Readme: Chromosphere

Chromosphere

The chromosphere (literally, "sphere of colour") is the second of the three main layers in the Sun's atmosphere and is roughly 2,000 kilometers deep. It sits just above the photosphere and just below the solar transition region. The density of the chromosphere is very small, it being only 10^{-4} times that of the photosphere, the layer just below it, and 10^{-8} times that of the atmosphere of Earth. This makes the chromosphere normally invisible and it can only be seen during a total eclipse, where its reddish color is revealed. The color hues are anywhere between pink and red.[1] However, without special equipment, the chromosphere cannot normally be seen due to the overwhelming brightness of the photosphere. The density of the chromosphere decreases with distance from the center of the sun. This decreases logarithmically from 10^{17} particles per cubic centimeter, or approximately 2×10^{-4} kg/m^3 to under 1.6×10^{-11} kg/m^3 at the outer boundary.[2] The temperature begins to decrease from the inner boundary of about 6,000 K[3] to a minimum of approximately 3,800 K[4], before increasing to upwards of 35,000 K[3] at the outer boundary with the transition layer of the corona. Figure 1 shows the trends which density and temperature follow through the chromosphere. (Wikipedia)

AVAILABLE DATASETS

Dataset: Calcium (1915 – 2011)

Description: This dataset consists of full-disk images of the sun in Calcium (Ca) II K wavelength (393.4 nm). Ca II K imagery reveal magnetic structures of the sun from about 500 to 2000 km above the photosphere that are not evident in white light images. The chromosphere is an extremely dynamic layer of the sun consisting of a mixture of hot ionized plasma and cool gas. The presence of calcium ions in the chromospheric (along with other ions such as helium and hydrogen) lead to the absorption of radiant emission from the sun. The Ca II K absorption lines are extremely sensitive to local magnetic fields wherein the presence of stronger magnetic fields results in less absorption (brighter features) than weaker fields (more absorption = darker features). Unique features of the chromosphere evident in Ca II K are plage, pores, supergranulation cells and the chromospheric network. Also observed in Ca II K are solar features typically discussed in the context of the photosphere, including sunspots and faculae. Sunspots in photospheric observations appear as dark regions due to the cooler temperatures (~3000 ^{o}K) of the overlying gas compared to the surrounding solar surface (~5500 ^{o}K). Although sunspots are regions of intense solar magnetic activity (i.e. less absorption), the lack of radiant emissions from the underlying photosphere results in chromospheric sunspot regions that remain darker than the surrounding sun. Faculae, on the other hand, are brighter regions in chromospheric observations which result from the concentration of magnetic field lines between solar granules (solar convection cells). Closely associated with faculae are bright areas of chromospheric plage, also referred to as floccule, within solar active regions that are associated with sunspot formation. Solar pores are actually small sunspots that have not yet formed (and may never form) into the standard picture of a dark central umbra surrounded by a somewhat brighter penumbra. Supergranulation cells are large regions of convective horizontal flows (larger than individual granules) wherein solar material and an embedded magnetic field flow radially outward from the center and downward at the outer boundaries causing the web-like appearance of the chromospheric network structure.

- McMath - McMath-Hulbert Solar Observatory (1948 –1979)
- Meudon – Observatoire de Paris – Site de Meudon (2007-2011)
- Mt Wilson – Mount Wilson Observatory (1915 – 1984)

Dataset Status: TBD

Dataset: H-alpha (1948 – 2011)

Description: This dataset consists of full-disk, daily photographs of the sun taken at the H-alpha wavelength. Collection includes a variety of H-alpha photographic datasets contributed by a number of national and private solar observatories located worldwide. Solar observations in hydrogen-alpha (656.3 nm) reveal the structure and dynamics of chromospheric features including prominences, filaments, plague, filaments and the chromospheric network. Contributing observatories are:

- Big Bear – Big Bear Solar Observatory (2001 – 2011)
- Boulder – Boulder Observatory (1967 – 1994)
- Canary Islands – Kiepenheuer-Institut fur Sonnenphysik (1972; 1996 – 2004)
- McMath – McMath-Hulbert Solar Observatory (1948 –1966)
- Meudon – Observatoire de Paris – Site de Meudon (2000 – 2001)

Dataset Status: This dataset is still active

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Dataset: Magnetograms (xxxx – xxxx)

Description: A solar magnetogram is a pictorial representation of the *spatial* variations in strength of the solar magnetic field. Magnetograms are often produced by exploiting the Zeeman effect (or, in some cases, the Hanle effect), which George Ellery Hale employed in the first demonstration that sunspots were magnetic in origin, in 1908. Solar magnetograms are produced by suitably instrumented telescopes referred to as magnetographs. Some magnetographs can only measure the component of the magnetic field along the line of sight from the observer to the source (the field's "longitudinal" component). One example of such a "line-of-sight" or "longitudinal" magnetograph is the Michelson Doppler Imager (MDI), a scientific instrument that takes magnetograms of the Sun in order to measure velocity and magnetic fields in the Sun's photosphere to learn about the convection zone and about the magnetic fields which control the structure of the solar corona. A vector magnetograph also measures the component of the magnetic field perpendicular to the line of sight (the field's "transverse" component), from which all three components of the magnetic field vector can be deduced. Two examples include the National Solar Observatory's SOLIS instrument and the Helioseismic and Magnetic Imager aboard NASA's Solar Dynamics Observatory satellite. (Wikipedia)

- Debrecen – Heliophysical Observatory Debrecen (xxxx – xxxx)
- Kitt Peak – Kitt Peak National Observatory (xxxx – xxxx)
- Mt Wilson – Mount Wilson Observatory (xxxx – xxxx)
- SOHO – Solar and Heliospheric Observatory (xxxx – xxxx)
- Wilcox – Wilcox Solar Observatory (xxxx – xxxx)

Dataset Status: TBD

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