A Comparison of the *Ovation Prime* and *POES* Auroral Models

Pattilyn McLaughlin[1,2], Rodney Viereck[2]
[1]Department of Physics & Astronomy, Alfred University, Alfred, New York
[2] NOAA Space Weather Prediction Center, Boulder, Colorado
pattilyn.mclaughlin@noaa.gov

Introduction

Aurora Borealis and Australis

- Caused by electrons energized through interactions between solar wind and the magnetosphere
- Accelerate Electrons which follow the magnetic field line of Earth to upper atmosphere and polar regions
- Electrons collide with atoms in upper atmosphere and are excited
- Emit specific wavelengths when they relax, this light is the Aurora
- Aurora are dynamic and good indicators of geomagnetic storms (where and when).
- Same particles affect radio wave propagation and satellites
- Forecasting the intensity & location of the aurora is important for many, including users of GPS, HF communications, and those who want to observe the aurora

Purpose: Compare the POES Aurora Model and the Ovation Prime Aurora Model.

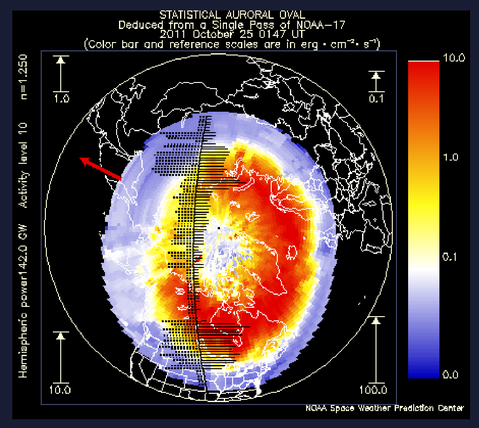
Procedure:

- Compare the estimated hemispheric power from both models
  - Both models provide estimates of the Hemispheric Power (HP) which is the total energy deposited by the aurora into the upper atmosphere and ionosphere in the northern or southern polar regions.
- Periods between October 2003 and March 2012 were selected to cover the full range of geomagnetic activity as well as seasonal variations and activity produced by CMEs and high speed solar wind.

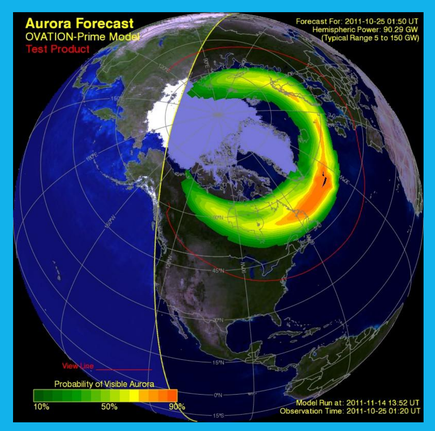
Results:

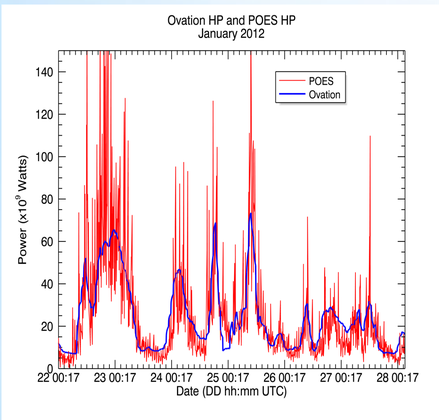
- Both models captured geomagnetic storms but the POES HP had more variability than Ovation HP indicating that POES HP might be capturing substorms whereas the Ovation HP only captured the larger scale geomagnetic storm.
- To improve comparisons and remove the short-term variations, POES HP data were smoothed with a 20 point (~4 hour) smoothing function.
- For each POES HP value, the coinciding Ovation Prime HP were interpolated to the time corresponding with the POES data points. The Ovation Prime data was then plotted as a function of the POES data. The correlation coefficient and the equation of the line were calculated for each event and compared

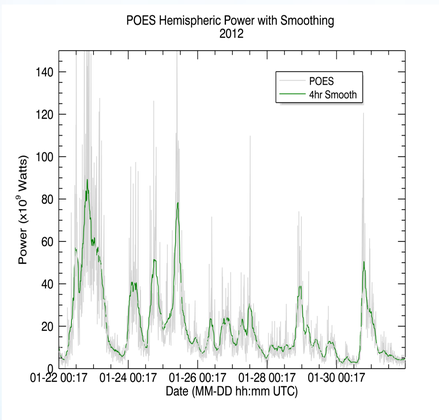
The **POES** (Polar Operational Environmental Satellite) Auroral Model provides auroral information to people who want to know when they can see the aurora. It is based on data from the Space Environment Monitor (SEM) on the NOAA POES spacecraft in polar Low-Earth-Orbit. The POES satellites measure the auroral particles at every pass through the auroral zone and provides a measure of the spatial distribution of the energy and number flux of the auroral particles. These passes are then correlated with one of ten auroral oval maps and an estimate of the total power deposited into that hemisphere is calculated. With six satellites, the aurora is sampled on average about once every 12 minutes however, the data are only sent down to one of two ground stations so the data are 30 to 90 minutes old by the time it reaches SWPC.

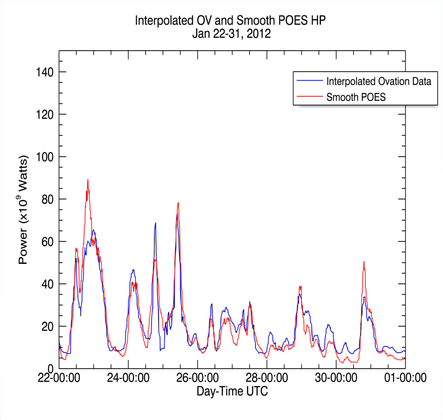


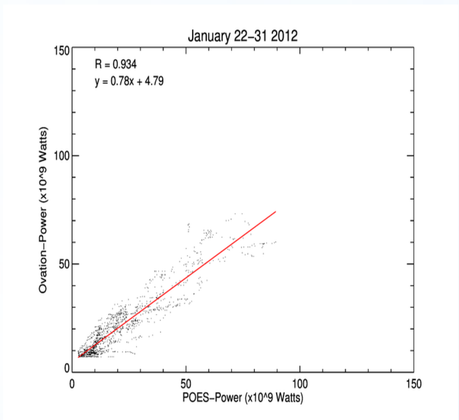
The **Ovation Prime** model is an empirical model based on the SSJ5 particle sensor on the DoD DMSP spacecraft. The model was developed by comparing the solar wind condition at the Advanced composition Explorer (ACE) satellite to the observations of the aurora by the DMSP. By combining many years of data, an empirical relationship between the solar wind and the location and intensity of the aurora were developed. Because the Ovation Prime model is driven by the solar wind, it is able to provide a 30-40 minute forecast of the aurora, thus making it much more useful to customers

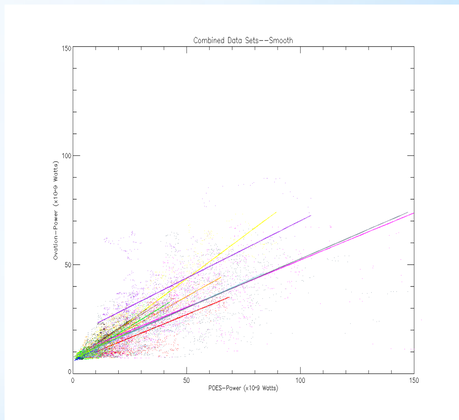












Q: Why was smoothing for POES needed?
A: Often times in the POES data spikes in hemispheric power occurred when no noticeable spikes in the Ovation Prime models nor any spikes in geomagnetic indices like AE occurred.
There are several possible causes of these data spikes in POES.

1. The spikes were usually produced by POES 15,17, 19, or METOP 2 and not by POES 14, 16, or 18. Thus there may be intercalibration issues between satellites.
2. The spikes were often produced when the satellite pass only skimmed the auroral oval on the dayside. Thus there may be issues with the day-night calibration in the model.

See Figures 1, 2, 3, & 4.

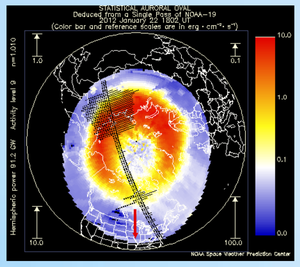


Figure 1.

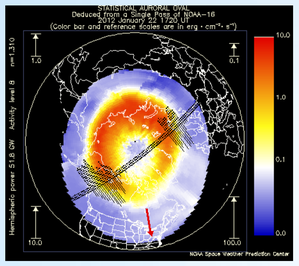


Figure 3.

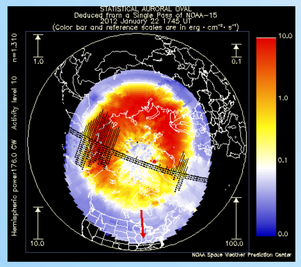


Figure 2.

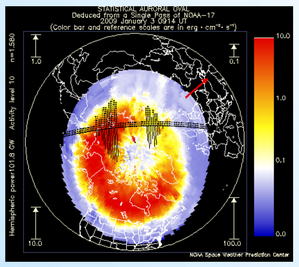


Figure 4.

Conclusions

- **OVATION Prime is a fairly accurate indicator of when and where aurora will happen.**
- **OVATION Prime is most accurate for quiet periods and periods of solar wind**
- **POES needs to be reevaluated and analyzed in order to understand spikes.**
- **Future work should include the validation of Ovation using observations of the visible Aurora**

Type	Time	Correlation Coefficient R	Slope	Y-intercept
CMEs	----------	.761 ± .060	.55 ±.07	9.77± 2.40
	Oct 2003	.779	.45	7.72
	Jan 27 2012	.934	.78	4.79
	Mar 12 2012	.595	.53	17.66
	Nov 4 2003	.739	.43	8.92
Season Change	----------	.833 ± .014	.62 ± .04	6.42 ± .21
	Spring 2012	.817	.68	6.74
	Winter 2011	.797	.72	6.52
	Fall 2012	.843	.51	6.7
	Summer 2009	.874	.55	5.71
Solar Wind	----------	.799 ± .024	.45 ±.01	6.34 ± .34
	Feb 6-19 2008	.764	.43	5.86
	Oct 17-29 2007	.833	.47	6.82
Quiet Periods	----------	.935 ± .002	.61 ± .02	6.05 ± .18
	Jan 20-26 2009	.938	.58	6.3
	Jul 7-19 2010	.932	.64	5.79
All	12 Time Periods	.820 ± .027	.56 ± .03	7.46 ± .93

References

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