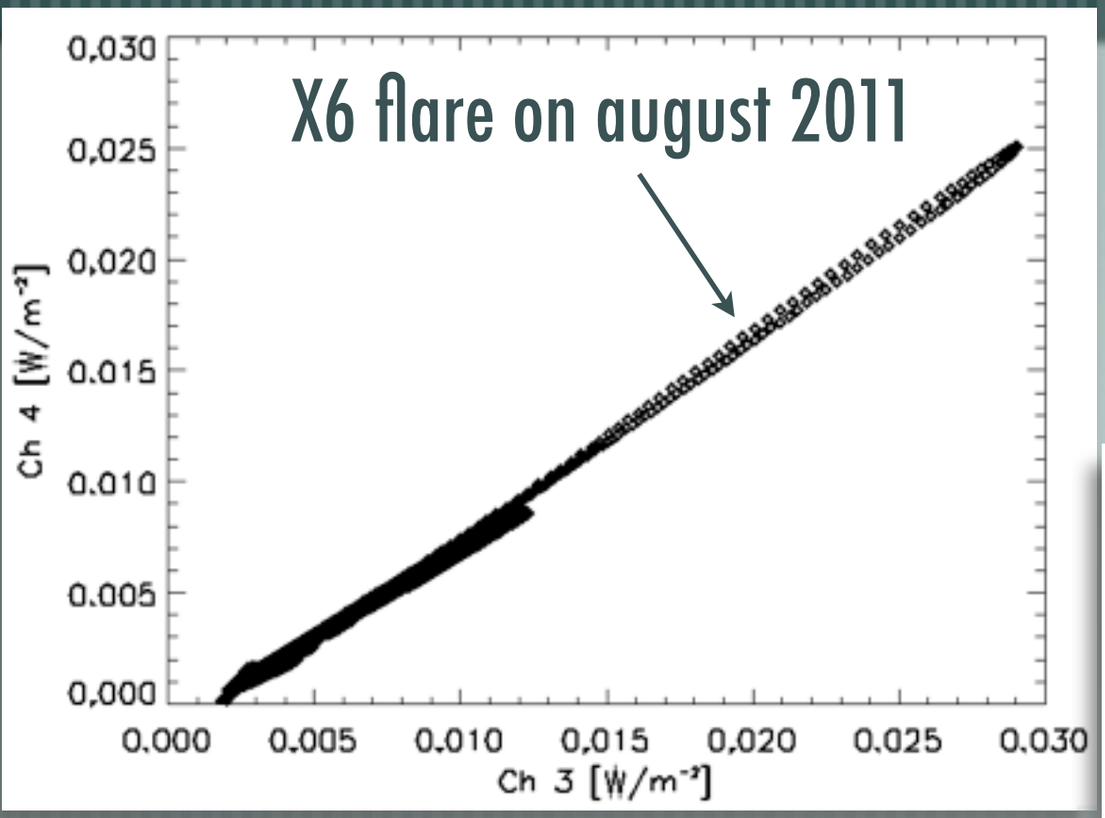


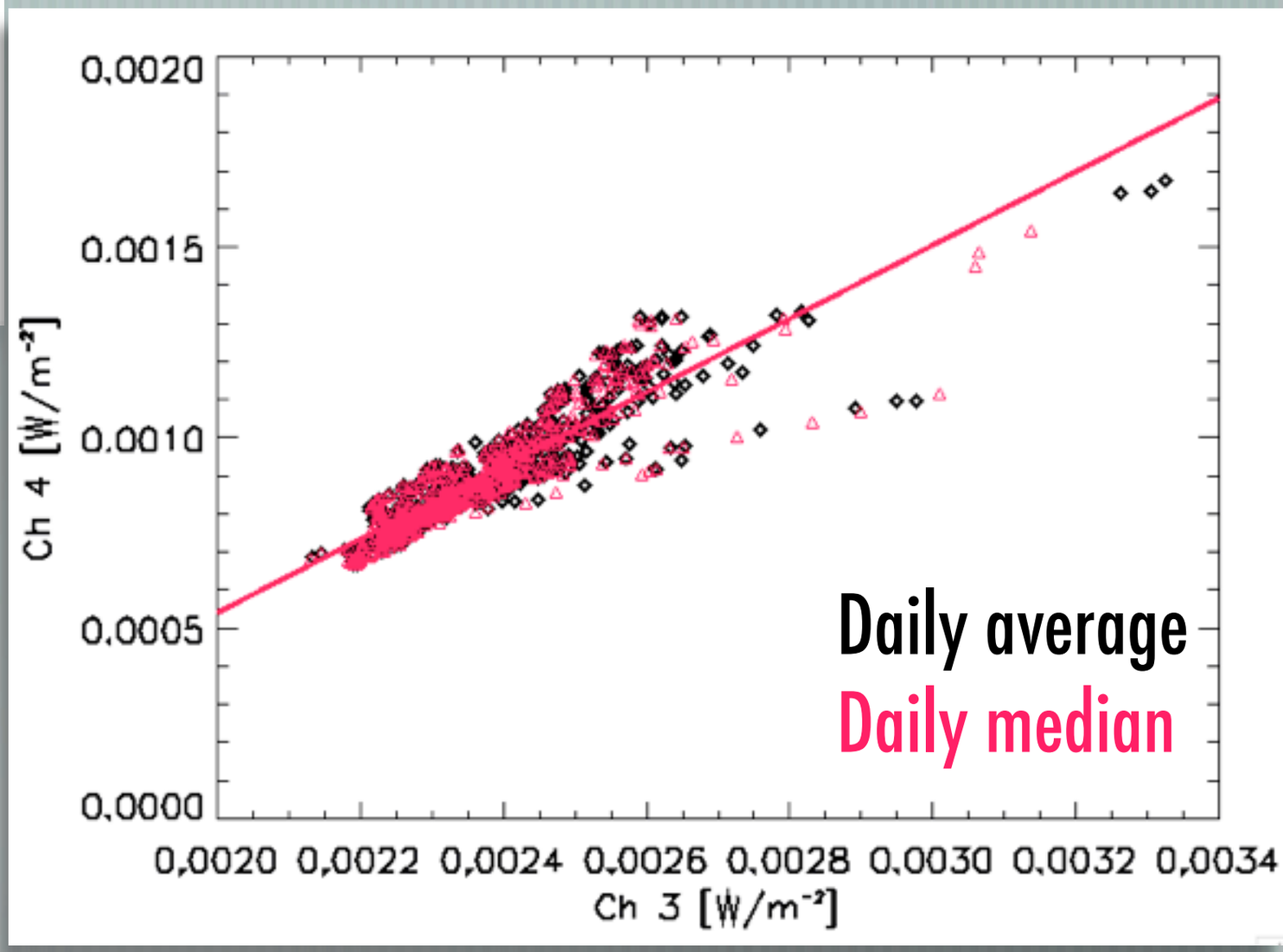


➡ LYRA data completely suitable for detailed analaysis

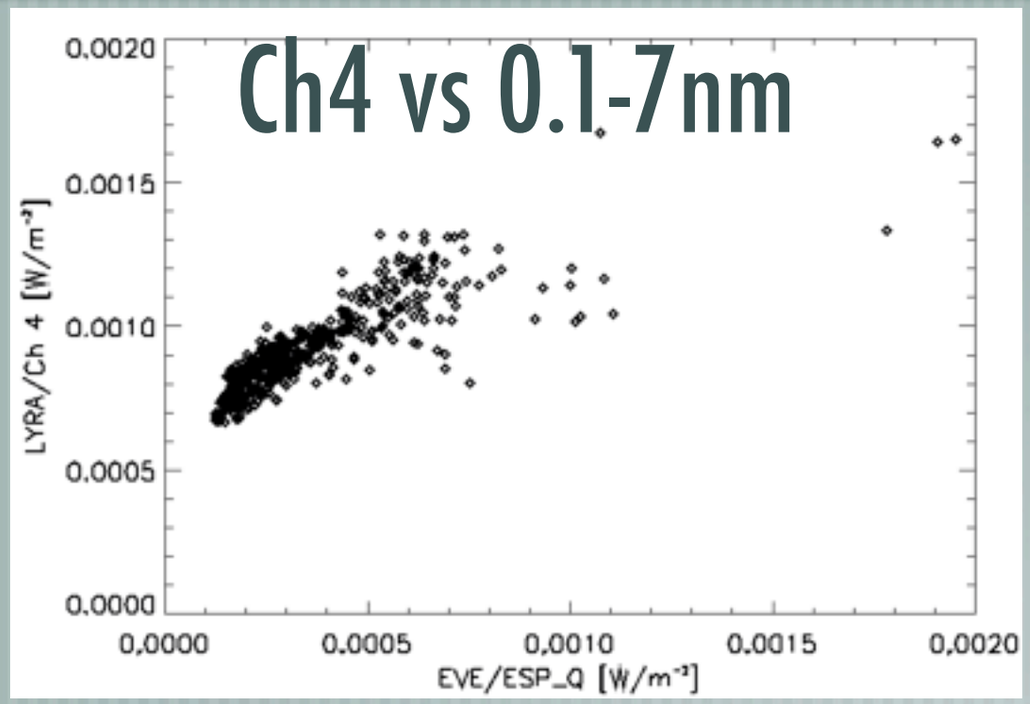
➡ in general useful for understanding solar variability

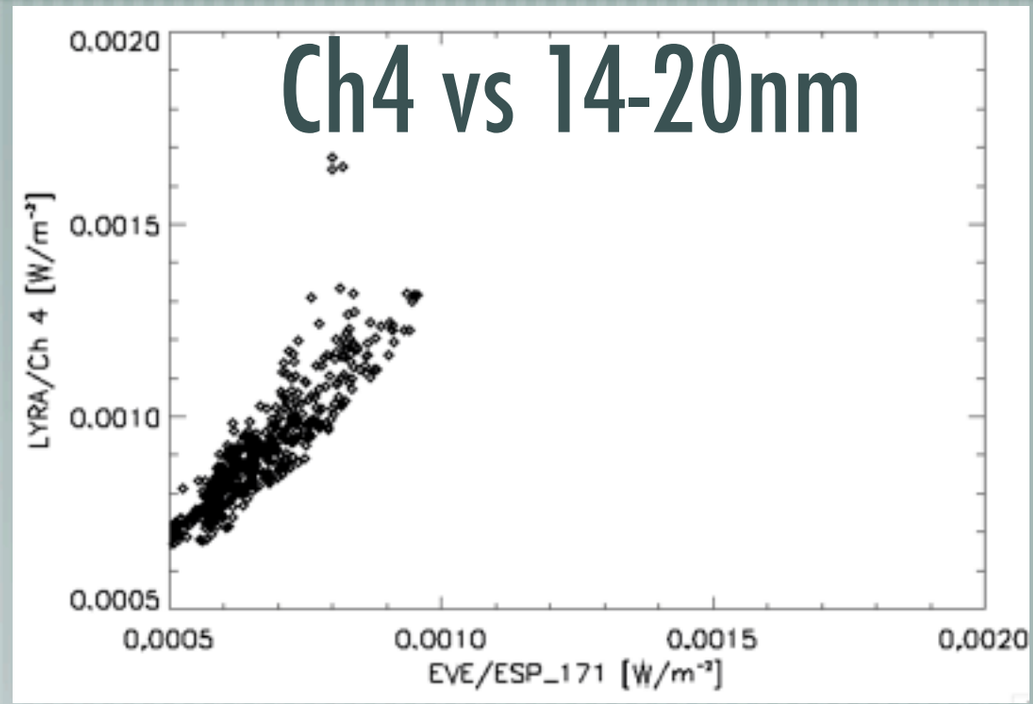
# Ch3 & 4 comparison

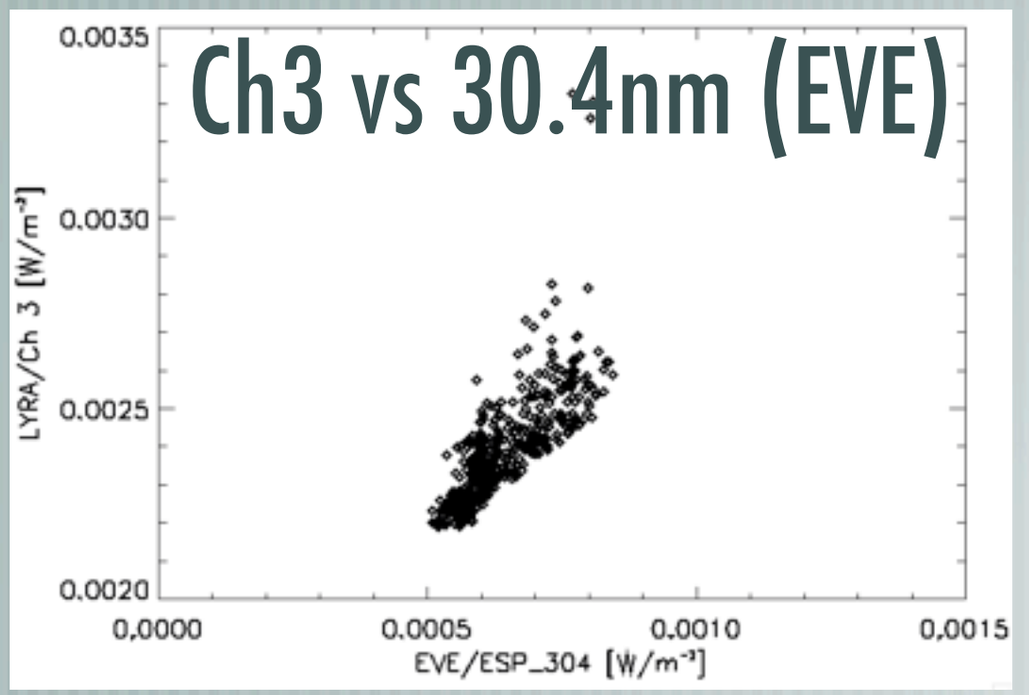


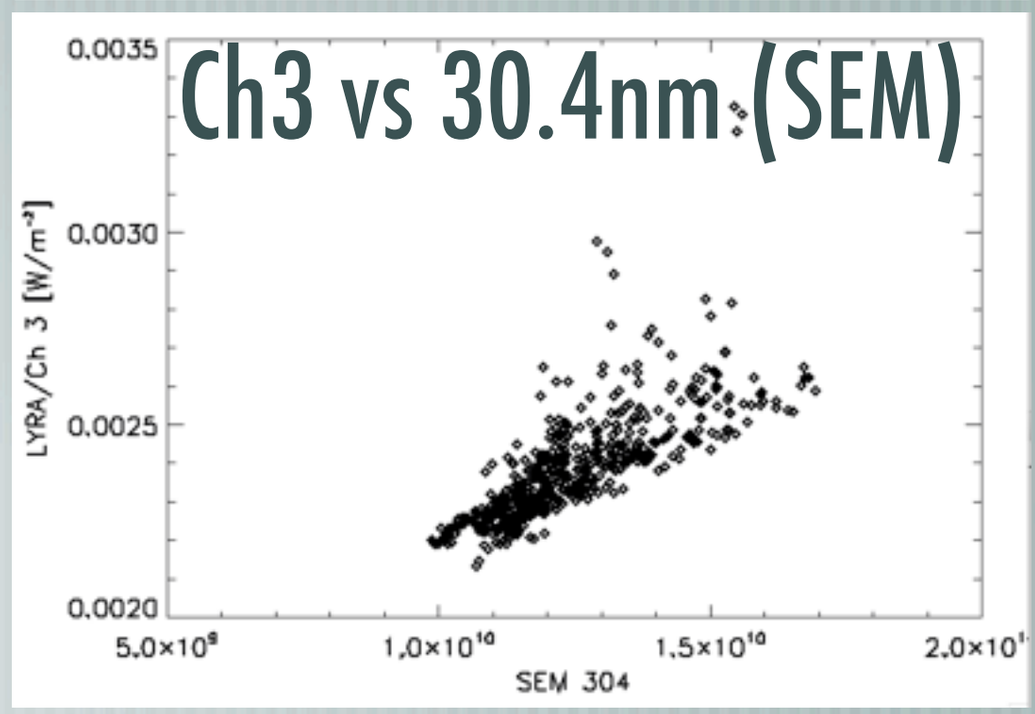



# Comparison with SDO/EVE and SOHO/SEM



# longer time scale

- Calibrating one instrument is hard. Intercalibrating several instruments over decades is really much harder.
- Yet this is <u>needed</u> to really assess and understand the impact of solar variability on Earth.
- The **SOLID** FP7 proposal proposes to assemble together all irradiance measurements to assess the SSI variability over the space era.

# Conclusions

- LYRA channel 3 and 4 have been analyzed and processed in order to provide daily value suitable for mid and long term studies.
- More work needed to assess if this is feasible for channel 1 and 2
- Measuring solar irradiance (esp. in the UV) is **difficult**:
  - main danger is degradation and usually comes from the S/C.
  - a bigger care yet to assess long term term trends.

# Thank you