



## **ANOMALIES FROM SOLAR EVENTS**

In response to CGMS Permanent Action 02

NOAA-WP-04 provided an example of a new space weather product, the progression and prediction of the solar cycle, and a summary of significant space weather events. The new experimental product is one that serves customers, such as airlines flying polar routes, by providing the effect of solar protons on High Frequency (HF) communications at high latitudes. Predictions were given for the year and magnitude of the maximum of Solar Cycle 24. There are two consensus predictions, one for a large solar cycle with a maximum in October 2011 and another for a small cycle with a maximum in August 2012. This prediction, of great importance for planning activities affected by solar activity, will be updated annually. Information was provided on major activity observed from August 2007 through July 2008. A single moderate-sized (M-class) solar flare occurred in March 2008. It is typical for energetic electron fluxes to increase during the declining phase of the solar cycle as recurrent coronal holes produce regular intervals of high-speed solar winds that interact with the geomagnetic field. Electron flux levels reached high levels at geosynchronous orbit on about 63% of the days during the period. Very high flux levels occurred on 29 March 2008.

## ANOMALIES FROM SOLAR EVENTS

### 1 INTRODUCTION

This paper documents significant space weather for the summary period AUG 2007–JUL 2008. Previous CGMS papers have addressed in more detail the status of Cycle 23, and what follows is an update of CGMS XXXV NOAA-WP-04.

### 2 SERVING CUSTOMERS WITH NEW PRODUCTS

Currently NOAA provides its customers with a D-region product that specifies high frequency (HF) communication outages caused by D-region ionization produced by solar X-ray emissions during solar flares. The product consists of four dynamic components: a global frequency map, an attenuation bar graph, status messages, and an estimated recovery time. All of the components update continuously, driven by one-minute GOES X-ray flux data. The global frequency map graphically illustrates the Highest Affected Frequency (HAF) as a function of latitude and longitude. We define the HAF as the frequency which suffers a loss of 1 dB during vertical propagation from the ground, through the ionosphere, and back to ground. Radio frequencies lower than the HAF suffer an even greater loss as described in the

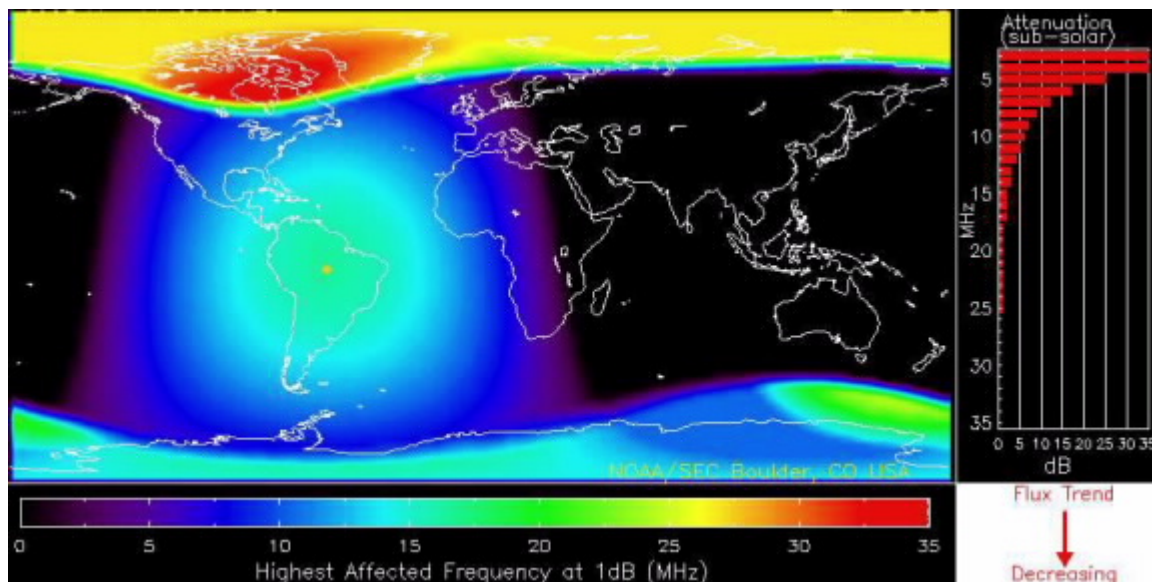


Figure 1: Global D-Region Absorption Prediction (Experimental Product)

Attenuation Bar Graph section (<http://www.swpc.noaa.gov/dregion/index.html>). Prior to the introduction of our newest experimental product, this product did not take into account the radio wave absorption caused by proton precipitation during solar energetic particle events that produce severe HF communication outages at high latitudes. However, such communication outages have strong impacts on

commercial airline flights and significant economic consequences. During solar energetic particle events, commercial airlines cannot fly the polar routes due to the

unavailability of HF communication, but instead must reroute to lower latitudes, resulting in longer travel times, additional fuel costs, and lower overall transport capacity. Therefore, as shown in Figure 1, a new experimental product has been developed to serve our many customers affected by high-latitude absorption caused by solar protons.

### 3 SOLAR CYCLE PROGRESSION

Monthly, the Space Weather Prediction Center updates the Solar Cycle Sunspot Number progression using the latest predictions from the International Space Environment Services (ISES). The official NOAA, NASA, and ISES Solar Cycle 24 prediction was released by the Solar Cycle 24 Prediction Panel on April 25, 2007. The Prediction Panel included members from NOAA, NASA, ISES and other US and international representatives. As shown in Figure 2, the panel consensus has

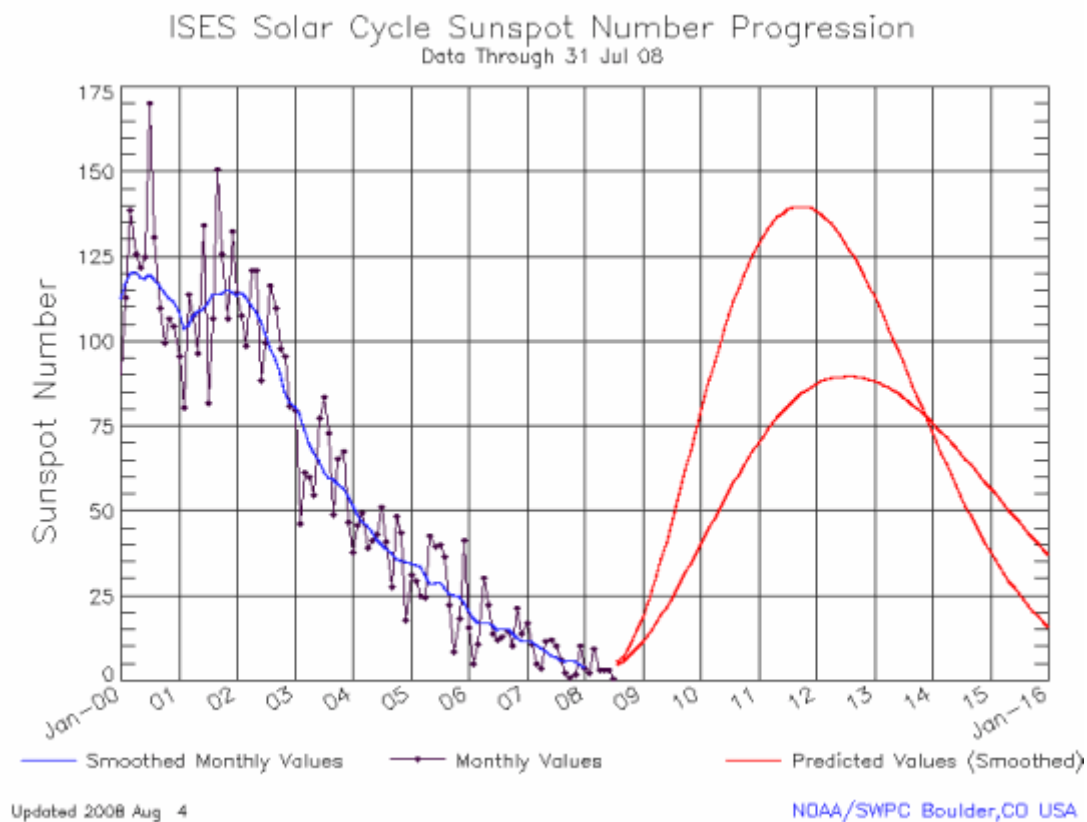


Figure 2: Solar Cycle Sunspot Number Progression and Prediction

resulted in two possible outcomes for Solar Cycle 24: a small cycle with a maximum in August 2012, or a large cycle with maximum in October 2011. The Panel expects to update this prediction annually to serve our many customers who make economic

decisions based on the level of solar activity and its affect on human and technological systems.

#### 4 SIGNIFICANT LATE-CYCLE EVENTS

A single moderate-sized (M-class) solar flare occurred in MAR 08.

**Table 1: Summary of Space Weather Events**

	X-ray Events		>2 MeV Events	F10.7	Proton Events		Geomagnetic Storms		
	M-class	X-class	Days > 1.0E+03		>10 SPE	>100 SPE	Ap	Major	Severe
<b>AUG 2007</b>	0	0	17	70.9	0	0	6.4	0	0
<b>SEP</b>	0	0	16	67.8	0	0	8.9	0	0
<b>OCT</b>	0	0	24	67.1	0	0	6.8	0	0
<b>NOV</b>	0	0	13	68.1	0	0	7.0	0	0
<b>DEC</b>	0	0	20	76.1	0	0	6.0	0	0
<b>JAN 2008</b>	0	0	25	71.9	0	0	7.8	0	0
<b>FEB</b>	0	0	26	71.1	0	0	10.9	0	0
<b>MAR</b>	1	0	26	72.9	0	0	11.1	0	0
<b>APR</b>	0	0	24	70.2	0	0	9.4	0	0
<b>MAY</b>	0	0	16	70.2	0	0	6.2	0	0
<b>JUN</b>	0	0	9	65.9	0	0	6.7	0	0
<b>JUL</b>	0	0	14	65.7	0	0	5.3	0	0

#### 5 ENERGETIC ELECTRON ACTIVITY

It is typical for energetic electron fluxes to increase during the declining phase of the solar cycle as recurrent coronal holes produce regular intervals of high-speed solar wind that interacts with the geomagnetic field. Electron flux levels reached high levels (1.0E+3 pfu) at geosynchronous orbit on about 63% of the days during the period. Very high flux levels (5.0E+04 pfu) occurred on 29 MAR 08.

#### 6 REFERENCES

NOAA/NCEP/SWPC Preliminary Report and Forecast of Solar Geophysical Data (PRF):PRF 1666, 07 AUG 2007 – PRF 1717, 01 AUG 2008.