



# L1 solar wind ACE data alerts by AFFECTS



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## 0

### Overview

To quantify the space weather effects of the solar wind on the Earth's magnetosphere in-situ measurements are indispensable. Satellites like the ACE spacecraft at L1 are thus necessary to obtain real-time solar wind parameters. We use these data to generate L1 based near real-time warnings of severe space weather and its effects through RSS feeds. As derivatives we provide Kp and aurorae feeds too. The services are freely available through the AFFECTS website. The space weather services will help increase space weather awareness to the scientific community and general public.

Panel 1 covers the used ACE data set, panel 2 explains the geomagnetic Kp index, panels 3 & 4 handle the solar wind influence on Kp and auroral position, panel 5 & 6 are about the RSS feed alerts.

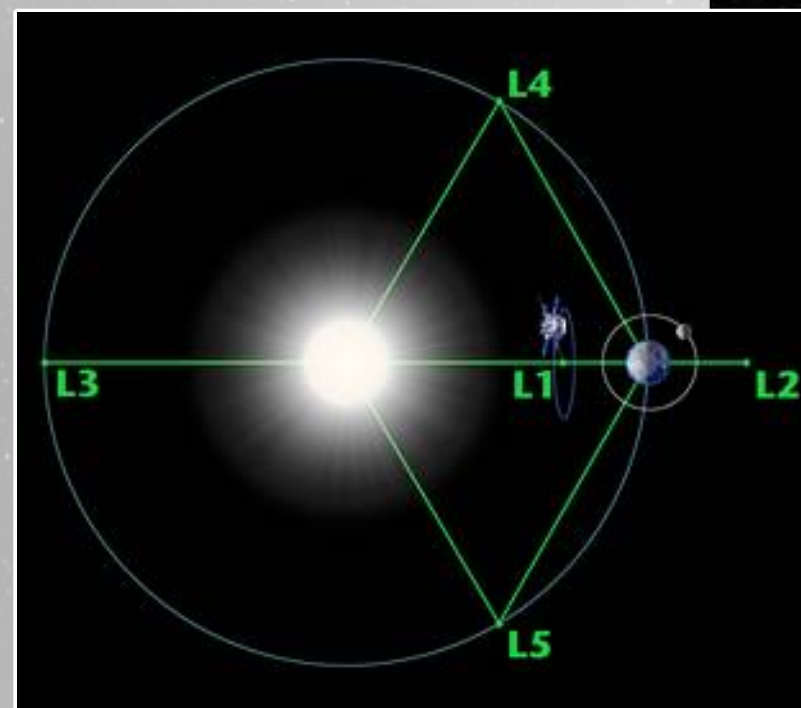
## 1

### ACE solar wind data from L1

The Advanced Composition Explorer (ACE) spacecraft is positioned at the Lagrange 1 point (L1) between Sun and Earth since its launch in 1997 by NASA. The instruments MAG and SWEPAM aboard ACE measure in-situ solar wind parameters. This data is provided online in near real-time and available from NOAA/SWPC ([www.swpc.noaa.gov/ftpmenu/lists/ace.html](http://www.swpc.noaa.gov/ftpmenu/lists/ace.html)).

The near real-time data allow short-term forecasts (~9 min):

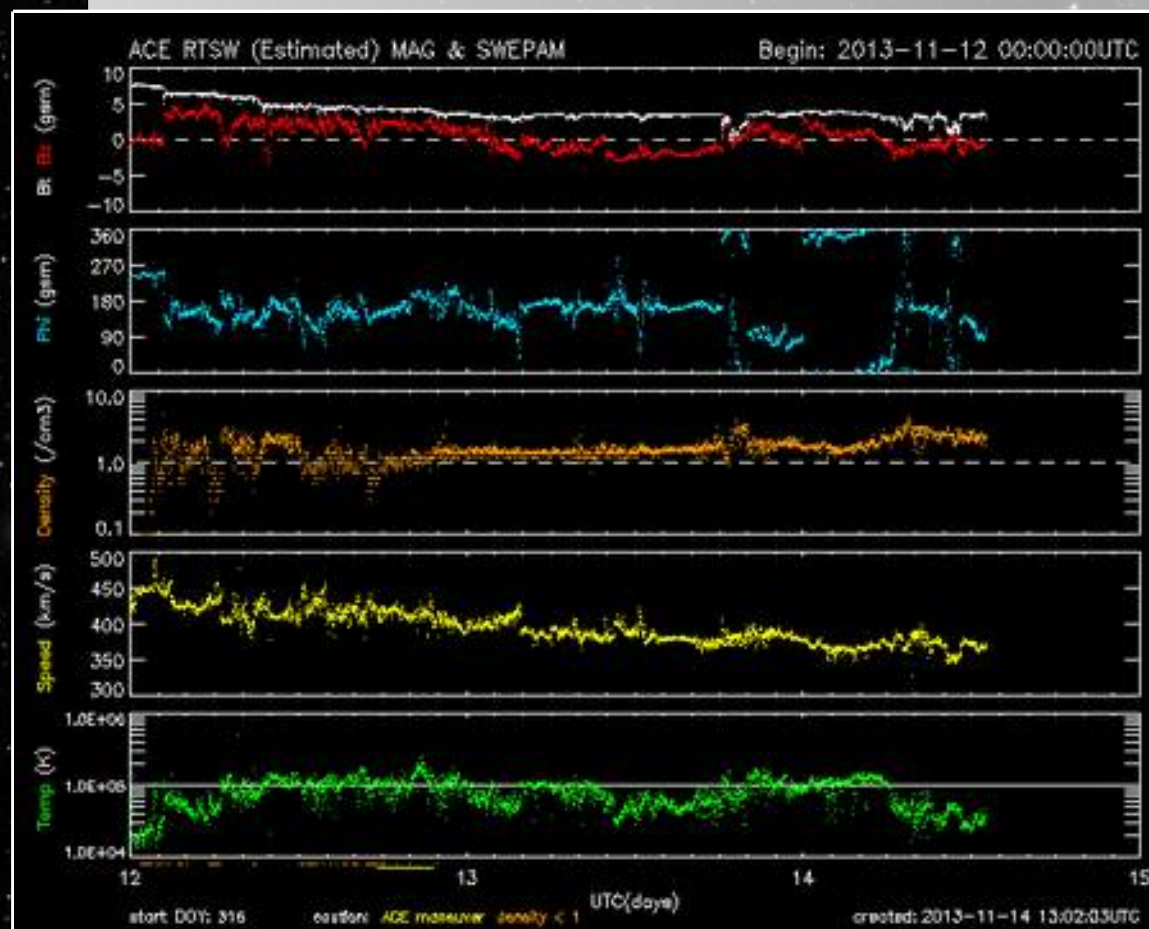
- ~3 minutes data delay to availability at SWPC server
- L1 to Earth travel time 12-60 min depending on speed (2000-400 km/s)



ACE satellite position around Lagrange 1. Credit: NASA/H. Zell

The measured in-situ parameters consist of:

- magnetic field strength
- magnetic field orientation
- proton density
- proton bulk speed
- ion temperature



ACE dynamic real-time solar wind plot for the last 3 days. Credit: SWPC/NOAA

### Geomagnetic Kp index

## 2

Extreme solar wind affects the Earth's magnetosphere. The Kp index is a measure for the planetary geomagnetic disturbance. It is based on the 3-hourly range of the magnetic field variation of 13 ground observatories. Kp was introduced by Bartels in 1948 at the Institute for Geophysics, Göttingen University. The linear equivalent is the ap index whose range is [0-400].

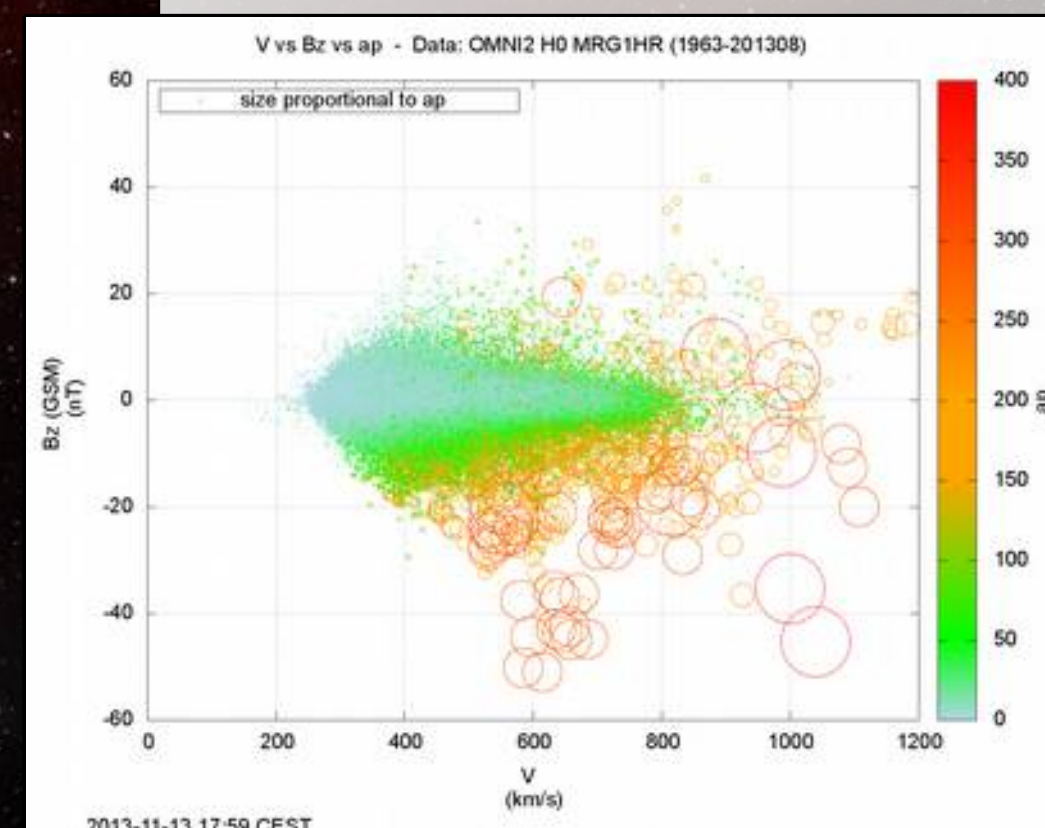
Kp scale ranges from 0 to 9 with +/- substeps:

0 1 2 3 4 5 6 7 8 9  
+ - + - + - + - + - + - + - + - + - + - + -

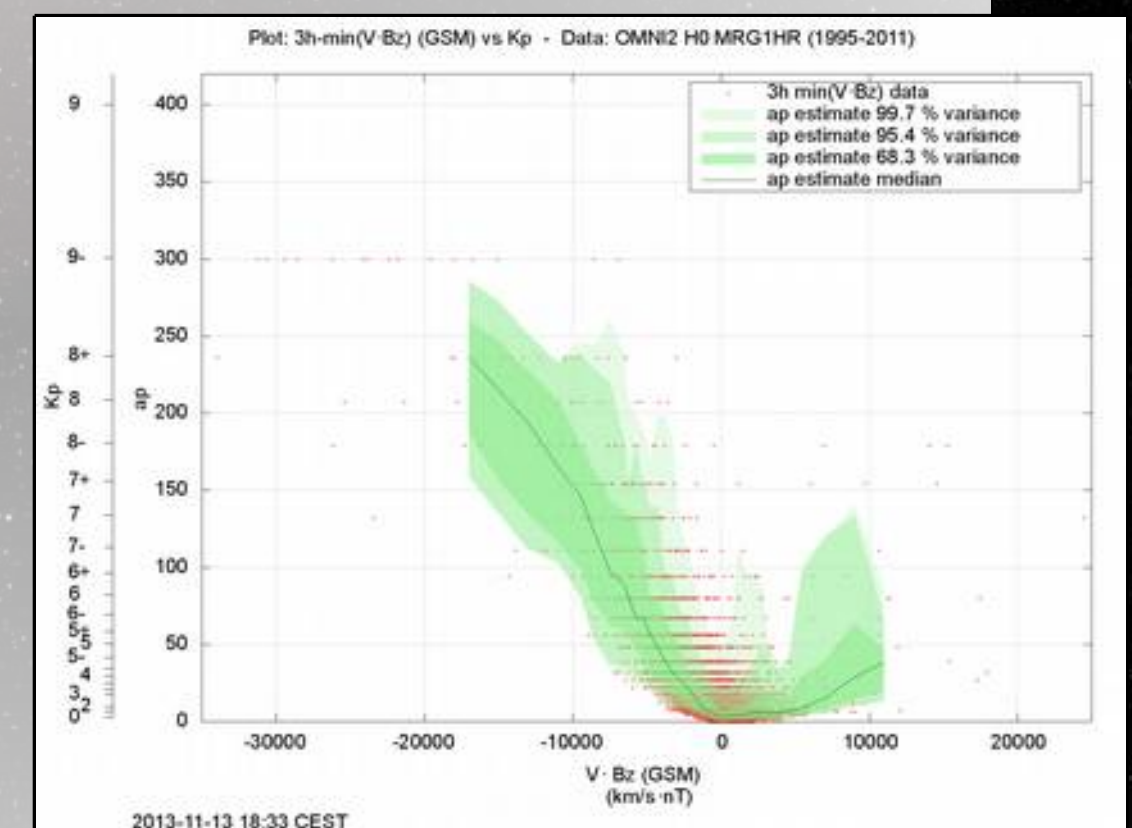
## 3

### Kp estimate from solar wind

Fast solar wind carrying a high B-field causes disturbed geomagnetic conditions. Especially the B-field orientation is important for the resulting ap value. A negative Bz leads to reconnection with the magnetosphere and subsequent injection of plasma from the magnetotail into the ring current system.



High ap values occur during fast solar wind with negative Bz component.



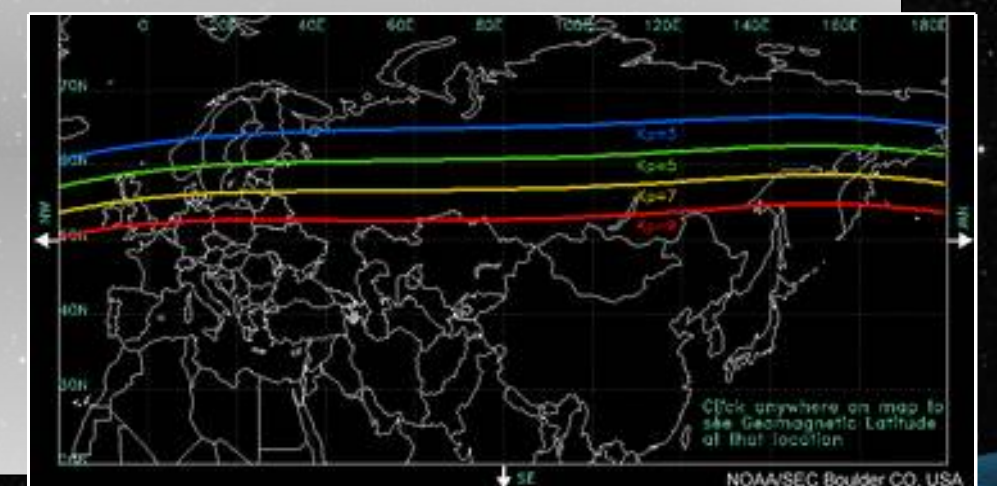
Empirical correlation between V \* Bz and ap index.

The ring currents electrical field E scales with the ap index. It can be derived via the Lorentz force ( $E \approx V \times B$ ). We use the product ( $V \cdot B_z$ ) to get an empirical ap estimate.

## 4

### Auroral position from solar wind

The midnight equatorward auroral boundary position correlates with the Kp index. We derive the auroral position via tables at SWPC/NOAA from our Kp estimate.



Kp map of midnight equatorward boundaries. Credit: NOAA/SEC Boulder CO, USA

## 5

### L1 alerts via RSS feeds

For the L1 solar wind and its derived parameters Kp estimate and auroral position we provide threshold based alerts via RSS feeds. A new alert is triggered if the threshold value of the specified parameter is exceeded. At the moment we provide the following RSS feeds:

- L1 Solar Wind Alert (parameters |B|, B<sub>z</sub> and V)
- L1 Kp Alert
- L1 Aurora Alert

## 6



### About RSS

Rich Site Summary (RSS) web feeds are used to publish frequently updated news. They can be viewed by many different feed readers like mobile apps, browsers or email-clients. The RSS reader automatically checks the user's subscribed feeds regularly for new content and allows users to avoid manually inspecting all of the websites they are interested in.

### Link to L1 alerts

The L1 alerts are located at the AFFECTS project website. The link to the space weather services:

[www.affects-fp7.eu/services](http://www.affects-fp7.eu/services)



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