CAS Professional Education
IN FOCUS: TAMING CATS-MANAGING NATURAL AND MAN-MADE CATASTROPHE RISKS
BALTIMORE, MD

EXAMINING EMERGING RISKS

Alan D. Roth, Ph.D.
Chief Risk Officer,
Advanced Fusion Systems, LLC

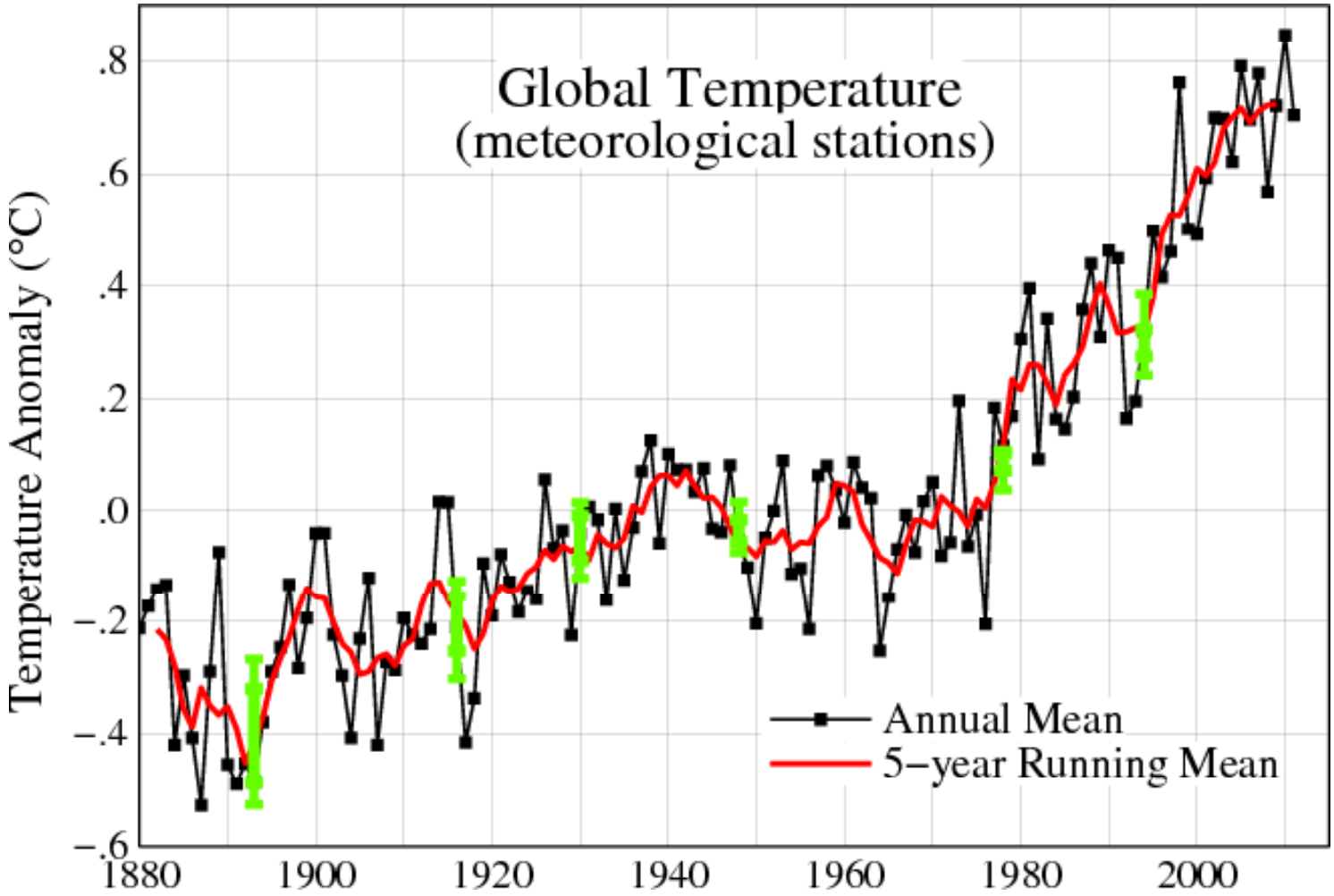
TOPICS TO BE COVERED

- CLIMATE CHANGE
- WATER SCARCITY
- FOOD SCARCITY
- FUEL SCARCITY
- SOLAR STORMS
- EMP
- PANDEMICS
- CYBER WARFARE

CLIMATE CHANGE

Is it real?

This is from NASA

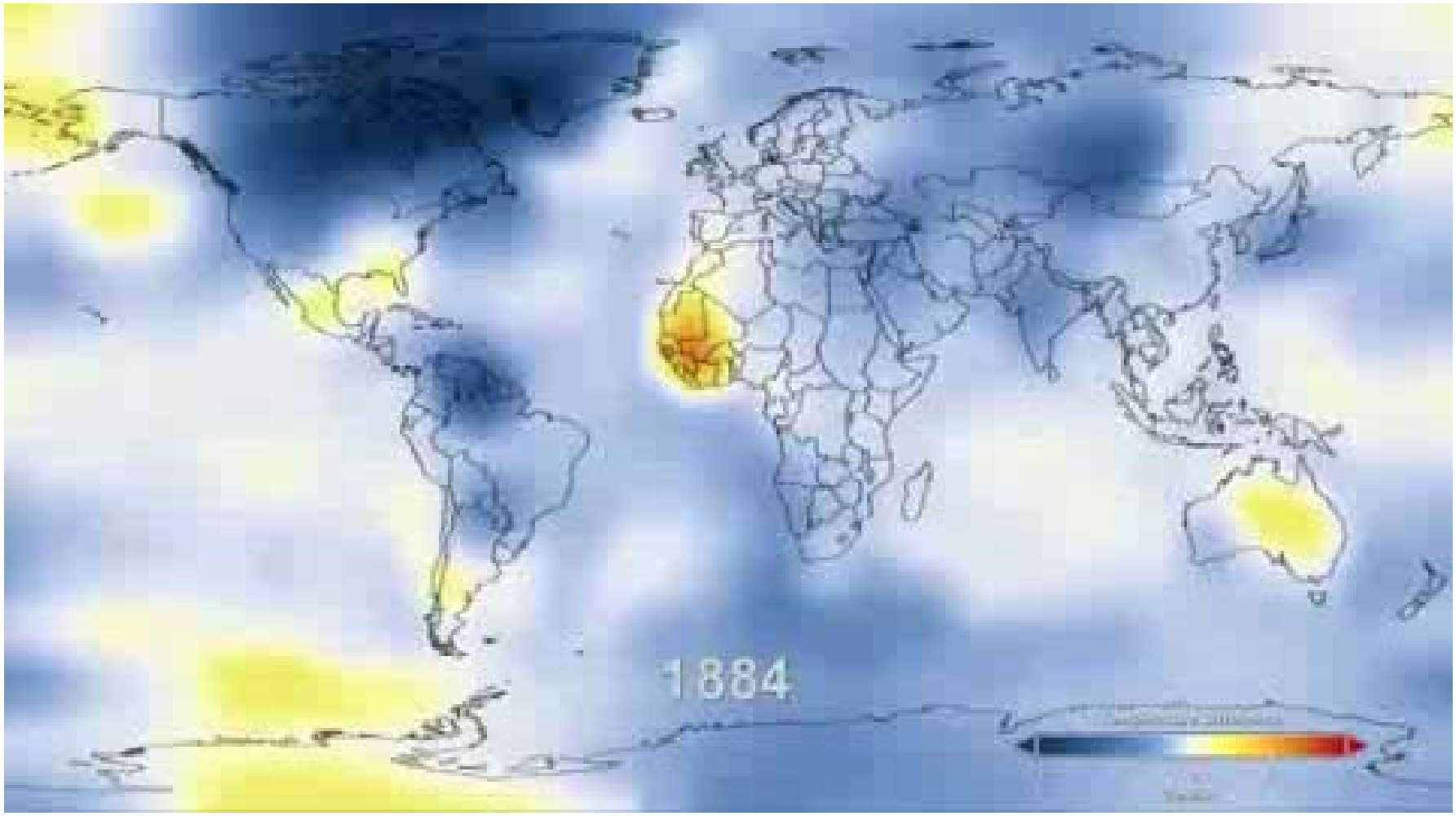


Where? – is also important!

We need to consider:

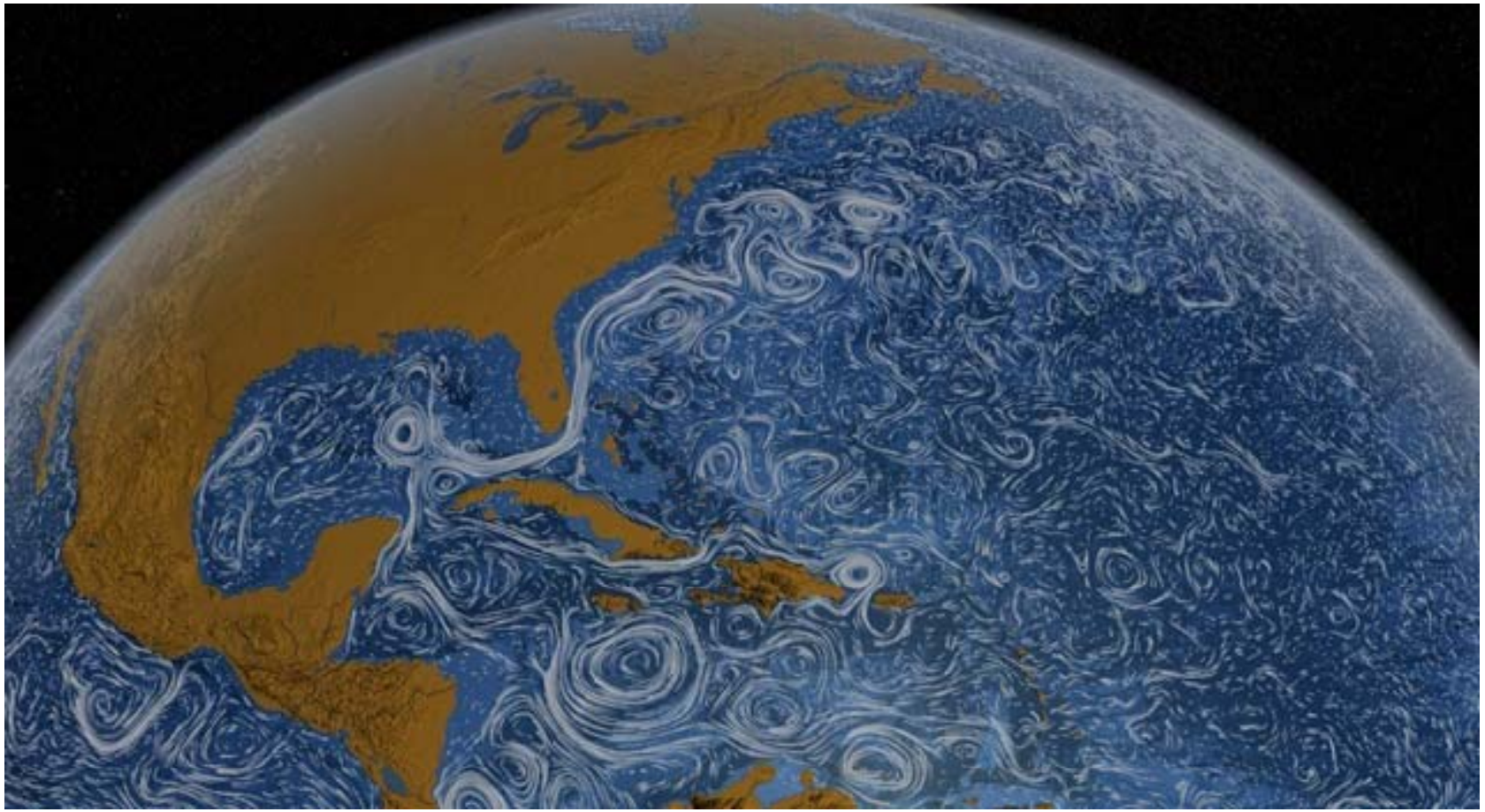
- Pacific Decadal Oscillation
- North Atlantic Oscillation
- Southern Oscillation: El Niño and La Niña
- Arctic Oscillation
- Trade winds
- Meridional Overturning Circulation (aka Conveyor Belt)

Temperature from 1884 to 2011

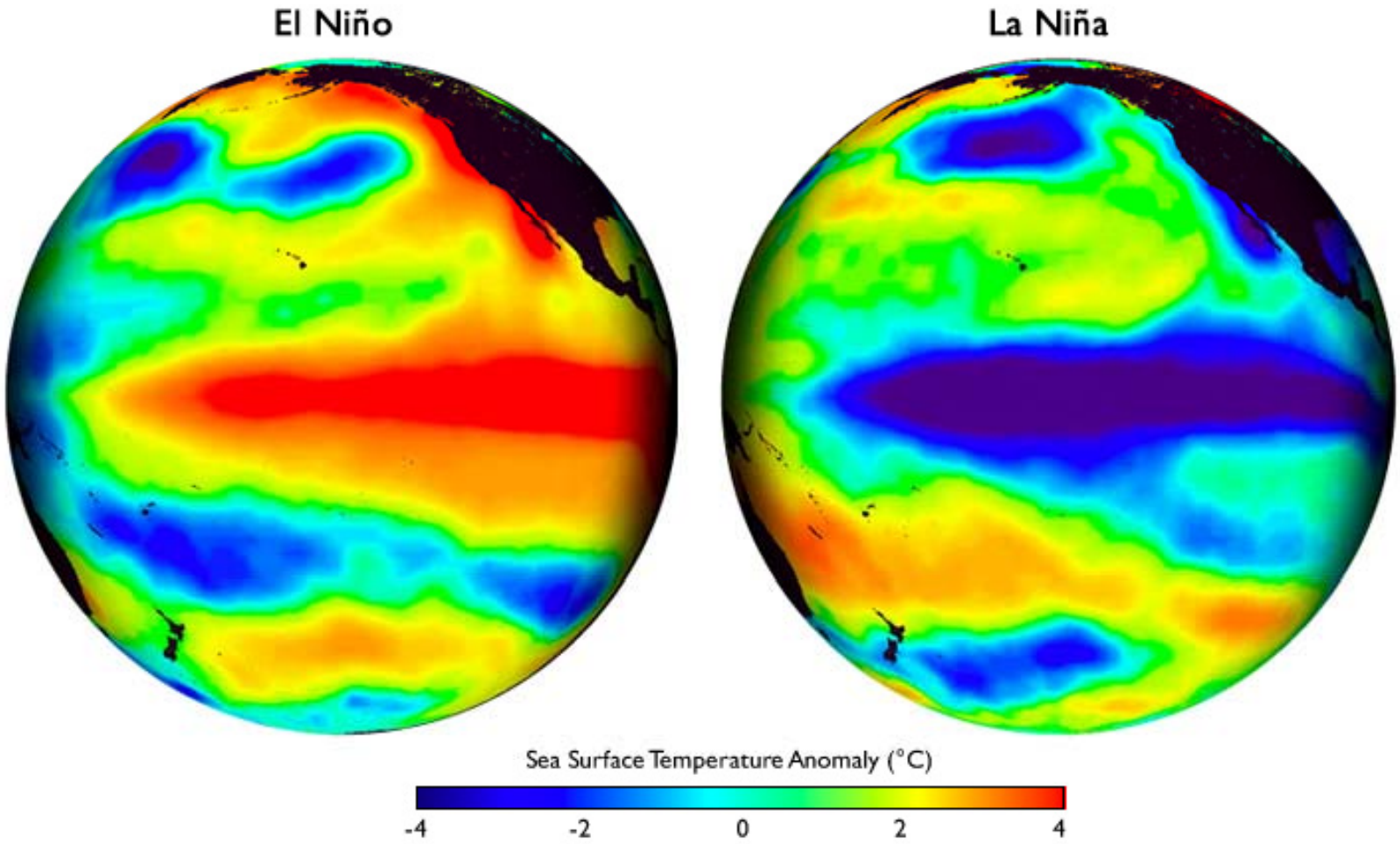


Ocean currents are varied

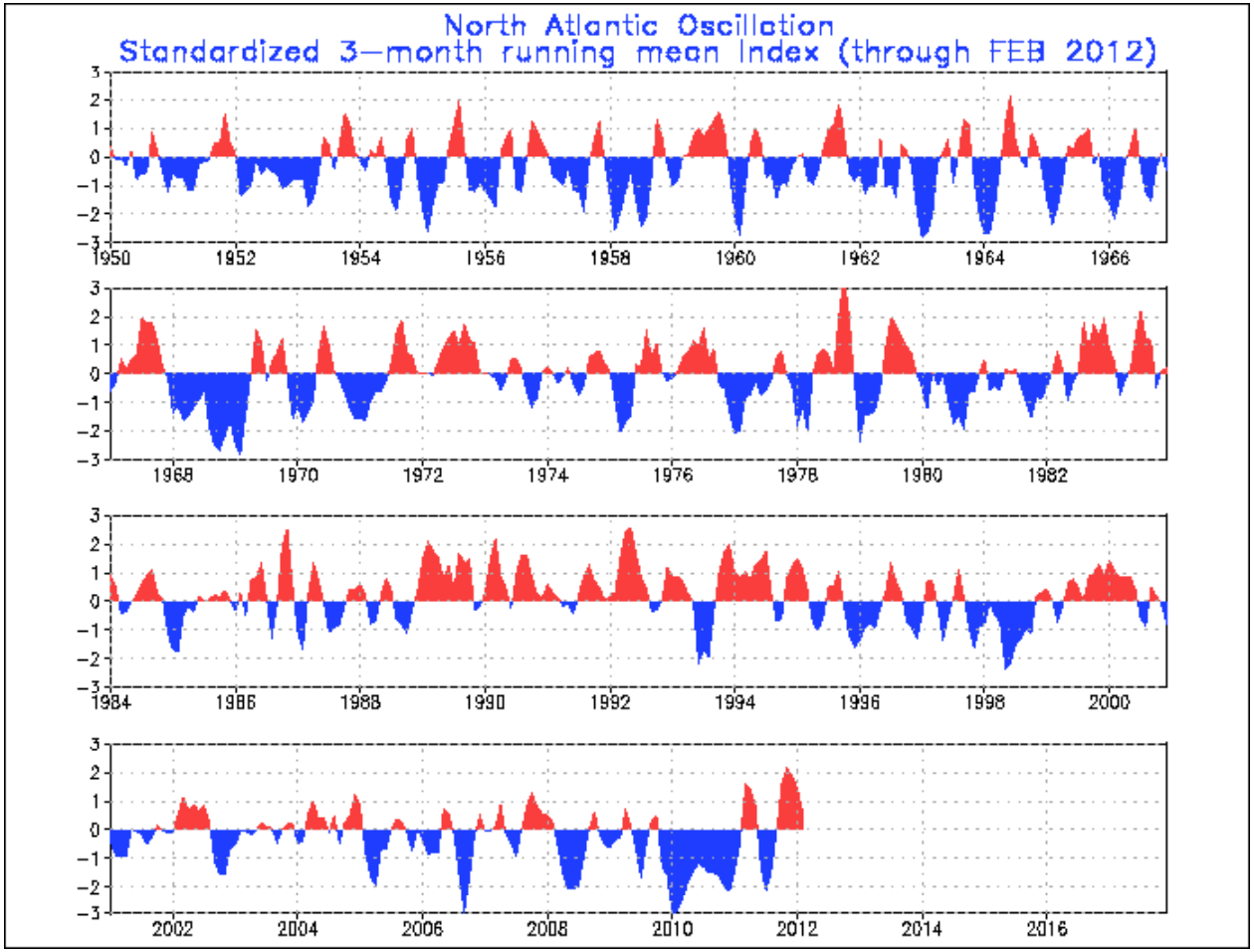
http://www.jpl.nasa.gov/news/news.cfm?release=2012-099



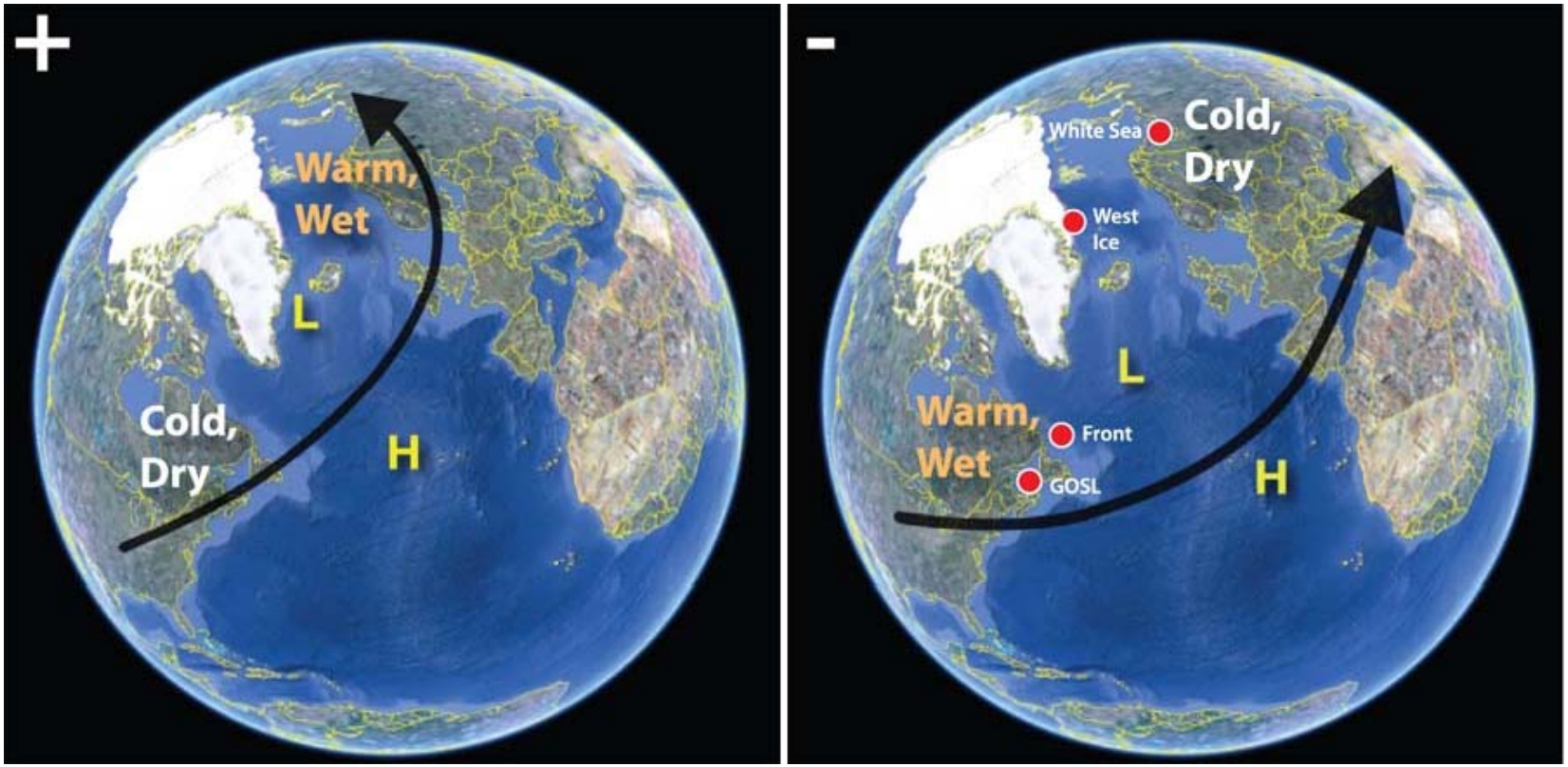
El Niño/Southern Oscillation (ENSO)



NOAA: North Atlantic Oscillation

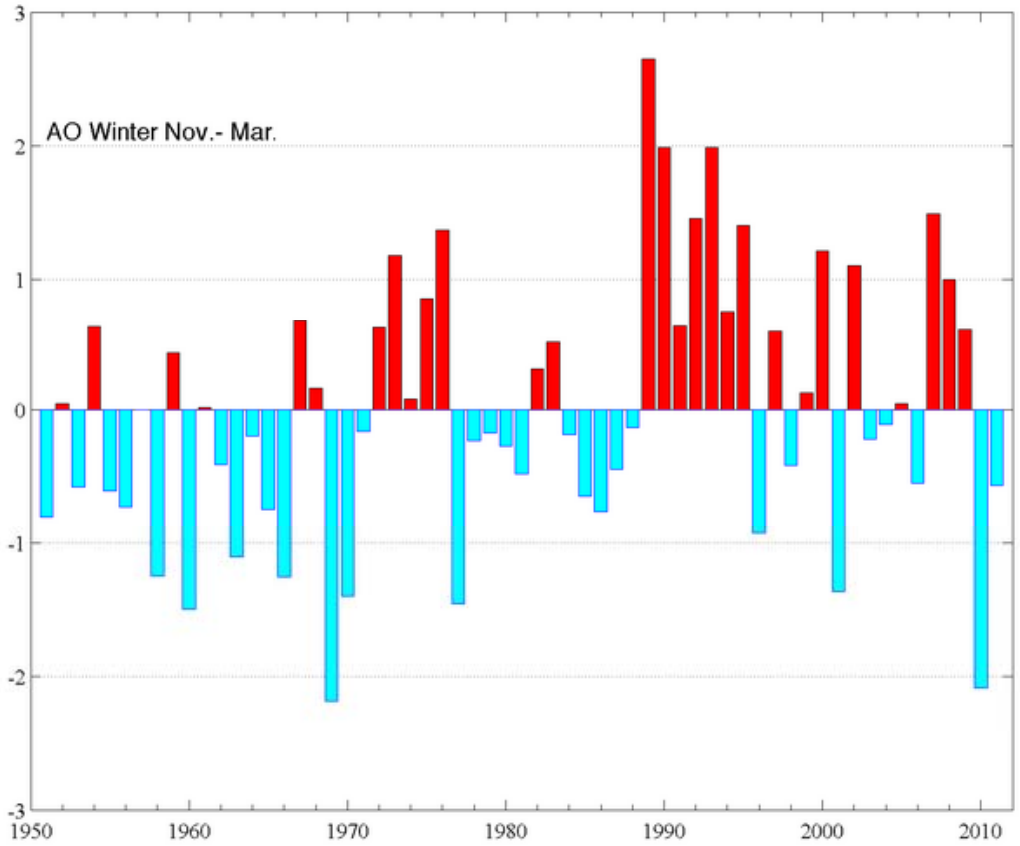


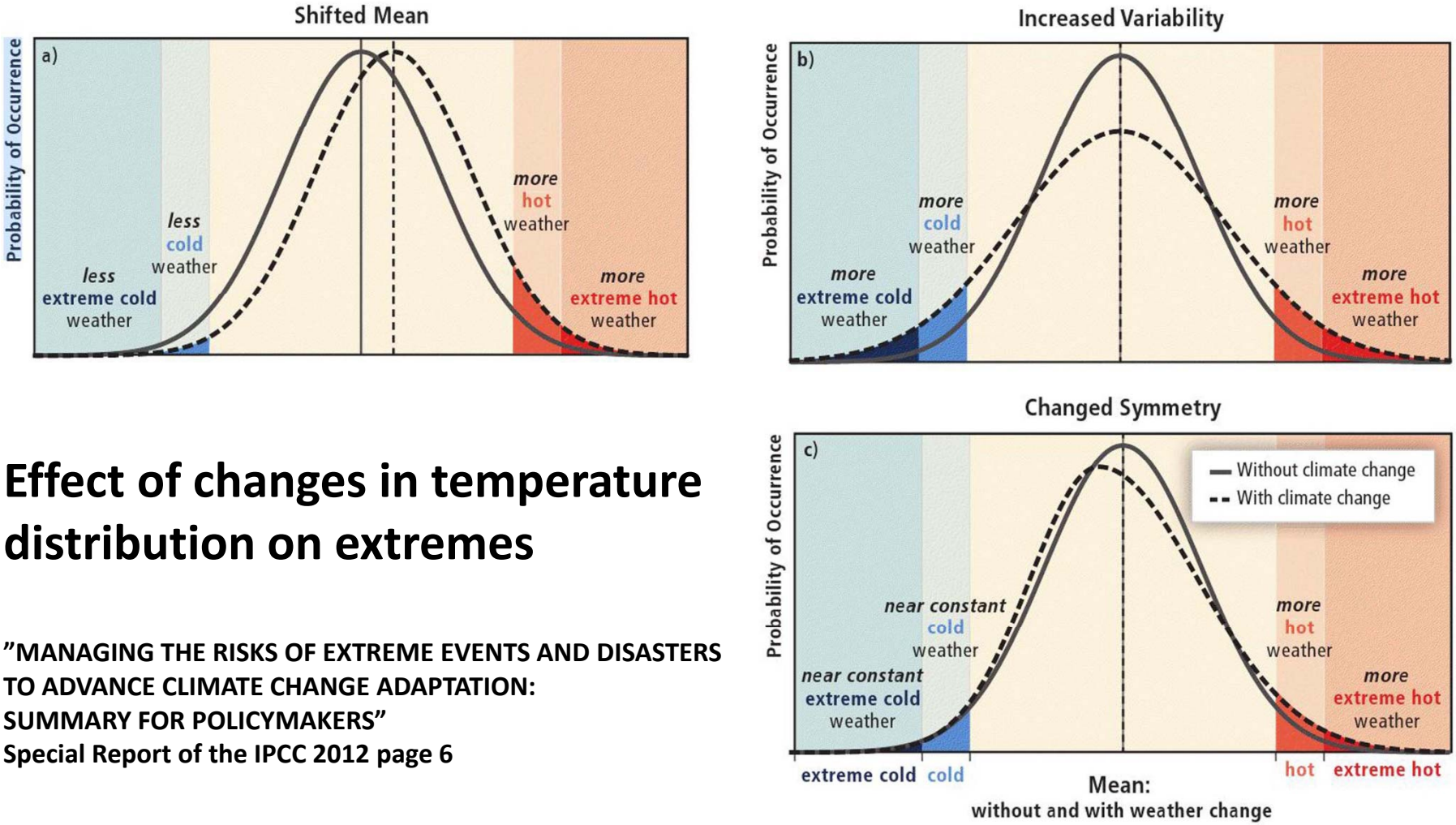
NOAA: North Atlantic Oscillation



Arctic Oscillation

The state of atmospheric circulation over the Arctic.
Red is low pressure, blue is high pressure.
Influences weather patterns at lower latitudes.





Effect of changes in temperature distribution on extremes

”MANAGING THE RISKS OF EXTREME EVENTS AND DISASTERS TO ADVANCE CLIMATE CHANGE ADAPTATION: SUMMARY FOR POLICYMAKERS”
Special Report of the IPCC 2012 page 6

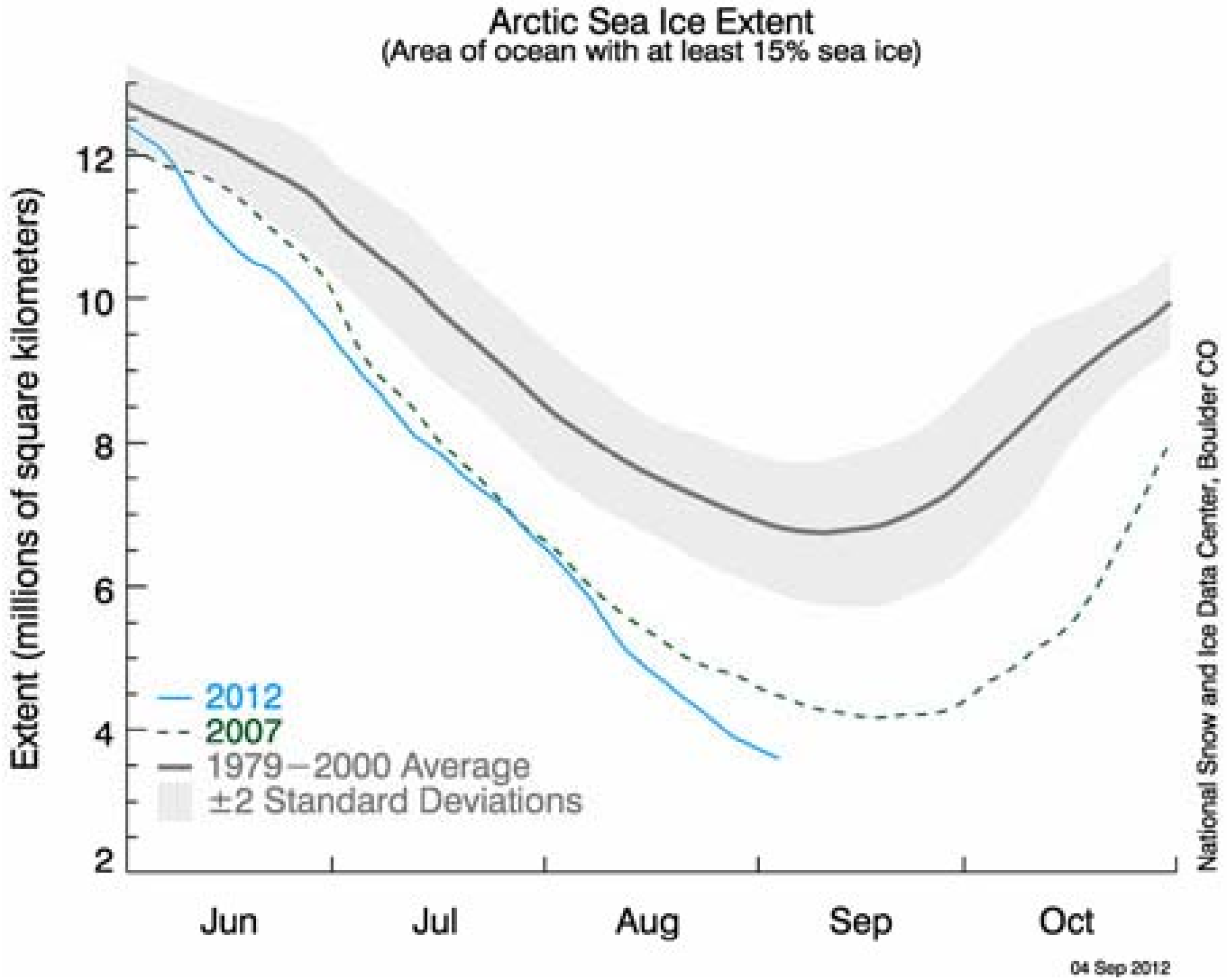
The. Different changes in temperature distributions between present and future climate and their effects on extreme values of the distributions:

(a) effects of a simple shift of the entire distribution toward a warmer climate;

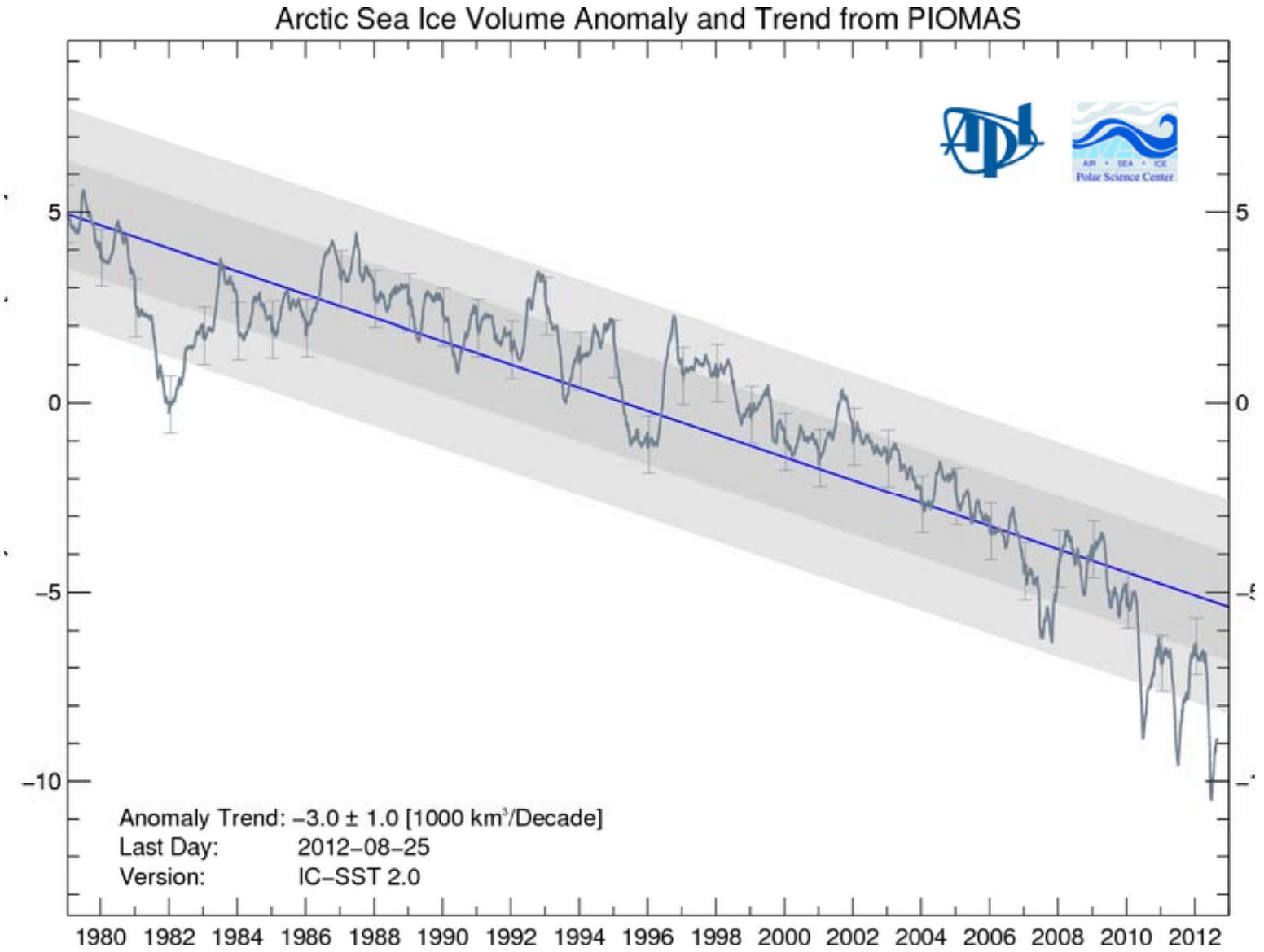
(b) effects of an increase in temperature variability with no shift in the mean;

(c) effects of an altered shape of the distribution, in this example a change in asymmetry toward the hotter part of the distribution. (courtesy IPCC)

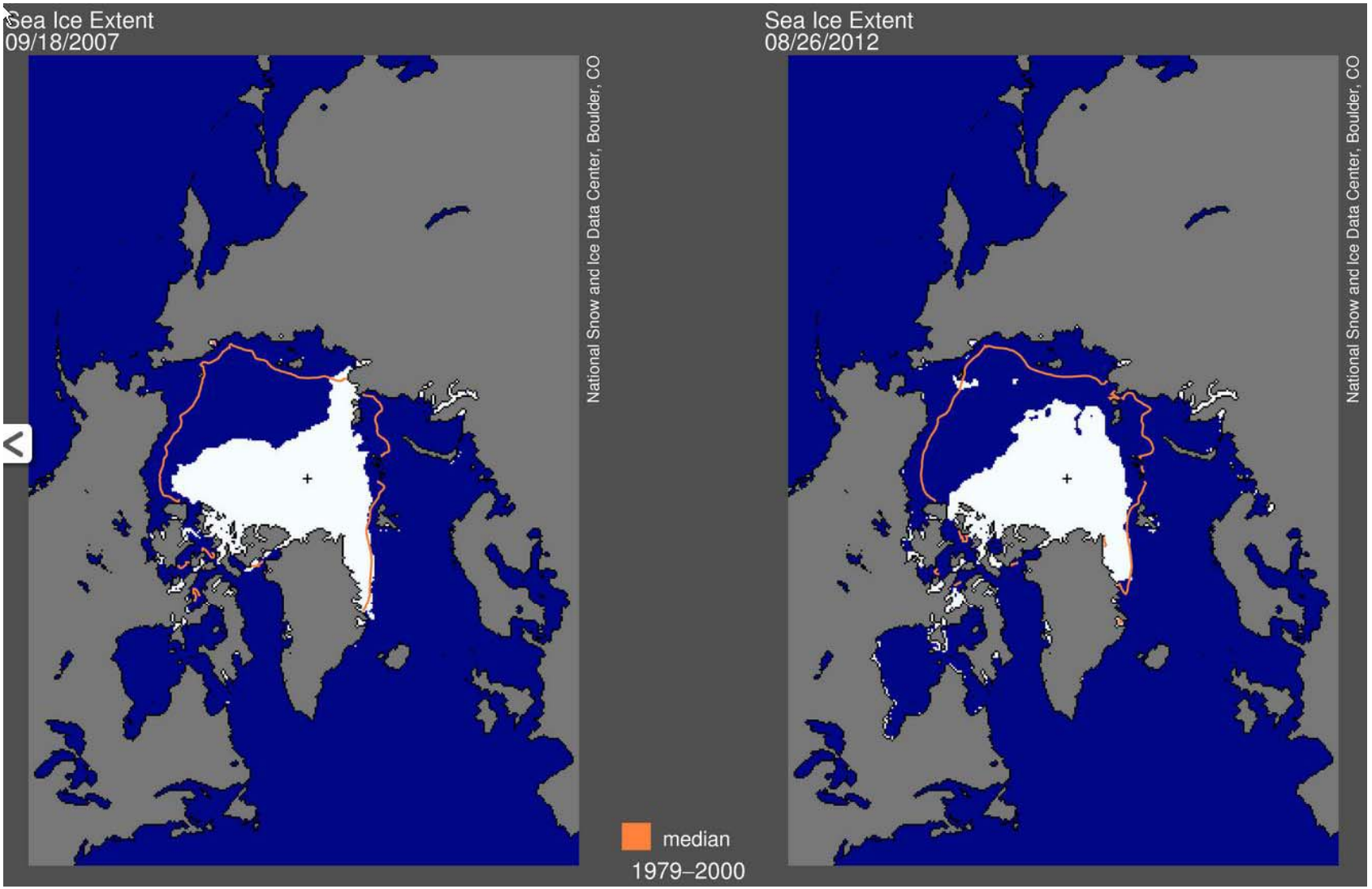
Arctic Sea Ice Extent thru Sept. ‘12



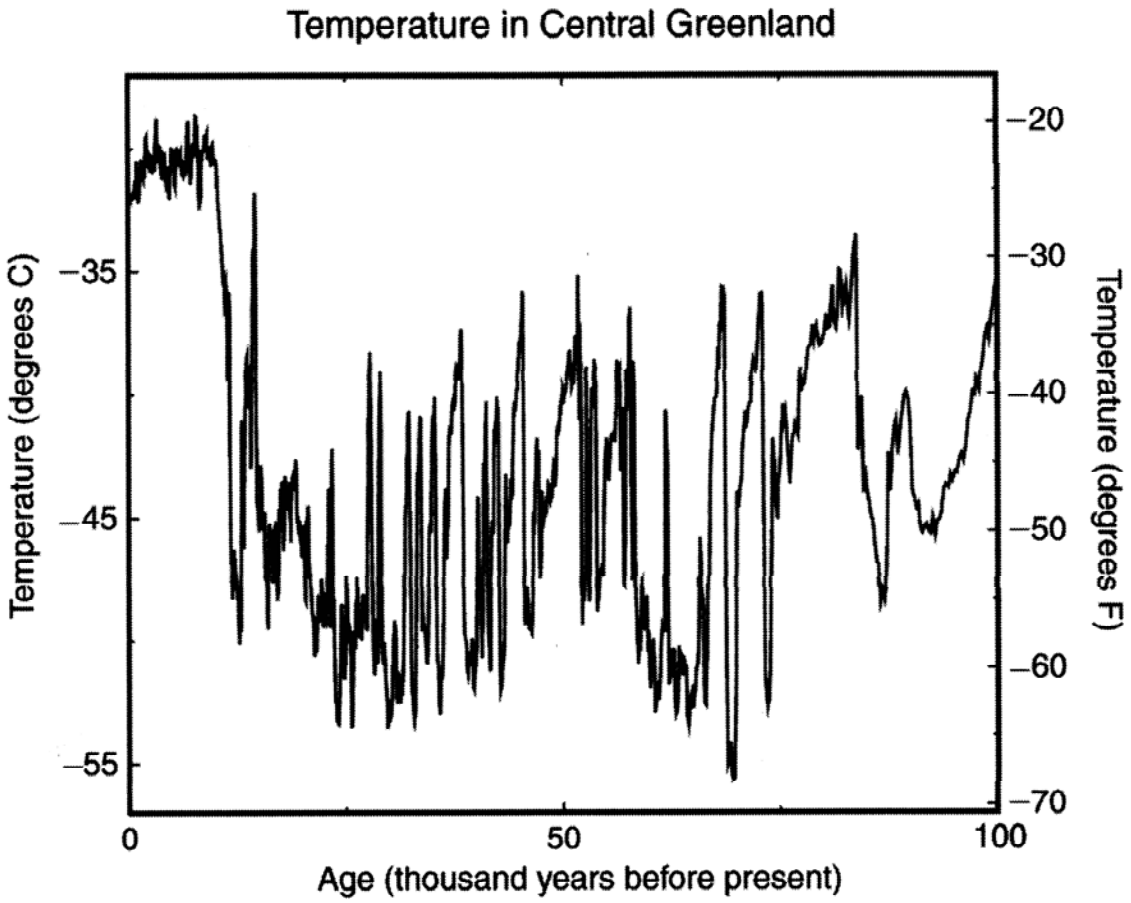
Ice Decreasing at an Increasing Rate



2007 vs 2012

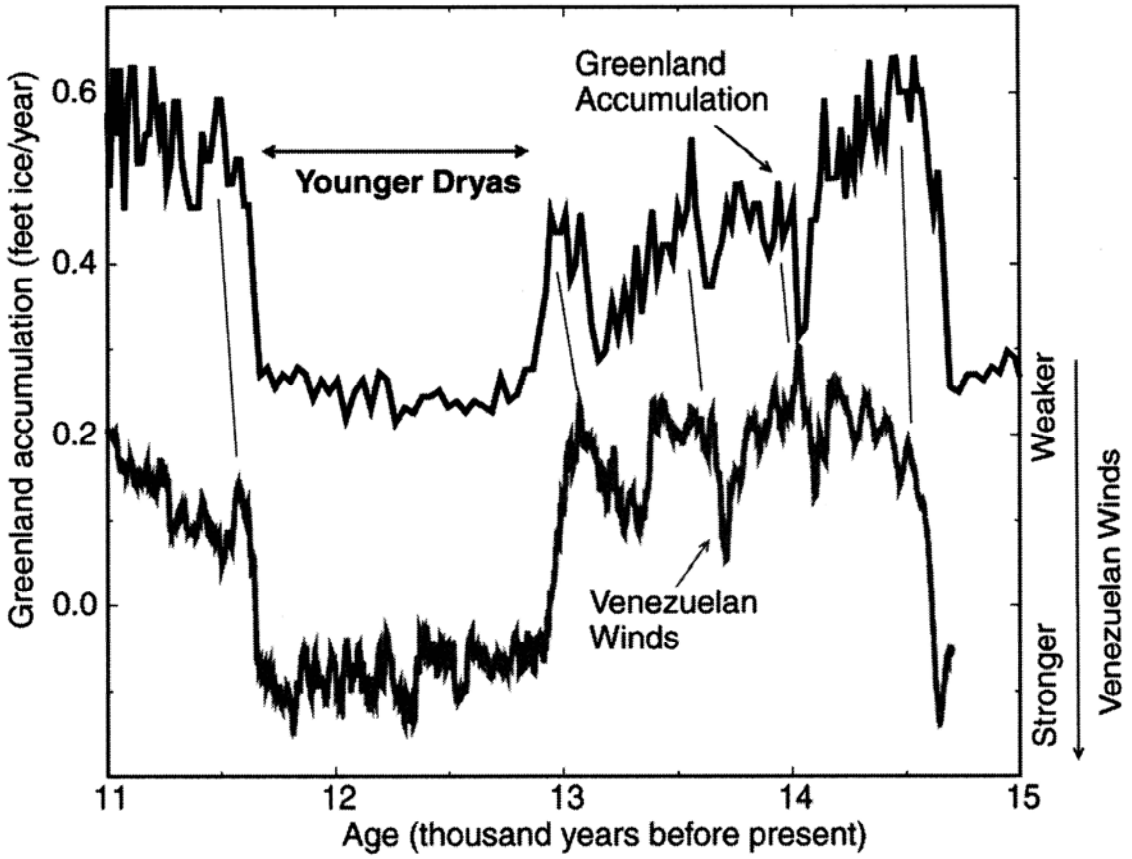

Sea Ice Extent
09/18/2007
National Snow and Ice Data Center, Boulder, CO
Sea Ice Extent
08/26/2012
National Snow and Ice Data Center, Boulder, CO
median
1979–2000

Abrupt Climate Change 23 Times!



Courtesy Richard B. Alley
The Two-Mile Time Machine, Princeton University Press, 2000, p. 117

The Same Pattern Seen in Venezuelan Winds



Courtesy Richard B. Alley

The Two-Mile Time Machine, Princeton University Press, 2000, p. 117

A Deadly Combination

- Fast melting sea ice increases Arctic Ocean temperature which can cause the release of a vast volume of methane from hydrates.
- Thawing permafrost holds a trillion tons of carbon in top 3 meters due to thaw this century – releases enormous amounts of methane.
- Methane is about 100 times more powerful than CO_2 during its lifetime in the atmosphere.
- The methane and thermal energy from warming ocean combine to dramatically increase further warming, creating a cascade. **This could already be happening.**

http://www.epa.gov/climatechange/impacts-adaptation/

http://cses.washington.edu/cig/

Welcome

CLIMATE IMPACTS GROUP

Climate Science in the Public Interest

- Home
- About CIG
- About Pacific Northwest Climate
- Research
- Forecasts and Planning Tools
- Outreach, Classes, and Seminars
- Publications
- Data / Links
- Contact CIG

Join the CIG's listserve

Search the CIG site.

Search

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phone 206.616.5350
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email:
cig@uw.edu

CIG Internal Site

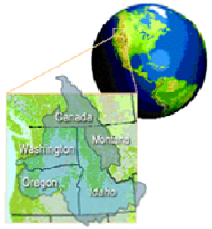
The **Climate Impacts Group (CIG)** is an internationally recognized interdisciplinary research group studying the impacts of natural climate variability and global climate change ("global warming"). Research at the CIG considers climate impacts at spatial scales ranging from local communities to the entire western U.S. region, with most work focused on the Pacific Northwest (PNW). Through research and interaction with stakeholders, the CIG works to increase community and ecosystem resilience to fluctuations in climate.

The CIG focuses on the intersection of climate science and public policy/resource management. We perform fundamental research on climate and climate impacts and work with planners and policy makers to apply this information to regional decision making processes. Key areas of the group's collective expertise include but are not limited to: downscaling global climate model data; regional climate modeling; hydrologic modeling; water resources and terrestrial/aquatic ecosystem modeling and impacts assessment; coastal impacts assessment; climate change vulnerability assessment and adaptation planning; and outreach and education.

The CIG is part of the Center for Science in the Earth System at the University of Washington's Joint Institute for the Study of the Atmosphere and Ocean (JISAO).

Spotlight *(past Spotlight features)*

- **(new!) The PNW Climate CIGnal Issue #29 is now posted**
  Read the latest issue of the CIG's on-line newsletter
- **(new!) Third Annual PNW Climate Science Conference Website posted**
  Information related to the October 1 - 2, 2012 PNW Climate Science Conference is available on the new conference website. Stay tuned for more information related to the call for abstracts and registration.
- **PNW climate change streamflow scenarios available**
  Climate change streamflow scenarios and summary figures for nearly 300 locations in the Columbia River Basin and coastal drainages are available



Pacific Northwest. The Climate Impacts Group focuses on the Columbia River basin (shaded) and the states of Washington, Oregon, and Idaho.

This site contains information about:

The CIG
... information about CIG researchers, accomplishments, future research directions, and partnerships with the stakeholder community
...more

Pacific Northwest Climate
... an overview of natural climate variability and human-caused climate change in the PNW
...more

Climate Impacts Research at the CIG
... summaries of key findings and details of current research
...more

CIG Publications
... a comprehensive listing of CIG publications by author, year, and research area
...more

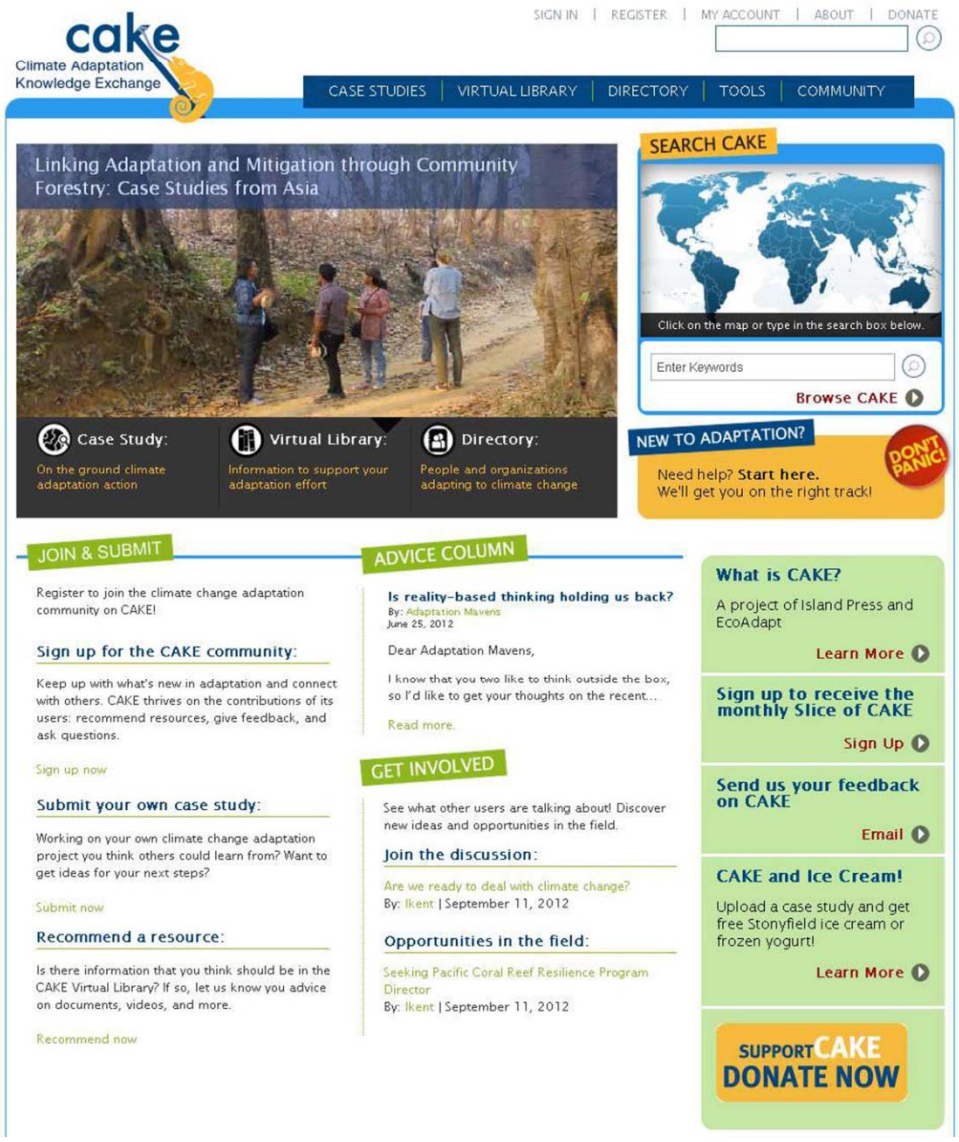
Forecasts and Planning Tools for PNW Resource Management
... short- to medium-term climate and resource forecasts, climate change scenarios, and information and case studies to enable planning for climate variability and change
...more

Outreach, Classes, and Seminars
... information about CIG-sponsored meetings, classes, and seminars
...more

Data/Links
... global and regional data sources for a variety of climate and natural resource conditions
...more

Contact CIG
... information about contacting CIG offices and departments, our location, and mailing address
...more

http://www.cakex.org/

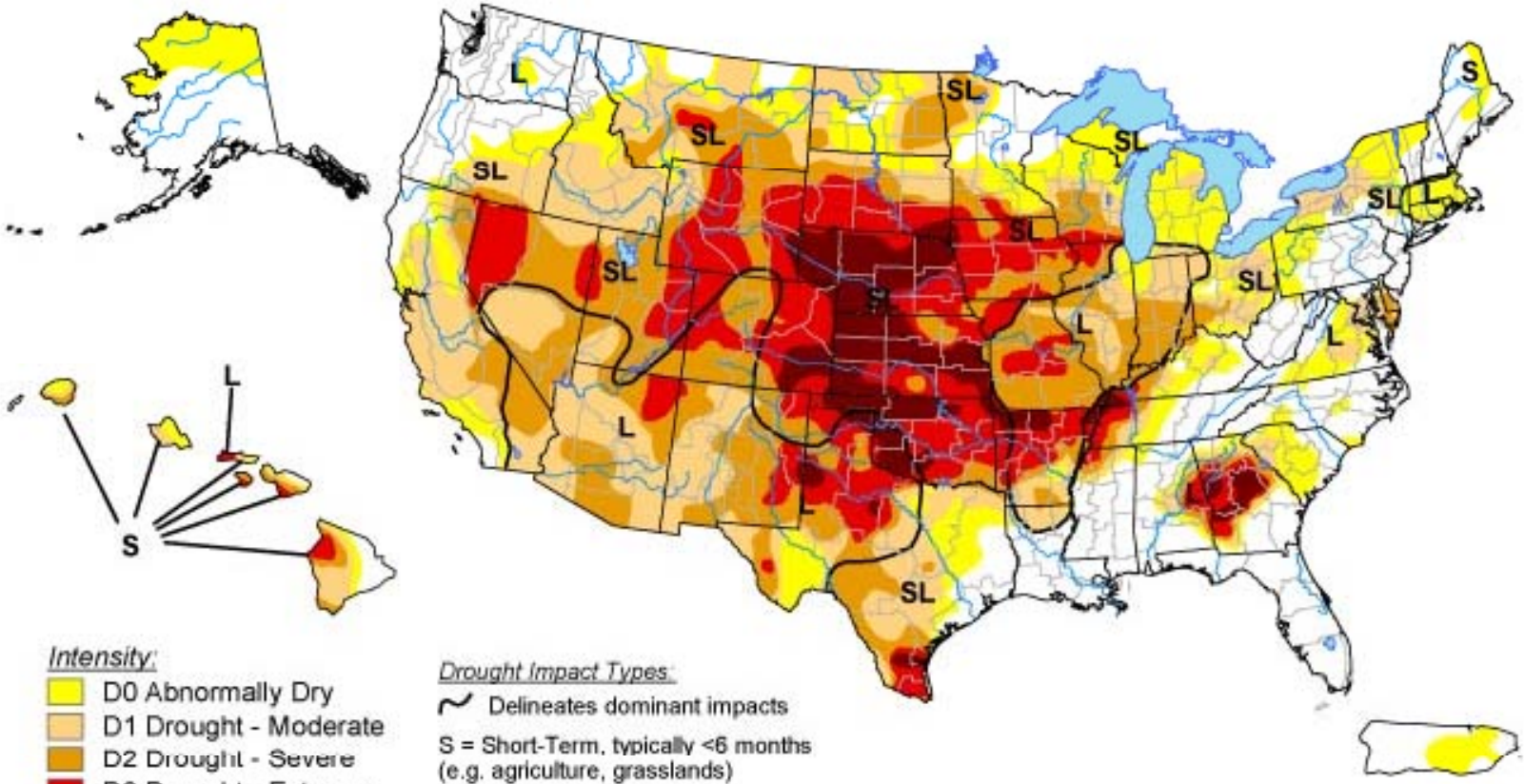


http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation

Water Scarcity

U.S. Drought Monitor

September 4, 2012
Valid 7 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

Delineates dominant impacts

S = Short-Term, typically <6 months (e.g. agriculture, grasslands)

L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

Released Thursday, September 6, 2012

Author: Brian Fuchs, National Drought Mitigation Center

Worldwide Droughts

The Amazon droughts (three 100-year droughts in 15 years) could cause the most damage.

Droughts in Africa and the Middle East are causing serious conflicts.

Droughts in China and India hit large populations.

Water scarcity problems are widespread

Some recent headlines:

“Drought May Threaten Much of Globe Within Decades”

“Land ‘evapotranspiration’ taking unexpected turn: Huge parts of world are drying up”

“80 Percent of Global Water Supplies at Risk”

“Groundwater depletion rate accelerating worldwide”

The Fouling of Water

- This is a worldwide problem of a high order. Many major rivers are heavily polluted.
- In the U.S., will hydraulic fracturing poison groundwater? The jury is still out on that. But it needs a lot of water.
- What are tar sands and what is the problem with the KK Pipeline?

FOOD SCARCITY

Problems with livestock

- High consumption of grains increases demand for scarce crops. ~7 lb. of grain produce 1 lb. of meat.
- Cause clearing of forests and natural grasslands for grazing.
- Represent 14.5% of total GHGs, more than transportation sector.
- Crowded planet with rising middle class increases demand for livestock products.

Biofuels compete with food

In 2009, biofuels used 119 million tons of grain, enough to feed 350 million people.

Climate change affects irrigated rice yield

- While higher daytime temperature increases yield, higher night-time temperature decreases yield even more.
- Yield has already dropped 10-20% over the past 25 years.
- Land is scarce and the population growth is overwhelming.
- Corn and soybeans are also at risk with temperature rise.

Extreme weather events destroy crops

- Add major flooding to the problem of droughts. The U.S. experienced historic flooding in 2011.
- We've seen disastrous flooding in many countries in 2010 and 2011. Now add 2012. Those include catastrophic floods in: The U.K., Canada, Russia, China, India, Australia, N. Korea, Ecuador…….

Other natural enemies

- The phorid fly is killing off honey bees.
- Bats are disappearing due to fungus.
- Wheat rust Ug99 is moving around the globe.
- A microscopic fungus is affecting cattle.
- Roundup's gyphosate could be irreversibly devastating the microbiodiversity of the soil.
- Hope for genetically-engineered crops is decreasing.

FAO Food Price Index

Fuel Scarcity

- Competition for oil is building as the middle class grows in China, India, Brazil and other emerging nations.
- Is “Peak Oil” real? Depends.
- Coal? We have plenty and we are mining plenty but a lot is for export.
- Natural gas? Is this the future?

Renewables

- Wind and solar are not “base load.” They are expensive to install. Will storage technology arrive?
- Will thin film solar come to the rescue?
- Thermal, hydro, wave, tidal, other. They all can help……some.
- How much will it take to offset global warming?

Potential new sources of energy

- Cold fusion.
- Hot fusion: National Ignition Facility

  Tokamaks

  ITER

  AFS

Other?

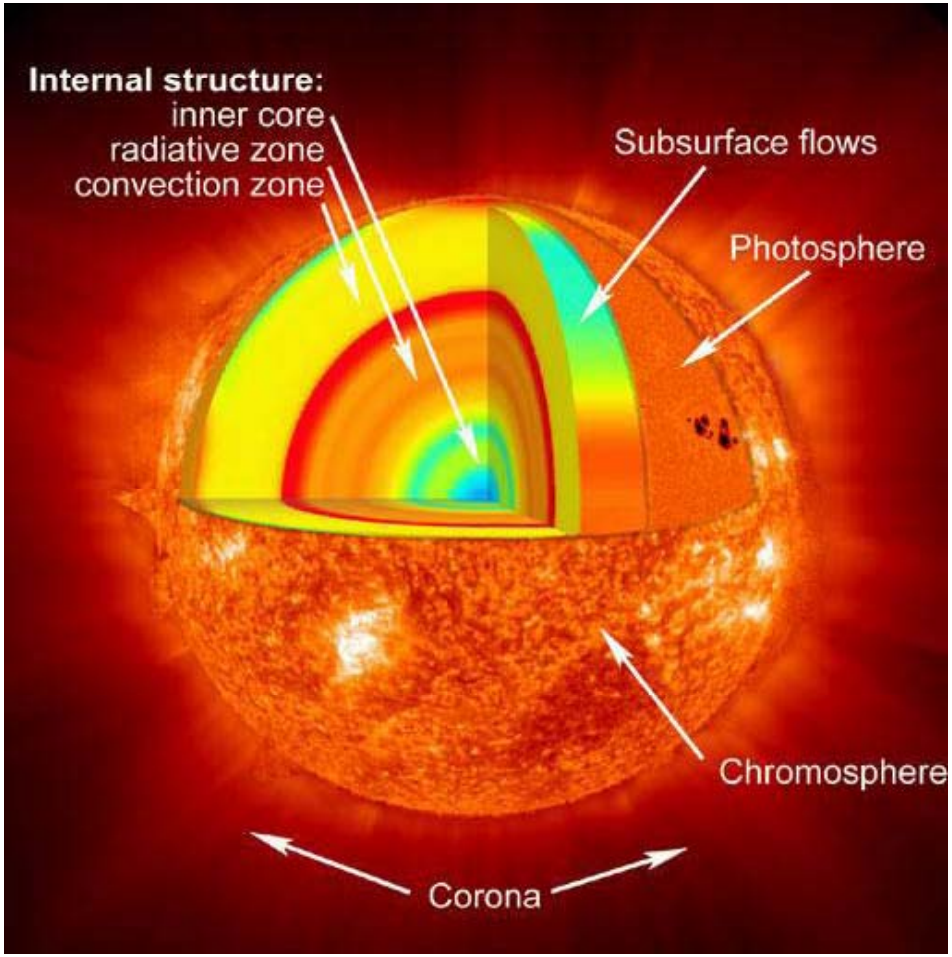
ELECTROMAGNETIC PULSE

Three main sources

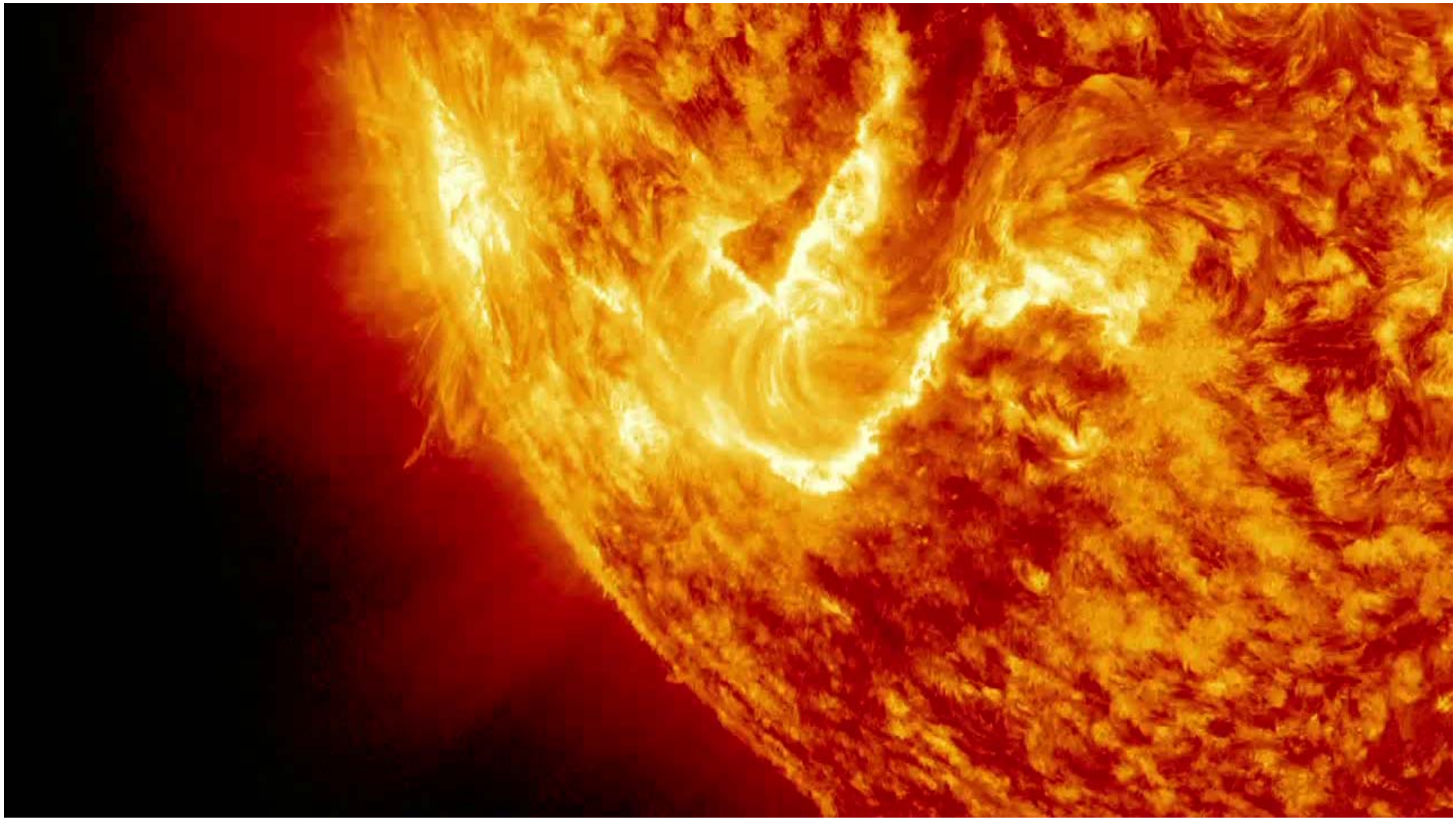
- **The Sun** – a certainty (99.9%?)
- **A nuclear blast** – possible (50%?) & devastating
- **A non-nuclear strike** – very likely (75%?) and near-term

Note: The scientific community has reached consensus to not use “EMP” for solar.

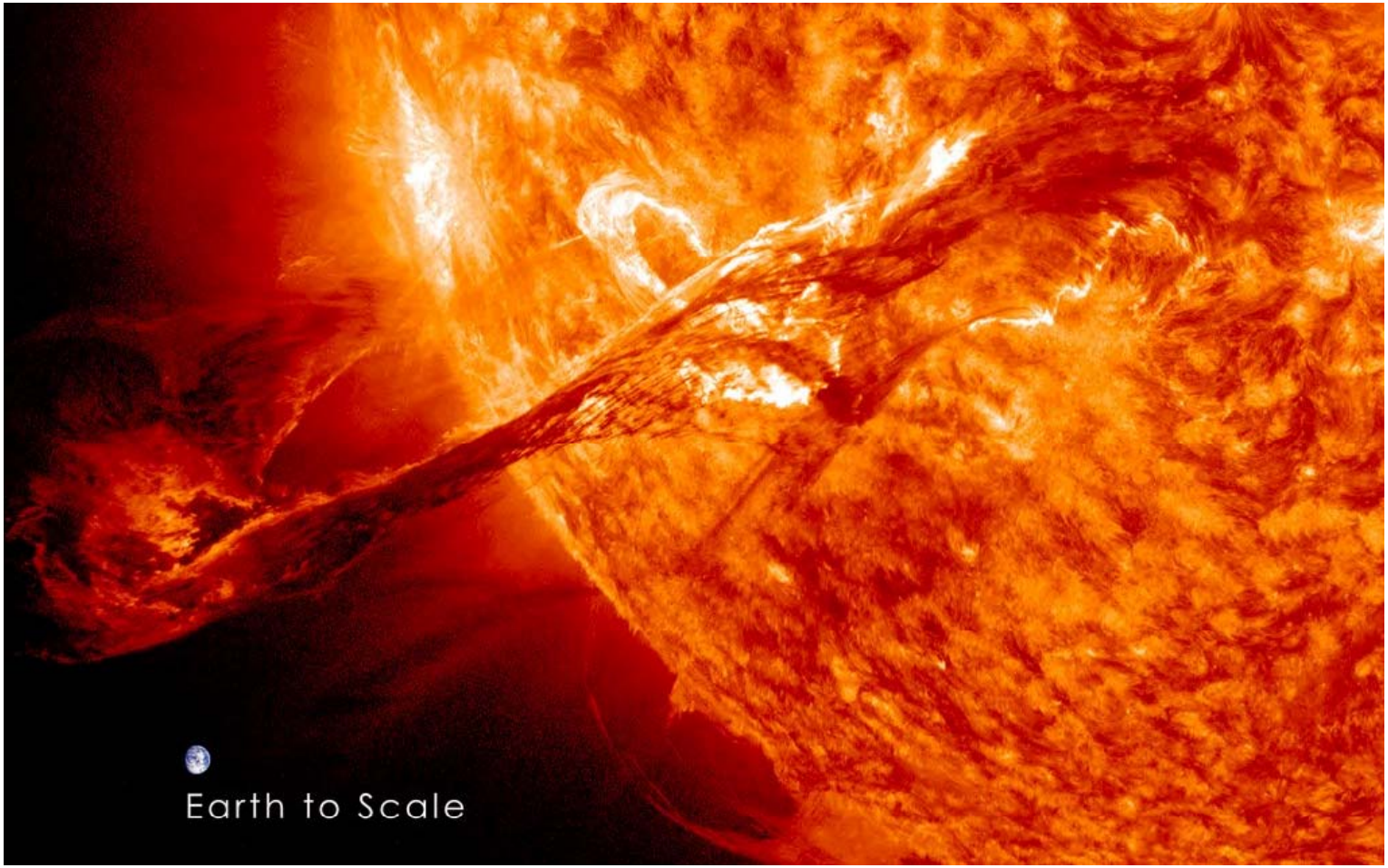
What causes the Sun to behave the way it does?



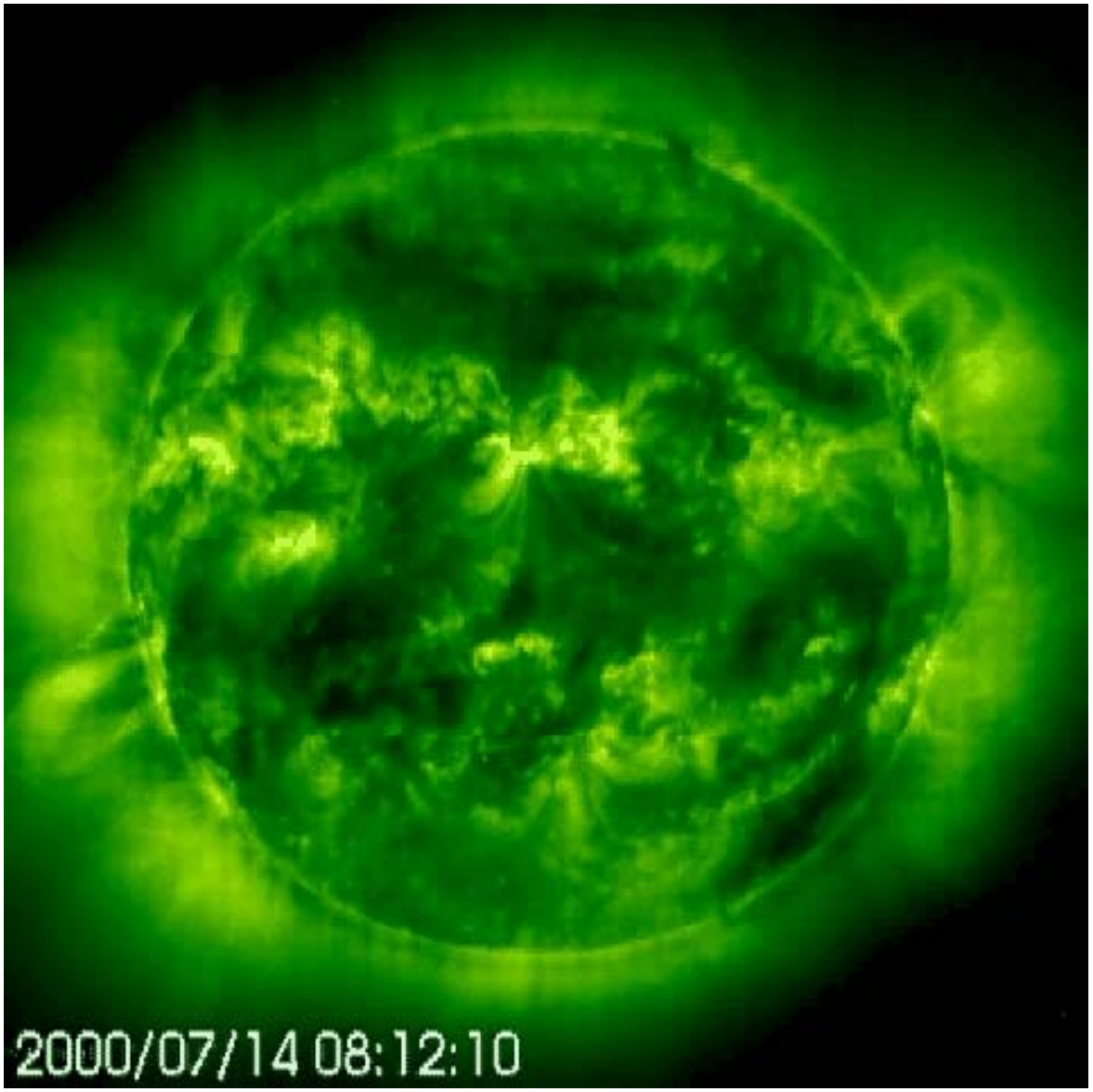
An active area fires off a CME
(Coronal Mass Ejection)



Earth to Scale



You don’t want to see this happen!



Solar Flares

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, high frequency radio airwaves, and airlines.

These CMEs are dangerous events

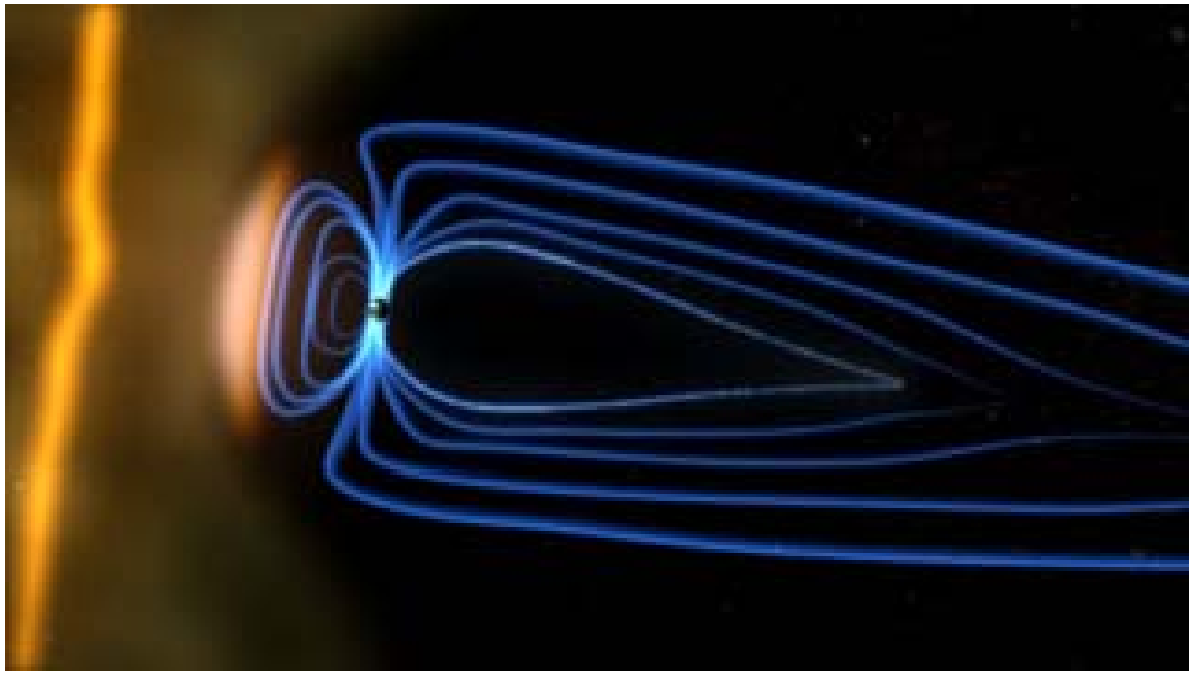
- They reach the earth in 1 to 4 days.
- They need to be fired directly at us (with help of the solar wind).
- They need to have the correct north/south orientation.
- We know if the conditions are right for a major geomagnetic storm only about 17 to 20 minutes ahead of its arrival.

Solar Wind

- A constant output of the Sun
- Greater output when there are holes in Sun's corona
- Gives us frequent aurorae near poles.
- Interacts with CMEs affecting their trajectory.

Coronal Mass Ejection meeting the earth's geomagnetic field

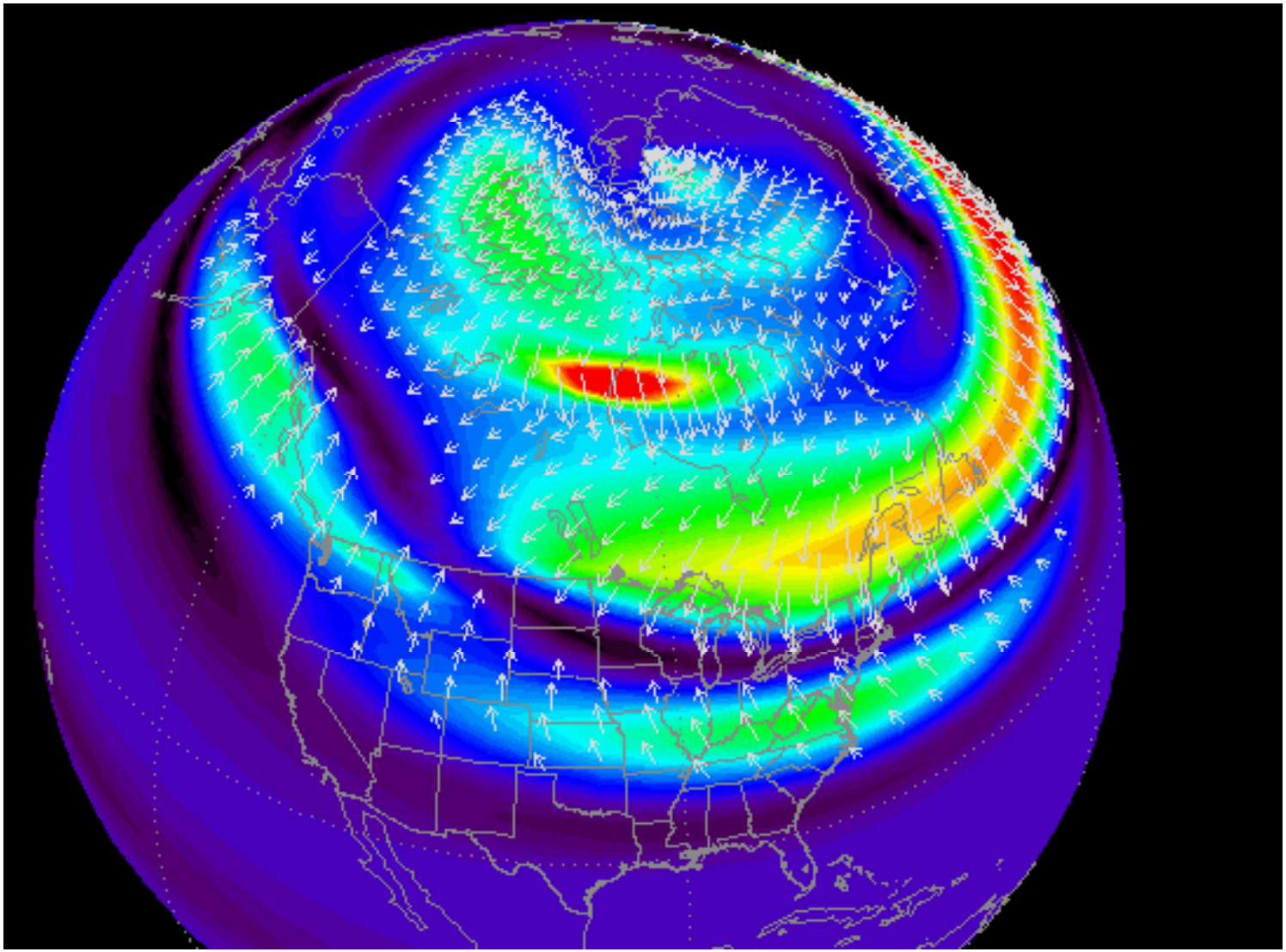
The small dot in the light blue area is the earth. The blue lines represent the earth's geomagnetic field.



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

Aurora Borealis – Northern Lights

Electrojets of the 1989 Storm



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. The sun produced 17 major flares and numerous CMEs from Oct. 19 thru Nov. 7. It occurred 3 ½ years after solar max.

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?

Impact of the 1989 storm

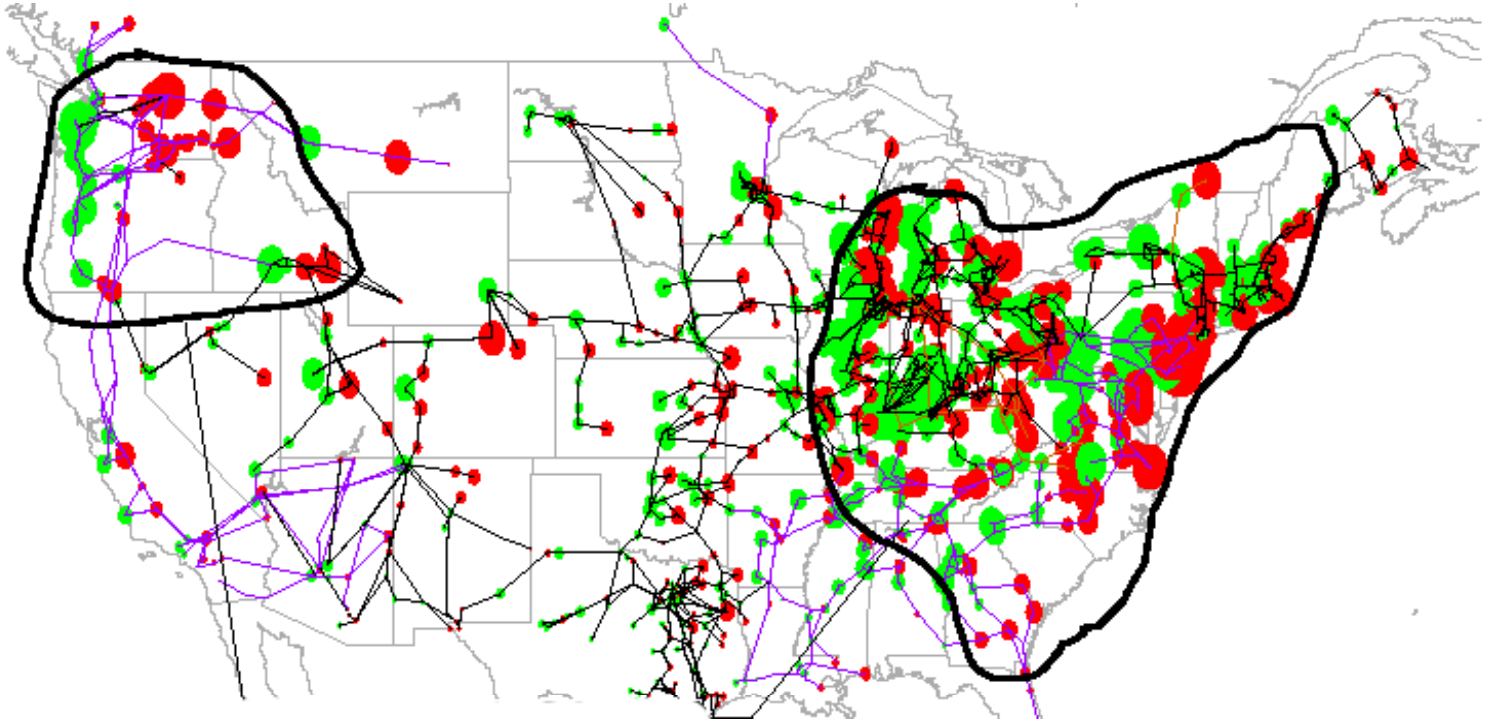
- Coronal mass ejection was launched on March 9, 1989. It reached earth **3 ½ days** later.
- It was manifested by a ground induced current (GIC) that coupled with transmission lines.
- The greatest impact was the outage of the Quebec Province electric grid for 9 hours.
- One large transformer was destroyed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

Damage from 1989 storm

- It burned up a large transformer in New Jersey.
- Within 2 years after the March ’89 exposure, 11 nuclear plants noted failures of large transformers, in addition to the Salem failure.

Power Grids should expect Storms 4 to 10 Times More Intense than the March 1989 Storm and to extend much further south.

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

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.

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.

HEMP Exposed Area for Height of Blast

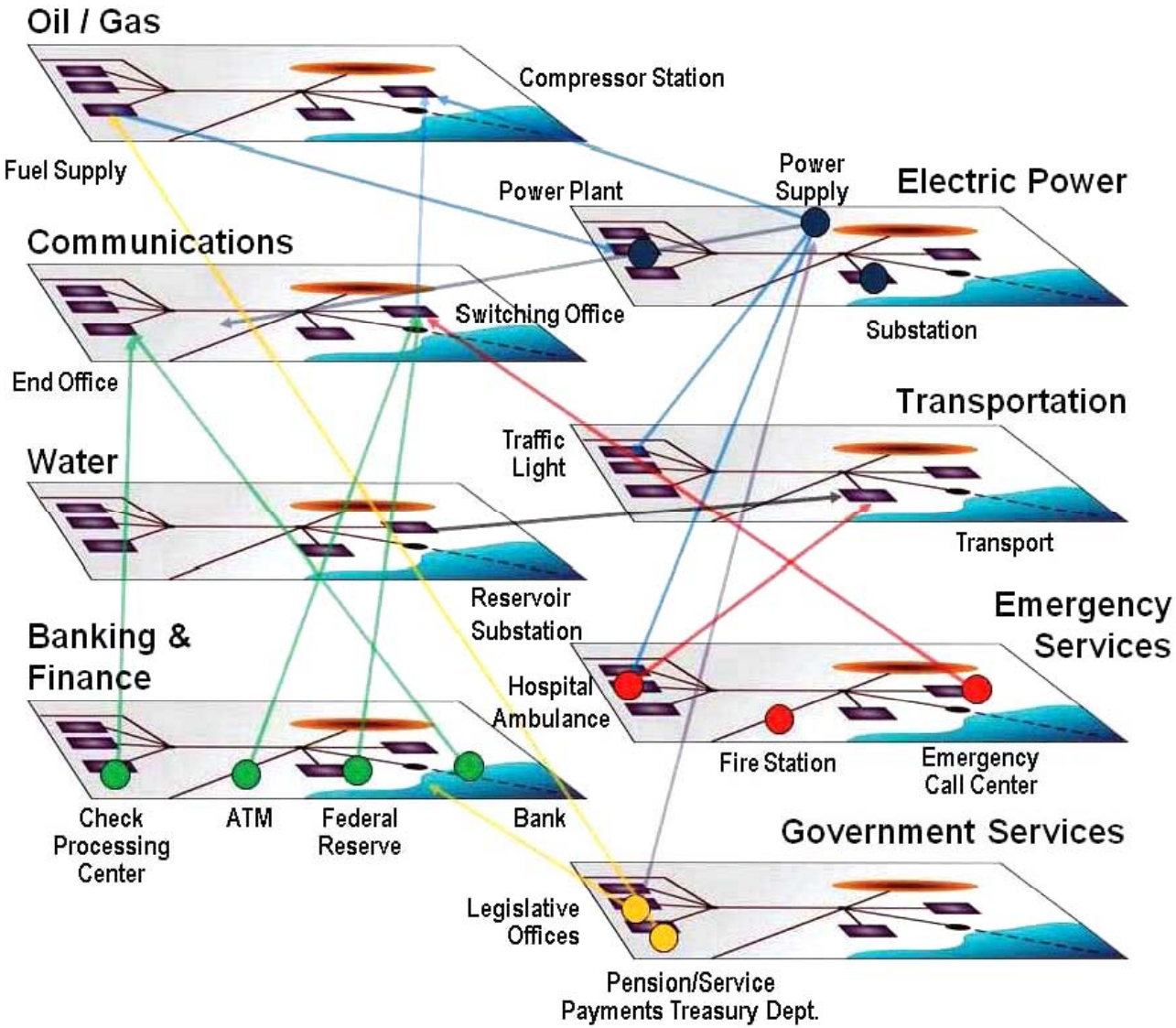
Electric Grid and other Consequences

- The pulse has 3 parts: E1, E2 and E3
- E1 will damage electronic gear including protection devices.
- E2 will saturate the core of transformers and generators.
- E3 will burn up the transformers and generators.
- Nuclear cooling systems will not function.
- Back-up generators will not function.
- Degree of dysfunction will vary for many reasons.

Your Virtual Wealth

- If you are virtually wealthy, your wealth could disappear in a flash!
- If records of your various types of assets are only in digital form, when they are zapped, those assets are no longer yours!
- If all the lights go out for a long, extended period, your assets are only what you can physically defend, including food, water, shelter, medical supplies, etc., etc., etc.
- How long before cities are abandoned? Weeks?

Interconnectedness



NON-NUCLEAR EMP (NNEMP)

EMP Generators

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.
- Electrically, 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.

Attack on Transformer

This shows what could happen after an NNEMP strike (video is not from an NNEMP)

Example is a 3 MVA-rated Transformer.

It could just as well have been a 200 MVA-rated Transformer.

Tasks that are needed now

- Educate others about this threat 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. There are many websites that can help.
- 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
- Think renewables. They may survive an attack.

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. Encourage 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.eiscouncil.org

www.preparehub.org

www.empcommission.org

PANDEMICS

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#

FLU Vaccines are Controversial

In The Lancet Infectious Diseases, Volume 12, Issue 1, Pages 36 - 44, January 2012

The study identified and qualified 14 observational studies and 17 randomized, controlled studies 1/1/67 to 2/15/11. For ages 18 to 65, the effectiveness rate was **59%**. They concluded: Flu vaccines "can provide moderate protection."

BUT, they added "…such protection is greatly reduced or absent in some seasons."

They urge that work proceed on developing more effective vaccines.

Adverse reactions to the flu vaccine have not been well-reported but there are many anecdotal reports outside of the conventional medical media.

Pandemic Insurance Coverage

- The principal liability exposure will likely 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. Adults should be taking at least 5,000 iu per day.

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 have focused only on bone health.
- 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.

“L” Articles on Vitamin D*

- **Lack of Sunlight Leads to Infertility**
- **Lack of Sunlight May Raise Stroke Risk**
- **Lack of Sunshine Causes One Million Deaths a Year**
- **Lack of Sunshine Vitamin Linked to Cognitive Decline**
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For the next pandemic

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Resources for Pandemics

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- 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

PANDEMICS

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#

FLU Vaccines are Controversial

In The Lancet Infectious Diseases, Volume 12, Issue 1, Pages 36 - 44, January 2012

The study identified and qualified 14 observational studies and 17 randomized, controlled studies 1/1/67 to 2/15/11. For ages 18 to 65, the effectiveness rate was **59%**. They concluded: Flu vaccines "can provide moderate protection."

BUT, they added "…such protection is greatly reduced or absent in some seasons."

They urge that work proceed on developing more effective vaccines.

Pandemic Insurance Coverage

- The principal liability exposure will likely 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. Adults should be taking at least 5,000 iu per day.

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 have focused only on bone health.
- 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.

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- 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/
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CYBER WARFARE

We have become dependent in ways we never anticipated

- Much of the commercial/industrial world operates online. Even our military is largely Internet dependent.
- We are not prepared to operate offline.
- Social media has become pervasive.
- How many of you do banking online?
- How many of you depend on VOIP for communications?

So what is happening?

- Cybercrime is rampant.
- Data breaches are a constant problem.
- Your ID is at risk.
- But these are not emerging risks. We already know them and they are happening now.
- The emerging risk is Cyber WARFARE.
- This puts the Internet at risk. You could be without Internet service for an extended period of time.

Have you considered:
NO Internet Service?

- What if the Internet is not available for a week? What will you do?
- What if the service is not there for two weeks?
- What if your company loses its databanks?

What is Cyber Warfare?

- The Stuxnet worm that damaged Iranian nuclear development operations was just a start.
- Cyberweapons may already be at work. Have the Russians and Chinese already infiltrated our industrial, commercial, military networks?
- If attacked, how will we know who is doing what?

Comments from a AAAS discussion of cyber risk among experts:

- We can’t do this by ourselves. Protection has to be globally organized.
- We can make our defenses better but still not good enough.
- We’ll need a higher order of protection than we have now.
- We may need a bad experience before we can take strong action.
- Power grids should be declared out of bounds.

Washington Post article of April 10, 2012

- “Cyberweapons on Pentagon fast track”
- Military is grappling with the establishment of rules for cyberwarfare.
- We can’t sit around and wait for the traditional weapons-building process.
- Sophisticated cyberweapons can be rendered obsolete in weeks or months.

Business Insurance magazine

- Insurance industry is still learning about cyber risk. Data breaches are widely covered but still new.
- Munich Re head of IT: “Business interruption losses from a major Internet outage are very difficult to model and could possibly impact all policies on a portfolio.”
- “We consider it noninsurable and therefore exclude it.”

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Available for consulting through 2012