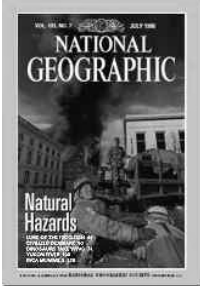


## Natural Hazards



David J. Brenner

- djb3@columbia.edu
- You can download this lecture from [www.columbia.edu/~djb3](http://www.columbia.edu/~djb3)
- Note, no radon today ... much more later!

## 2002 USA Skin Cancer Statistics

➤ Over 1,000,000 new cases of primary skin cancer projected

- 800,000: Basal cell carcinomas
- 160,000: Squamous cell carcinomas
- 53,600: Malignant melanomas

# of deaths due to skin cancer – 9,600  
7,400 – Malignant melanomas

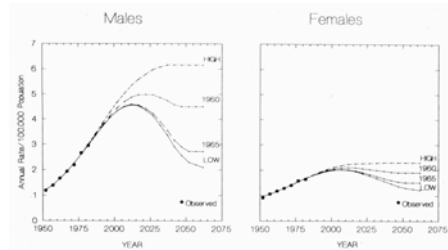
## Malignant Melanoma

Yearly increase in melanoma rate: 3% per year

Lifetime risks for malignant melanoma:

- 1935: 1 in 1,500
- 1980: 1 in 250
- 1991: 1 in 100
- 2002: 1 in 70

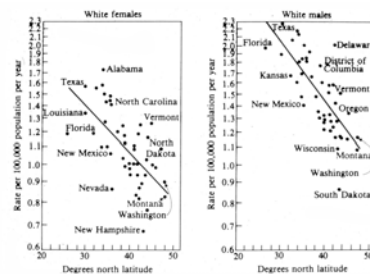
## Malignant Melanoma



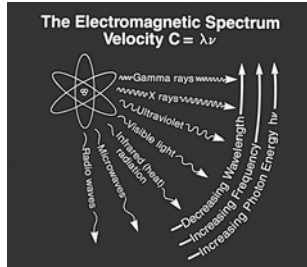
## Malignant Melanoma

- Melanoma is more common than any non-skin cancer among women between 25 and 29 years old.
- Every hour one person dies from melanoma.

## Skin Cancer



## Electromagnetic Spectrum



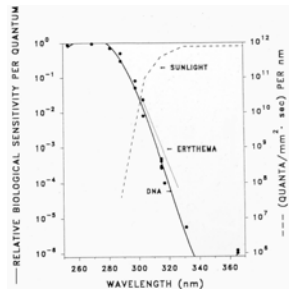
## Ultraviolet (UV) Radiation

**UVC: Wavelength 200 - 280 nm**

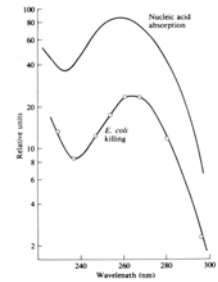
**UVB: Wavelength 280 - 320 nm**

**UVA: Wavelength 320 - 400 nm**

## Absorption of UV Radiation

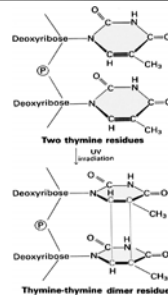


## Biological Effects of UV Radiation



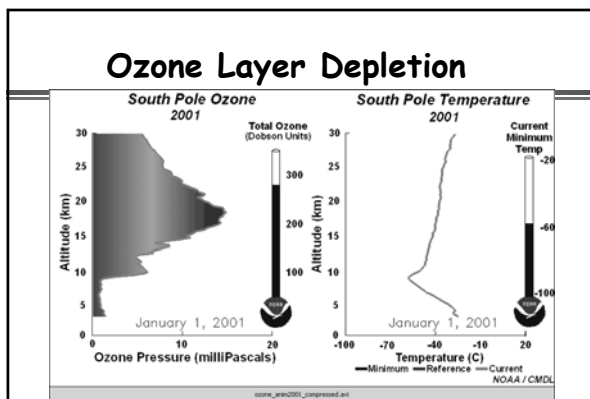
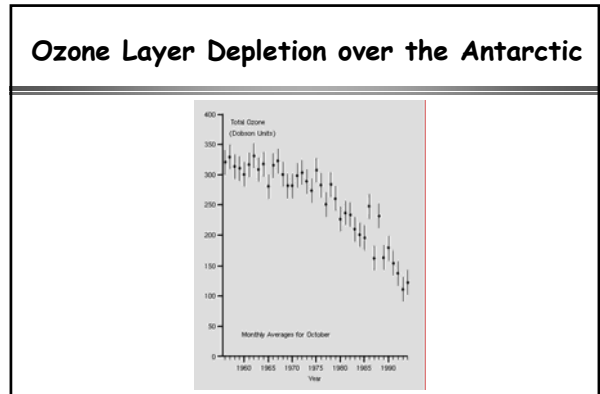
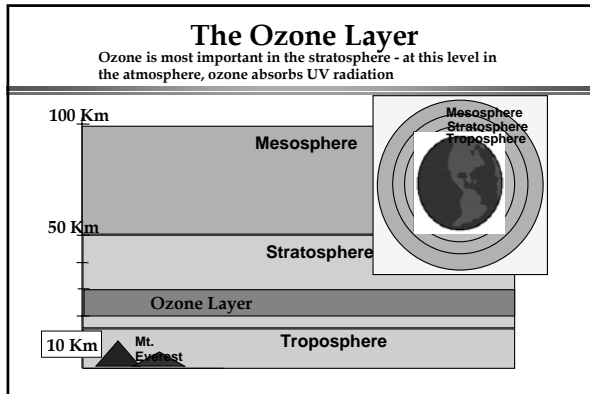
## UVB Irradiation and Thymine-Thymine Dimers

UVB irradiation induces formation of thymine-thymine dimers which alter the local DNA structure



## How do thymine dimers get repaired?





- ### Chlorofluorocarbons (CFC's)
- Chemically inert
  - Highly volatile
  - Used in refrigeration, insulation fire extinguishers, air conditioners, aerosols

### Molina and Rowland, Nature 1974

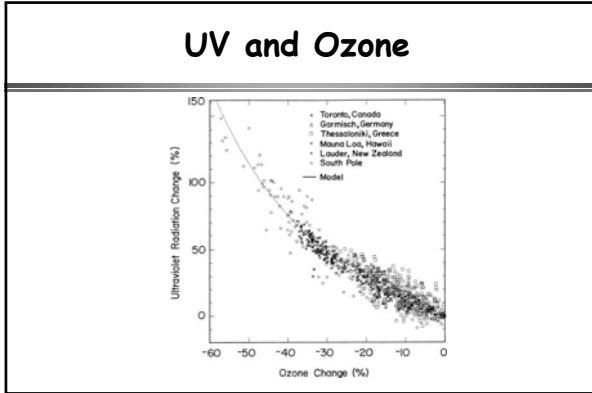
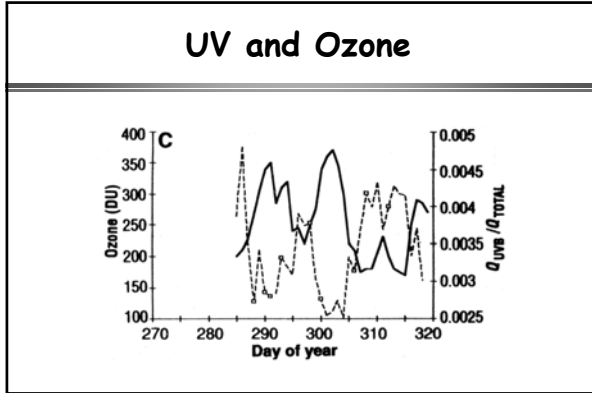
In the stratosphere...

CFCs :  $\text{CCl}_2\text{F}_2 \rightarrow \text{CClF}_2\cdot + \text{Cl}\cdot$   
 $\text{Cl}\cdot + \text{O}_3 \rightarrow \text{ClO}\cdot + \text{O}_2$   
 $\text{ClO}\cdot + \text{O} \rightarrow \text{Cl}\cdot + \text{O}_2$

Net:  $\text{O} + \text{O}_3 \rightarrow 2\text{O}_2$

The Cl acts basically as a catalyst:  
 ~10,000  $\text{O}_3$  will break down to  $\text{O}_2$  for every Cl.

- ### Montreal Protocol on Substances that Deplete the Ozone Layer
- Signed 1987
  - Ratified by over 50 countries
  - Took effect 1989
- Development of HCFC's and HFC's  
 Less Cl, more H.



### 1987 EPA Estimates

1% reduction in stratospheric ozone  
 ⇒ 2% increase in UVB on Earth

2-3% average global decrease in ozone,  
 1968-1988

### Have UVB levels increased?

**Table II.** UVB levels from 1974 to 1985 with Robertson-Berger meters at 297 nm

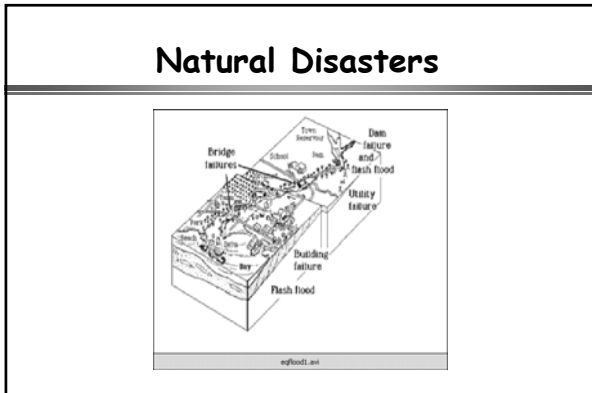
Location	Monthly average UVB level
El Paso, Tex.*	11% decrease
Florida*	Slight decrease
Albuquerque, N.M.*	Slight decrease
Oakland, Calif.*	Slight decrease
Minnesota*	Slight decrease
Fort Worth, Tex.*	No change
Philadelphia, Pa.*	No change
Bismarck, N.D.*	No change
Mauna Loa, Hawaii†	No change

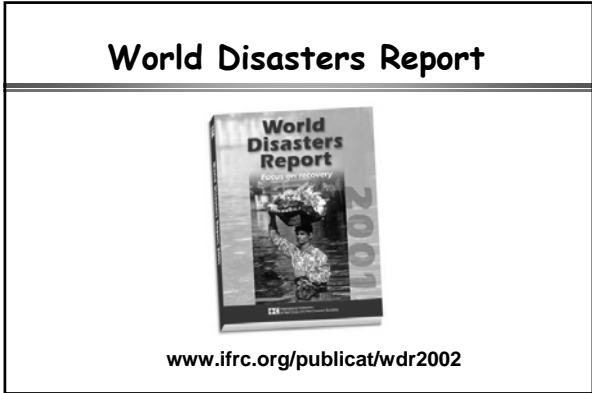
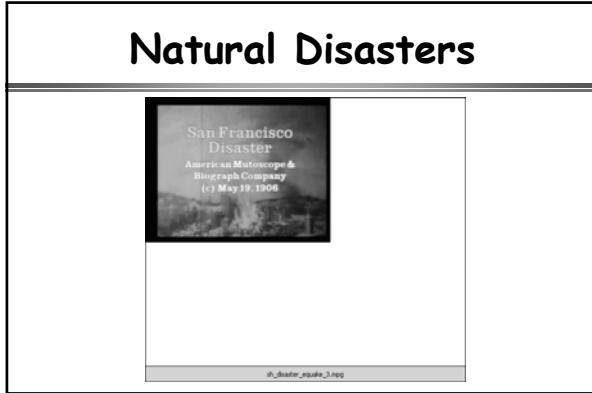
\*From Scotto JG, Cotton F, Urbach F, et al. Science 1988;239:762-4.  
 †From Urbach F. Photochem Photobiol 1989;50:507-13.

### Sunbathing

Exposure Situation	Risk of NMSC at age 70 (%)
Indoor worker, no sunbathing	2-3
Indoor worker, sunbathing 2 wks / year	10-15
Indoor worker, sunbathing 4 wks / year	20-60

Diffey et al: Photoderm 1987, 4, 118-26





### Natural Disasters

10 Deadliest Natural Disasters of the 20<sup>th</sup> Century

	Country	Year	Disaster	Killed
1	China, P Rep	1931	Flood	3,700,000
2	China, P Rep	1928	Drought	3,000,000
3	China, P Rep	1959	Flood	2,000,000
4	India	1942	Drought	1,500,000
5	India	1900	Drought	1,250,000
6	Soviet Union	1921	Drought	1,200,000
7	China, P Rep	1920	Drought	500,000
8	China, P Rep	1938	Flood	500,000
9	China, P Rep	1939	Flood	500,000
10	India	1965	Drought	500,000

### Lima vs Japan

Why do earthquakes in Lima kill, on average, 50 times as many people, as comparably-sized earthquakes in Japan?

Note: the two countries have comparable population densities.

### Risk of Disaster

**Risk of Disaster = Hazard x Vulnerability**

**Hazard = Probability of a potentially damaging natural phenomenon**

**Vulnerability = Probability of a structure subject to a given hazard being damaged / destroyed**

### Japan vs Lima

**Different vulnerability...**

**Parts of Lima have:**

- overcrowded conditions
- unsuitable buildings
- dilapidated buildings
- limited movement options for inhabitants

## Disaster Prevention

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### Two Conceptual Approaches

**Dominant:** Concentrates on hazard prevention / prediction

**Political:** Concentrates on vulnerability seen as the consequences of socio-economic processes

## Disaster Mitigation

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### “Top down” mitigation

- before or after a disaster
- flood defenses
- disaster relief
- large scale
- high tech


## Top-Down Approach

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### An Example: Peru, 1970, Huaraz earthquake



Before



After

## Top-Down Approach

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### An Example: Peru, 1970, Huaraz earthquake


**Government reconstruction plan:**

➤ Seismo-geological zoning	✓ Three years spent on zoning
➤ Construction of new housing	✓ No reconstruction allowed during this time
➤ Reconstruction of infrastructure	✓ Housing built in marginally vulnerable areas
➤ New-housing credits	✓ Housing credits to middle class only

## Top-Down Approach

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### Bolivia, 1983 Drought



## Top-Down Approach

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### Bolivia, 1983 Drought

**Bolivian Government National Emergency Plan:**

➤ Creating new farms in non-drought regions	✓ 23% of planned new farms built
➤ Digging wells	✓ No wells dug
➤ Providing new potato seed	✓ No potato seed distributed
➤ Distribution of emergency food	✓ Food distribution successful

### Critiques of "Top down" Mitigation

- Failure to address vulnerability
- Failure to involve people
- Susceptibility to manipulation

### Successful Mitigation

**An important aspect of successful mitigation seems to be involvement of community-based organizations**

### Example: Ecuador, 1982-83, Rural Areas Flooding



### Example: Ecuador, 1982-83, Rural Areas Flooding

Program organized by UNOCAVB  
(Union de Organizaciones Campesina de Vines-Baba)  
Confederation of 30 peasants' organizations

- Distribution of food supplies by local distribution committees
- Set up of local health committees
- Assistance from government technical staff

### Are we doing better?

Natural disasters now kill an average of 100,000 people / yr, compared with 3 million / yr between 1900 and 1920

But the number affected by natural disasters has increased from 50 million / yr in 1950 to 200 million / yr now

### Compound Disasters are Increasing

Compound disasters: Disasters involving both natural and technological hazards

Flooding along the Mekong river (2000/2001)

- \* Partly bad luck - long monsoon season
- \* Partly man made - illegal logging

**Vietnam government recommended flood relief support  
for consideration by the UN disaster management team**

*September, 2001*

- Life-vests for children (Must keep head out of water)
- Assist local people to setup kindergartens in potential deeply flooded areas, and in remote areas (Salaries for child-care, and food for children).
- Communication equipment
- Rescue boats and canoes
- Boats, canoes, and fishing nets for poor households
- Temporary houses for evacuated households.
- Water treatment equipment and water treatment chemicals for residents in deeply flooded areas and in remote areas.
- Food, especially processed foods for people that have been moved to safe havens.

## **Compound Disasters**

**The “developed” countries  
are certainly not immune  
from compound disasters!**