

Collection of Geomagnetic indices and like

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aa index. A daily and half daily index of geomagnetic activity determined from the k indexes scaled at two nearly antipodal stations at invariant magnetic latitude 50 degrees (Hartland, England, and Canberra, Australia). The aa values are in units of 1 nT. The index is available back to 1868, and is provided by the Institut de Physique du Globe de Paris, France.

ak index. A 3-hourly "equivalent amplitude" index of geomagnetic activity for a specific station or network of stations (represented generically here by k) expressing the range of disturbance in the horizontal magnetic field. "ak" is scaled from the 3-hourly K index according to the following table:

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

At SESC these values are used directly for operational purposes. But to convert the ak values to nanoteslas (nT), a local (station-dependent) conversion factor must be found by dividing the station's lower limit for K=9 by 250. For example, at Boulder and Fredericksburg the lower limit for K=9 is 500 nT so the factor is 2; therefore the ak values for these stations are in units of 2 nT. (To obtain an equivalent amplitude in nanoteslas for Boulder or Fredericksburg, the index value must be doubled).

Ak index. A daily index of geomagnetic activity for a specific station or network of stations (represented generically here by k) derived as the average of the eight 3-hourly ak indexes in a Universal Time day.

am index. A mean, 3-hourly "equivalent amplitude" of geomagnetic activity based on standardized K index data from a global network of 23 Northern and Southern Hemisphere stations by the Institut de Physique du Globe de Paris, France; am values are given in units of 1 nT.

Am index. The daily Ak index determined from the eight daily am indexes.

An index. The daily Ak index determined from only the Northern Hemisphere stations of the am index network.

ap index. A mean, 3-hourly "equivalent amplitude" of magnetic activity based on K index data from a planetary network of 11 Northern and 2 Southern Hemisphere magnetic observatories between the geomagnetic latitudes of 46 degrees and 63 degrees by the Institut für Geophysik at Gottingen, F.R. Germany; ap values

Ap index. Formally the daily Ak index, determined from the eight daily ap indexes. However, for daily operational uses (since several weeks are required to collect the data and calculate the index), Air Force Space Forecast Center estimates the value of the Ap index by measuring the geomagnetic field in near-real time at several Western Hemisphere magnetometer stations and statistically weighting the data to represent the Gottingen Ap. The value of this estimated Ap index is reported in SESC daily and weekly summaries of geophysical activity.

C index. A subjective daily character figure (index) of geomagnetic activity for a single observatory; for each UTC day the figure is 0 for very quiet magnetic conditions, 1 for moderately disturbed conditions, and 2 for severely disturbed conditions.

Ci index. The daily international magnetic character figure formed by taking the arithmetic mean of the C index values from all reporting observatories.

Cp index. A daily index of geomagnetic activity analogous to the Ci index, obtained from the sum of the eight daily values of the ap index. The range of Cp is 0.0 to 2.5, 2.5 representing the most disturbed.

Dst index. A measure of variation in the geomagnetic field due to the equatorial ring current. It is computed from the H-components at approximately four near-equatorial stations at hourly intervals. At a given time, the Dst index is the average of variation over all longitudes; the reference level is set so that Dst is statistically zero on internationally designated quiet days. An index of -50 or deeper indicates a storm-level disturbance, and an index of -200 or deeper is associated with middle-latitude auroras. Dst is determined by the World Data Center C2 for Geomagnetism, Kyoto University, Kyoto, Japan.

K index. A 3-hourly quasi-logarithmic local index of geomagnetic activity relative to an assumed quiet-day curve for the recording site. Range is from 0 to 9. The K index measures the deviation of the most disturbed horizontal component (see geomagnetic elements).

Km index. A 3-hourly planetary index of geomagnetic activity calculated by the Institut de Physique du Globe de Paris, France, from the K indexes observed at a large, symmetrically located network of stations. The Km indexes are used to determine the am indexes.

Kp index. A 3-hourly planetary index of geomagnetic activity calculated by the Institut für Geophysik der Gottingen Universität, F.R. Germany, from the K indexes observed at 13 stations primarily in the Northern Hemisphere. The Kp indexes, which date from 1932, are used to determine the ap indexes.

Q index. A 15-minute index of geomagnetic activity intended for high-latitude (auroral) stations. After quiet diurnal variations are removed, Q is the largest deviation scaled from the undisturbed level for the two horizontal components. (This differs from the K index, which is scaled from the largest relative deviation.) The 15-minute periods are centered on the hour and at 15, 30, and 45 minutes past each hour. The range of Q is from 0 to 11; the upper limit, in nanoteslas, for each index value is given below.

Q =	0	1	2	3	4	5	6	7	8	9	10 (T)	11 (E)
	10	20	40	80	140	240	400	660	1000	1500	2200	Unlimited

Note: Not to be confused with Qe (effective Q index) from the USAF 55th Space Weather Squadron (55SWS) (= auroral activity index), presented on the pages of NWRA (Northwest Research Associates, Inc.) Qe is being used as an input to space-weather models.

Miscellaneous geomagnetic terms

geomagnetic activity. Natural variations in the geomagnetic field classified quantitatively into quiet, unsettled, active, and geomagnetic storm levels according to the observed a index:

Category Range of index

quiet 0 - 7

unsettled 8 - 15

active 16 - 29

minor storm 30 - 49

major storm 50 - 99

severe storm 100 - 400

geomagnetic elements. The components of the geomagnetic field at the surface of the earth. These elements are usually denoted thus in the literature:

X - the geographic northward component

Y - the geographic eastward component

Z - the vertical component, reckoned positive downward

H - the horizontal intensity, of magnitude $\sqrt{(X)^2 + (Y)^2}$

F - the total intensity $\sqrt{(H)^2 + (Z)^2}$

I - the inclination (or dip) angle, $\arctan (Z/H)$

D - the declination angle, measured from the geographic north direction to the H component direction, positive in an eastward direction.

$D = \arctan (Y/X)$

However, in SESC use, the geomagnetic northward and geomagnetic eastward components are called the H and D components. The H axis direction is defined by the mean direction of the horizontal component of the field; the D component is expressed in nanoteslas and is related to the direction of the horizontal component relative to geomagnetic north by using the small-angle approximation. Thus the D component = H (the horizontal intensity) multiplied by ΔD (the declination angle relative to geomagnetic north, expressed in radians).

geomagnetic field. The magnetic field in and around the earth. The intensity of the magnetic field at the earth's surface is approximately 32,000 nT at the equator and 62,000 nT at the north pole (the place where a compass needle points vertically downward). The geomagnetic field is dynamic and undergoes continual slow secular changes as well as short-term disturbances (see geomagnetic activity). The geomagnetic field can be approximated by a centered dipole field, with the axis of the dipole inclined to the earth's rotational axis by about 11.5 degrees. Geomagnetic dipole north is near geographic coordinate 78.3 N 69 W (Thule, Greenland), and dipole south is near 79 S 110 E (near Vostok, Antarctica). The observed or dip poles, where the magnetic field is vertical to the earth's surface, are near 76 N 101 W, and 66 S 141 E. The adopted origin of geomagnetic longitude is the meridian passing through the geomagnetic poles (dipole model) and the geographic south pole. (See also corrected geomagnetic coordinates.)

geomagnetic storm. A worldwide disturbance of the earth's magnetic field, distinct from regular diurnal variations. A storm is precisely defined as occurring when the daily Ap index exceeds 29. (See geomagnetic activity).

Initial Phase: Of a geomagnetic storm, that period when there may be an increase of the middle-latitude horizontal intensity (H) (see geomagnetic elements) at the surface of the earth. The initial phase can last for hours (up to a day), but some storms proceed directly into the main phase without showing an initial phase.

Main Phase: Of a geomagnetic storm, that period when the horizontal magnetic field at middle latitudes is generally decreasing, owing to the effects of an increasing westward-flowing magnetospheric ring current. The northward component can be depressed as much as several hundred nanoteslas in intense storms. The main phase can last for hours, but typically lasts less than 1 day.

Recovery Phase: Of a geomagnetic storm, that period when the depressed northward field component returns to normal levels. Recovery is typically complete in one to two days, but can take longer.

pulsation. A rapid fluctuation of the geomagnetic field having periods from a fraction of a second to tens of minutes and lasting from minutes to hours. There are two main patterns: Pc (a continuous, almost sinusoidal pattern), and Pi (an irregular pattern). Pulsations occur at magnetically quiet as well as disturbed times. Pc's are grouped, according to their physical and morphological properties, into five categories:

Pc1 - periods 0.2-5 s. May occur in bursts ("pearls"), or in consecutive groups of pulsations with sharply decreasing frequency.

Pc2 - periods 5-10 s. Do not seem to be physically related to Pc1 or Pc3.

Pc3 - periods 10-45 s. Are observed over a wide range of latitudes.

Pc4 - periods 45-150 s. Are also known as Pc II or Pc.

Pc5 - periods 150-600 s. Are sometimes called giant micropulsations.

quiet day curve (QDC). Especially in connection with the components of the geomagnetic field (see geomagnetic elements), the trace expected in the absence of activity. The K index and Q index are measured

from deviations relative to a QDC. Riometer and neutron monitor deviations are also measured relative to a QDC.

Sq. The diurnal variation of the geomagnetic field. The Sq variation is explained in terms of solar tidal motions of the ionosphere and thermally driven ionospheric winds.

substorm. A geomagnetic perturbation lasting 1 to 2 hours, which tends to occur during local post-midnight nighttime. The magnitude of the substorm is largest in the auroral zone, potentially reaching several thousand nanoteslas. A substorm corresponds to an injection of charged particles from the magnetotail into the auroral oval.

sudden commencement (SC, or SSC for Storm Sudden Commencement). An abrupt increase or decrease in the northward component (see geomagnetic elements) of the geomagnetic field, which marks the beginning of a geomagnetic storm. SCs occur almost simultaneously worldwide but with locally varying magnitudes.

sudden impulse (SI + or SI -). A sudden perturbation, positive or negative, of several nanoteslas in the northward component (see geomagnetic elements) of the low-latitude geomagnetic field, not associated with a following geomagnetic storm. (An SI becomes an SC if a storm follows.)

Space Weather Indices (Northwest Research Associates, Inc.)

This page provides access to plots of several indices of solar and geomagnetic activity that are frequently used as inputs to space-weather models.

Brief definitions of each of the indices plotted are as follows:

F10.7 - Solar radio noise flux at a wavelength of 10.7 cm;
GPS-derived F10.7 - F10.7 value derived from GPS IONO coefficients;
SSNe - Effective sunspot number derived from ionospheric measurements;
IPS T index - Ionospheric index derived from ionospheric measurements;
Ap - Daily global index of geomagnetic activity.
Qe - Effective Q index (auroral activity index).
Kpe - Effective Kp index (auroral activity index).

Additional information defining the various indices are included with the expanded plots that are obtained by clicking on the "button" versions of the plots on this page. References for the various indices are listed at the end of each page of expanded plots.

The data shown in these plots came from the following sources:

F10.7, SSN, and Ap from the NOAA Space Environment Center(SEC)
GPS IONO coefficients from NAWCWPNS, China Lake, CA
SSNe from the USAF 55th Space Weather Squadron (55SWS) via the NOAA SEC
SSNe from NWRA calculated using foF2 data from the NOAA SEC
IPS T index from the Australian Ionospheric Prediction Service (IPS) Radio and Space Services
Qe from the USAF 55th Space Weather Squadron (55SWS) via the NOAA SEC
Kpe from NWRA calculated using DMSP SSJ/4 data from the NOAA SEC

The parameter Qe is the effective Q index derived from observations of the precipitating electrons which are the source of high-latitude aurora. The measurements are from an electron spectrometer on the USAF Defense Meteorological Satellite Program (DMSP) satellites (part of the SSJ/4 sensor package). An algorithm developed by the Geophysics Directorate of the USAF Phillips Laboratory is used by the USAF 55th Space Weather Squadron (located at Falcon AFB, CO) to determine the equatorward boundary of auroral electron precipitation from which the effective Q index is derived.

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