The Sun as a Star: Flare Response of the FUV Continuum

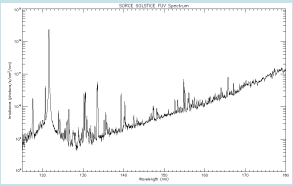
Willow Reed and Martin Snow LASP, University of Colorado Boulder

Introduction

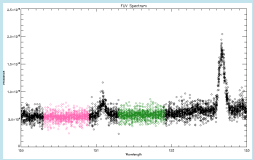
Solar flares are energetic events that radiate at all wavelengths. However, the spectral distribution in the ultraviolet of this energy is not well known. We looked into how the spectral distribution in the Far Ultraviolet (FUV) irradiance spectrum (115 nm to 180 nm) is affected by X-class flares. In particular, we looked at the response of the FUV continuum.

Flares and FUV Continuum

- Flares are built up magnetic energy that is released into the solar atmosphere.
- While most of the energy is released into the solar corona, a portion of the energy impacts the chromosphere, which is what we aim to detect in this project.
- Far Ultraviolet is considered from 115 nm to 180 nm
- FUV continuum are formed in the chromosphere
- We looked at 150 nm to 153 nm for our project.



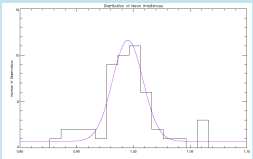
The Sun's Natural Variance



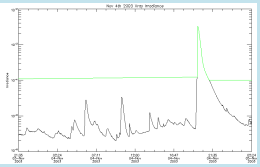
In order to be able to see how significant the flare response would be to the FUV continuum, we first wanted to measure the natural variance of the Sun.

- First, we looked at a solar minimum year (2008)
- Found two sections that were wavelength regions that were continuum only.
- Found the average of each scan in both the highlighted areas

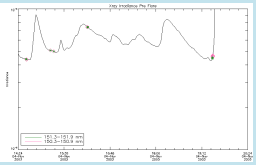
- After averaging all the scans, we created a histogram of that data
- To find the best half peak center point, we fit a Gaussian curve to the histogram (represented in purple)
- Found the natural variance of the Sun to be 0.017, which we later use as the error.
- The chi-squared value was near 1

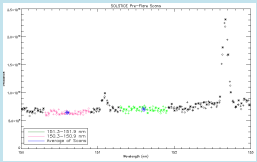


Flare Data: November 4th 2003

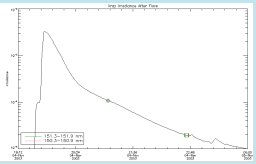


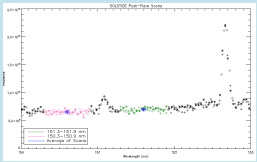
Our analysis looked at five x-class flares in an active solar year (2003). These plots show what we found for the x-class flare on November 4th, 2003. This plot is the x-ray irradiance as a function of time. The green line indicates when there is an x-class flare.





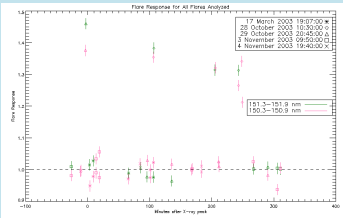
These plots are taken from a time interval before the flare. On the right, we plotted the irradiance, and showed each scan that was found. The colors represent the section of spectrum we pulled data from, and each symbol is a scan. On the left, we plotted each scan in the continuum, and then averaged those scans (represented in blue) to make sure there were no outliers.





Looking at the time after the scan, we again looked at the irradiance over time (right), and irradiance over wavelength (left).

Flare Response



Above is our final results for all five x-class flares. The dotted line represents where there is no change in the FUV continuum to the flare. As we expected, there was little change from the flares, however there are a few large changes, especially on October 28th, 2003. With further research, we will look at why there are a variety of different responses and further our understanding of the spectral distribution of solar flares.