

SPACE WEATHER IMPACTS on GNSS



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Ministerie van Infrastructuur en Milieu

Indices of geomagnetic activity

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1 Introduction

2 Planetary activity indices

- Equatorial ring current disturbances
- Mid-latitude activity
- Auroral electrojet & polar cap activity

3 Local activity indices

The main driver for the ionosphere is solar irradiation, but the main driver for ionospheric *disturbances* is the geomagnetic field.

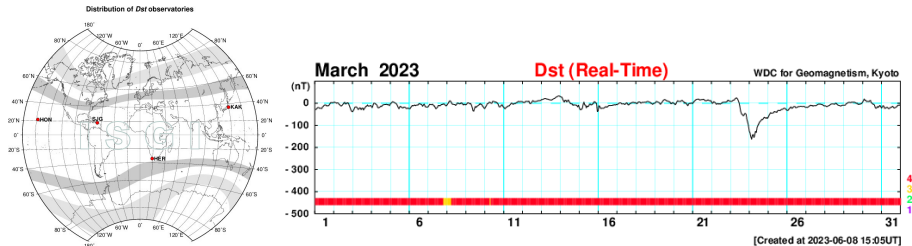
Magnetic field exhibits quiet time variations (Sq and L) and disturbance variations D' .

D' is further split into *storm-time variation* Dst —due to disturbance of the equatorial ring current—and *disturbance-daily variation* Ds —due to ionospheric currents.

Various indices exist to assess the level of disturbance in the ring current, the auroral electrojet, and the mid-latitude geomagnetic field.

Ring current index: *Dst*

The *Dst* index is calculated as a weighted average of the deviations from the quiet field at four equatorial magnetic observatories.

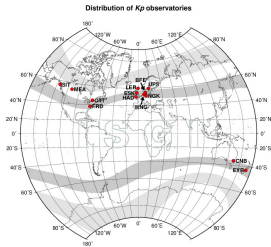


Calculate hourly in near-real-time, given in nano-Tesla, available at <https://wdc.kugi.kyoto-u.ac.jp>.

Storms happen in three phases: onset (positive *Dst*), main phase (large negative *Dst*), en slow recovery.

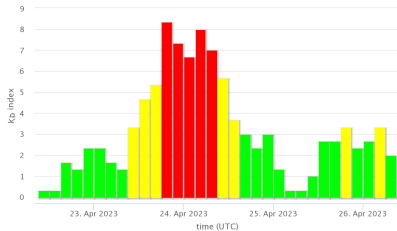
K-indices

K index is obtained from the difference between maximal and minimal field in a three-hour window, converted according to an observatory specific scale. Planetary K_p is weighted average over 13 mid-latitude observatories.



Most recent geomagnetic storm with K_p index > 6

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Major limitations:

- 1 Irregular distribution of observatories (alternative K_m).
- 2 Only calculated at three hour intervals (higher cadence exists).

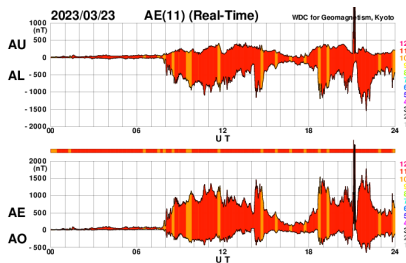
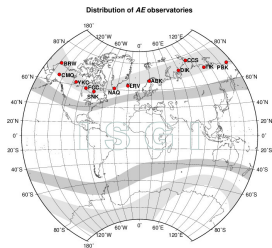
Available from <https://kp.gfz-potsdam.de/en/>.

Auroral activity indices

Auroral electrojet activity indices are obtained from the envelope of the field measured at twelve observatories in the northern auroral region.

High time resolution, but only relevant for northern auroral oval (there can be significant hemispherical differences!). Available at

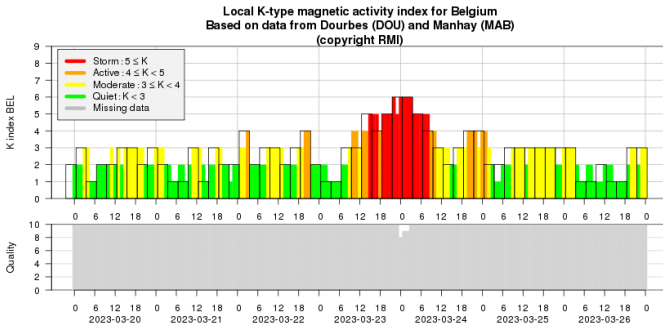
<https://wdc.kugi.kyoto-u.ac.jp/>.



Polar cap indices for both poles (*PCS* from Vostok & *PCN* from Thule, doi:10.11581/DTU:00000057) exist, but mostly only relevant for the polar cap regions.

Local magnetic activity indices

It is well known that the ionospheric response, especially at storm onset, depends on place and local time. This is a limitation to the use of planetary indices.



In some countries, local K -indices are available calculated similarly to the K_p but from local observatories only.

The end!

Questions?

References:

- P.N. Mayaud: *Derivation, Meaning, and Use of Geomagnetic Indices*, American Geophysical Union, 1980.
- <https://isgi.unistra.fr/index.php>