

# Solar Cycle 24

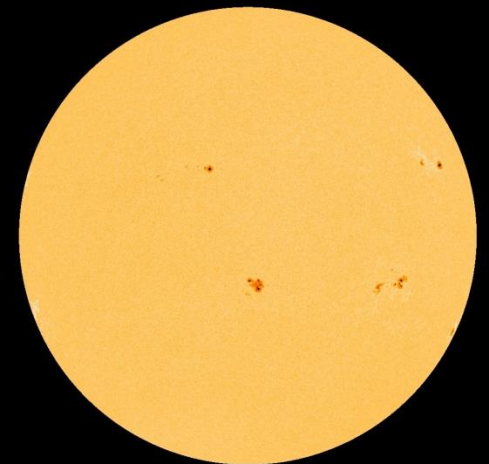
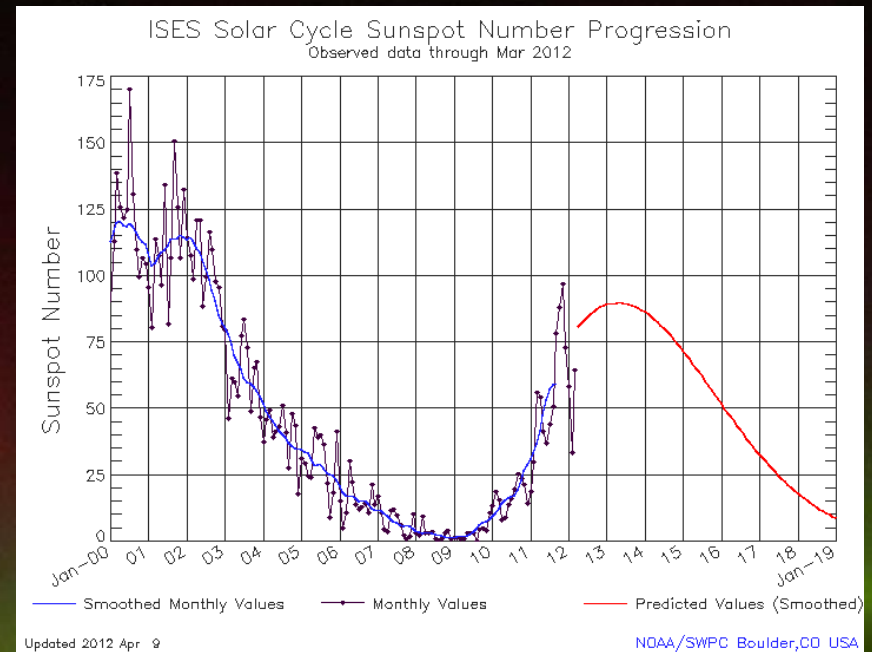
## Where has it been and where will it go?

Doug Biesecker  
NOAA/NWS/SWPC

The Space Weather Prediction Center  
with 42 experts on data, research,  
modeling and forecasting

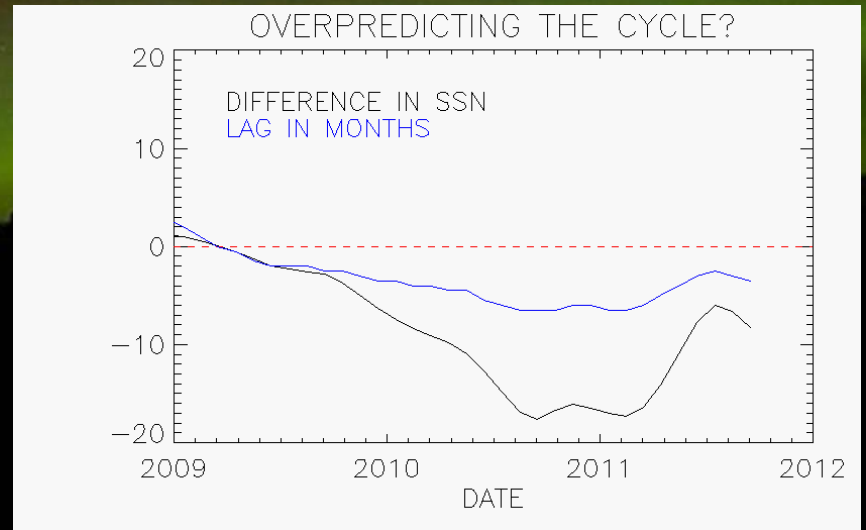
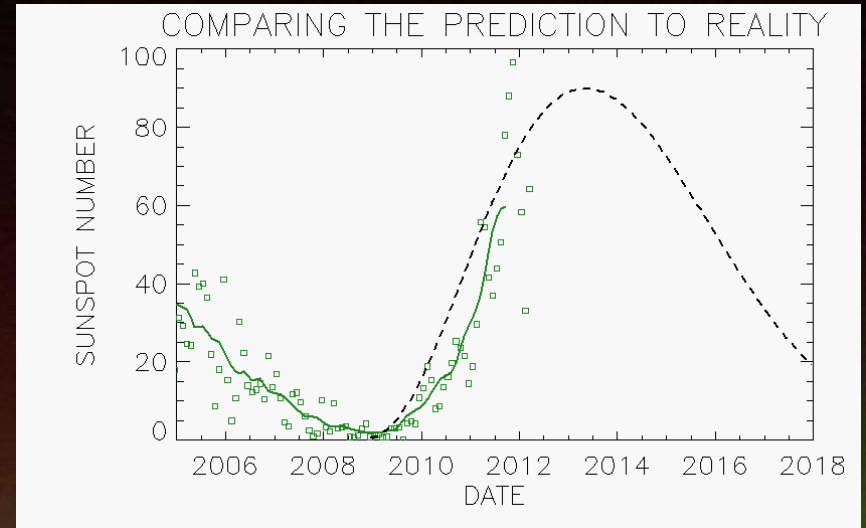
# The Solar Cycle 24 Prediction

- May, 2008: The Cycle 24 panel predicted
  - Sunspot peak of 90
  - May, 2013
- So far, the prediction looks good, but how good?
- Will maximum behave as expected?



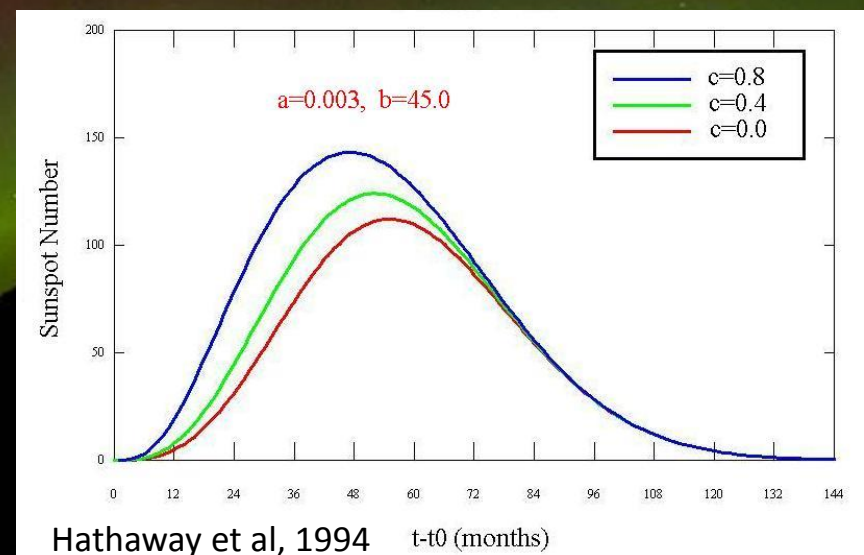
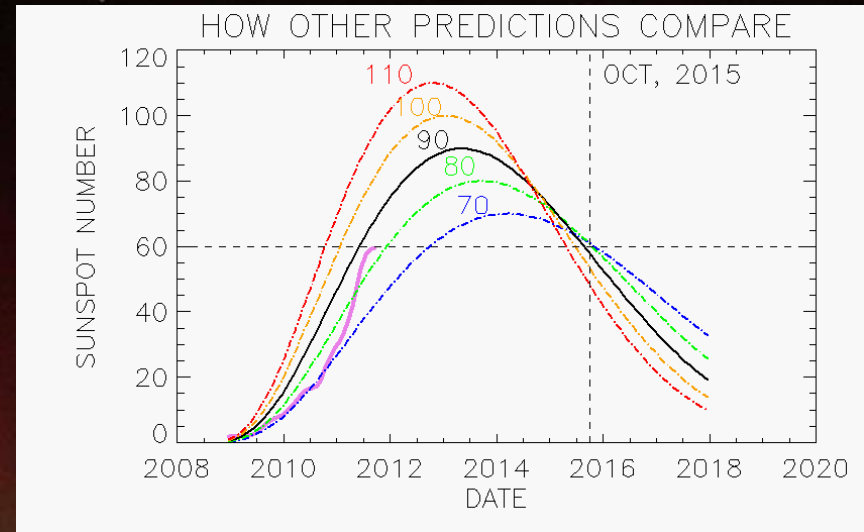
# Truthiness vs Reality

- The prediction isn't perfect, but it seems close enough
  - How close?
    - Never out by more than 6 months
    - The gap is now 2-3 months



# What if we had predicted something else?

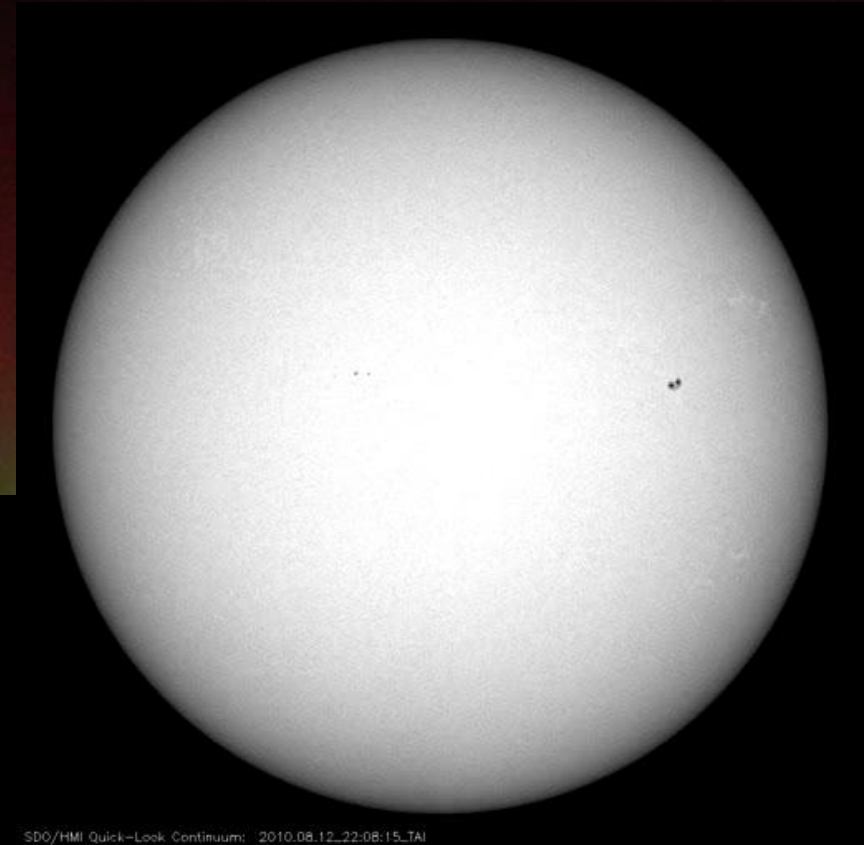
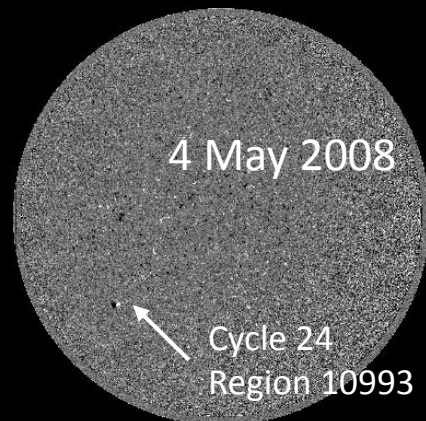
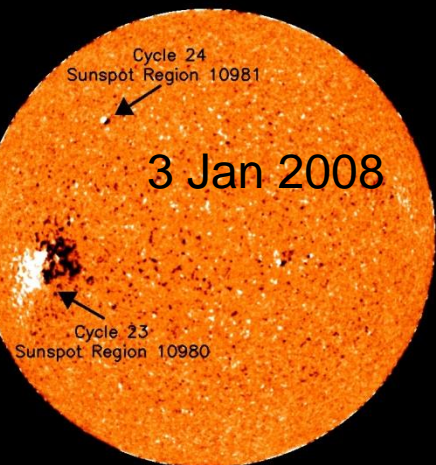
- In 2010, the cycle looked like it would come in lower  $\sim 70$
- In 2011, the cycle picked up and is a better match for at least 80
  - Within the error of the prediction ( $\pm 10$ )
- All trends point to below the historical average of 114



Hathaway et al, 1994

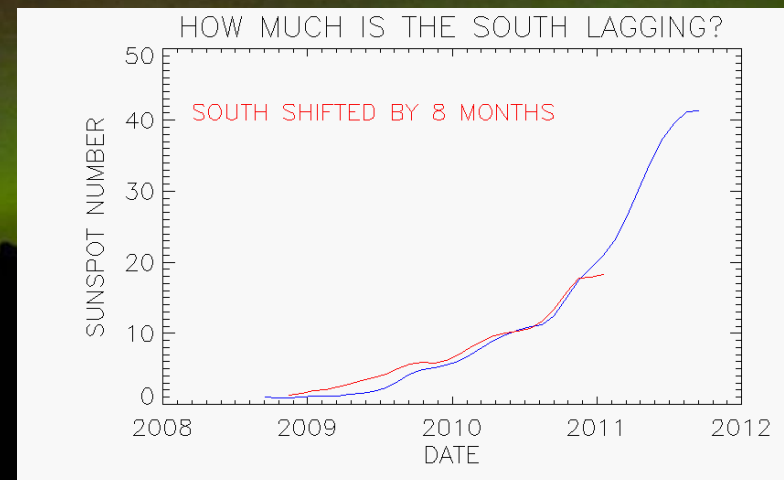
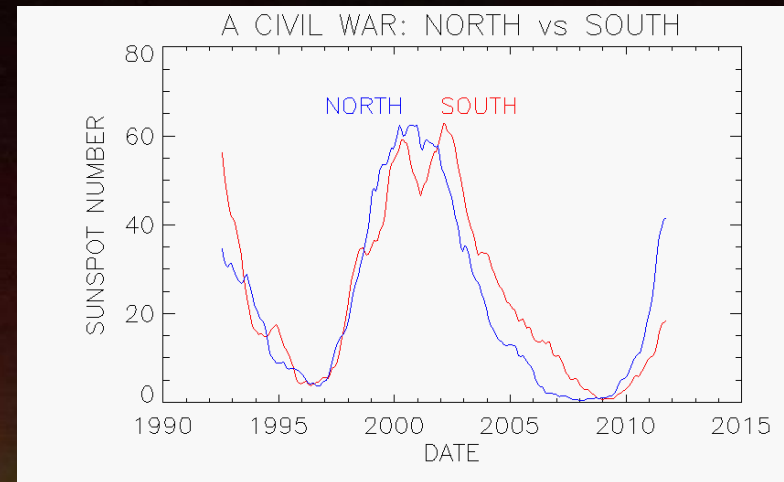
# Hemispheric Differences

- Where is the southern hemisphere?
  - First northern spot
    - 3 Jan 2008
  - First southern spot
    - 4 May 2008



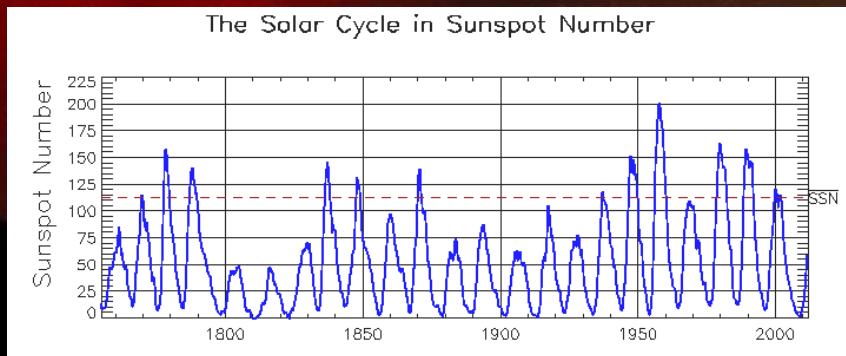
# NORTH v SOUTH

- The southern hemisphere has lagged the north in recent cycles
  - The two reached minimum ~1 year apart
  - The southern hemisphere continues to lag by ~8 months
- This isn't enough to make a huge difference to the prediction
  - A double peaked max in store?



# Why Sunspot Number?

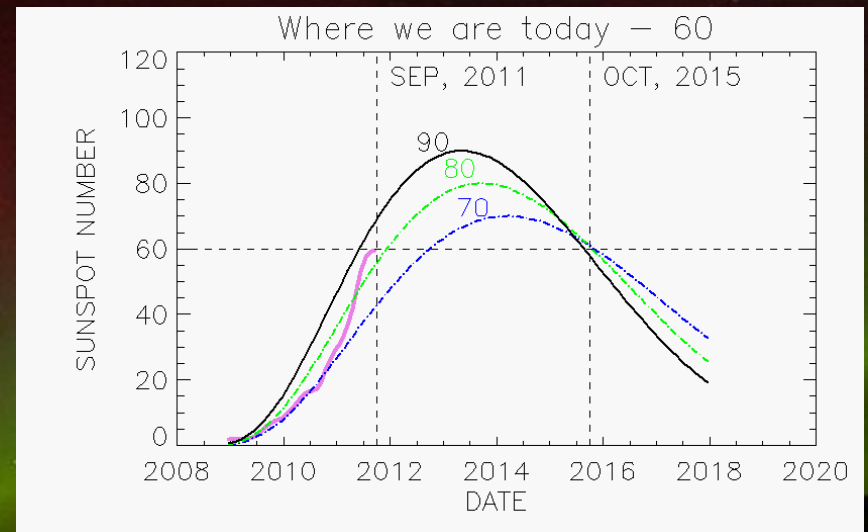
- It's what almost everyone predicts
- Longest most reliable record
- It gets a bad rap, but it's not really deserved
  - $|B_v|$



$$b_0 + b_1 R_z + b_2 R_z^2$$

# Imagine what can happen when SSN>60

- The smoothed sunspot number is at 60 right now
  - September, 2011
- It's expected to stay above 60 for 4 years
  - Under any scenario
- We've seen some strong storms (R3, G3, S3) and plenty of impacts so far
  - What have those been?





# Media (unprecedented?)

## The Telegraph

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Solar flares could cause "as much devastation as a tsunami"

## CBS NEWS TECH

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January 31, 2012 12:35 PM

## Sun storms could help clear away space junk

comments 1 Facebook 15 Tweet 12 +1 5 Share 3 More

By Nola Taylor Redd



## Experts: Extreme Solar Storm Could Cause Cosmic 'Katrina'

A cosmic "Katrina" could cause global damage and knock out crucial electronics, experts say

By JASON KOEBLER

March 5, 2012 | RSS Feed | Print

## The CHRISTIAN SCIENCE MONITOR

## Solar flares: Be glad you're on Earth, not Mars (+video)

The recent solar flares provide a dramatic backdrop for a study that shows Mars gets far more of its atmosphere stripped away by solar storms than does Earth. Thank you, magnetosphere.

## Sun Erupts With Major Solar Flare

SPACE.com Staff  
Date: 05 March 2012 Time: 10:04 AM ET

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This story was updated at 11:42 a.m. EST.

A major solar flare erupted from the sun late last night (March 4) sending an explosion of plasma and charged particles hurtling toward Earth.

The flare was an X1.1-class solar flare and exploded from the surface of the sun at 11:13 p.m. EST (0413

## ABC Science

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## Can solar storms unleash communications chaos?

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## Solar flare disrupted GPS systems

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## AIR & SPACE

## Electronic Armageddon? Congress Worries That Solar Flares Could Spell Disaster

Published June 10, 2010 | FOXNews.com

## EWS

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## CASBAA Singapore

## Orbital Blames Galaxy 15 Failure on Solar Storm

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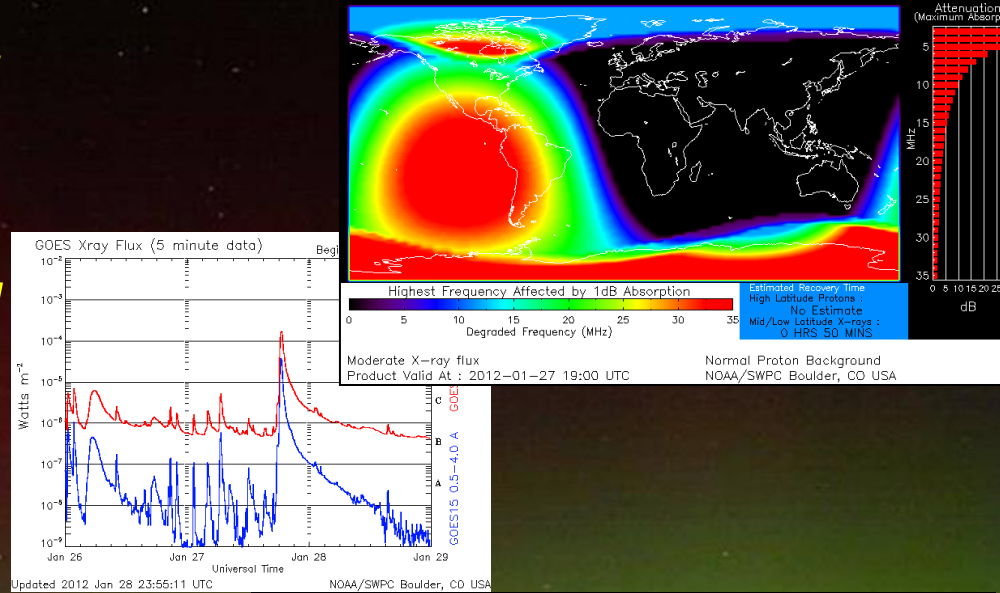
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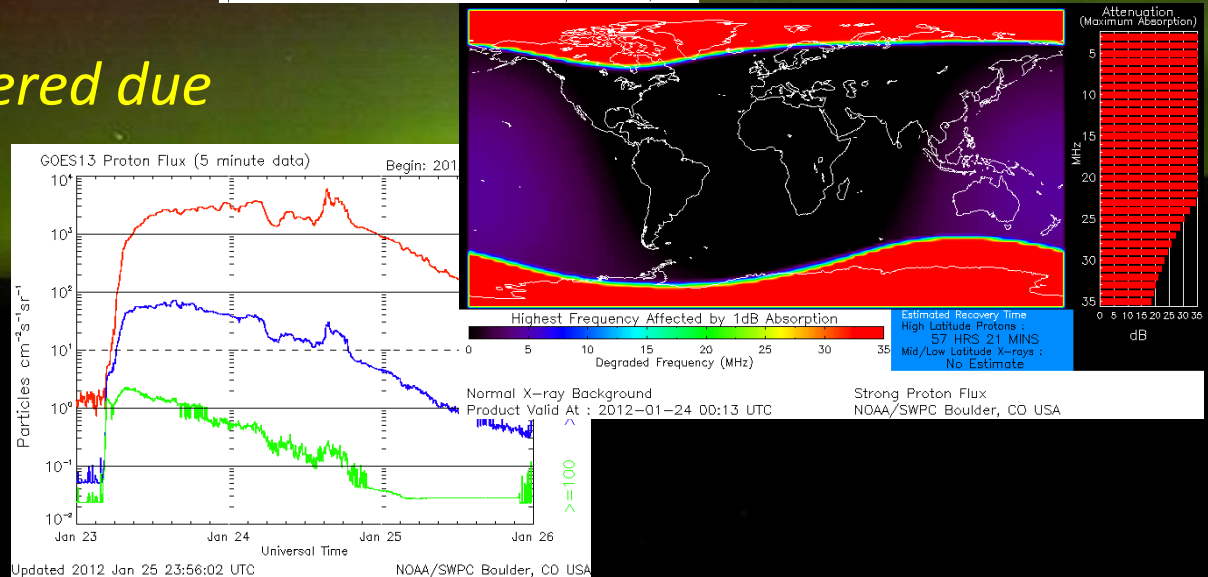
## Solar flares could paralyse Britain's power and communications, Liam Fox says

Britain's electrical system, financial networks and transport infrastructure could all be paralysed by a solar flare or a nuclear attack, Liam Fox will warn next week.

Radio Communications Center reported that the CEP (Central East Pacific) and CWP (Central West Pacific) regions were impacted severely by solar activity between 1830Z and 1930Z on 27 Jan due to the R3 solar flare radio blackout. Thirteen requests were received from ATC for overdue position reports."



Several Polar flights altered due to S3 Radiation Storm (23-25 Jan)



# March 2012 Impacts on Aviation

7 March 2012: INCERFA was issued for Air Canada 003 (Vancouver to Tokyo) until communications were established with the flight.

*(INCERFA is issued when there is uncertainty as to the safety of an aircraft and its occupants.)*

6-7 March 2012: “Severe impact at 2249Z initially affecting CWP [Central West Pacific] but by 2400Z, impact peaked and was affecting all communications. 25 ATC messages were delayed.”

- Air Traffic Communications

- Several polar flights altered.
- Numerous reports of HF communication outages on lower-latitude trans-oceanic flights.
- FAA WAAS reported the detection of minor issues for GPS users in Alaska.



U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

ORDER  
JO 7110.10V

Effective Date:  
February 9, 2012

Subject: Flight Services

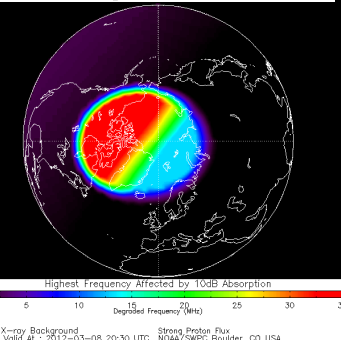
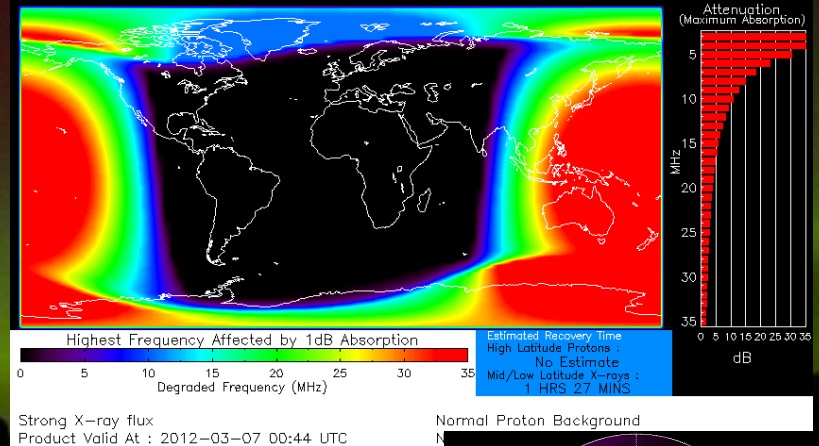
## Section 3. Alerting Service

### 7-3-2. ALERTING PHASES

a. Air traffic services units must notify rescue coordination centers immediately when an aircraft is considered to be in a state of emergency in accordance with the following:

1. Uncertainty phase when:

(a) No communication has been received from an aircraft within a period of 30 minutes after the time a communication should have been received, or from the time an unsuccessful attempt to establish communication with such aircraft was first made, whichever is the earlier.



# Reported impacts on satellites

- April 2010
  - Galaxy-15
- March 2012
  - Spaceway
  - SkyTerra-1
  - US Military

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04/30/10 05:34 PM ET

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**Solar Flares Knock Out  
LightSquared Satellite  
As Run of Bad Fortune Continues**

by Karl Bode 7 hours ago tags: satellite · business · wireless · alternatives · bandwidth · trouble · wireless



REDSTONE  
COLLEGE



**Solar Flares Likely Knocked Military  
Satellites Offline**

Solar storms earlier this month may have caused  
military satellites to reboot

By JASON KOEBLER

March 22, 2012 | RSS Feed | Print

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
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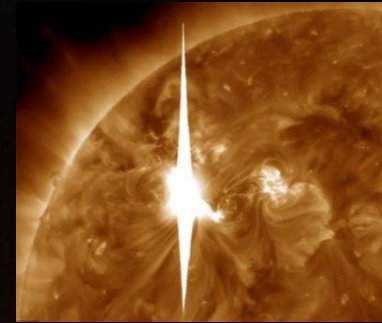
## Solar Flares Knock Out LightSquared Satellite As Run of Bad Fortune Continues

by Karl Bode Friday 16-Mar-2012 tags: satellite · business · wireless · alternatives · bandwidth · trouble · wireless



Tipped by viperadamr 

Earlier this week we noted that recent solar flares managed to [knock HughesNet's Spaceway 3 satellite offline](#) for a significant part of Tuesday. User viperadamr  writes in to note that the flares also took out



### -- IMPORTANT OUTAGE NOTIFICATION --

Status:

Unscheduled

Details of services impacted:

All existing Voice, Push-to-Talk (PTT), Mobile Data Services, and PNC customers

START DATE:

March 7, 2012

START TIME (UTC\*):

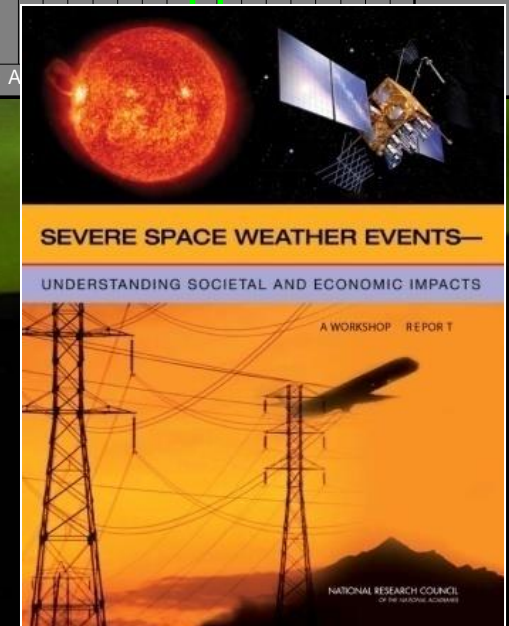
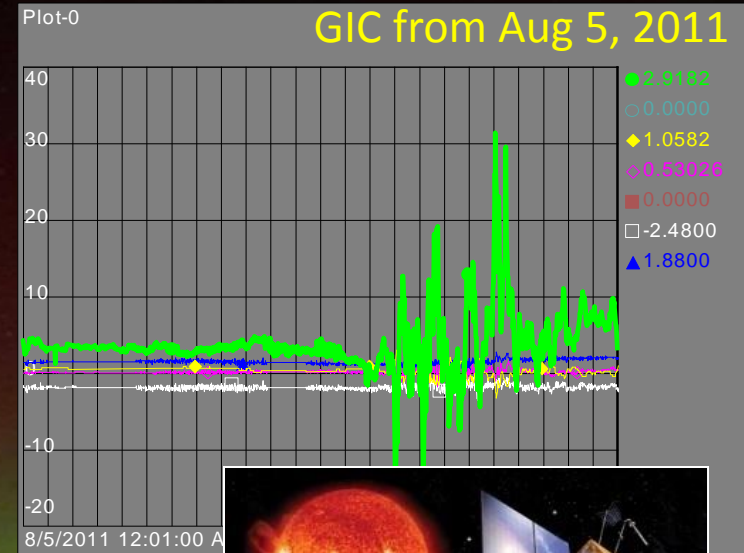
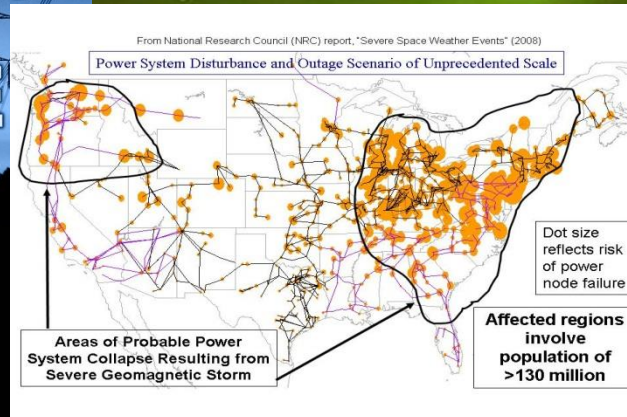
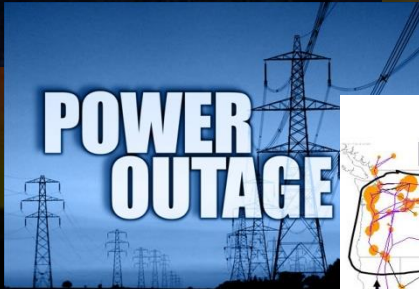
1330

Service Summary:

UPDATE 1 03/07/2012 @ 0943 EST - LightSquared is currently experiencing a satellite network outage over our SkyTerra 1 satellite. Preliminary investigation reveals **that a solar event has created an automatic system safeguard** as a measure to protect the satellite. The recovery procedures are underway which could take from 4 to 24 hours.

# Power Grid impacts have been minor

The power grid impacts have been minor so far in Solar Cycle 24

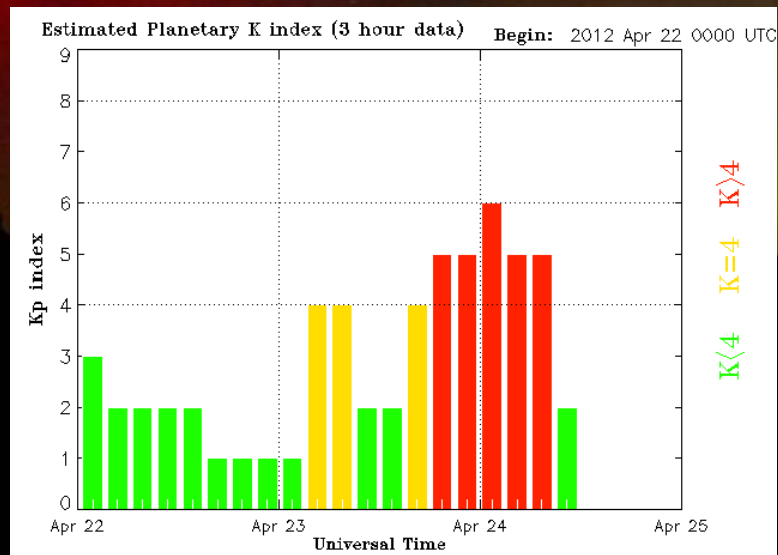
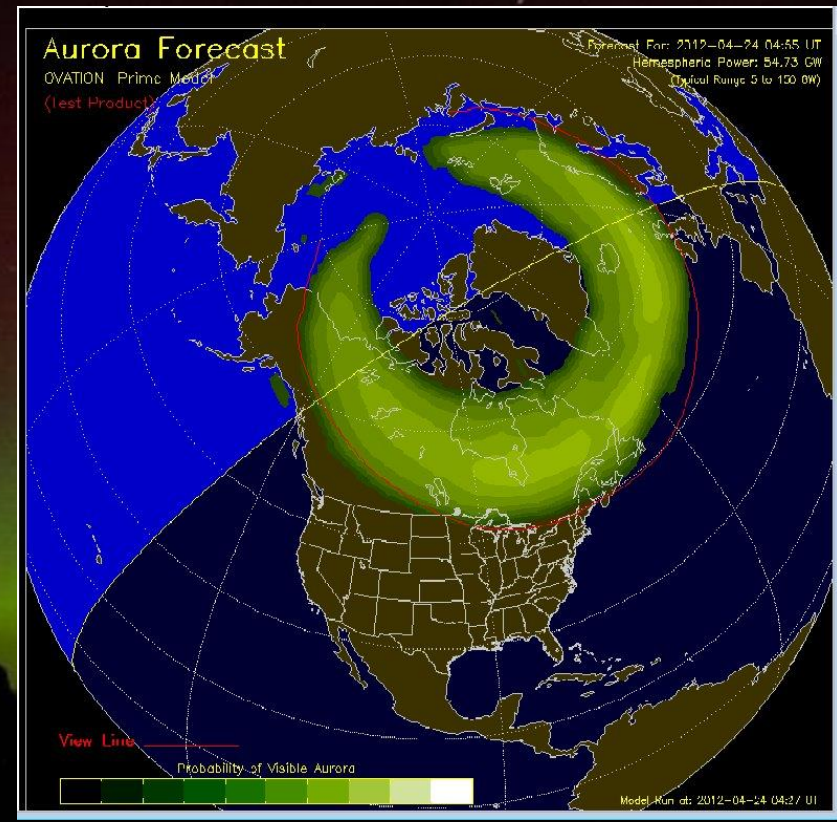
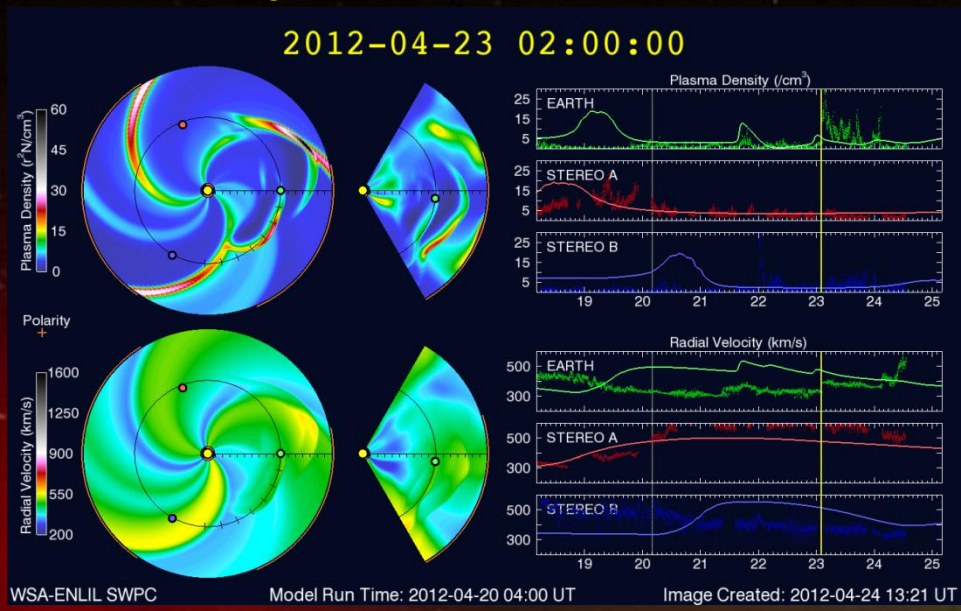


# Other reports...

- We received reports from one manufacturer of UAV's that they weren't flying right...
- Anybody else?



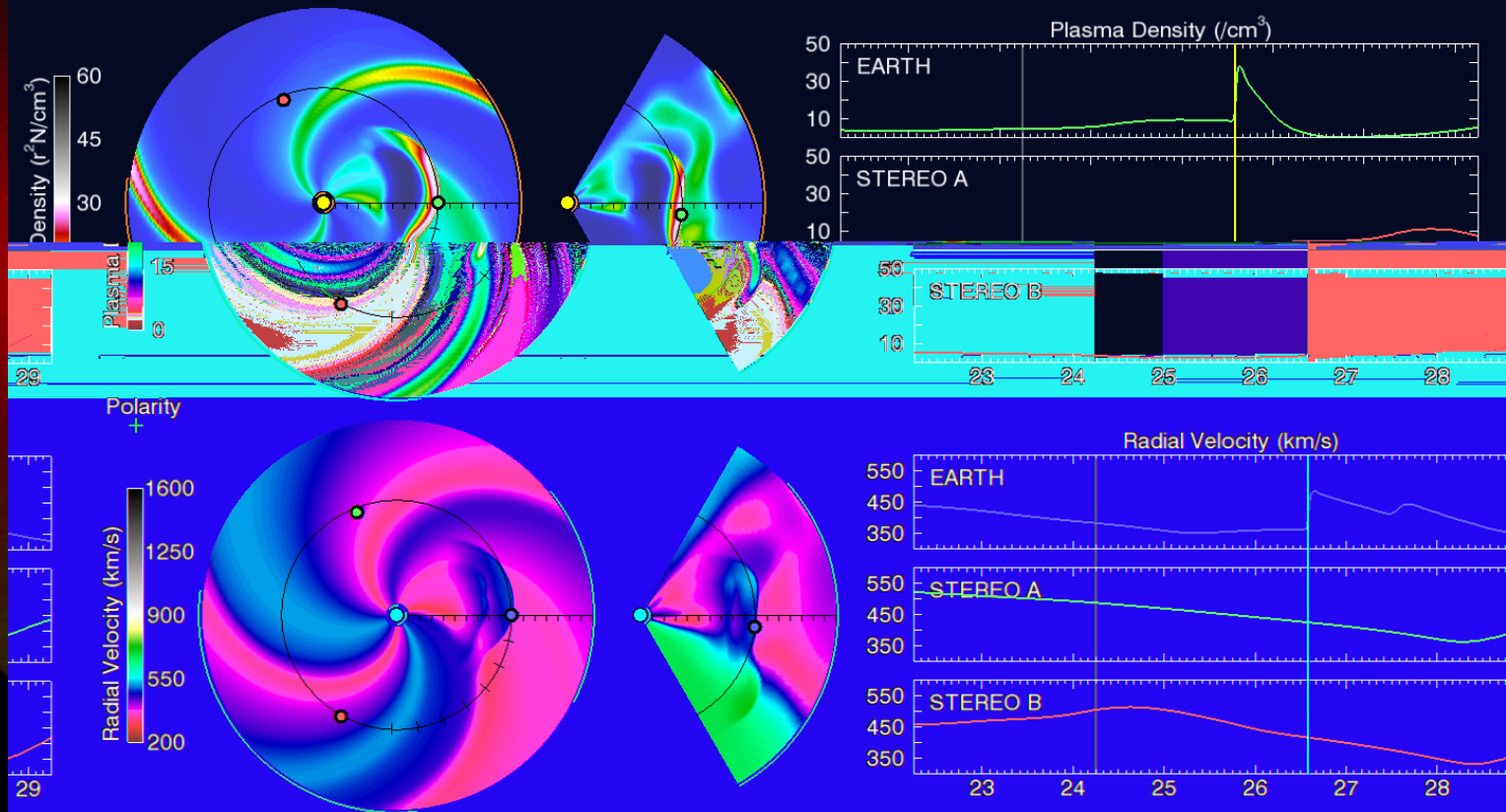
# Why not start SWW with a bit of SWx





# More to come this week?

2012-04-26 14:00:00



27 UT WSA-ENLIL SWPC

Model Run Time: 2012-04-24 06:00 UT

Image Created: 2012-04-24 13:2

# Summary

- The Sunspot Number prediction from 2008 still looks to be a good bet
  - Peak of 90 in May 2013
  - Hedge towards maybe slightly lower and later
  - The hemispheres are out of phase
    - Now that the South is in on the action, can expect the cycle to keep rising
- Cycle 24 is teaching us to be patient
- Impacts have been minor to moderate so far
  - Biggest impacts would seem to be airlines & satellites
  - Power grid is still humming along