

Effects of Climate Change on Africa



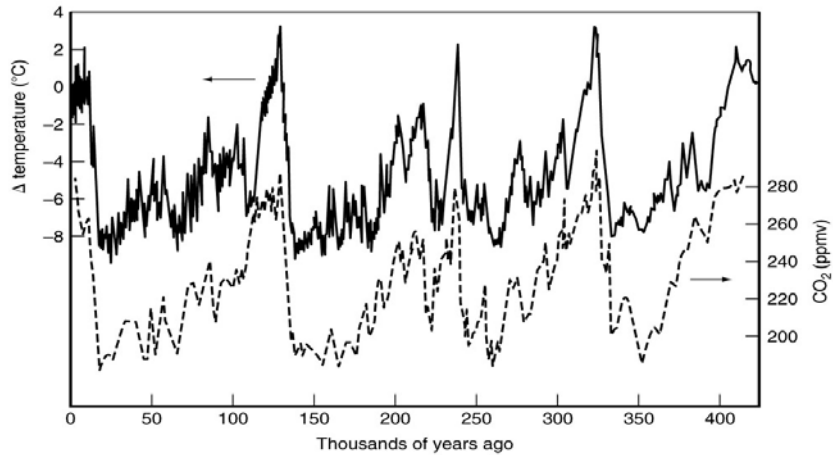
Dr. David Karowe
Department of Biological Sciences

Outline of this afternoon's talk

- 1. Patterns and causes of recent climate change**
- 2. Predicted future climate change**
- 3. Effects of future climate change on African plants and animals**
- 4. Effects of future climate change on human health in Africa**
- 5. Solutions**

Earth's climate has always been changing

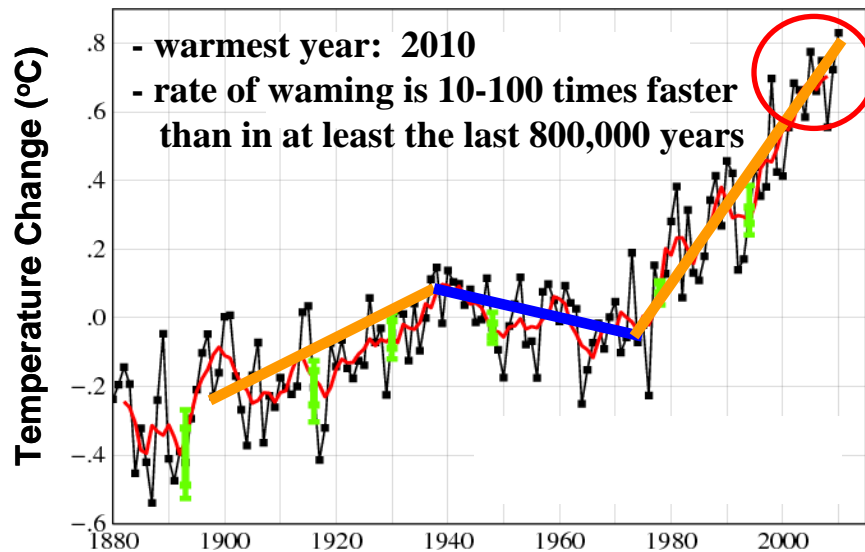
Over the past 800,000 years:

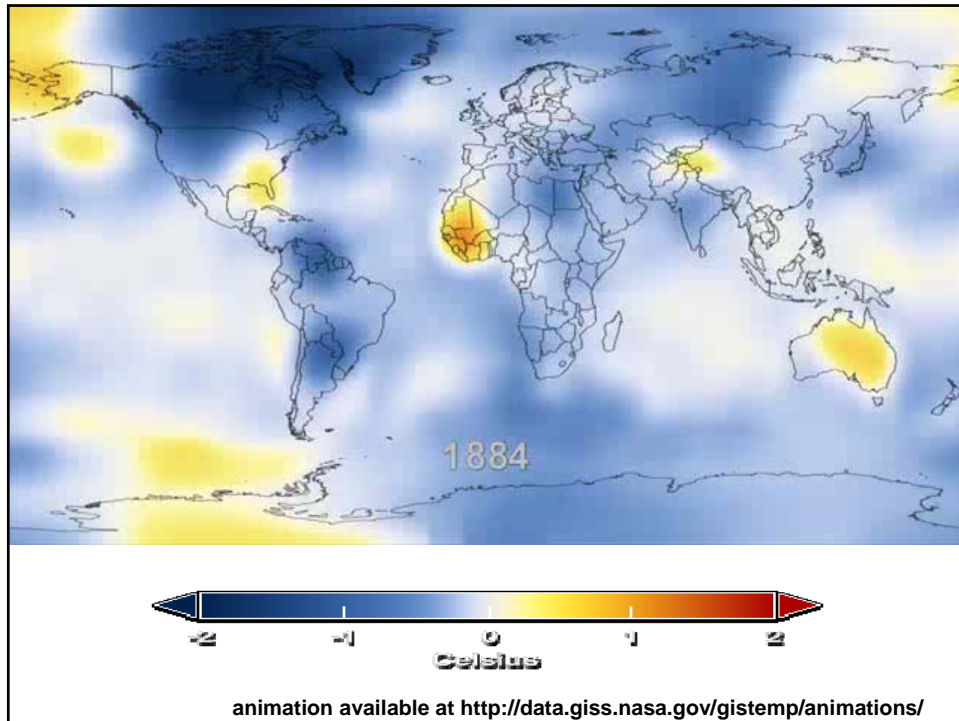


~ 100,000-year climate cycles, due to cyclic changes in amount of solar radiation

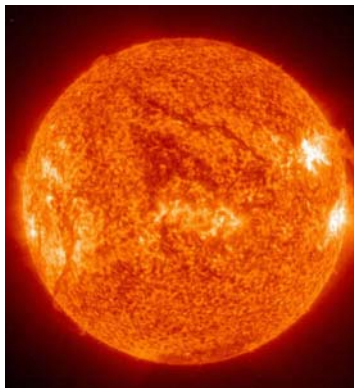
Since 1900, Earth has warmed by ~ 0.8° C

10 warmest years in history: 2002-2010, 1998





Can climate change be due to “natural variation”?



For the last 30 years, solar input has been decreasing

**Since 1900, “natural factors” would have caused
a slight cooling of Earth**

Bottom line: At least 95% of global warming is due to human activities

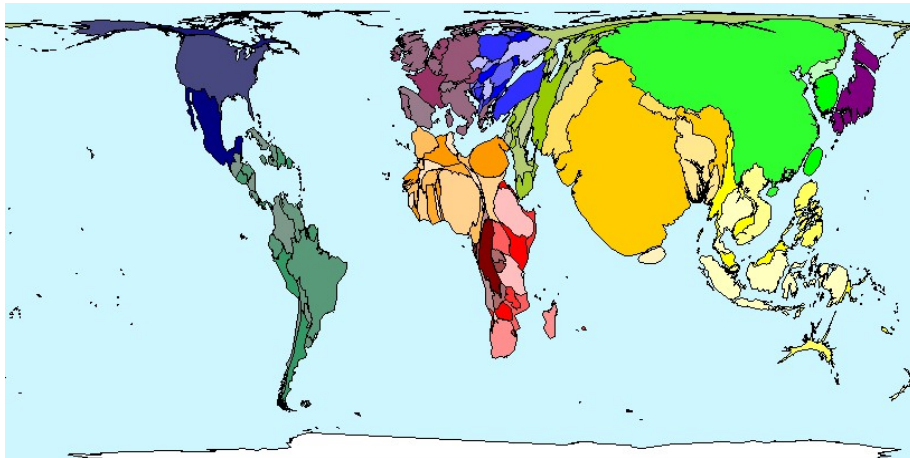


Fossil fuel use (~80%)

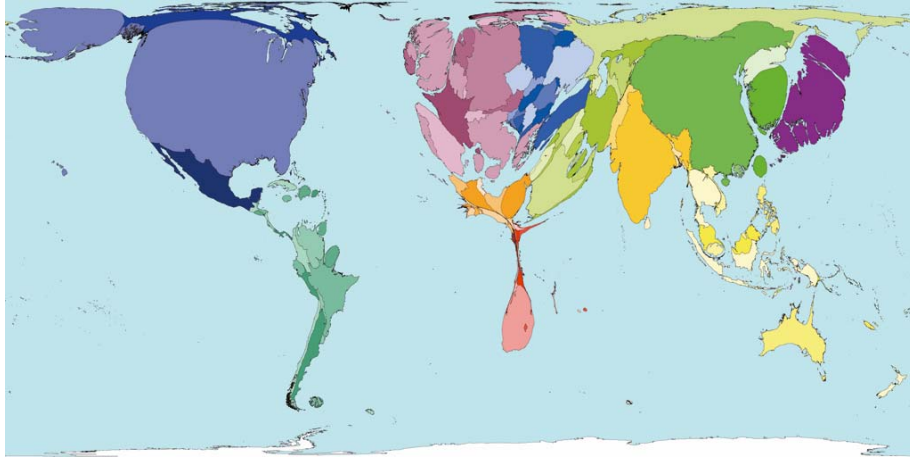


Deforestation (~20%)

Size proportional to population

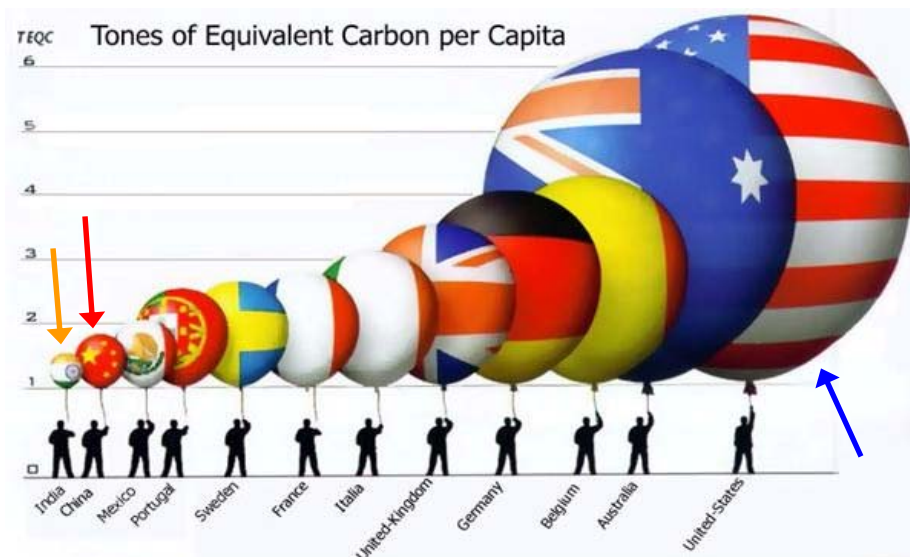


Size proportional to national CO₂ emissions



Midwest would be 4th highest emitting country

U.S. emits the most carbon per person



On average, CO₂ stays in the atmosphere for ~100 years

Average U.S. citizen generates 20 tons of CO₂ per year



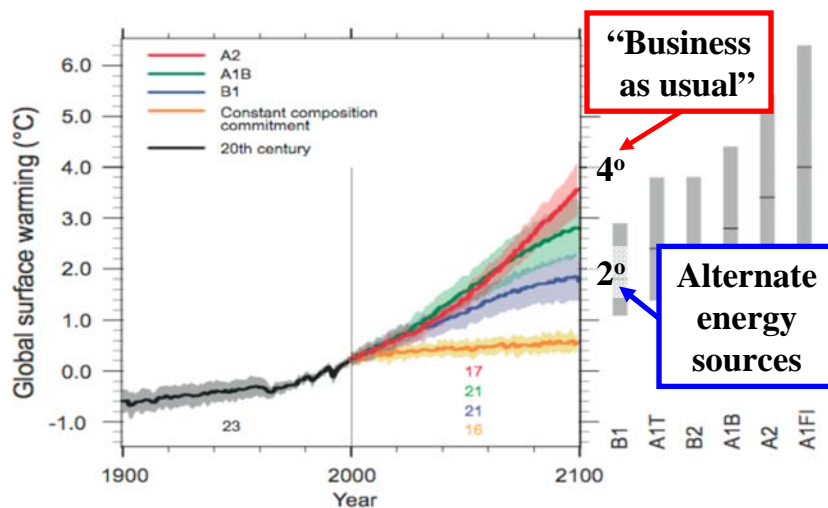
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What does the future hold?



Climate change is very likely to accelerate
Earth is expected to warm by at least 2-4° C by 2100

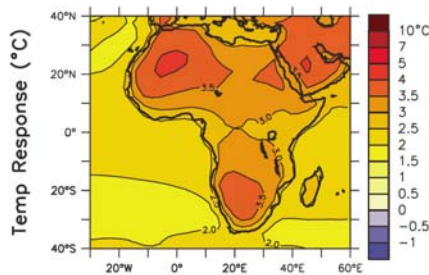


Will a 4° temperature rise matter?

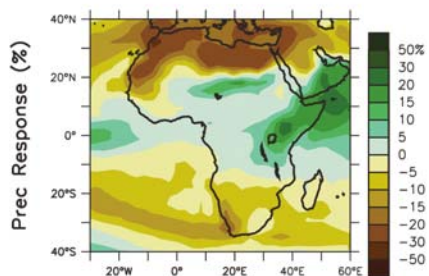
When Earth was 5° cooler:



**By 2100, most of Africa is predicted to warm by
at least 3-4° C**

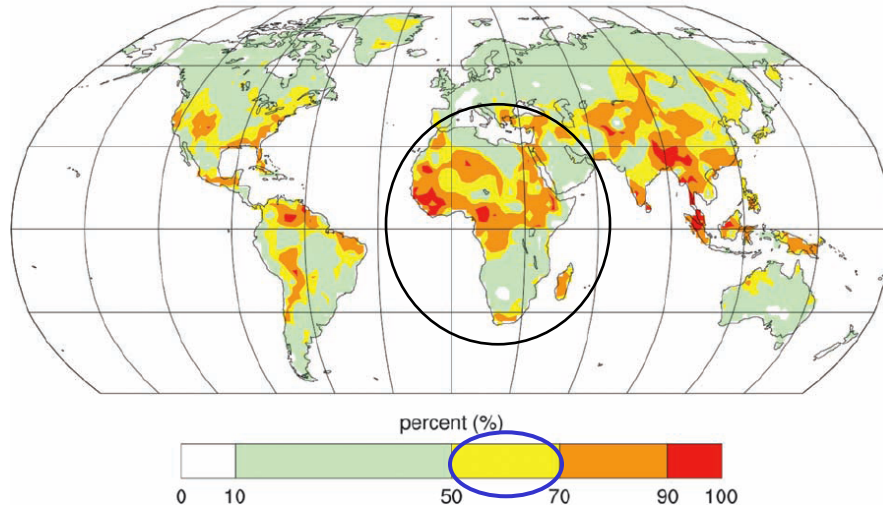


**Precipitation is
predicted to
increase in Central
Africa, but decrease
in north and south**



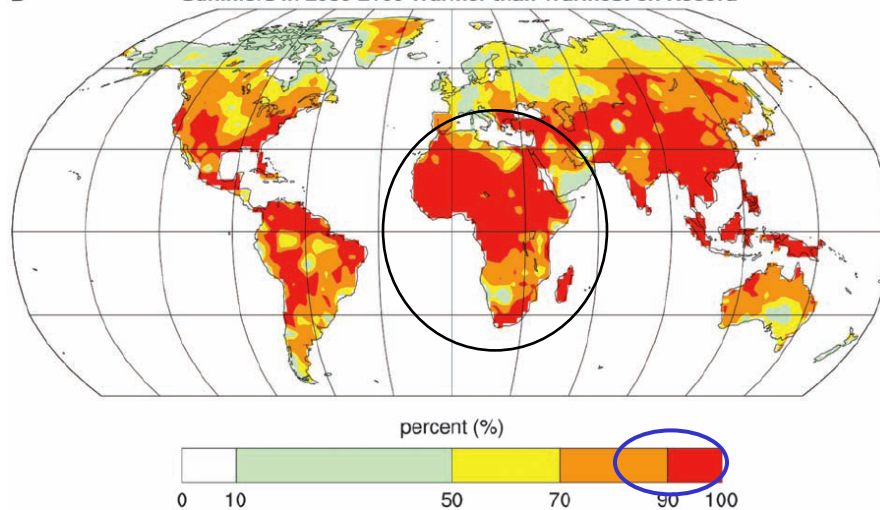
In the future, most summers are likely to be hotter than any experienced thus far

A Summers in 2040-2060 Warmer than Warmest on Record

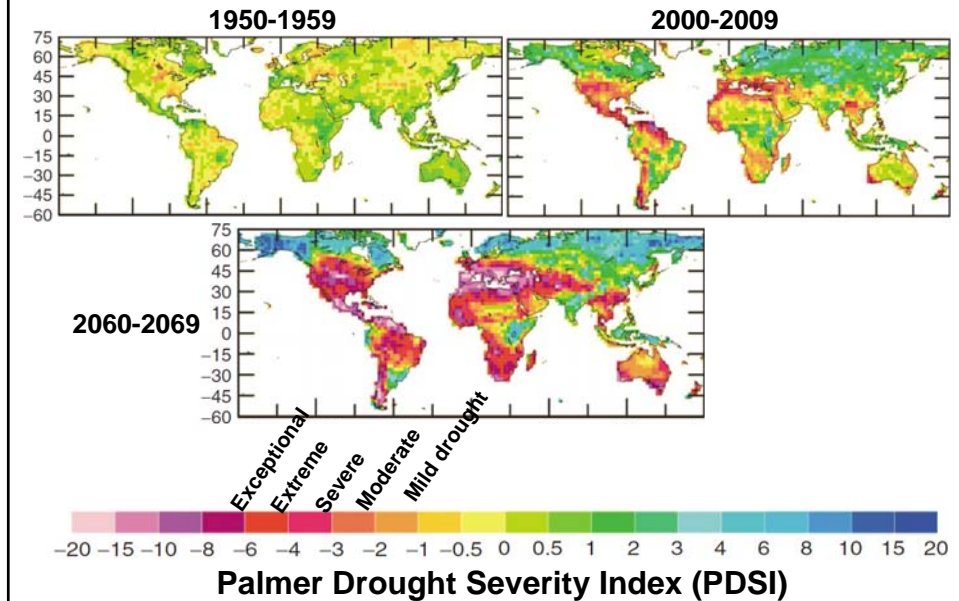


In the future, most summers are likely to be hotter than any experienced thus far

B Summers in 2080-2100 Warmer than Warmest on Record



Much of Africa is likely to experience much more frequent and stronger droughts by the 2060s



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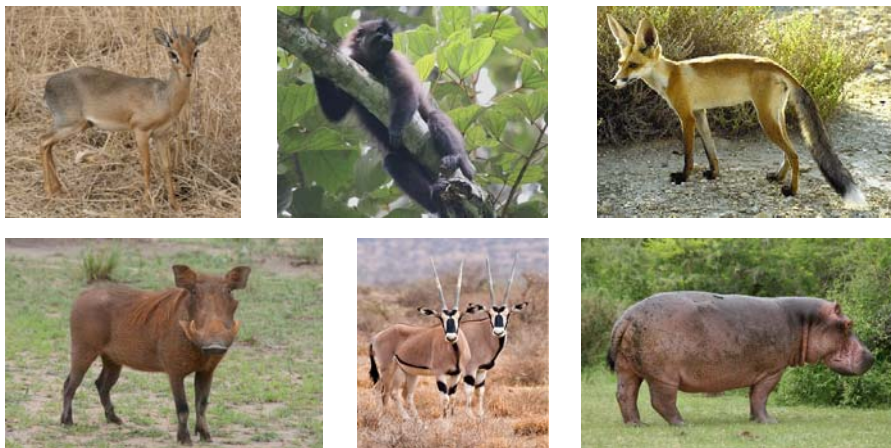
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Huge losses are predicted for 5,200 African plant species, even with “full dispersal”



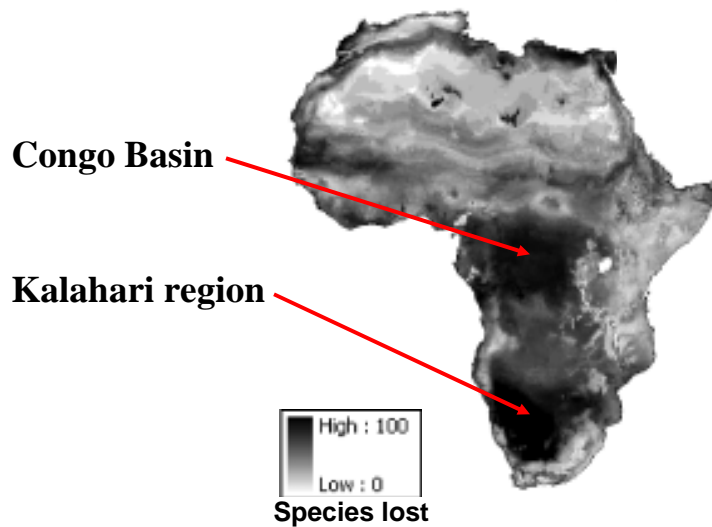
- 41% species extinction by 2085
- decreased habitat for 81-97% of species

African mammals are likely to be adversely affected

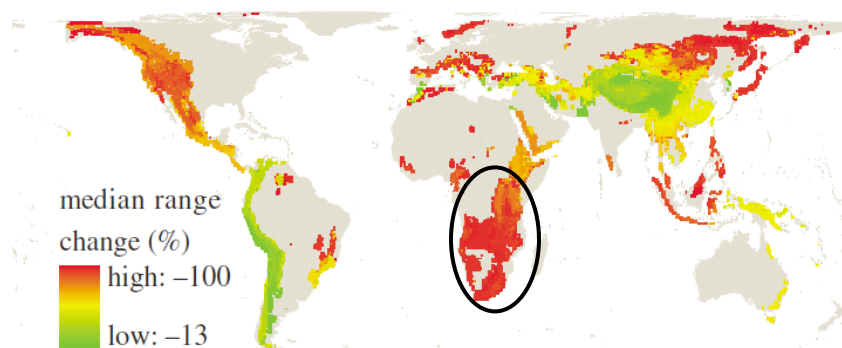


- Of 227 species, 20% are predicted to be extinct by 2080 even with full dispersal**
- 40% extinction with no dispersal

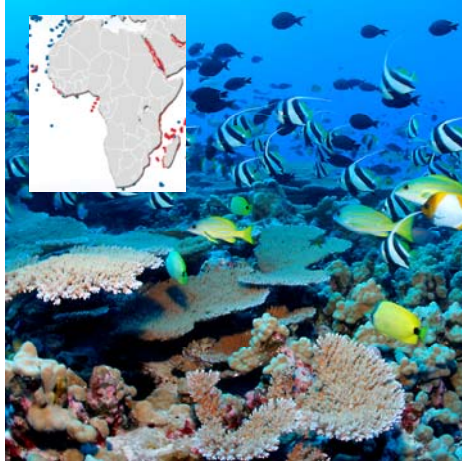
Species loss predicted to be highest in Congo Basin and Kalahari region



By 2100, 38% of Africa's montane bird species are predicted to lose at least half of their range



**Possible loss of all African coral reefs with 3° rise
and >650 ppm CO₂**

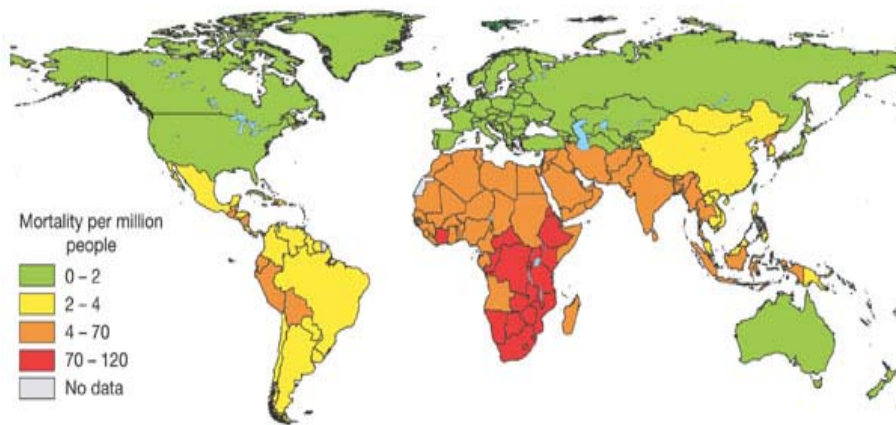


- due to ocean warming and acidification

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World Health Organization estimates that climate change already kills 150,000 people annually

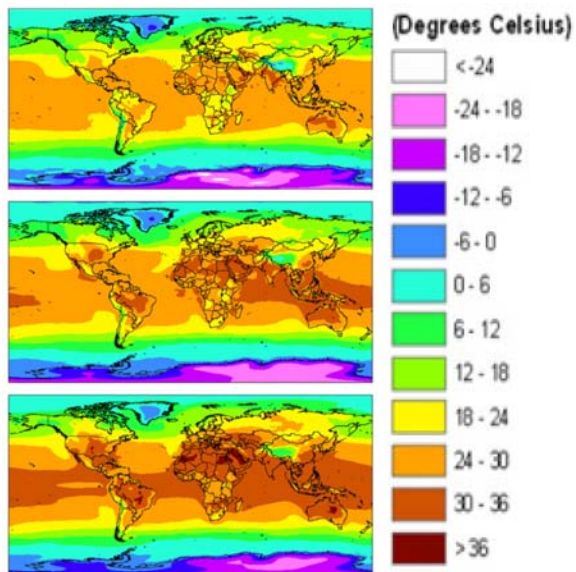


- death rates are greatest in Africa

How can future climate change affect human health in Africa?

- 1. Increased heat stress and/or decreased cold stress**
- 2. Change in frequency and/or severity of disease**
- 3. Change in rates of malnutrition**
- 4. Change in air quality**
- 5. Change in frequency and/or severity of conflict**

Heat waves are likely to become more intense



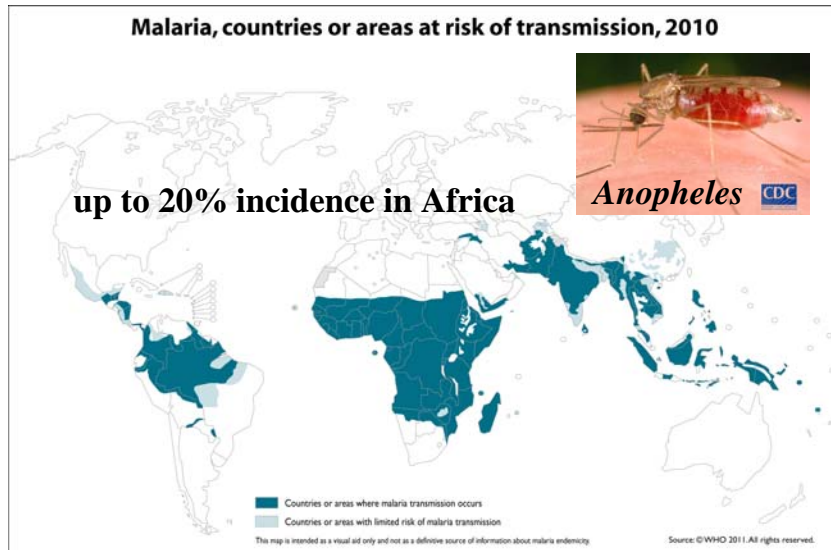
Maximum temperature during a heat wave is likely to increase by 15-20° F

- but increased mortality is hard to quantify

How could climate change affect human health?

1. Increased heat stress and/or decreased cold stress
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Likely increase in vector-borne diseases *e.g.* malaria



**WHO estimates 250,000,000 cases annually,
resulting in 1,000,000 deaths**



- on average, an African child has 1.5 to 5.5 episodes of malaria fever each year
- every 30 seconds a child dies from malaria

How can climate change affect malaria incidence?

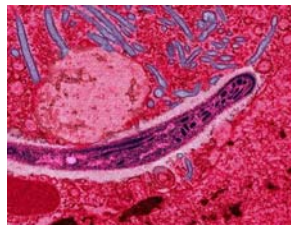
1. Change in geographic range of vector (*Anopheles*)
2. Change in length of transmission season



Anopheles gambiae

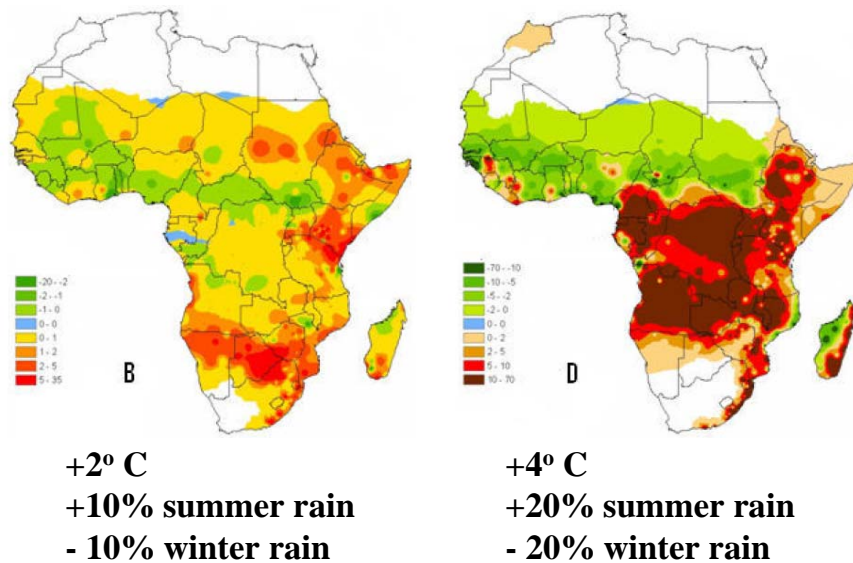


Anopheles arabiensis

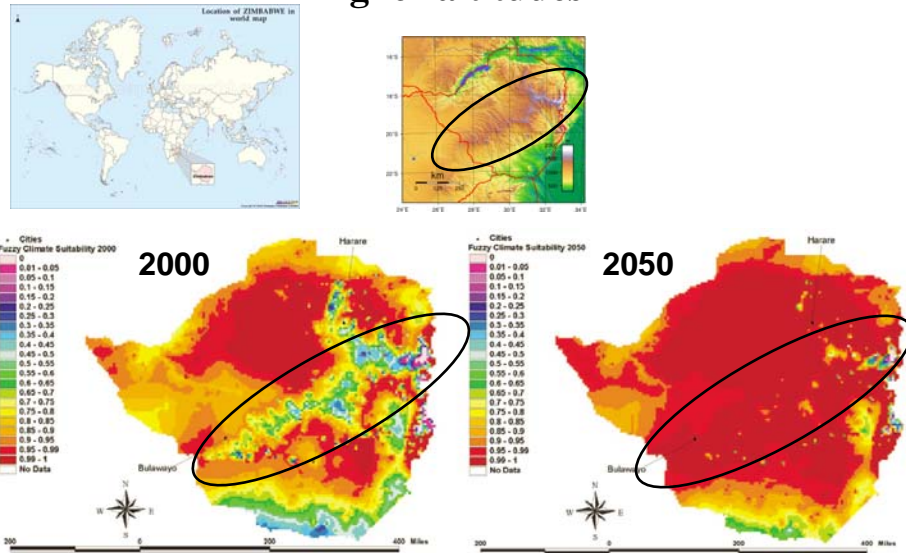


Plasmodium falciparum

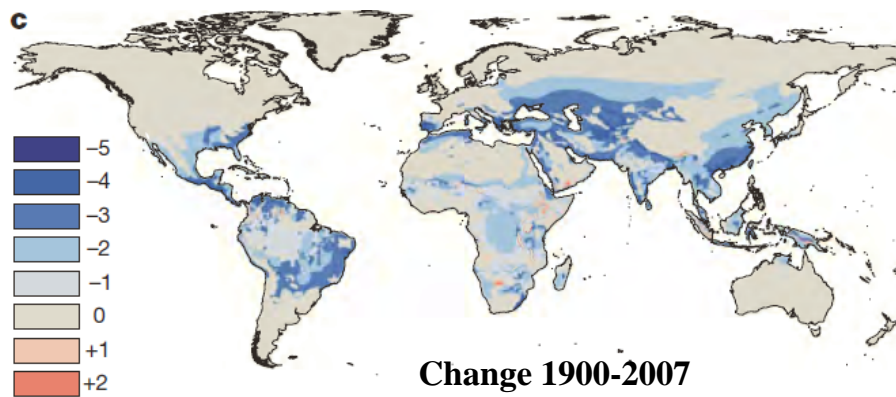
Anopheles range predicted to increase, but change depends on climate scenario



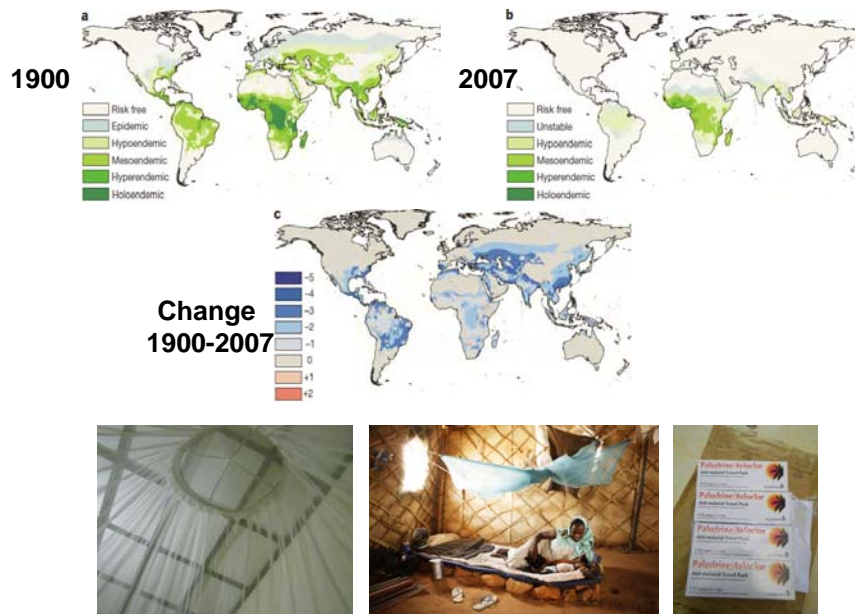
In Zimbabwe, *Anopheles* range increases mostly to higher altitudes



But malaria can be diminished by “adaptation”



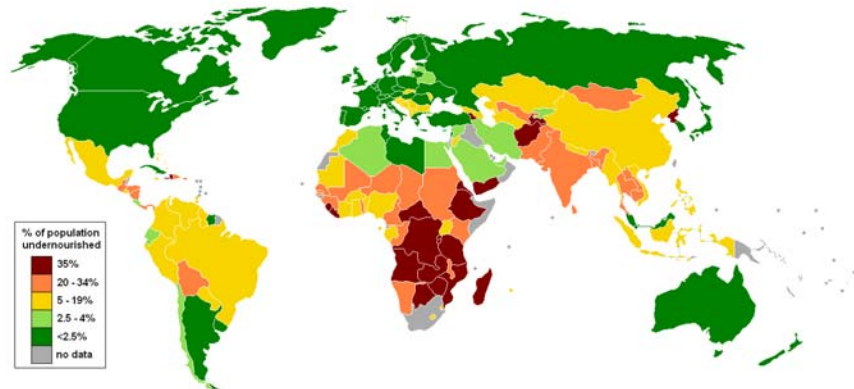
But malaria can be diminished by “adaptation”



How could climate change affect human health?

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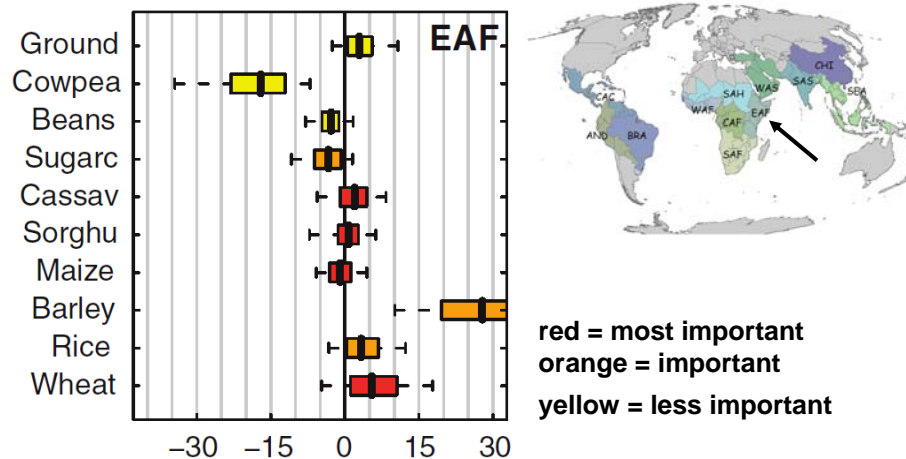
**UN Food and Agriculture Organization estimates
1.02 billion hungry people worldwide**



- in most African countries, 20-35% of children under 5 are chronically malnourished

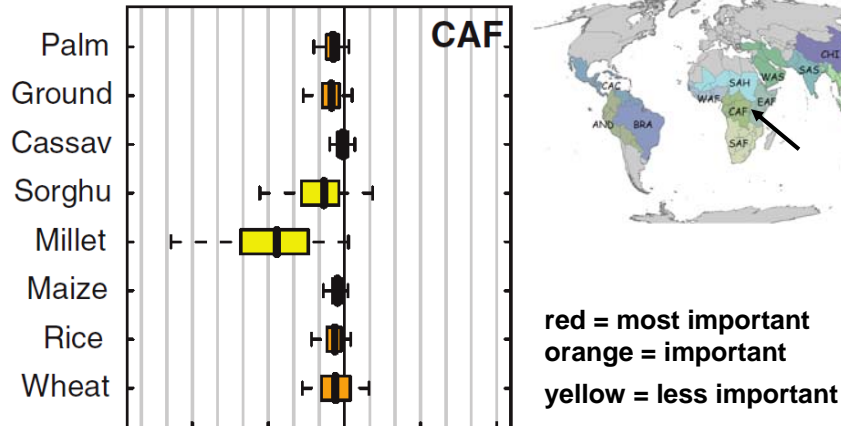
**In East Africa, most of the important crops are
predicted to have slightly increased yields by 2030**

EAF = 79,000,000 malnourished people



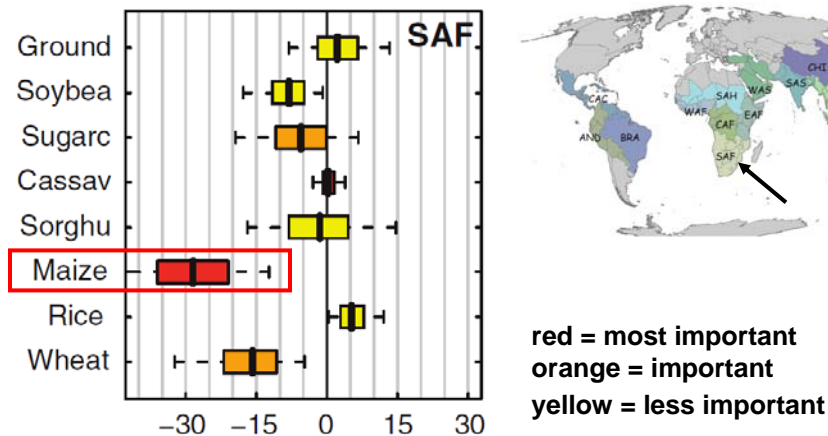
In Central Africa, the important crops (cassava and corn) are predicted to have slightly decreased yields by 2030

CAF = 48,000,000 malnourished people

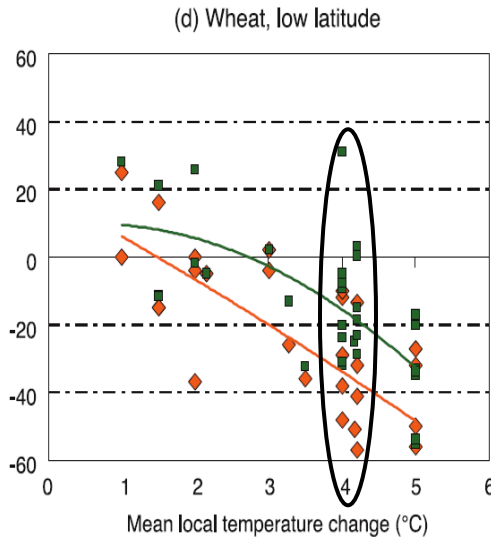


In Southern Africa, the important crop (corn) is predicted to have strongly decreased yields by 2030

SAF = 33,000,000 malnourished people



But yields of most crops is predicted to decline sharply as climate change continues



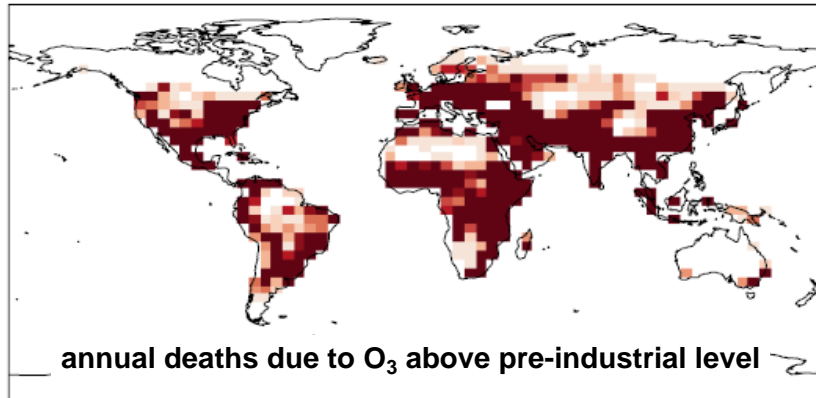
e.g. wheat yields decline by 20-40% with 4° warming

- and all predictions ignore severe weather events, including droughts

How could climate change affect human health?

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**By 2050, increased ozone is predicted to cause
~2 million deaths**



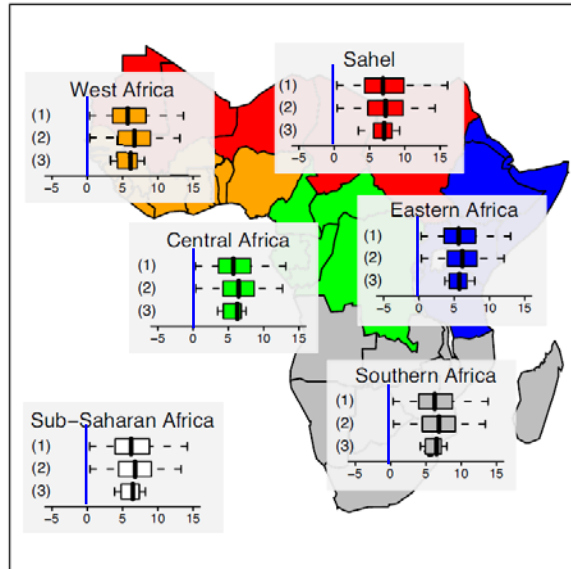
-1000 -500 0 500 1000 people

- global human health cost estimated to be \$580 billion/yr
- substantial agricultural costs also

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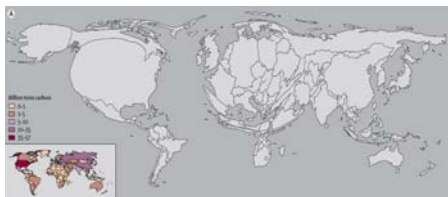
Climate change is predicted to increase civil wars in six African regions by 5-10% by 2030



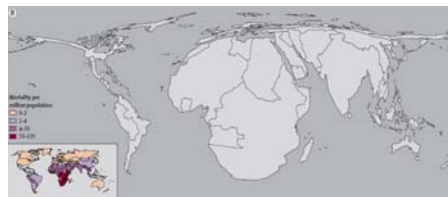
- and, overall, in sub-Saharan Africa by
44% (2° rise)
48% (3° rise)
54% (4° rise)

Developed countries are causing the problem, but developing countries experience most health costs

Countries proportional to CO₂ emissions (1950-2000)



Countries proportional to climate-sensitive health effects



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To avoid this future, we need to rapidly and substantially reduce greenhouse gas emissions

80% reduction by 2050 to avoid worst scenarios

Urgent need for alternate energy sources



Solar



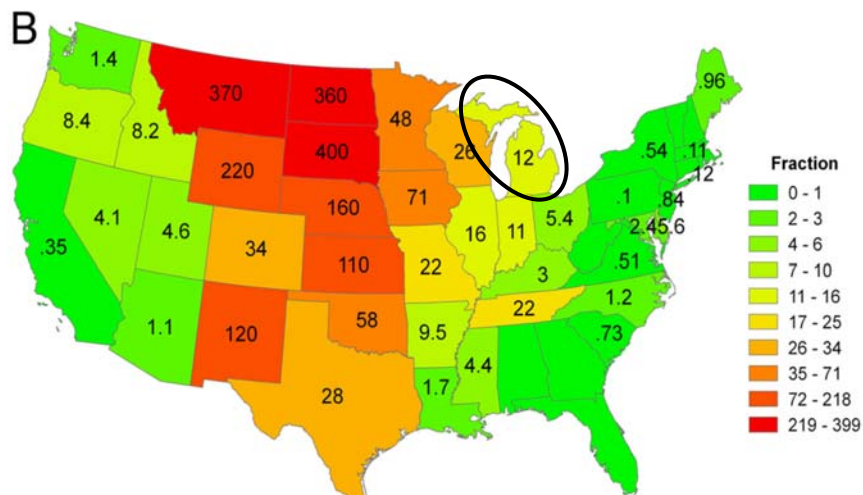
Wind

**The TRUE COSTS of wind and solar are already
lower than coal-generated electricity**

True cost per kilowatt hour of power

| | |
|----------------|-----|
| Coal: | 26¢ |
| Offshore wind: | 3¢ |
| Onshore wind: | 6¢ |
| Solar troughs: | 11¢ |
| Solar towers: | 20¢ |
| Solar PV: | 40¢ |

**Wind power could supply 16 times current U.S.
electricity demand using only onshore windmills**



- Michigan can supply 12 times our current use

Concentrating Solar Power (CSP) is very promising



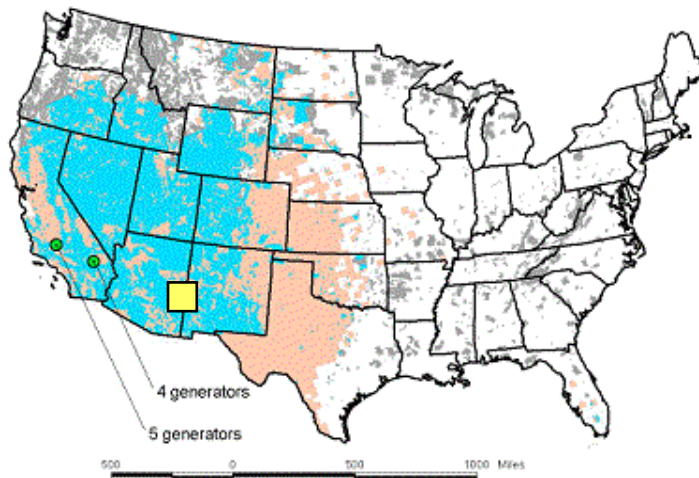
Central tower



Parabolic trough

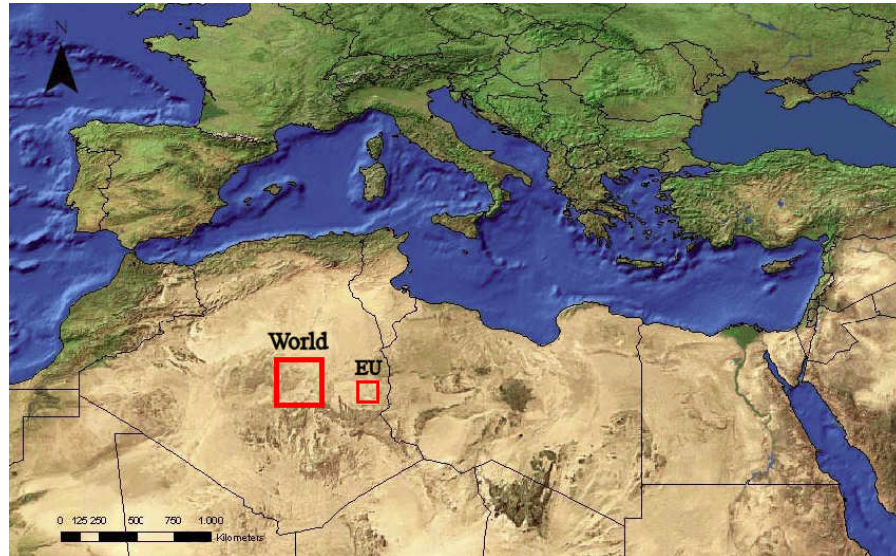


**A CSP solar array 100 x 100 miles could provide
all of U.S. electricity needs today**



**- excess energy captured during the day could be stored
as heat and used to produce electricity at night**

A small portion of the Sahara desert could supply all of Europe's electricity (and the world's)



What can I do in the meantime to minimize adverse impacts of climate change?

1. Next time, buy a more fuel-efficient car



Increasing by 10 mpg saves \$585 and 1.6 tons of CO₂ per year

2. Weatherize your house: weather-strip, insulate the attic, and replace single-pane windows with triple-pane windows



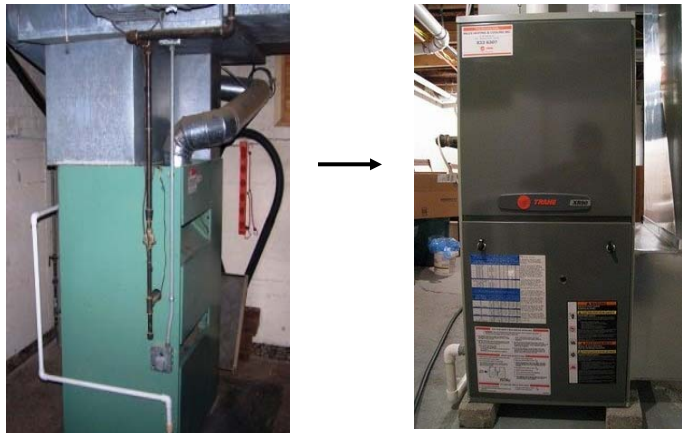
- would reduce U.S. CO₂ emissions by 21 million tons/yr

3. Next time, buy energy star appliances



- would reduce U.S. CO₂ emissions by 12 million tons/yr

4. When necessary, replace older furnace and central AC unit with Energy Star model



- would reduce U.S. CO₂ emissions by 11 million tons/yr

5. Change to compact fluorescent light bulbs



- one per household would have the same effect as taking 6 million cars off the road**

6. Turn the thermostat down (winter) or up (summer)



- can save 7 tons of CO₂ per year for a family of four**

7. Buy green electricity



One GreenBlock supports 150 KWh of electricity from wind and landfill methane

- same as driving 3,300 fewer miles/yr
- costs \$1.50/month

Unfortunately, energy conservation is not a solution



- really just delays the inevitable

Who has the largest impact on Earth's future?



9. Vote



10. Educate others



Worst case scenario:

