

So I have all this data. Now what?

Congratulations you have SID data! Now let's see what it means. After importing your data into a graphing program such as Excel, you should have a line graph that looks a little like a seismograph. It may look daunting at first but with the right key these graphs yield a tremendous amount of information about the Sun and how it affects the Earth. You will also find other more "local" events that interfere with the solar data but also provide us with information that is useful. You will be confirming your data with the GOES satellite data on the SEC online database. But before we get into that lets begin with the basics.

Let's Get Started!

With your graphs ready let's take a first look at the data. I suggest that you look at more than one graph at first and see what patterns there are. Every graph should have a distinct sunset and sunrise. For our purposes we are only concerned with the day time hours. Notice how the graph is sloped sharply downward at sunrise and sharply upward at sunset. The area between them is where we will be doing our flare hunting.

Now comparing a few graphs together what patterns in the data can you see? Is there a sharp spike every day at the same time or is the graph really spiky all the time? Get an eye for what your SID monitor is like. Some times data is more rounded and sometimes it spikes sharply, it really depends on what other "noise" your detector is picking up. Noise can't always be helped so it's a good idea to see what the background signature of your SID monitor is.

The next step is more fun. It's kind of like a treasure hunt. Look at your graphs and see if there are any large spikes in the data. They will rise very steeply come to a peak and then taper off. These are possibly flare signatures. As SID monitors our nemesis is "noise", interference from sources other than the sun. Sometimes "noise" is very clever and tries to look like a flare but there is a way to know for sure. We have to check with the data from the GOES satellites. They don't get the same interference that we do because they are in space. Now that you have taken a good look at your graph it's time to get on the internet. Go to this link for the SEC online solar data.

http://www.sec.noaa.gov/ftpmenu/indices/2004_events.html

Navigating the GOES Data.

On this page you will see a lot of dates. These are links to that days solar data. They read yyyyymmdd, so 20040615 is June 15, 2004. Above the dates you will see links to *Top level directory* and *To parent level directory*. These will take you other data pages on the SEC site. Try clicking around in the parent directory. You will also find the data for other years. If you get lost don't worry, you can always type in the hyperlink to get back to the 2004 events data.

Find the day you want to investigate and click on the link. You will find a page that looks like this:

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Product: 20040613events.txt  
:Created: 2004 Jun 15 0329 UT
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:Date: 2004 06 13
# Prepared by the U.S. Dept. of Commerce, NOAA, Space Environment Center.
# Please send comments and suggestions to SEC.Webmaster@noaa.gov
#
# Missing data: ///
# Updated every 30 minutes.
#
#                               Edited Events for 2004 Jun 13
#
#Event      Begin      Max      End  Obs  Q  Type  Loc/Frq  Particulars      Reg#
#-----
2460 +      0238      0242      0247  G12  5   XRA  1-8A      B8.9      4.3E-04      0634
2460 +      0241      0245      0246  COM  5   XFL  N12E90     3.1E+03  7.5E+03      0634

2470        0358      0358      0358  PAL  G   RBR  245        51

2570        0421      ///       0537  LEA  C   RSP  086-180    CTM/1

2480 +      0427      0444      0452  G12  5   XRA  1-8A      C4.1      3.3E-03      0634
2480 +      0430      0449      0450  COM  5   XFL  N13E90     4.1E+03  2.0E+04      0634

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The first important thing to notice is whether you are using UT time or Local time to record your events. The GOES data uses UT time so I would suggest you graph your data in it as well. The SID software gives you the option to use either in your graphs.

Now let's get down to it. I'll give you a rough break down of the important information we will be using to verify our data but if you would like detailed information on everything in these reports try this link: <http://www.sec.noaa.gov/ftpd/indices/events/README> I recommend going here and getting the full scoop on events data!

Let's begin at the top! The very top is basically telling you what the date is and when the data was posted. Make sure you are not looking at the "created" date when comparing your data. A little further down you will see the statement "updated every 30 minutes". This means that if you are looking at real time data on your SID monitor it will take 30 minutes before GOES will post that moment's event. Still pretty fast I'll say! Now you should be looking at the actual even reports.

The Event column is not important to us since it is a way that SEC uses to catalog events in their own system so we can ignore it for now. The next column is Begin. This is the time in UT that the event started. Any time before about 1200- 1400 is in the night time (depending on what season it is the sun rises at different times) so when you are looking for your events start further down in the 1300's. The Max column is when the event has hit its peak X-ray flux. This is useful when dealing with a flare whose beginning has been lost in interference or sunrise/sunset. End is...you guessed it, when the event officially ends.

The Obs column stands for observer, and tells you which observatory is reporting the event. We are most interested in the G12 and G10 satellites. These are the instruments that report solar flares. Different observers report different types of events most of which we can't detect.

Q is for radio bursts, sweep frequencies, storms and optical flares. It's a way of categorizing the quality of the data they received. Since SID can pick up some radio bursts and optical flares it may be worth your while to read more about the Q column in the README file listed above.

Type is very important, it tells you what type of event has occurred and boy there are a lot of different kinds. Remember SID can only pick up things that disturb our Ionosphere but there a lot of other things going on out in space! Solar flares are listed as XRA for X-ray event. These are the events that you will pick up on your SID. We have detected a few radio bursts and optical flares with SID but these have been rare occurrences.

Loc/Frq stands for Location or frequency. You don't have to worry about this.

Now for my favorite part, Particulars! This is what tells how big a flare you have. It is important to know how solar flares are calculated. The smallest flares are B class flares. They are tiny and occur often. SID is not sensitive enough to detect them. C class flares are also common but they can get pretty big. SID is able to detect flares Class C2.0 or above although there have been incidents where we have picked up C1.0 flares. M class flares are big and occur less frequently and should be very apparent on your SID graphs. The granddaddy of them all is the X class flares. These are huge and if aimed at the earth can cause major disruptions in Cell phone communication, radio, power grids ect. In November a X28 flare was recorded, the largest flare recorded in history! X class flares are usually too much for SID to handle and they will peak off the charts causing a plateau effect. These classifications are the best way to confirm you have a flare or not. With practice you will get to know your own SID monitor and predict how it handles certain classifications of flares. With practice you may even be able to guess what classification of flare you have before you verify it with the GOES data. Here is a formal chart on how flares are classified:

Solar Flare Classifications

Ranking of a solar flare is based on its x-ray output. Flares are classified according to the order of magnitude of the peak burst intensity (I) measured at the earth in the 0.1 to 0.8 nm wavelength band as follows:

Class	<u>Peak, 0.1 to 0.8 nm band</u> (Watts/square metre)
B	$I < 10^{-6}$
C	$10^{-6} I < 10^{-5}$
M	$10^{-5} I < 10^{-4}$
X	$I 10^{-4}$

A multiplier is used to indicate the level within each class. For example:

$$M6 = 6 \times 10^{-5} \text{ Watts/square metre}$$

Last but not least is the REG#. The Sun has been mapped out with region numbers much like the Earth is with longitude and latitude. The region number associated with an event is where that event occurred on the Sun. Now that there are near real time pictures of the sun on the internet you can look up the time and region number of a flare and see it on the sun itself!

Now that you have the tools to investigate your data it should be fun! It will become easier and faster with practice. You may find events that GOES data has not posted or maybe you found an event other than a solar flare. You are part of a network of people watching the sky and looking for solar flares. We will all have questions and answers. If you have found something new or strange let us know. Share your findings with other people in this program. Happy hunting!