Solar Spectral Irradiance: lyman Alpha, MagnEsium II, and Sigma k proxiEs (SSIAMESE)

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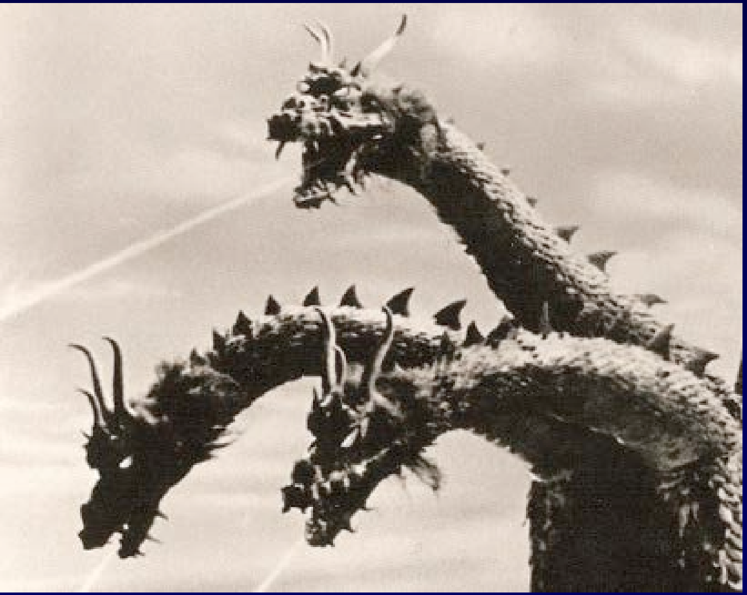
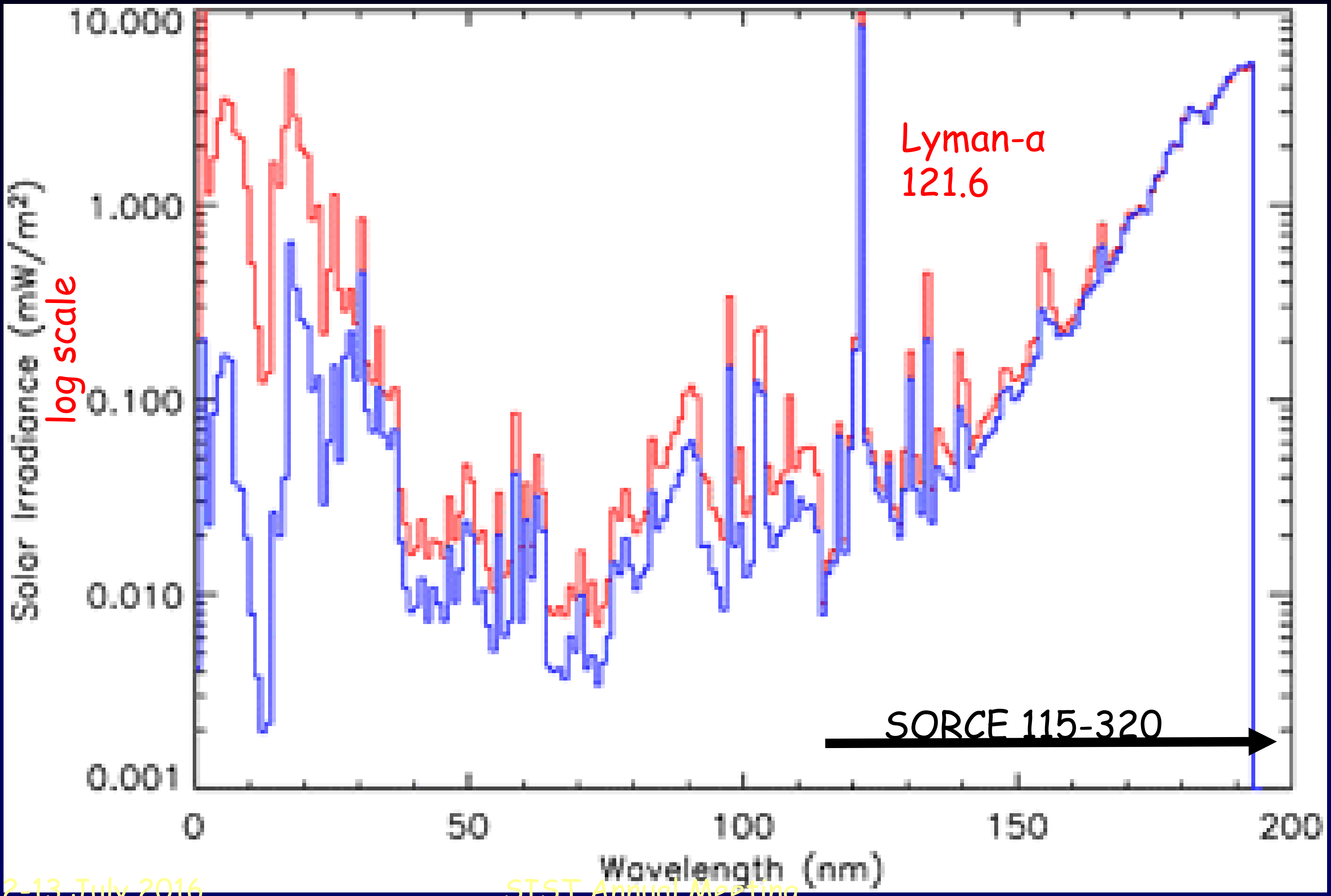
SSIAMESE Objectives

- Improve the Lyman alpha composite
- Improve the Magnesium II composite
- Improve the SFO proxies



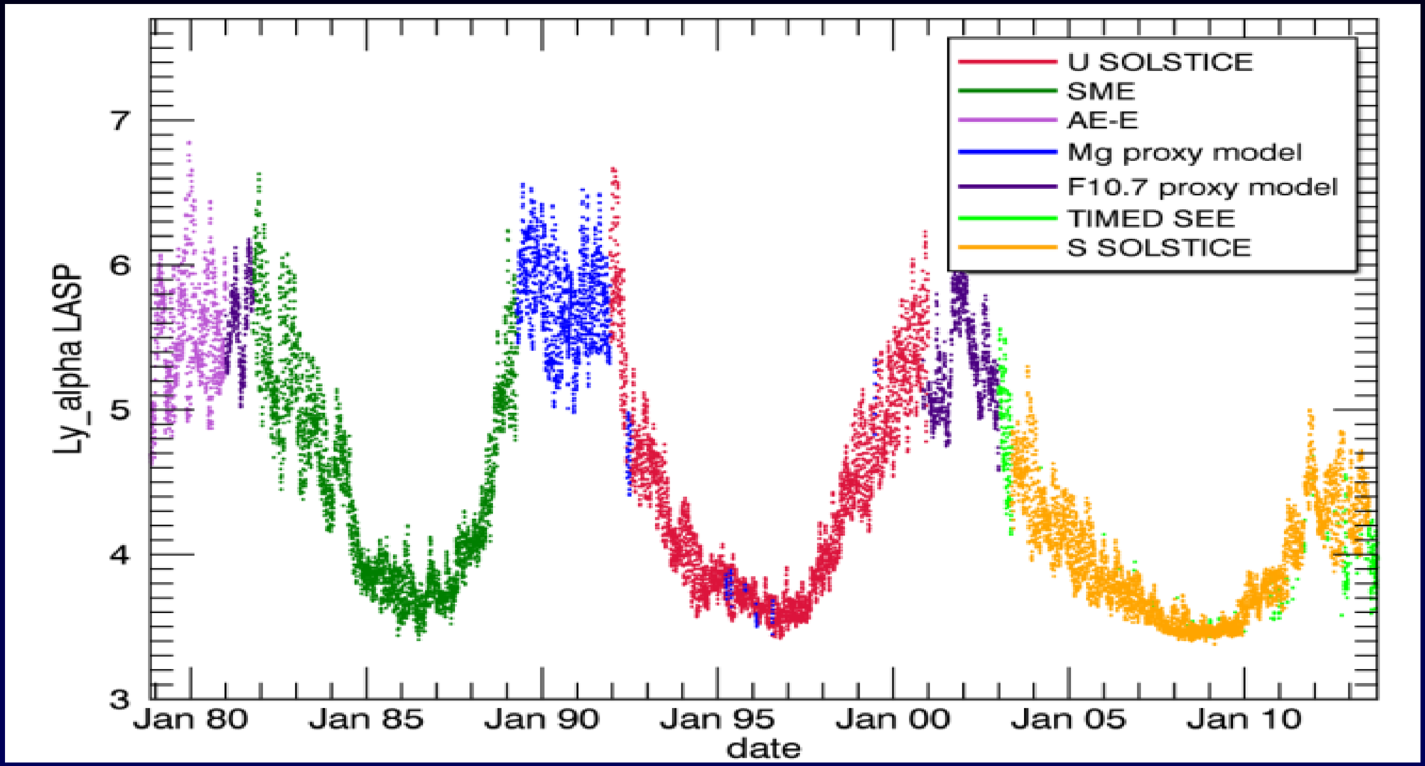
i.e. Untangle the Solar Magnetic Field

EUV spectrum with Lyman-a



TIMED SEE 28 October 2003: https://www.asr.ucar.edu/2004/HAO/tiso.html

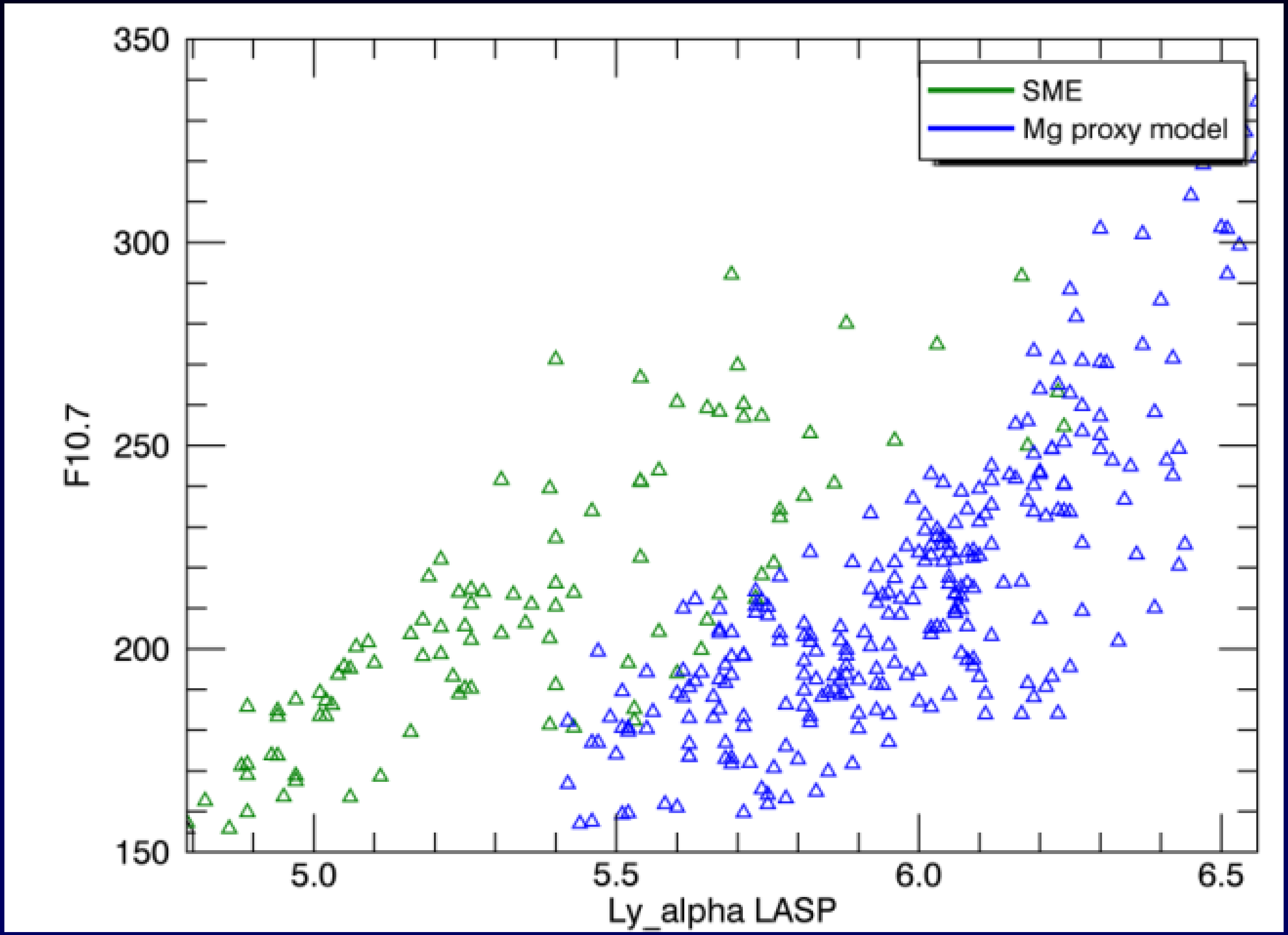
LASP Lyman-α composite



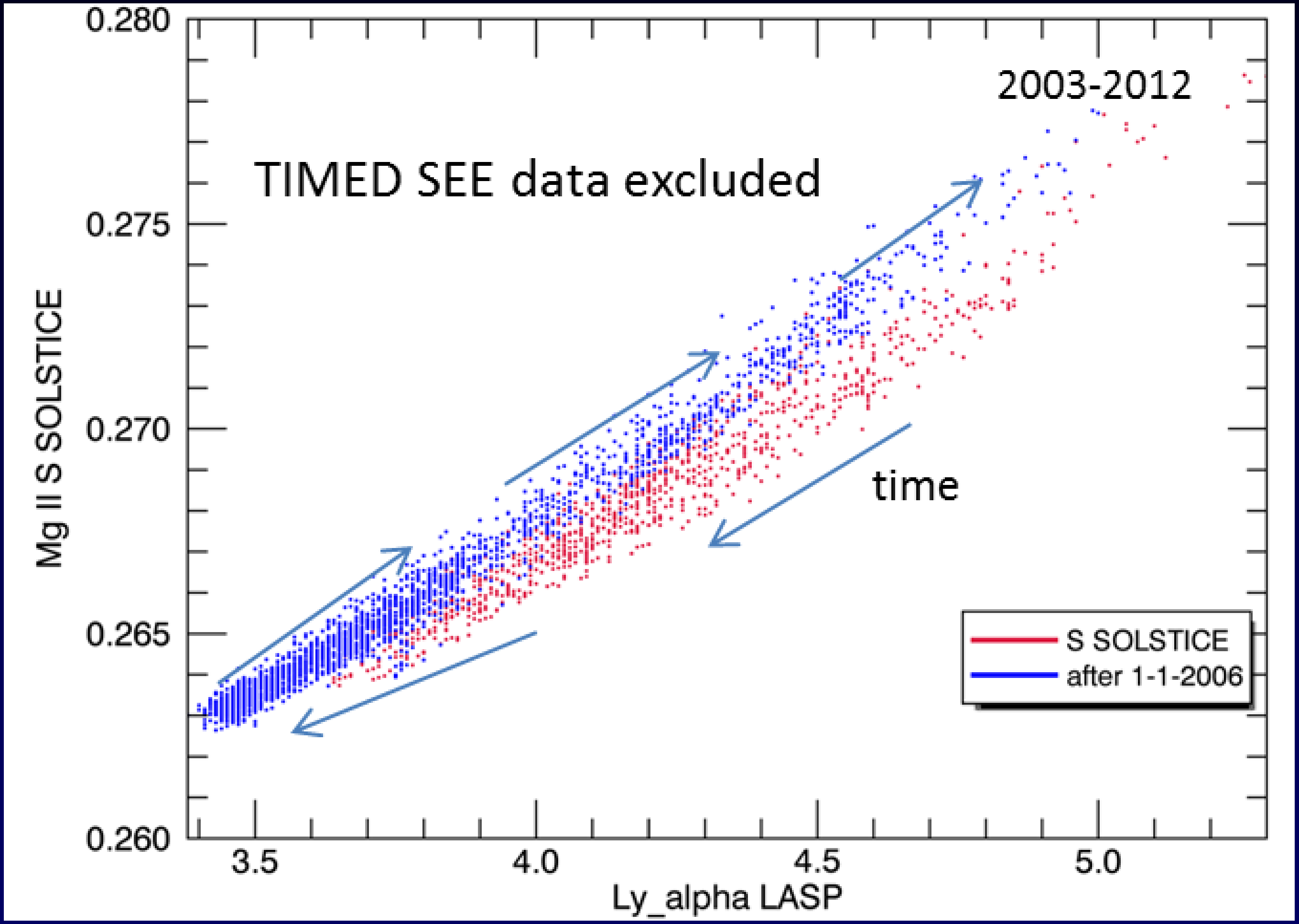
Woods and Rottman (1997)
Woods, T.N., Tobiska, W.K., Rottman, G.J. and Worden, J.R. (2000)

Daily composite, goes back to 1947, uses proxies to gap fill
Scaled to UARS SOLSTICE (4% offset relative to SORCE SOLSTICE)

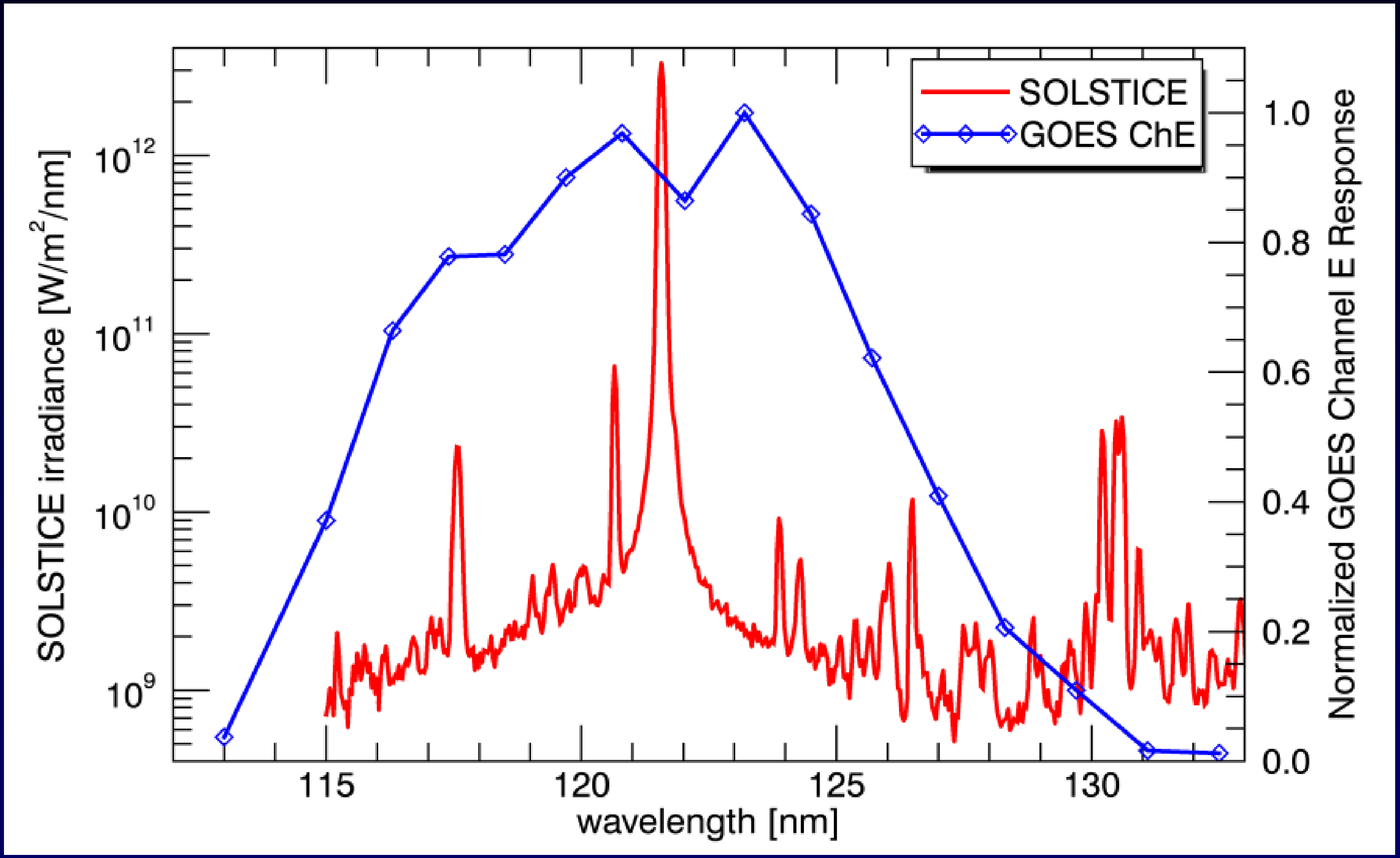
Calibration Issues?



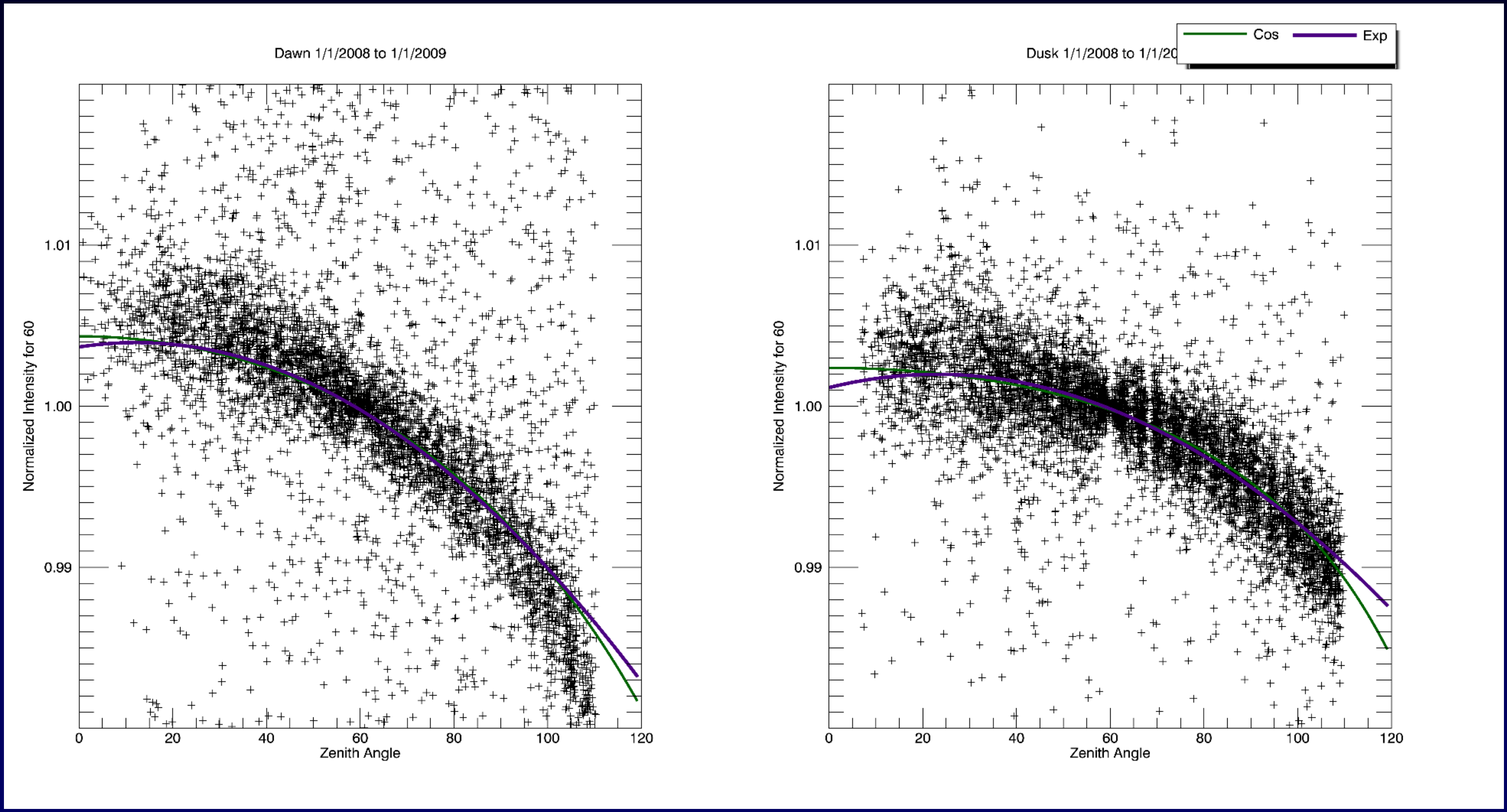
Trend Issues?



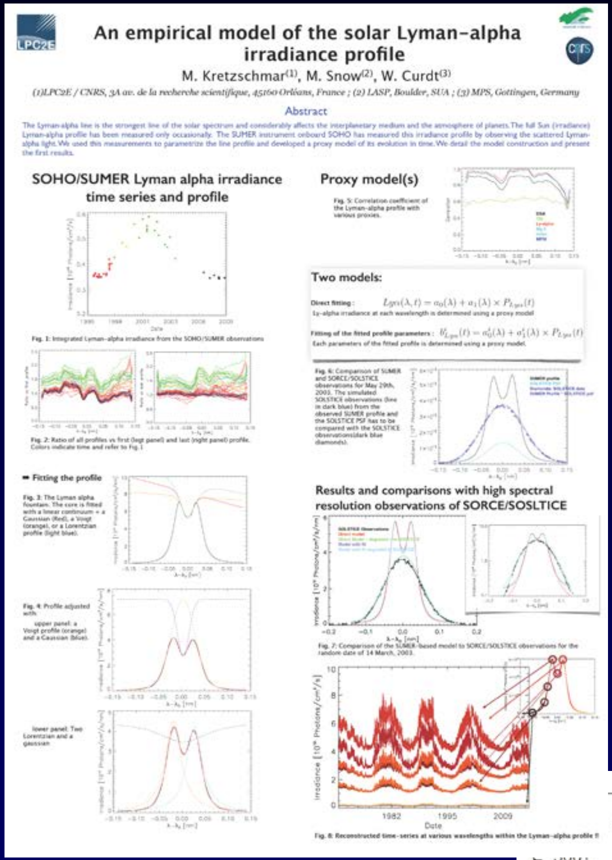
New Data Sources

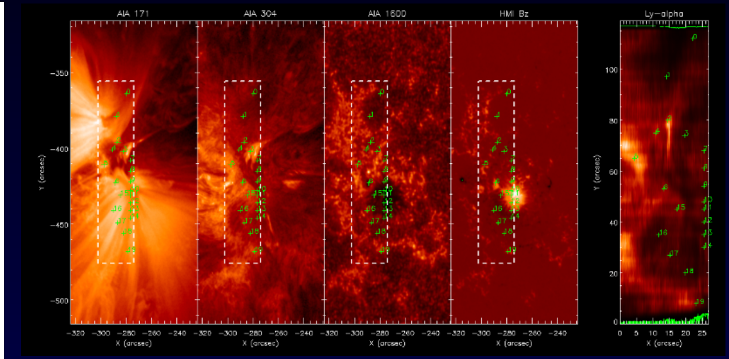


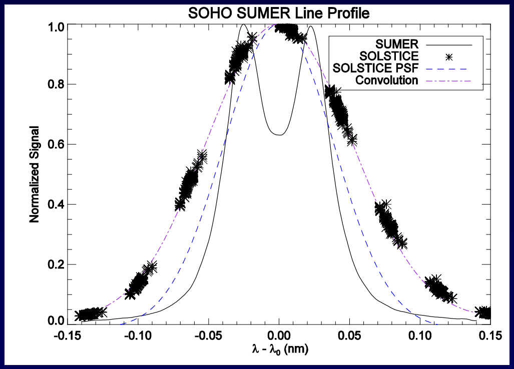
Correction for Exosphere

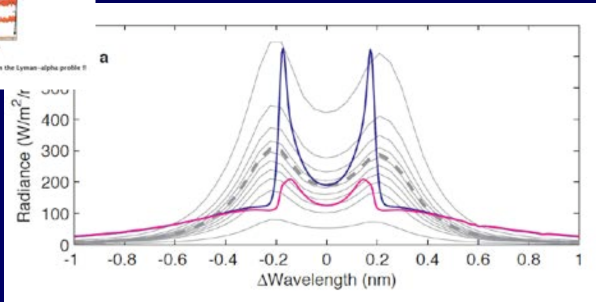


ISSI Team -- SHAPE

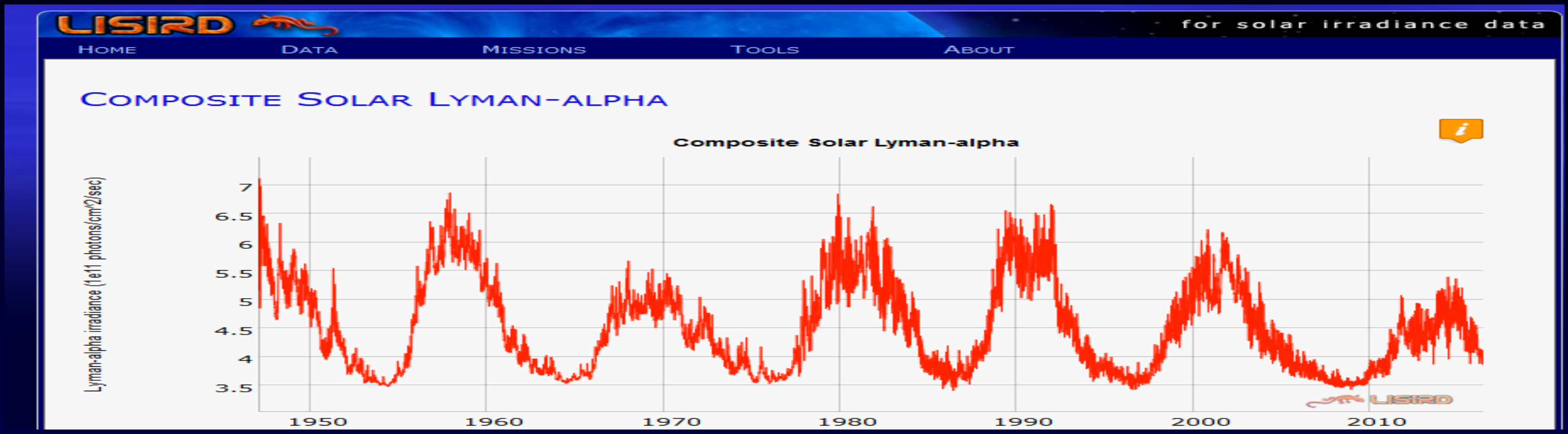








Year 1: Prepare data



1. Optimize SORCE SOLSTICE calibration.
   - Compare to GOES 15 to check post-2014 calibration. -- Comparison is good.
   - Determine correction due to H scatter in exosphere. -- In progress.
2. Rescale (degraded) GOES to SOLSTICE. New data set for composite. -- Code ready.

Challenge: How to select scaling factors for various data sets?

Scaling over different time periods yields different results due to

- degradation of instruments
- non-linear scaling as a function of solar activity and instrument bandwidth.

Lyman-α composite: Years 2 and 3

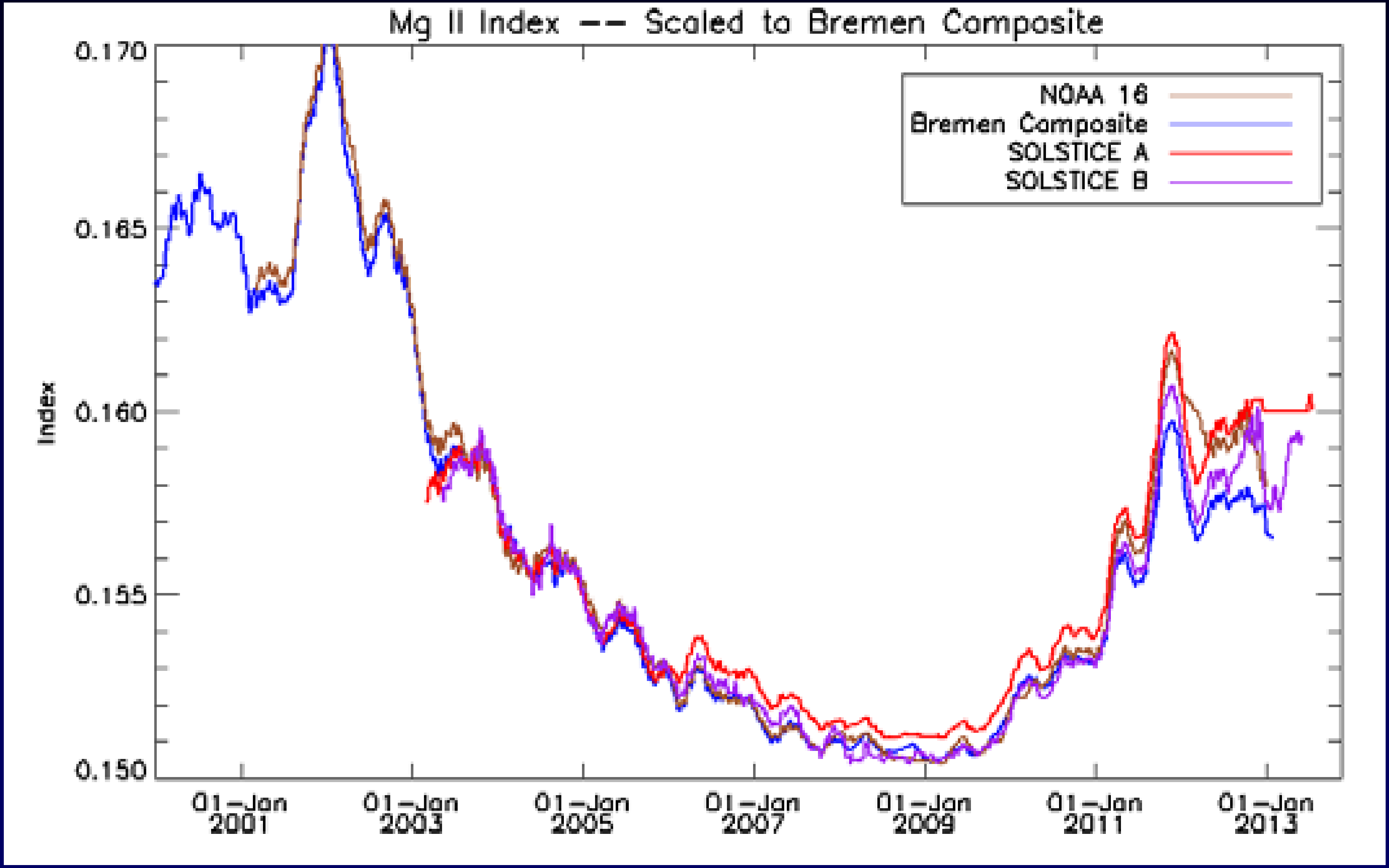
Year 2: Proxy Models, Make Composite

1. Readjust Mg proxy model. This will fix jumps in 1989 and 1992. Use Bremen data.
2. Readjust scaling factors for other data sets to account for switch to SOLSTICE.
3. Create composite.

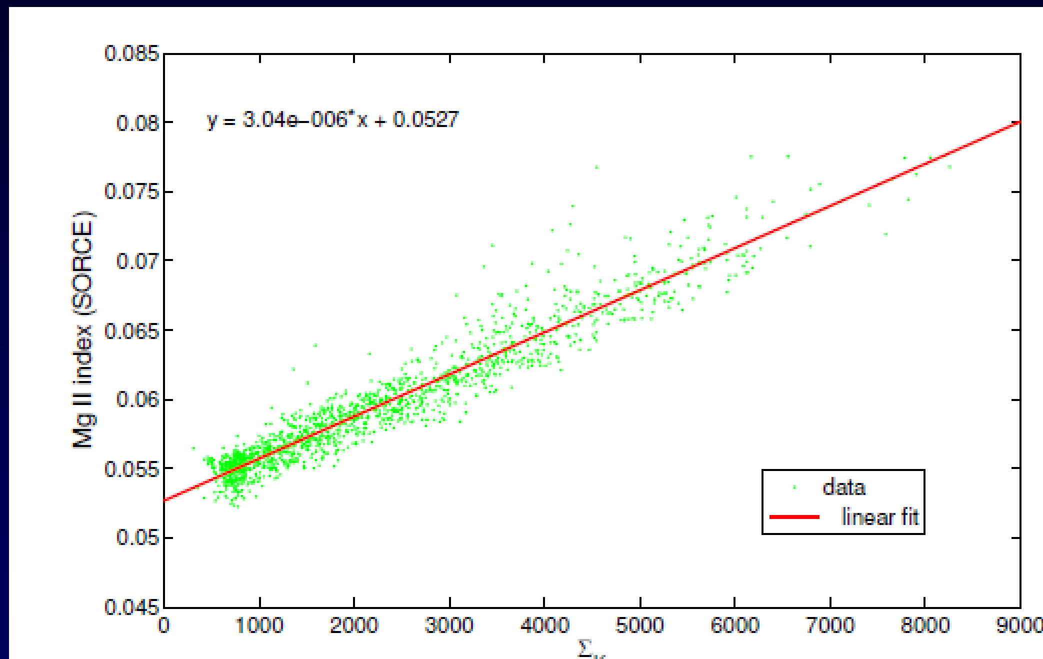
Year 3: Improve Composite

1. Add GOES-R data.
2. Study possibility of creating 'master' Lyman-α reference spectra for different activity levels.

MgII is Perfect, right?



Ground based CaII may help

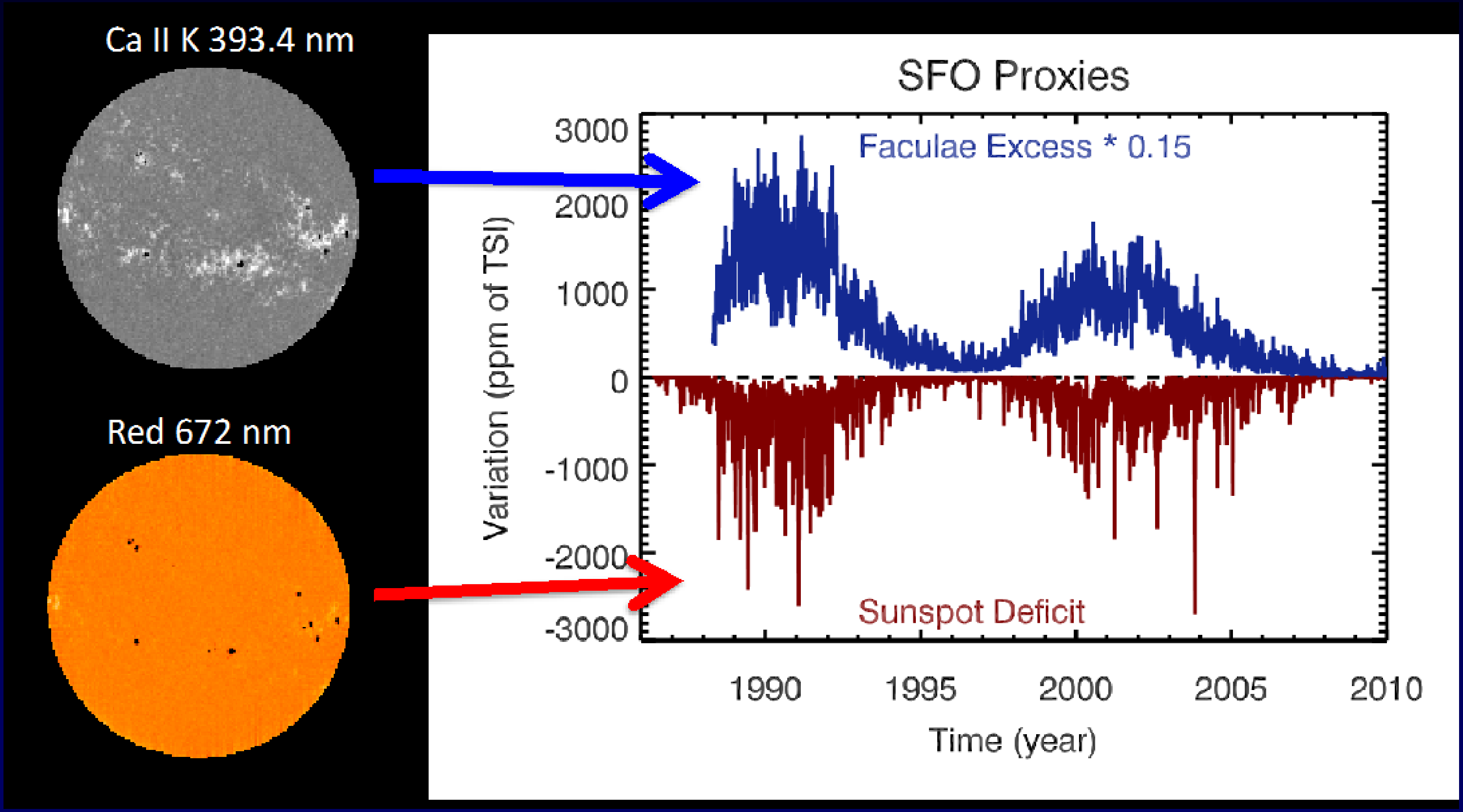


Unlike space-based observations, the SFO observation record goes back to the mid 1980s with few calibration shifts. Correlation before and after space instrument changes can help to better constrain the composite.

Magnesium II Direction

- Use SFO excess as reference dataset to better guide preferences in the final composite
- Use Bayesian inference and wavelet analysis to identify artifacts

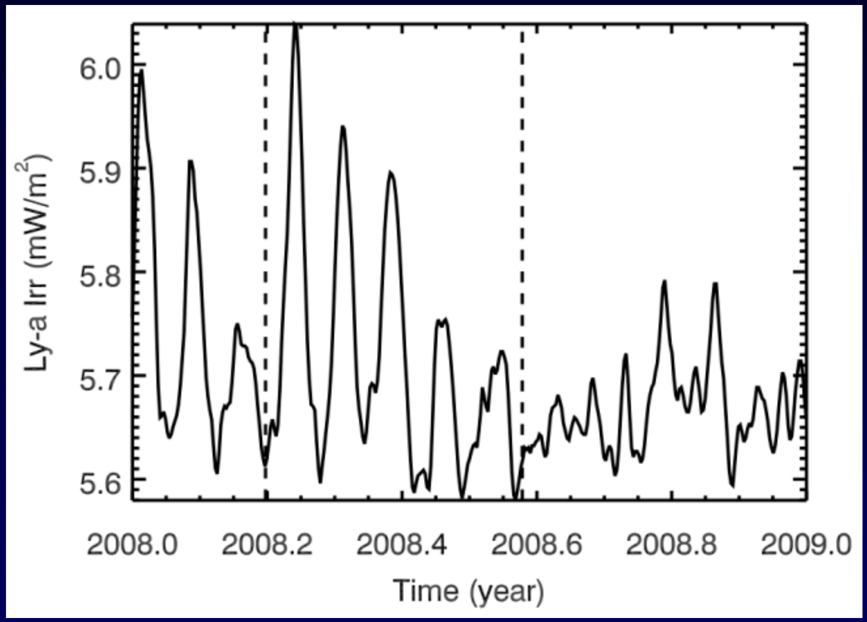
SFO Sunspot Deficit and Facular Excess

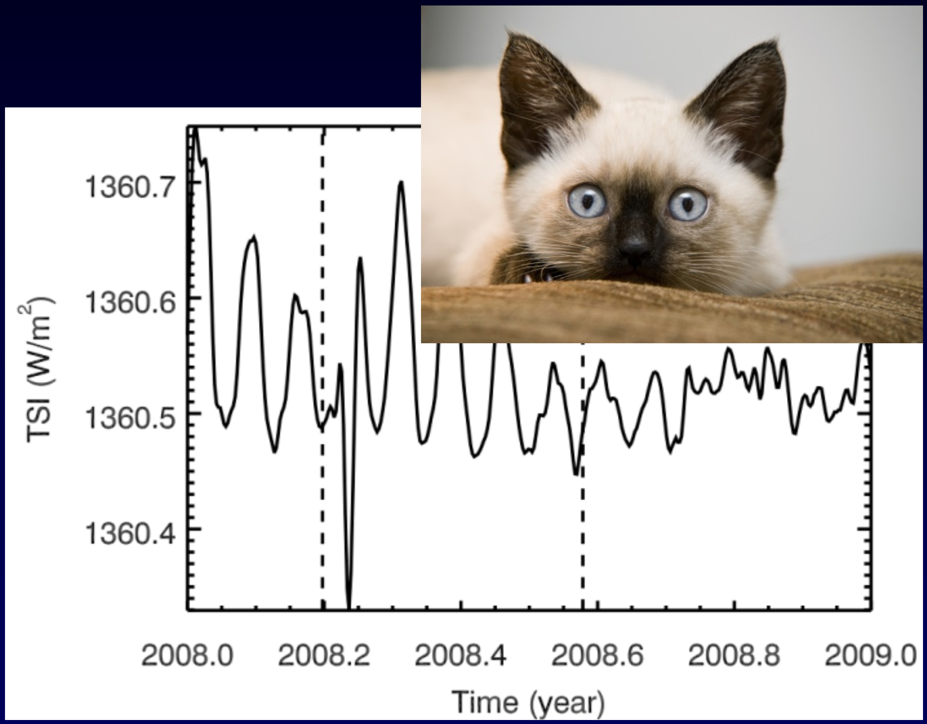


SFO Direction

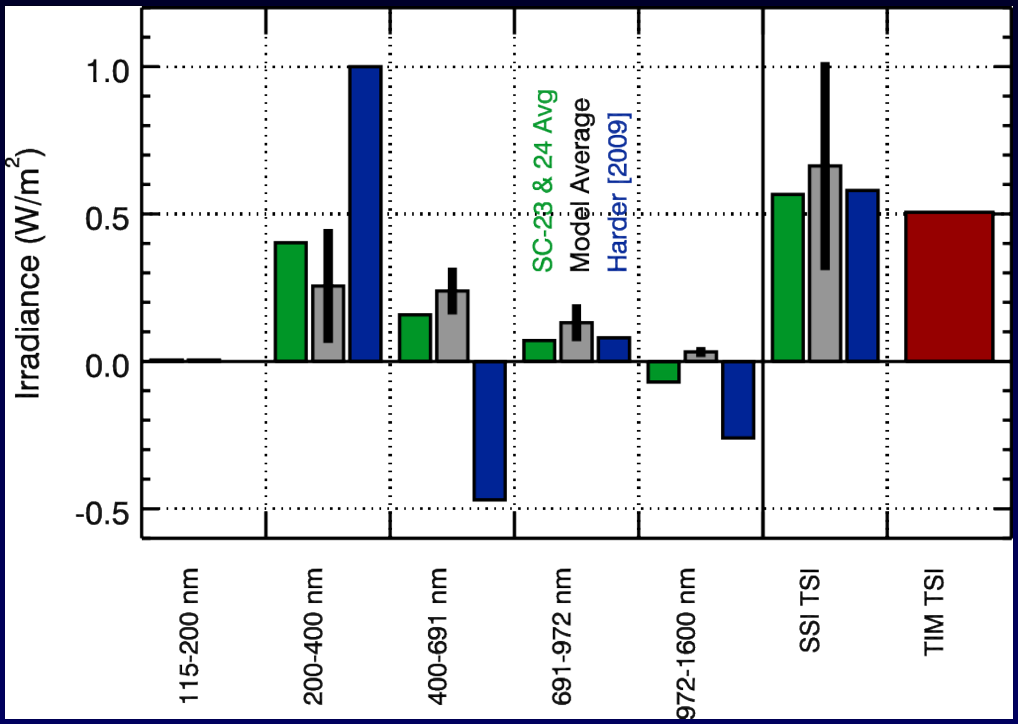
- Make SFO proxies more widely available to the community through LISIRD
- Quantify improvements to proxy models from using SFO deficit rather than USAF group areas (CLV, undercounting small spots, etc.)

First SSIAMESE ~~result~~ kitten





Spectral variation



Woods et al. Solar Physics 2015

SSIAMESE Tasks: Year 1a

- Revise SORCE SOLSTICE Ly-a to correct for anomalies
- Rescale TIMED SEE to match SORCE rather than UARS
- Revise analysis of SDO EVE MEGS-P
- Reanalyze GOES EUVS-E
  - Scale to revised SORCE SOLSTICE
  - Exclude geocoronal artifacts
- Rescale UARS SOLSTICE (4% change)
- Determine proper scaling factor to convert broadband GOES to Lyman alpha flux as a function of activity level.

SSIAMESE Tasks: Year 1b

- Ingest SFO sunspot and faculae data into LISIRD
- Establish relationships between MgII index and SFO Sigma K (excess)
  - Identify differences between MgII datasets using SFO Sigma K as a common reference
  - Use Bayesian approach to detect and correct artifacts in MgII
- Establish long term “third” proxy needed to model SSI variability: SFO excess and deficit plus TSI
- Attend annual SIST workshop

SSIAMESE Tasks: Year 2

- Create (and publish) new MgII index composite
- Update Lyman alpha proxy model used to fill gaps in the composite (both F10.7 model and MgII model)
- Update early Ly-a datasets using new scaling and models (and other SIST progress, e.g. SME)
- Understand contribution of SFO indices (long and short term excess and deficit) to revised proxy model.
- Attend annual SIST workshop

SSIAMESE Tasks: Year 3

- Create new Lyman alpha composite
  - Distribute through LISIRD
  - Publish
  - Incorporate GOES-R series when it becomes available (2016+)
- Improve understanding of SSI solar cycle variation with improved proxies and publish
- Attend annual SIST workshop

Overall Goal