Introduction

The chromosphere, the transition layer between the photosphere and the corona, is thought to house small reconnection events before a flare event. The chromosphere is the region where high-temperature plasma interacts with the cooler photosphere. We use data from the MMS Ha CCD Imaging Spectrograph, specifically a database of high-cadence Ha images and spectra of the Sun's active regions. By sampling points in time that are directly before a flare or remain quiet for hours to days, we will be able to effectively compare the populations and how they change over time. The use of this data will enable us to look at activity before a flare that may differ in nature from a region that will remain quiet. Differentiating between the two will allow us to understand basic physical differences between the two populations and hence improve accuracy for flare prediction. High temporal cadence of the instrument allows us to show small intermittent changes that could possibly signify a developing flare. We will be sampling the data to measure characteristics such as line width, line depth, and Doppler shift – taking full advantage of the presence of the Ha well-sampled and widely sampled spectra (±9 Å). We parameterize these values and apply them to discriminant analysis to see if we can successfully describe pre-flare and pre-quiet chromospheric characteristics.

How we sample the data and things to consider:
- Determine quiet vs event
- Event is defined by X-ray increase to B 5.0 level or greater (5 x 10^21 W m^-2)
- Quiet event times are chosen within a 4 hour block of no activity
- Buffer ranges from 6-15 minutes.
- Compare what the sun is like normally to determine differences characterizing pre-flare activity.
- The two hours of clear at least 30 minutes after a previous event (if one exists).
- We also account for multiple events that occur one after the other.
- Sample size: 30 minutes
- Choose only one 30 minute slice during the 2 hour block (so as not to double count an event)

Parameters and Analysis

Within the 30 minutes there are scans, and a value is determined at each scan. Therefore, we can show change over time.

Below is an example of kurtosis and skew of the difference image distribution at every point in time. There is also a line fit to the data from which we can get a slope and an intercept (the two values used to represent the single value parameter).

Discriminant Analysis

Here, we use a method of statistical analysis that uses the calculated parameters to try and differentiate between two different populations (event & non-event). Utilize higher order statistics to differentiate between the populations.

The goal is to correctly classify as many events/non-events as possible and to perform better than simply using the event climatology.

References:

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