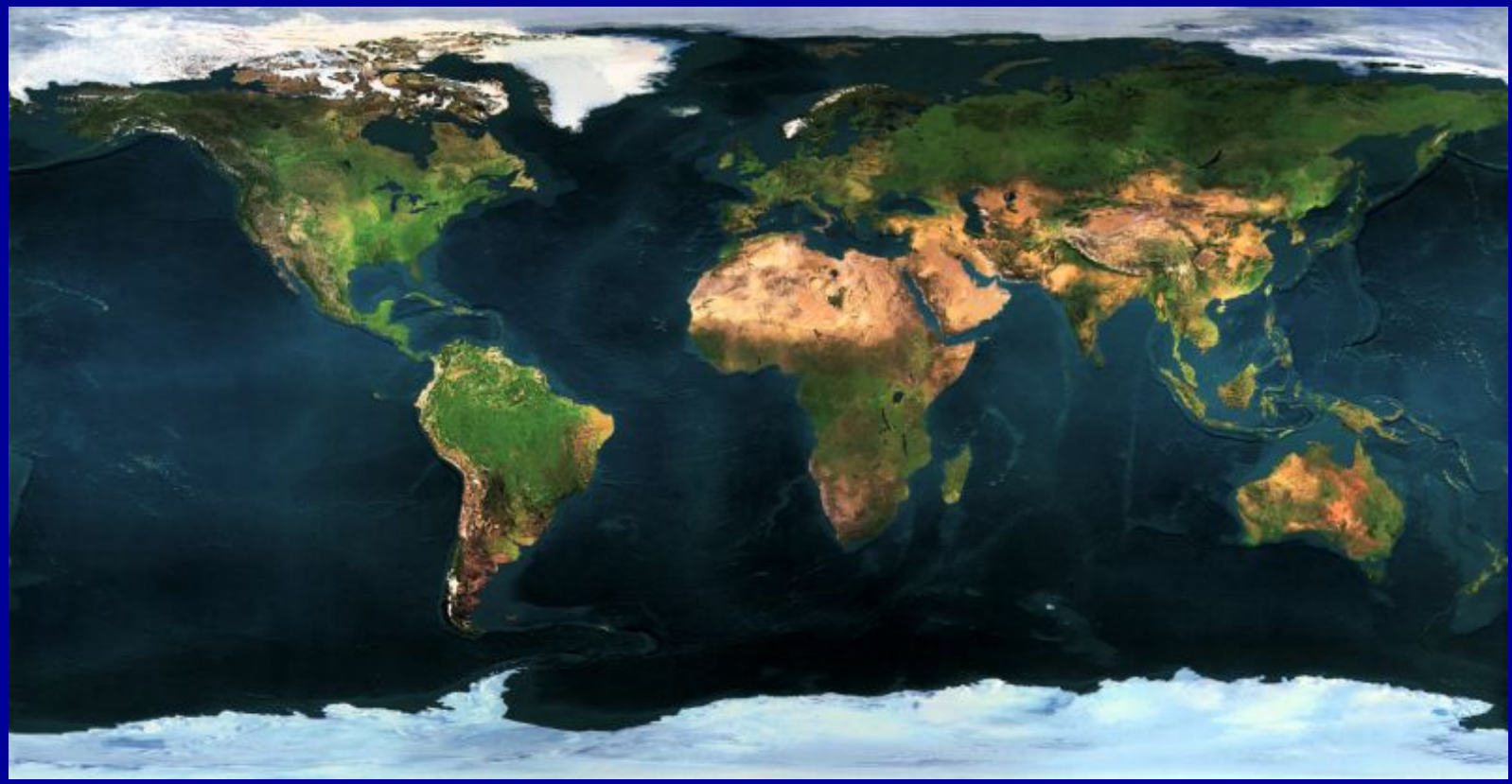
Climate Change and Health

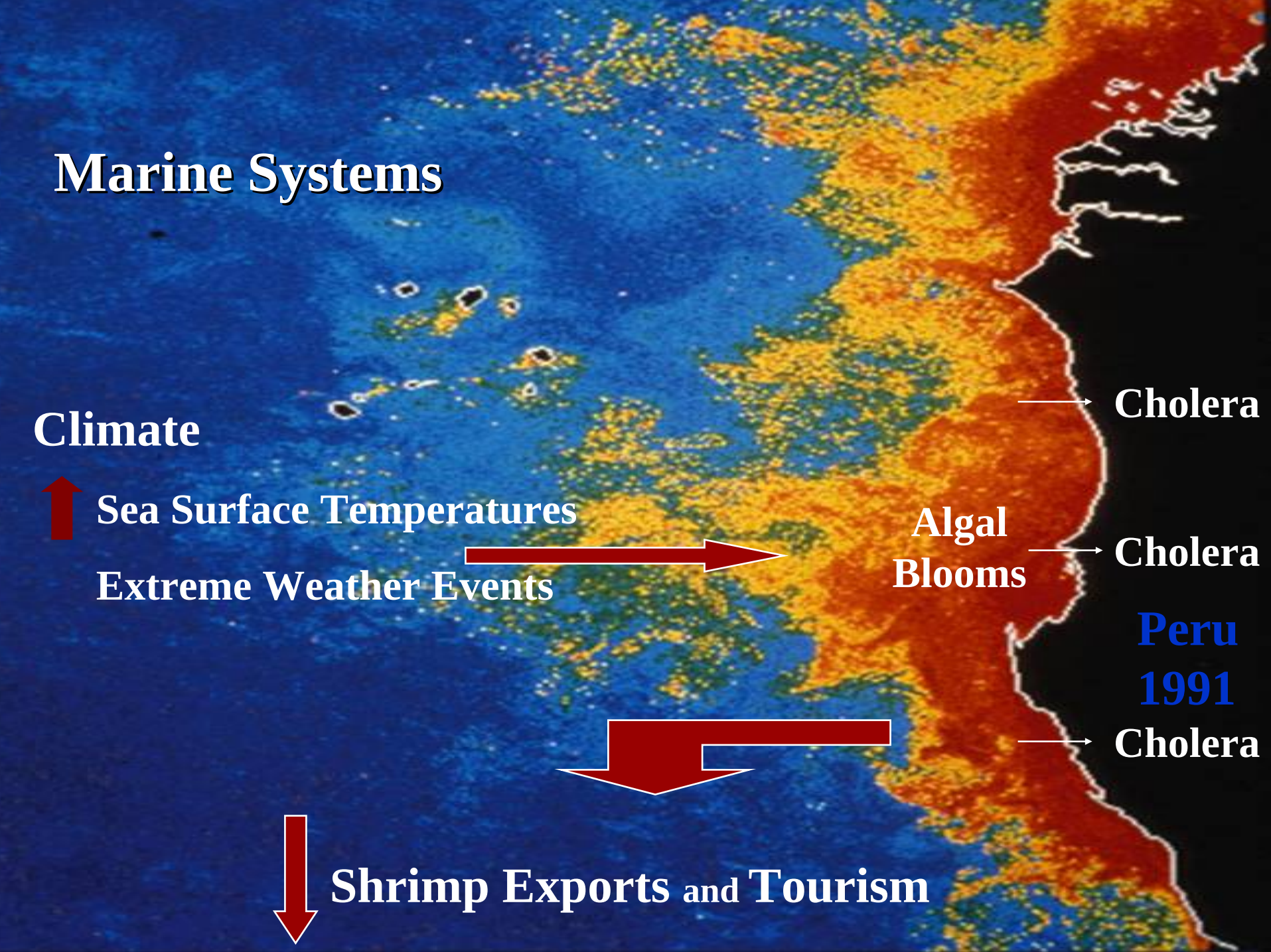


STAPPA/ALAPCO

May 1-2, 2006

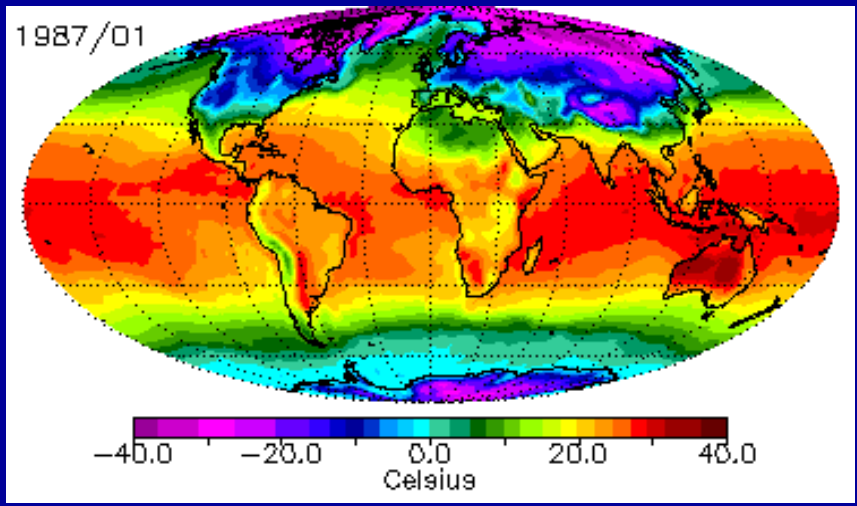
CENTER FOR HEALTH AND THE GLOBAL ENVIRONMENT

HARVARD MEDICAL SCHOOL


Marine Systems
Climate
Sea Surface Temperatures
Extreme Weather Events
Algal Blooms
Cholera
Cholera
Peru 1991
Cholera
Shrimp Exports and Tourism

IPCC TAR: 2001

1. Climate is changing
2. Human activities are contributing

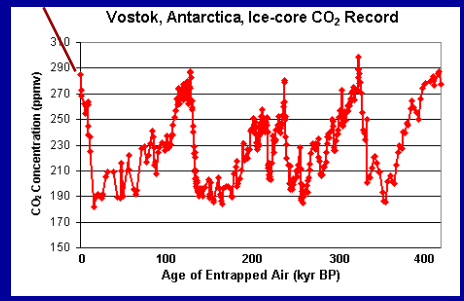


3. Biological systems are responding to warming on all continents and in the oceans
4. Weather is becoming more extreme

Since 2001 We Have Learned

1. CO_2 rise is accelerating: 3ppm/yr, up from 1.8 ppm/yr

380 ppm



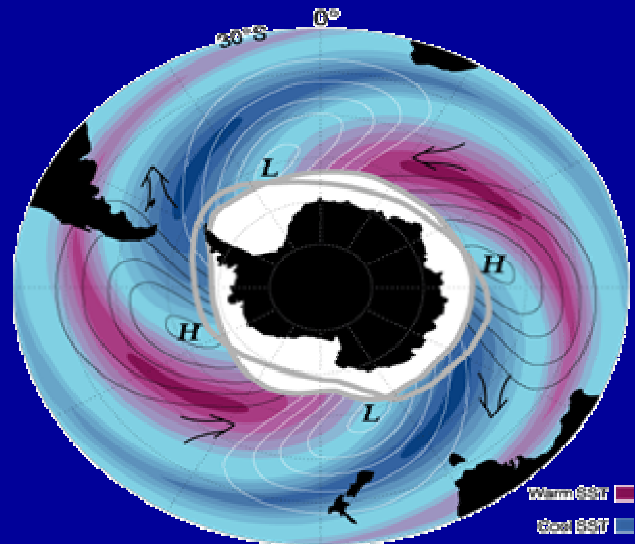
280 ppm

180 ppm

2. Polar and mountain glacial ice loss is accelerating

3. Ocean temperatures and currents are changing

4. Winds around both poles are becoming more forceful



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Cold

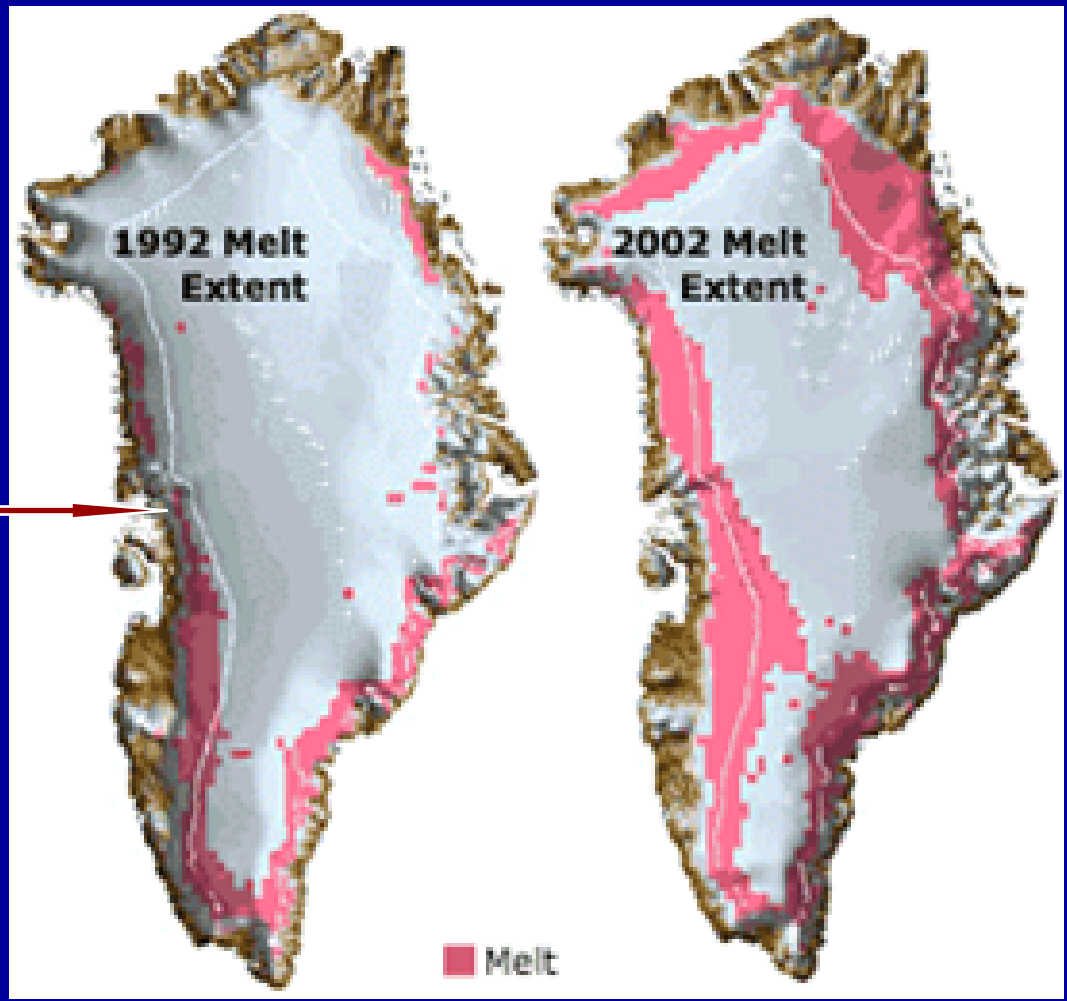
Sea Surface Temperatures 9/04

Bryden et al.
Nature 2005

Greenland Ice Sheet

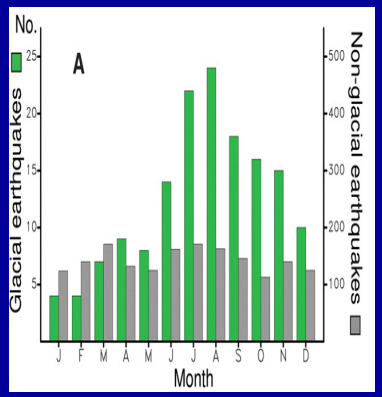
Glacial flow

14 km/yr

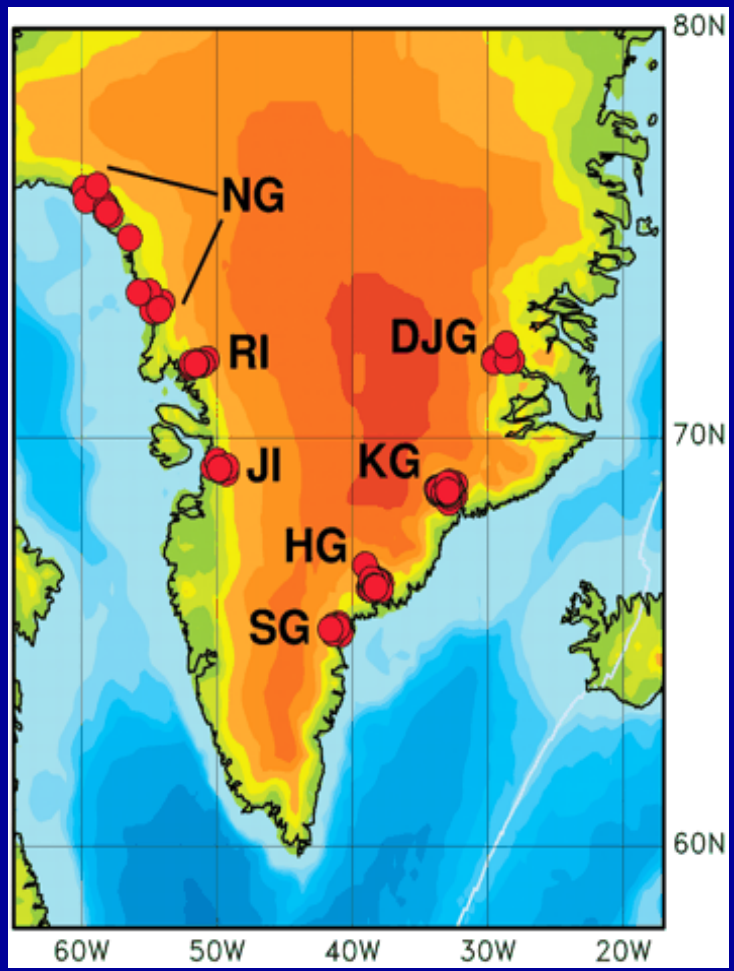


Rignot & Kanagaratnam
Science 2006; **311: 986**

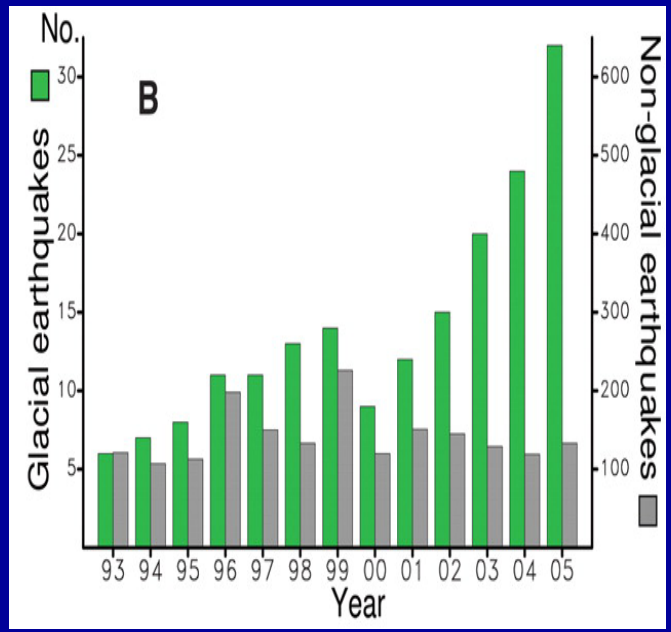
Greenland Glacial Earthquakes



Seasonality



Locations of 136 glacial earthquakes



Frequency

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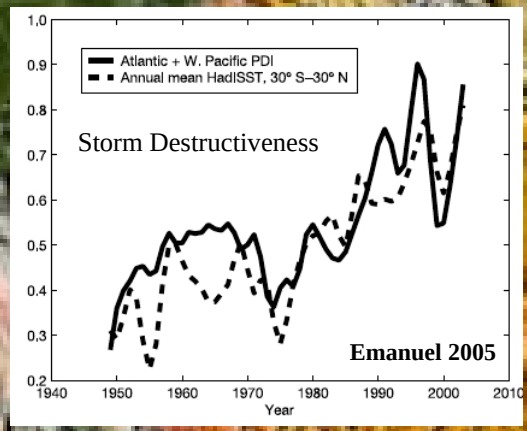
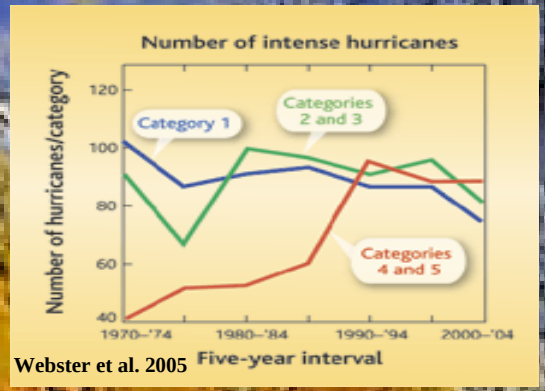
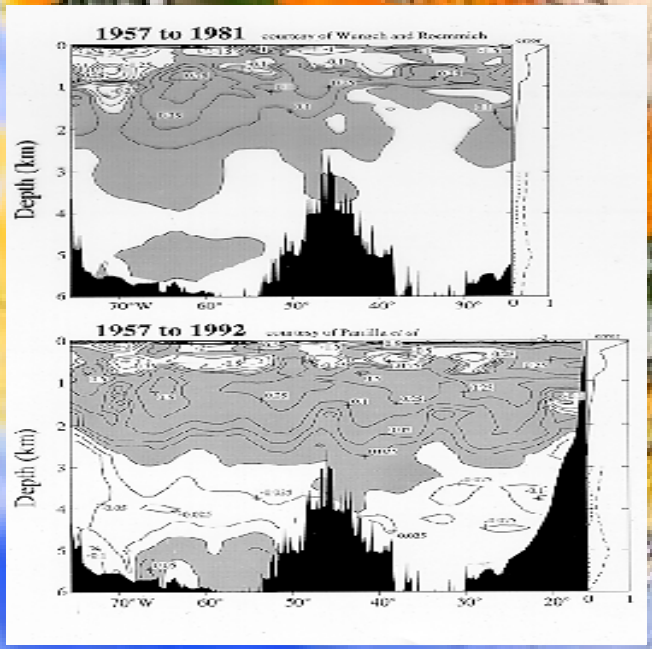
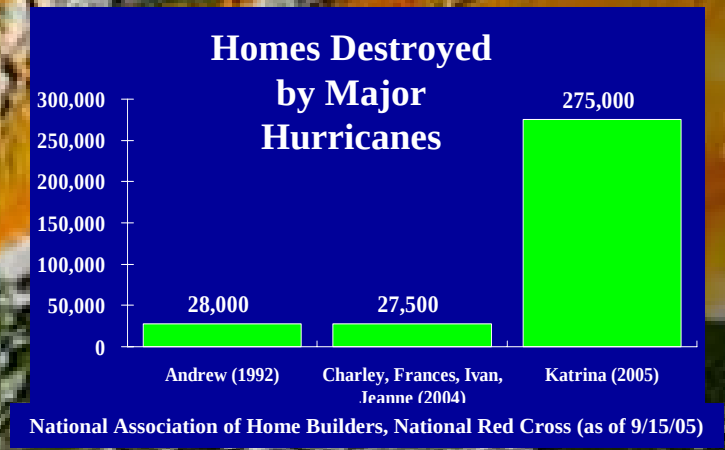
Ekström et al. Science 2006





Webster et al. 2005



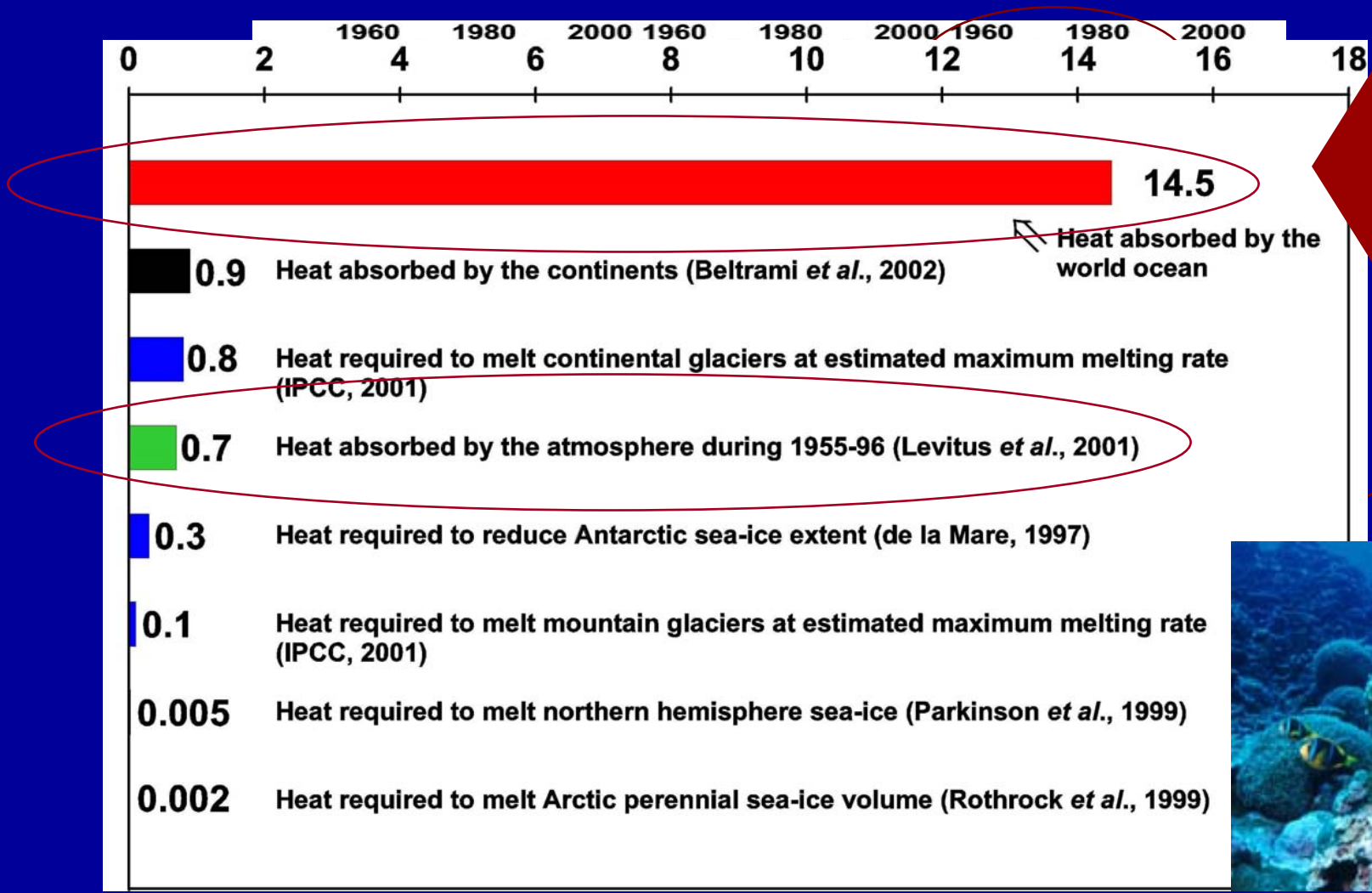


National Association of Home Builders, National Red Cross (as of 9/15/05)

Parilla *et al.* 1994

DEEP OCEAN WARMING - III

DEEP OCEAN WARMING



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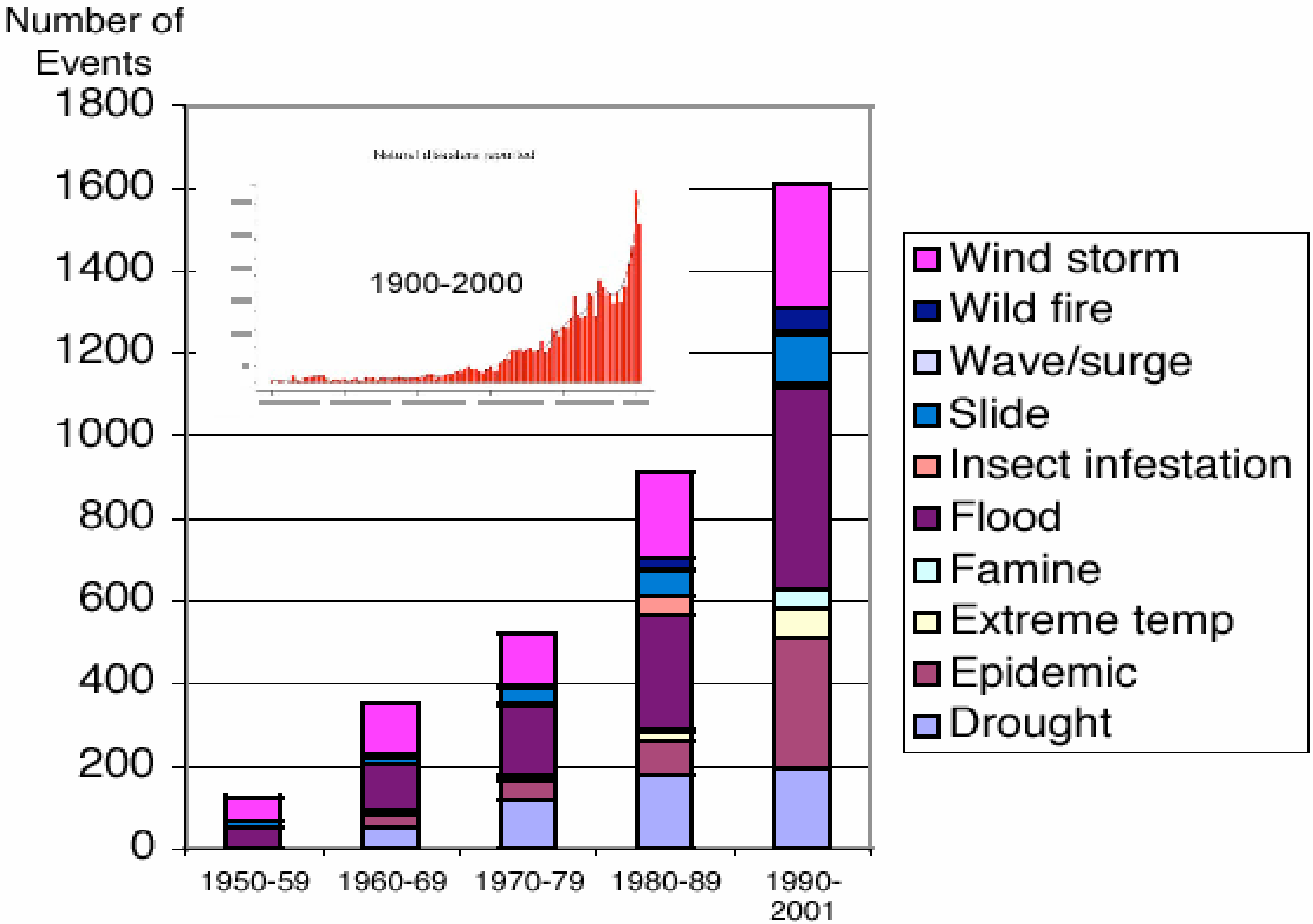
Levitus et al. *Science* 2005

Barnett et al. Science 2005

Changing Nature and Structure of Events

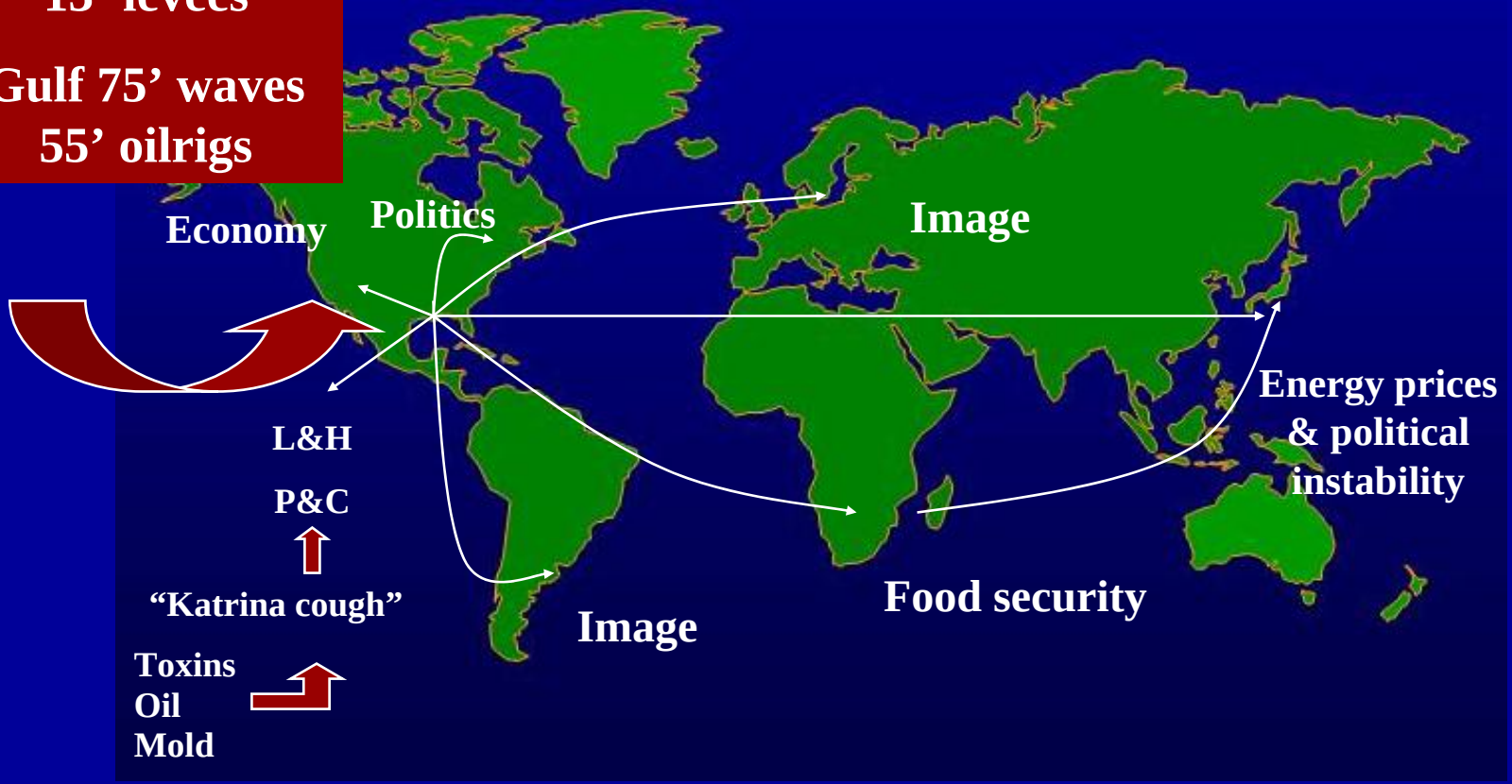


Sources: OFDA / Center for Research in the Epidemiology of Disasters (CRED) Intl database of Disasters

Katrina Rita Wilma Mega-event

L. Pontchartrain
28’ high waves
13’ levees

Gulf 75’ waves
55’ oilrigs



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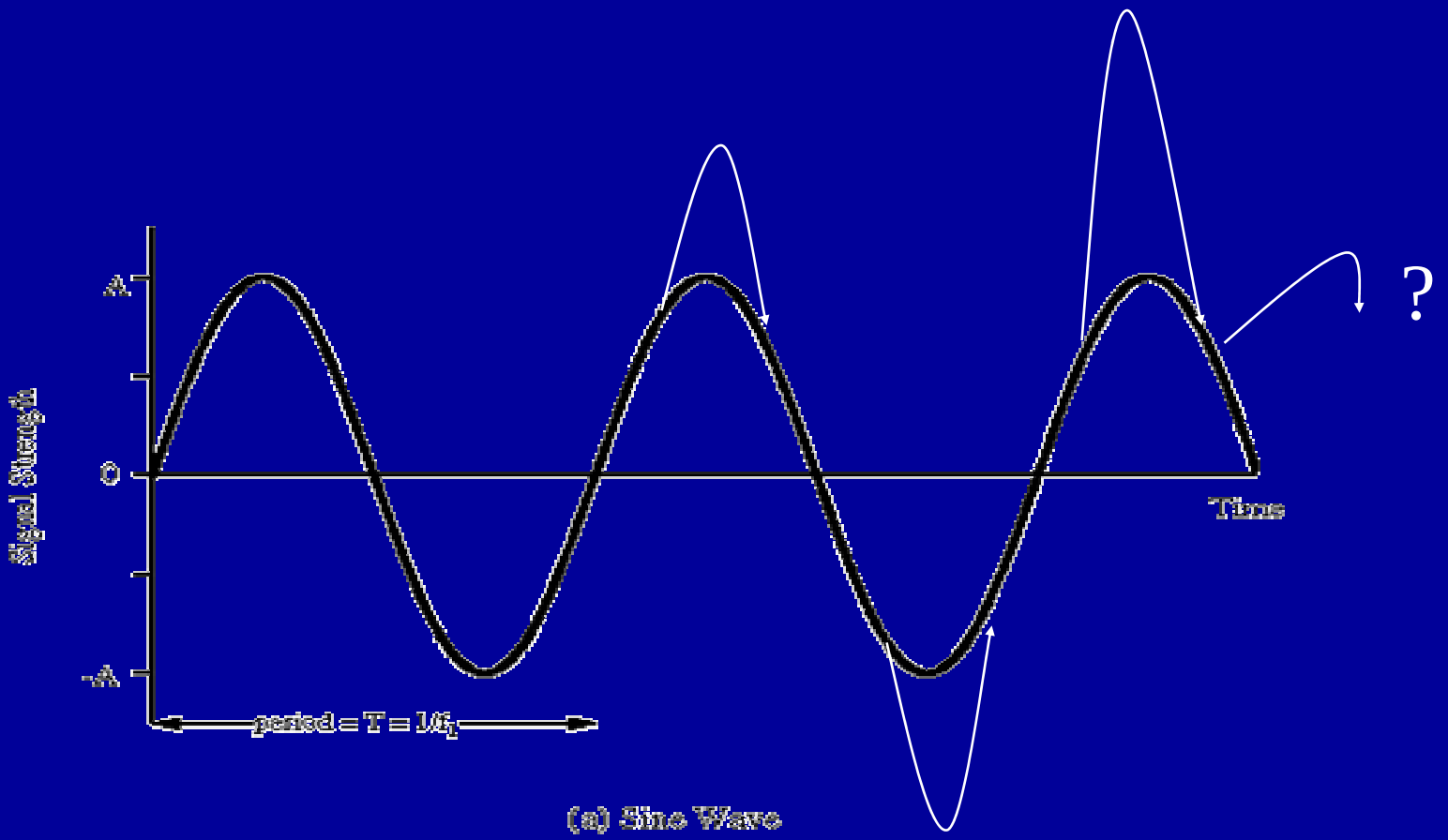
A turning point

Weather = *f* (CC + NV)



Atlantic Multidecadal Oscillation (AMO), Pacific Decadal Oscillation (PDO), La Niña, Deep Ocean Warming

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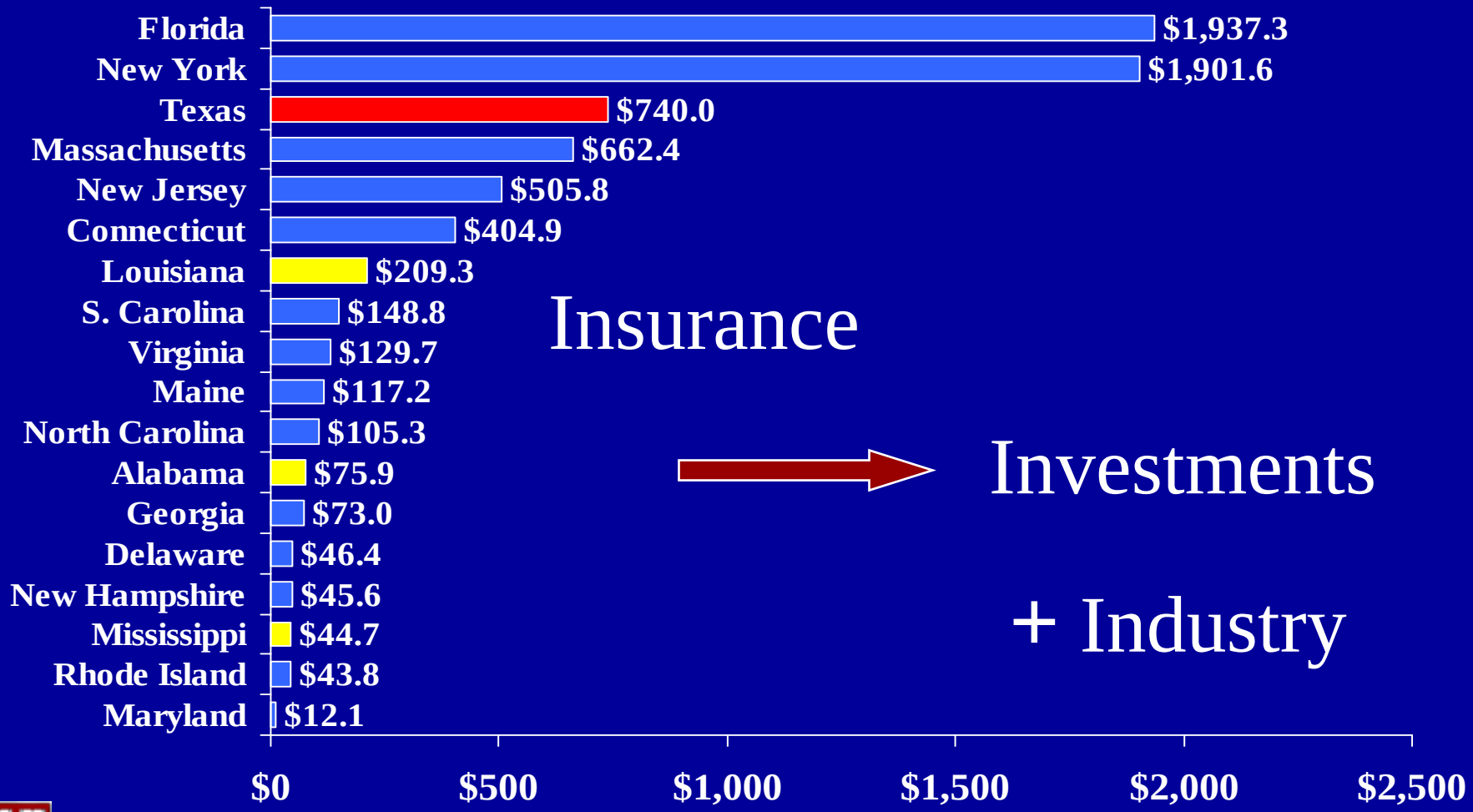
Third Consecutive Year of Intense Storms

Total Value of Insured Coastal Exposure



Insurance

Investments

+ Industry

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-AIR Worldwide, 2004 US $ Billions

Climate Change Futures

Infectious and Respiratory Disease

Malaria	3,000 children/day	5-17.4% GDP 1.3 growth rate % pts./yr
West Nile virus	Wildlife	$500 million/yr for S&R
Lyme disease	25,000 cases/yr	$2.5 billion/5 years
Asthma	Fourfold increase in US	$16 billion

Extreme Weather Events

Heat waves 2003 summer	Mortality, crops, forests, Alps	Over $15 billion
Floods 2002 summer	Drownings, WBDOs, VBDs	Over $16 billion

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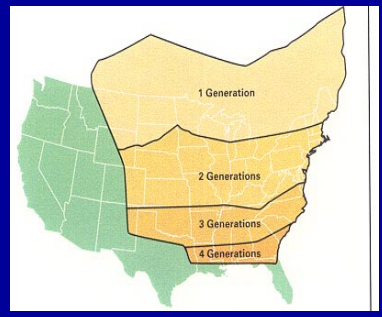
Swiss Re and UNDP

Natural and Managed Systems



Forests Beetles and wildfires	Millions of acres, timber industry, watersheds, wildlife, carbon pulse	$3 billion in 2003 in US
Agriculture EWEs Pests, pathogens and weeds	Food security	Over $120 billion/yr
Marine systems Coral Bivalves	Food, barriers, salination, livelihoods, insured property Food, filtering	$800 billion $75-150 million
Water Quality and quantity	Agriculture, health, hydropower	$10-40 billion in the US projected

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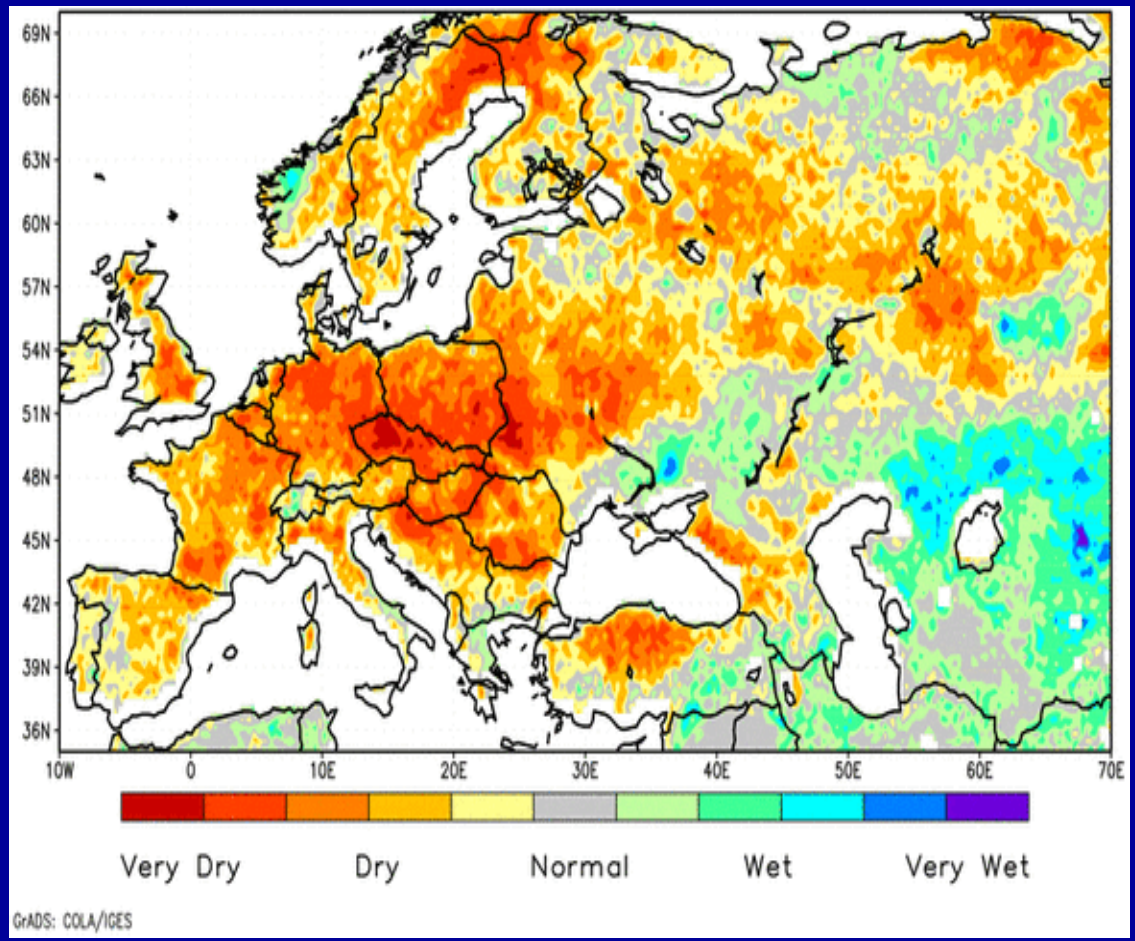
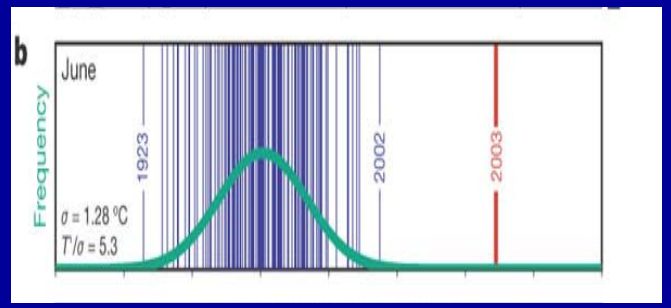
European Summer 2003





Temperatures 11ºF >30year average
6 std. dev. from the mean

Deaths: 21-35,000
- **Crops & livestock: US$12.3 billion**
- **Wildfires: 1.2 million acres**
- **Nuclear plant shutdowns**
- **Hydropower reduced**
- **Alpine glaciers: 10% lost**

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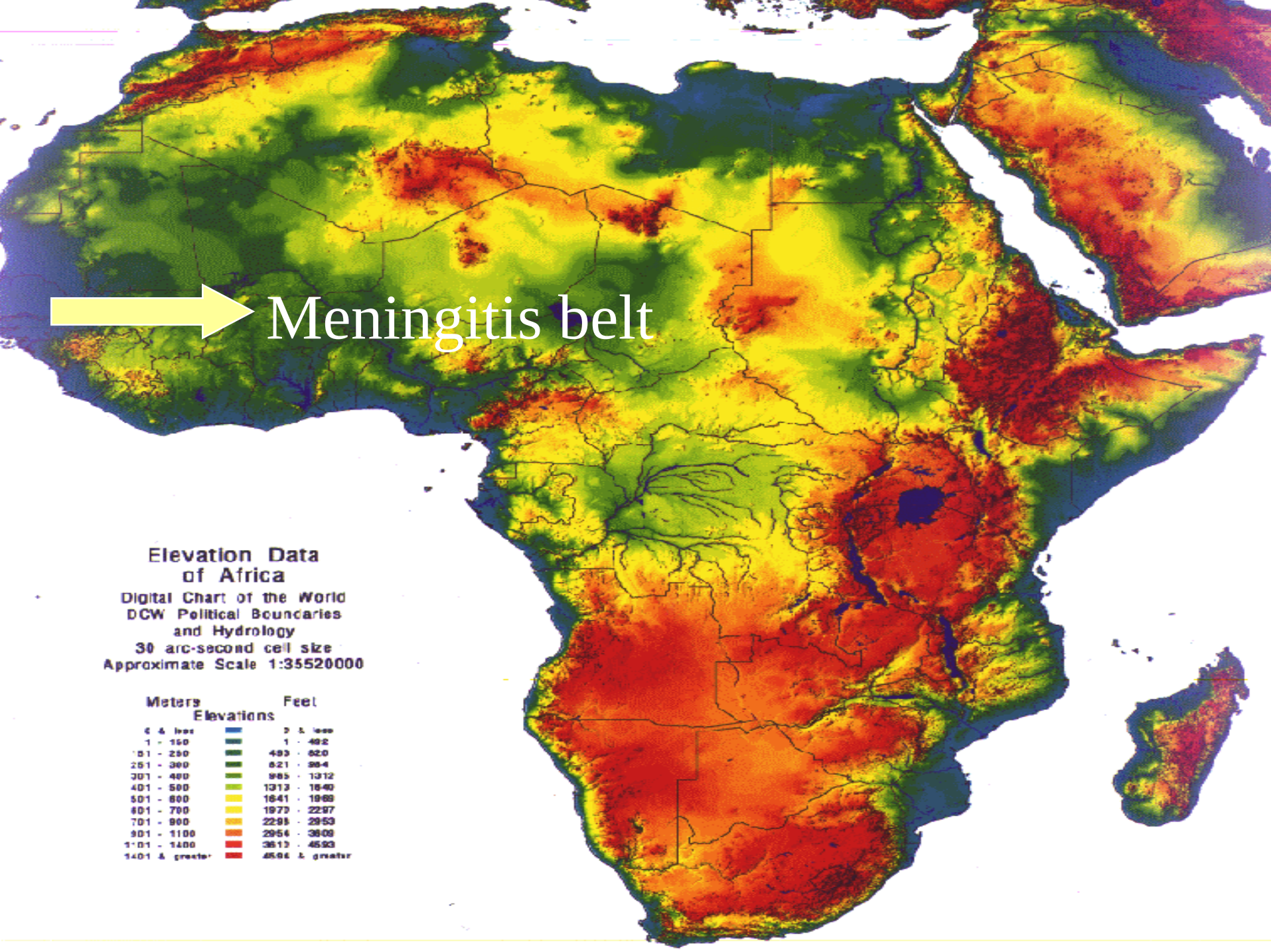
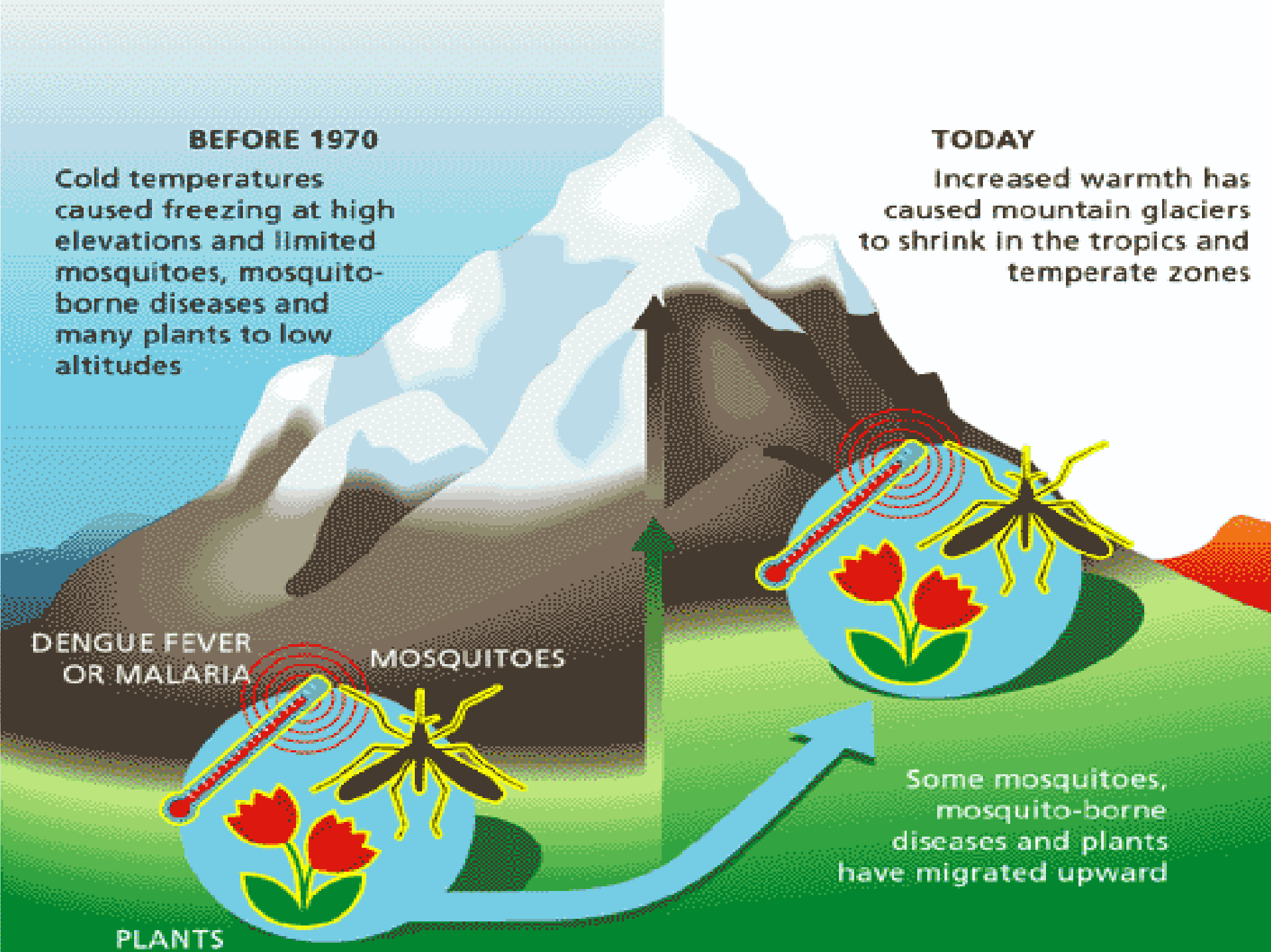

Meningitis belt
Elevation Data
of Africa
Digital Chart of the World
DCW Political Boundaries
and Hydrology
30 arc-second cell size
Approximate Scale 1:35520000
Meters
Elevations
Feet
0 & less
1 - 150
151 - 250
251 - 300
301 - 400
401 - 500
501 - 600
601 - 700
701 - 900
901 - 1100
1101 - 1400
1401 & greater
0 & less
1 - 492
493 - 820
821 - 984
985 - 1312
1313 - 1640
1641 - 1969
1970 - 2297
2298 - 2953
2954 - 3609
3610 - 4593
4594 & greater

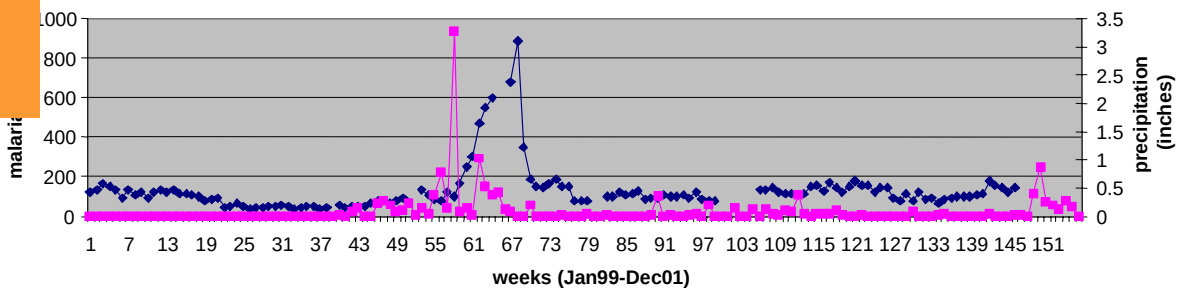

BEFORE 1970
Cold temperatures caused freezing at high elevations and limited mosquitoes, mosquito-borne diseases and many plants to low altitudes
TODAY
Increased warmth has caused mountain glaciers to shrink in the tropics and temperate zones
DENGUE FEVER OR MALARIA
MOSQUITOES
PLANTS
Some mosquitoes, mosquito-borne diseases and plants have migrated upward

Mozambique Floods 2000

Drought 2005

- Konzo

Figure 1: Malaria Cases and Maputo Precipitation, 1999-2001



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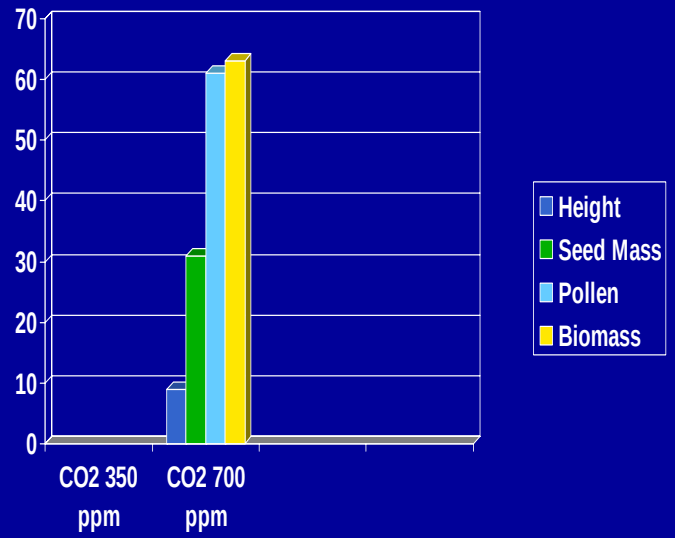
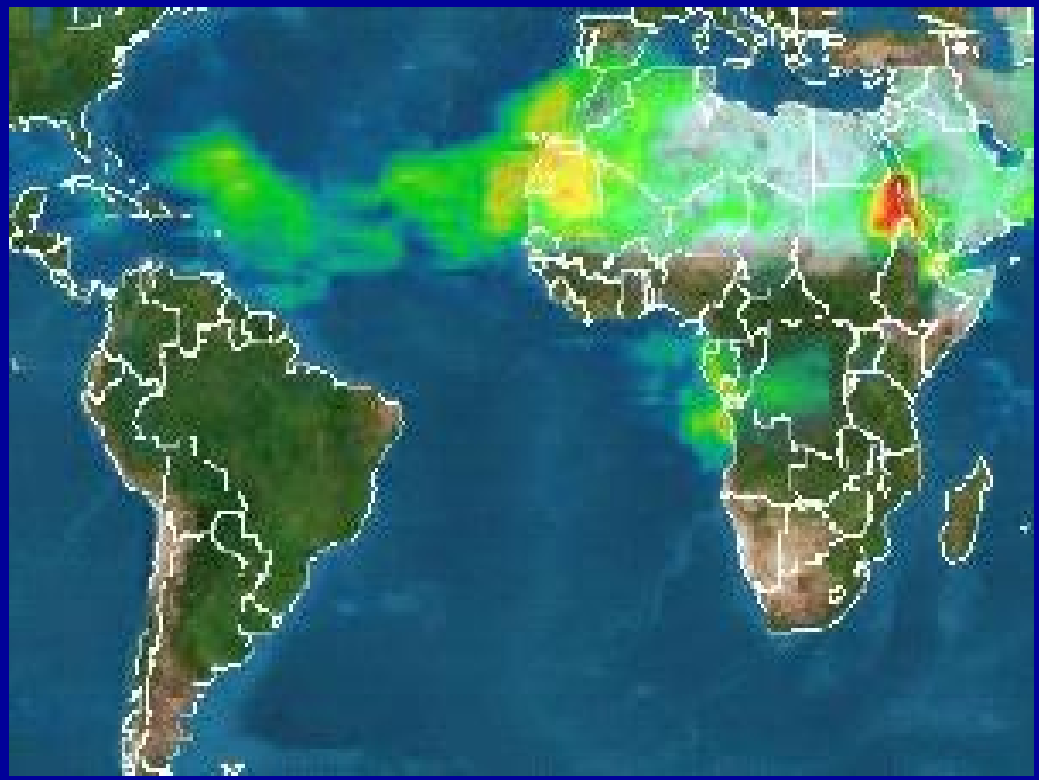
Fivefold increase in malaria

ASTHMA

Ragweed Pollen and CO_2



-Wayne et al., 2002



Dust Storms

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VARIABILTY

Freeze-Thaw

Humans

Birds

Forests

Farms

Allergies

Migration

Fruiting trees

Maple syrup

Herbivores

Predators

Pests

Parasites

Pollinators

Health

FOOD SECURITY

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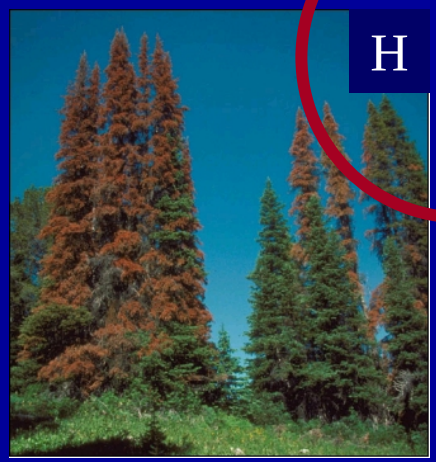
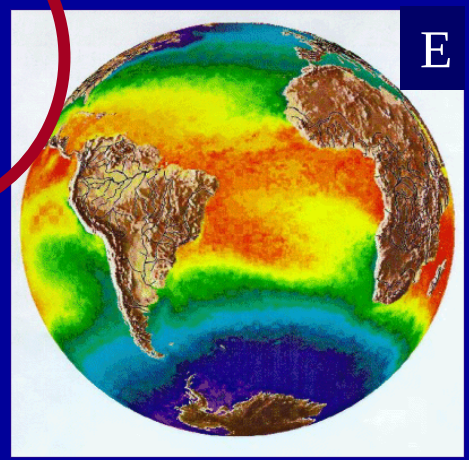
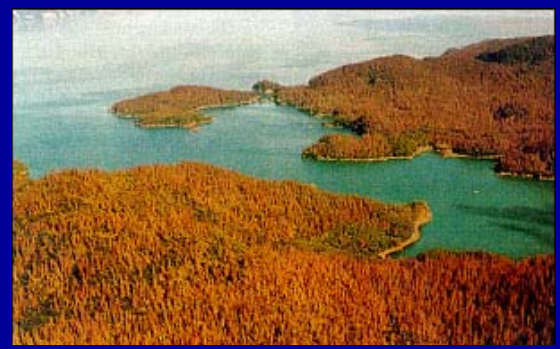
Bark Beetles and Forest Fires





Injury, Respiratory Disease, Water, Wildlife, Property, Carbon Pulse



TIMBER

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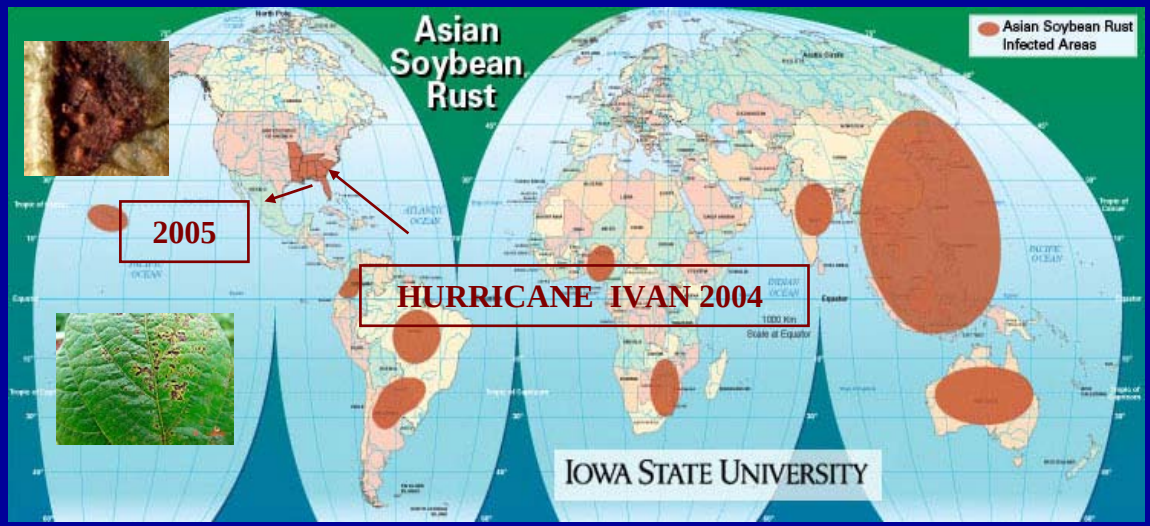
FARMING SECTOR

STORMS



RANGE CHANGE:

SOYBEAN SUDDEN DEATH SYNDROME

FLOODS: Fungi and Nematodes

DROUGHTS: Aphids, Whiteflies, Locust

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The Energy Sector

- Storms and interruptions
- Heatwaves and blackouts
- Cooling water and power plants

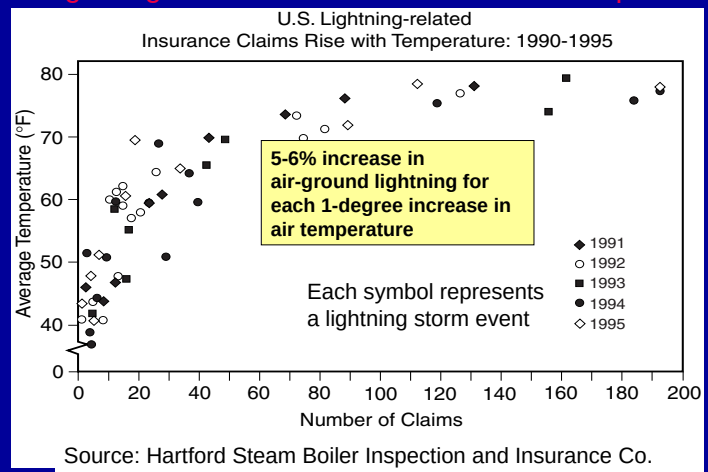
- Melting permafrost and pipelines
- Lightning and warming

FEEDBACKS

Firewood – Deforestation

Glacier loss – Coal-fired plants

Lightning-related claims *accelerate* with temperature



Source: Hartford Steam Boiler Inspection and Insurance Co.

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Confluence of Forces
Convergence of Agendas

- **Climate instability**
- **Availability**
- **Affordability**
- **Energy sector vulnerability**
- **Environmental integrity**
- **Security and unrest**

Peak oil

→ Venezuela
→ Chad
→ FSU
→ Nigeria
→ Sudan
→ Middle East

OIL INDEPENDENCE

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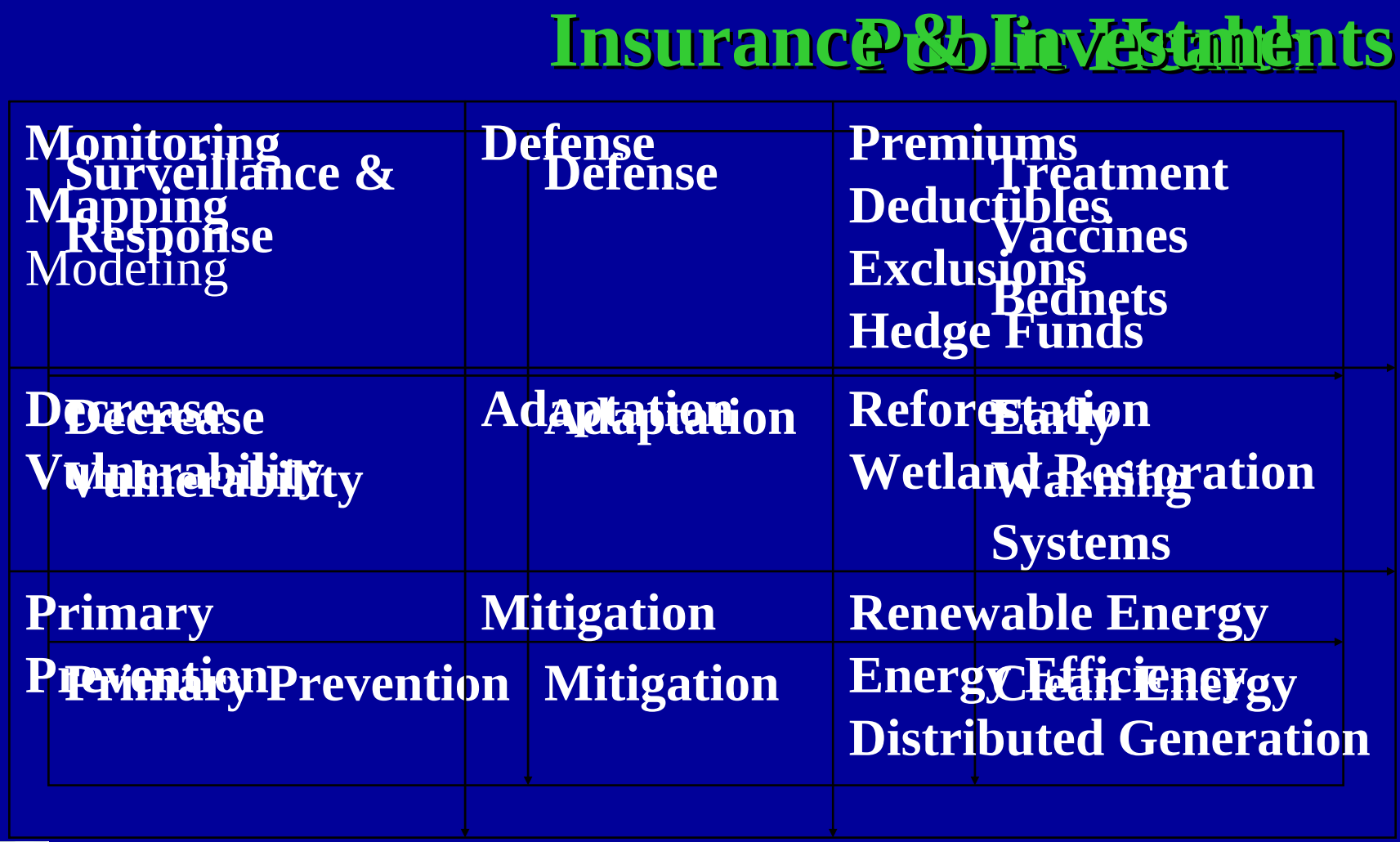
Levels of Responses



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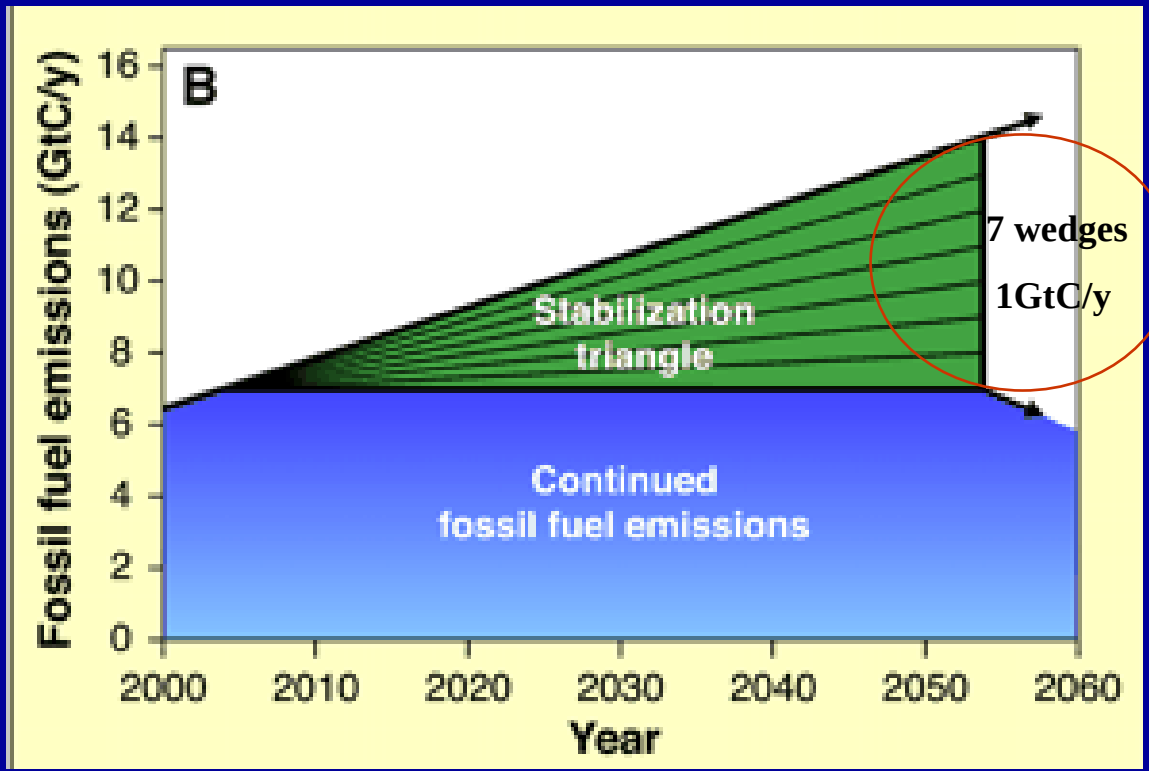
All levels are needed

Stabilization Wedges



Bending the Curve

Pacala and Socolow. *Science* 2004

Green Buildings

Estimated Savings

Respiratory disease: $6 to $14 billion

Allergies and asthma: $1 to $4 billion

Sick building syndrome: $10 to $30 billion

Worker performance: $20 to $160 billion

Lawrence Berkeley National Lab

Studies

Schools with natural light

20% faster on math tests

26% faster on reading tests

Stores with natural light: 40% more sales

Hospitals with better lighting & ventilation: improved patient outcomes

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Harmonizing Adaptation and Mitigation

Distributed Generation

Distributed Development

Water

Purification

Pumping

Irrigation

Desalinization

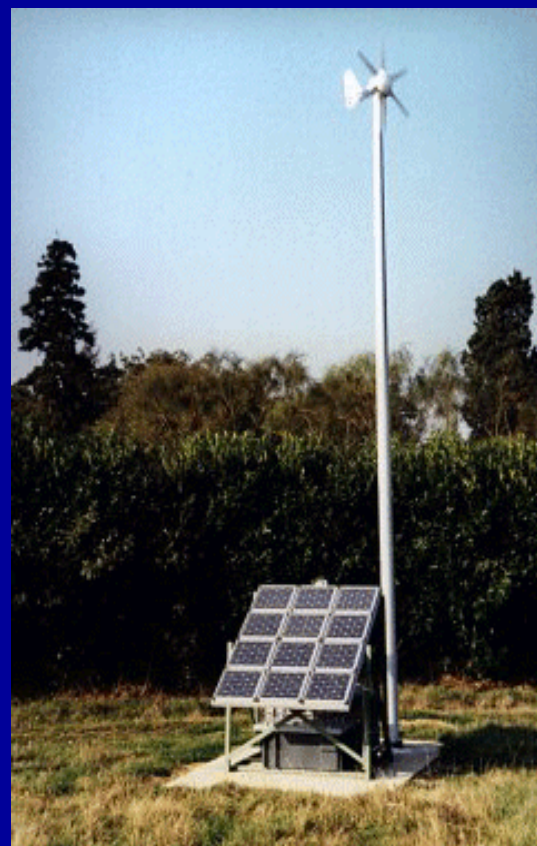
Schools

Clinics

Homes

Computers

Cooking



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Stabilization Wedges

EE & Conservation

1. CAFÉ Stds. 30-60 mpg
2. DSM – reduced use
3. Green buildings/heat capture (2/3)
4. Efficient Coal Plants

Renewables

5. Wind
6. PV
7. Renewable H_2, FC Hybrids
8. Biofuels (sugar, corn, grass, waste)

Natural Sinks

9. Forest nurturing
10. Conservation tillage

Fossil Fuel-based

11. Coal-to-CH4
12. C Capture & Storage (CCS)
13. H_2 Plants with CCS
14. Coal-to-Synfuels w/ CCS
15. *Nuclear fission*

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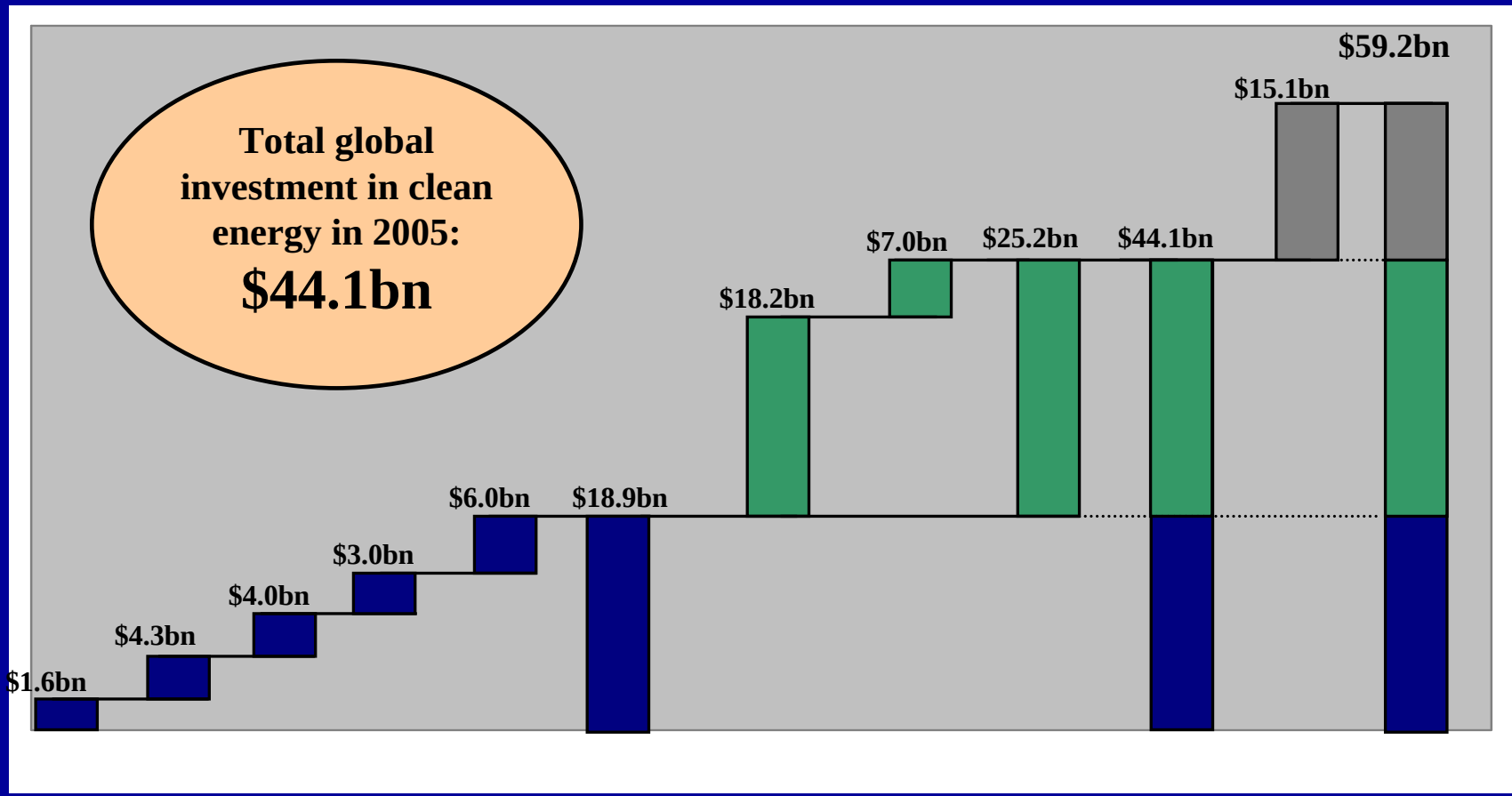
No regrets
LCA needed
Fossil fuel
Nuclear

Global Investment in Clean Energy in 2005



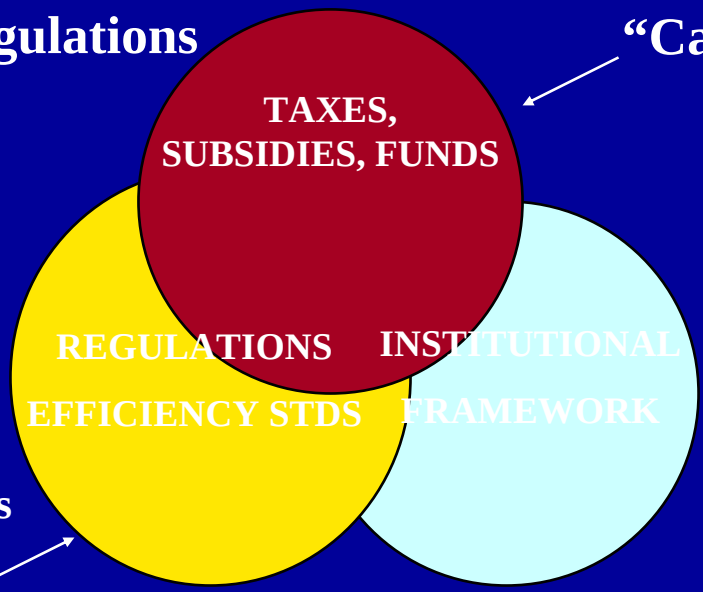
Chris Walker, Swiss Re

Financial Instruments for a Clean and Sustainable Energy Transition (FICSET)

Aligning Rewards and Regulations

Private sector
- Investments
- Insurance
- Ratings

Public sector
- Incentives
- Infrastructure
- R&D
- Procurement practices



"Carrots"

"Sticks"

Public health

Security

Economy

Climate Stability

New Energy Plan

- Efficiency, Conservation & Renewables
- Distributed Generation
- Rationalized Transport & Transit
- "Green Buildings" & Smart Growth
- Retrofitting Infrastructure

THE ENGINE OF GROWTH for the 21st CENTURY

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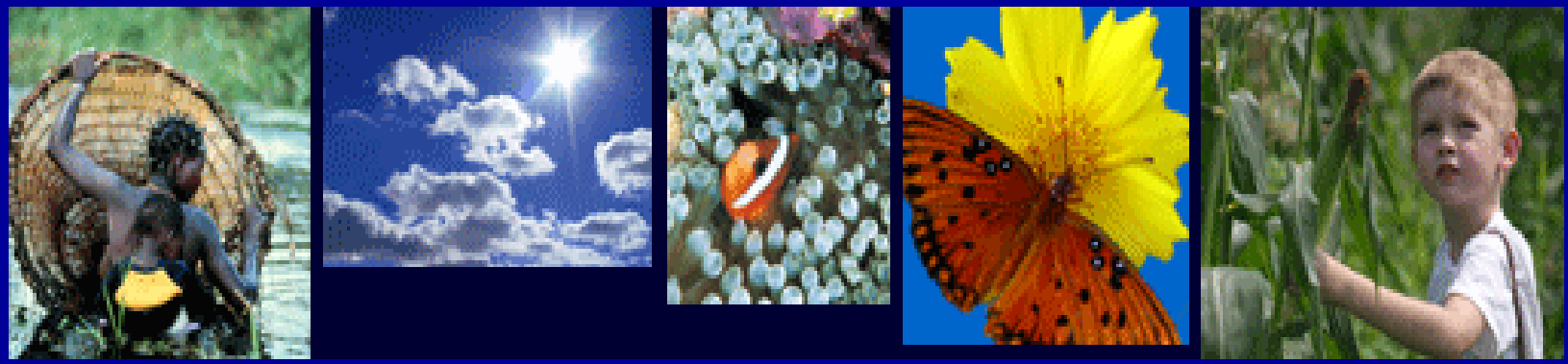

http://chge.med.harvard.edu

http://www.climatechangefutures.org

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