# GEOMAGNETIC INDICES BULLETIN

**MAY 2004**

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**THE GEOMAGNETIC FIELD.** The geomagnetic field measured at any point on the Earth's surface at any time is a combination of the MAIN field internal to the planet,of fields arising from electrical currents flowing in the ionized upper atmosphere, and of fields induced by currents flowing within the Earth's crust. The main field component varies slowly in time and can be grossly described as that of a bar magnet with north and south poles deep inside the Earth and magnetic field lines that extend well out into space.

The main field creates a cavity in interplanetary space called the magnetosphere, where the Earth's magnetic field dominates the magnetic field of the solar wind. The magnetosphere is shaped somewhat like a comet in response to the dynamic pressure of the solar wind. It is compressed on the side toward the sun to about 10 Earth radii and is extended tail-like on the side away from the sun to more than 100 Earth radii. The magnetosphere deflects the flow of most solar wind particles around the Earth, while the geomagnetic field lines guide charged particle motion within the magnetosphere.

The differential flow of ions and electrons inside the magnetosphere and in the ionosphere form current systems, which cause variations in the intensity of the Earth's magnetic field. These EXTERNAL currents in the ionized upper atmosphere and magnetosphere vary on a much shorter time scale than the INTERNAL main field and may create magnetic fields as large as 10% of the main field.

Daily regular magnetic field variations arise from current systems caused by regular solar radiation changes. Other irregular current systems produce magnetic field changes caused by the interaction of the solar wind with the magnetosphere, by the magnetosphere itself, by the interactions between the magnetosphere and ionosphere, and by the ionosphere itself. Magnetic activity indices, including those below, are designed to describe variations in the geomagnetic field caused by these irregular current systems.

MONTHLY SUMMARY OF GEOMAGNETIC ACTIVITY FOR MAY 2004

| Day | | | Rank | Kp Three-Hour Indices | | | | | | | | Kp | | | Sc* | | | | aa Provisional | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cal | # | Bart | Q/D | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Sum | Ap | Cp | (UT) | An | As | Am | N | S | M1 | M2 | |
| 1 | 122 | 20 | | 4- | 2+ | 2+ | 2- | 2 | 2 | 2- | 2+ | 18 | 9 | 0.5 | | 20 | 25 | 22 | 24 | 19 | 25 | 18 | |
| 2 | 123 | 21 | Q10 | 3 | 1- | 1- | 2+ | 1 | 1 | 2 | 1+ | 12 | 6 | 0.3 | | 12 | 11 | 12 | 17 | 8 | 17 | 9 | K K |
| 3 | 124 | 22 | | 1 | 2- | 2 | 1+ | 1 | 2 | 2+ | 2+ | 14- | 6 | 0.3 | | 14 | 15 | 15 | 15 | 14 | 10 | 19 | |
| 4 | 125 | 23 | | 2 | 2+ | 2 | 1 | 2- | 1 | 2 | 3 | 15 | 7 | 0.4 | | 17 | 17 | 17 | 17 | 19 | 17 | 19 | |
| 5 | 126 | 24 | D3 | 2+ | 3 | 3- | 2+ | 3- | 4 | 3+ | 3- | 23 | 14 | 0.8 | | 27 | 27 | 27 | 29 | 28 | 25 | 33 | |
| 6 | 127 | 25 | | 2- | 2+ | 2 | 2- | 2 | 1+ | 3- | 3- | 16+ | 8 | 0.4 | | 17 | 16 | 16 | 19 | 14 | 14 | 19 | |
| 7 | 128 | 26 | D1 | 3 | 4 | 3 | 2+ | 3- | 3 | 4- | 3 | 25- | 16 | 0.9 | | 29 | 30 | 30 | 31 | 29 | 30 | 30 | |
| 8 | 129 | 27 | | 3- | 3- | 2- | 2 | 2+ | 2 | 2 | 2 | 17+ | 8 | 0.5 | | 20 | 17 | 18 | 20 | 18 | 18 | 20 | |
| 9 | 130 | 1 | Q7 | 2 | 2+ | 1 | 1- | 2- | 1+ | 0+ | 1 | 10+ | 5 | 0.2 | | 11 | 8 | 9 | 9 | 10 | 8 | 11 | C K |
| 10 | 131 | 2 | Q9 | 2- | 2 | 1 | 1- | 1 | 1 | 2- | 3- | 12- | 6 | 0.3 | | 11 | 8 | 9 | 14 | 7 | 9 | 13 | C K |
| 11 | 132 | 3 | | 4- | 3 | 1 | 1 | 1 | 1+ | 3+ | 4 | 18+ | 12 | 0.7 | | 21 | 21 | 21 | 27 | 15 | 19 | 24 | |
| 12 | 133 | 4 | | 4 | 5- | 2- | 1+ | 1 | 1+ | 2 | 1+ | 17+ | 12 | 0.7 | | 21 | 22 | 22 | 28 | 16 | 32 | 12 | |
| 13 | 134 | 5 | | 1+ | 2+ | 4+ | 2- | 2- | 2- | 3+ | 3- | 19 | 12 | 0.7 | | 23 | 24 | 23 | 25 | 23 | 25 | 23 | |
| 14 | 135 | 6 | Q8 | 2- | 2+ | 1 | 0+ | 1+ | 1 | 2- | 2- | 11 | 5 | 0.2 | | 12 | 7 | 9 | 12 | 7 | 7 | 13 | C |
| 15 | 136 | 7 | | 3+ | 2 | 2- | 2- | 1+ | 1- | 1- | 2 | 13+ | 7 | 0.3 | | 13 | 13 | 13 | 13 | 9 | 12 | 9 | C C |
| 16 | 137 | 8 | Q5 | 2- | 1 | 1 | 1- | 1- | 1- | 1- | 2- | 8 | 4 | 0.1 | | 9 | 7 | 8 | 10 | 7 | 8 | 9 | C C |
| 17 | 138 | 9 | Q3 | 1 | 1 | 0+ | 1- | 1- | 1- | 1 | 2 | 7+ | 4 | 0.1 | | 8 | 5 | 6 | 11 | 5 | 5 | 11 | C C |
| 18 | 139 | 10 | Q2 | 1+ | 1- | 1 | 1+ | 1+ | 1- | 1- | 0+ | 7+ | 4 | 0.1 | | 10 | 5 | 7 | 9 | 6 | 8 | 7 | C C |
| 19 | 140 | 11 | | 1- | 1 | 1- | 1+ | 4- | 4- | 2+ | 2 | 15+ | 9 | 0.5 | | 18 | 11 | 14 | 24 | 14 | 7 | 32 | |
| 20 | 141 | 12 | D4 | 2- | 2- | 3- | 4+ | 2- | 2+ | 3 | 3+ | 21- | 13 | 0.7 | | 25 | 20 | 23 | 28 | 22 | 28 | 22 | |
| 21 | 142 | 13 | | 4- | 2 | 2- | 1+ | 1+ | 2 | 1+ | 0+ | 14- | 7 | 0.4 | | 17 | 13 | 15 | 17 | 11 | 17 | 12 | |
| 22 | 143 | 14 | | 1+ | 3- | 3+ | 2 | 1+ | 1+ | 1- | 1+ | 14 | 8 | 0.4 | | 18 | 13 | 15 | 15 | 13 | 19 | 9 | |
| 23 | 144 | 15 | | 3 | 3- | 2- | 2 | 3- | 2+ | 3 | 3- | 20 | 11 | 0.6 | | 23 | 19 | 21 | 23 | 16 | 18 | 21 | |
| 24 | 145 | 16 | | 3+ | 2 | 3+ | 2+ | 3+ | 1+ | 1+ | 1 | 18 | 10 | 0.6 | | 24 | 17 | 21 | 24 | 20 | 25 | 19 | |
| 25 | 146 | 17 | Q6 | 2- | 1 | 2- | 1+ | 1+ | 1 | 1- | 1- | 9+ | 4 | 0.2 | | 9 | 7 | 8 | 8 | 7 | 9 | 6 | C K |
| 26 | 147 | 18 | Q1 | 1- | 1- | 1- | 1- | 1 | 1 | 0+ | 1+ | 6+ | 3 | 0.1 | | 6 | 3 | 4 | 7 | 5 | 4 | 7 | C C |
| 27 | 148 | 19 | Q4 | 1+ | 1 | 2- | 1 | 0+ | 1- | 1 | 1- | 8- | 4 | 0.1 | | 8 | 4 | 6 | 6 | 5 | 7 | 4 | C C |
| 28 | 149 | 20 | | 1 | 0+ | 1 | 1 | 2+ | 2+ | 3- | 3- | 13+ | 7 | 0.4 | | 17 | 13 | 15 | 14 | 15 | 5 | 24 | |
| 29 | 150 | 21 | D2 | 3 | 3+ | 2+ | 4- | 2+ | 3 | 2+ | 4- | 24- | 15 | 0.8 | | 28 | 28 | 28 | 38 | 22 | 32 | 27 | |
| 30 | 151 | 22 | | 2 | 2- | 1+ | 3 | 3- | 2 | 3+ | 4- | 20- | 12 | 0.7 | | 25 | 19 | 22 | 22 | 22 | 18 | 26 | |
| 31 | 152 | 23 | D5 | 4+ | 2+ | 2+ | 3- | 3- | 2- | 3- | 2 | 21- | 12 | 0.7 | | 25 | 24 | 25 | 25 | 20 | 25 | 20 | |
| Mean | | | | | | | | | | | | | 8 | 0.44 | | 17 | 15 | 16 | 19 | 14 | 17 | | |

*preliminary

Column headings defined on back side.

## DEFINITIONS OF COLUMN HEADINGS

**Kp** **PLANETARY 3-HOUR RANGE INDEX.** K-indices were originally defined to measure effects of solar particles on the geomagnetic field. They classify the 3-hour range of the most active horizontal field component at an observatory into disturbance levels from 0 = least to 9 = most disturbed. The levels are related almost logarithmically to the disturbance amplitude range after removal of an estimated quiet-day variation produced by regular ionospheric currents. Kp indices are the average of K indices measured at 11 sub-auroral zone observatories located mainly in Europe.

**A** **EQUIVALENT AMPLITUDE A-INDEX.** The A-index ranges from 0 to 400. The A indices are daily averages of "a" indices, which convert K-values to a linear scale in field units. Ap is the daily average of the eight "ap" indices derived from 3-hourly Kp indices. Similarly, An and As are daily means derived from "an" and "as" indices obtained from groups of Northern Hemisphere (12) and Southern Hemisphere (10) observatories, respectively.

**Dst** **DISTURBANCE AMPLITUDE-STORM TIME.** Dst tracks variations in the solar-induced electric currents flowing about 5.6 Earth radii above the equatorial region. Each hourly value is the average symmetric disturbance amplitude, projected onto the equator, of the horizontal component recorded at 4 mid-latitude stations. Values are given in nT and are near 0 during quiet times. A storm sudden commencement (ssc) is seen as a sharp positive peak in Dst before the main phase of the global storm produces large negative values of Dst.

**#** **NUMBER.** The day number is a simple count of the days of the year, where January 1 = 1 and December 31 = 365 (non-leap year). It is often mistakenly called the "Julian Day".

**Bart** **DAY NUMBER OF BARTELS 27-DAY CYCLE.** The recurrence of geomagnetic activity every 27 days reflects the solar source. J. Bartels defined a series of 27-day periods to aid tracking times of unsettled magnetic conditions. He started the sequence in January 1833.

**Q/D** **MAGNETICALLY QUIET AND DISTURBED DAYS.** The following criteria are used to rank the 10 most quiet days of the month from most (Q1) to least quiet (Q10) and the 5 most active days from the most (D1) to least disturbed (D5). Criteria used in the rankings include the sum of the eight Kp values, the sum of the squares of the eight Kp values, and the greatest Kp value.

**aa** **aa INDEX.** The aa indices are 3-hourly values computed from K indices of two roughly antipodal observatories (invariant magnetic latitude 50). They provide a quantitative characterization of the global level of magnetic activity. Half-daily and daily values compare closely with the global "ap" and "am" indices (see above). The aa indices are computed for the following cases: N = daily values for the Northern Hemisphere; S = daily values for the Southern Hemisphere; and M1, M2 = half-daily values of aa for the UT day.

**NUMEROUS WORLDWIDE INDICES.** What is an index and why are there so many for terrestrial magnetism? An index continuously summarizes a complex measurement; its discrete values simplify and clarify the variations. Ideally each geomagnetic index should follow a single class of magnetic disturbance; in reality few do. The bewildering array of magnetic indices reflects many attempts to define measurements that isolate a single source of variation.

The subscript "p" designates a global magnetic activity index. The following 11 observatories, which lie between 46 and 63 north and south geomagnetic latitudes, now contribute to the Kp indices: Lerwick (UK), Eskdalemuir (UK), Hartland (UK), Ottawa (Canada), Meanook (Canada), Fredericksburg (USA), Sitka (USA), Eyrewell (New Zealand), Canberra (Australia), Lovo (Sweden), and Brorfelde (Denmark).

**SOURCES.** The aa Provisional numbers and the An, As, and Am indices are prepared monthly by M. Menvielle, International Service of Geomagnetic Indices, Tour 14, Institut de Physique du Globe de Paris, 4, Place Jussieu, 75252 Paris CEDEX 05, FRANCE. These and other indices are published annually in the IAGA Bulletin No. 32 series.

The Kp and related indices and the quiet and disturbed days are taken from a monthly report prepared by M. Siebert, Institut fur Geophysik, Gottingen University, Herzberger Landstrasse 180, Gottingen, Germany.

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