Why Are We Here?

By
I Sam Higuchi
NASA-HQ Environmental Management Division

Resilience and Adaptation to Climate Risks Workshop:
NASA Stennis Space Center
15-18 October 2012

NASA Stennis Space Center, MS

Taking Responsibility

During the workshop:

*For things that go **wrong** – **it's Sam's fault**.*
*For things that go **right** – the **credit goes to the "team".***

So, Why are We Here?

http://photography.nationalgeographic.com/photography/photo-of-the-day/black-sheep/

Responding to Climate Risks

1) Mitigation: *An intervention to reduce the causes of changes in climate, such as through reducing emissions of greenhouse gases to the atmosphere.* *(GHG)*

2) Adaptation: *Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects.*
(Temperature, precipitation, sea level change)

3) Mitigation and Adaptation (Dutch Windmills) – Wind energy used directly to pump flood water.

Hey –
Buddy wake-up, we've got to get going.

This ice stuff is melting fast!

Do you remember where Noah parked the "boat" – I mean the ark?

http://www.joeydevilla.com/2011/03/13/daylight-saving-time-2011/

THE RIGHT PEOPLE ARE IN THE ROOM!!

It is OK to be prepared for life as it is today;

But it is awesome to be prepared for making life better for today and the future.

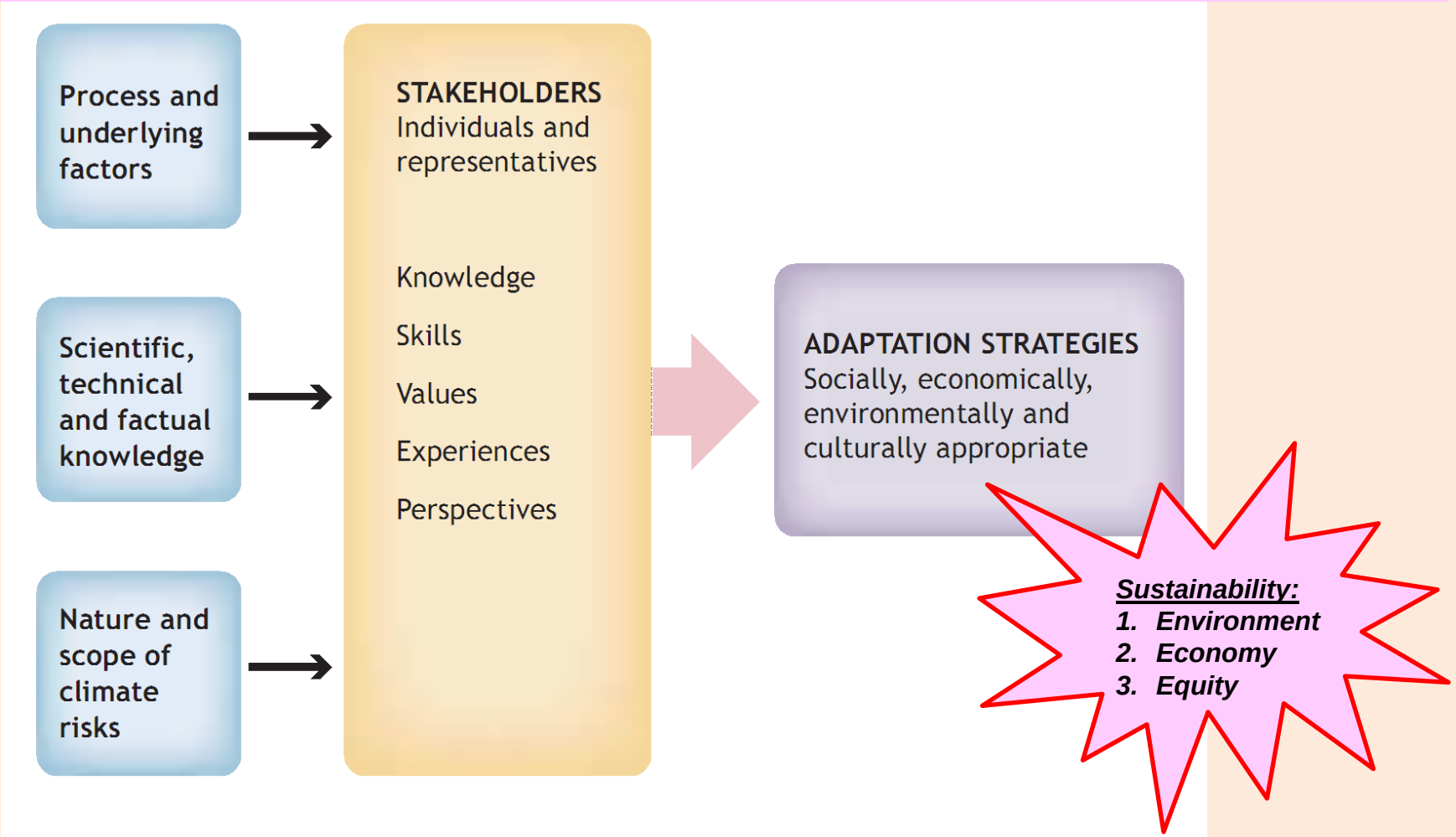


Figure 3: Roles and responsibilities of stakeholders in the adaptation process.

UKCIP (xxxx) Identifying Adaptation Options http://www.ukcip.org.uk/images/stories/Tools_pdfs/ID_Adapt_options.pdf

"We know now that some impacts are inevitable and we know that these impacts will affect many of the essential services and functions that our governments are expected to provide. We must prepare for the impacts underway while we work to avoid even worse future effects."

Local entities "… are on the front lines of climate change impacts, and have a responsibility to respond. *** [B]y nature, … strategies designed at the federal … level have limited level of specificity, whereas local [entities] … are in a stronger position to tailor climate change preparedness strategies to their specific circumstances, and to the unique set of climate change impacts that they expect to face."

ICLEI (September 2007) Preparing for Climate Change: A Guidebook for Local, regional, and State Governments

Hurricane Isaac 2012

MAP: Hurricane Isaac's Path Aims For Gulf Coast

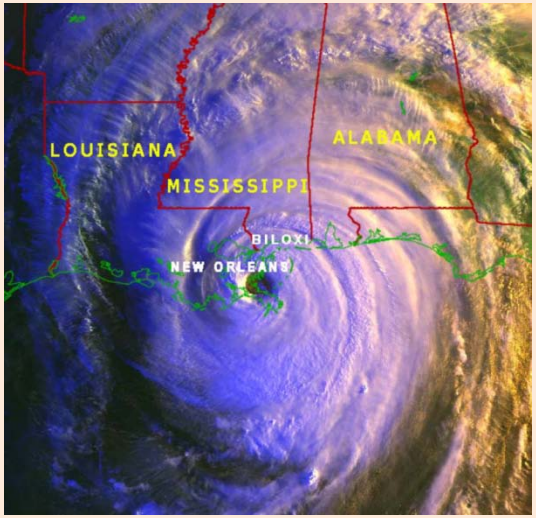
Isaac Leaves Thousands In Shelters Or Powerless Homes

Isaac Continues To Present Life-Threatening Weather

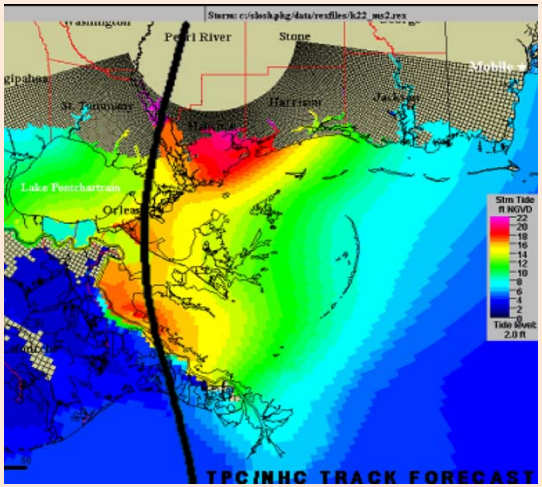
Hurricane Isaac Spurs Design Of Storm Surge Warnings

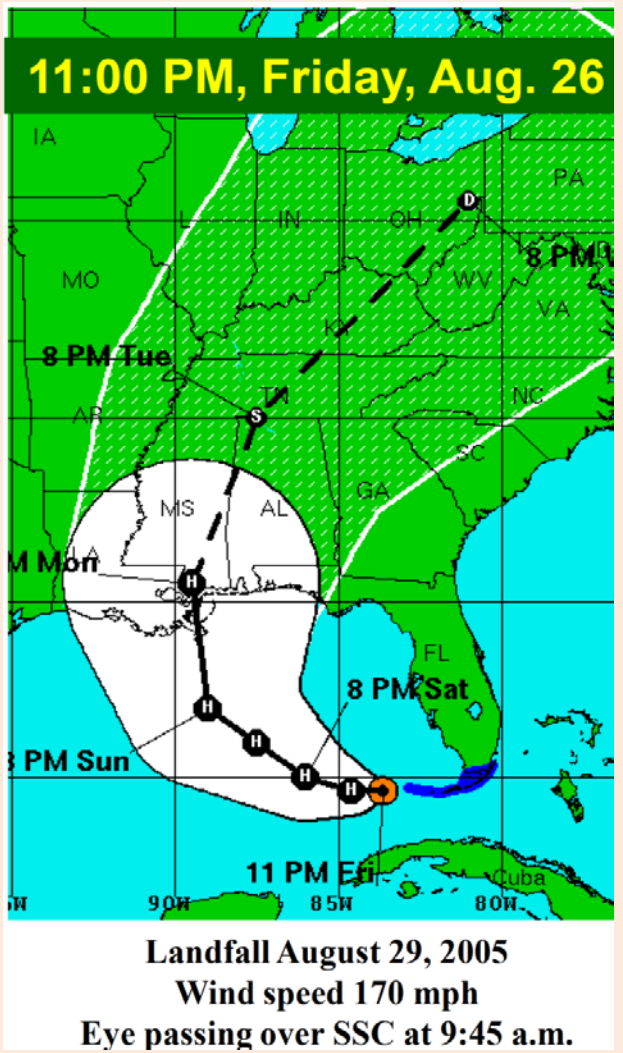
http://www.huffingtonpost.com/news/hurricane-isaac-2012/1

Hurricane Katrina
east of New Orleans
NOAA-15 satellite image at
7:47 a.m. CDT August 29, 2005.



Storm surge data (SLOSH):
Max. 22 feet
Hancock & Harrison Counties, MS
at 9:20 a.m. CDT, August 28, 2005.
Katrina forecast track (black line).





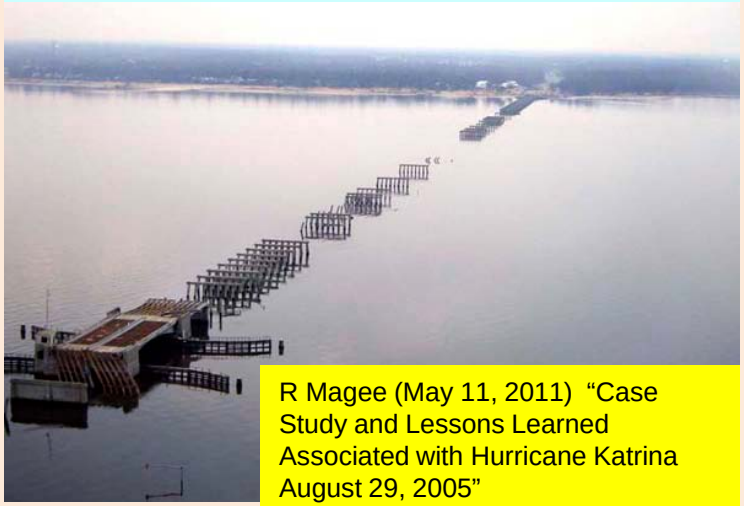
Landfall August 29, 2005
Wind speed 170 mph
Eye passing over SSC at 9:45 a.m.

D L Johnson (2006) "NOAA Service Assessment : Hurricane Katrina August 23-31, 2005"

R Magee (May 11, 2011) "Case Study and Lessons Learned Associated with Hurricane Katrina August 29, 2005"

BAY OF ST. LOUIS BRIDGE

Bridge Over the Bay of St. Louis



R Magee (May 11, 2011) "Case Study and Lessons Learned Associated with Hurricane Katrina August 29, 2005"

Spans split in half and fallen from piers
(Bay St. Louis Bridge)

Case Study of the Transportation Sector's Response to and Recovery from Hurricanes Katrina and Rita LANCE R. GRENZEBACK ANDREW T. LUKMANN Cambridge Systematics, Inc.
http://www.aiche.org/uploadedFiles/FSCarbonMgmt/Resources/Case_Study_-_Katrina.pdf

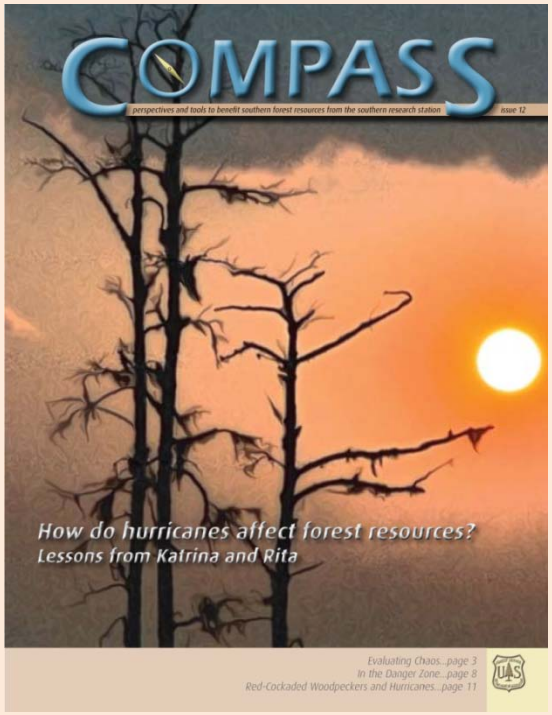
Hurricane Katrina damage to U.S. Highway 90 at Bay St. Louis, MS.
(Source: NASA Remote Sensing Tutorial)

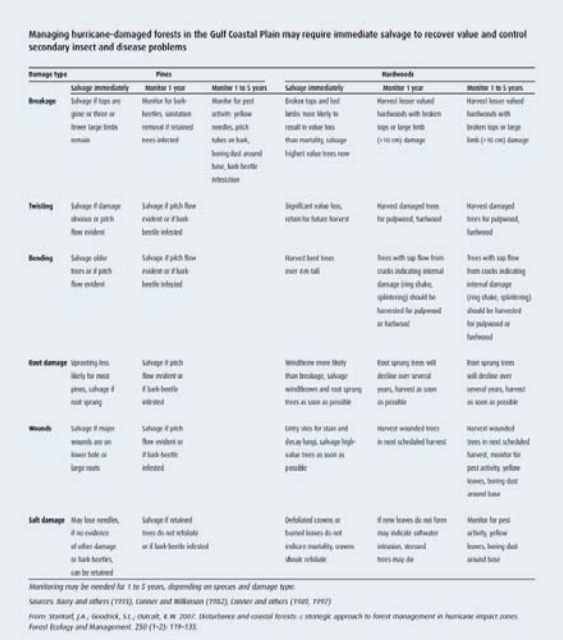
http://www.climatescience.gov/Library/sap/sap4-7/final-report/sap4-7-final-all.pdf

Ghost Forests

In this Louisiana wetland, salt-water intrusion has killed the cypress trees.

http://pubs.usgs.gov/circ/c1075/images/wetland.gif





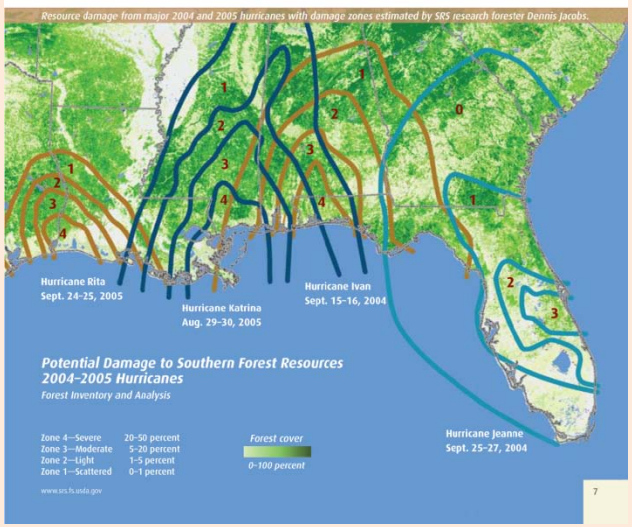
Managing hurricane-damaged forests in the Gulf Coastal Plain may require immediate salvage to recover value and control secondary insect and disease problems

Damage type	Pines			Hardwoods		
	Salvage immediately	Monitor 1 year	Monitor 1 to 5 years	Salvage immediately	Monitor 1 year	Monitor 1 to 5 years
Breakage	Salvage if tops are gone or three or fewer large limbs remain	Monitor for bark-beetles, sanitation removal if retained trees infected	Monitor for pest activity: yellow needles, pitch tubes on bark, boring dust around base, bark beetle infestation	Broken tops and lost limbs more likely to result in value loss than mortality, salvage highest value trees now	Harvest lesser valued hardwoods with broken tops or large limb (>10 cm) damage	Harvest lesser valued hardwoods with broken tops or large limb (>10 cm) damage
Twisting	Salvage if damage obvious or pitch flow evident	Salvage if pitch flow evident or if bark-beetle infested		Significant value loss, retain for future harvest	Harvest damaged trees for pulpwood, fuelwood	Harvest damaged trees for pulpwood, fuelwood
Bending	Salvage older trees or if pitch flow evident	Salvage if pitch flow evident or if bark-beetle infested		Harvest bent trees over 4 m tall	Trees with sap flow from cracks indicating internal damage (ring shake, splintering) should be harvested for pulpwood or fuelwood	Trees with sap flow from cracks indicating internal damage (ring shake, splintering) should be harvested for pulpwood or fuelwood
Root damage	Uprooting less likely for most pines, salvage if root sprang	Salvage if pitch flow evident or if bark-beetle infested		Windthrow more likely than breakage, salvage windthrown and root sprung trees as soon as possible	Root sprung trees will decline over several years, harvest as soon as possible	Root sprung trees will decline over several years, harvest as soon as possible
Wounds	Salvage if major wounds are on lower bole or large roots	Salvage if pitch flow evident or if bark-beetle infested		Entry sites for stain and decay fungi, salvage high-value trees as soon as possible	Harvest wounded trees in next scheduled harvest	Harvest wounded trees in next scheduled harvest, monitor for pest activity, yellow leaves, boring dust around base
Salt damage	Max loss needles, if no evidence of other damage or bark beetles, can be retained	Salvage if retained trees do not refoliate or if bark-beetle infested		Defoliated crowns or burned leaves do not indicate mortality, crowns should refoliate	If new leaves do not form may indicate saltwater intrusion, stressed trees may die	Monitor for pest activity, yellow leaves, boring dust around base

Monitoring may be needed for 1 to 5 years, depending on species and damage type.

Sources: Banks and others (1993), Conner and Wilkinson (1982), Conner and others (1980, 1991)

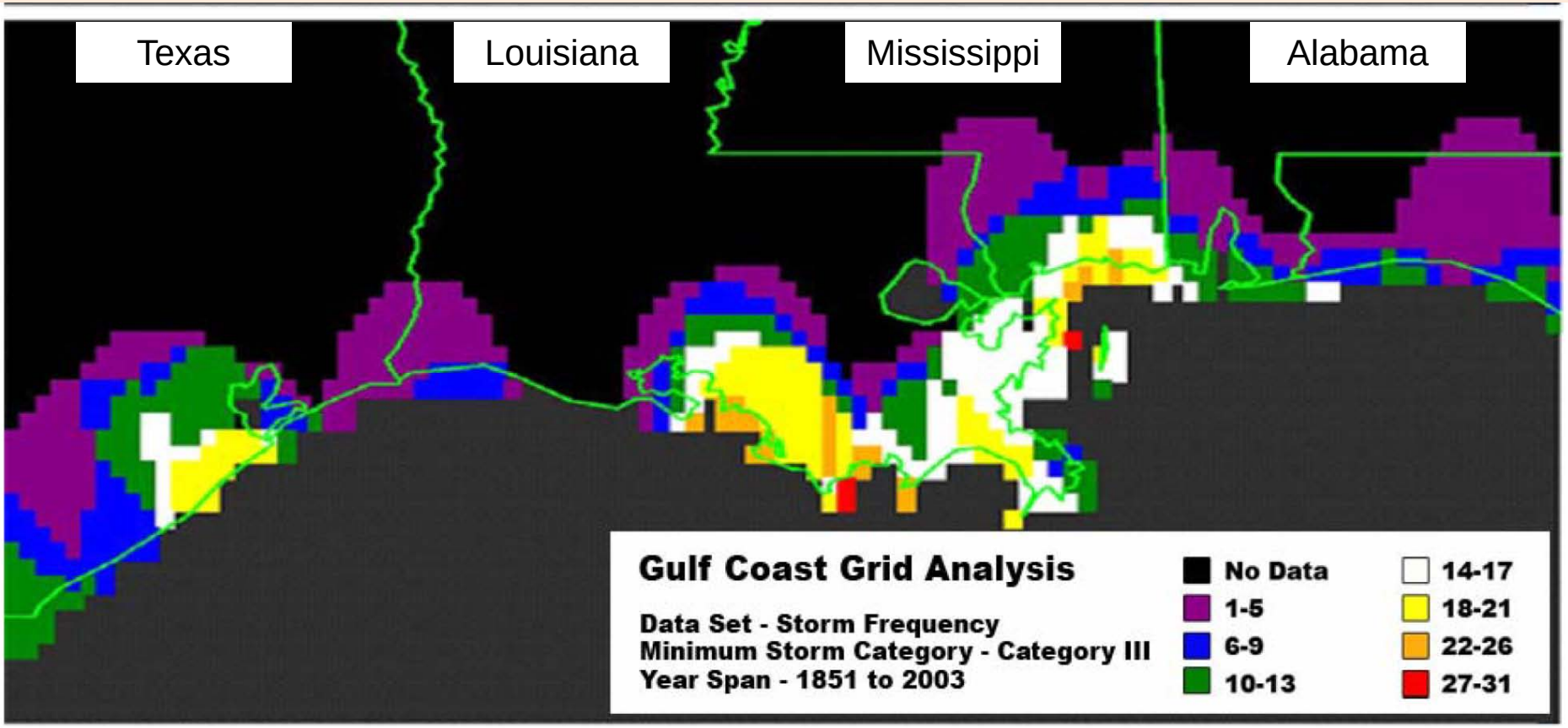
From: Stanturf, J.A.; Goodrick, S.L.; Outcalt, K.W. 2007. Disturbance and coastal forests: a strategic approach to forest management in hurricane impact zones. Forest Ecology and Management. 250 (1-2): 119-135.



http://www.srs.fs.usda.gov/compass/issue12/issue12.pdf

“Category 3” winds or higher across the Gulf Coast

Frequency analysis of storm events



http://www.climatescience.gov/Library/sap/sap4-7/final-report/sap4-7-final-all.pdf

Water Spout over Lake Pontchartrain, Slidell, LA

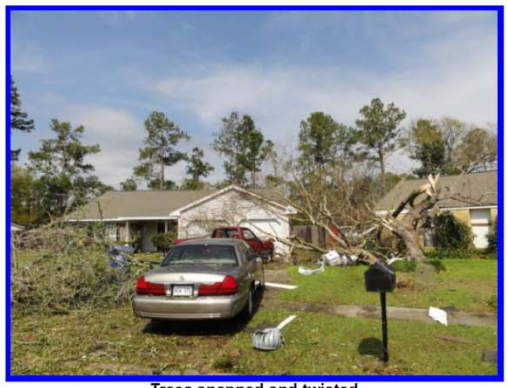
6 July 2008

http://www.wunderground.com/wximage/viewsingleimage.html?mode=singleimage&handle=sailormankvd&number=6

Severe Storm including tornado near Slidell, LA

March 9, 2011

Parial loss of wall and roofing deck



Trees snapped and twisted

Total roof loss

Partial roof loss of another home

http://www.srh.noaa.gov/lix/?n=slidelltornado03092011

Microburst

Rogersville, AL
28 September 2006

http://www.rogersvillealabama.org/Locations.asp

Why should we stay? Sam, we've already done this.

The Built Environment

Slide #1: *Networks and Grids*

Power

(Lessons Learned)

Pre-Katrina:

1) Center lost its electrical power service as both feeds were from the south
2) High-pressure systems required priority attention to restore power to them to prevent serious damage
3) Fuel management was a big concern for weeks following Katrina

Today the Center:

1) Northbound 115 KV power transmission line is under contract
2) Generators will be pre-positioned at the beginning of hurricane season to reduce last minute activity
3) Fuel tanks are kept 90% full throughout the hurricane season

Communications

(Lessons Learned)

Pre-Katrina:

1) Center was totally dependent on voice land lines many of which went underwater
2) Center lost internet connectivity

Today the Center:

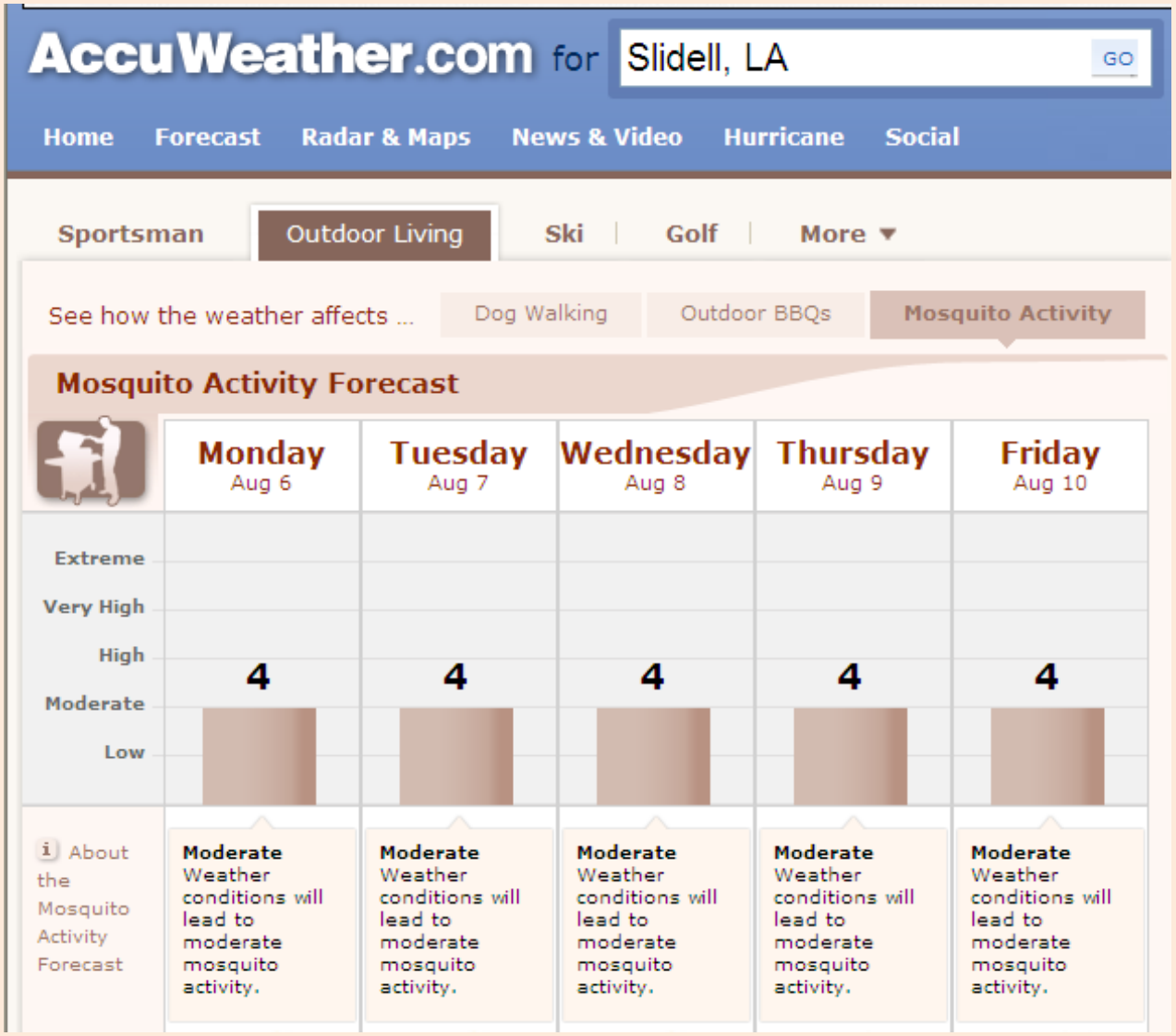
1) Northbound buried communication line
2) A portable satellite internet and communications system
3) Four satellite phones
4) Ham radio/SHARES network

R Magee (May 11, 2011) "Case Study and Lessons Learned Associated with Hurricane Katrina August 29, 2005"

Sam's
Challenge Topics
For:

NASA-Stennis Space Center

Slidell, LA
Mosquito Activity Forecast



http://www.accuweather.com/en/us/slidell-la/70458/mosquito-activity/333398

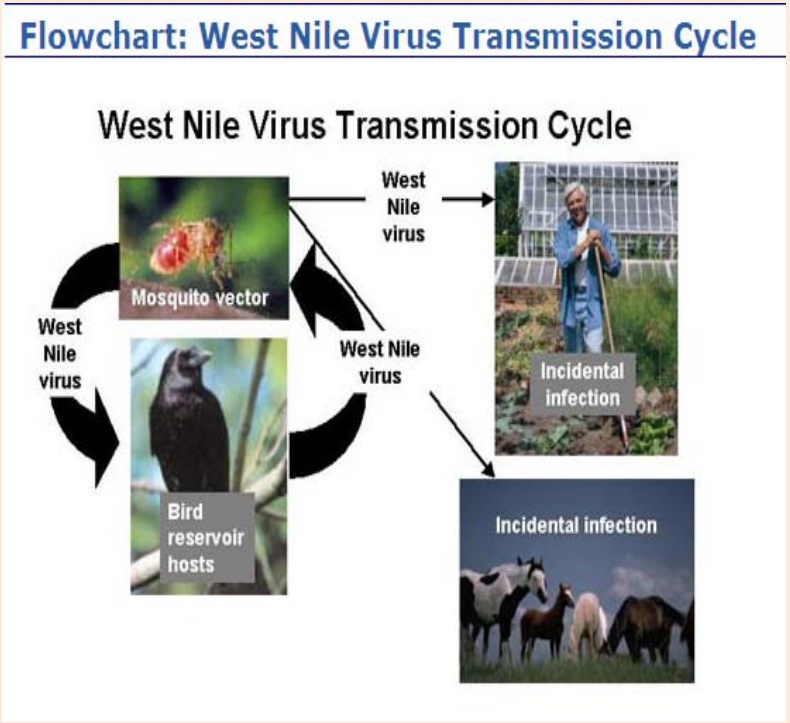
Global Change Impacts in the United States – 2009 Report: **Human Health**

The first outbreak of **West Nile virus** in the United States occurred in the summer of 1999…. [During] the epidemic summers of 2002 to 2004, epicenters … were linked to **locations with either drought or above average temperatures**.

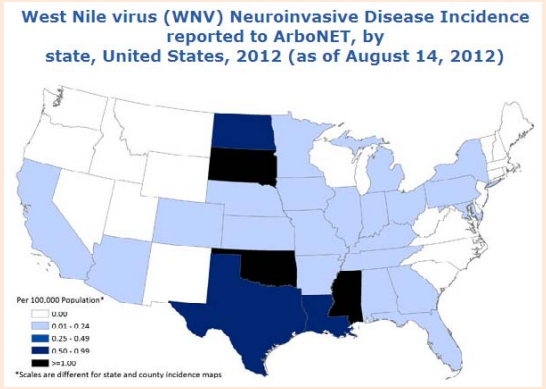
During 2002, a more virulent strain ,,, emerged …. [Analyses} indicate that this mutated strain responds strongly to higher temperatures, suggesting that greater risks from the disease may result from **increases in the frequency of heat waves**….

[One] in 150 infected people develop serious illness, including the brain inflammation diseases encephalitis and meningitis.

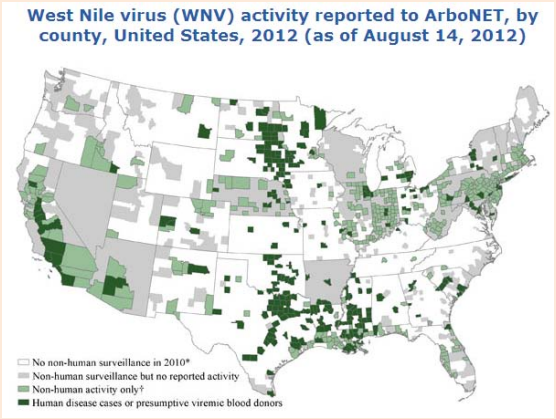
http://nca2009.globalchange.gov/human-health#footnote45_ymbhace



http://www.cdc.gov/ncidod/dvbid/westnile/cycle.htm



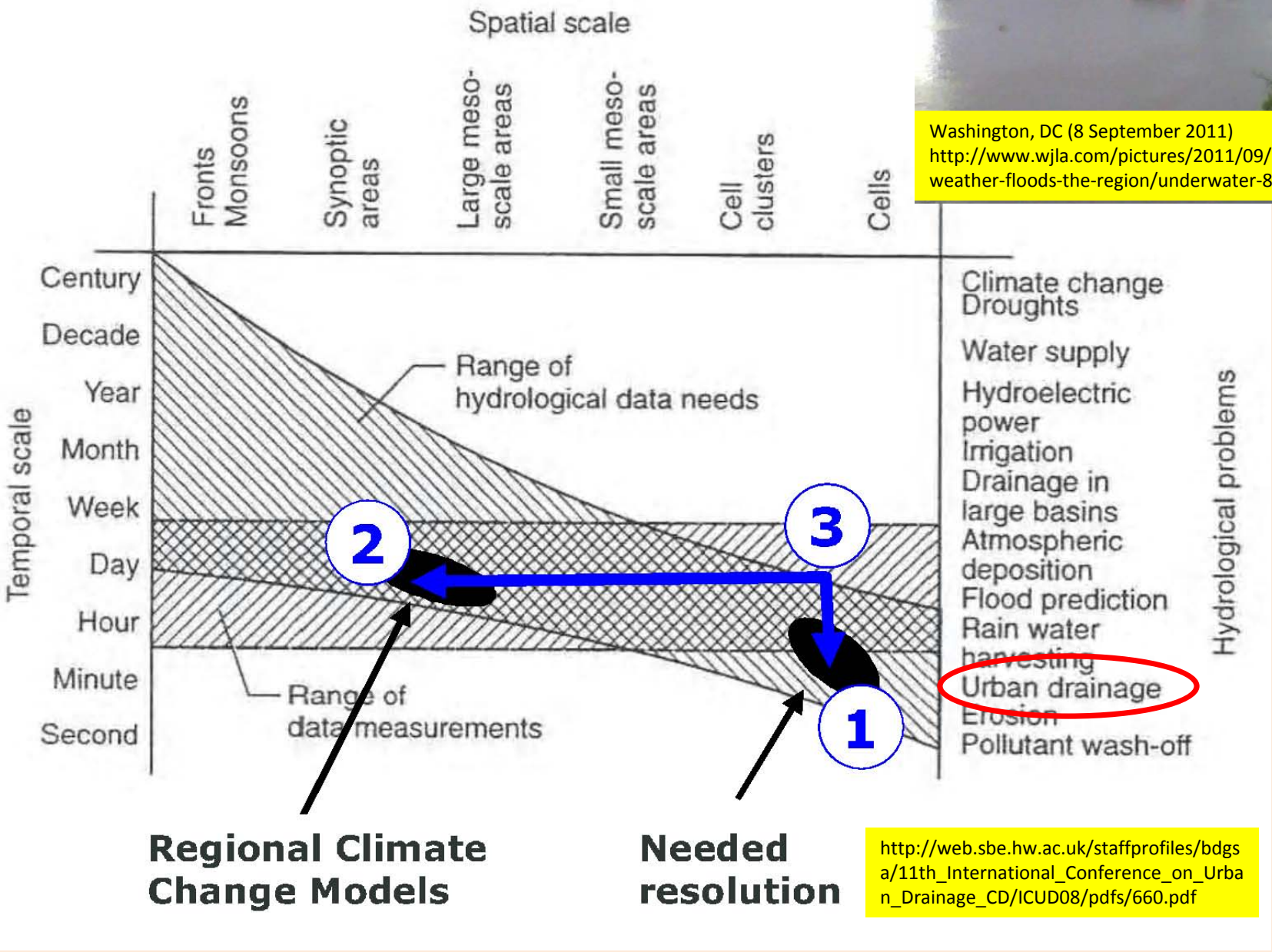
http://www.cdc.gov/ncidod/dvbid/westnile/Mapsincidence/surv&control12IncidbyState.htm



http://www.cdc.gov/ncidod/dvbid/westnile/Mapsactivity/surv&control12MapsAnybyCounty.htm

Extreme Events = "Right Tail" (*or upper tail)*

Washington, DC (8 September 2011)
http://www.wjla.com/pictures/2011/09/photos-severe-weather-floods-the-region/underwater-8185-560.html



http://web.sbe.hw.ac.uk/staffprofiles/bdgsa/11th_International_Conference_on_Urban_Drainage_CD/ICUD08/pdfs/660.pdf

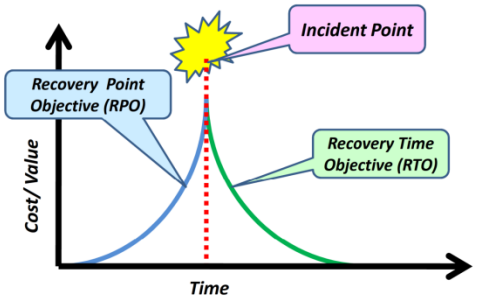
Sam's struggle and challenge … moving to the next level

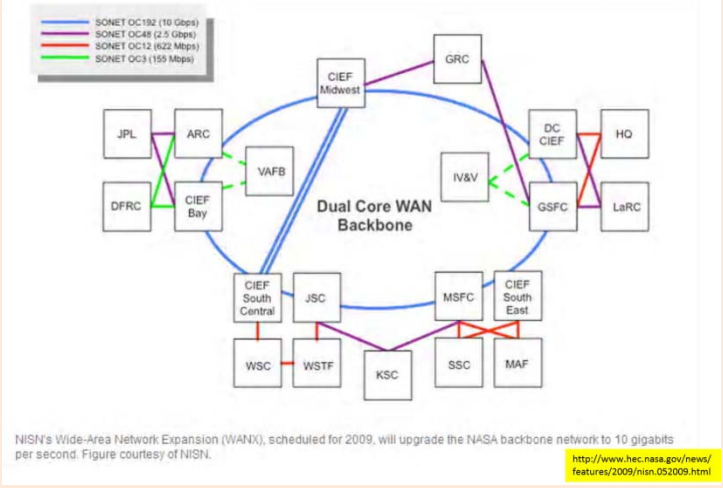
The Built Environment

Slide #2: dependent and interdependent Networks & Grids

HOW TO DETERMINE ACCEPTABLE DATA LOSS	
RPO = Recovery point Objective	**RTO = Recovery Time Objective**
How much data can you tolerate losing and not having access to?	*How quickly do you need to have access to your data?*

Impact on Cost of Incident in Relation to RPO and RTO





NISN's Wide-Area Network Expansion (WANX), scheduled for 2009, will upgrade the NASA backbone network to 10 gigabits per second. Figure courtesy of NISN.

http://www.hec.nasa.gov/news/features/2009/nisn.052009.html

Vol 464 15 April 2010 | doi:10.1038/nature08932 nature

LETTERS

Catastrophic cascade of failures in interdependent networks

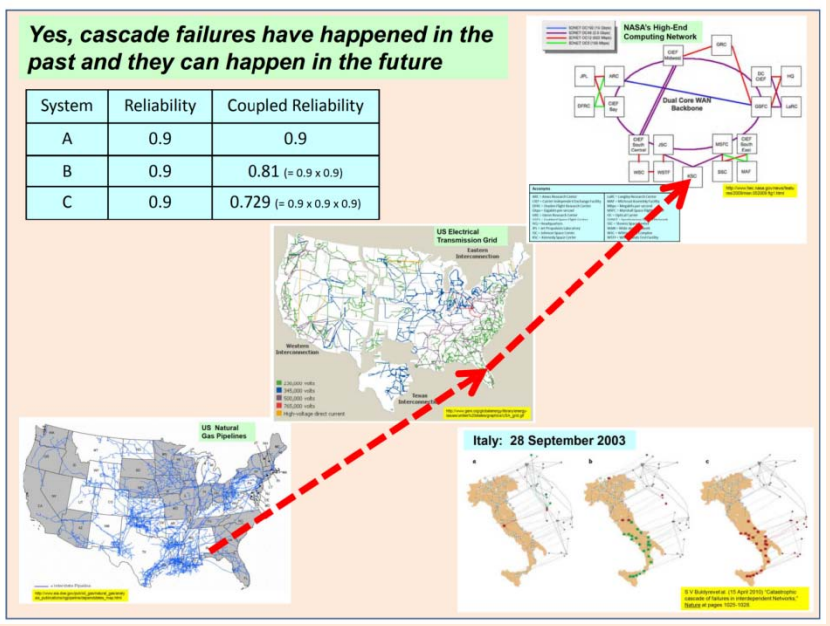
Sergey V. Buldyrev[1,2], Roni Parshani[3], Gerald Paul[2], H. Eugene Stanley[2] & Shlomo Havlin[3]

Complex networks have been studied intensively for a decade, but research still focuses on the limited case of a single, non-interacting network[1–14]. Modern systems are coupled together[15–19] and therefore should be modelled as interdependent networks. A fundamental property of interdependent networks is that failure of nodes in one network may lead to failure of dependent nodes in other networks. This may happen recursively and can lead to a cascade of failures. In fact, a failure of a very small fraction of nodes in one network may lead to the complete fragmentation of a system of dependencies between the networks, removal of only a small fraction of nodes can result in the complete fragmentation of the entire system.

To model interdependent networks, we consider for simplicity, and without loss of generality, two networks, A and B, with the same number of nodes, N. The functioning of node A_i ($i = 1, 2, \ldots, N$), in network A, depends on the ability of node B_i, in network B, to supply a critical resource, and vice versa. If node A_i stops functioning owing to attack or failure, node B_i stops functioning. Similarly, if node B_i

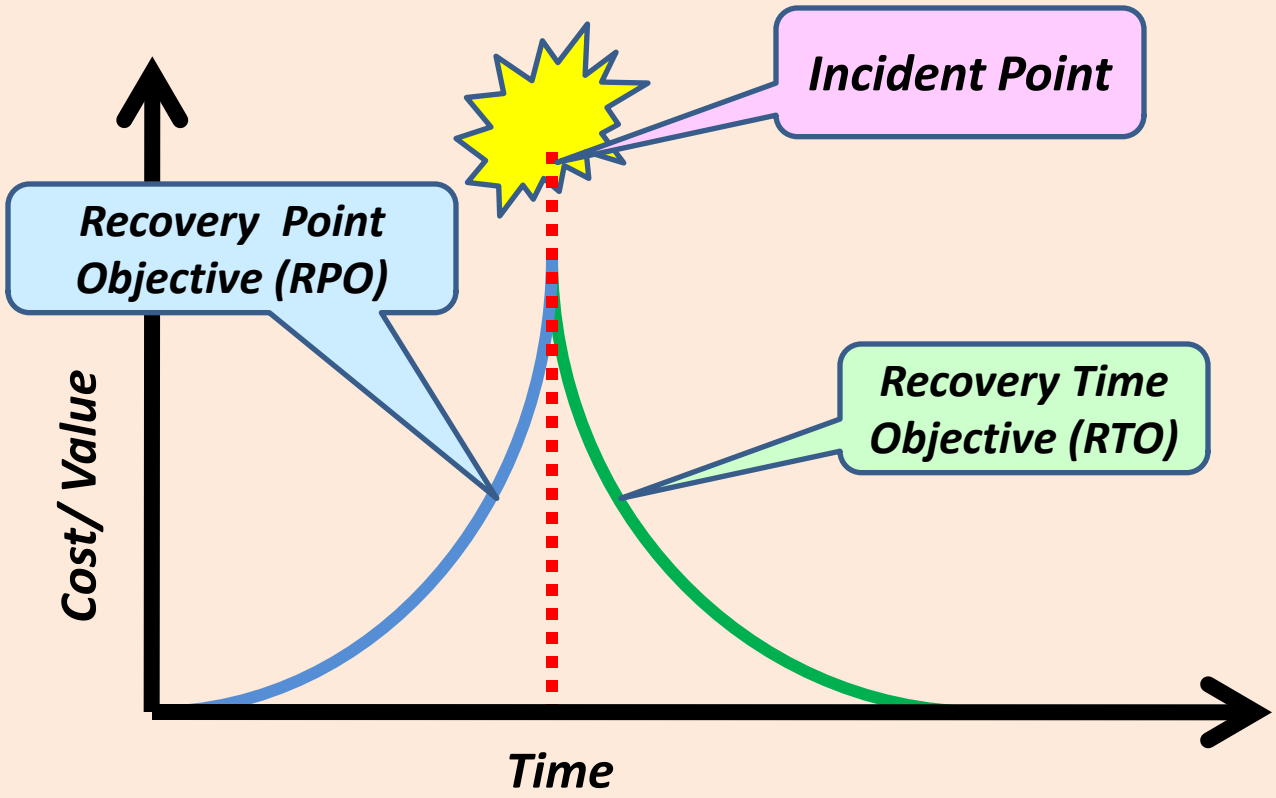
Yes, cascade failures have happened in the past and they can happen in the future

System	Reliability	Coupled Reliability
A	0.9	0.9
B	0.9	0.81 (= 0.9 x 0.9)
C	0.9	0.729 (= 0.9 x 0.9 x 0.9)



HOW TO DETERMINE ACCEPTABLE DATA LOSS	
RPO = Recovery Point Objective	**RTO = Recovery Time Objective**
How much data can you tolerate losing and not having access to?	*How quickly do you need to have access to your data?*

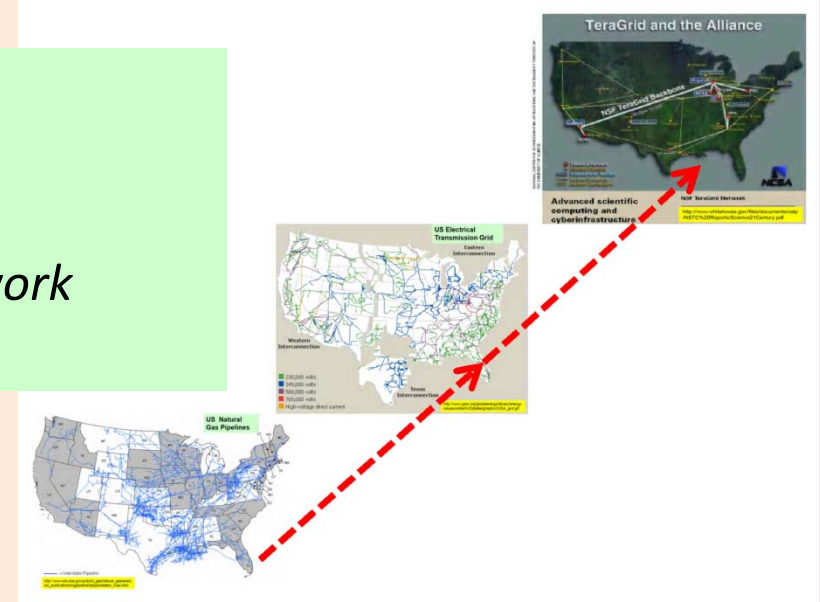
Impact on Cost of Incident in Relation to RPO and RTO



Cascade failures

EXAMPLES:

- *Natural Gas Pipelines*
- *Electrical Grid*
- *Communication Network*
- *Information Network*



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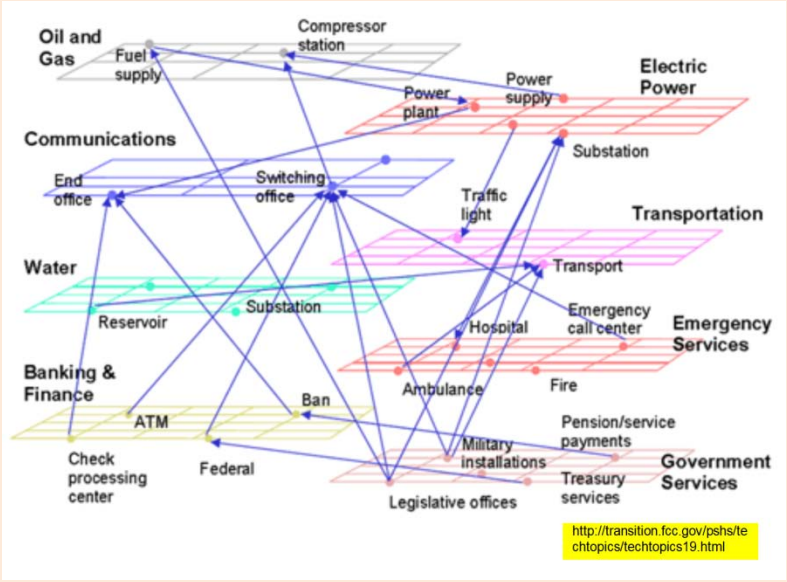
dependencies between the networks, removal of only a small fraction of nodes can result in the complete fragmentation of the entire system.

To model interdependent networks, we consider for simplicity, and without loss of generality, two networks, A and B, with the same number of nodes, N. The functioning of node A_i ($i = 1, 2, \ldots, N$), in network A, depends on the ability of node B_i, in network B, to supply a critical resource, and vice versa. If node A_i stops functioning owing to attack or failure, node B_i stops functioning. Similarly, if node B_i stops functioning then node A_i stops functioning. We denote such a dependence by a bidirectional link, $A_i <\!> B_i$, that defines a one-to-one correspondence between nodes of network A and nodes of network B. Within network A, the nodes are randomly connected by A-links



Stakeholders, Impacts, and Impacts Related to Stakeholders

Who are the NASA Center Stakeholders?

POTENTIAL PARTICIPANTS IN A CLIMATE CHANGE PREPAREDNESS TEAM	
Planning Areas	
Agriculture	Planning and zoning
Economic development	Public health
Emergency management	Stormwater management
Fire	Transportation
Flood control	Wastewater treatment
Natural resources / environmental protection	Water supply
Parks and recreation	Coastal zone management and port and harbor management
Forestry and forest resources	
Other Potential Team Members	
Business community	Non-profit organizations
Consultants	Science advisor(s)
Native American Tribes	State and federal agencies
Neighboring governments	Metropolitan planning organizations

Table 6.1 – Potential participants in a climate change preparedness team. Potential participants in a climate change preparedness team. The actual make-up of your climate change preparedness team will depend on your organization's particular responsibilities, vulnerability to climate change, and relationships with the broader community.

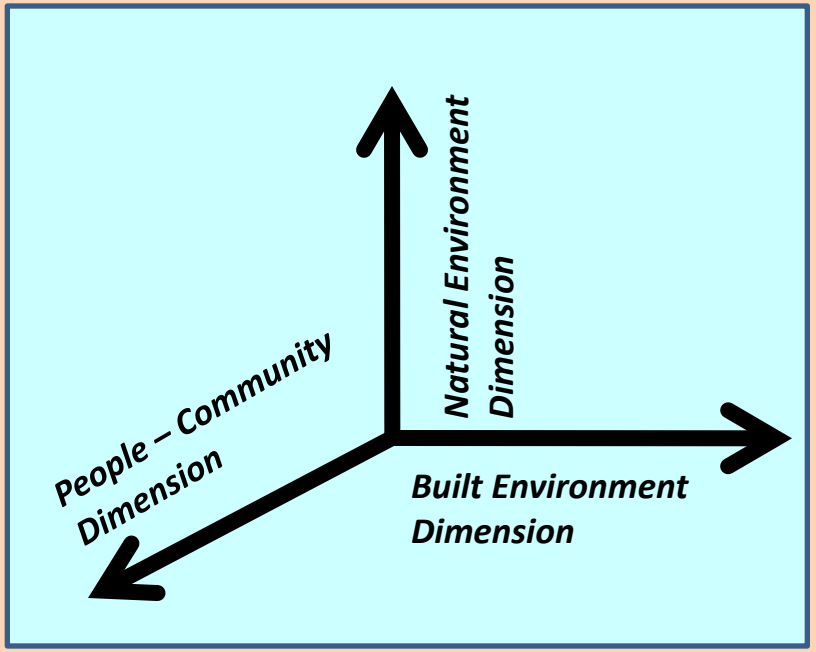
ICLEI (September 2007) Preparing for Climate Change: A Guidebook for Local, regional, and State Governments

Some NASA Center examples are:

Fire & Emergency Mgt Staff
Natural Resources Mgt Staff
Environmental Mgt Staff
Planning Staff
Safety and Health Staff
Engineering & Facilities Mgt Staff
Utilities Staff
Human Resources Staff
Center Climate Scientists

SECTORS or SUPER-SYSTEMS

1) People and Community
2) Built Environment
3) Natural Environment



What are some climate variables and generic impacts?

Table 3.1: A classification of the more common climate variables for use in preliminary climate change risk assessments. This table is to be used in conjunction with the variable properties list in Table 3.2. Note that compound and proxy variables may be influenced by non-climate factors, but these are not highlighted in this table.

Variable	Assessments should consider these aspects of the climate variable
PRIMARY	
Carbon dioxide	Particulary atmospheric concentration. Concentrations in other media (water, land) generally equilibrate rapidly with respect to atmospheric concentration, but may be significantly influenced by local biogeochemical processes.
Sea level	Long-term mean sea level is determined (with a considerable lag) by long-term climate changes. Tidal range, and distribution of tidal maxima and minima will be influenced by a number of other climate variables (see sea level entry under 'compound variables', and wave climate entry under proxy variables).
Temperature	Assessments of temperature will often be media-specific. Includes occurrence of frosts and freezing conditions. Assessments may need to have regard to synoptic conditions (see below).
Precipitation	All forms of precipitation are included e.g. rain, snow, sleet, hail.
Wind	Includes both wind speed and compass direction (including change in direction: backing/ veering; see Table 3.2).
Cloud cover	Conversely, ground incident light intensity. May be represented by 'cloud' or 'sunshine-days'.
SYNOPTIC	*These are variables measured over a large spatial domain*
Weather types	Classification (such as that due to Lamb) of synoptic weather types, such as cyclonic, anticyclonic, or air flow directions like westerly or southerly may be useful.
Pressure	E.g. mean sea level pressure.
Pressure gradient	Includes established indices based on pressure, such as the North Atlantic Oscillation.
Storm tracks	Determined in part by the pressure patterns and the position of the high-level jet stream.
Ocean climatology	Sea surface temperatures, ocean circulation, currents and other large scale water movements, including the El Nino/La Nina.
Lightning	As determined by the synoptic situation likely to bring about lightning incidence.
COMPOUND	*Compound variables are dependent on combinations of several of the above primary (and other) variables*
Humidity	Dependent on temperature, pressure, moisture content of the air.
Evapotranspiration	Dependent on temperature, radiation (cloud cover), wind speed, humidity.
Mist, Fog	Dependent on synoptic conditions, temperature, moisture content of the air, wind.
Sea level	Dependent on wind speed and direction and synoptic variables including pressure and antecedent weather types. (See also sea level entry under primary variables and wave climate entry under proxy variables.)
Growing season	Dependent on temperature (perhaps expressed as degree-days), precipitation, cloud cover/ sunshine.
PROXY CLIMATE VARIABLES	*There are many potential proxy climate variables. Proxy variables will be recognised as having a close and possibly complex dependence on one or (more frequently) a number of other climate variables.*
Soil moisture	Dependent on temperature, precipitation, evapotranspiration.
Water run-off	Seasonal distribution of flows dependent on antecedent rainfall, evapotranspiration, as well as catchment characteristics (geology, soils, land-use).
Wave climate	Dependent on storm surge, water level, local and synoptic scale wind speed, direction and duration. (See also sea level entries under 'primary variables' and 'compound variables'.)

DEFRA (UK) (May 2003) Climate Adaptation: Risk, Uncertainty and Decision-making

Table E: Generic Impact Types for NI 188 Risk Assessment

Generic Impact Types	
Increasing summer temperatures	Higher summer temperatures
	Heat waves
Increasing winter temperatures	Milder winters
	** Low temperatures / Cold spells
	** Frost / Snow / Ice
Decreasing summer precipitation	Drought
Increasing winter precipitation	Pluvial flooding (flash floods from rainfall)
	Fluvial flooding (river flooding)
	Damp / waterlogged soils
Combined climatic effects	Storms / High winds
	Lightning
	Fog / Mist / Low cloud
Indirect impacts resulting from climate change	Power disruption
	Sea level rise
	Climate enforced immigration
	Social disorder

Please Note: This list is only to be used as an indication in aid discussions with staff. Staff working within the service areas will be able to determine the appropriate timescales through consideration of the speed which with the service area can respond to changes in weather events and climate and the projected changes in climate variables in the time periods.

East Midlands(2009) East Midlands - NI 188 Planning to Adapt Project 2009-2010

What climate impacts are related to Stakeholders?

INITIAL SCOPING: A SAMPLE OF SECTORS AND POTENTIAL CLIMATE CHANGE IMPACTS

Sector	Impacts in some regions could include…
Hydrology and water resources	• Shift in the timing of spring snowmelt to earlier in the spring • Lower summer streamflows, particularly in snowmelt-dependent water systems in the western U.S. • Increased risk of drought • Increased risk of flooding • Increased competition for water • Warmer water temperature in lakes and rivers • Changes in water quality (varies by water quality parameter)
Agriculture	• Changes in crop yields (varies by crop) • Potential ability to "double crop" • Increased risk of heat stress, particularly in the South • Increased demand for irrigation water due to longer and warmer growing season • Increased risk of pest outbreaks and weeds
Biodiversity	• Shift in the distribution and range of species • Loss of species not able to adapt to changes • Increased competition from invasive species • Loss of habitat
Forests (including parks and urban forests)	• Increase in growth and productivity in the near-term where soil moisture is adequate and fire risk is low • Shift in the distribution and range of species • Increased risk of insect outbreaks • Increased risk of forest fire • Increased competition from invasive species
Recreation	• Increased opportunities for warm season activities in milder regions of the U.S. • Decreased opportunities for warm season activities during the hottest part of the year, particularly in the southern U.S. (e.g., from heat, forest fires, low water levels, reduced urban air quality) • Reduced opportunities for cold season recreation due to decreased snowpack and/or reduced snow or ice quality • Increased reliance on snow-making at ski areas • Shifts in tourism dollars within a community from one recreation sector to another, or from communities losing recreational opportunities to communities gaining opportunities
Energy	• Reduced heating demand during winter months • Increased cooling demand during summer months • Increased or decreased hydroelectric generating capacity due to potential for higher or lower streamflows

Table 4.2 – A sample of sectors and potential climate change impacts. Planning for climate change requires identifying which sectors of a community are likely to be affected by a changing climate. Most communities will be sensitive to climate change in one or more of the sectors listed above. The likelihood of any one impact occurring will vary by community. This list is not all-inclusive; other impacts not listed here may also occur.

INITIAL SCOPING: A SAMPLE OF SECTORS AND POTENTIAL CLIMATE CHANGE IMPACTS

Sector	Impacts in some regions could include…
Transportation	• Fewer travel disruptions and lower maintenance and infrastructure costs associated with snow and ice • More travel disruptions associated with landslides, road washouts, and flooding • Increased road surface damage from higher temperatures • Potential reductions in water-based navigation due to lower summer streamflows • Increased maintenance requirements for roadside and median strip vegetation • Increased brush fires in roadside and median strip vegetation
Infrastructure	• Need for new or upgraded flood control and, erosion control structures • More frequent landslides, road washouts, and flooding • Increased demands on stormwater management systems with the potential for more combined stormwater and sewer overflows • Reduced effectiveness of sea walls with sea level rise
Coastal resources and ecosystems	• Increased erosion or damage to coastal infrastructure, dunes, beaches, and other natural features due to sea level rise and storm surge • Loss of coastal wetlands and other coastal habitats due to sea level rise, erosion • Increased costs for maintenance and expansion of coastal erosion control (natural or man-made) • Saltwater intrusion into coastal aquifers due to sea level rise • Increased risk of pollution from coastal hazardous waste sites due to sea level rise Loss of cultural and historical sites on coastline to sea level rise and related impacts
Aquatic ecosystems	• Shifts in species range and distribution • Increased competition from invasive species • Loss of near-shore habitat and coastal wetlands to sea level rise, where sufficient space for habitat migration is not available • Increased stress on coldwater species in lakes and rivers
Business	• Price volatility in energy and raw product markets due to more extreme weather events • Increased insurance premiums due to more extreme weather events • Fewer shipping disruptions associated with snow and ice • Impacts on business infrastructure located in floodplains or coastal areas • Shifts in business opportunities
Health	• More heat-related stress, particularly among the elderly, the poor, and other vulnerable populations • Fewer extreme cold-related health risks • Increase in vector-born illnesses (e.g., West Nile) • Reduced summer air quality in urban areas due to increased production of ground-level ozone
Emergency response	• Increased demands on emergency response services related to extreme weather events (e.g., heat, flooding, storms)

Sources: NAST 2000, IPCC 2001b, NAST 2001, Mote et al. 2003, UKCIP 2003

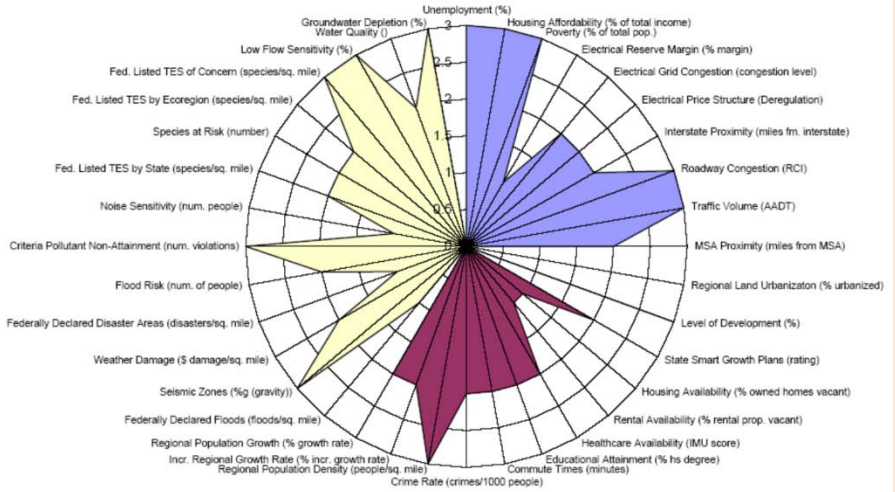
ICLEI (September 2007) Preparing for Climate Change: A Guidebook for Local, regional, and State Governments

Sustainability

"The future isn't what it used to be." – Yogi Berra

1) Static Perspective

People tend to think of "sustainability" in terms of a snapshot in time



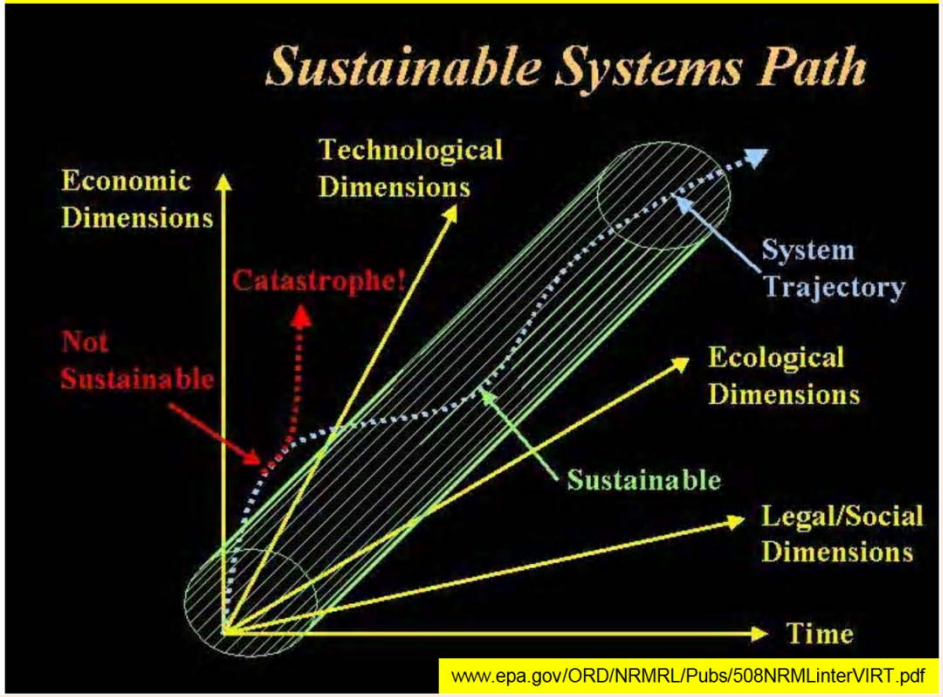
INDICATORS OF INSTABILITY: V-SAM ("fingerprint")

2) Actually - Dynamic

System Perspective

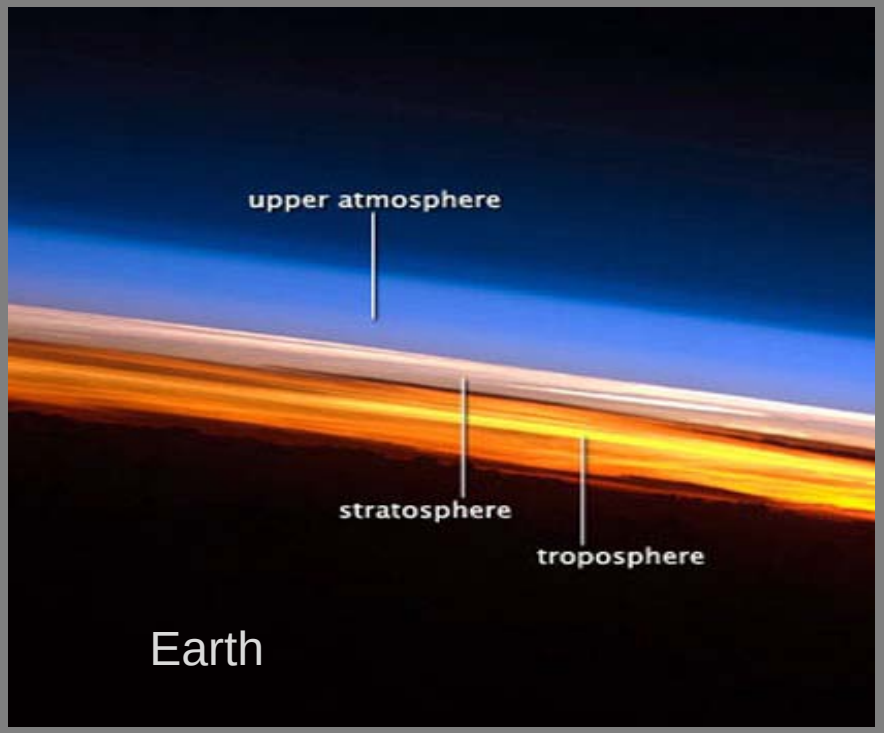
What appears to be sustainable today may not be sustainable in the future

1) The system is "dynamic." ***The system is not static.***
2) The system's trajectory is subject to external influences. ***One such aspect is Climate Change.***



www.epa.gov/ORD/NRMRL/Pubs/508NRMLinterVIRT.pdf

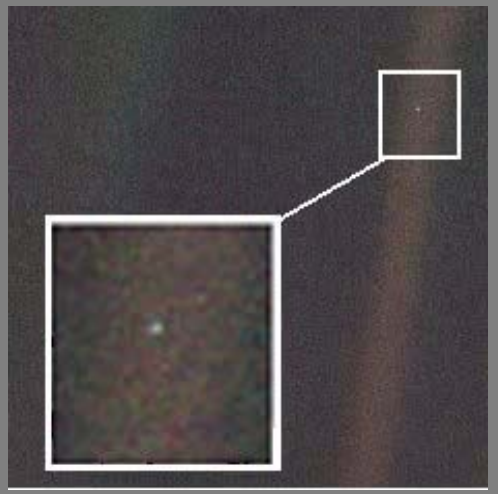
http://www.flickr.com/photos/martin_tod/5164234117/sizes/l/in/photostream/



http://apod.nasa.gov/apod/ap100623.html

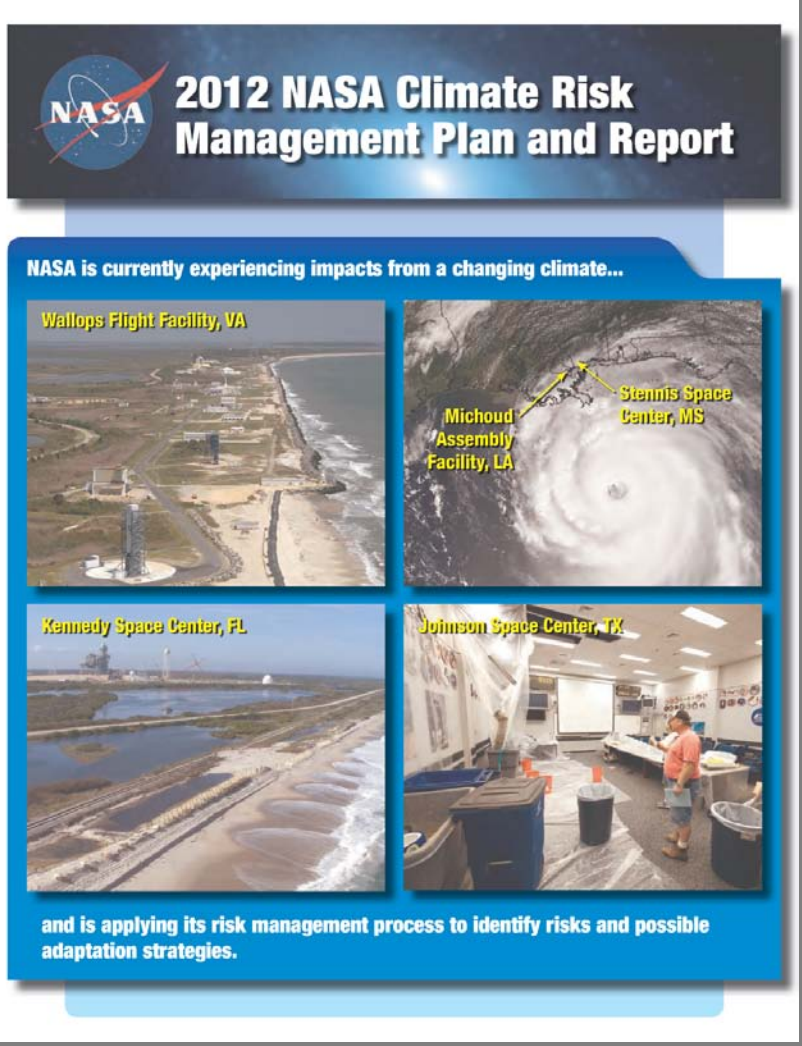
http://spaceflight.nasa.gov/gallery/images/station/crew-28/hires/iss028e006161.jpg

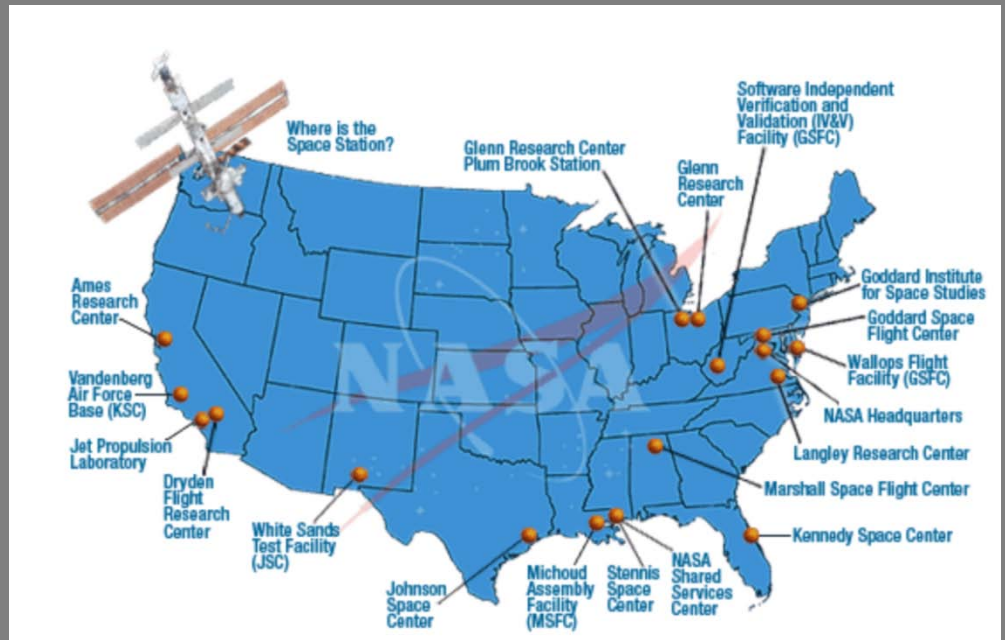
http://earthobservatory.nasa.gov/Features/RemoteSensingAtmosphere/Images/bluemarble.jpg



http://i379.photobucket.com/albums/oo232/vladislaw_photo/PaleBlueDot3_jpg.jpg

68% of NASA's Assets are within 16 feet of sea level





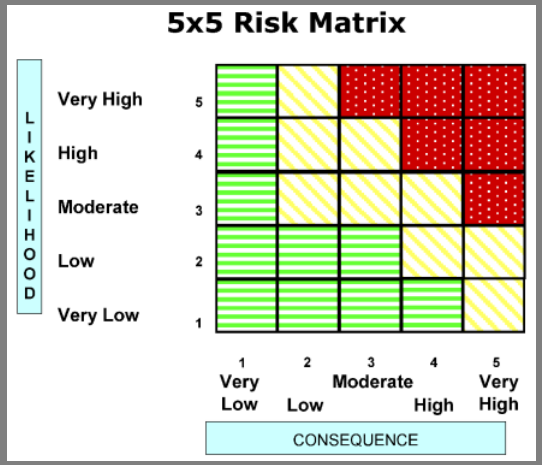
Protecting people, natural, and built systems at NASA sites:

NASA's Climate Risk Workshop Progress

Installation	*Workshop*	*Share of NASA's assets*		
		Onsite Staff	*Land Managed*	*Const. Assets*
Agency-wide	7/2009	**58,000**	**330 mi²**	**$32 B**
Kennedy Space Center, FL	5/2010	12.1%	66.4%	18.5%
Ames Research Center, CA	2/2011	7.8%	1.0%	15.1%
Dryden Flight Research Center, CA	8/2011	2.4%	0.4%	1.2%
Langley Research Center, VA	9/2011	6.4%	0.4%	11.3%
Johnson Space Center, TX	3/2012	12.7%	0.8%	7.0%
Progress as of June 2012		***41.4%***	***69.0%***	***54.1%***
Stennis Space Center, MS	10/2012	7.1%	9.9%	9.4%
Wallops Flight Facility, VA	11/2012	1.7%	2.9%	2.8%
Planned by June 2013		***50.2%***	***81.8%***	***66.3%***

NASA-HQ Risk Management Framework

Federal Managers' Financial Integrity Act of 1982 (31 USC Sec 3512)



NASA RISK MANAGEMENT

Risk Dispositions:

- *Research*
- *Watch*
- *Mitigate**
- *Accept*
- *Elevate*

* *Mitigate is "the modification of a process, system or activity in order to reduce a risk by reducing its probability, consequence, severity, or uncertainty, or by shifting its timeframe."*

RISK MANAGEMENT HISTORY

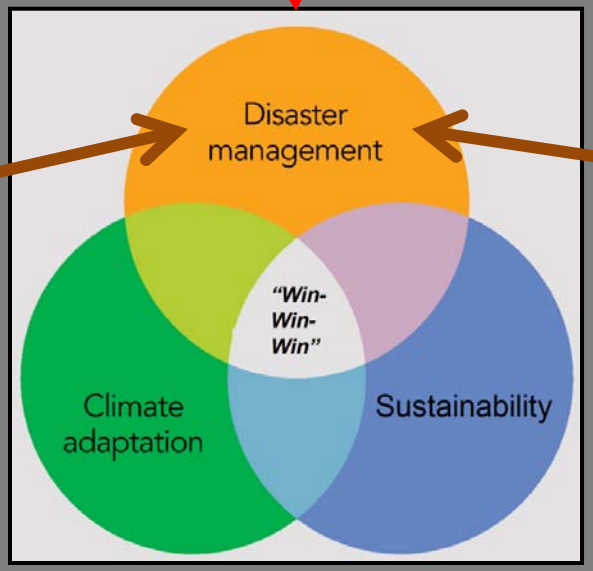
(August 16, 2005)	(June 2, 2006)	(December 31, 2009)
I&A Risk ID: #21 *Global Climate Change & Regional Climate Variability - Impacts Vision for Space Exploration*	**I&A ARM: #1624** *Regional Climate Variability – Impacts Vision for Space Exploration*	**IO ARM: #3345** *Natural Catastrophic Events [such as global warming]*
Identifier & Author: I Higuchi		
Owner: I Higuchi	Owner: J Wright	Owner: F Bellinger
Entity: EMD	Entity: FERPD	Entity: FERPD
Contact Person: I Higuchi	Contact Person: W Brodt	Contact Person: K Toufectis, W Brodt
	Co-Contact Person (technical aspects): I Higuchi (EMD)	Co-Contact Person (technical aspects): I Higuchi (EMD)

CLIMATE RISKS

Enterprise Risk Management

Federal Managers' Financial Integrity Act of 1982 (31 USC Sec 3512)

1. GAO (1999) Standards of Internal Control in the Federal Government
2. OMB circular A-123 (2004) Management's Responsibility for Internal Control
3. GAO (2001) Internal Control Management and Evaluation Tool *(see Risk Assessment section; includes natural catastrophes)0*



Presidential Policy Directive/ PPD-8: National Preparedness

30 March 2011

(including catastrophic natural disasters)

- *[under revision Integrated Planning System (2009) (see Annex E: Risk Management Overview and Integrated Planning System]*

National Security and Homeland Security Presidential Directive/ NSPD-51 & HSPD-20: National Continuity Policy

9 May 2007

Agencies to ensure that Primary Mission-Essential Functions continue to be preformed during a wide range of emergencies, including localized acts of nature ….

Executive Order 13514: "Federal Leadership in Environmental, Energy, and Economic Performance"

8 October 2009

4 June 2012 – Requirement: Agency Adaptation Plan

52117

Federal Register
Vol. 74, No. 194
Thursday, October 8, 2009

Presidential Documents

Title3—
The President

Executive Order 13514 of October 5, 2009

Federal Leadership in Environmental, Energy, and Economic Performance

By the authority vested in me as President by the Constitution and the

1) ISSUE of: Risk

2) ISSUE of: Scale & Level

Section 8 (i) *[E]ach agency Plan shall: … evaluate agency climate-change risks and vulnerabilities to manage the effects of climate change on the agency's operations and mission in both the short and long term ….*

***

Section 16 *[P]rovide … a progress report on agency actions in support of the national adaptation strategy and recommendations ….*

	Climate-Change Risks and Vulnerabilities	
	A. Short-Term	B. Long-Term
1. Agency Operations *(capabilities, facilities)*		
2. Agency Mission		

http://www.whitehouse.gov/assets/documents/2009fedleader_eo_rel.pdf

http://www.buyercampus.com/images/blue_chips.jpg

http://www.visittheca pitol.gov/

http://gaininginsight.com/blog/wp-content/uploads/2010/02/US-WhiteHouse-Logo.jpg

http://images.cdn.fotopedia.com/flickr-2375613159-hd.jpg

http://gaininginsight.com/blog/wp-content/uploads/2010/02/US-WhiteHouse-Logo.jpg

Companies Offering Securities	**All Executive Branch Agencies** *(NASA's way of managing climate risks)*	**All Executive Branch Agencies**
Securities Act of 1933; Securities Exchange Act of 1934	Federal Managers Financial Integrity Act of 1982 *(and other management statutes)*	Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance
Companies publicly offering securities must provide information about risks in investing	Agencies must safeguard funds, property and other assets against loss	Climate change risks and vulnerabilities to Agency's missions and operations
Sarbanes-Oxley Act of 2002, sec 404 Internal Control includes risk management	OMB Cir A-123; GAO/AIMD-00-21.3.1 Internal Control includes risk management	
Enterprise Risk Management	Risk Management Framework	
Disclose climate change risks such as impacts of: legislation & regulation, international climate change accords, indirect consequences of regulation & business trends, and physical impacts	Report to the President and Congress "Material Weaknesses" that are Agency significant risks and deficiencies. Less significant deficiencies are reported only internally in an agency.	Make publicly available the Agency's Climate Change Adaptation Plan to ensure transparency and inform the public
Climate Disclosure Standards Board develops voluntary standards	*OMB Circular A-119 mandatory compliance with voluntary standards*	

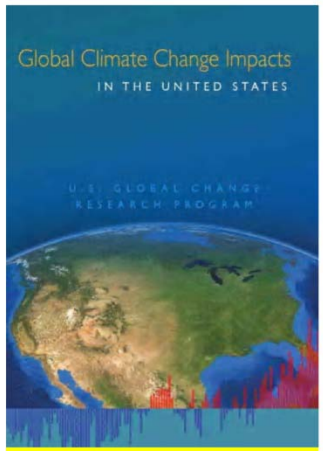
Let us paint in some details

http://pandimasbox.files.wordpress.com/2010/05/draw_me_the_world_by_sticker sticker.jpg

Climate Information

1) US GCRP 2009, *coarse information*

2) California (Climate) *Project , ~12 km*



http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts

http://www.globalchange.gov/images/cir/pdf/20page-highlights-brochure.pdf

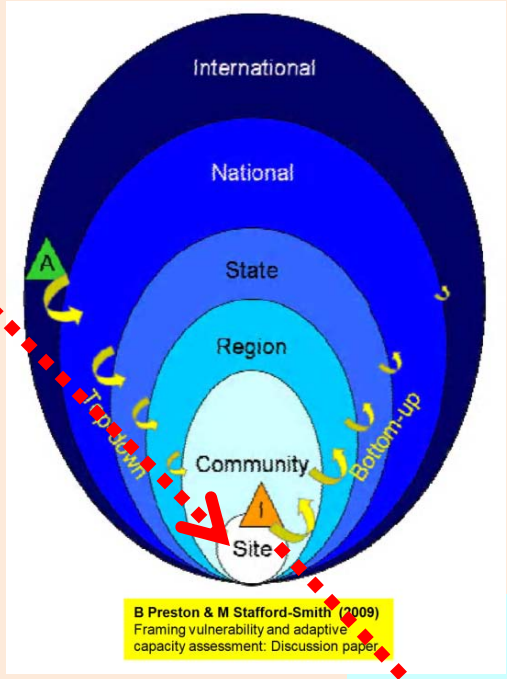
GAINING A PERSPECTIVE ON "GRID RESOLUTION"		
	Continental US	Continental US (km)
1/8^{o} Grid Resolution	~12 km	~12 km
USGS "Quad" Map or 7.5 min. (=1/8^{o}) Quadrangle Map	49 square miles (7 mi x 7 mi) to 70 square miles (8.4 mi x 8.4 mi)	~11.2 km to ~13.4 km
"Survey Township" (US Public Land Survey System)	36 square miles (6 mi x 6 mi)	~9.6 km

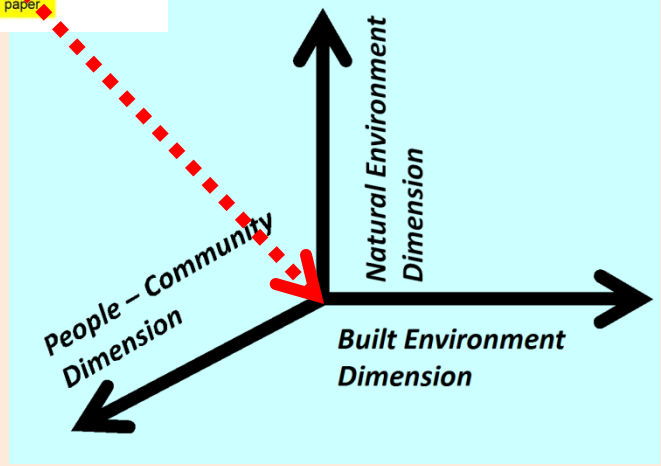
http://wikiadapt.org/images/8/8e/Cal1.jpg

http://safety.fhwa.dot.gov/local_rural/training/fhwasa07018/images/VegetationGuide_img_24.jpg

At the Ordinate:

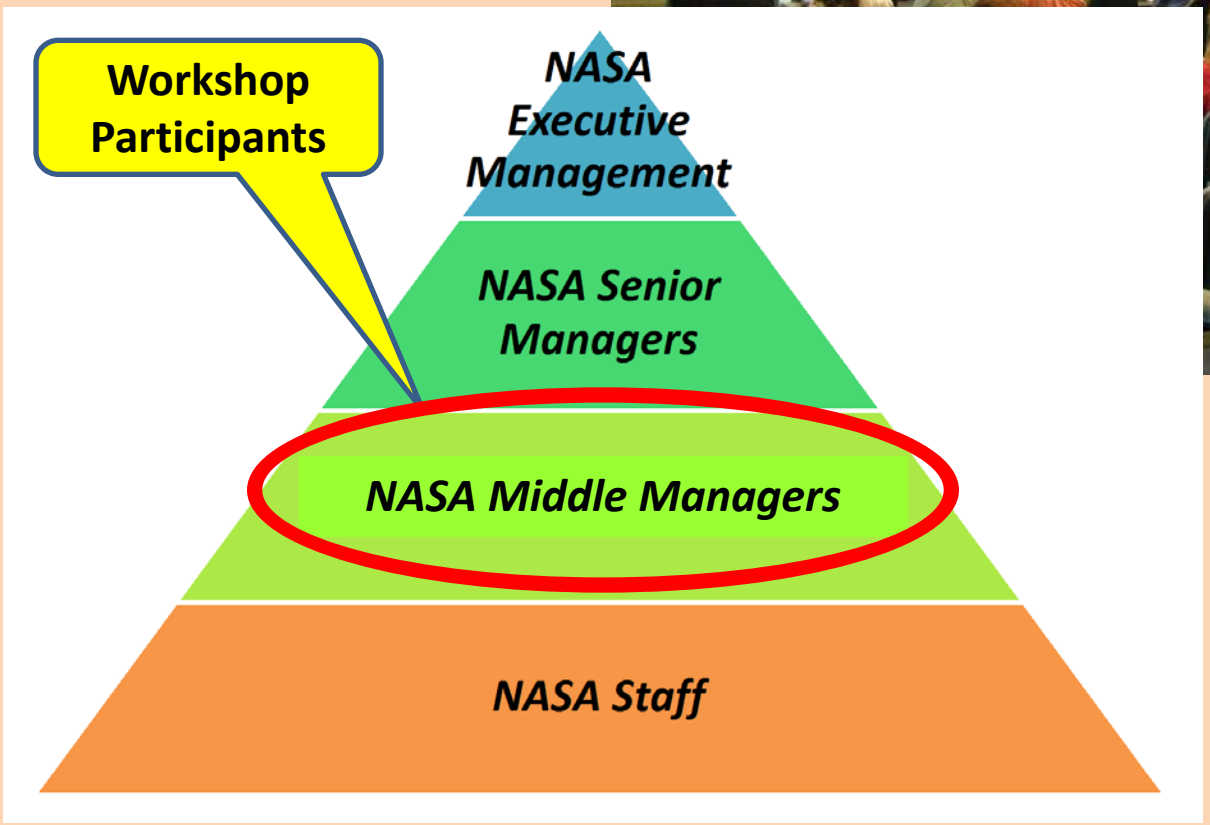
1) *a person, people - community*
2) *a tree, natural environment*
3) *a sidewalk, built environment*





2009 NASA-wide Workshop

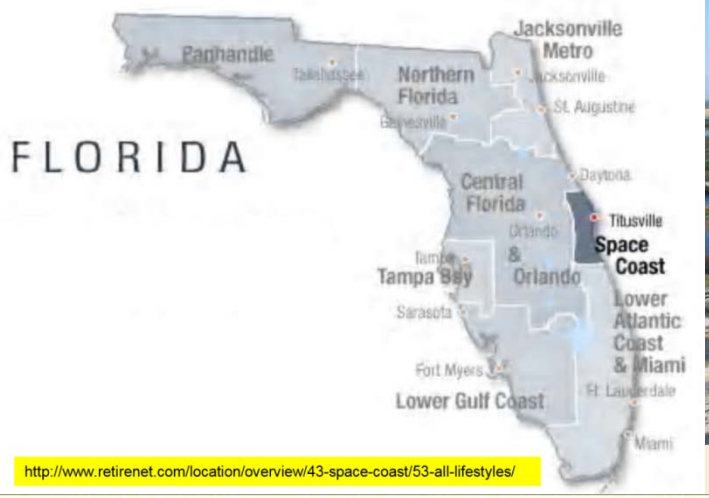
29-30 July 2009 at NASA-Kennedy Space Center, FL



2010 KSC & Space Coast Workshop (*Drilling Down*)

17-21 May 2010 at Cocoa Beach, FL

http://kaitlynnblyth.wordpress.com/2009/08/01/the-wisdom-teeth-monster/



http://www.retirenet.com/location/overview/43-space-coast/53-all-lifestyles/

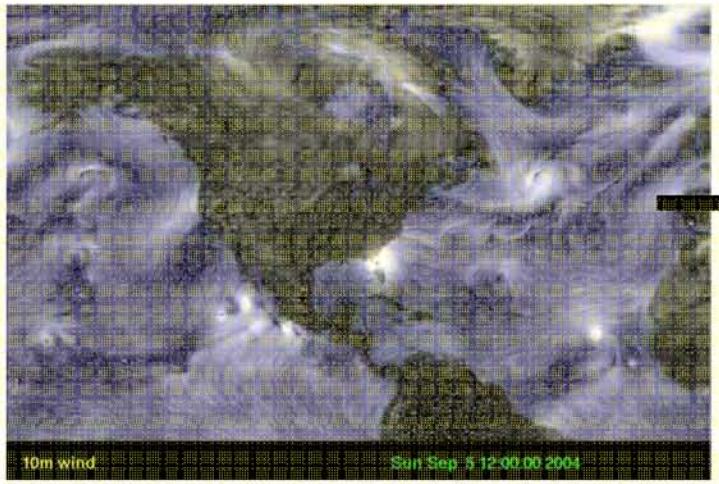
Courtesy of J Shaffer (2010)

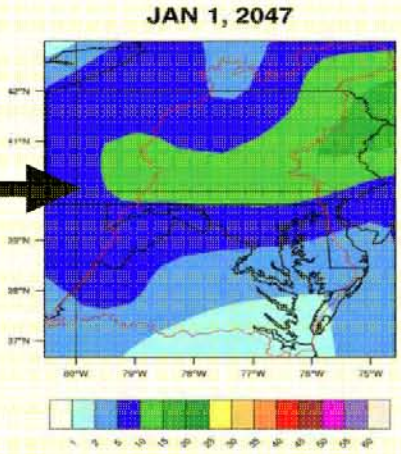
Dynamic Downscaling: Scales That Matter to Decisions

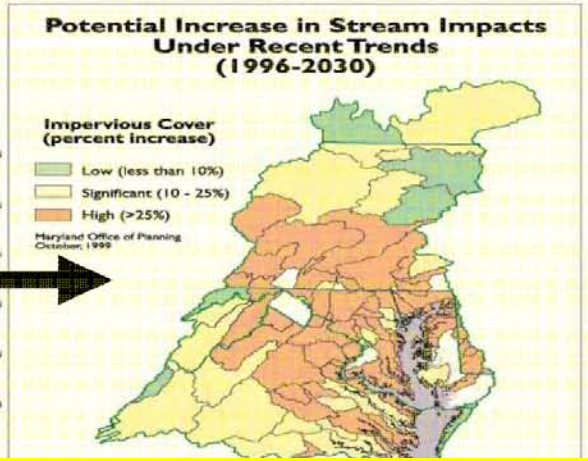
GLOBAL MODEL

REGIONAL MODEL

REGIONAL DECISIONS



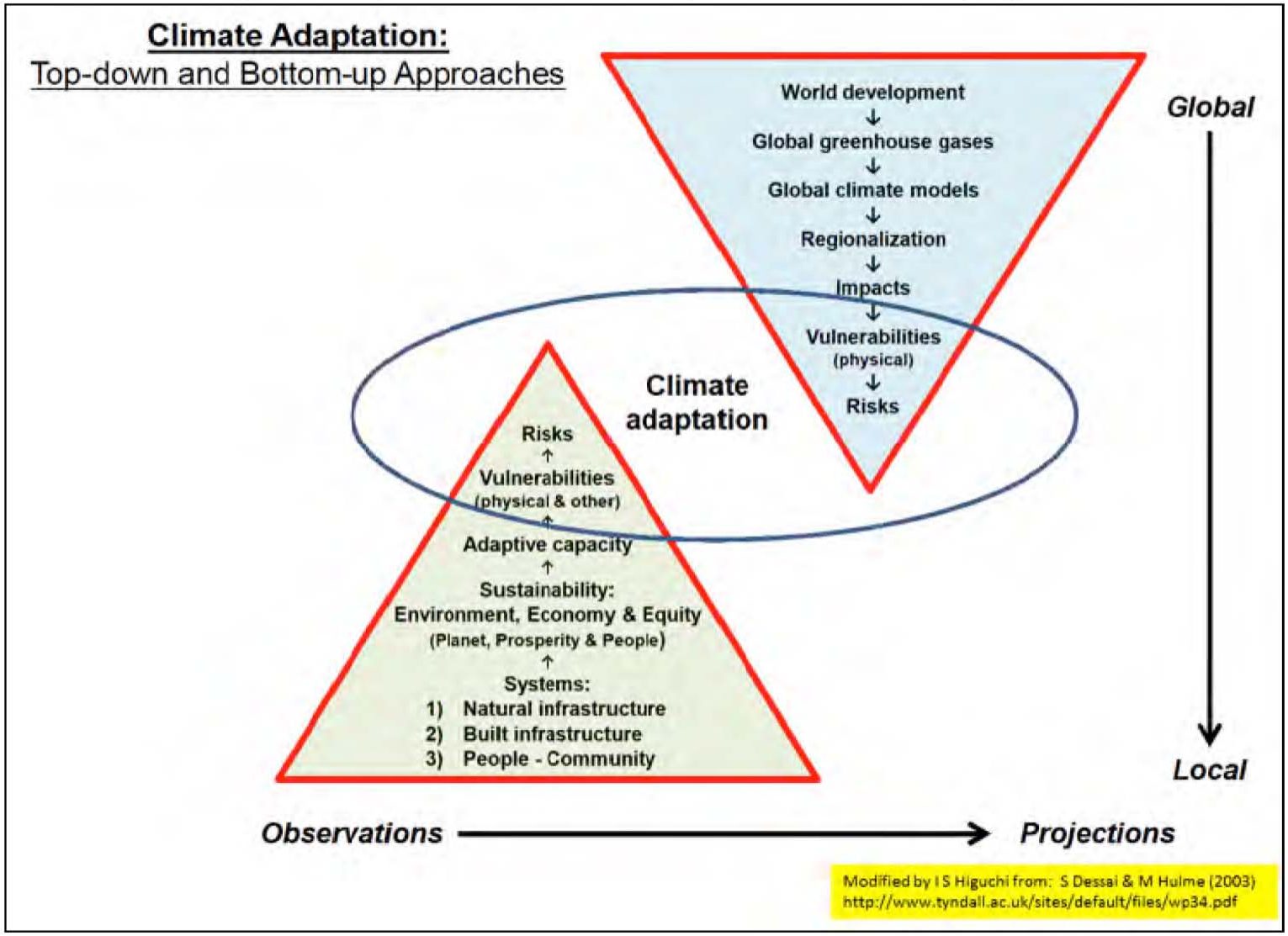




T Lee (2008) (Presentation) Climate-in-a-Box: A NASA Computational Climate Modeling Campaign

NASA-wide Workshop (2009) → NASA site specific Workshops (2010-201x)

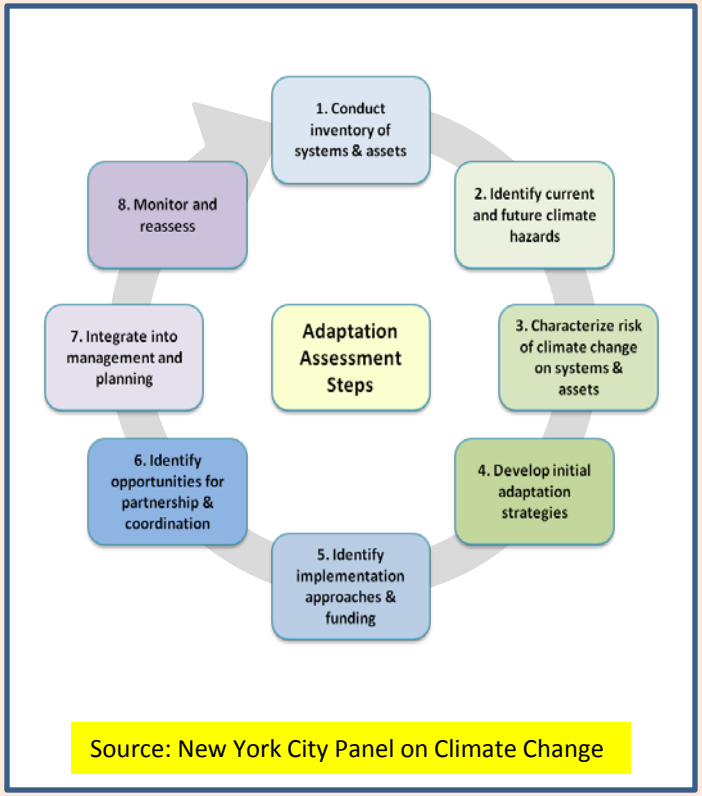
Figure 4. Top-down and Bottom-up Elements of Managing Climate Risks



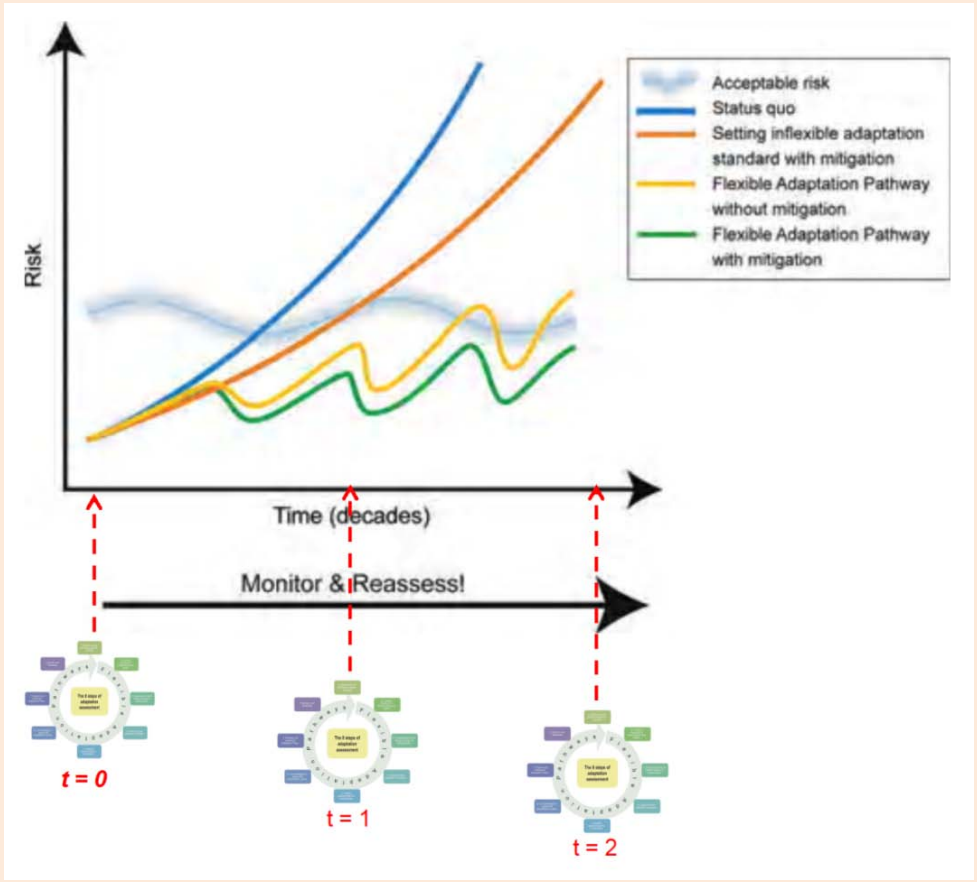
What tools have you given us?

NASA-GISS Approach

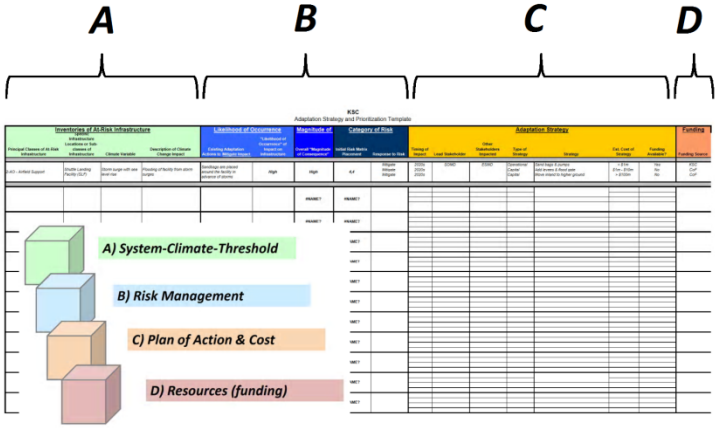
Applied in NASA Workshops



Source: New York City Panel on Climate Change



NASA: Workshop "Chunks":
Chunking Work Tasks

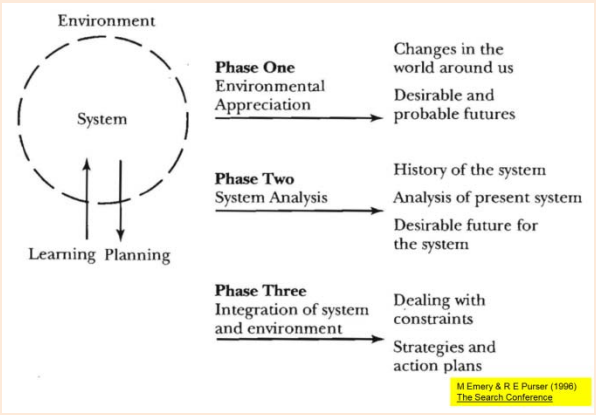


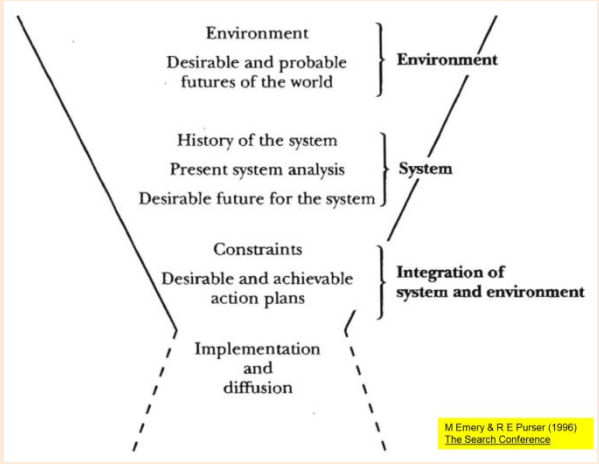
http://www.nyas.org/Publications/Annals/Detail.aspx?cid=ab9d0f9f-1cb1-4f21-b0c8-7607daa5dfcc

What approach are we applying?

Applied Social Sciences in Workshop Design –

- *Large Group Intervention: "Future Search", "Search Conference", and others* *(see B B Bunker & B T Alban (1997) Large Group Interventions; M Emery & R E Purser 1996) The Search Conference; M R weisbord & S Janoff (1995) Future Search)*
- *Best Practices of Others*





IS THIS A "WORKSHOP"?

A workshop is a group of persons with a common interest or problem, often professional or vocational, who meet for an extended period of time to improve their individual proficiency, ability, or understanding by means of study, research, and discussion. The workshop allows considerable flexibility, and the emphasis is on improving individual proficiency and understanding. Theory and practice are often treated concurrently. The learner is encouraged to work out a program of personal study and receives help with this program from the other participants and resource people. The learning situations tend to be based on interests and needs identified by the participants themselves, rather than by experts. [J L Reith (1967) "Chapter 22: Meetings, Conferences, Workshops, and Seminars"; In R L Craig, editor (1967) 3th Edition: Training and Development Handbook]

"Workshop" ELEMENTS	This Forum
1) Group with a common interest to improve individual understanding by means of study, research and discussion	X
2) Allows for considerable flexibility with emphasis on improving individual proficiency and understanding	X
3) Theory and practice are often treated concurrently	X
4-a) The learner is encouraged to work out a program of personal study	X
4-b) The learner receives help with this program from other participants and resource people	X
5) The learning situations tend to be based on interests and needs identified by the participants themselves, rather than by experts	X

Workshop Design

Best Practices of Others

1 2 3 4 5 6 7




[National Research Council Publications]










1 - US Global Change Research Program
2 – New York City
3 – United Kingdom
4 – ICLEI, Seattle WA
5 – National Research Council
6 – ICLEI, Canada
7 – Canada

How was the Climate information Handout designed?

Climate Information Handout

(N Pigeon & B Fischhoff (2011) “The role of social and decision sciences in communicating uncertain climate risks”)

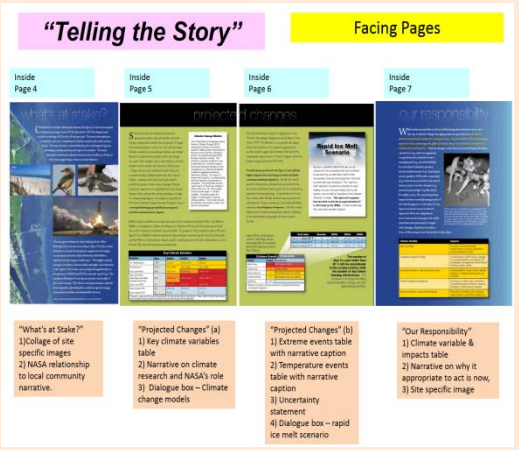
The TEAM

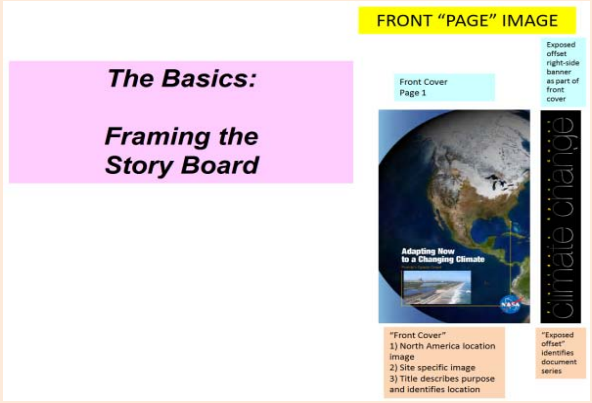
(e-mails were bouncing around like a ping-pong ball.
A team slowly formed informally through a social network)

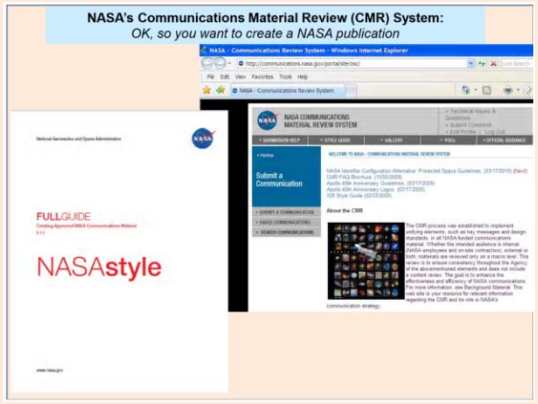
The Project Manager
The Training Instructor & Project Coordinator
The Science Information Expert
The Climate Scientist
The Risk Communication Expert
The Communication Specialist
The Visual Communication Expert
The Graphic Designer

A VISION: *The Goal*

1) Great graphics
2) 8th Grade reading level
3) “The Wow factor”: Nice enough to put on your coffee table
4) Light enough to hang with magnets on your refrigerator
5) Engaging enough for your family to talk about at the dinner table
6) Something you would like your children to take to school for “show and tell”
7) Informative enough to ***start*** a polite and reasoned conversation







PERSPECTIVE ON:

National-Regional-State-Local-Site Adaptation

NASA INSTITUTIONAL COORDINATION FRAMEWORKS:

"Levels" of Organization

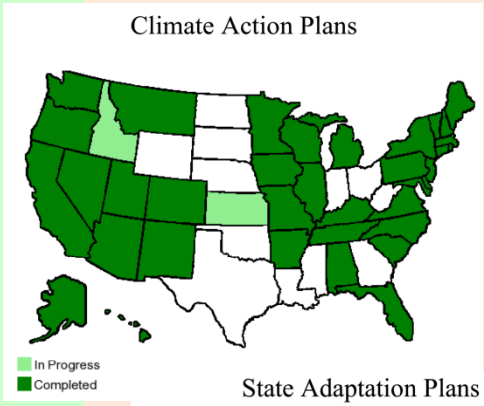
1) National Adaptation Strategies & Recommendations: for Federal Agencies (Executive Order 13514)

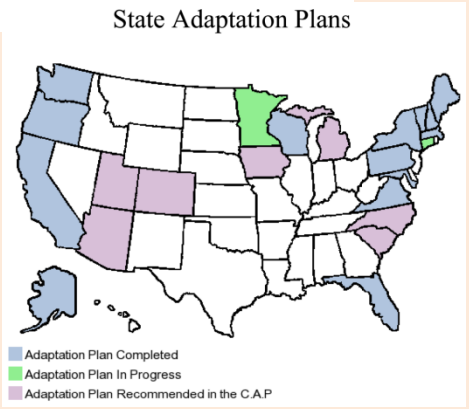
2) Agency Adaptation Strategies: NASA Decision Support Process and NASA Strategic Sustainability Performance Plan (National Security Presidential Directive #40 – "Access to Space;" NASA-HQ OSI (ARM) Risk #3345)

3) State & Local Adaptation Strategies and Plans: *Examples -*

- *State of California*
- *State of Maryland*

4) NASA Center's Adaptation Strategies and Plans: Integrated into Center's traditional Plans, Processes, Systems, and "Communities of Practice" (e.g., Center's Master Plan)





http://www.c2es.org/us-states-regions <accessed 7 Aug 2012>

THE RIGHT PEOPLE ARE IN THE ROOM!!

It is OK to be prepared for life as it is today;

But it is awesome to be prepared for making life better for today and the future.

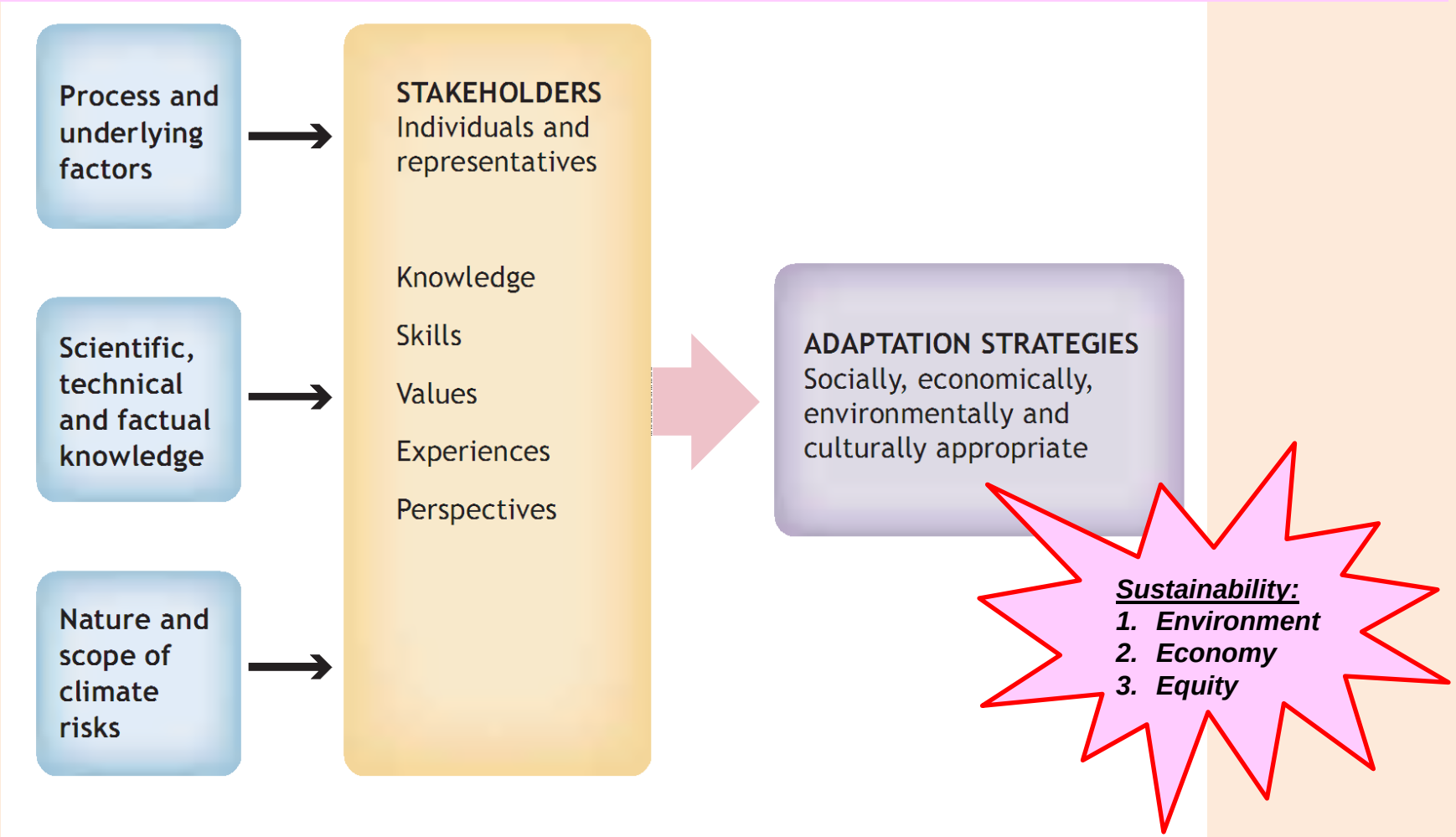
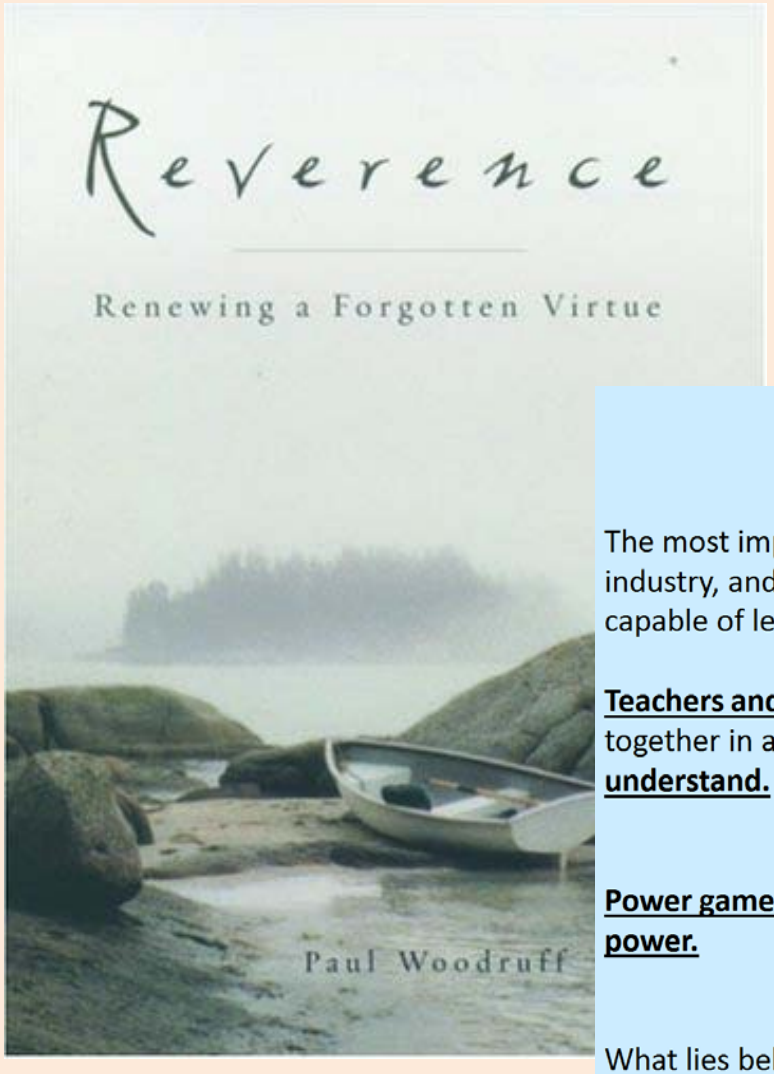


Figure 3: Roles and responsibilities of stakeholders in the adaptation process.

UKCIP (xxxx) Identifying Adaptation Options http://www.ukcip.org.uk/images/stories/Tools_pdfs/ID_Adapt_options.pdf

Reverence: Renewing a Forgotten Virtue



http://photo.goodreads.com/books/1173207926l/257480.jpg

Aspects of Reverence:

- Respect
- Awe
- Shame

Reverence: Renewing a Forgotten Virtue

by P Woodruff (2001)

The most important example a teacher sets is by learning – by showing the **curiosity,** industry, and **open mind** that **learning requires**. That is why an exemplary teacher must be capable of learning from students.

***

Teachers and students will respect each other insofar as they recognize that they belong together in a **common effort – trying to understand something that it is important to understand.**

***

Power games don't support education, because learning and teaching are not about power.

***

What lies behind the teacher's respect is devotion to the truth, and **it is devotion to the truth that … draws teacher and students into the circle of mutual respect**.

http://www.flickr.com/photos/fragileoasis/6080246926/in/photostream

OK –

So, where do we go from here?

http://icanhascheezburger.com/2010/04/18/funny-pictures-but-i-eated-it/

STOP

Sam's struggle and challenge … moving to the next level

The Built Environment

Slide #2: dependent and interdependent Networks & Grids

PUBLIC NOTICE

Federal Communications Commission
445 12th St., S.W.
Washington, D.C. 20554

News Media Information 202 / 418-0500
Internet: http://www.fcc.gov
TTY: 1-888-835-5322

DA 10-494
Released: March 24, 2010

FCC'S PUBLIC SAFETY AND HOMELAND SECURITY BUREAU REMINDS TELECOMMUNICATIONS SERVICE PROVIDERS OF IMPORTANCE OF IMPLEMENTING ADVISORY COMMITTEE 9-1-1 AND ENHANCED 9-1-1 SERVICES BEST PRACTICES

PUBLIC NOTICE

Federal Communications Commission
445 12th St., S.W.
Washington, D.C. 20554

News Media Information 202 / 418-0500
Internet: http://www.fcc.gov
TTY: 1-888-835-5322

DA 12-1153
Released: July 18, 2012

PUBLIC SAFETY AND HOMELAND SECURITY BUREAU SEEKS COMMENT ON 9-1-1 RESILIENCY AND RELIABILITY IN WAKE OF JUNE 29, 2012, DERECHO STORM IN CENTRAL, MID-ATLANTIC, AND NORTHEASTERN UNITED STATES

PS Docket No. 11-60

NEWS

Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

News Media Information 202 / 418-0500
Internet: http://www.fcc.gov
TTY: 1-888-835-5322

This is an unofficial announcement of Commission action. Release of the full text of a Commission order constitutes official action. See MCI v. FCC, 515 F 2d 385 (D.C. Circ 1974).

FOR IMMEDIATE RELEASE
February 15, 2012

NEWS MEDIA CONTACT:
Lauren Kravetz, (202) 418-7944
Email: lauren.kravetz@fcc.gov

FCC EXTENDS NETWORK OUTAGE REPORTING REQUIREMENT TO INTERCONNECTED VoIP SERVICE TO HELP ENSURE A MORE RESILIENT AND RELIABLE 9-1-1 SYSTEM

New Reporting Requirement Will Help Provide Reliable Phone Service to 9-1-1 for All Voice Calls

Washington, D.C. – The Federal Communications Commission today took action to make the nation's 9-1-1 systems more reliable and resilient by requiring interconnected Voice over Internet Protocol (VoIP) service providers to report significant network outages that meet specific criteria and thresholds. The new rules will help ensure that the country's critical communications infrastructure remains available in times of crisis. The FCC will use outage reports to track and analyze information on interconnected VoIP outages affecting 9-1-1 service and determine if action is needed to prevent future outages.

http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-10-494A1.pdf
http://www.telecomlawmonitor.com/uploads/file/Derecho%20Storm%20PN.pdf
http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0215/DOC-312495A1.pdf

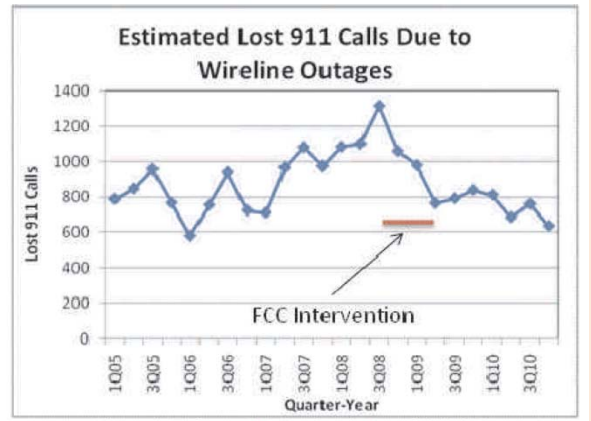
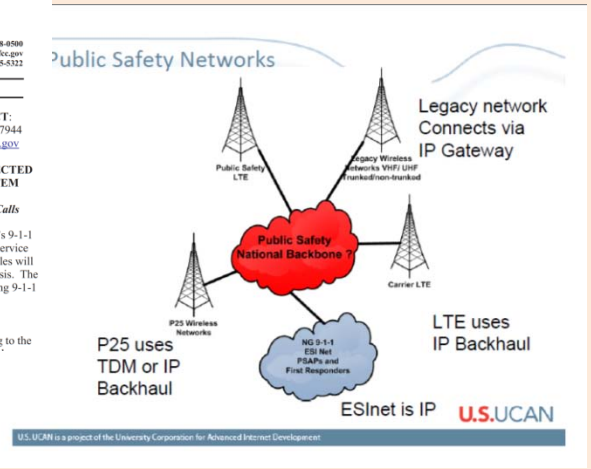


Figure 1: Estimated Reduction in Lost 9-1-1 Calls



W Magnussen (2011) "Resource Sharing to Enhance Public Safety"

Federal Communications Commission FCC 12-22

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
)
The Proposed Extension of Part 4 of the) PS Docket No. 11-82
Commission's Rules Regarding Outage Reporting)
To Interconnected Voice Over Internet Protocol)
Service Providers and Broadband Internet Service)
Providers)

REPORT AND ORDER

Adopted: February 15, 2012 **Released: February 21, 2012**

By the Commission: Chairman Genachowski and Commissioners McDowell and Clyburn issuing separate statements.

TABLE OF CONTENTS

http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0221/FCC-12-22A1.pdf

Washington Post

911 failure affected 2.3 million in Northern Virginia

By Patricia Sullivan, Published: July 11

About 2.3 million Northern Virginia residents lost emergency 911 service for up to four days after the June 29 thunderstorm, in part because a backup generator would not start, a senior Verizon official told government leaders Wednesday.

The outage prevented hundreds, perhaps thousands, of calls for help from getting through to emergency responders in Fairfax and Prince
land-line and wire

Thirty-one people

"This region expe
Metropolitan Was
first time this has

Investigations are
Commission, as w

David Turetsky, t
outage as well as

"We intend to get

Verizon, 911 service providers out of sync on storm outage

By Patricia Sullivan and Mary Pat Flaherty, Published: July 12

CHESTER, Va. — Verizon executives and leaders of Northern Virginia's 911 emergency centers agree that a brutal storm passed through the area June 29 and that, for a while, people couldn't reach police, fire and other emergency responders by dialing 911. They agree that a breakdown in Verizon's network prevented calls from getting through. They also agree on the importance of 911 for public safety.

They disagree on alm

Verizon officials told
towns in Northern Vir
reliable emergency se

Verizon said 911 calli
officials said it wasn't

About Arlington, they

"The Arlington [emer
operations.

"That's not true," said

FCC to look into Verizon's 911 outages

By Mary Pat Flaherty and Patricia Sullivan, Published: July 18

The Federal Communications Commission has opened an inquiry into what prevented Verizon's Northern Virginia customers from getting through to several 911 emergency centers after the brutal June 29 storms.

The review of Verizon's performance is included in a broad inquiry into service problems at about a dozen carriers from Ohio to Virginia that handle calls for 911 call centers. The review will also look at the loss of customers' telephone service.

Problems in Nor
breakdowns in (

The overall effe
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Verizon has sai
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Verizon continu

The FCC said it
with assessing t
FCC's Public Sa
scheduled mont

Northern Virginia 911 outages draw FCC attention

By Mary Pat Flaherty, Published: July 19

From Kentucky to Virginia, the fast-moving June 29 storm created outages at 911 emergency call centers.

But as the FCC pursues the causes and effects of those problems, it was the massive and still-unexplained outages in Northern Virginia that drew specific comments Thursday from FCC commissioners who underscored the importance of 911 during events as expansive as a terrorist attack and as personal as a heart attack.

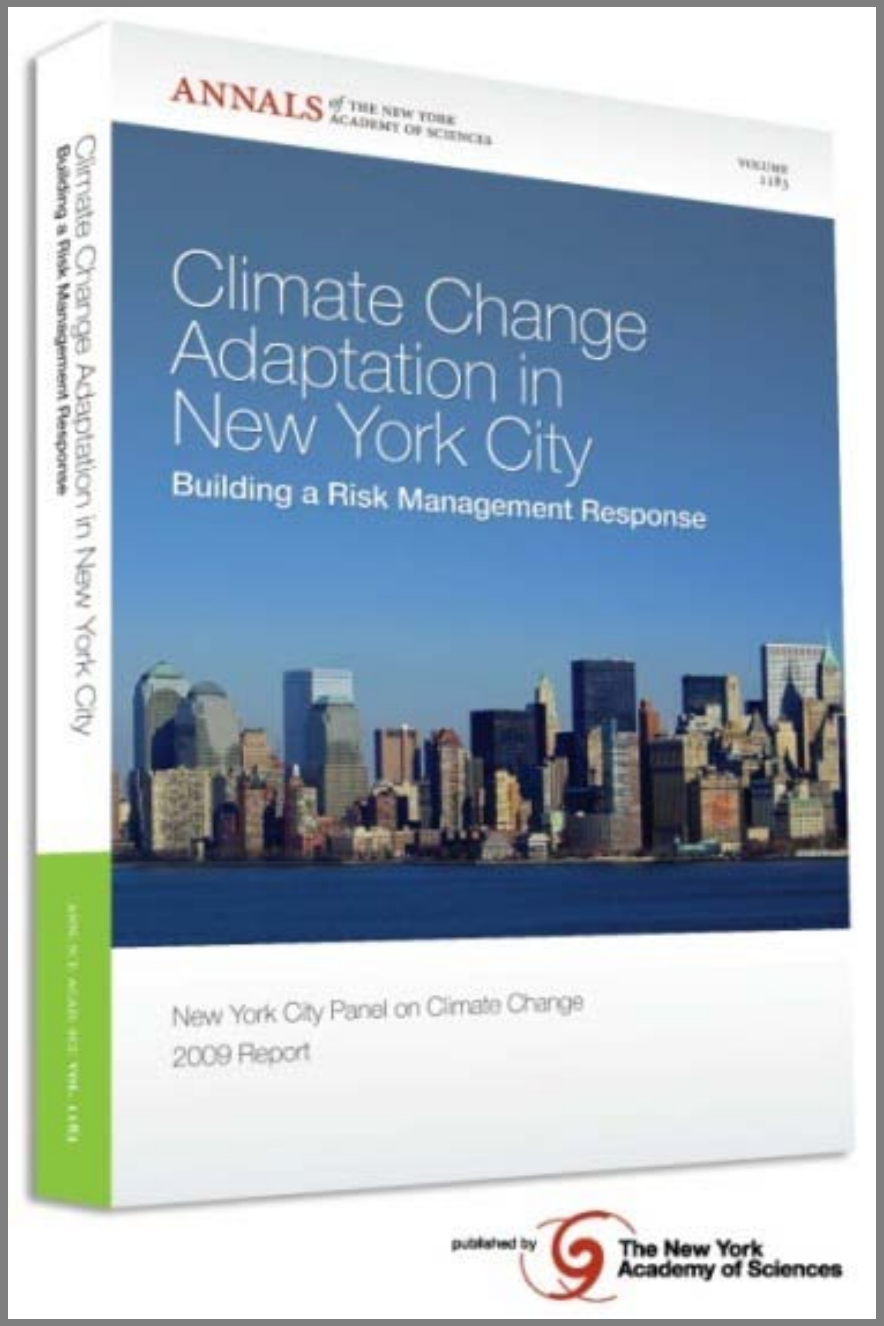
At an FCC public hearing, commissioner Robert M. McDowell said the storm was "no doubt a trying time," but it also may have exposed "fundamental weaknesses" in a system of heightened importance for the Capital area, with its risk of attack. "Having hardened and reliable 911 systems is crucial," he said.

Chairman Julius Genachowski recounted an emergency call for a heart attack victim in Prince William County, where the 911 center lost service. The caller got a busy signal but was able to find a non-emergency line and get the victim help.

"That can't be the way it works," Genachowski said.

FCC officials will contact 911 emergency call centers in areas hit hard by the June 29 storm to determine whether problems with incoming calls and information on callers' locations extended beyond the significant issues already known.

David Turetsky, head of the FCC's Public Safety and Homeland Security Bureau, outlined the broadening review to the five FCC commissioners at their monthly public meeting. The session did not include statements from phone companies or public safety officials, although FCC staff members have begun contacting them and reviewing outage reports.



What is our approach?

NASA's Guide Book

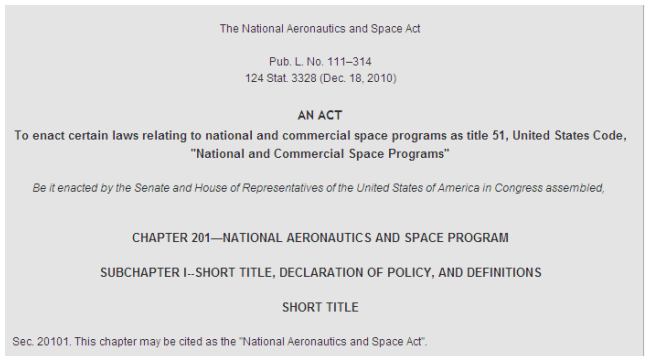
For site-specific climate adaptation

"The 'How to do Guide Book' for engaging stakeholders"

1) Framing site-specific climate change adaptation
2) Adapting to climate risks
3) Tools for adaptation

http://www3.interscience.wiley.com/journal/123443047/issue?CRETRY=1&SRETRY=0

National Aeronautics and Space Act of 2010



The National Aeronautics and Space Act

Pub. L. No. 111–314
124 Stat. 3328 (Dec. 18, 2010)

AN ACT

To enact certain laws relating to national and commercial space programs as title 51, United States Code, "National and Commercial Space Programs"

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

CHAPTER 201—NATIONAL AERONAUTICS AND SPACE PROGRAM

SUBCHAPTER I--SHORT TITLE, DECLARATION OF POLICY, AND DEFINITIONS

SHORT TITLE

Sec. 20101. This chapter may be cited as the "National Aeronautics and Space Act".

NASA's Authorization Act* and Climate

NASA's Mandatory Statutory Objectives *NASA's Mandatory Strategic Goals (51 USC Sec. 20102)*	*Climate Science*	*NASA's Climate Risks*	**REMARKS**
1) Expand knowledge of earth and phenomena in atmosphere & space	X	X	Assured access to space at-risk
2) Improve usefulness, performance, speed, safety & efficiency of aeronautical and space vehicles		X	Test facilities and training at-risk
3) Develop & operate vehicles that carry instruments, equipment, supplies, and living organisms through space		X	Training facilities and test facilities at-risk
4) Conduct long-range scientific studies of problems requiring the utilization of aeronautical and space activities	X	X	Assured access to space at-risk; Ground systems at-risk
5) Preserve the US leadership in aeronautical and space science & technology and in the application of activities within and outside the atmosphere.	X	X	Assured access to space at-risk; Training facilities and test facilities at-risk
6) Make available to agencies valuable or significant discoveries and information of value or significance relating to aeronautical and space actives.	X	X	Ground systems at-risk (especially IT systems)
7) Cooperate with other nations within the scope of the stated objectives and for peaceful purposes	X		
8) Close cooperation with other agencies on the use of US scientific and engineering resources to avoid unnecessary duplication of effort, facilities, and equipment.	X	X	Training facilities and test facilities at-risk
9) Preserve the US preeminent position in aeronautics and space through research & technology development related to manufacturing processes		X	Test facilities at-risk; Ground systems at-risk (especially IT systems)

* National Aeronautics and Space Act of 2010, 51 USC Sec. 20101 et seq (http://www.nasa.gov/offices/ogc/about/space_act1.html)

STOP