

Using This Flip Chart

Sunspots are the first indicators that a storm from the Sun is a possibility. However, not all sunspots cause problems for Earth. By following the steps in this flip chart you will soon be able to answer the big question, ***“Do sunspot regions exist today that could be a source of solar storms?”***

In the flipchart you will find **INSTRUCTION CARDS** followed by **INFORMATION CARDS**.

- **INSTRUCTION CARDS** contain every step necessary to obtain, analyze and record all required online data.
- **INFORMATION CARDS** contain a variety of sample images and helpful tips when interpreting and analyzing the data.

Don't forget to keep your **Data Collection Sheets** nearby in order to collect all of the information you will need to complete your Space Weather News Report!



Space Weather Data
sunearthday.nasa.gov/swac/data.php

Using The Resources

COLOR CODING

We have divided all of the Space Weather Action Center resources into four 'color-coded' categories: Sunspot Regions (orange), Storm Signals (green), Magnetosphere (blue) and Aurora (purple). The same color code scheme is used in the flipchart, the data collection sheets and on the Live Data and Tutorials webpage. You can always know which section you're in with one quick glance!

SPACE WEATHER DATA

All of the data links required to make your space weather observations are located on this single webpage. Beside each of the '**live data**' links you will also find '**tutorial**' links containing easy to read tutorials that that will help you when interpreting the data. You can always find your place by returning to this page!

THE SPACE WEATHER MEDIA VIEWER

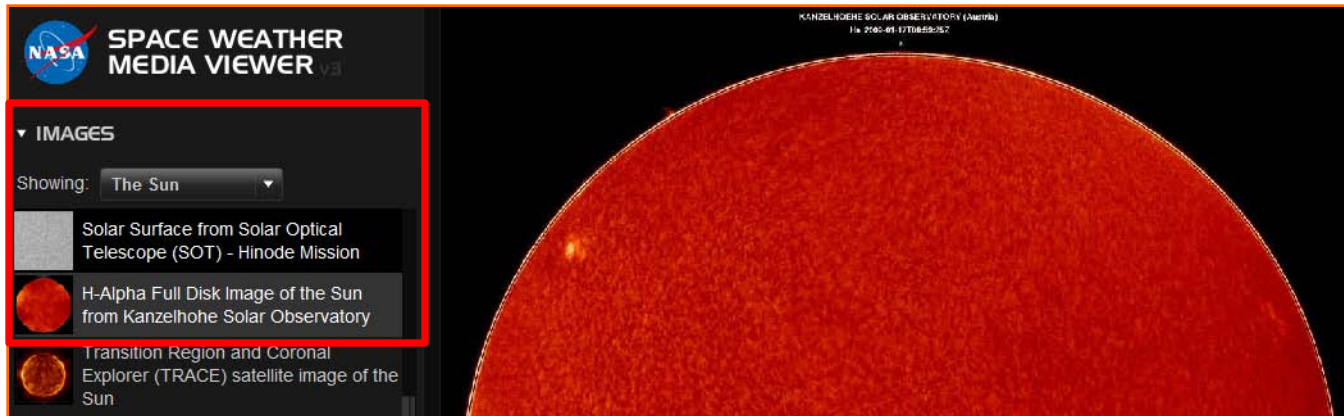
The Space Weather Media Viewer is one of the main observation tools that you will be using. Once the Viewer is open, we recommend that you simply keep it open in a separate browser tab or window for faster data access when needed.



Space Weather Data
sunearthday.nasa.gov/swac/data.php

H-Alpha Full Disk Image of the Sun

1. Open “**Space Weather Data**” and select “**H-Alpha Full Disk Image of the Sun (Live Data)**”. The Space Weather Media Viewer will open. Under the ‘**IMAGES**’ section of the Viewer select “Showing: **The Sun**” in the small drop-down menu. Select the image called, “**H-Alpha Full Disk Image of the Sun from Kanzelhoehe Solar Observatory**”.



2. Look for any visible signs of sunspots.
3. Refer to your ‘Sunspot Regions Data Collection’ sheet to answer questions **(a)** through **(e)**.
4. Keep the Viewer open for your next set of observations.

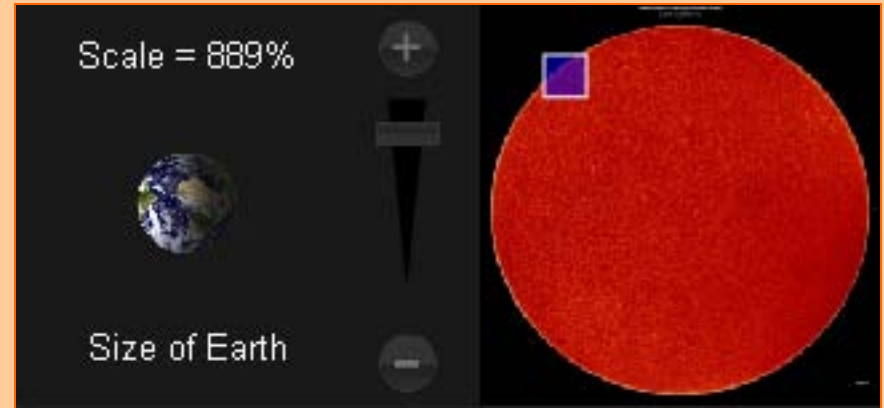
H-Alpha Full Disk Image of the Sun

ABOUT THE DATA:

Kanzelhohe Solar Observatory allows us to look at the sun through a ground based telescope using a special Hydrogen-alpha filter. These filters allow us to look safely at the Sun by filtering out all light except a specific wavelength of red light. These particular images of the Sun are updated every day if viewing conditions are good.

ANALYSIS TIP:

The size and position of sunspots can tell us about solar activity that might produce solar flares and coronal mass ejections.



With any image in the Space Weather Media Viewer you can *zoom* and *pan*. This feature allows you to see sunspots on the Sun in great detail along with the relative size of Earth. Some small sunspots may not be visible until you zoom. If you zoom in and pan down to the left, you can see the exact date and time of the image. It is important to check the date and time because the images are not updated if viewing conditions are poor (cloudy) at the Kanzelhohe Solar Observatory.



Helioseismic and Magnetic Imager (HMI Intensitygram)

1. Under the '**IMAGES**' section of the Viewer select "Showing: **The Sun**" from the small drop-down menu. Select the image called, "**Helioseismic and Magnetic Imager (HMI Intensitygram) – SDO Mission**".
2. On your '**Sunspot Regions Data Collection**' sheet answer question (f) by drawing any sunspots that you observe. Also, include any given sunspot region numbers.
3. Keep the Viewer open for your next set of observations.

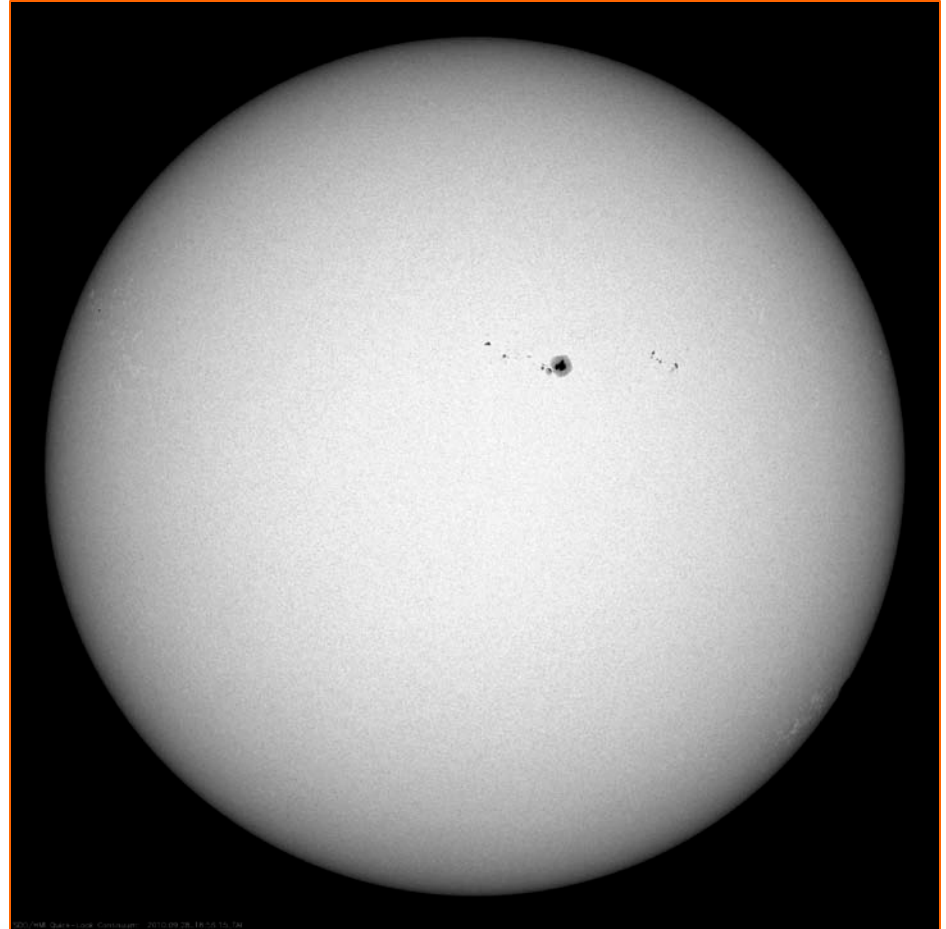
Helioseismic and Magnetic Imager (HMI Intensitygram)

ABOUT THE DATA:

The "HMI Intensitygram" shows black and white images of sunspots. It produces images that appear most nearly as the Sun would look at sunrise or sunset. (Remember to never look directly at the Sun.)

ANALYSIS TIP:

When describing the location of a sunspot region on your report, make note of its location as it relates to the equator of the sun. You might also imagine the hands of a clock superimposed over the sun to further convey its location.



Helioseismic and Magnetic Imager (HMI Magnetogram)

1. Under the '**IMAGES**' section of the Viewer select "Showing: **The Sun**" from the small drop-down menu. Select the image called, "**Helioseismic and Magnetic Imager (HMI Magnetogram) - SDO Mission**".
2. Answer question (g) on your '**Sunspot Regions Data Collection**' sheet.
3. Keep the Viewer open for your next set of observations.

Observation Note:

When black and white areas within an observed region of this image are clearly separated, there is less chance of a solar eruption. When they are mixed together, there is a better chance for a solar eruption from that location.

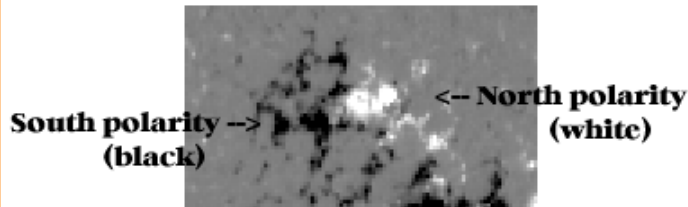
Helioseismic and Magnetic Imager (HMI Magnetogram)

ABOUT THE DATA:

The fields and forces of magnetism are invisible to our eyes, so how can we see them? The **(HMI)** instrument aboard the SDO spacecraft 'can' detect the strength and locations of magnetic fields on the Sun and represent that information in specialized images called magnetograms. These images demonstrate the intensity of magnetic twisting in the solar photosphere.

ANALYSIS TIP:

Think of a bar magnet. One end of a bar has a north magnetic pole and the other end has a south magnetic pole. In a magnetogram white areas show regions of north magnetic poles while black areas show regions of south magnetic poles. The gray color shows an absence of magnetic fields.



The areas of black, white, and gray are artificially colored to represent the magnetic field lines.



Atmospheric Imaging Assembly

1. Under the '**IMAGES**' section of the Viewer select "Showing: **The Sun**" from the small drop-down menu. Select and observe the first 4 images called, "**AIA 193, 304, 171 and Composite Image (AIA 171 and HMI) – SDO Mission**".
2. On your "**Sunspot Regions Data Collection**" sheet answer question **(h)**.
3. Keep the Viewer open for your next set of observations.

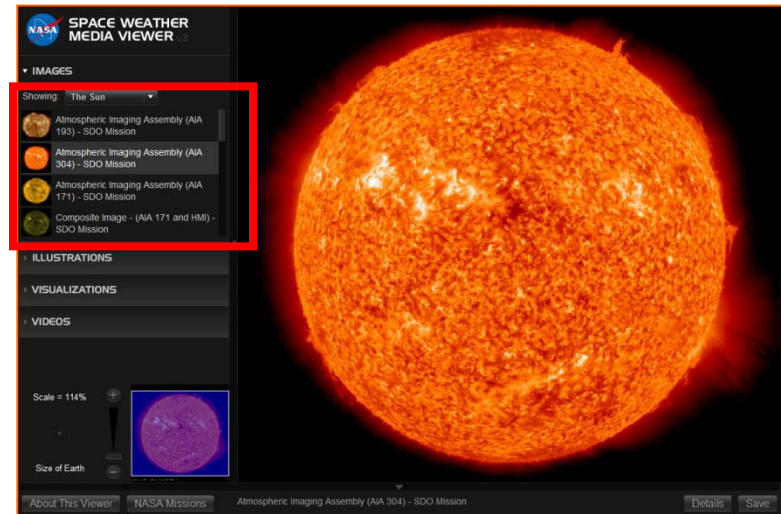
Observation Note:

Ultraviolet light is invisible to our eyes and has no color as we know it. These images are artificially colored to help scientists know what filter was used.

Atmospheric Imaging Assembly

ABOUT THE DATA:

The first 3 images in the Space Weather Media Viewer show images from the SDO instrument, “**The Atmospheric Imaging Assembly**” (AIA 193, 304, 171). AIA uses filters to allow the camera to record only particular kinds of ultraviolet light.



1. The material we're looking at is HOT; millions of degrees hot. Exactly how hot depends on the wavelength.
2. When material is this hot we call it a plasma (the fourth state of matter, after solid, liquid, and gas). Plasma has properties that make it very useful for studying the Sun.

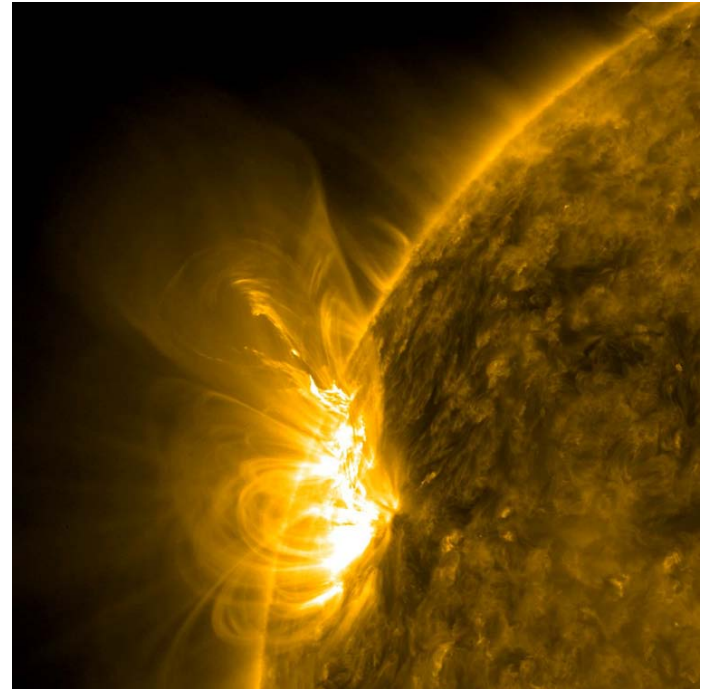


Atmospheric Imaging Assembly

ABOUT THE DATA:

Plasma is composed of electrically charged particles.

Magnetic fields themselves are invisible; but by making pictures of the plasma, we can see where the magnetic "pipes" are, and what direction they're oriented. By watching these images, we can see how the magnetic field is structured in such regions, and we can monitor how it gets twisted and stretched, and how it sometimes erupts in a solar flare.



Here's how the different wavelengths correspond to temperatures:

- *193 angstroms comes from Fe XII at about 1.25 million degrees.*
- *304 angstroms comes from ionized helium (He II) at about 50,000 degrees.*
- *171 angstroms comes from Fe IX at about 1 million degrees.*

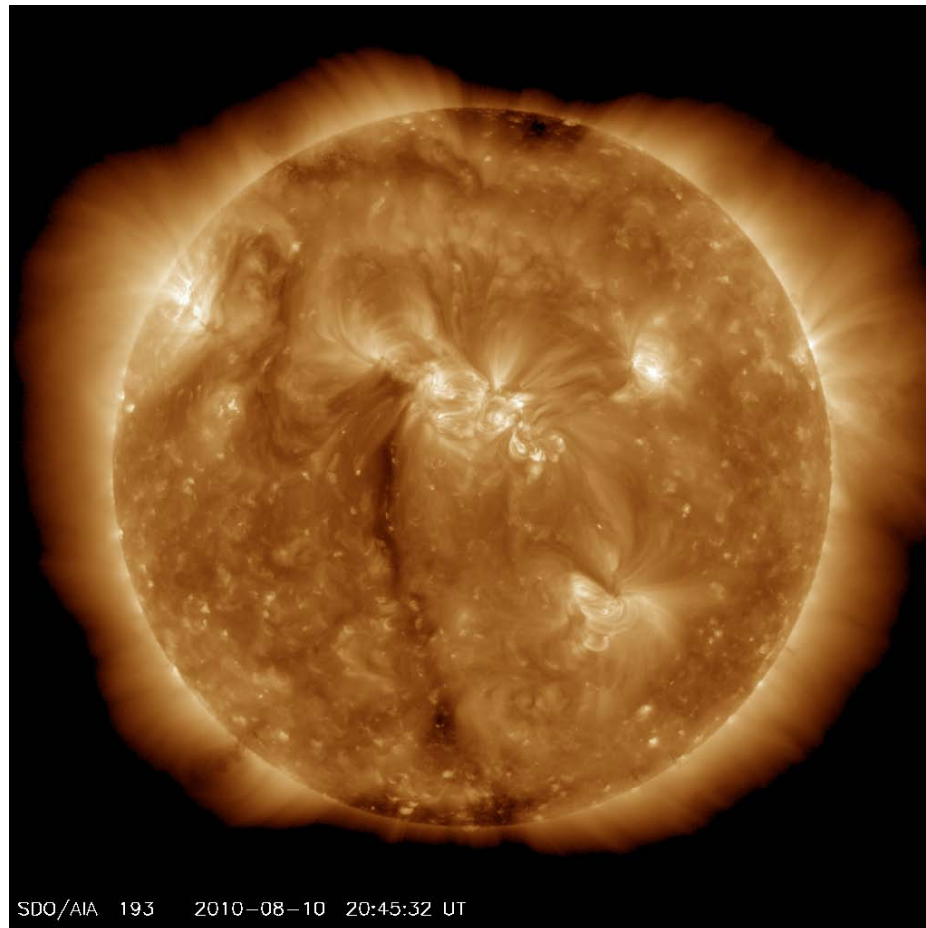


Atmospheric Imaging Assembly

ANALYSIS TIP:

Watch the active region, to see how the magnetic structure changes. With the different wavelengths you can see which parts are getting hotter, which are getting cooler--you do that by seeing in which wavelengths the loops appear/disappear.

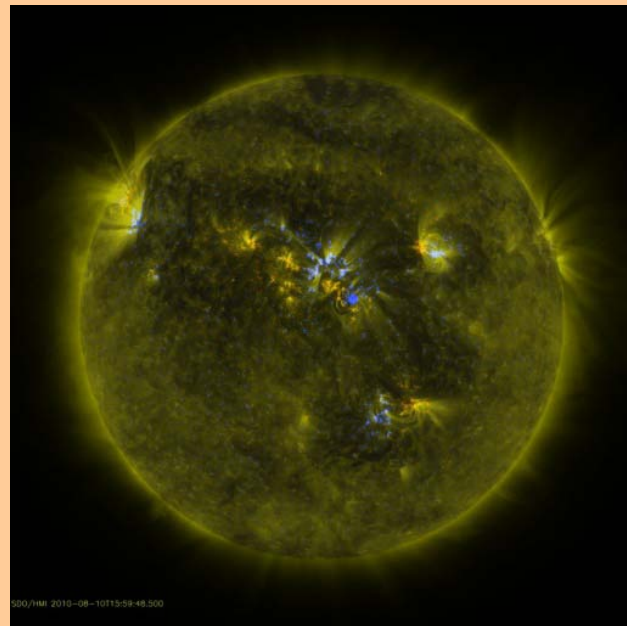
We're not just interested in the active region--there are many smaller features all over the Sun, some that last only a few minutes. But all of them are shaped by the magnetic fields, so we can monitor their behaviors by watching the plasma flowing within them.



Composite Image – (AIA 171 and HMI)

ANALYSIS TIP

The 4th image in the Space Weather Media Viewer is a *composite* image that shows the HMI magnetic field in blue and orange (indicating opposite polarity) aligned with the AIA 171 channel in extreme ultraviolet superimposed over it. The juxtaposition is especially effective at showing how the arcs that we observe in UV light emerge from regions of strong magnetic field. The loops are connected at their feet, to the surface of the Sun. Technically we would say "the coronal loops have footpoints in the photosphere." By watching these images, we can see how the magnetic field is structured in such regions, and we can monitor how it gets twisted and stretched, and how it sometimes erupts in a solar flare.



The fourth image in the Space Weather Media Viewer shows a composite image from 2 SDO instruments, the "AIA 171" and the "HMI Magnetogram."



Large Angle and Spectrometric Coronagraph

1. Under the '**IMAGES**' section of the Viewer select "Showing: **The Sun**" from the small drop-down menu. Select and observe 2 images called, "**Large Angle and Spectrometric Coronagraph (LASCO C2 and LASCO C3) - SOHO**".
2. Refer to your '**Sunspot Regions Data Collection**' sheet to answer questions (i) through (k) and the (**Comprehension Question**).
3. Return to '**Space Weather Data**'.

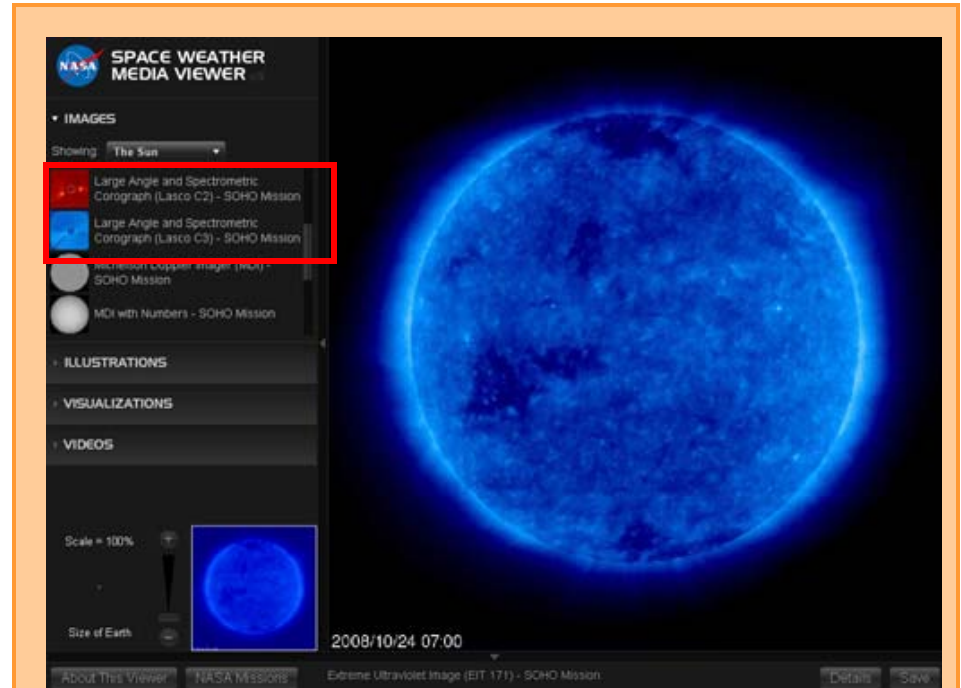
Large Angle and Spectrometric Coronagraph

ABOUT THE DATA:

LASCO (Large Angle Spectrometric Coronagraph) is able to take images of the solar corona by blocking the light coming directly from the Sun with an occulter disk (the dark circle in the center of the image), creating an artificial eclipse within the instrument itself. The position of the solar disk is indicated in the images by the white circle.

ANALYSIS TIP:

The most prominent feature of the corona is usually the coronal streamers, those nearly radial bands that can be seen both in LASCO images.



This is a classic image of a "halo event", so called because the circular area of the edges of the blast seem to form a kind of halo around the Sun. This can indicate that a storm is headed directly towards Earth.

