

ERM Symposium 2012

Managing Risk in a Dangerously Changing World

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ELECTROMAGNETIC PULSE

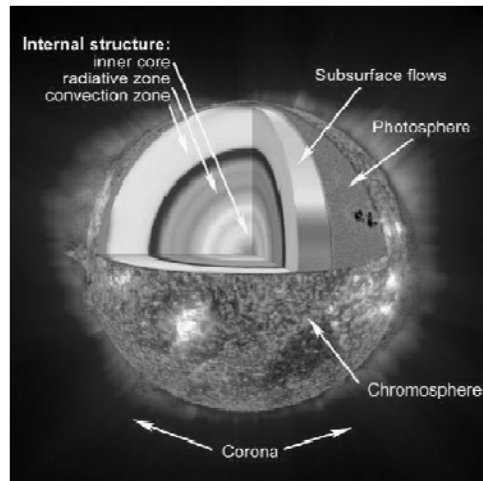
Three main sources

- **The Sun** – a certainty (99.9%?)
- **A nuclear blast** – possible (50%?) & devastating
- **A non-nuclear strike** – very likely (75%?) and near-term

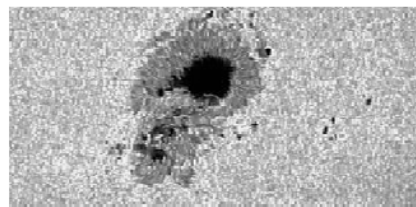
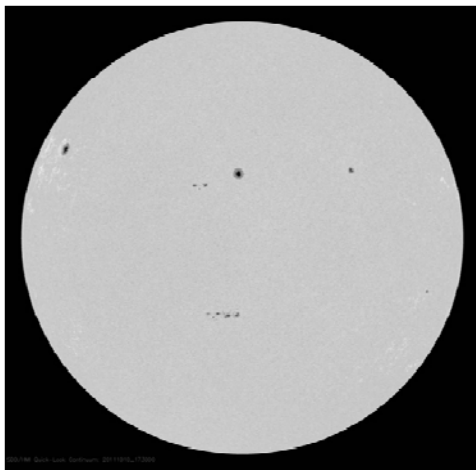
Let's take a look at the sun.

You don't need to put on sunglasses for this.

What causes the Sun to behave the way it does?

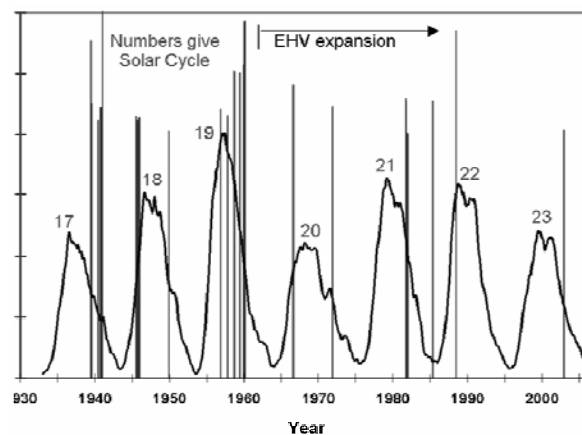


Sunspots



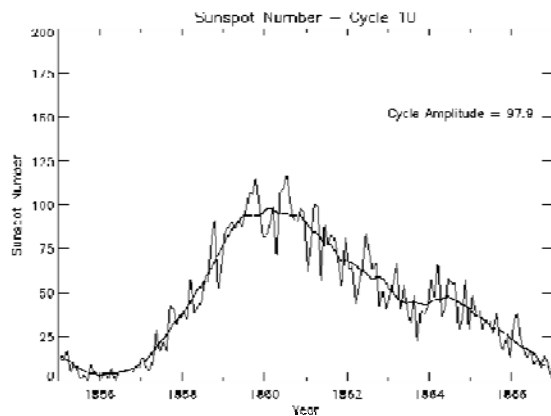
Sunspots

- Sun has an 11-year cycle of sunspot activity
- Currently it is Cycle 24 which follows a very deep minimum and is expected to peak in 2013.
- Sunspots are very active areas on the Sun's surface where there are often solar flares and the launching of coronal mass ejections (CMEs)



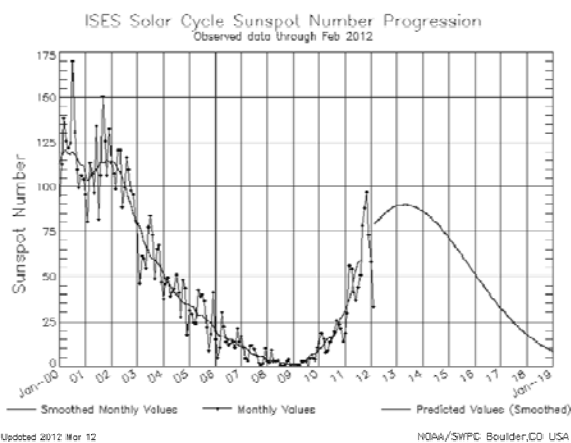
Geomagnetic Storms during solar cycles

Vertical red lines show timing and intensity of storms.
Only occasionally do they coincide with solar maximums.



**The Carrington Event of 1859 in Cycle 10
Not even 100 sun spots at peak that year**

<http://www.ips.gov.au/Educational/2/3/1>

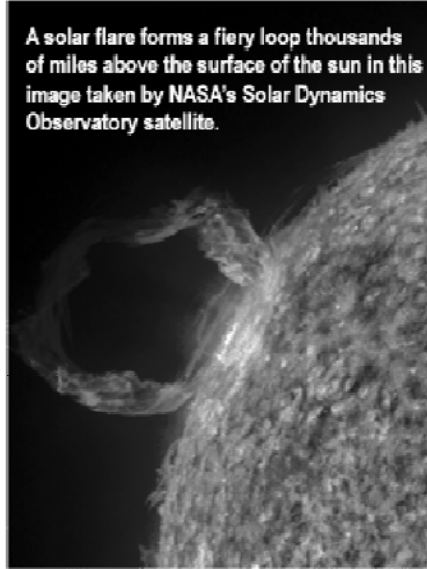


**The recent long, deep solar minimum lasted almost two full years 2008-09
This last happened in 1912-14**

<http://www.swpc.noaa.gov/SolarCycle/>

A SOLAR FLARE

A solar flare forms a fiery loop thousands of miles above the surface of the sun in this image taken by NASA's Solar Dynamics Observatory satellite.



Effect of the Sun's Rotation

- Show video of spinwheel effect.

Solar Flares

- Solar flares generate radiation storms that affect satellites. They arrive in about 17-19 minutes. This is not well known. Confusion with CMEs.
- Because the Sun revolves, the radiation storms come from the left side of the Sun.
- NOAA provides radiation storm alerts for major GPS users, managers of communications satellites and airlines.

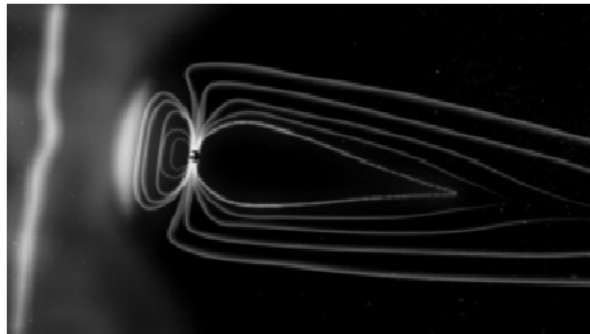
- Video of Coronal Mass Ejection to be added.

These CMEs are dangerous events

- They reach the earth in 1 to 4 days.
- They need to be fired directly at us (with help of the solar wind).
- They need to have the correct north/south orientation.
- We know if the conditions are right for a major geomagnetic storm only about 17 to 20 minutes ahead of its arrival.

Coronal Mass Ejection meeting the earth's geomagnetic field

The small dot in the light blue area is the earth. The blue lines represent the earth's geomagnetic field.



<http://svs.gsfc.nasa.gov/vis/a010000/a010100/a010104/index.html>

Aurora Borealis – Northern Lights



k

Photo: <http://geology.com/nasa/aurora-borealis.shtml>

There have been many geomagnetic storms

- The online Operations Manual of the North American Electric Reliability Corporation (NERC) cites geomagnetic storms of **1957, 1958, 1968, 1970, 1972, 1974, 1979, 1982, and 1989** as causes of major power system disturbances.
- The last geomagnetic storm that had serious damaging effects was 2003.

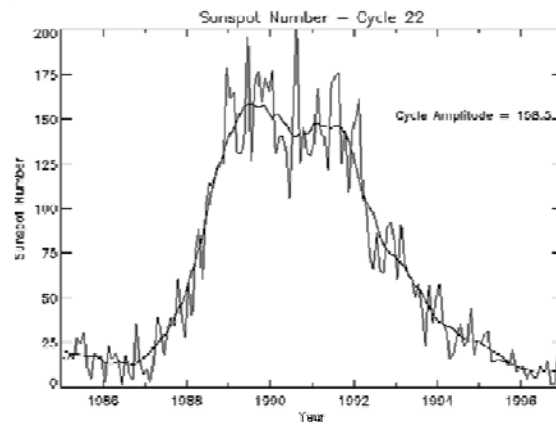
We have become more and more vulnerable to solar activity

- As our electric grid technology improves to give us better, more efficient service, the grid becomes more vulnerable to geomagnetic storms.
- We depend on electricity for so many things that would no longer be available.
- What specifically would not be available?

The Carrington Event of 1859 and the Geomagnetic Storm of 1921 are considered 100-year events.

NASA scientists tell us the next big one is due.

The question is not “if” but “when”.



The Geomagnetic Storm of 1989 in Cycle 22
Around 175 sun spots at peak that year

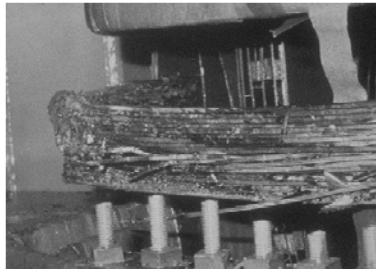
<http://www.ips.gov.au/Educational/2/3/1>

Impact of the 1989 storm

- Coronal mass ejection was launched on March 9, 1989. It reached earth **3 ½ days** later.
- It was manifested by a ground induced current (GIC) that coupled with transmission lines.
- The greatest impact was the outage of the Quebec Province electric grid for 9 hours.
- One large transformer was destroyed (cooked) at the Salem nuclear plant in New Jersey.

Damage from 1989 storm

Part of the cooked transformer



Kappenman, Geomagnetic Storms and Their Impacts on the U.S. Power Grid
Prepared for Oak Ridge National Laboratory, January 2010, p. 2-29

Damage from 1989 storm cont'd

Within 2 years after the March '89 exposure, 11 nuclear plants noted failures of large transformers, in addition to the Salem failure.

Electrojets of the 1989 Storm

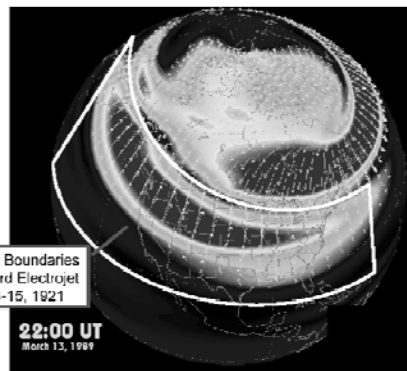
- Video to be added.

Great Geomagnetic Storms

Comparison of March 1989 Storm & May 1921 Storm

The latter estimated to be
largest storm of 20th
Century – 10x stronger than
'89 - extended further south

Estimated Boundaries
of Eastward Electrojet
May 14-15, 1921



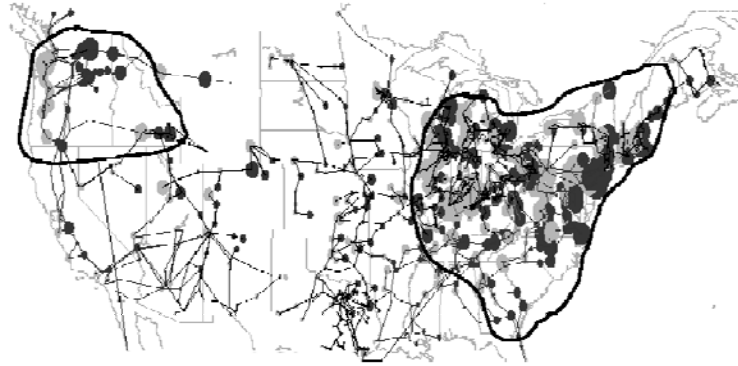
- Source John G. Kappenman, Storm Analysis Consultants, Oct 2010

**Power Grids should expect
Storms 4 to 10 Times More
Intense than the March 1989
Storm**

But less destruction is more likely

We can recover from a moderate or indirect hit. But we may need to get through some weeks or some months. Those who prepare will be the most likely to regain operations.

Power System Disturbance and Outage Scenario of Unprecedented Scale



Areas of Probable Power System Collapse
Impacted Regions involve population of >130 Million

John G. Kappenman, Storm Analysis Consultants, October 2010

THE NUCLEAR BLAST

High Altitude (Nuclear) EMP = HEMP

- First example of **HEMP** was 9 July 1962 – Starfish Prime
- The nuclear pulse reached Honolulu 898 miles from the detonation point. Burned out 300 street lights and triggered many burglar alarms. Some hotels had “Rainbow Parties” watching the aurora.
- Today’s nuclear devices can be made to maximize the electromagnetic pulse.

Other nuclear attacks

- A low altitude or ground level nuclear explosion emits the same EMP. It reaches a smaller geographical area but closer proximity makes it more powerful.
- Nuclear causes a very low-frequency GIC like a solar geomagnetic storm but also has other frequencies that can destroy electronic equipment.
- Everything fails at once.

NON-NUCLEAR EMP (NNEMP)

NNEMP may be the greatest most immediate threat.

- An EMP generator can fit inside a van and can destroy an electrical substation from the road.
- It is not difficult to get parts for it and make it.
- It can be **5 times stronger** than a nuclear blast.
- The van then drives to other substations unnoticed. We wouldn't know what hit us.

Tasks that are needed now

- Educate others about this and the need for priority attention.
- Determine what is needed to manage a week or more and then a month or more without electricity. This is not easy.
- Plan what to do when satellite malfunction causes a loss of communications or GPS service.
- Water, food, medical supplies, and other basics can be stored. Plan for this and start storing.
- Steuben Foods in Elma, NY provides an example. www.steubenfoods.com

More tasks

- Back-up generators and fuel need to be in place.
- Speak with your utilities to see what their plans are. Work with them.
- Investigate preparations at all of your locations and along your supply chains.
- Plan strong protection for storage depots.
- Consider renewable energy options.
- Insurers need to consider what risks can be transferred. Actuaries will struggle.

Solutions are coming

Devices to counter the EMP pulse at key locations are on the drawing board and may start to be available as early as the end of this year.

Websites of value:

www.empactamerica.org

www.empcoalition.org

www.empcommission.org

PANDEMICS

Note: I will try to upload more slides on pandemics in early April.

Pandemics

- H1N1 virus reached pandemic levels in 2009.
- It was less virulent than expected but it infected about 55 million Americans with as many as 16,000 deaths and more than 360,000 hospitalizations, said the CDC.¹
- A study by Mercer LLC of 1,000 employers across the U.S., Latin America, Canada, Asia and Europe found that only 25% have integrated contingency plans in the event of an outbreak.²

1. Reuters, Jan 15, 2010

2. <http://www.businessinsurance.com/apps/pbcs.dll/article?AID=/20091221/NEWS/912219994#>

Pandemics cont'd

- Mercer found that 94% of employers with a plan distributed hand sanitizers, 64% started more frequent or intensive office cleaning and 54% started providing more H1N1 educational sessions.*
- Only one-third of organizations worldwide have issued guidance to their employees about the message that should be given to clients and suppliers should business be affected by the spread of the virus. (also Mercer)

*<http://www.businessinsurance.com/apps/pbcs.dll/article?AID=/20091221/NEWS/912219994#>

Pandemic Insurance Coverage

- The principal liability exposure will be alleged negligence (failing to protect against exposure to the virus).
- Business interruption coverage may not cover losses. Check policies and investigate options.
- It pays to do small things that have a big payback in employee health.

Some small things for employee health

- Sunshine makes a big difference. Facilitate access outdoors during mid-day when there is sun and comfortable temperature. The H1N1 pandemic was seasonal when people were mostly indoors. Sunshine provides needed vitamin D. Many studies support this. Visit www.vitaminDcouncil.org.
- Vitamin D3 capsules are small, easy to swallow, very cheap and strongly protective.

More small things for employee health

- Use the Vitamin D Council recommendation for dose, backed by hundreds of scientific studies, not government recommended levels set by committees that appear to have industry bias.
- You will be amazed at all of the illnesses that vitamin D can help avoid. Make vitamin D available to employees regularly, not just for pandemics.
- Set up hand sanitizer stations throughout the workplace.

For the next pandemic

- Review plans to operate with diminished personnel and a drop in supplier capability.
- Review telecommunications capability for many people to work from home. Smart phones can help.
- Review how travel, meetings and conferences will be affected.
- Work with public health and other public services.

Resources for Pandemics

- <http://global.marsh.com/risk/pandemic/index.php#Resources>
- <http://www.pandemicflu.gov/>
- <http://www.flu.gov/>
- <http://www.cdc.gov/flu/tools/fluaid/>
- <http://www.cdc.gov/h1n1flu/>
- <http://www.rims.org/RESOURCES/BUSINESSCONTINUITYANDPANDEMICS/Pages/default.aspx>
- http://www.osha.gov/Publications/influenza_pandemic.html
- <http://bioethics.iu.edu/reference-center/pandemic-influenza/>
- <http://nnlm.gov/ep/disaster-plan-templates/pandemic-planning/>
- <http://www.hhs.gov/pandemicflu/plan/appendixj.html>
- http://www.lrc.fema.gov/path_pandemic.html

CYBER SECURITY

Note: I will try to upload more slides on cyber security in early April.

- **Cybercrime is rampant.** In 2010, McAfee detected an average of 60,000 new pieces of malware each day.*
- There is a vast array of professional services to help you secure your systems.
- There is a big push now to move companies to the “cloud”. It appears to have value. There is higher efficiency and the cloud service companies assure adequate security.

*<http://www.mcafee.com/us/resources/reports/rp-good-decade-for-cybercrime.pdf>

Cyber Security cont'd

- The Internet is a fabulous innovation. We accomplish so much with it. So much more business can be done. We now have our social networking and smart phones to enhance our personal lives. How wonderful! **Not!**
- We have given our enemies the means to cause us **grave harm**. We are so dependent on the Internet that its loss would be **catastrophic**.

Cyber Security cont'd

- The Stuxnet worm that damaged Iranian nuclear development operations was just a start.
- "A malicious computer attack that appears to target Iran's nuclear plants can be modified to wreak havoc on industrial control systems around the world, and represents the most dire cyberthreat known to industry, government officials and experts said."*

*Senate Homeland and Government Affairs Committee, Nov. 17, 2010

Cyber Security cont'd

While White House cybersecurity czar Howard Schmidt tried to quell fears by saying "**Cyber war is a terrible metaphor. Don't make it something it's not,**" Others at the RSA security conference in San Francisco on Feb 15, 2011, **did not agree.**

Bruce Schneier of BT Group said, "We haven't seen offensive cyber weapons companies, but they are coming. Big defense contractors are working on this; you know they would be dumb not to."

Deputy Secretary of Defense William Lynn said in a keynote address to the gathering, "**The threat is moving up a ladder of escalation, from exploitation to disruption to destruction.**"

"Perhaps the greatest concern in our judgment is a terrorist group that gains the level of disruptive and destructive capability currently possessed by nation-states," Lynn said.

Cyber Security cont'd

- If the Internet goes down for an hour, a day, a week, **what will you do? What will you lose?**
- Clearly, cyber security has improved and cyber security companies sound confident, but Homeland Security and Defense Dept. officials have a different take on it.
- Is there a Black Swan waiting in the background?
- Risk managers need to ask a lot of questions.

Climate Change Concerns

- Slides here will supplement the general session that precedes this concurrent session.

Dealing with Black Swans

- Discussion on threats already presented and others if there is time.