P2-SWE-I database

Past values of solar activity indices used in atmosphere models. R - sunspot number.

Daily total sunspot number derived by the formula: R= Ns + 10 * Ng, with Ns the number of spots and Ng the number of groups counted over the entire solar disk.

The service SST/arv will provide the Daily total sunspot number (R) since 1.01.1018 (recalibrated) to the last elapsed month (The Daily total sunspot number is produced on the first day of each month). The R index is based on estimated international sunspot number (EISN) obtained by a simple average over available sunspot counts from prompt stations in the SILSO network.

The service SST/arv will provide Daily Total Sunspot Number since 01.01.1818 to the last elapsed month.

The cadence of actualisation update rate of the sunspot number R in the SST/arv database will be monthly in SST/arv no later than one day after the release of data in WDC-SILSO.

The source of data is WDC-SILSO, Royal Observatory of Belgium (http://sidc.oma.be/silso/datafiles).

Outputs are generated as CSV, JSON files and figures illustrating past values in formats PNG, PDF and EPS.

Past values of solar activity indices used in atmosphere models. F10.7 -10.7 -cm radio flux proxy for solar EUV in solar flux units.

The 10.7cm Solar Flux is a measurement of the integrated emission at 10.7cm wavelength from all sources present on the disc. The 10.7cm Solar Flux, i.e., the solar flux density at 10.7cm wavelength is measured using two fully automated radio telescopes (called Flux Monitors), located at the Dominion Radio Astrophysical Observatory, Canada.

The two instruments record the strength of the solar radio emission at 10.7cm wavelength each day for as long as the Sun is above the horizon. In addition, the instruments interrupt the continuous monitoring each day to make three precise measurements of the solar flux density. These measurements constitute the 10.7cm Solar Flux index.

Each measurement of the 10.7cm Solar Flux is expressed in three values: the observed, adjusted and URSI Series D values.

Observed Flux Density - The observed value is the number measured by the solar radio telescope. This is modulated by two quantities: the level of solar activity and the changing distance between the Earth and Sun.

Flux Density Adjusted for 1.A.U. - quantity, corrected for variations in the Earth-Sun distance, and given for the average distance.

URSI Series D Flux - is the adjusted value multiplied by 0.9.

The service SST/arv will provide Observed Flux Density as well as Flux Density Adjusted for 1.A.U. and URSI Series D Flux since 14.02.1947 to now.

The update rate of the F10.7 data in the SST/arv database is daily, at the end of the measurement UTC day.

The source of data is the National Research Council and the, Herzberg Institute of Astrophysics, (Dominion Radio Astrophysical Observatory) (ftp://ftp.geolab.nrcan.gc.ca/data/solar_flux/daily_flux_values/current.txt).

Outputs are generated as CSV, JSON files and figures illustrating past values in formats PNG, PDF and EPS.

Past values of solar activity indices used in atmosphere models. Past values of solar activity indices used in atmosphere models. S10.7 -10.7 -cm radio flux proxy for solar EUV in solar flux units.

S10.7 index is an activity indicator of the integrated 26–34 nm solar irradiance measured by the Solar Extreme-ultraviolet Monitor (SEM) instrument on the NASA/ESA Solar and Heliospheric Observatory (SOHO) satellite.

This integrated 26–34 nm emission, which is also measured by the post-GOES 12 operational satellites, has been normalized and converted to sfu through linear regression with F10, producing the new index S10. The broadband (wavelength integrated) SEM 26-34 nm irradiances are EUV line emissions dominated by the chromospheric He II line at 30.4 nm with contributions from other chromospheric and coronal lines. This energy principally comes from solar active regions.

The service SST/arv will provide daily S10.7 index with 40 days lag since 01.01.1997.

The update rate of the S10.7 data in the SST/arv database is daily, at the end of the measurement UTC day.

The source of data is Space Environment Technologies (http://sol.spacenvironment.net/jb2008/indices.html).

Outputs are generated as CSV, JSON files and figures illustrating past values in formats PNG, PDF and EPS.

References: “A New Empirical Thermospheric Density Model JB2008 Using New Solar and Geomagnetic Indices” Bruce R. Bowman, W. Kent Tobiska, Frank A. Marcos, Cheryl Y. Huang, Chin S. Lin, William J. Burke, AIAA/AAS Astrodynamics Specialist Conference, AIAA 2008-6438, 2008.

Past values of solar activity indices used in atmosphere models. M10.7 proxy.

The M10.7 index is derived from the Mg II core-to-wing ratio that originated from the NOAA series operational satellites, which host the Solar Backscatter Ultraviolet (SBUV) spectrometer.

The 280 nm solar spectral band contains photospheric continuum and chromospheric line emissions.

The chromospheric Mg II h and k lines at 279.56 and 280.27 nm, respectively, and the weakly varying photospheric wings (or continuum longward and shortward of the core line emission), are operationally observed by the instrument. The Mg II core-to-wing ratio (cwr) is calculated between the variable lines and nearly non-varying wings. The result is a measure of chromospheric and some photospheric solar active region activity independent of instrument sensitivity change through time, and is referred to as the Mg II cwr. The Mg II cwr have been used in a linear regression with F10 to derive the M10 index in sfu units.

The service SST/arv will provide daily M10.7 index with 40 days lag since 01.01.1997.

The update rate of the M10.7 data in the SST/arv database is daily, at the end of the measurement UTC day.

The source of data is Space Environment Technologies (http://sol.spacenvironment.net/jb2008/indices.html).

Outputs are generated as CSV, JSON files and figures illustrating past values in formats PNG, PDF and EPS.

References: “A New Empirical Thermospheric Density Model JB2008 Using New Solar and Geomagnetic Indices” Bruce R. Bowman, W. Kent Tobiska, Frank A. Marcos, Cheryl Y. Huang, Chin S. Lin, William J. Burke, AIAA/AAS Astrodynamics Specialist Conference, AIAA 2008-6438, 2008.

Past values of solar activity indices used in atmosphere models. Y10.7 Index.

The operational GOES X-ray Spectrometer (XRS) instrument provides the 0.1–0.8 nm solar X-ray emission. X-rays in the 0.1–0.8 nm range come from the cool and hot corona and are typically a combination of both very bright solar active region background that varies slowly (days to months) plus flares that vary rapidly (minutes to hours), respectively. The photons arriving at Earth are primarily absorbed in the mesosphere and lower thermosphere (80–90 km) by molecular oxygen and nitrogen where they ionize those neutral constituents to create the ionospheric D-region. An index of the solar X-ray active region background, without the flare component, has been developed. This is called the X10 index. The 0.1-0.8 nm X-rays are a major energy source in these atmospheric regions during high solar activity but relinquish their dominance to the competing hydrogen (H) Lyman-α

emission during moderate and low solar activity. Lyman-α is also deposited in the same atmospheric regions, is created in the solar upper chromosphere and transition region, and demarcates the EUV from the FUV spectral regions. It is formed primarily in solar active regions, plage, and network; the photons, arriving at Earth, are absorbed in the mesosphere and lower thermosphere where they dissociate nitric oxide (NO) and participate in water (H2O) chemistry. Lyman-α has been observed by the SOLSTICE instrument on the UARS and SORCE NASA research satellites as well as by the SEE instrument on NASA TIMED research satellite. Since these two solar emissions are competing drivers to the mesosphere and lower thermosphere, a mixed solar index Y10 was developed. It is weighted to represent mostly X10 during solar maximum and to represent mostly Lyman-α during moderate and low solar activity. The independent, normalized F10 is used as the weighting function and multiplied with the X10 and Lyman-α as fractions to their solar maximum values.

The service SST/arv will provide daily Y10.7 index with 40 days lag since 01.01.1997.

The update rate of the Y10.7 data in the SST/arv database is daily, at the end of the measurement UTC day.

The source of data is Space Environment Technologies (http://sol.spacenvironment.net/jb2008/indices.html).

Outputs are generated as CSV, JSON files and figures illustrating past values in formats PNG, PDF and EPS.

References: “A New Empirical Thermospheric Density Model JB2008 Using New Solar and Geomagnetic Indices” Bruce R. Bowman, W. Kent Tobiska, Frank A. Marcos, Cheryl Y. Huang, Chin S. Lin, William J. Burke, AIAA/AAS Astrodynamics Specialist Conference, AIAA 2008-6438, 2008.

Past values of geomagnetic activity indices used in atmosphere models. Ap - planetary daily magnetic index.

The geomagnetic Ap index is derived from the Kp index. (Source: ftp://ftp.gfz-potsdam.de/pub/home/obs/kp-ap/readme.txt)

In order to obtain a linear scale from Kp, J. Bartels gave the following table to derive a three-hour equivalent range, named ap index:

Kp	0o	0+	1-	1o	1+	2-	2o	2+	3-	3o	3+	4-
ap	0	2	3	4	5	6	7	9	12	15	18	22

Kp	4o	4+	5-	5o	5+	6-	6o	6+	7-	7o	7+	8-
ap	27	32	39	48	56	67	80	94	111	132	154	179

Kp	8o	8+	9-	9o

ap 207 236 300 400

This table is made in such a way that at a station at about dipole latitude 50 degrees, ap may be regarded as the range of the most disturbed of the two horizontal field components, expressed in the unit of 2nT. (http://www.gfz-potsdam.de/en/section/earths-magnetic-field/data-products-services/kp-index/explanation/related-indices/)

The **daily index Ap** is obtained by averaging the eight values of ap for each day.

The service SST/arv will provide the Definitive planetary daily geomagnetic Ap index since 1.01.1932 to the last elapsed month.

The update rate of the Ap index in the SST/arv database will be monthly.

The source of data is GFZ German Research Centre for Geosciences (http://www.gfz-potsdam.de/en/section/earths-magnetic-field/data-products-services/kp-index/archive/).

Outputs are generated as CSV, JSON files and figures illustrating past values in formats PNG, PDF and EPS.

Past values of geomagnetic activity indices used in atmosphere models. Kp - planetary three-hour magnetic index.

Geomagnetic disturbances can be monitored by ground-based magnetic observatories recording the three magnetic field components. The global Kp index is obtained as the mean value of the disturbance levels in the two horizontal field components, observed at 13 selected, subauroral stations.

Local disturbance levels are determined by measuring the range (difference between the highest and lowest values) during three-hourly time intervals for the most disturbed horizontal magnetic field component. First, however, the quiet-day variation pattern has to be removed from the magnetogram, a somewhat subjective procedure. The range is then converted into a local K index (first introduced 1938 for the magnetic observatory Niemegk near Potsdam) taking the values 0 to 9 according to a quasi-logarithmic scale, which is station specific; this is done in an attempt to normalize the frequency of occurrence of the different sizes of disturbances. But K still remains a local index, describing disturbances in the vicinity of each observatory. According to the geographic and geomagnetic coordinates of the observatories, each observatory still has an annual cycle of daily variations. Using statistical methods, Julius Bartels generated conversion tables to eliminate these effects. By applying the conversion tables, a standardized index Ks for each of the 13 selected observatories is determined. In contrast to the K values, the Ks index is expressed in a scale of thirds (28 values):

0o, 0+, 1-, 1o, 1+, 2-, 2o, 2+, ... , 8o, 8+, 9-, 9o

The main purpose of the standardized index Ks is to provide a basis for the global geomagnetic index Kp which is the average of a number of "Kp stations", originally 11. The Ks data for the two stations Brorfelde and Lovö, as well as for Eyrewell and Canberra, are combined so that their average enters into the final calculation, the divisor thus remaining 11. (Source: http://www.gfz-potsdam.de/en/section/earths-magnetic-field/data-products-services/kp-index/explanation/)

The service SST/arv will provide the Definitive Planetary geomagnetic three-hour Kp since 1.01.1932 to the last elapsed month.

The update rate of the Kp index in the SST/arv database will be monthly. The source of data is GFZ German Reserch Centre for Geosciences (http://www.gfz-potsdam.de/en/section/earths-magnetic-field/data-products-services/kp-index/archive/).

Outputs are generated as CSV, JSON files and figures illustrating past values in formats PNG, PDF and EPS.

Past values of geomagnetic activity indices used in atmosphere models. Dst - Disturbance Storm Time Index.

The Dst index is an index of magnetic activity derived from a network of near-equatorial geomagnetic observatories that measures the intensity of the globally symmetrical equatorial electrojet (the "ring current"). (https://www.ngdc.noaa.gov/stp/geomag/dst.html)
The baseline for H is defined for each observatory in a manner that takes into account the secular variation. For each observatory, the annual mean values of H, calculated from the "five quietest day" for each month, form the database for the baseline. It should be remembered that the final Dst values are determined after each calendar year and that therefore in this determination the annual mean values are available only up to and including the year (referred to below as the current year) for which the Dst is to be deduced. (http://wdc.kugi.kyoto-u.ac.jp/dstdir/dst2/onDstindex.html)
After Sq (Solar quiet daily variations) eliminations and averaging over the observatories the Hourly Equatorial Dst Index is obtained.
The service SST/arv will provide the **Final** and **Provisional** Dst index since 1.01.1957 to the last available data.
The cadence of actualisation of the Dst index in the SST/arv database will every time new data appear (database is checking the server at Kyoto every day, at the end of UTC day). The source of data is World Data Center for Geomagnetism, Kyoto. (http://wdc.kugi.kyoto-u.ac.jp/dstdir/).
Outputs are generated as CSV, JSON files and figures illustrating past values in formats PNG, PDF and EPS.

Past values of geomagnetic activity indices used in atmosphere models. IG12 - 12-month-running mean of the ionospheric IG index.

The IF2 and IG indices of solar activity are derived from the monthly median noon foF2 data available from the following thirteen ionospheric observatories:

Canberra

Christchurch

Churchill

College

Delhi

Huancayo

Johannesburg

Moscow

Mundaring

Port Stanley

Slough

Tokyo

Wallops Island

The IG index has been confirmed as an alternative to sunspot number when predictions of foF2 are being prepared with the aid of the CCIR atlas of ionospheric characteristics. The values given in the Ionospheric Indices table continue the series of tabulated data for the period 1943-1980 published in the ITU Telecommunication Journal (Vol 50, Aug 1983, p 408) where the index was referred to as the Global Effective Sunspot Number(GESSN).

When foF2 data are late in arriving, provisional index values are calculated and are shown in parentheses; the final values will be published later. (References: https://www.ngdc.noaa.gov/stp/iono/if2ig.html)

IG12 is 12-month-running mean of the ionospheric IG index.

The service SST/arv will provide the Final and Provisional IG12 index since 1.07.1943 with the seven months delay (IG12 running mean is “central moving average”).

The update rate of the IG12 index in the SST/arv database will be monthly. The source of data is UK Solar System Data Centre (UKSSDC) (http://www.ukssdc.ac.uk/Help/RADIO_PROP.html)

Outputs are generated as CSV, JSON files and figures illustrating past values in formats PNG, PDF and EPS.

Past values of geomagnetic activity indices used in atmosphere models. IMF - Interplanetary Magnetic field.

The magnetic field carried with the solar wind.

Intense southward interplanetary magnetic field is believed to be one the most important causes for a major magnetic storm, which can produce severe space weather. The primary cause of these storms are the long-duration southward interplanetary magnetic fields (IMF) in solar magnetospheric coordinate system (GSM), usually called –Bz or Bs events, which play a crucial role in determining the amount of solar wind energy to be transferred to the magnetosphere. (References: Chao, J. K. and Chen, H. H. (2001) Prediction of Southward IMF Bz, in Space Weather (eds P. Song, H. J. Singer and G. L. Siscoe), American Geophysical Union, Washington, D. C.. doi: 10.1029/GM125p0183)

The service SST/arv will provide IMF Magnetometer measurements (total field and three components) from ACE satellite since 3127.12.1997 to last data provided by NASA (database is checking the availability of data every day, at the end of UTC day).

The source of data is NASA (http://omniweb.gsfc.nasa.gov or ftp://spdf.gsfc.nasa.gov/pub/data/ace/mag/level2_hdf/)

Outputs are generated as CSV, JSON files and figures illustrating past values in formats PNG, PDF and EPS.

P2-SWE-II database

Past values of solar activity indices used in atmosphere models. aa index (K-derived planetary)

The purpose of the aa index is to measure the amplitude of global geomagnetic activity during 3-hour intervals normalized to geomagnetic latitude ±50°. *aa* was introduced to monitor geomagnetic activity over the longest possible time period.

aa is derived from the *K* indices measured at two antipodal observatories. The *K* indices are converted into amplitudes using mid-class amplitudes then averaged with weighting factors that account for slight changes in geomagnetic disturbance intensities between successive Northern and Southern *aa*-observatories.

The aa index is produced by EOST, Strasbourg, France. The index is available from 1868 onward. The time resolution is 3 hours.

aa values are obtained every day from the UK Solar System Data Centre (UKSSDC). Only definitive values are provided through the SGIArv service.

Past values of solar activity indices used in atmosphere models. Aa index (K-derived planetary)

The daily Aa index is the daily average of eight aa values.

The aa index is produced by EOST, Strasbourg, France. The index is available from 1868 onward. The time resolution is 1 day.

aa values are obtained every day from the UK Solar System Data Centre (UKSSDC). Only definitive values are provided through the SGIArv service.

Past values of solar activity indices used in atmosphere models. am index (K-derived planetary)

The purpose of the am index is to provide a characterization of global geomagnetic activity using a large set of stations representing all longitudes and possible hemispheric discrepancies.

The stations are situated close to 50° corrected geomagnetic latitude (in the subauroral zones), and are gathered into groups, each corresponding to a longitude sector. There are 5 such groups in the Northern hemisphere, and 4 in the Southern one.

In each longitude sector, the *K* scaled for each station, are averaged, and the result is converted into amplitude using mid-class amplitudes for L9 = 500 nT (L9 being the K=9 lower limit). The weighted average of the so-obtained amplitudes give rise to the hemispheric indices *an* (North) and *as* (South), the weighting factors accounting for the differences in the longitude sector extents in each hemisphere. The planetary index *am* is equal to (*an* + *as*) / 2.

The am index is produced by EOST, Strasbourg, France. The index is available from 1959 onward. The time resolution is 3 hours.

am values are obtained every day from the UK Solar System Data Centre (UKSSDC). Only definitive values are provided through the SGIArv service.

Past values of solar activity indices used in atmosphere models. Am index (K-derived planetary)

The daily Am index is the daily average of eight am values.

The Am index is produced by EOST, Strasbourg, France. The index is available from 1959 onward. The time resolution is 1 day.

Am values are obtained every day from the UK Solar System Data Centre (UKSSDC). Only definitive values are provided through the SGIArv service.

Past values of solar activity indices used in atmosphere models. F30 index

The Nobeyama Radio Observatory performs daily measurements of the 30 cm radio flux on an operational 7/365 basis. Additional measurements are made at 15, 8.2, 3.0, and 1.8 cm. The radio polarimeters are operated by the Nobeyama Radio Observatory (NRO), a branch of National Astronomical Observatory of Japan (NAOJ).

Fluxes at the real Sun-Earth distance are referenced as “absolute”, and fluxes at 1 AU (Astronomical Unit) are referenced as “adjusted”.

Absolute F30 values are obtained every day from CLS.). Only definitive values are provided through the SGIArv service.