Assessment of solar irradiance datasets for the

SOLID !

project.

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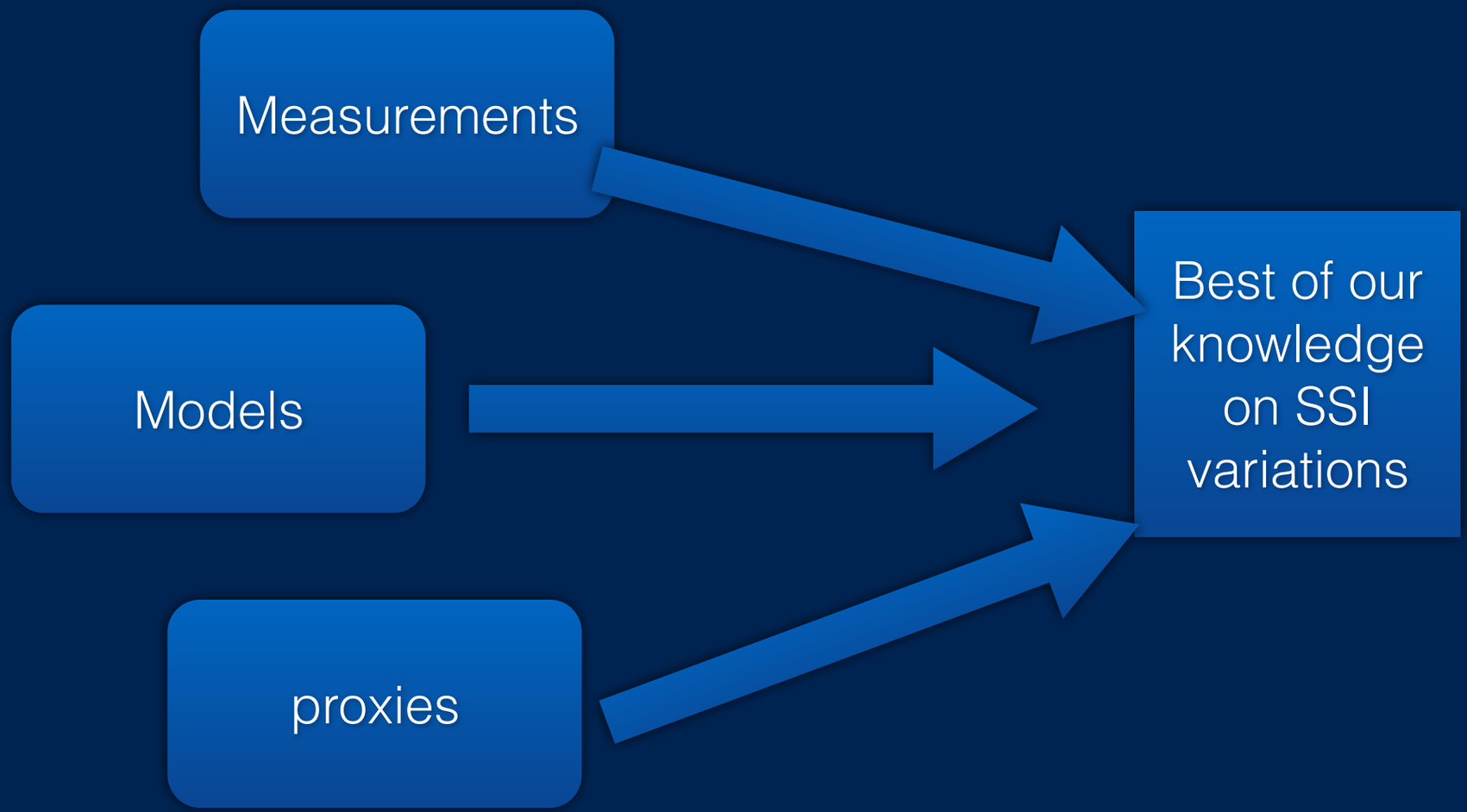
Ultimate Goal

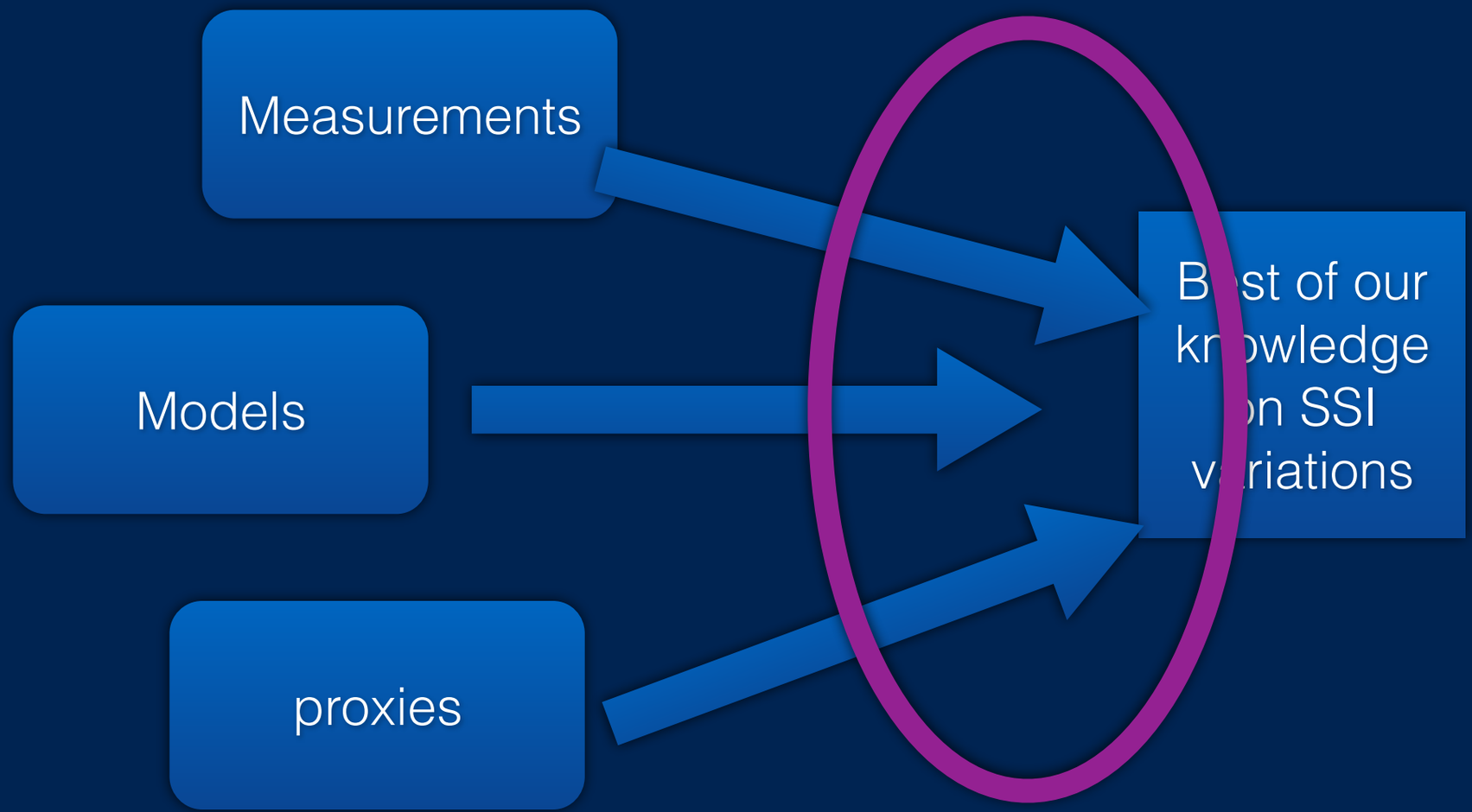
- What does the SSI spectrum look like for each day over the last decades ?



Ultimate Goal

- What does the SSI spectrum look like for each day over the last decades ?

How can we combine these ?

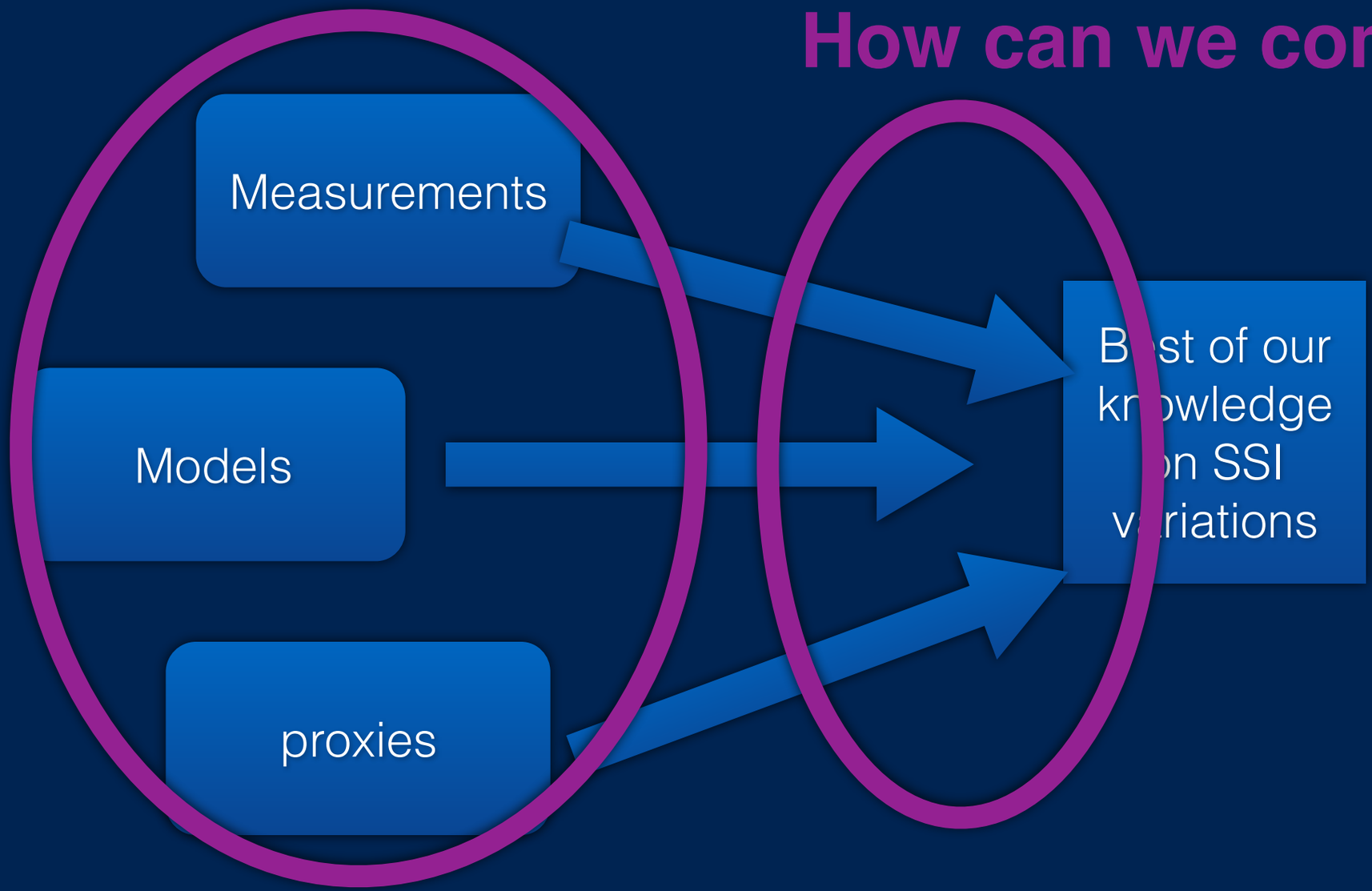


Ultimate Goal

- What does the SSI spectrum look like for each day over the last decades ?

How can we characterize these ?

How can we combine these ?



Concentrate on data

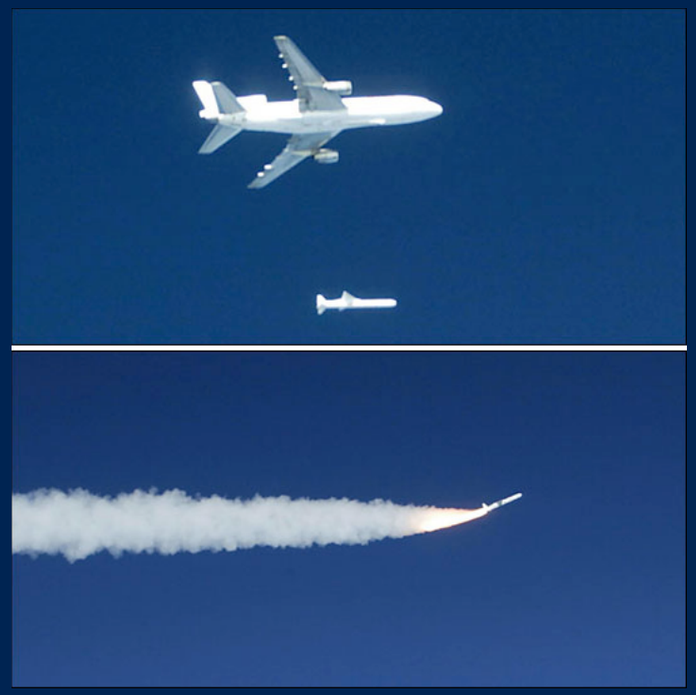
- What does the SSI spectrum look like for each day over the last decades ?

- **What is our current knowledge of SSI variability coming from the instruments ?**

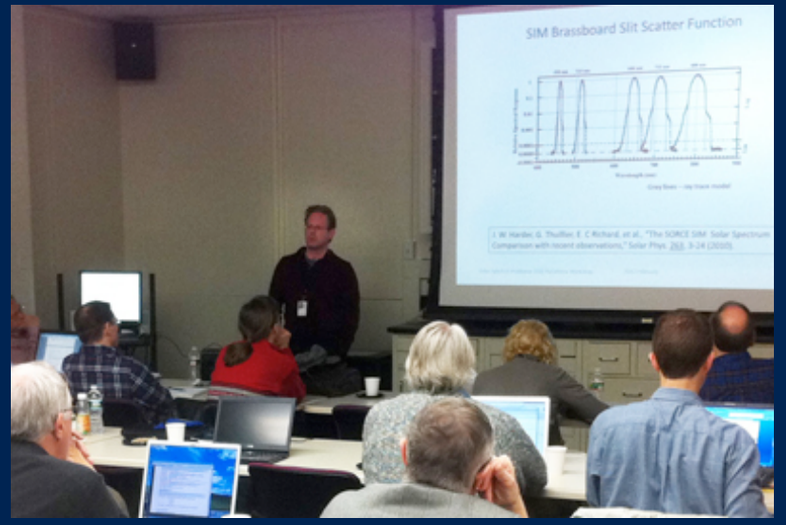
  - Looking at the past is also a ways to prepare the future**.**

  ➡ **Take an homogeneous look at available SSI datasets**

Measuring SSI Variability



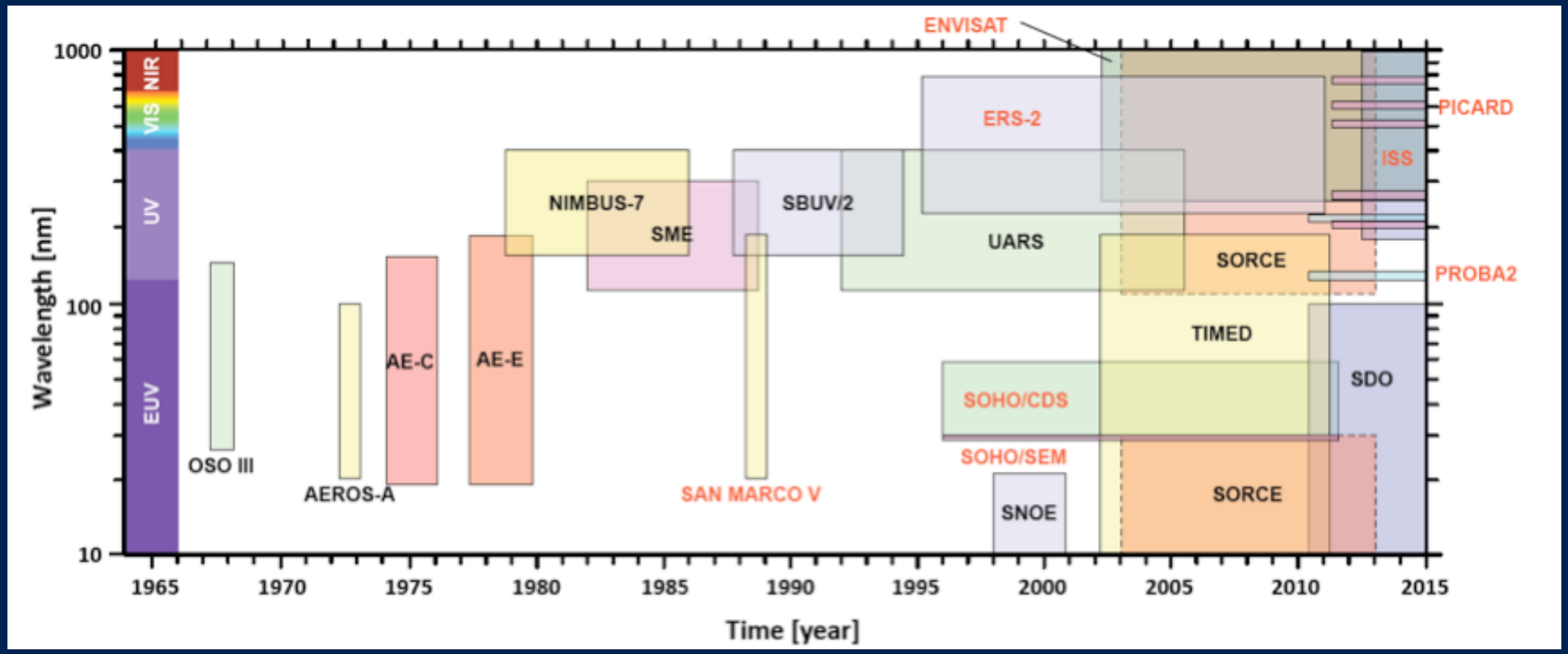
- SSI observations must be made in space to be accurate.



- A smart part of the humanity has devoted time and effort to perform these space observations (and still do)

- Instruments behave strangely in space and sometimes beyond our understanding.

SSI datasets: when and where ?



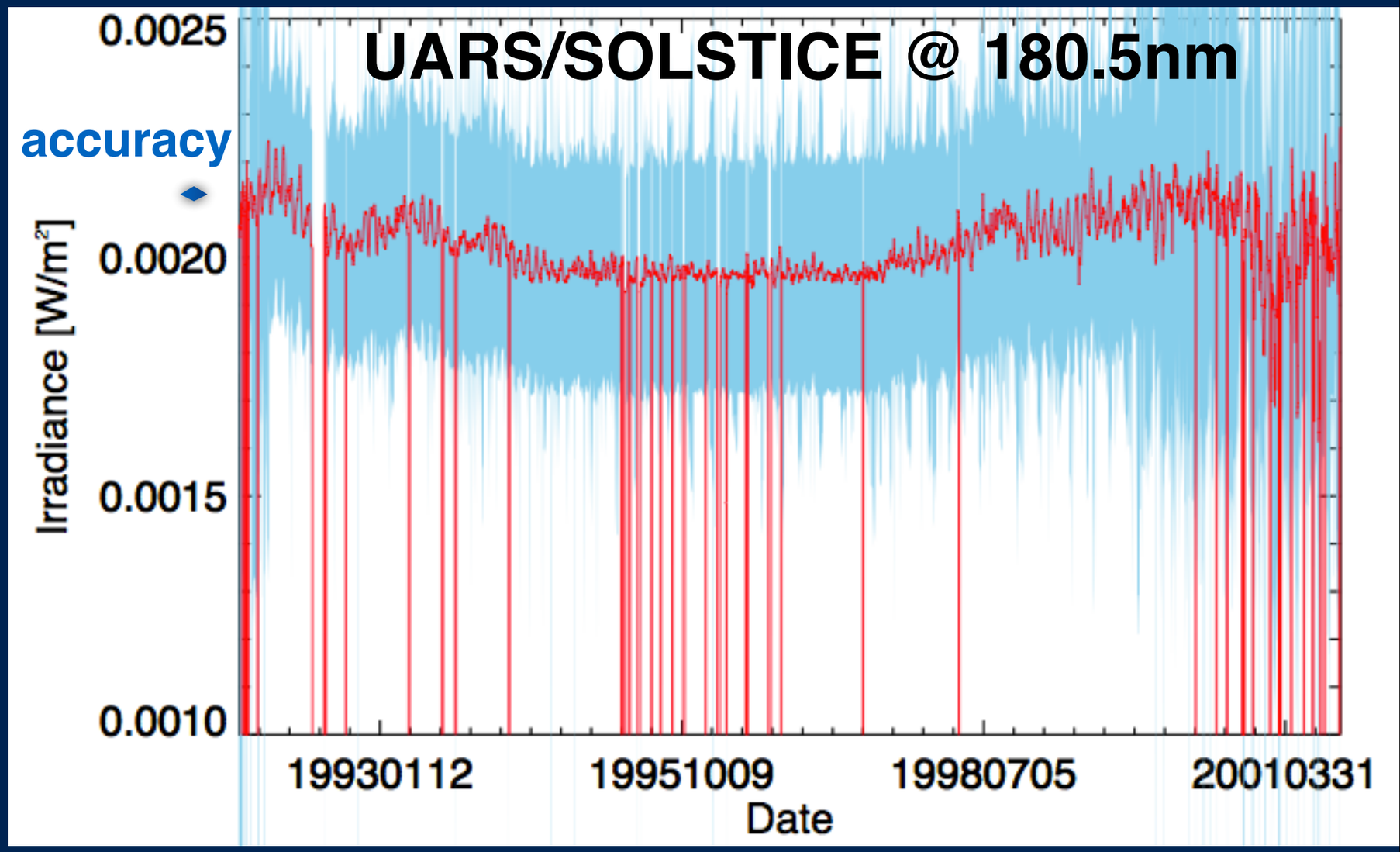
- Numerous datasets. Some old.
- Most coverage in the UV

SSI datasets: what is in there ?

- Data are **usually** provided (thank you!) by instrumental teams with

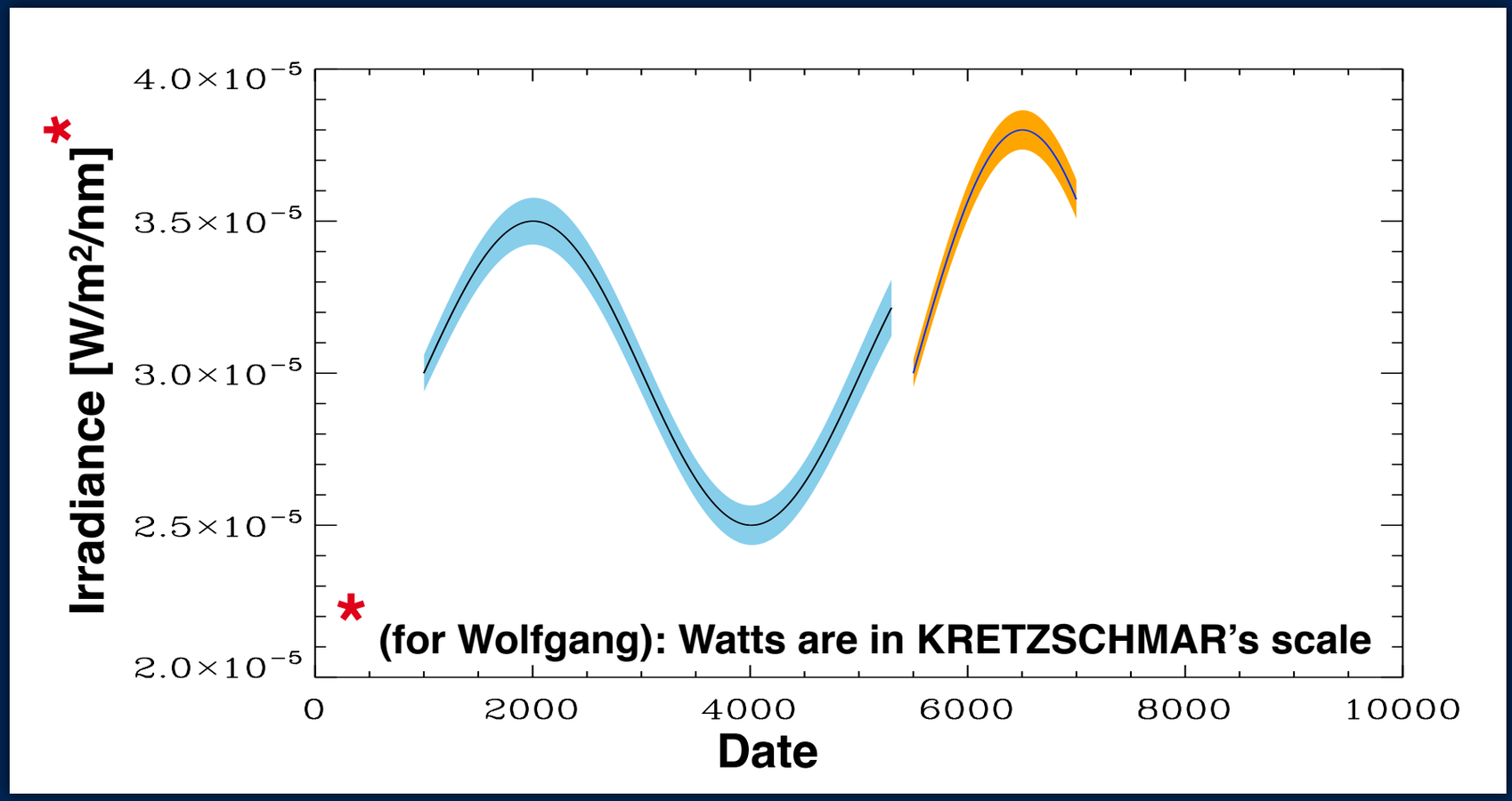
  ✳ *the uncertainty*

  ✳ *the long term accuracy*



Different voices

Ex: 2 measurements *or* 1 measurement and 1 model



- 2 approaches:
  - Use the more precise/accurate instrument (prior: define them !) as reference to make your best estimate.
  - Use discrepancies in measurements to estimate our knowledge (=uncertainties)

SSI datasets: an homogeneous look

- *Step 1*: format, gap, outliers, noise estimation **-> SEE MICHA'S TALK JUST AFTER**

- *Step 2*: Common procedure to identify weakness and strength of various datasets.
  - Search for ambiguous behavior in the datasets by identifying deviations to a proxy-based model.
    - ➡ Detect potential residual instrumental effects in the data that affects the mid term variations (e.g. temperature effects, ..)
  - Compare the long term (cycle) variations between data and the proxy-based model.
    - ➡ SSI measurements suffer from degradation. **Hypothesis:** The observed irradiance trend is most likely true if we can reproduce it with proxies.

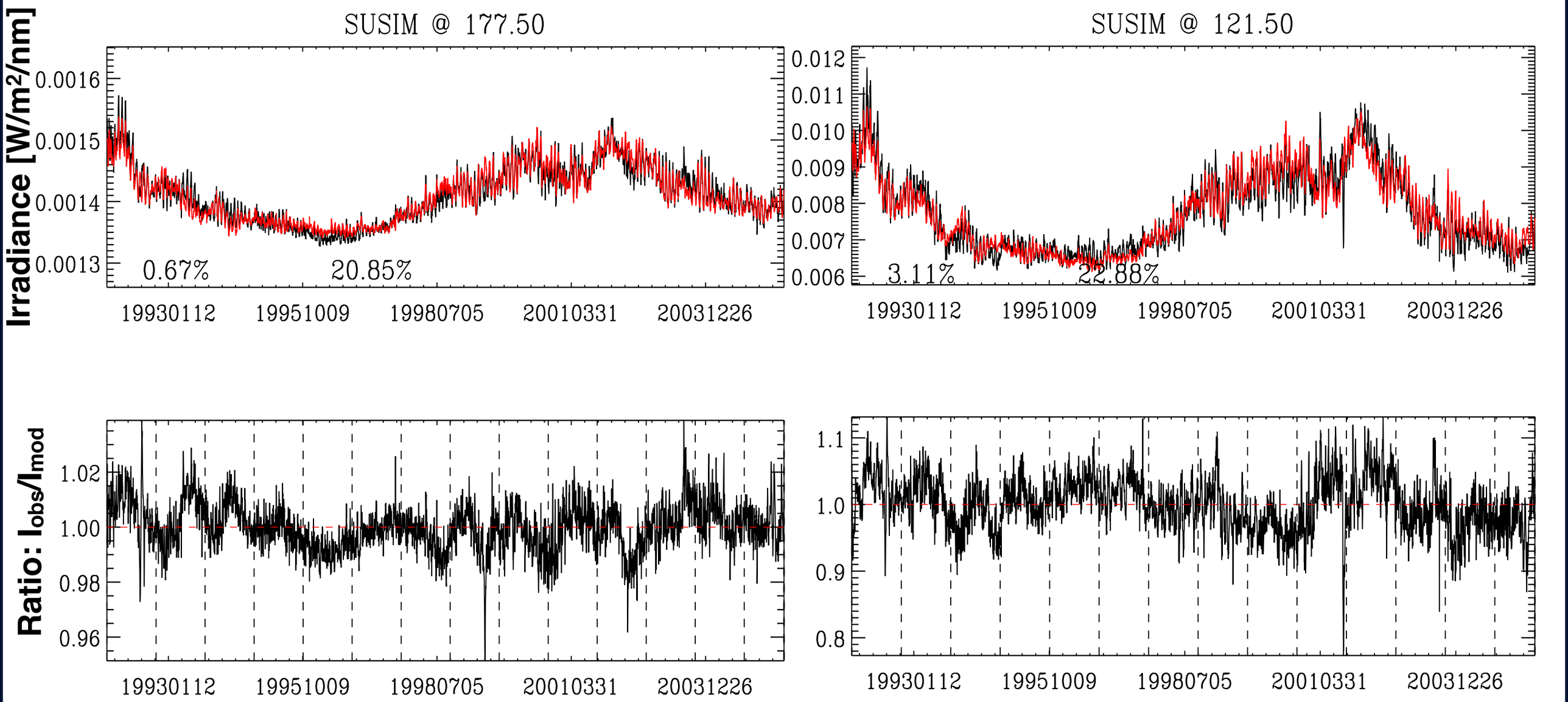
Proxy model

- 3-components model based on DSA, Mg II, and radio fluxes at 3.2cm, 10.7cm, 15cm, 30cm.

$$I(\lambda,t) = \sum_i a_i + b_i.P_i^{HF}(t) + c_i.P_i^{LF}(t)$$

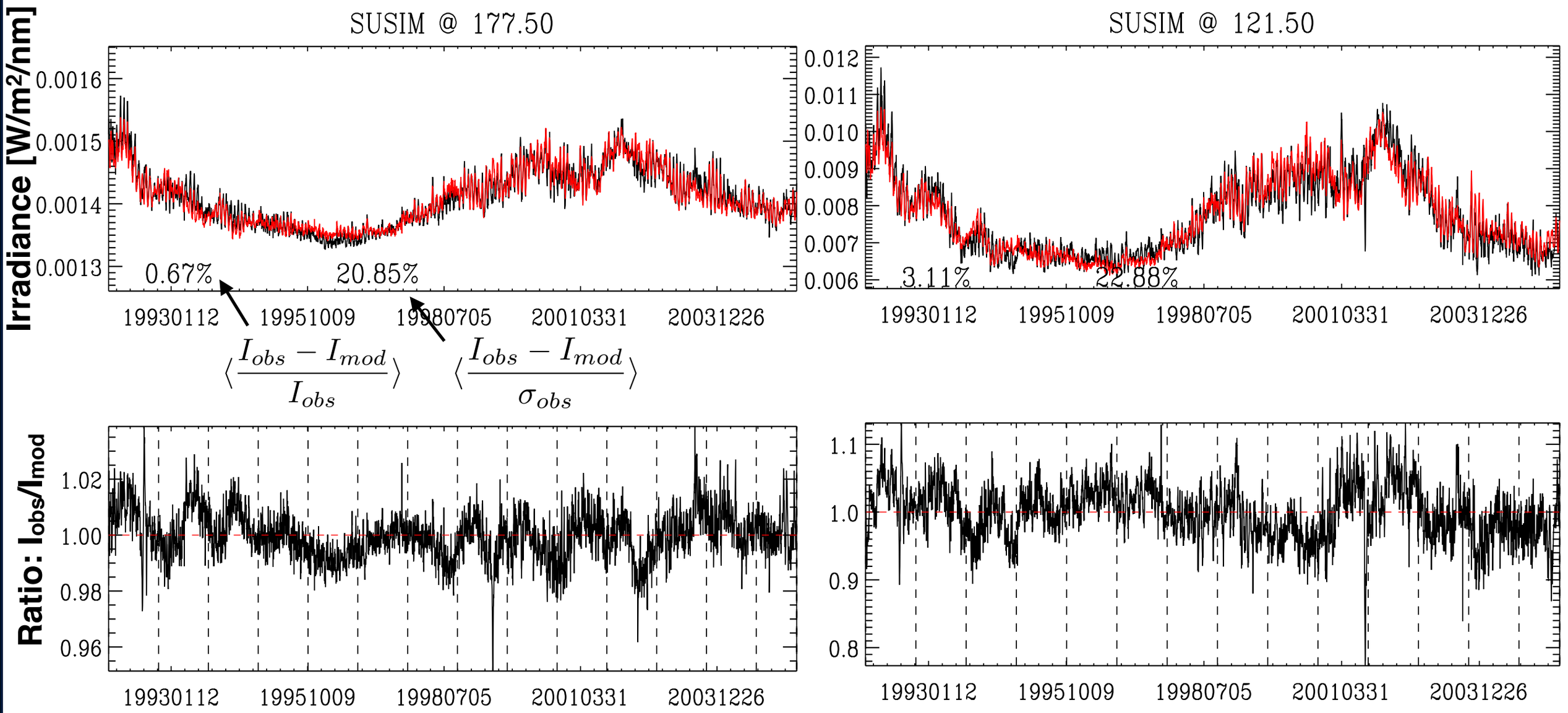
- Distinction HF and LF at 108 days.
- Easy to change / add proxy.

Proxy models: example 1



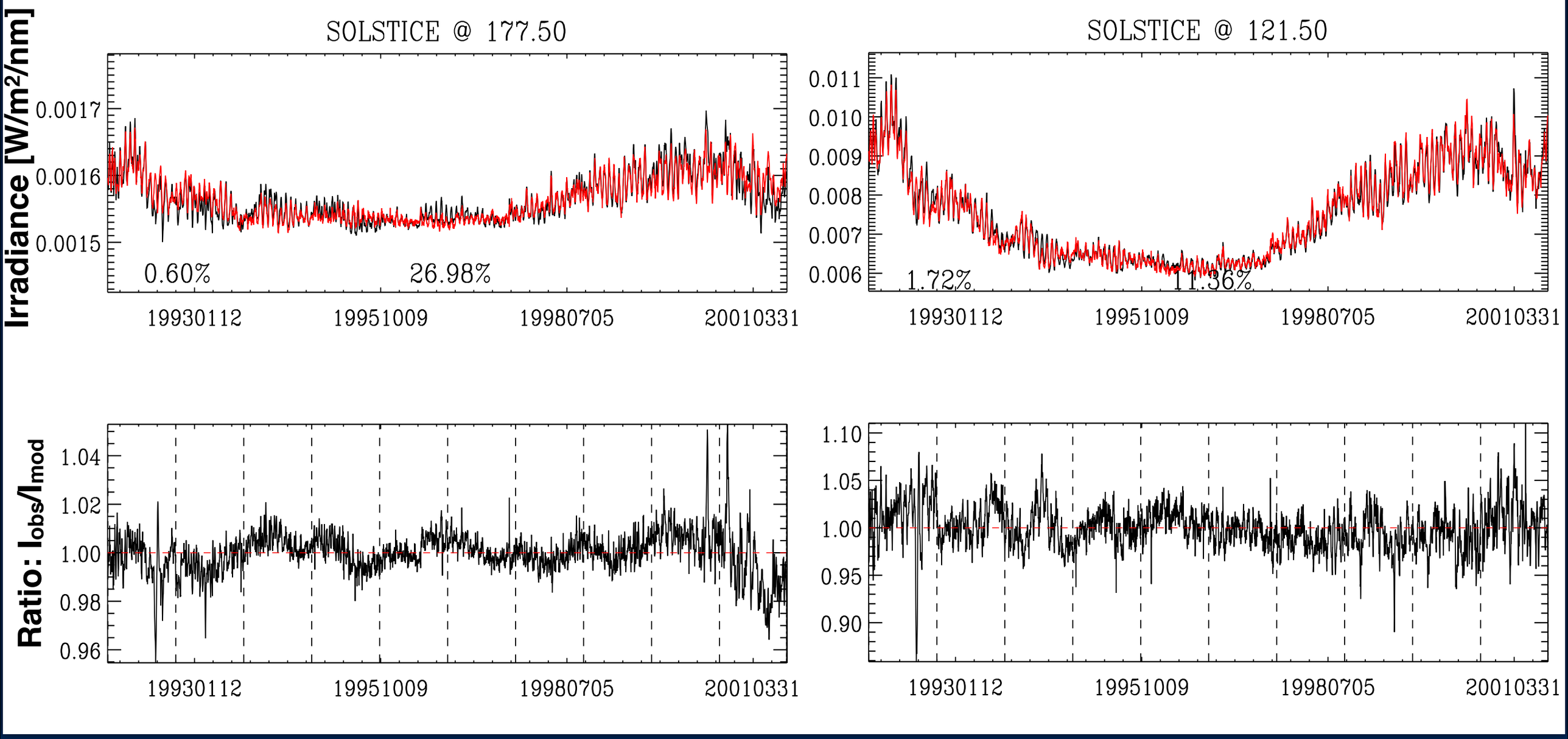
- Good agreement on both rotational time scale and solar cycle.

Proxy models: example 1



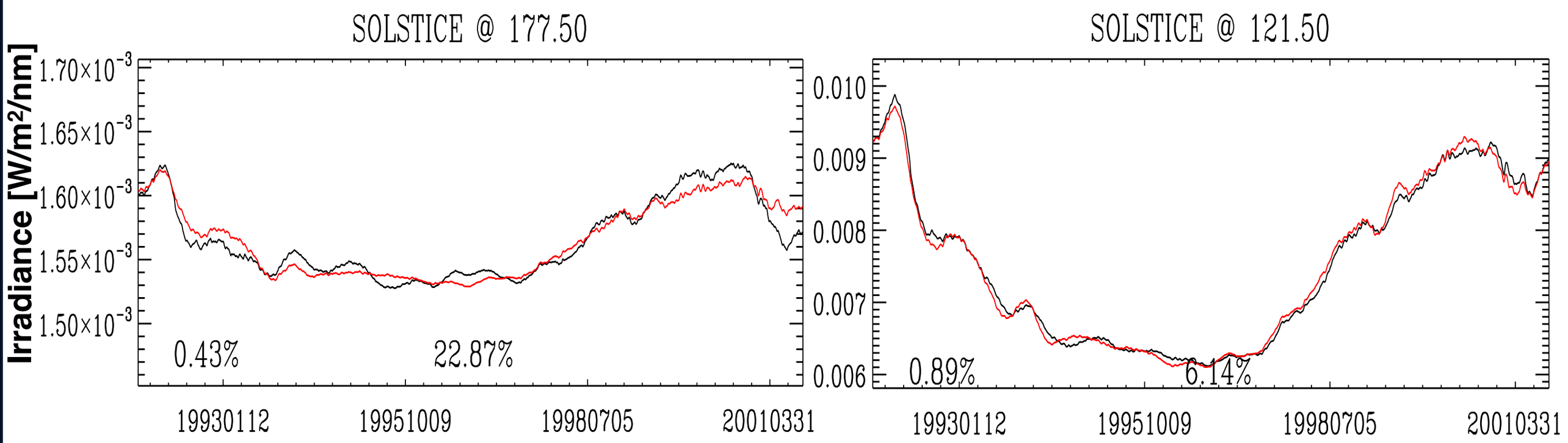
- Good agreement on both rotational time scale and solar cycle.

Proxy models: example 2



- Good agreement on both rotational time scale and solar cycle.

Proxy models: smoothing

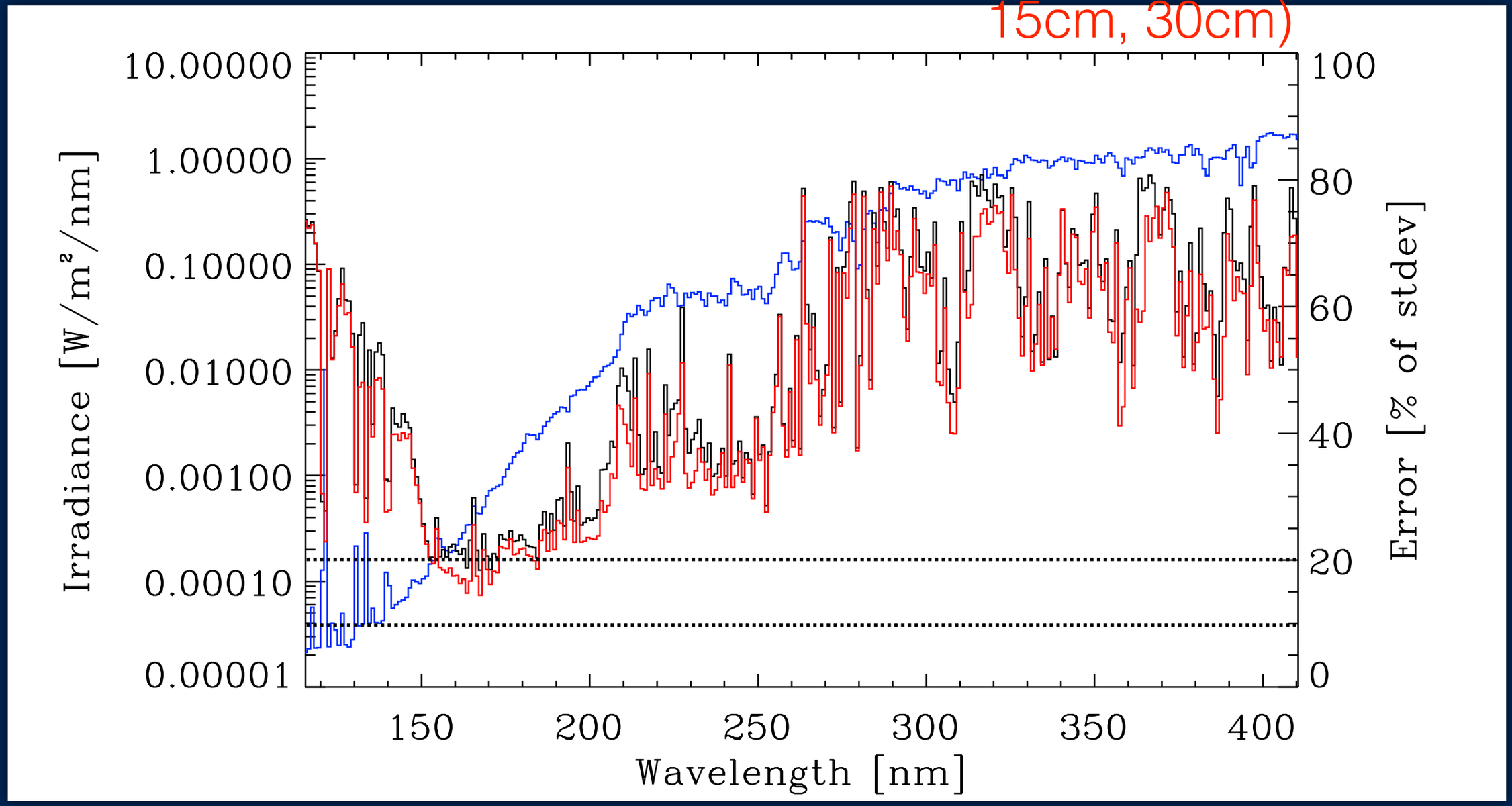


- smoothing allows us to compare the long term trend more clearly.

Model performance

UARS/SUSIM

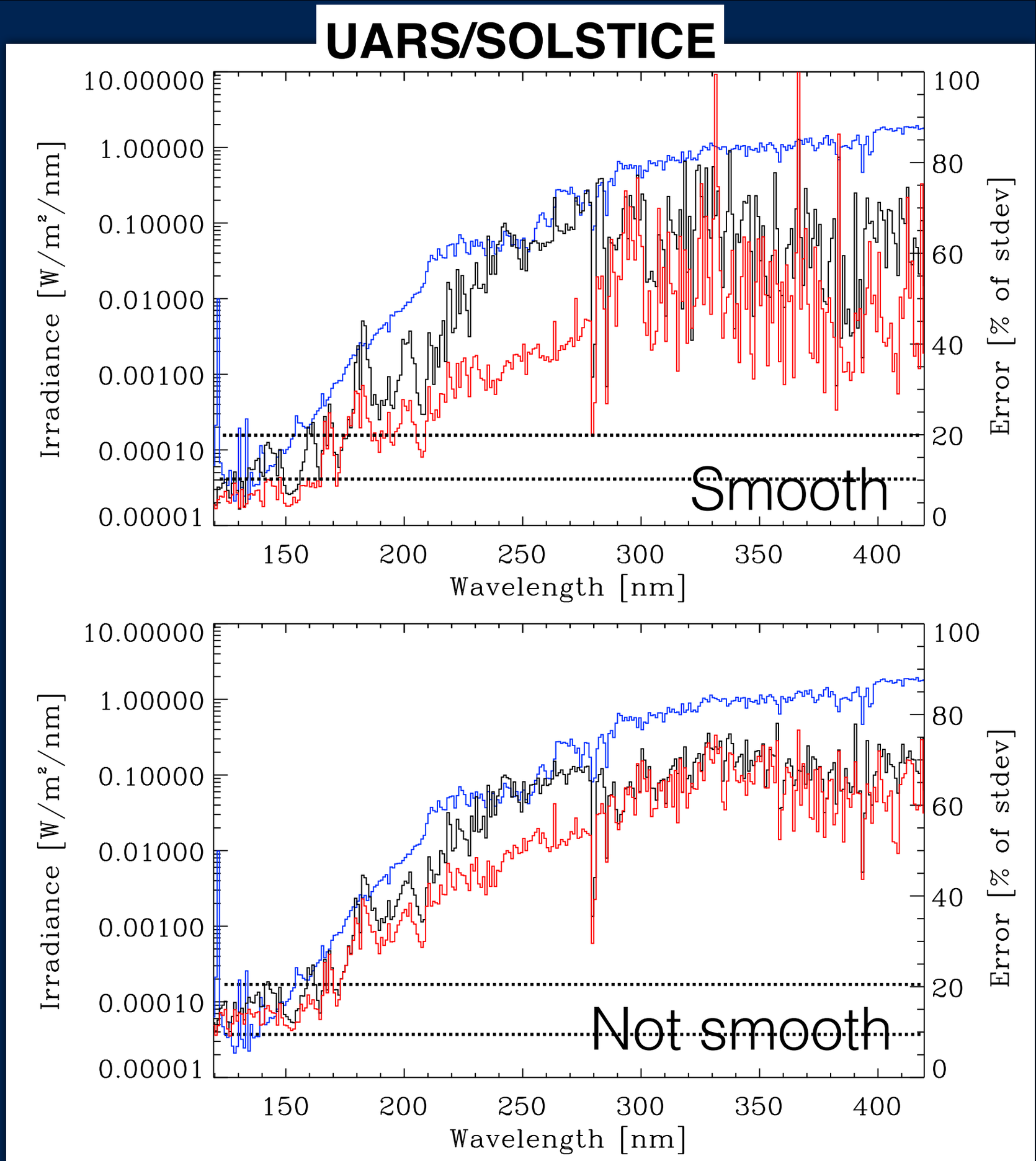
- Model based on: DSA, MgII + Radio fluxes (3.2cm, 10.7cm, 15cm, 30cm)



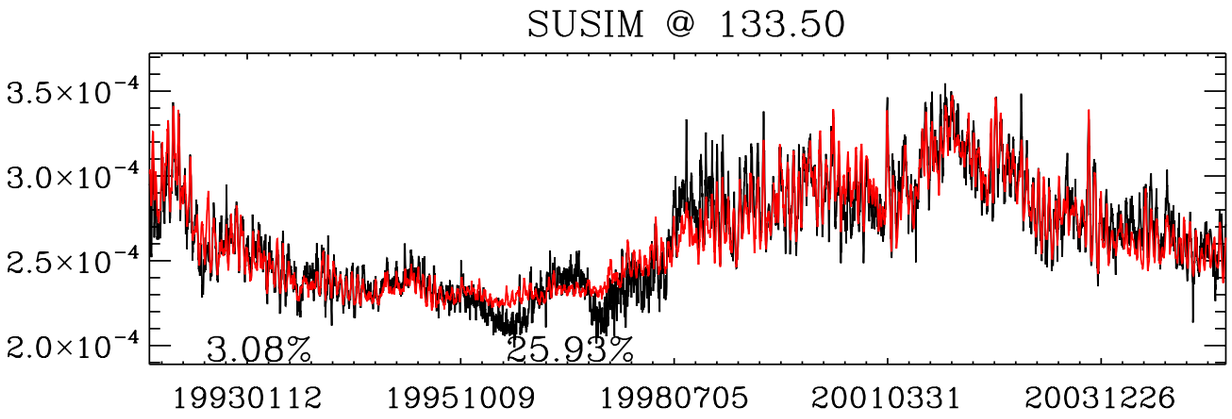
- Radio fluxes help.
- More disagreements in the continuum at short wavelengths and at long wavelengths.

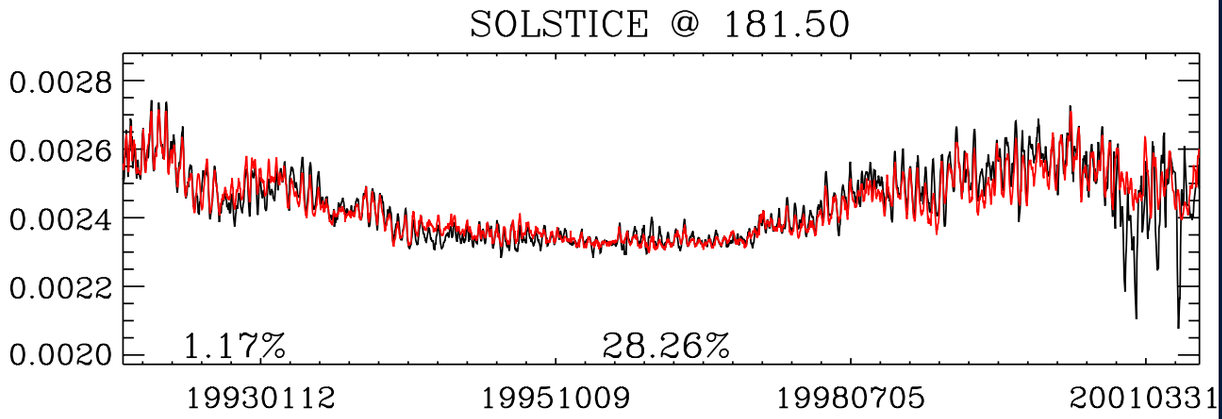
Model performance

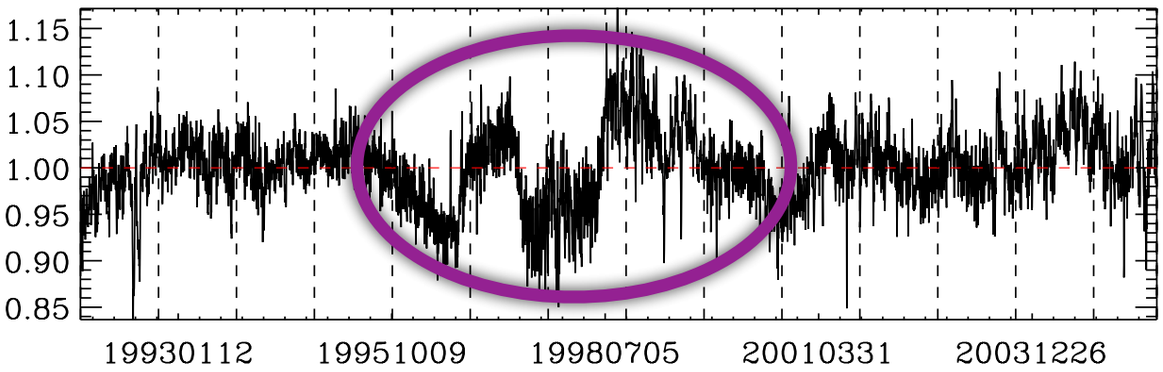
- Radio fluxes help (more yet for the long trend !),but not at longer wavelength.

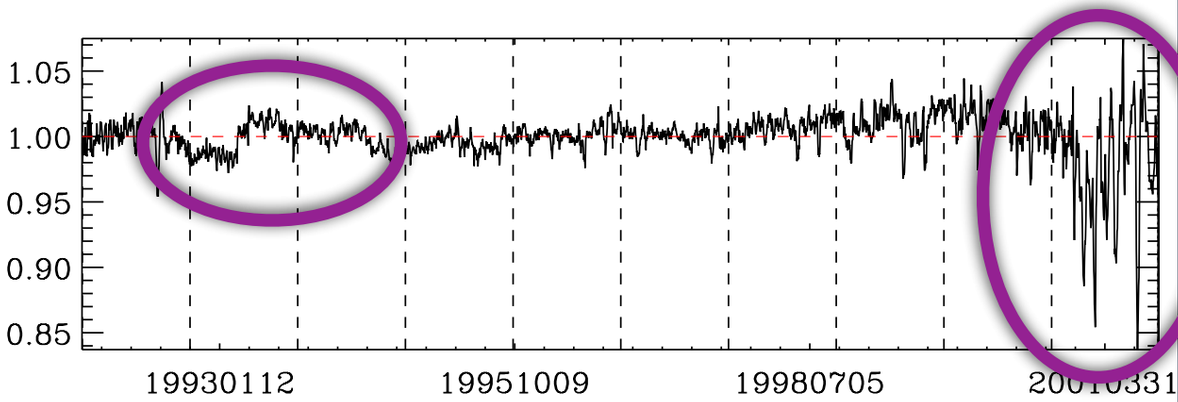


Less good examples









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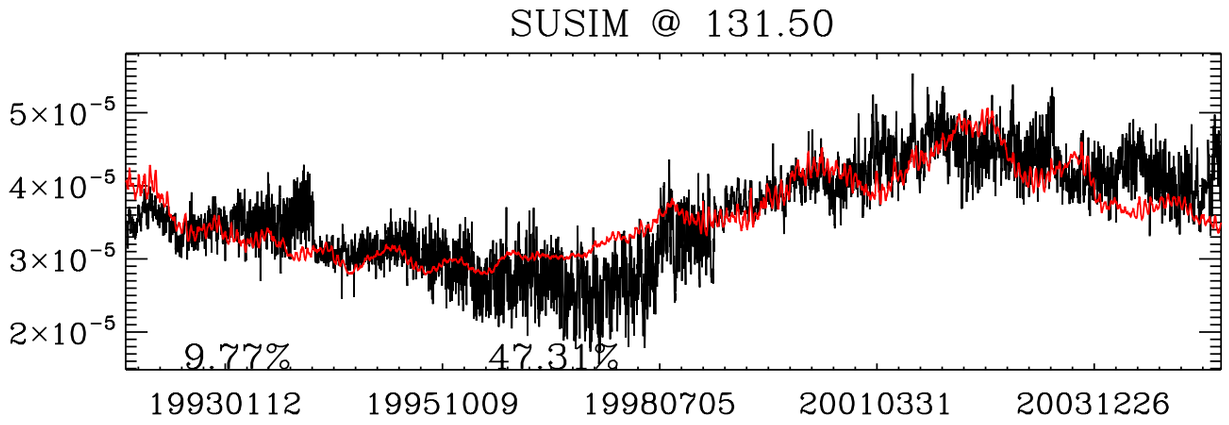
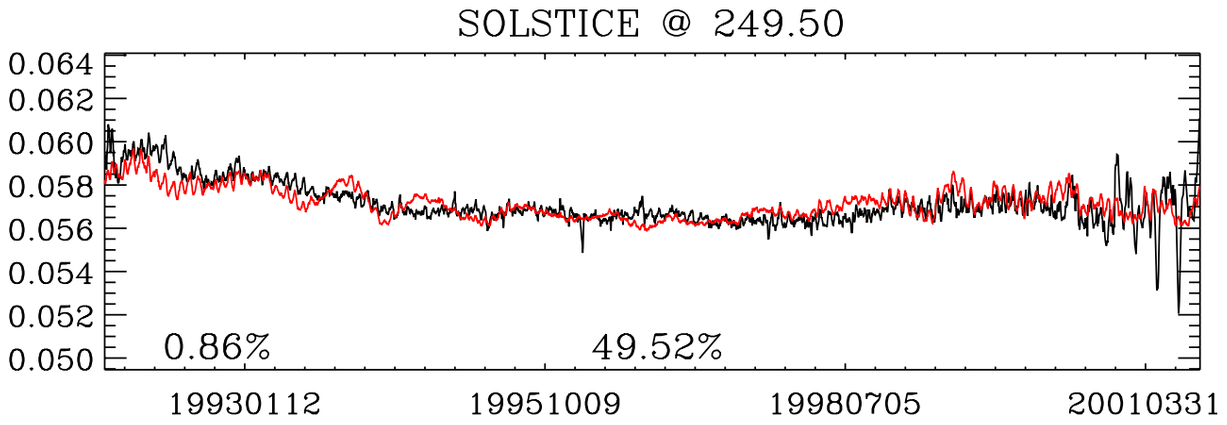
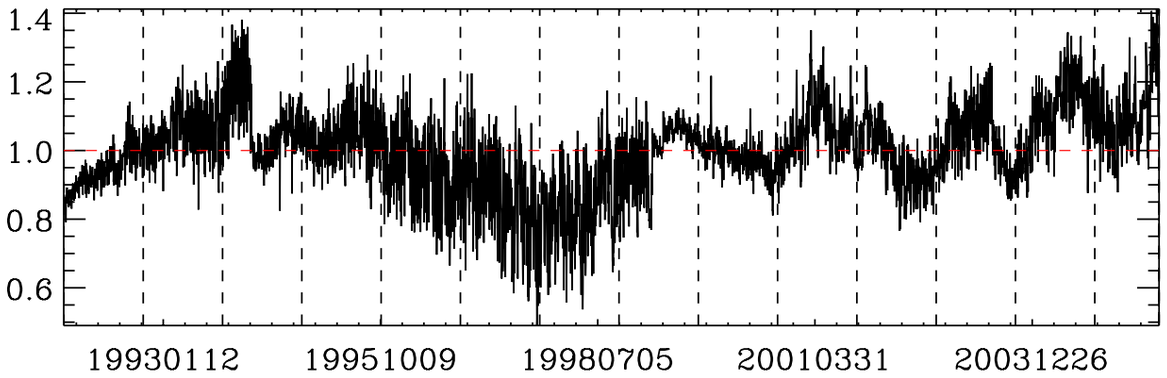
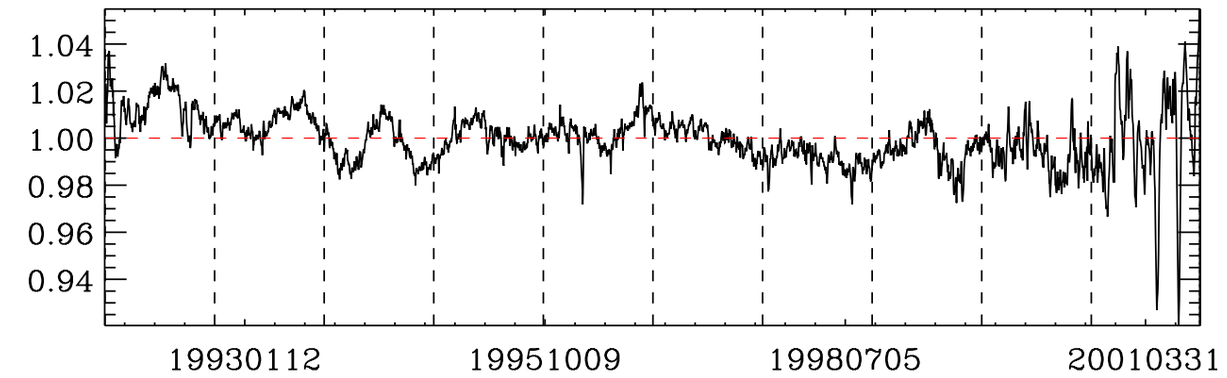


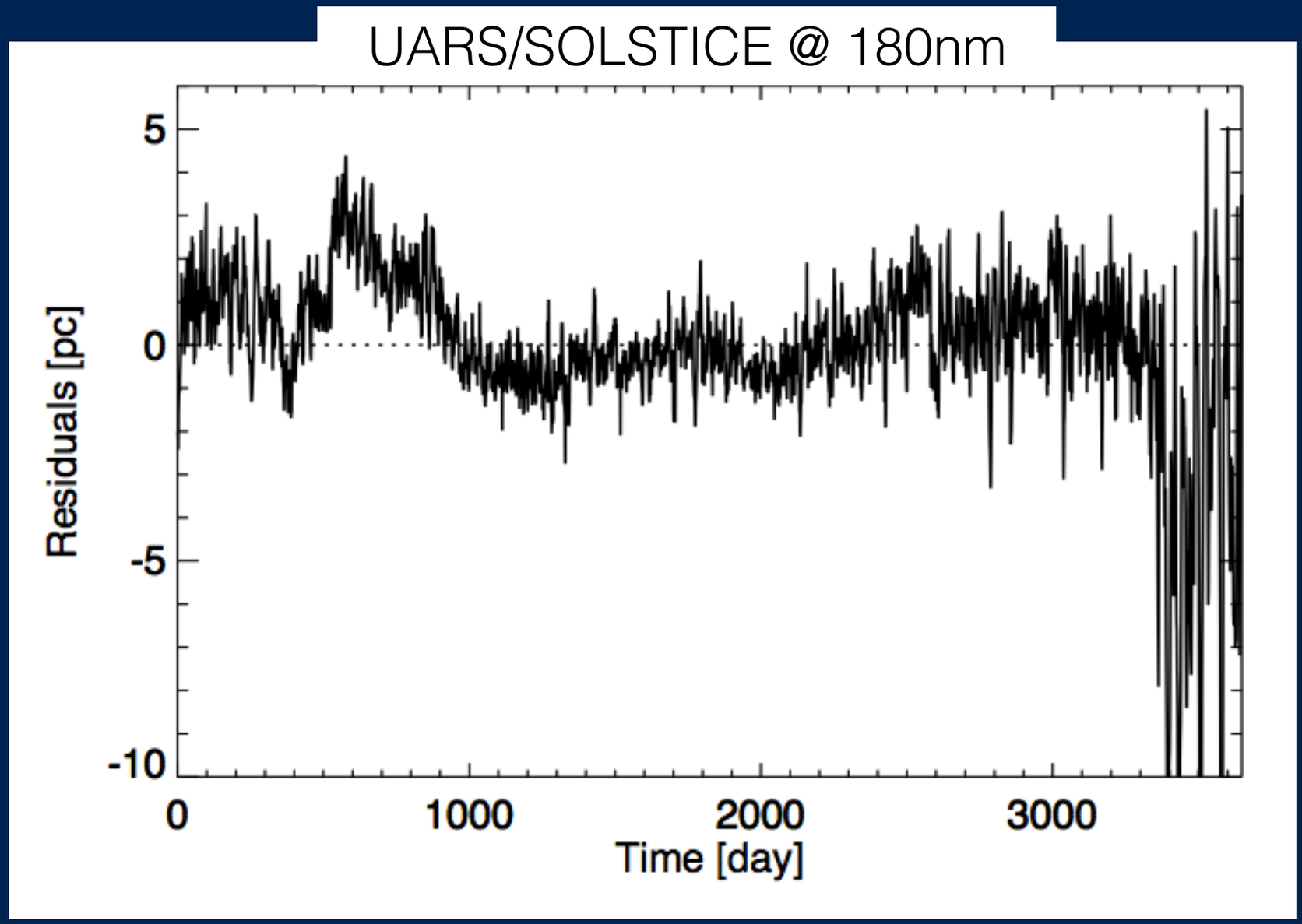




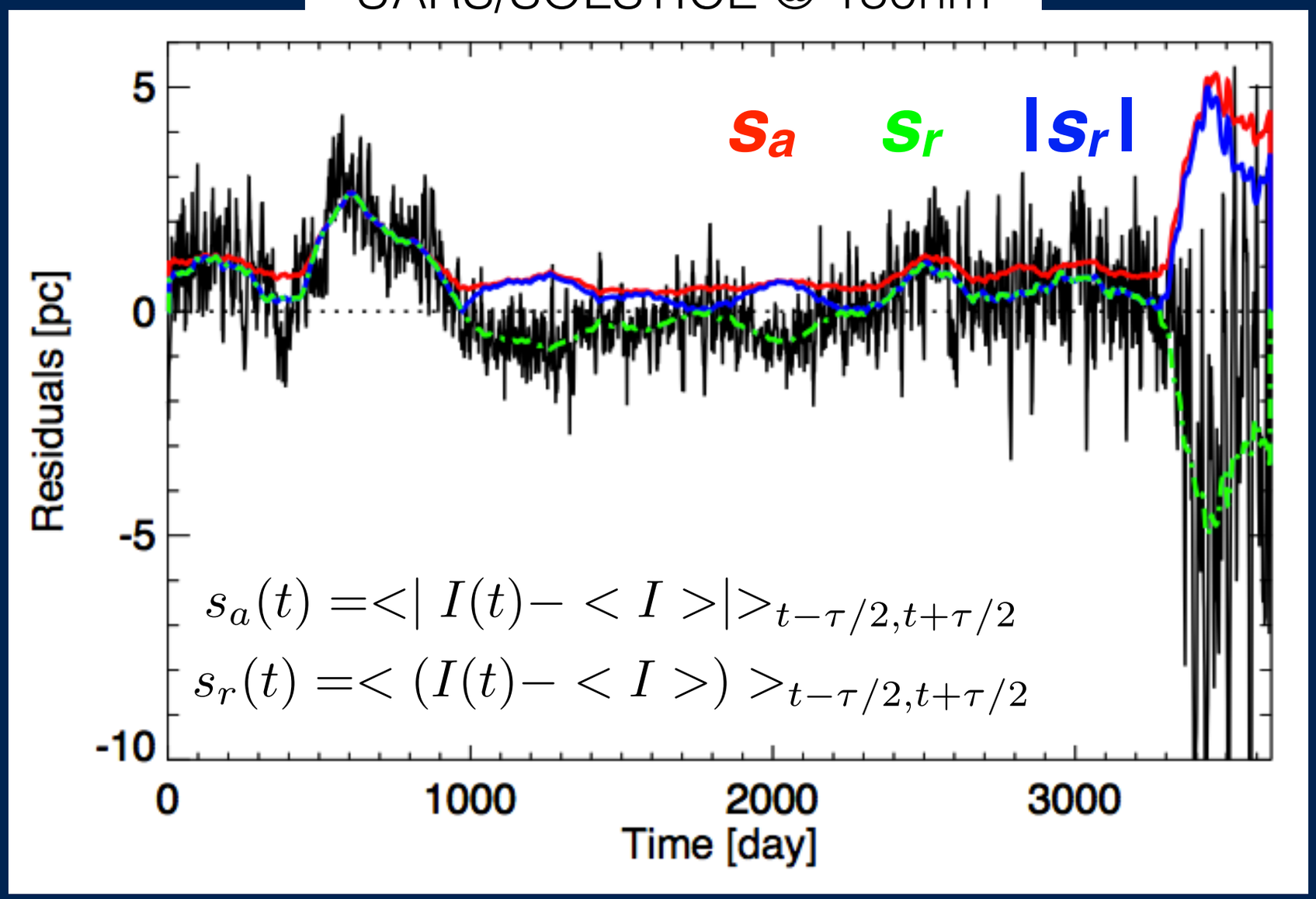


- We want an automatic procedure to detect such period where data are less likely to be correct:
  - Compute the absolute s_a and relative s_r deviations between data and model at different scales

Deviations in the residual



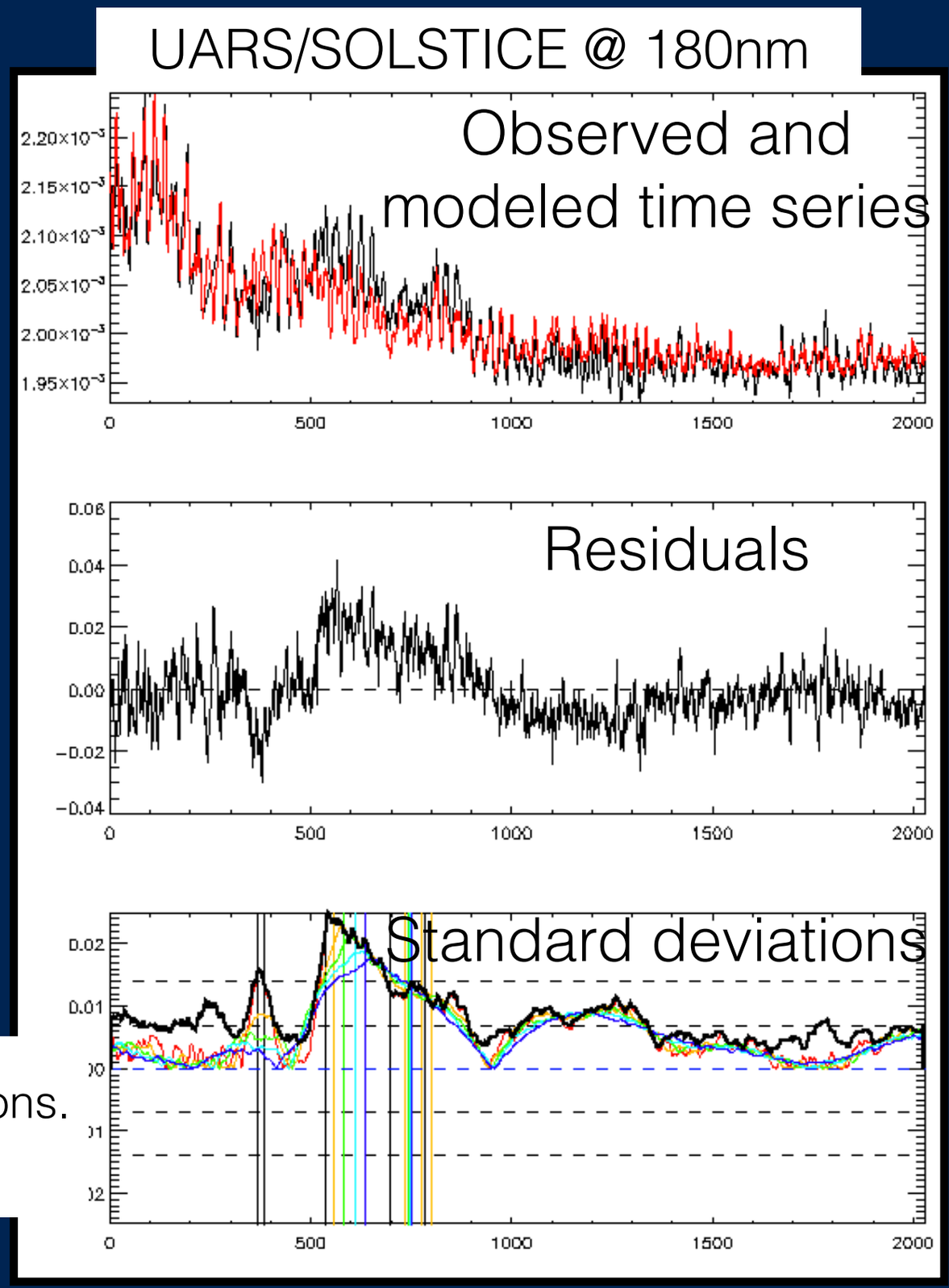
Deviations in the residual



- s_a and s_r computed over 108 days
- IF $s_a > 1.5 * <s_a>$ AND $s_r/s_a > 0.99$ THEN … maybe.

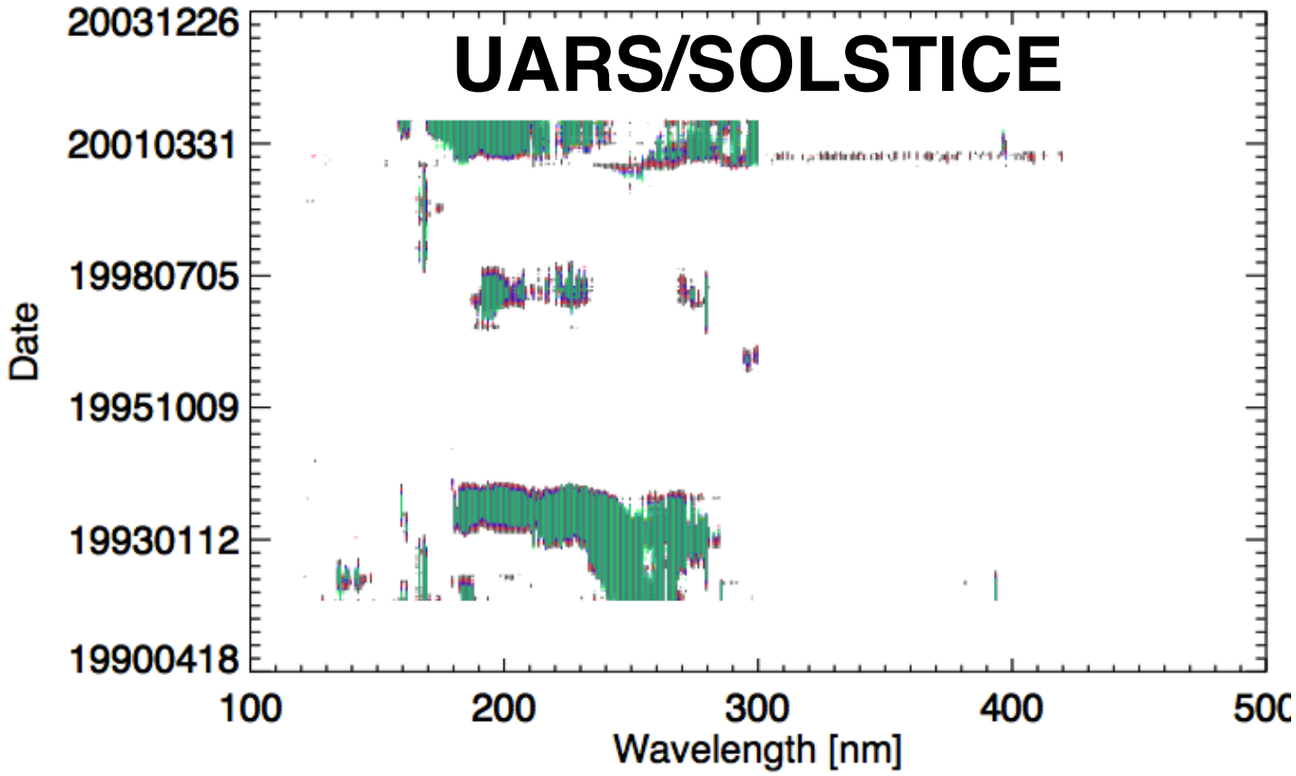
Automatique detection

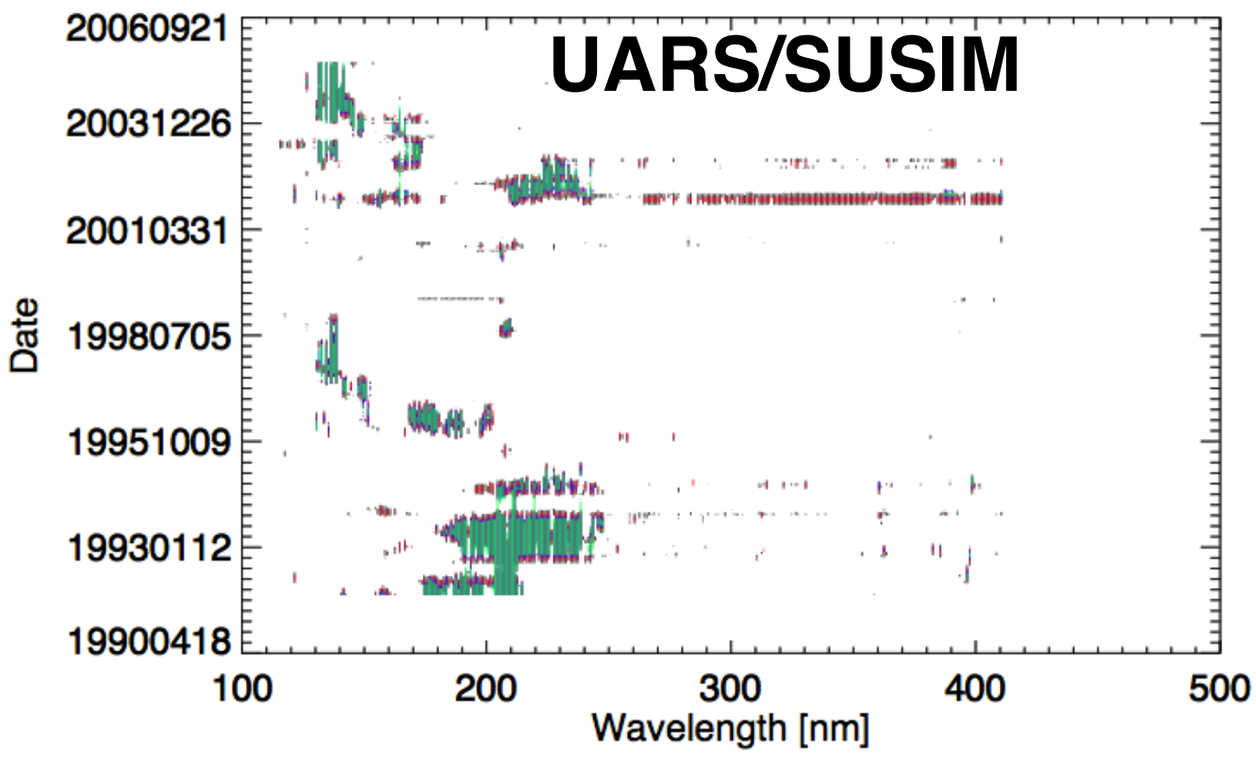
The deviation is detected at different time scale.



vertical bars indicate the detected deviations.
Colors correspond to different time scale

Analyse datasets.





1. The procedure indicate periods where there **might** be more uncertainty and where we need to look at.

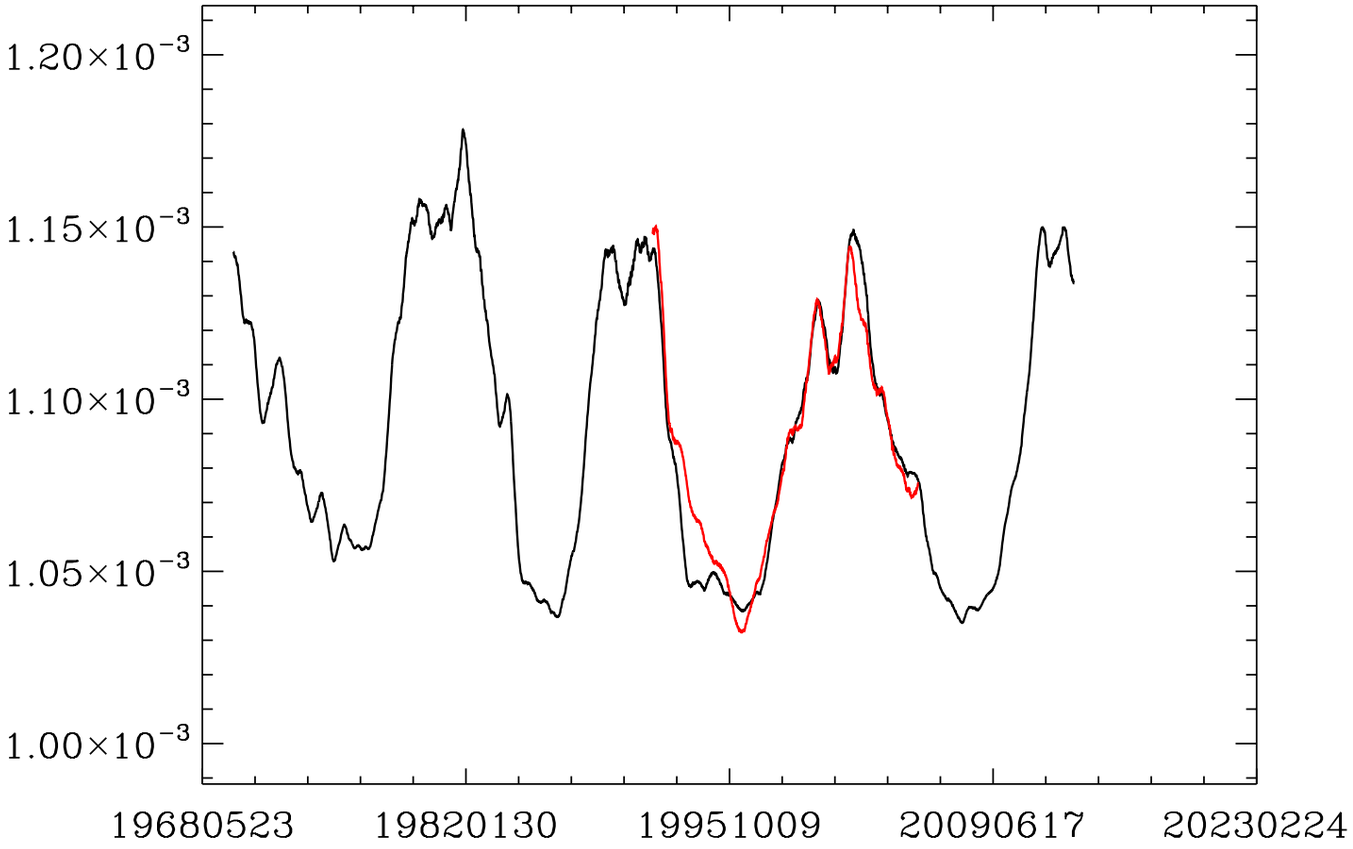
2. We ask for feedback to the instrument team who can confirm or not the dubious behavior of the data.

3. The information should be made accessible to users: solar physicist and climate community.

Your feedback on this is very welcome !

Compare long term variations

How do we compare them ???



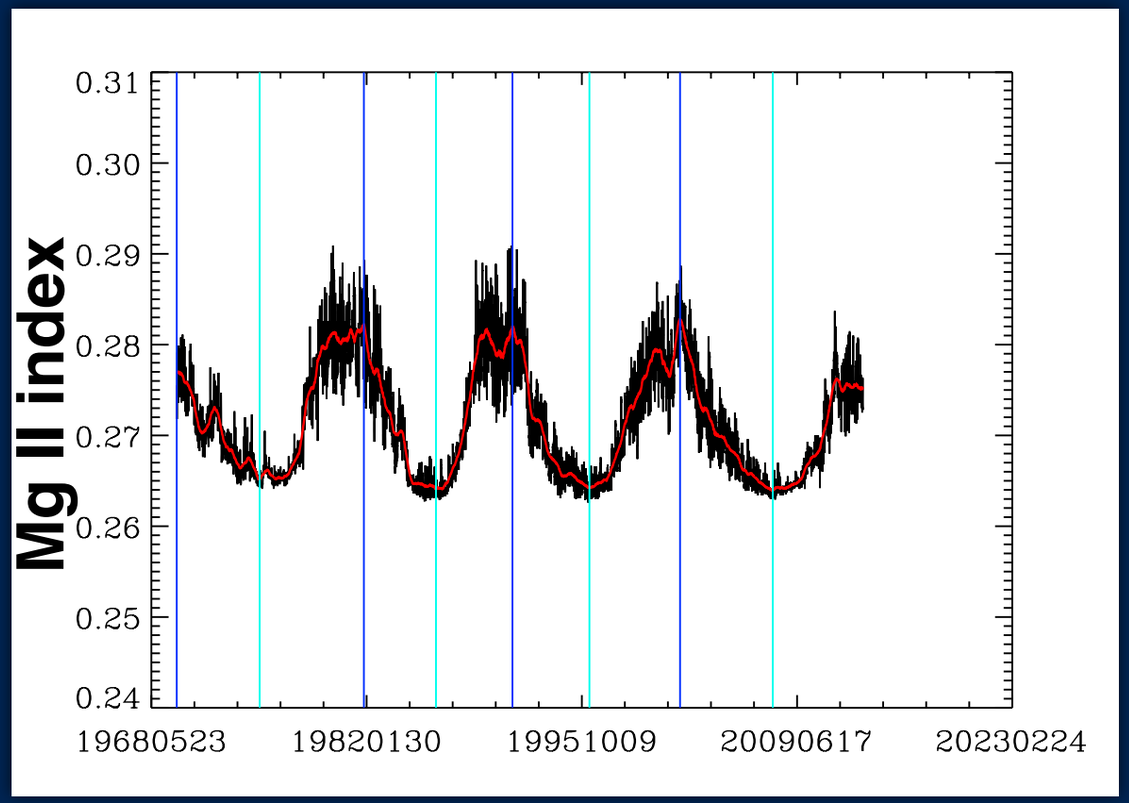
We need to define a good measure…

I am let with distance and min/max ratios

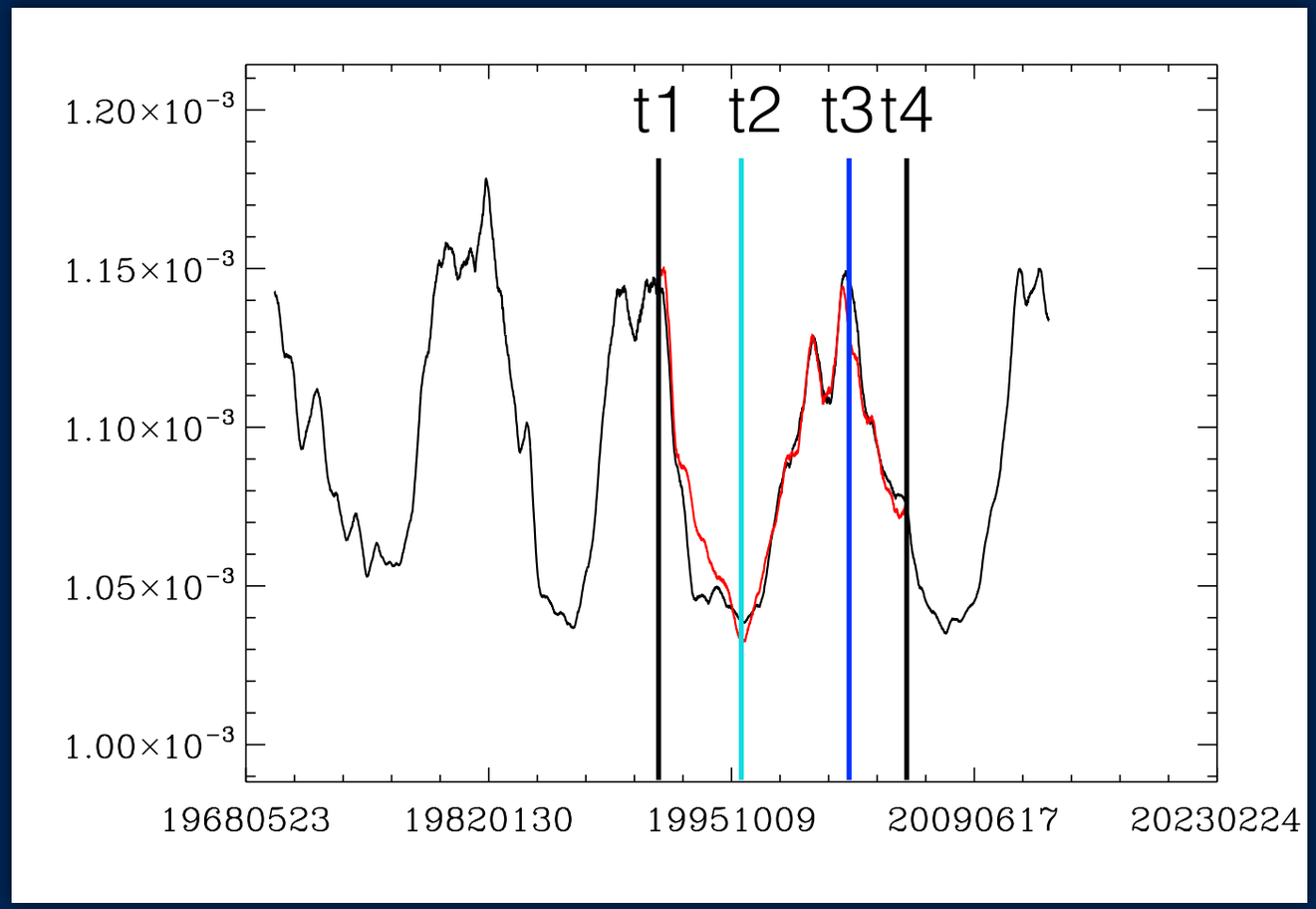
$$Err_1 = \frac{\langle I_{obs} - I_{mod} \rangle_{\min,\max}}{I_{obs}(\max) - I_{obs}(\min)}$$

$$Err_5 = \frac{I_{obs}(\max) - I_{obs}(\min)}{I_{mod}(\max) - I_{mod}(\min)}$$

Define min and max

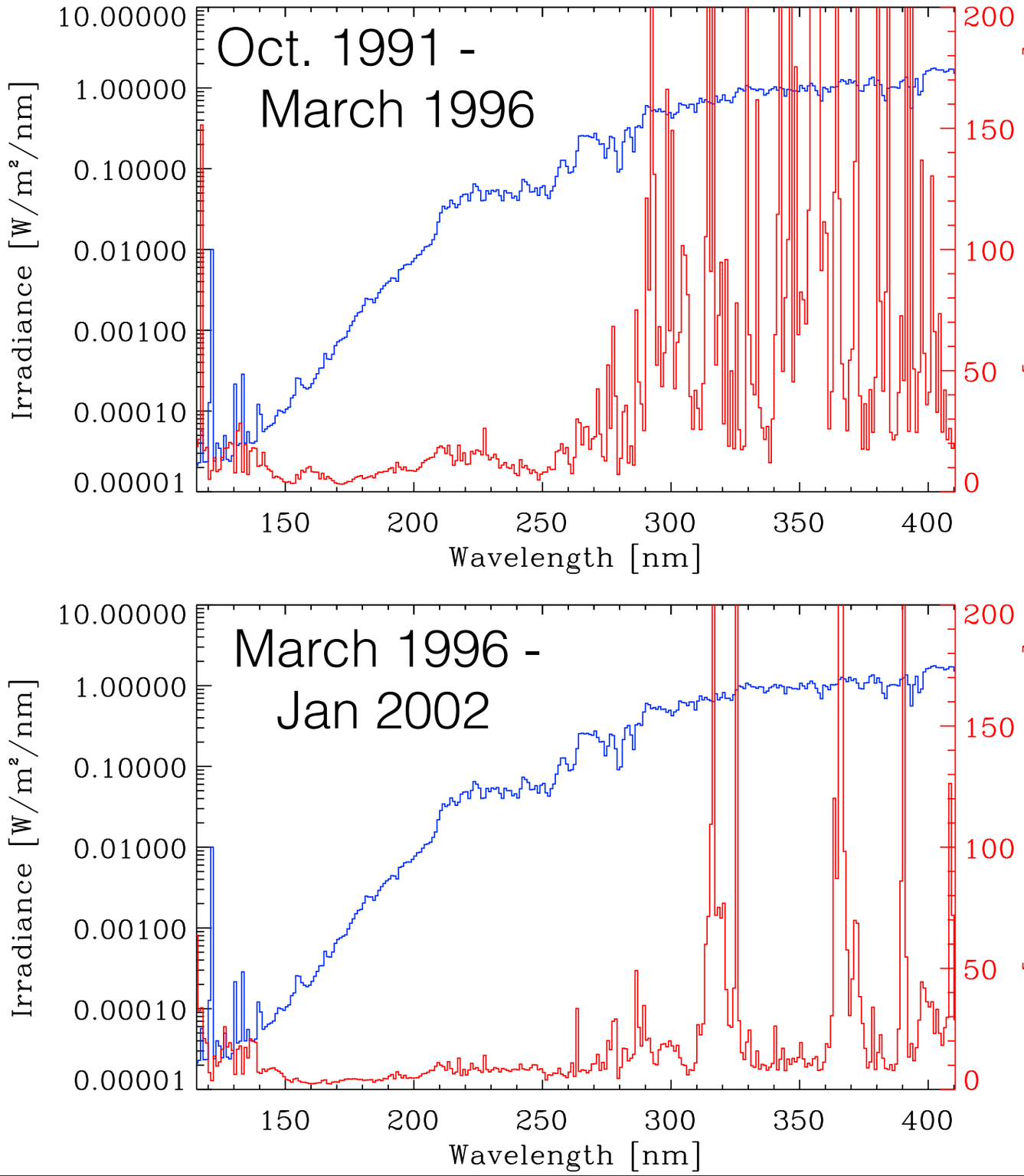


Minimum and maximum of the cycle determined with Mg II index.

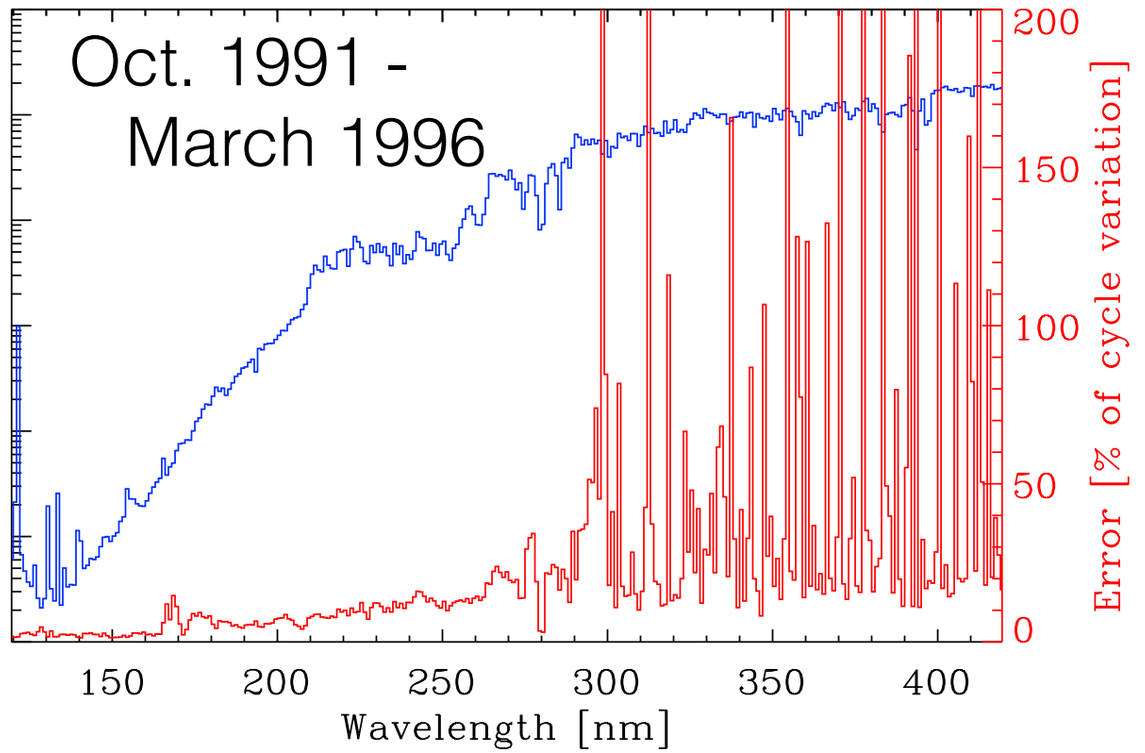


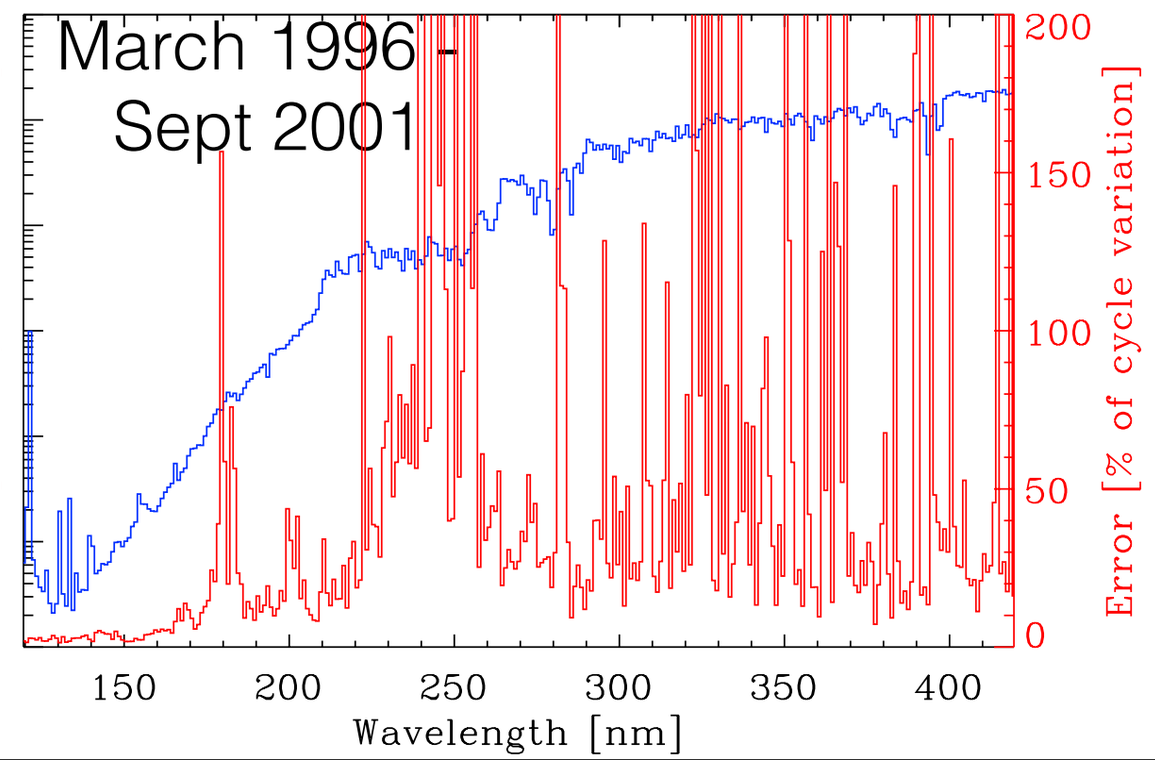
Trend assessment $\frac{\langle I_{obs} - I_{mod} \rangle_{\min,\max}}{I_{obs}(\max) - I_{obs}(\min)}$

UARS/SUSIM



UARS/SOLSTICE

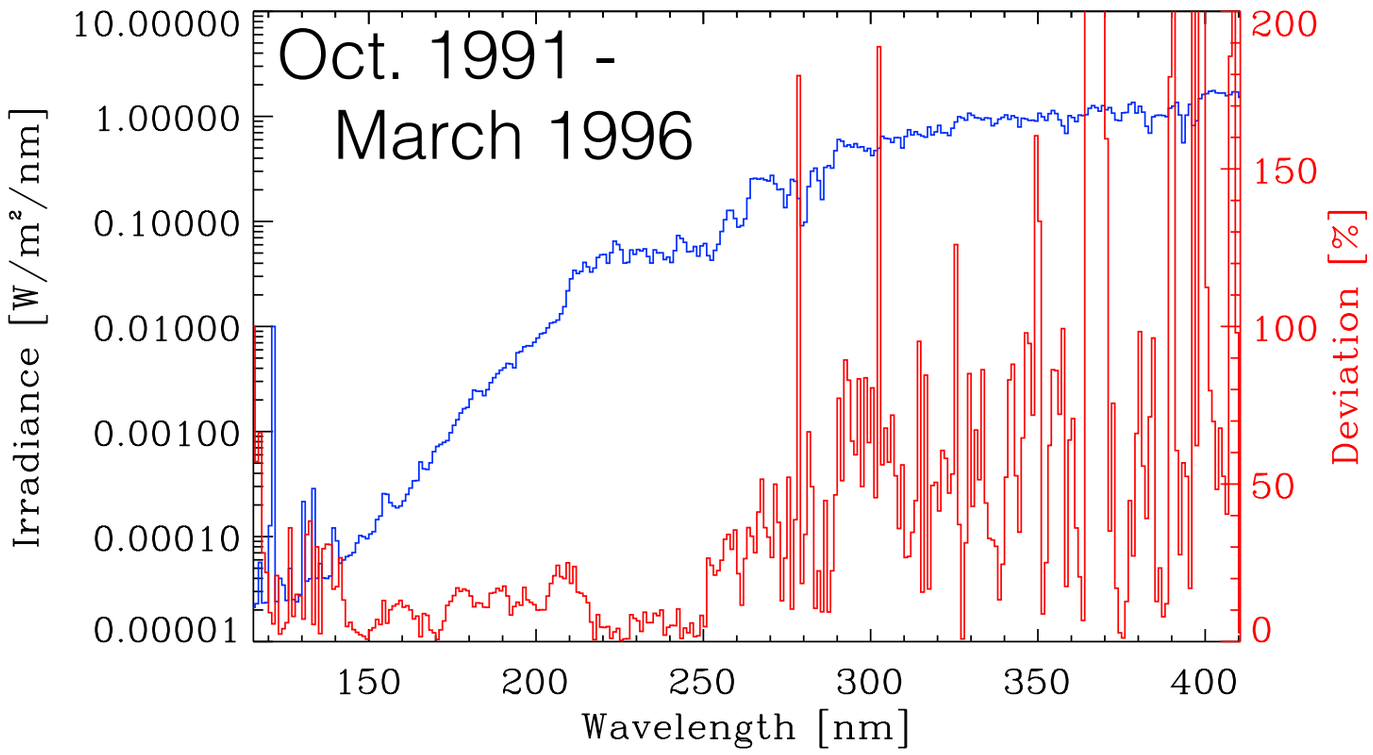




Trend assessment

$$\frac{I_{obs}(\max) - I_{obs}(\min)}{I_{mod}(\max) - I_{mod}(\min)}$$

UARS/SUSIM



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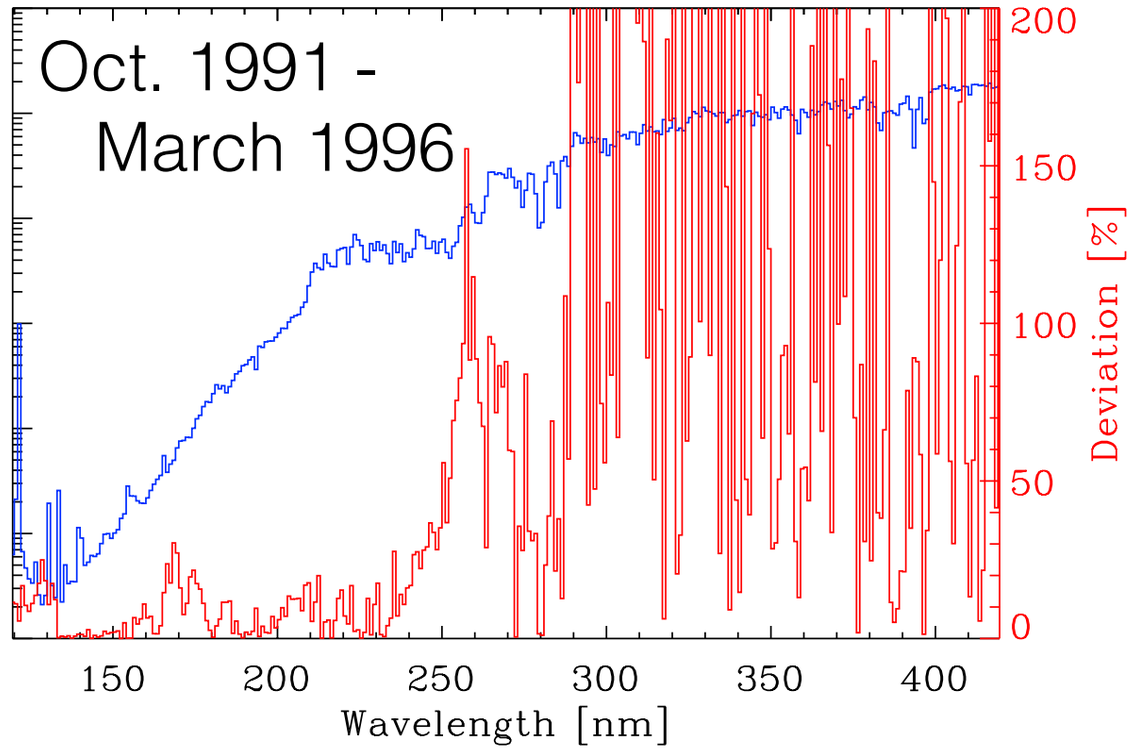

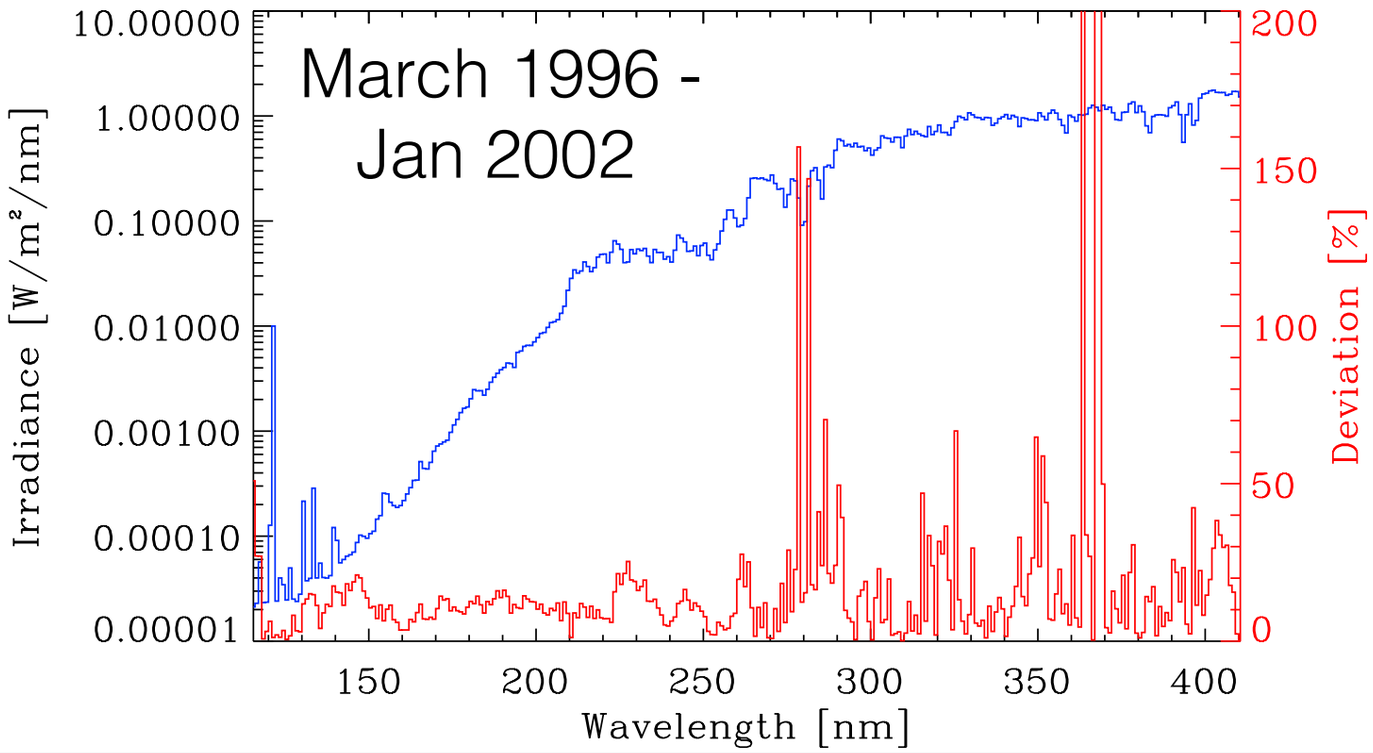

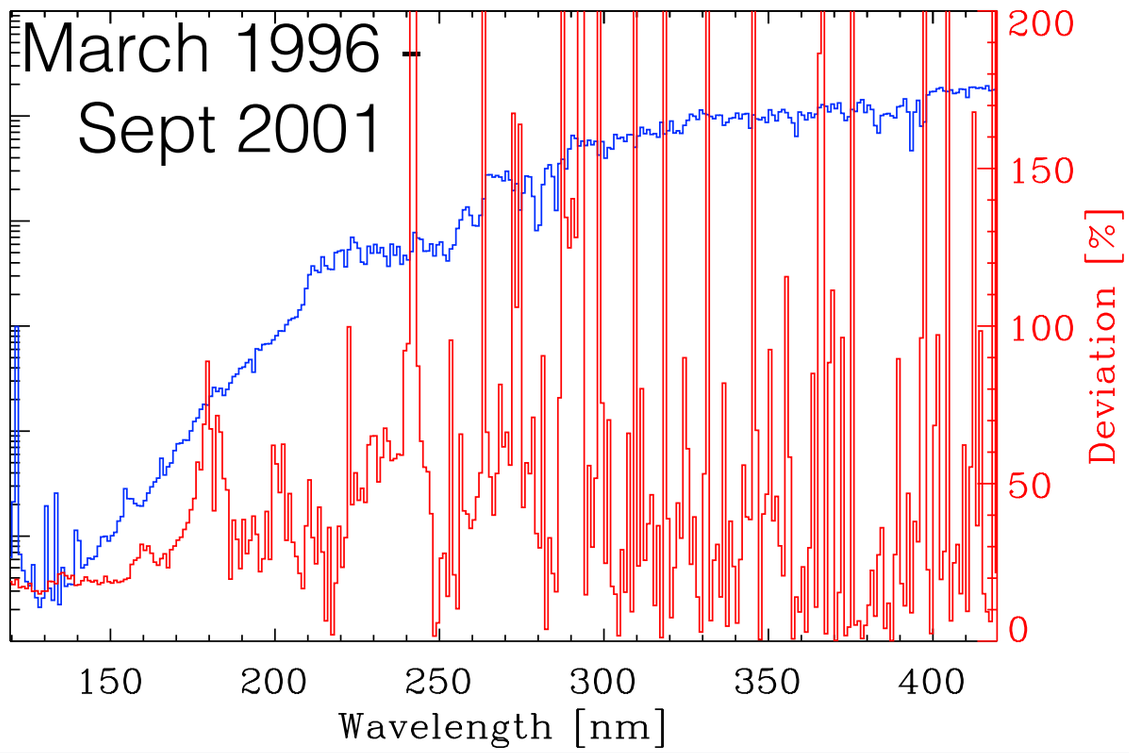

Trend assessment

$$\frac{I_{obs}(\max) - I_{obs}(\min)}{I_{mod}(\max) - I_{mod}(\min)}$$

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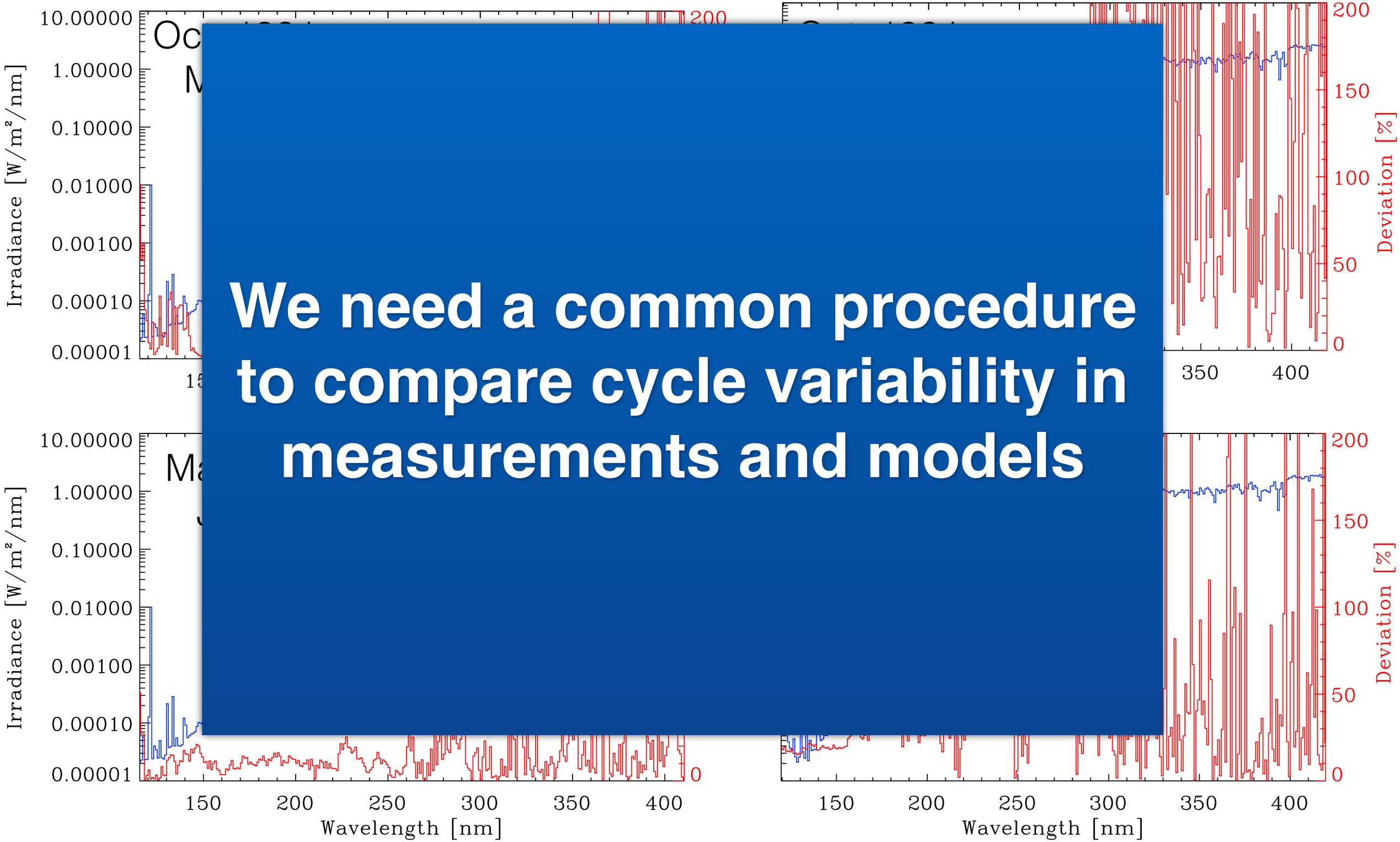
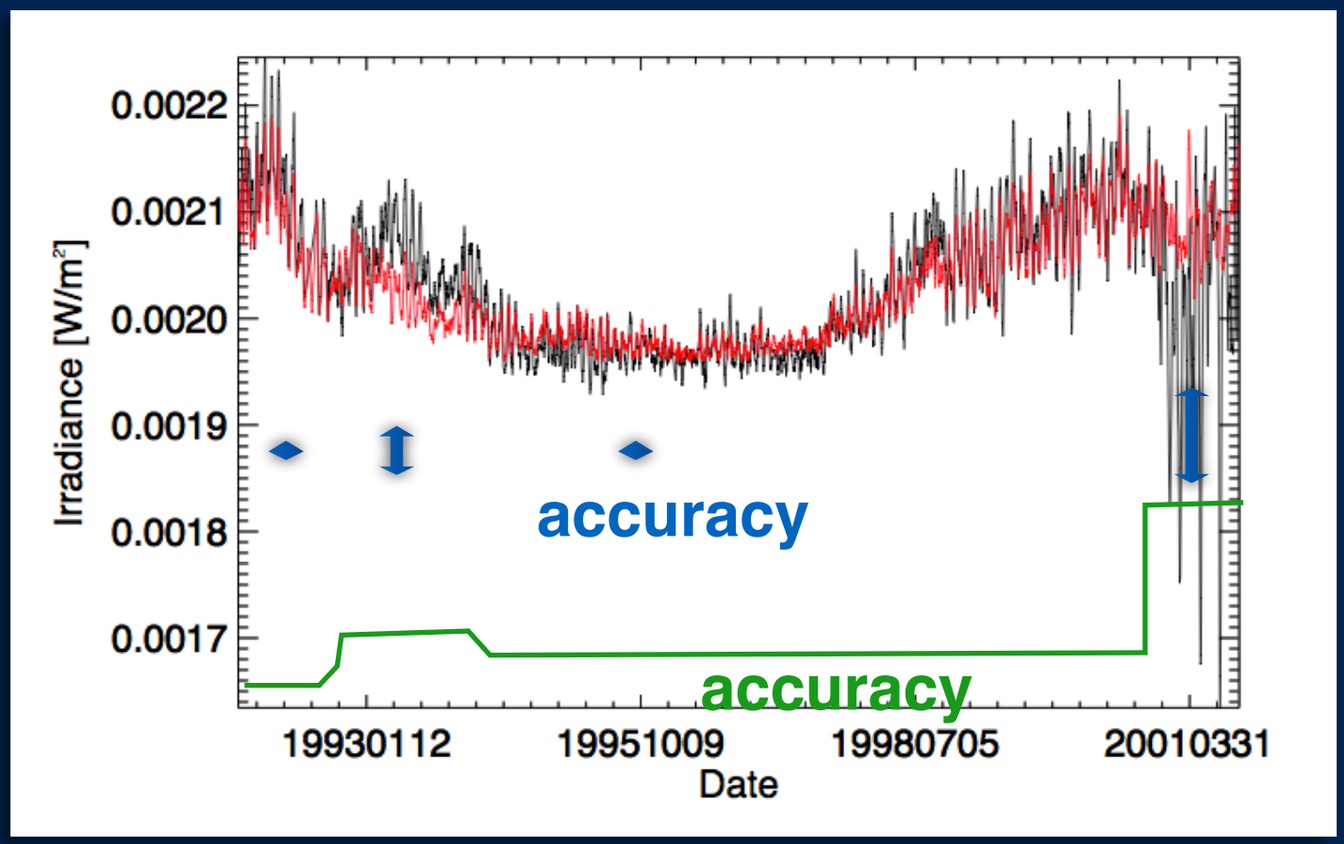


We need a common procedure to compare cycle variability in measurements and models

What next ?

1. Conclude on methods and parameters.
2. Analyse datasets and contact instrument teams.
3. Decide on how to reflect this in SSI measurements uncertainty.



What next ?

1. Conclude on methods and parameters
2. Ana ms.
3. Dec nents unc

Should accuracy/stability characterization depend on time ?

Conclusion

We aim at providing an uniform assessment of available irradiance datasets.

- Common format, gaps, outliers removal.
- We developed a proxy model with good performances
- Detection of residual instrumental effects in SSI time series.
  - Look at deviation between data and proxy models are various scales.
  - Evaluate with the knowledge of the instrument if this can be of solar origin or not.
- Comparison of the longer term.. need to define a COMMON measure.
- Share the information.

- **Your comments and contributions are very welcome !**

thank you