

The High Frequency Active Auroral Research Program

HAARP

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Glossary of Solar and Geophysical Terms

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a INDEX

A 3-hourly "equivalent amplitude" index of local geomagnetic activity; "a" is related to the 3-hourly [K INDEX](#) according to the following scale:

K	0	1	2	3	4	5	6	7	8	9
a	0	3	7	15	27	48	80	140	240	400

A INDEX

A daily index of geomagnetic activity equal to the average of the eight 3-hourly "a" indices.

ABSORPTION

The process by which energy in a radio wave passing through the ionosphere is converted to heat through electron collisions with other particles. For applications using frequencies above the [VLF](#) range, absorption predominately occurs in the [D region](#). Absorption can further be described as [DEVIATIVE](#) or [NONDEVIATIVE](#).

ACTIVE

For Geomagnetic activity, levels where [Ap](#) is greater than 15 but less than 29. For Solar activity, levels with at least one geophysical event or several larger radio events (10cm)per day (Class M Flares).

ACTIVE PROMINENCE

A [PROMINENCE](#) displaying material motion and changes in appearance over a few minutes of time.

ACTIVE REGION (AR)

A localized, transient volume of the solar atmosphere in which [PLAGES](#), [SUNSPOTS](#), [FACULAE](#), [FLARES](#), etc. may be observed.

AFRED

Abbreviation for the [A INDEX](#) for Fredericksburg.

ALL SKY CAMERA

A camera having a very wide field of view used to observe the overhead sky from horizon to horizon in studies of the visible aurora.

ANGSTROM (Å)

A unit of length = 10^{-8} cm. Ten angstroms = 1 nanometer.

Ap INDEX

An averaged planetary [A INDEX](#) based on data from a set of specific stations.

ASTRONOMICAL UNIT (AU)

The mean Earth-sun distance, equal to 1.496×10^{13} cm or 214.94 solar radii.

AURORA

A faint visual phenomenon associated with geomagnetic activity, occurring mainly in the high-latitude night sky. Typical auroras occur 100 to 250 km above the ground as high speed particles from the [SOLAR WIND](#) collide with atmospheric gasses at these altitudes.

AURORAL OVAL

An oval band situated between **MAGNETIC LATITUDES** of 64 and 70 degrees where the visible **AURORA** occurs overhead. During disturbed geomagnetic conditions, the auroral oval generally expands equatorward. Areas within the auroral ovals are called the **POLAR CAPS**.

BARTEL'S ROTATION NUMBER

The serial number assigned to 27-day rotation periods of solar and geophysical parameters. Rotation 1 in this sequence was assigned arbitrarily by Bartel to begin in January 1833.

BURST

A transient enhancement of the solar **RADIO EMISSION**, usually associated with an **ACTIVE REGION** or **FLARE**.

CENTIMETER BURST

A solar radio burst in the centimeter **WAVELENGTH** range.

CHORDAL MODE

An ionospheric propagation mode characterized by two successive Earthward reflections from an ionized layer without an intermediate ground reflection, usually caused by an ionospheric tilt.

CHROMOSPHERE

The layer of the solar atmosphere above the **PHOTOSPHERE** and beneath the transition region and the **CORONA**.

CHROMOSPHERIC EVENTS

A **FLARE** that is only a Chromospheric Event without Centimetric Bursts or Ionospheric Effects. (SID) (Class C flare)

COMPREHENSIVE FLARE INDEX (CFI)

An index indicative of solar flare importance given by the sum of the following five components:

- a) Importance of ionizing radiation as indicated by time-associated Short Wave Fade or Sudden Ionospheric Disturbance (**SID**); (Scale 0-3)
- b) Importance of H-Alpha flare; (Scale 0-3)
- c) Magnitude of 10cm flux; (Characteristic of log of flux in units of 10^{-22} Watt/m²/Hz)
- d) Dynamic spectrum; (Type II = 1, Continuum = 2, Type IV with duration > 10 minutes = 3)
- e) Magnitude of 200MHz flux; (Characteristic of log of flux in units of 10^{-22} Watt/m²/Hz)

CONJUGATE POINTS

Two points on the Earth's surface, at opposite ends of a geomagnetic field line.

CONTINUUM STORM (CTM)

General term for solar noise lasting for hours and sometimes days.

COORDINATED UNIVERSAL TIME

By international agreement, the local time at the prime meridian, which passes through Greenwich, England. Therefore, it is also known as **GREENWICH MEAN TIME**, or sometimes simply **UNIVERSAL TIME** (UT or UTC).

CORONA

The outermost layer of the solar atmosphere, characterized by low densities ($<10^9$ /cc) and high temperatures ($>10^6$ degK).

CORONAL HOLE

An extended region of the **CORONA**, exceptionally low in density and associated with unipolar photospheric regions.

CORONAL MASS EJECTION (CME)

A major solar event in which a large amount of coronal mass (as much as 10^{16} grams) is ejected from the sun at speeds of tens of km/sec up to 1000 km/sec. CMEs are thought to occur with a frequency of one per day.

CORONAL TRANSIENTS

A general term for short-time-scale changes in the **CORONA**, but principally used to describe outward-moving **PLASMA** clouds.

COSMIC RAY

An extremely energetic (relativistic) charged particle.

CRITICAL FREQUENCY

The frequency at which a radio wave just penetrates a given ionospheric layer. Higher frequencies pass through the layer; signals at lower frequencies are returned by reflection from the layer.

CROCHET

A sudden deviation in the **H component** of the sunlit geomagnetic field associated with large solar **FLARE** X-ray emission.

D REGION

A daytime layer of the Earth's **IONOSPHERE** approximately 50 to 90 km in altitude. The D layer is effective as a reflector only for frequencies below **VLF**. It is the primary cause of **ABSORPTION** for signals in the **HF** band.

DEVIATIVE

Type of **ABSORPTION** occurring wherever the ray path bends significantly such as near the top of a ray trajectory. Deviative absorption predominately occurs near a layer critical frequency.

DIFFERENTIAL ROTATION

The change in Solar rotation rate with latitude. Low latitudes rotate at a faster angular rate (approx. 14° per day) than do high latitudes (approx. 12° per day).

DISAPPEARING SOLAR FILAMENT (DSF)

The sudden (timescale of minutes to hours) disappearance of a solar **FILAMENT** (Also see **PROMINENCE**).

DISK

The visible surface of the sun (or any heavenly body) projected against the sky.

Dst INDEX

A geomagnetic index describing variations in the equatorial ringcurrent.

ELECTROJET

A region of sheet current flowing in the **E Region** of the ionosphere. At **high latitudes**, the auroral electrojet may flow east-west or west-east in an arc centered on the geomagnetic pole. An equatorial electrojet also exists.

ELECTRON

An elementary particle carrying a charge of negative electricity equal to 1.602×10^{-19} coulomb and having a resting mass of about 9.107×10^{-28} gram.

E REGION

A daytime layer of the Earth's **ionosphere** roughly between the altitudes of 85 and 140 km.

ERUPTIVE

Solar activity levels with at least one radio event (10cm) and several chromospheric events per day (Class C Flares)

EXTRAORDINARY MODE (X-MODE)

A radio wave entering the ionosphere with right hand elliptical polarization in the northern magnetic hemisphere (or left hand in the southern hemisphere). Also see **O - MODE**.

EXTREMELY LOW FREQUENCY (ELF)

That portion of the radio frequency spectrum from 30 to 3000 hertz.

EXTREME ULTRAVIOLET (EUV)

A portion of the electromagnetic spectrum from approximately 100 to 1000 **Å**.

F CORONA

Of the white-light **CORONA** (that is, the corona seen by the eye at a total solar eclipse), that portion which is caused by sunlight scattered or reflected by solid particles (dust) in interplanetary space.

F REGION (Also F LAYER).

The upper layer of the **IONOSPHERE**, approximately 120 to 1500 km in altitude. The F region is subdivided into the F1 and F2 regions. The F2 region is the most dense and peaks at altitudes between 200 and

600 km. The F1 region is a smaller peak in electron density, which forms at lower altitudes in the daytime.

FACULA

A bright region of the [PHOTOSPHERE](#) seen in white light, seldom visible except near the solar [LIMB](#).

FILAMENT

A mass of gas suspended over the [PHOTOSPHERE](#) by magnetic fields and seen as dark lines threaded over the solar [DISK](#). A filament on the [LIMB](#) of the sun seen in emission against the dark sky is called a [PROMINENCE](#).

FLARE

A sudden eruption of energy on the solar [DISK](#) lasting minutes to hours, from which radiation and particles are emitted. (See also [X-RAY FLARE](#).)

FLUTTER

A common term describing rapid variations in amplitude and sometimes frequency (doppler) on signals that pass through the [POLAR CAP](#). Flutter is thought to be a [MULTIPATH](#) effect produced by discrete patches of ionization moving rapidly through the polar cap region.

FLUX

The rate of flow of a physical quantity through a reference surface. Also see [SOLAR FLUX](#).

f_{MIN}

The lowest radiowave frequency that can be reflected from the [IONOSPHERE](#).

f_{oEs}

The maximum [ORDINARY MODE](#) radiowave frequency capable of reflection from the [SPORADIC E](#) region of the [IONOSPHERE](#).

f_{oF2}

The maximum [ORDINARY MODE](#) radiowave frequency capable of reflection from the [F2 REGION](#) of the [IONOSPHERE](#).

FORBUSH DECREASE

An abrupt decrease, of at least 10%, of the background galactic [COSMIC RAY](#) intensity as observed by neutron monitors.

GAMMA

A unit of magnetic field intensity equal to 10^{-5} [GAUSS](#), also equal to 1 [NANOTESLA](#).

GAMMA RAYS

High energy radiation (energies in excess of 100 keV) observed during large, extremely energetic solar [FLARES](#).

GAUSS

The unit of magnetic induction in the cgs (centimeter-gram-second) system.

GEOMAGNETIC ELEMENTS

The components of the geomagnetic field at the surface of the Earth expressed in [gammas](#). The northward, eastward and vertical components are referred to as H, D and Z respectively.

GEOMAGNETIC FIELD

The magnetic field observed in and around the Earth. The intensity of the field at the Earth's surface is approximately 0.32 gauss at the equator and 0.62 gauss at the north pole.

GEOMAGNETIC STORM

A worldwide disturbance of the Earth's magnetic field, distinct from regular diurnal variations. Storms are described as follows:

- Minor Storm: A storm for which the [Ap](#) index was greater than 29 and less than 50.
- Major Storm: A storm for which the [Ap](#) index was greater than 49 and less than 100.
- Severe Storm: A storm for which the [Ap](#) index was 100 or more.
- Initial Phase: Of a geomagnetic storm, that period when there may be

an increase of the [MIDDLE-LATITUDE](#) horizontal intensity.

Main Phase: Of a geomagnetic storm, that period when the horizontal magnetic field at middle latitudes is generally decreasing.

Recovery Phase: Of a geomagnetic storm, that period when the depressed northward field component returns to normal levels.

GEOFYSICAL EVENTS

Flares (Importance two or larger) with Centimetric Outbursts (maximum of the flux higher than the [Quiet](#) Sun flux, duration longer 10 minutes) and/or strong [SID](#). Sometimes these flares are followed by [Geomagnetic Storms](#) or small [PCA](#). (Class M Flares)

GMT

Greenwich Mean Time. (See [COORDINATED UNIVERSAL TIME](#).)

GRADUAL COMMENCEMENT

The commencement of a geomagnetic storm that has no well-defined onset.

GREAT CIRCLE

The intersection of the Earth's surface with a plane containing the center of the Earth and two points on its surface. A great circle is the shortest distance between those two points. Radio waves usually (but not always) follow great circle paths from transmitter to receiver.

GROUND-LEVEL EVENT (GLE)

A sharp increase in ground-level [COSMIC RAY](#) count to at least 10% above background, associated with solar protons of energies greater than 500 MeV. GLEs are relatively rare, occurring only a few times each [SOLAR CYCLE](#).

HAARP

HAARP is an acronym for the "High frequency Active Auroral Research Program."

H-ALPHA

This ABSORPTION LINE of neutral hydrogen falls in the red part of the visible spectrum and is convenient for solar observations. The H-alpha line is universally used for patrol observations of solar flares.

HIGH FREQUENCY (HF)

That portion of the radio frequency spectrum between 3 and 30 MHz. This frequency range, characterized by [WAVELENGTHS](#) between 10 and 100 meters, is commonly called the Short Wave band.

HIGH LATITUDES

With specific reference to zones of geomagnetic activity, "high latitudes" refers to 50 - 80 degrees geomagnetic.

HIGH-SPEED STREAM

A feature of the [SOLAR WIND](#) having velocities about double average solar wind values.

HIPAS

An acronym for High Power Auroral Stimulation. An active ionospheric research facility located near Fairbanks, AK and operated by UCLA.

INCOHERENT SCATTER RADAR (ISR)

A large, high power [RADAR](#) used to study the small scale structure of the overhead ionosphere by analyzing the backscattered return signals.

INTERPLANETARY MAGNETIC FIELD (IMF)

The magnetic field carried with the [SOLAR WIND](#).

ION

An atom that carries a positive or negative electric charge as a result of losing or gaining an electron, respectively. Also, a free [ELECTRON](#).

IONOGRAM

A chart of ionospheric layer virtual height versus frequency obtained from an ionosonde.

IONOSONDE

A device used to measure the virtual height of ionospheric layers using a sweep-frequency, pulsed [RADAR](#) technique.

IONOSPHERE

The region of the Earth's upper atmosphere containing a small percentage of free electrons and ions produced by photoionization of the constituents of the atmosphere by solar ultraviolet radiation at very short [WAVELENGTHS](#) (<1000 Å). The ionosphere significantly influences radiowave propagation of frequencies less than about 30 MHz. (Also see the [Ionosphere pages](#).)

IONOSPHERIC IRREGULARITIES

Small volumes within the ionosphere where the electron density deviates slightly from the average background level, producing a small scale non-homogeneous refractive index that can produce scattering of incident electromagnetic energy.

IONOSPHERIC STORM

A disturbance in the [F REGION](#) of the [IONOSPHERE](#), which occurs in connection with geomagnetic activity.

K CORONA

Of the white-light [CORONA](#) (that is, the corona seen by the eye at a total solar eclipse), that portion which is caused by sunlight scattered by electrons in the hot outer atmosphere of the sun.

K INDEX

A 3-hourly quasi-logarithmic local index of geomagnetic activity relative to an assumed quiet-day curve for the recording site. Ranging from 0 to 9, the K index measures the deviation of the most disturbed horizontal magnetic field component.

KELVIN

A unit of absolute temperature.

Kp INDEX

A 3-hourly planetary geomagnetic index of activity generated in Gottingen, Germany, based on the K INDEX from 12 or 13 stations distributed around the world.

LEADER SPOT

In a magnetically bipolar or multipolar [SUNSPOT](#) group, the western part precedes and the main spot in that part is called the leader.

LIDAR

A LIDAR (LIght Detection And Ranging) instrument uses a low power Laser and sensitive optical detectors to study the chemical composition of a vertical column of the atmosphere.

LIMB

The edge of the solar [DISK](#).

LOOP PROMINENCE SYSTEM (LPS)

A system of loop prominences associated with major [FLARES](#).

LOW FREQUENCY (LF)

That portion of the radio frequency spectrum from 30 to 300 kHz.

M 3000

The optimum [HIGH FREQUENCY](#) radio wave with a 3000 km range, which reflects only once from the [IONOSPHERE](#) (single hop transmission).

MAGNETIC BAY

A relatively smooth excursion of the H (horizontal) [component](#) of the geomagnetic field away from and returning to [quiet](#) levels.

MAGNETIC DIP

The angle between the horizontal plane and the magnetic field vector. By convention, downward angles are positive. Also called magnetic inclination.

MAGNETIC EQUATOR

The locus of geographic points where the magnetic dip is zero. At the magnetic equator, there is no vertical component of magnetic field strength.

MAGNETIC LATITUDE

The locus of points having identical magnetic dip angles. Analogous to geographic latitude except referenced to the geomagnetic equator. The magnetic dip (MD) is approximately related to the magnetic latitude (ML) by

the equation $\tan(MD) = 2 * \tan(ML)$

MAGNETIC TIME

The time of day reckoned with respect to the Earth's magnetic (not geographic) pole. Magnetic noon is that time when the sun is highest on the **GREAT CIRCLE** containing the observer and the geomagnetic pole.

MAGNETOGRAM

Magnetograms are a graphic representation of magnetic field strengths and polarity.

MAGNETOMETER

A device that responds to changes in the Earth's magnetic field. Magnetometers are used to monitor variations in the field along three mutually orthogonal axes, magnetic north-south, east-west and vertically.

MAGNETOPOUSE

The boundary layer between the **SOLAR WIND** and the **MAGNETOSPHERE**.

MAGNETOSPHERE

The magnetic cavity surrounding the Earth, carved out of the passing **SOLAR WIND** by virtue of the **GEOMAGNETIC FIELD**, which prevents, or at least impedes, the direct entry of the **SOLAR WIND PLASMA** into the cavity.

MAJORFLARE

A **FLARE** significant enough to issue a forecast of geomagnetic storm, cosmic storm and/or protons in the Earth's vicinity.

MAXIMUM USABLE FREQUENCY

The highest frequency that can be used for ionospheric radio communication between two points on the Earth. MUF is a function of the time of day, season, solar conditions and geometry.

MeV

Mega (million) electronvolt. A unit of energy used to describe the total energy carried by a particle or photon.

MEDIUM FREQUENCY (MF)

That portion of the radio frequency spectrum from 0.3 to 3 MHz.

MICROWAVE BURST

A radiowave signal associated with optical and/or X-ray **FLAREs**.

MIDDLE LATITUDES

With specific reference to zones of geomagnetic activity, "middle latitudes" refers to 20 - 50 degrees geomagnetic.

MIDLATITUDE

The ionospheric region lying between the **AURORAL OVAL** and the equatorial band.

MOUNT WILSON MAGNETIC CLASSIFICATIONS.

- Alpha. Denotes a unipolar **SUNSPOT** group.
- Beta. A sunspot group having both positive and negative magnetic polarities, with a simple and distinct division between the polarities.
- Beta-Gamma A sunspot group that is bipolar but in which no continuous line can be drawn separating spots of opposite polarities.
- Delta. A complex magnetic configuration of a solar sunspot group consisting of opposite polarity **UMBRAe** within the same **PENUMBRA**.
- Gamma. A complex **ACTIVE REGION** in which the positive and negative polarities are so irregularly distributed as to prevent classification as a bipolar group.

MULTIPATH

Term applied to propagation conditions where a signal may arrive at a receiving location through more than one geometric path.

NANOTESLA (nT)

A unit of magnetism 10^{-9} tesla, equivalent to a gamma (10^{-5} gauss).

NEUTRAL GAS

That portion of an **IONOSPHERIC** volume consisting only of

non-ionized atoms and gas molecules.

NONDEVIATIVE

Absorption occurring along non-bending radio wave ray trajectories. This type of absorption is inversely proportional to the square of the radio frequency and (for HF and VHF waves) occurs in the D region.

ORDINARY MODE

The polarization of a radio wave such that the rotation of the electric field vector opposes the trajectory of electrons about magnetic field lines. A radio wave entering the ionosphere with left hand elliptical polarization in the northern magnetic hemisphere. (Also see [X-MODE](#))

OZONE

A molecule consisting of three Oxygen atoms. Ozone is created by ultraviolet radiation from the sun.

PENUMBRA

The [SUNSPOT](#) area that may surround the darker [UMBRA](#) or umbrae. It consists of linear bright and dark elements radial from the sunspot umbra.

PHOTOSPHERE

The lowest layer of the solar atmosphere; corresponds to the solar surface viewed in [WHITE LIGHT](#). [SUNSPOTS](#) and [FACULAE](#) are observed in the photosphere.

PICOTESLA (pT)

A unit of magnetism 10^{-12} tesla, equivalent to 0.001 gamma.

PLAGE

An extended emission feature of an [ACTIVE REGION](#) that exists from the emergence of the first magnetic flux until the widely scattered remnant magnetic fields merge with the background.

PLASMA

Any ionized gas, that is, any gas containing [IONS](#) and [ELECTRONS](#).

POLAR CAP

The area of the ionosphere located within the [AURORAL OVALS](#), both north and south. Plasma is convected across the polar cap from day to darkness by electric fields in the [MAGNETOSPHERE](#).

POLAR CAP ABSORPTION (PCA)

An anomalous condition of the polar [IONOSPHERE](#) whereby [HF](#) and [VHF](#) radiowaves are absorbed, and [LF](#) and [VLF](#) radiowaves are reflected at lower altitudes than normal. In practice, the absorption is inferred from the [PROTON](#) flux at energies greater than 10 MeV, so that PCAs and [PROTON EVENTS](#) are simultaneous. Transpolar radio paths may still be disturbed for days, up to weeks, following the end of a proton event.

PROMINENCE

A term identifying cloud-like features in the solar atmosphere. The features appear as bright structures in the [CORONA](#) above the solar [LIMB](#) and as dark [FILAMENTS](#) when seen projected against the solar [DISK](#).

PROTON

An elementary particle with a mass equal to 1.672×10^{-24} gram and carrying a charge of positive electricity equal to 1.602×10^{-19} coulomb. A Hydrogen atom consists of one [PROTON](#) and one [ELECTRON](#).

PROTON EVENT

By definition, the measurement of at least 10 protons/cm²/sec/steradian at energies greater than 10 MeV in the vicinity of the Earth. Protons having energies greater than 10 - 30 MeV can produce increased ionization in the [D REGION](#) resulting in a [PCA](#) event.

PROTON FLARE

Any [FLARE](#) producing significant [FLUXes](#) of greater than 10 MeV protons in the vicinity of the Earth.

QUIET

When applied to the geomagnetic field, a descriptive word specifically meaning geomagnetic levels such that [Ap](#) is less than 8. When applied to Solar activity, a descriptive word indicating levels with less than one [CHROMOSPHERIC EVENT](#) per day.

RADIO EMISSION

Emissions of the sun in radio [WAVELENGTHS](#) from centimeters to dekameters, under both quiet and disturbed conditions. Radio Emissions are described as follows:

- Type I A noise storm composed of many short, narrow-band bursts in the metric range (50 - 300 MHz).
- Type II Narrow-band emission that begins in the meter range (300 MHz) and sweeps slowly (tens of minutes) toward dekameter [WAVELENGTHS](#) (10 MHz). Type II emissions occur in loose association with major [FLARES](#) and are indicative of a shock wave moving through the solar atmosphere.
- Type III Narrow-band bursts that sweep rapidly (seconds) from decimeter to dekameter wavelengths (500 - 0.5 MHz). They often occur in groups and are an occasional feature of complex solar [ACTIVE REGIONS](#).
- Type IV A smooth continuum of broad-band bursts primarily in the range 30 - 300 MHz. These bursts are associated with some major [FLARE](#) events beginning 10 to 20 minutes after the flare maximum, and can last for hours.

RADAR

A Radio Detection And Ranging system used to detect the presence and location of objects by the transmission and return of an electromagnetic signal.

RADIO EVENT

Flares with Centimetric Bursts and/or definite Ionospheric Event ([SID](#)).

RECOMBINATION

The process by which free [IONS](#) and [ELECTRONS](#) recombine to form a [NEUTRAL GAS](#).

RECURRENCE

Used especially in reference to the recurrence of physical parameters every 27 days (the rotation period of the sun).

RIOMETER

(Relative Ionospheric Opacity meter). A specially designed radio receiver for continuous monitoring of cosmic noise. The absorption of cosmic noise in the polar regions is very sensitive to the solar low-energy [cosmic ray](#) flux. Also see the [HAARP Riometer](#) page for a detailed description.

SCINTILLATION

Variations in amplitude, phase, polarization and angle of arrival of a radio wave upon passing through the [IONOSPHERE](#), such as would occur with a satellite signal. Scintillations can be severe (especially near the equator) and present problems to communication services.

SECTOR BOUNDARY

In the [SOLAR WIND](#), the area of demarcation between sectors, which are large-scale features distinguished by the predominant direction of the [interplanetary magnetic field](#), toward or away from the sun.

SHORT WAVE FADE (SWF)

A particular ionospheric solar [FLARE](#) effect under the broad category of sudden ionospheric disturbances ([SIDs](#)). It consists of a rapid decrease in signal strength for an [HF](#) radio signal that may last for several hours. The onset is usually abrupt.

SMOOTHED SUNSPOT NUMBER

An average of 13 monthly RI numbers, centered on the month of interest.

SOLAR CYCLE

The approximately 11-year quasi-periodic variation in frequency or number of solar active events such as sunspot number.

SOLAR FLUX

The daily solar radio noise flux measured at the frequency 2800 MHz ([Wavelength](#)=10.7 cm). The solar flux is one of the most commonly used indicators of the general level of solar activity because it is highly correlated with X-ray, [EUV](#) and UV fluxes and with many ionospheric and upper atmospheric parameters. Solar flux (SF) is empirically related to smoothed sunspot number (SSN) by the formula:

$$SF = 63.74 + 0.727*(SSN) + 0.000895*(SSN)^2$$

SOLAR MAXIMUM

The month(s) during the [SOLAR CYCLE](#) when the 12-month mean of monthly average [SUNSPOT](#) numbers reaches a maximum. The solar maximum for sunspot cycle 23 occurred in April 2000.

SOLAR MINIMUM

The month(s) during the [SOLAR CYCLE](#) when the 12-month mean of monthly average [SUNSPOT](#) numbers reaches a minimum. The solar minimum between Cycles 22 and 23 was believed to have occurred in May 1996.

SOLAR WIND

The outward flux of solar particles and magnetic fields from the sun. Typically, solar wind velocities are near 350 km/s.

SPORADIC E

A phenomenon occurring in the [E REGION](#) of the [IONOSPHERE](#), which significantly affects [HF](#) radiowave propagation. Sporadic E can occur during daytime or nighttime and it varies markedly with latitude.

SPREAD F

A phenomenon in which pulses returned from the ionosphere are of much greater duration than the transmitted pulse. Spread F is seen on an [IONOGRAM](#) as a spreading or blurring (in virtual height) of the normal [F LAYER](#) return. It is believed to result from scattering from multiple [IRREGULARITIES](#) at differing ranges and zenith angles.

SUDDEN COMMENCEMENT (SC)

An abrupt increase or decrease in the northward component of the geomagnetic field, which marks the beginning of a [GEOMAGNETIC STORM](#). (May also be called Sudden Storm Commencement or SSC.)

SUDDEN IMPULSE (SI+ or SI-)

A sudden perturbation of several gammas in the northward component of the low-latitude geomagnetic field, not associated with a following [GEOMAGNETIC STORM](#). (An SI becomes an SC if a storm follows.)

SUDDEN IONOSPHERIC DISTURBANCE (SID).

Propagation anomalies affecting [HF](#) signals due to ionospheric changes resulting from solar [FLARES](#), [PROTON EVENTS](#) and [GEOMAGNETIC STORMS](#).

SUNSPOT

An area seen as a dark spot on the [PHOTOSPHERE](#) of the sun. Sunspots are concentrations of magnetic flux, typically occurring in bipolar clusters or groups. They appear dark because they are cooler than the surrounding photosphere.

SUNSPOT GROUP CLASSIFICATION (Modified Zurich Sunspot Classification)

- A - A small single unipolar [SUNSPOT](#) or very small group of spots without [PENUMBRA](#).
- B - Bipolar sunspot group with no penumbra.
- C - An elongated bipolar sunspot group. One sunspot must have penumbra.
- D - An elongated bipolar sunspot group with penumbra on both ends of the group.
- E - An elongated bipolar sunspot group with penumbra on both ends. Longitudinal extent of penumbra exceeds 10° but not 15°.
- F - An elongated bipolar sunspot group with penumbra on both ends. Longitudinal extent of penumbra exceeds 15°.
- H - A unipolar sunspot group with penumbra.

SUNSPOT NUMBER

A daily index of [SUNSPOT](#) activity (R), defined as $R = k(10g + s)$ where S = number of individual spots, g = number of sunspot groups, and k is an observatory factor.

TROUGH (Sub-auroral trough)

A region of the ionosphere characterized by a depletion of [ELECTRONS](#). The term is commonly applied to the subauroral trough, a region of the F layer lying between 50 - 70 degrees [MAGNETIC LATITUDE](#) with a north-south extent of 500 - 1000 km. The most common occurrence is between 1800 - 0600 [MAGNETIC TIME](#).

TYPE I, II, III, IV. See [RADIO EMISSION](#)

U BURST

A fast radio burst spectrum of a [FLARE](#). It has a U-shaped appearance in an intensity versus frequency plot.

ULTRA HIGH FREQUENCY (UHF)

Those radio frequencies between 300 MHz and 3 GHz.

UMBRA

The dark core or cores (umbrae) in a [SUNSPOT](#) with [PENUMBRA](#), or a sunspot lacking penumbra.

UNIVERSAL TIME (UT or UTC). See [COORDINATED UNIVERSAL TIME](#).

UNSETTLED

With regard to geomagnetic levels, a descriptive word specifically meaning that the [Ap INDEX](#) is greater than 8 but less than or equal to 15.

VERY HIGH FREQUENCY (VHF)

That portion of the radio frequency spectrum from 30 to 300 MHz.

VERY LOW FREQUENCY (VLF)

That portion of the radio frequency spectrum from 3 to 30 kHz.

WATT

The power required to do work at the rate of 1 joule per second.
 1000 Watts = 1 kW
 1 million Watts = 1 MW.
 One Horsepower = 746 Watts.

WAVELENGTH

For a propagating electromagnetic wave, the distance between successive peaks of electric or magnetic field strength. Wavelength (W) can be found from the equation: $W = c / F$ where c is the speed of light and F is the frequency.

WHITE LIGHT (WL)

Sunlight integrated over the visible portion of the spectrum (4000 - 7000 Å) so that all colors are blended to appear white to the eye.

WOLF NUMBER

An historic term for [SUNSPOT NUMBER](#). In 1849, R. Wolf of Zurich originated the general procedure for computing the sunspot number.

X-RAY BACKGROUND

A daily average background X-ray flux in the 1 to 8 Å range.

X-RAY BURST

A temporary enhancement of the X-ray emission of the sun. The time-intensity profile of soft X-ray bursts is similar to that of the [H-ALPHA](#) profile of an associated [FLARE](#).

X-MODE See [EXTRAORDINARY MODE](#).

X-RAY FLARE

A solar [FLARE](#) having increased emissions in the [WAVELENGTHS](#) range 1 - 8 Å. Because these wavelengths ionize the [D REGION](#), X-RAY flares can have a serious effect on ionospheric radio communications, often producing short wave fadeouts ([SWF](#)).

X-RAY FLARE CLASS

Rank of a [FLARE](#) based on its X-ray energy output. Flares are classified by the order of magnitude of the peak burst intensity (I) measured at the Earth in the 1 to 8 Å band as follows:

Class	(in Watt/sq. Meter)
B	I less than 10^{-6}
C	I between 10^{-6} and 10^{-5}
M	I between 10^{-5} and 10^{-4}
X	I greater than 10^{-4}

References:

1. SESC Glossary of Solar-Terrestrial Terms DOC/NOAA/ERL Space

- Environment Lab.
2. Kelley, M. C., **The Earth's Ionosphere**, Academic Press, Inc:San Diego 1989.
 3. Davies, Kenneth, **Ionospheric Radio**, Peter Peregrinus Ltd.:London, 1990.
 4. Van Valkenburg, M. E.(editor), **Reference Data for Engineers**, Prentice Hall:Carmel,IN, 1993

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