

# XIX...Magnetic Storms and Aurora

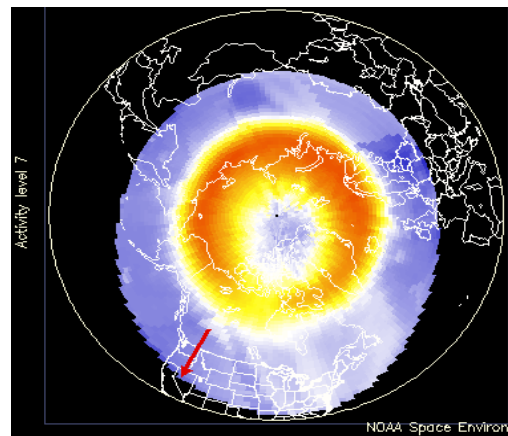
## Introduction:

In the 1800's Alexander Von Humbolt discovered that magnetic storms are often correlated with sightings of bright aurora. From the ground, aurora look like curtains of light. From space they look like luminous donuts crowning the magnetic poles of a planet. The size and extent of these 'Auroral Ovals' change constantly during severe magnetic storms as particles from the distant magnetic tail of the Earth slam into the oxygen and nitrogen atoms in Earth's atmosphere. These currents dissipate electrical energy in the upper atmosphere and satellites such as the NOAA NPOES satellites can measure how much energy is released.

## Objective:

To compare the amount of energy dissipated by an aurora in the northern hemisphere, with the recorded Kp index of magnetic storm severity.

NOAA-16(N)  
January 22, 2001  
Power Level (P) = 7



## Procedure:

1) From the previous activity, note the dates and times of two or three magnetic storms with Kp values of 6,7,8 and if possible, 9.

2) Convert the date into a day number. Example:  
January 1 = 0, December 31 = 365.

3) Visit the archive of data from the NPOES satellite at:

**[gopher://solar.sec.noaa.gov/11/lists/hpi](http://gopher://solar.sec.noaa.gov/11/lists/hpi)**  
where you will see text files listed as, for example, POWER\_1978.TXT.

4) Click on the file for the year when you are seeking data for the first Kp value in #1 above. For example, on November 28, 2000, Kp = 7 on Day = 334 so open the file POWER\_2000.TXT by clicking on it.

5) Scan down to the section that represents that day number. See the underlined example on the right for details on how to read the line of data.

6) Extract the peak power measurement for the northern hemisphere at that time.  
Example, for November 29, 2000 when Kp = 7, the peak power was 253.3 gigawatts (see below sample) at UT = 14:28

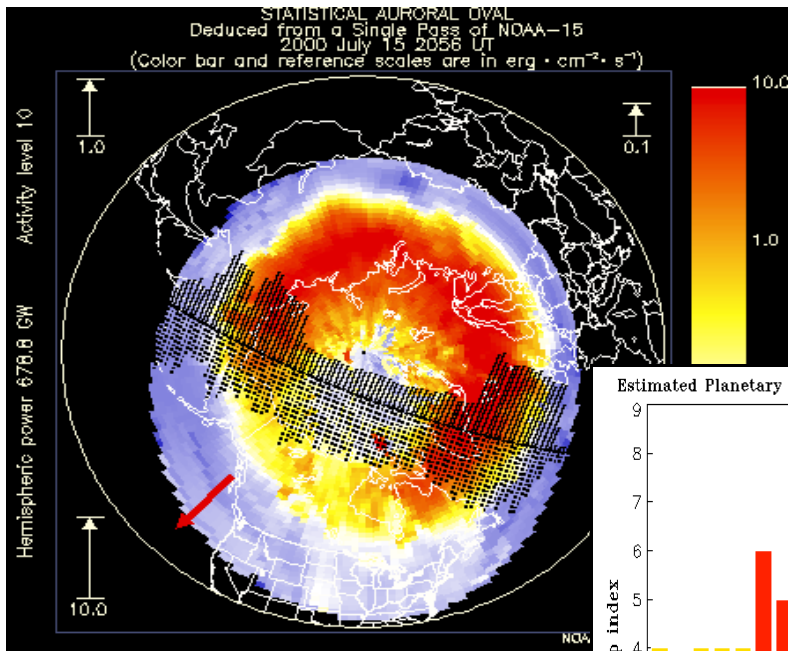
8) Repeat this for each of the selected magnetic storms.

9) On a graph, plot the Kp value for each storm on the horizontal axis, and the power dissipated on the vertical axis. (See Activity XVII)

Satellite	Day UT	Power	P	F
NOAA-12(S)	3341359	74.8	9	1.298
NOAA-16(S)	3341424	44.1	8	1.075
NOAA-14(N)	3341428	208.6	10	1.287
<u>NOAA-15(N)</u>	<u>3341428</u>	<u>253.3</u>	<u>10</u>	<u>1.279</u>
NOAA-12(N)	3341449	107.3	10	1.179
NOAA-16(N)	3341515	32.1	7	1.228

## Questions:

- 1) Does the severity of the Kp index correlate with the amount of dissipated power during an aurora?
- 2) For each Kp index, what is the range of power dissipation levels that you recorded?
- 3) Is there a difference in the ranges of the power dissipation levels for each Kp? If so, which ones seem to have the narrowest range? The widest range?
- 4) If you were planning to travel to see an aurora in Alaska or Canada, for what value of Kp would you start planning your journey?
- 5) From the Kp plots for specific storms, how much warning would you have that a measurement of Kp=7 would lead to a spectacular Kp=8+ storm and a consequently spectacular aurora?
- 6) If you were a power plant or electrical utility, how much warning would you have to protect your equipment from geomagnetic damage using only the Kp index as a guide?



The Bastille Day Storm on July 14-15, 2000 was one of the most powerful storms during the current solar activity cycle.

The above image based on the NOAA-15 satellite data shows a powerful oval encircling the north magnetic pole. Total power dissipation was over 678 billion watts. The bar graph shows that during this time, the Kp was at a level of 9 for 9 consecutive hours. Each bar represents a single, planetary 3-hour average.

