

Changing Climate

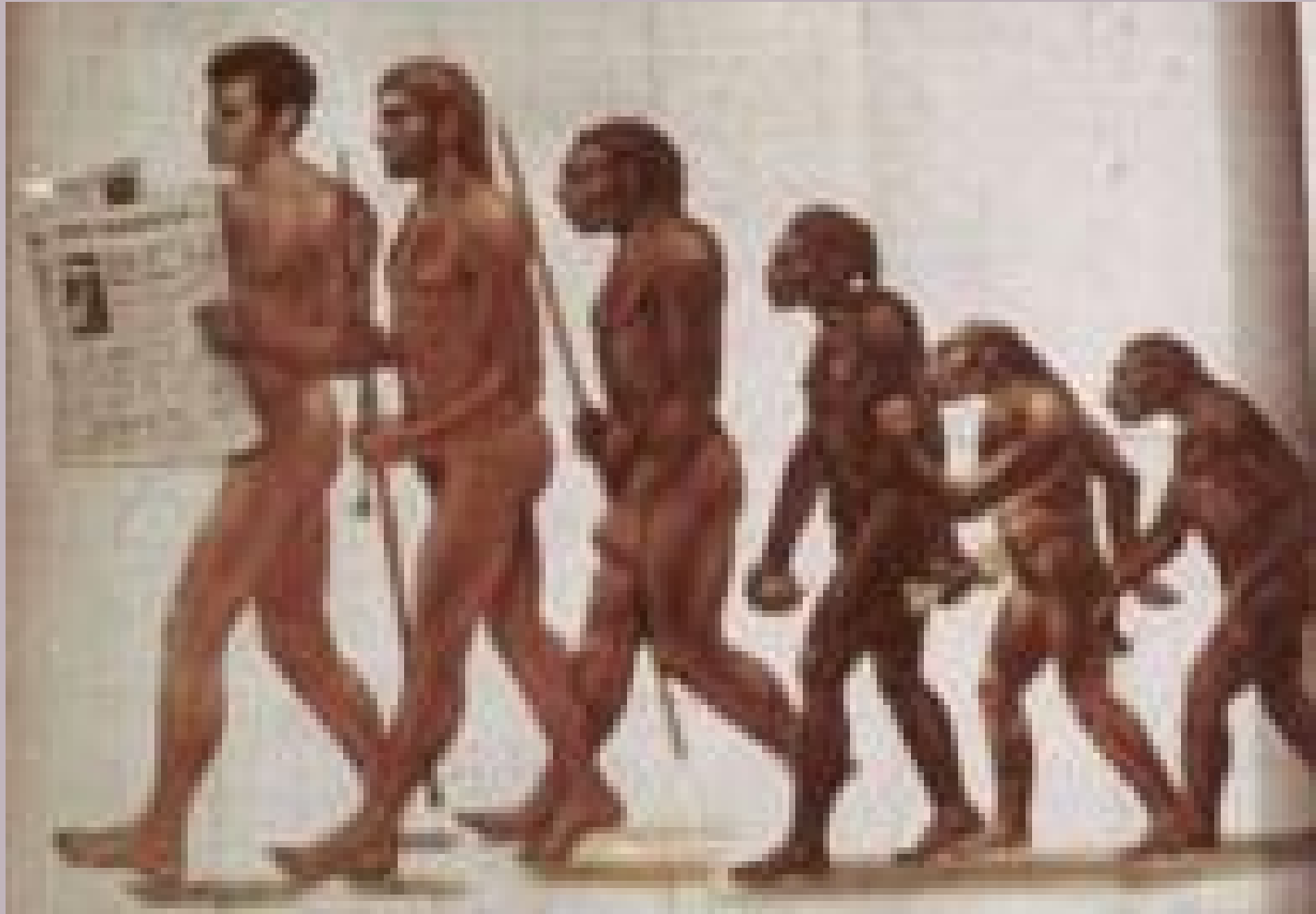


From a presentation

March 28, 2010

Karen Street

Man Evolves



Creates Agriculture



Writing



And ways to put greenhouse gases back into the atmosphere

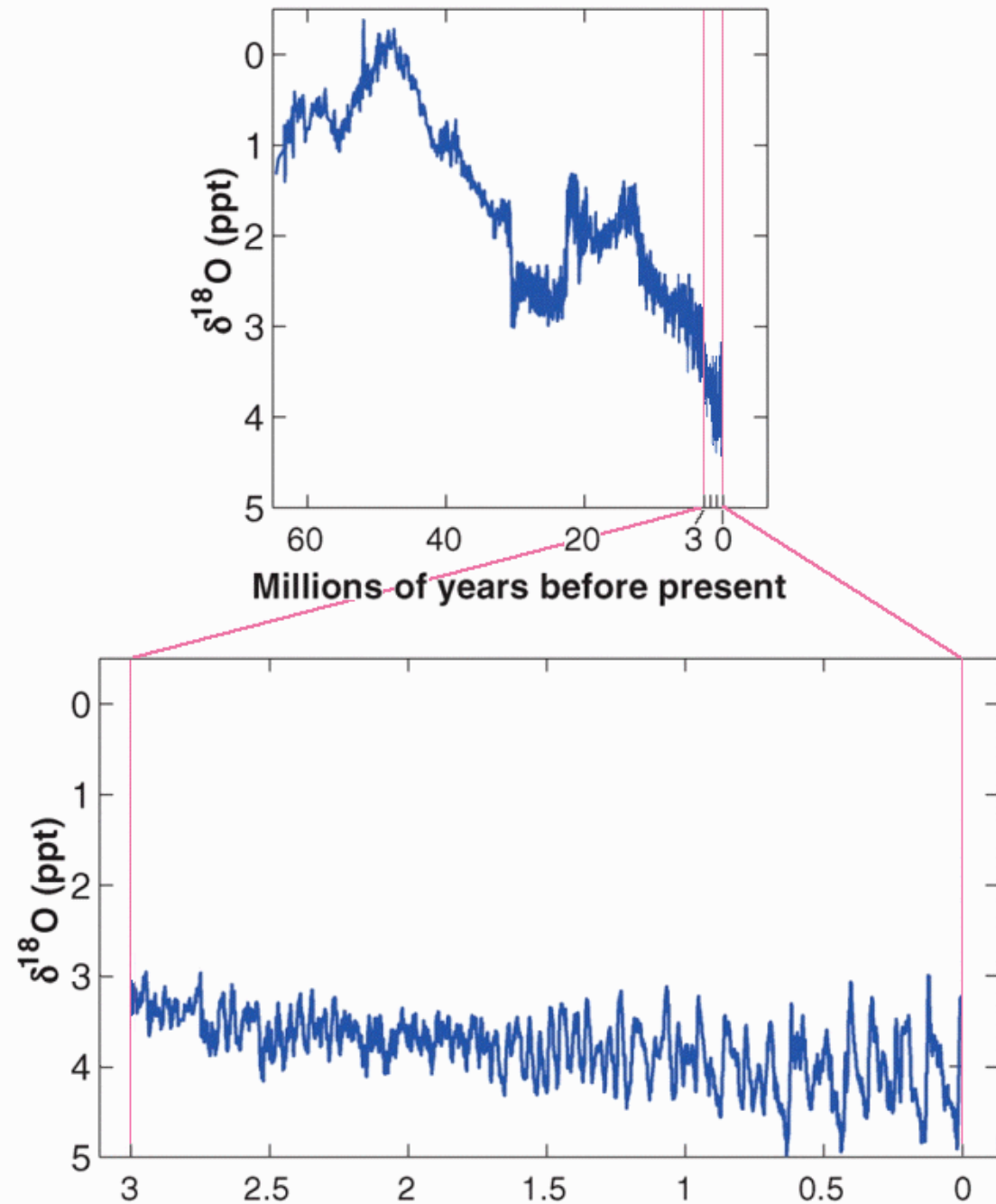


GHG help hold in the heat, and warm the Earth.

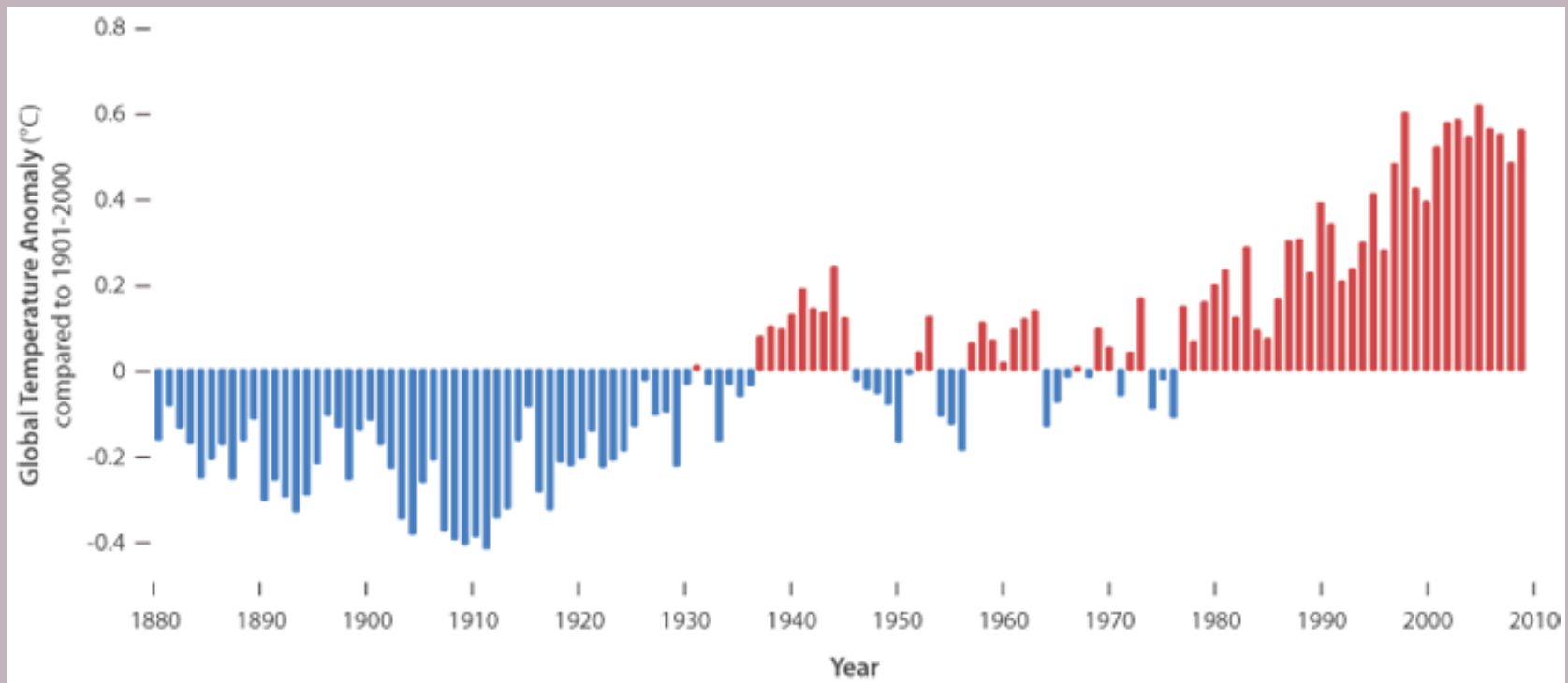
Carbon dioxide, CO_2 and methane, CH_4 are important greenhouse gases.



Natural and
Anthropogenic
(Human Caused)
Variation in GHG
and Temperature



Recent Changes in Temperature



Compared to 1961-90, 0.7°C increase today compared to pre-industrial. Variations caused by volcanoes (cooler), El Ninos (warmer), and added GHG. 1998 extreme El Nino year.

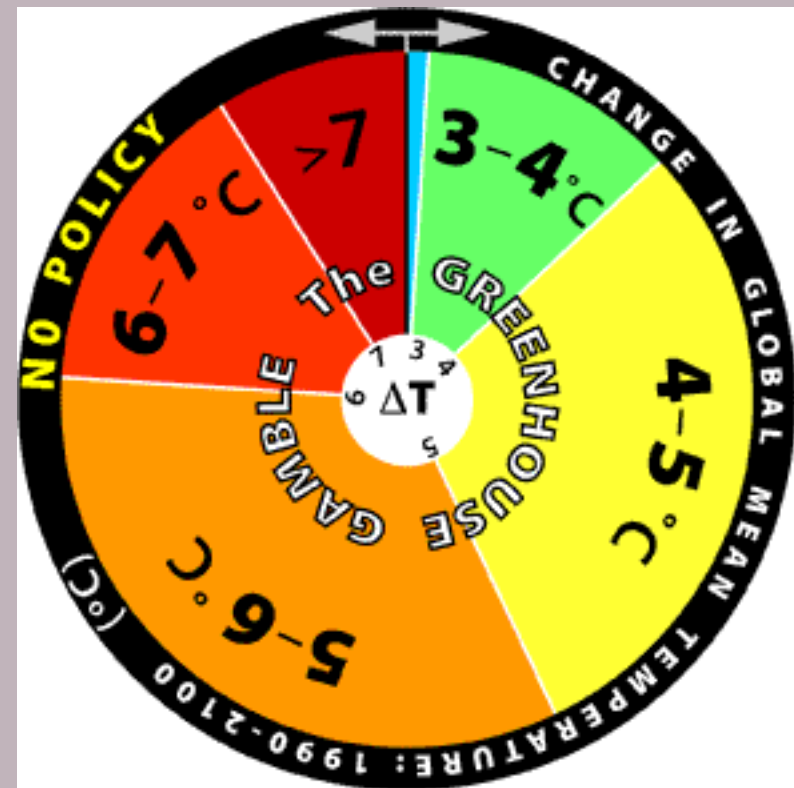
Note: The year 2007 was eighth warmest on record, exceeded by 1998, 2005, 2003, 2002, 2004, 2006 and 2001.

Today

- Temperature increase 0.7°C (1.3°F) by 2000 compared to pre-industrial times. $4 - 6^{\circ}\text{C}$ ($7-11^{\circ}\text{F}$) is the difference between an ice age and today.
- Most climatologists prefer to see $<1.3^{\circ}\text{C}$ (2.3°F) increase this century, and some would like to see even less.
- Policy analysts see these goals as difficult.

Predictions

- Temperature increase expected to be $0.2^{\circ}\text{C}+$ (0.4°F)/decade for at least two decades.
- It could be hot:



More recent MIT prediction—pie graph giving chances of various scenarios.

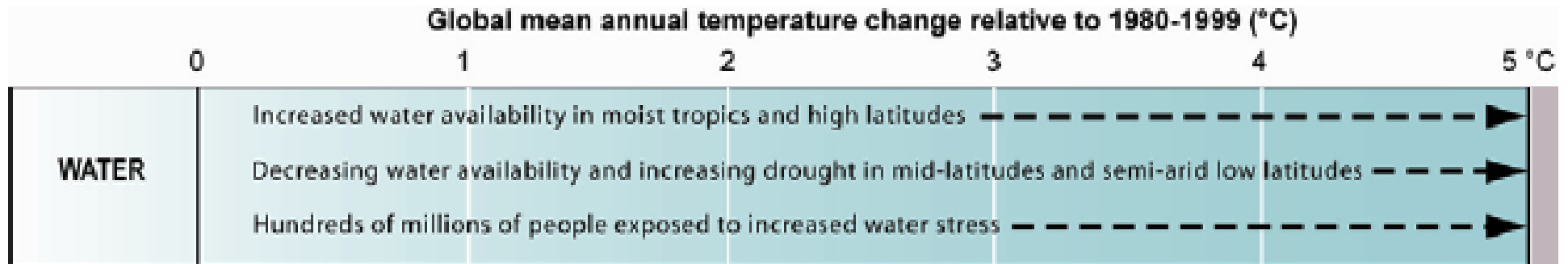
Challenges

International Energy Agency *Energy Technology Perspectives* hopes to keep increase to 1.7°C (3.1°F) this century:

- “A global revolution is needed in ways that energy is supplied and used.”
- “A dramatic shift is needed in government policies.”
- “Unprecedented levels of cooperation among all major economies.”
- “The global energy economy will need to be transformed over coming decades.”

Many think they are too optimistic.

Key Impacts: Water



Temperature increase expected to be 0.2°C+/decade until 2020, then...? Total increase this century: 1.1-6.4°C. However, greenhouse gas emissions are rising faster than the fossil intensive scenario.

Changing currents and changes in land/ocean temperatures alter monsoon patterns.



Causing drought in China and elsewhere, where food doesn't come from the store.

Observation and prediction: more extreme precipitation and more droughts in a warming world.

Worldwide,
hundreds of
millions get their
water from
shrinking
glaciers

Peru



China's Roof of the World Glacier



- half of China's glacier coverage
- shrinking 7%/year

Asia and Fresh Water

“Freshwater availability in Central, South, East and Southeast Asia ... is projected to decrease due to climate change which... could adversely affect more than a billion people by the 2050s.” Worldwide this number could be 2 billion.

Intergovernmental Panel on Climate Change: Summary for Policy Makers: *Climate Change Impacts, Adaptation and Vulnerability*

Ganges River, a
holy site



California: the best scenario

Snow reservoir, which releases water for ecosystems and agriculture in late spring and early summer, will be (almost) gone by the end of this century.



Snow stores water, melts



and some of it makes its way to reservoirs.

But not for much longer.

Worst Case Scenario

Steven Chu:

“I don't think the American public has grasped in its gut what could happen.”

Optimistic: 47% snow pack gone by century end

Pessimistic: 70-90% gone by century end

“I don't see how agriculture can continue. California produces 20 percent of the agriculture in the United States. I don't actually see how they can keep their cities going.”

Not worst enough?



PNAS (2009): *Irreversible climate change due to carbon dioxide emissions*

Carbon dioxide *today*: 390 ppm
Current path: 550 ppm by 2035,
increase at 4.5%/year afterwards

“Among illustrative irreversible impacts that should be expected if atmospheric carbon dioxide concentrations increase...to a peak of 450 - 600 parts per million... are irreversible dry-season rainfall reductions in several regions comparable to “dust-bowl” era and inexorable sea level rise.”

Dust Bowl?



American dust bowl: 10% decrease in rainfall for 15 - 20 years

$\Delta(\text{precipitation} - \text{evaporation})$

Every inhabited continent:

20%/°C warming

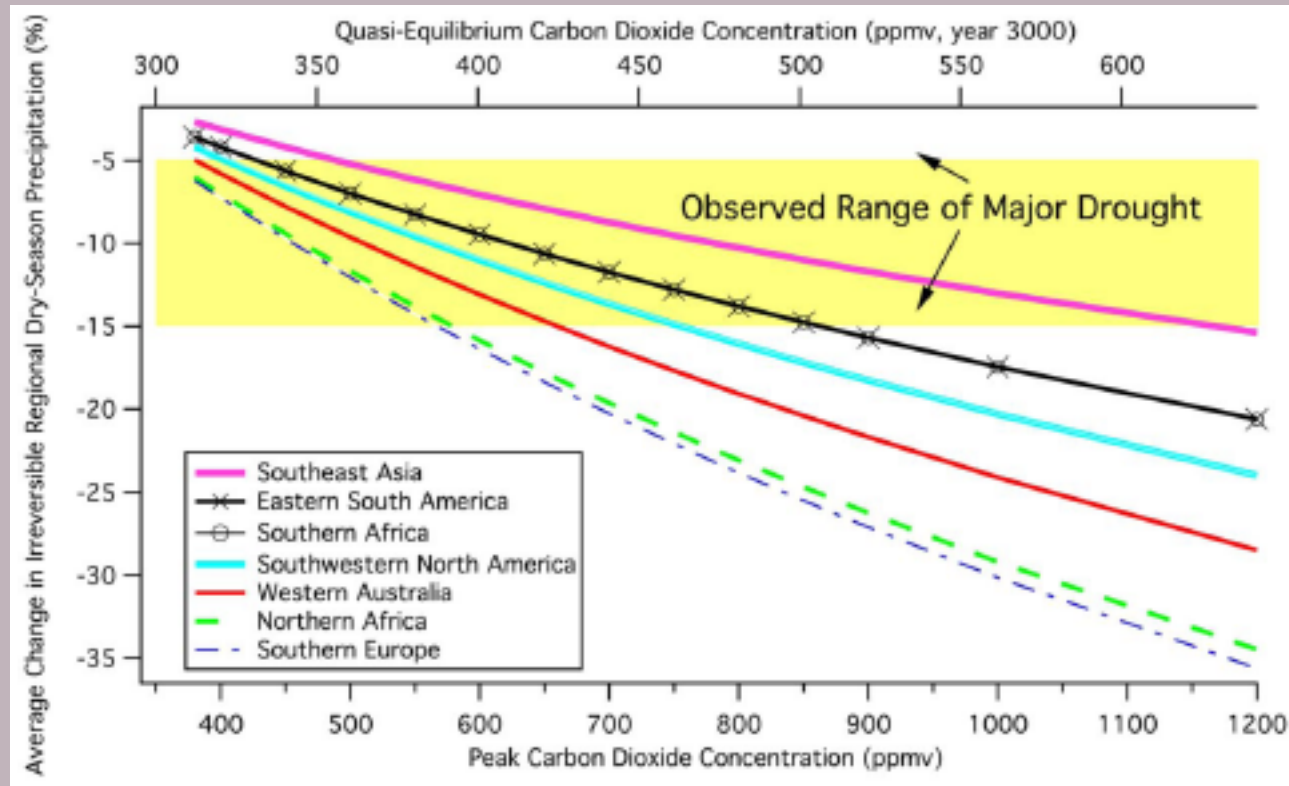
- Mediterranean/southern Europe/northern Africa
- western Australia

10%/°C warming

- southwestern North America
- eastern South America
- southern Africa

Droughts already observed in Mediterranean, southwestern North America, and western Australia.

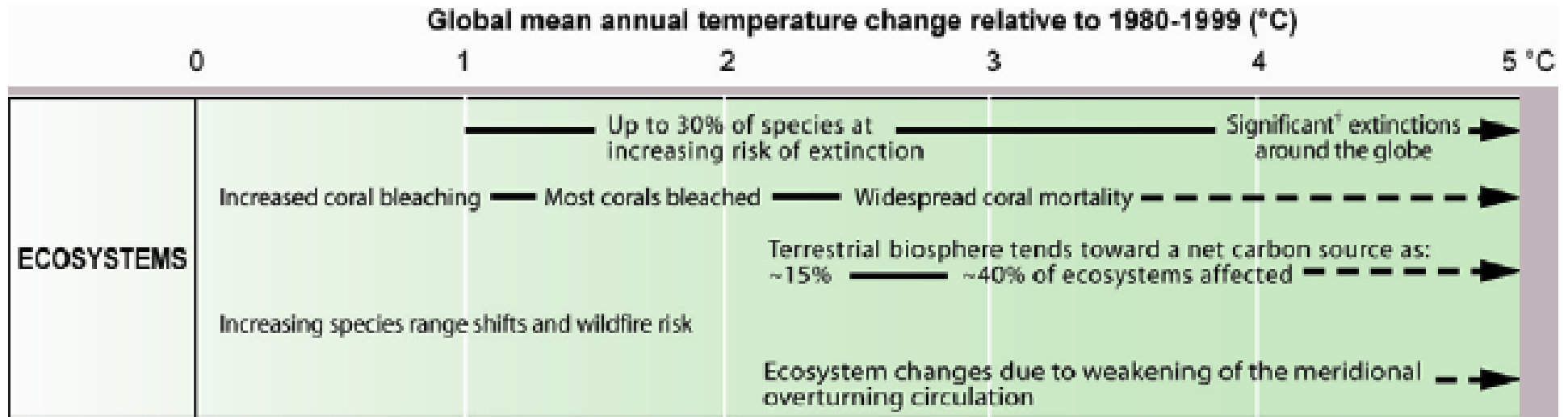
Dust Bowl?



Dry season decrease

Yellow box: range of precipitation change during major drought such as American “dust bowl”

Key Impacts: Ecosystems



Temperature increase expected to be 0.2°C+/decade until 2020, then...? Total increase this century: 1.1-6.4°C. However, greenhouse gas emissions are rising faster than the fossil intensive scenario.

Not all climate change

**IUCN Red List reveals
world's mammals in crisis**



*Iberian Lynx: **Endangered***

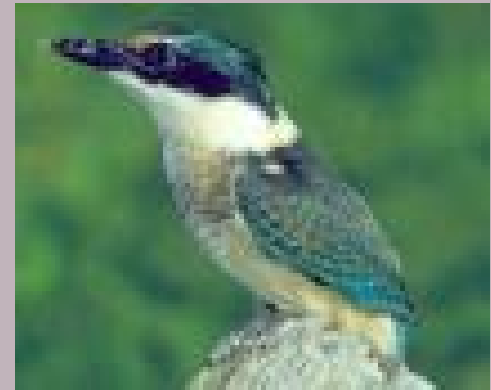
More than 1/4 of all mammals are now considered threatened by habitat destruction and hunting/fishing.

<http://www.iucn.org>

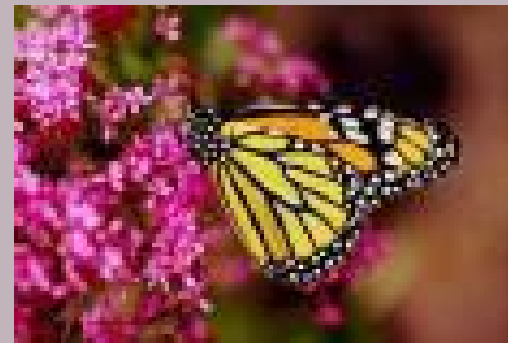
Some can't migrate far.



Others migrate at different speeds from the rest of the ecosystem.



Plants, animals, and insects are migrating towards the poles 4 miles every 10 years since 1950.



They will soon need to migrate faster -
- 70 miles every 10 years.

We are in the midst of the sixth mass extinction since complex life began.



Meteorites striking Earth throw up dust -- plants can't get light, animals can't get plants.



Continental drift moves plants and animals away from friendly climates.

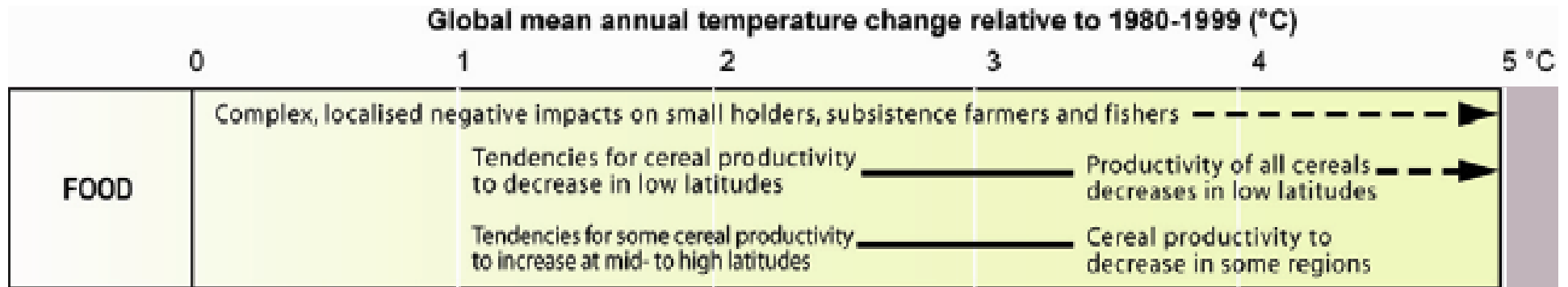
We are in the midst of the sixth mass extinction since complex life began.



One sixth to one third of species may be committed to extinction by 2050.

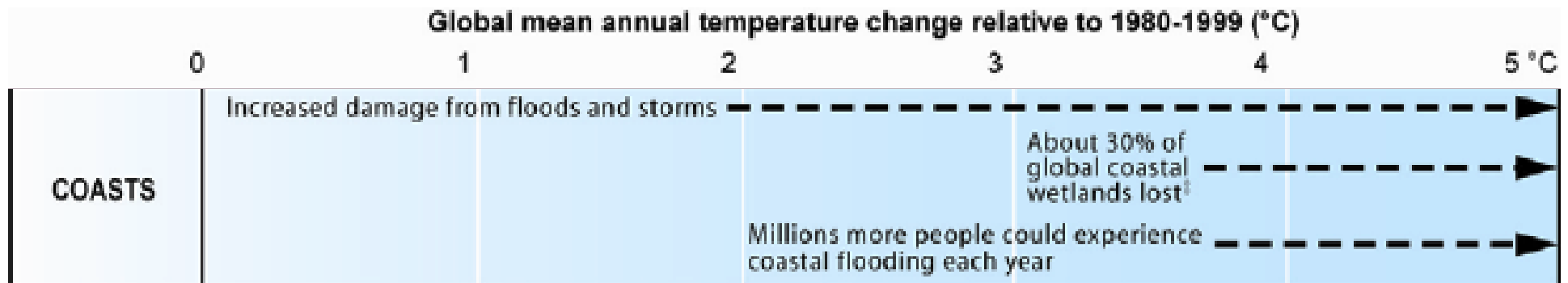


Key Impacts: Food



Temperature increase expected to be 0.2°C+/decade until 2020, then...? Total increase this century: 1.1-6.4°C. However, greenhouse gas emissions are rising faster than the fossil intensive scenario.

Key Impacts: Coasts



Temperature increase expected to be 0.2°C+/decade until 2020, then...? Total increase this century: 1.1-6.4°C. However, greenhouse gas emissions are rising faster than the fossil intensive scenario.

Sea Level Rise

Sea level rise since 1992: 2"

Ice sheet dynamics are poorly understood, but many estimate sea level rise between 1 and 2 meters this century.

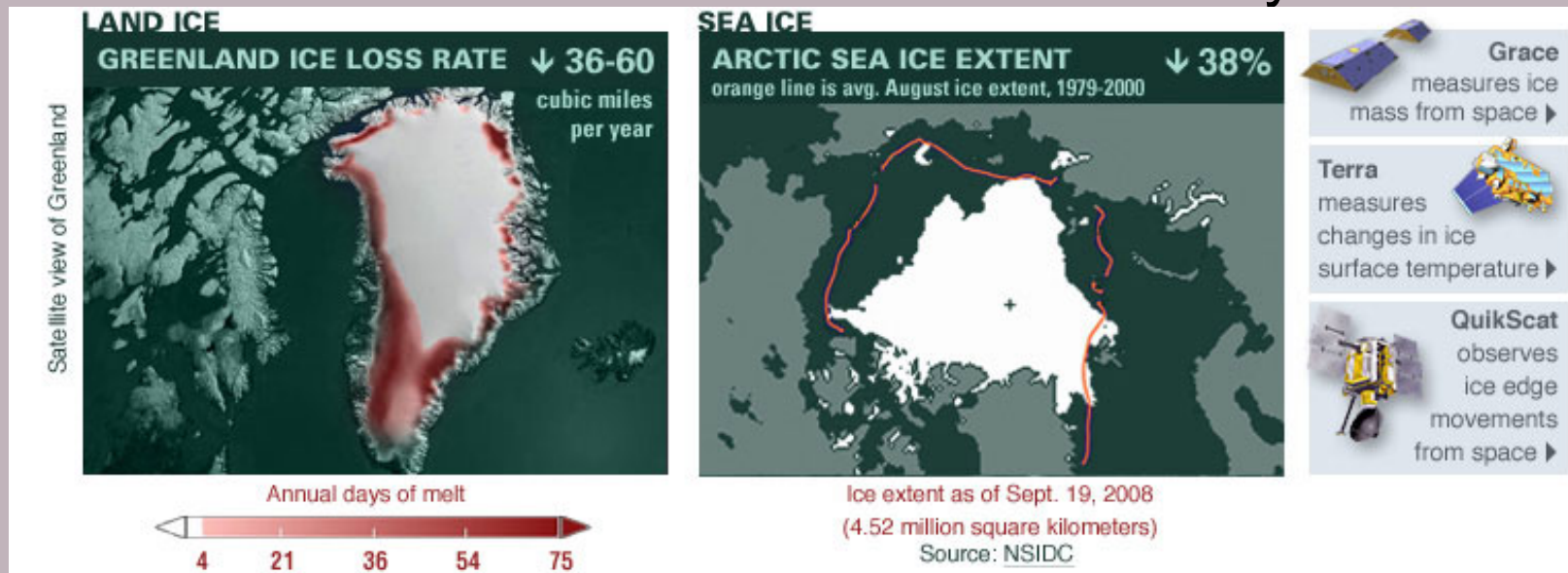


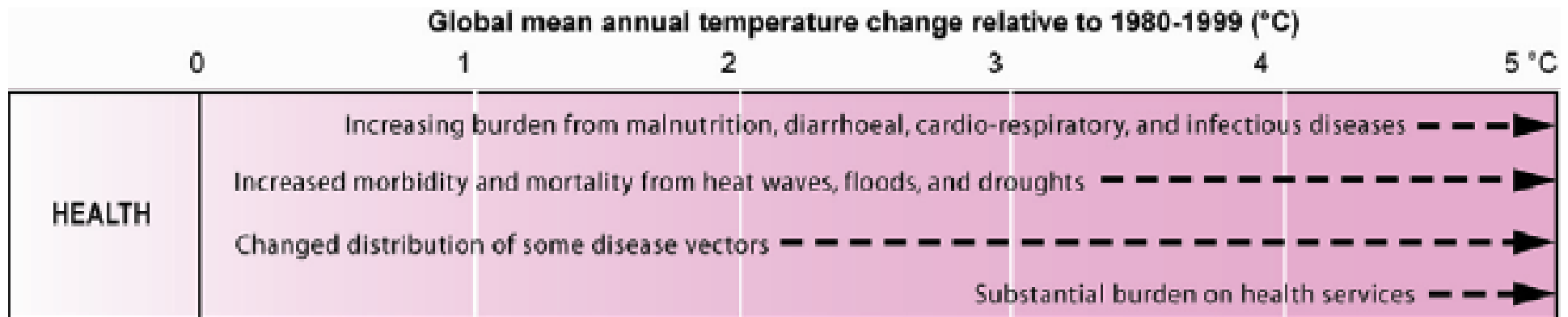
Illustration on the left shows areas where ice melt occurred for more than three days over Greenland during 2007. Areas in which melt occurred for longer time periods are shown in a darker red while those areas melted for fewer days are shown in lighter red.

Sea Level Rise



Heavily populated delta regions vulnerable to sea level rise

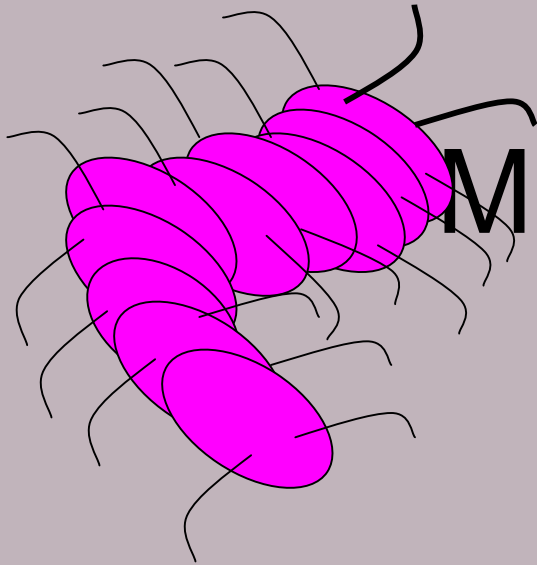
Key Impacts: Health



Temperature increase expected to be 0.2°C+/decade until 2020, then...? Total increase this century: 1.1-6.4°C. However, greenhouse gas emissions are rising faster than the fossil intensive scenario.

WHO: 170,000 died from climate change in 2000.

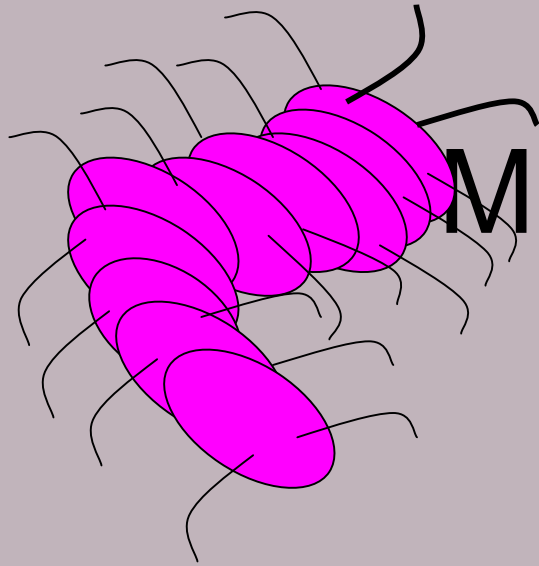
IPCC: 2003 heat wave, 35,000 dead just in Europe, “likely” from climate change



Move Like a Centipede

If we can get 20 legs moving more or less in the same direction, we can get the centipede moving.

So what constitutes motion?

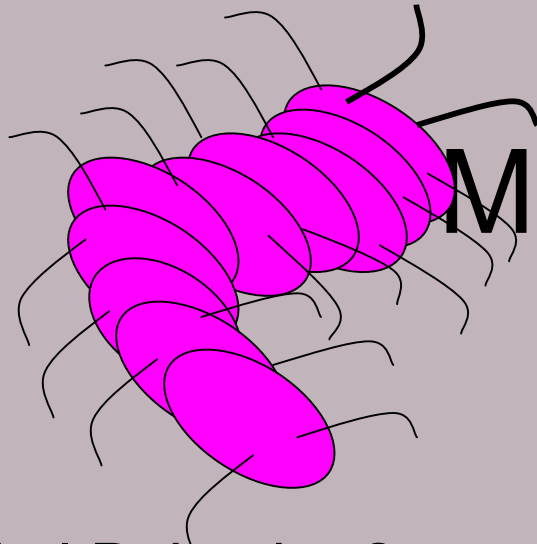


Move Like a Centipede

Vital Behavior 1:

Teach climate change science and impacts to others and hold them emotionally during the process.

- How do we communicate, and how do we communicate the urgency?

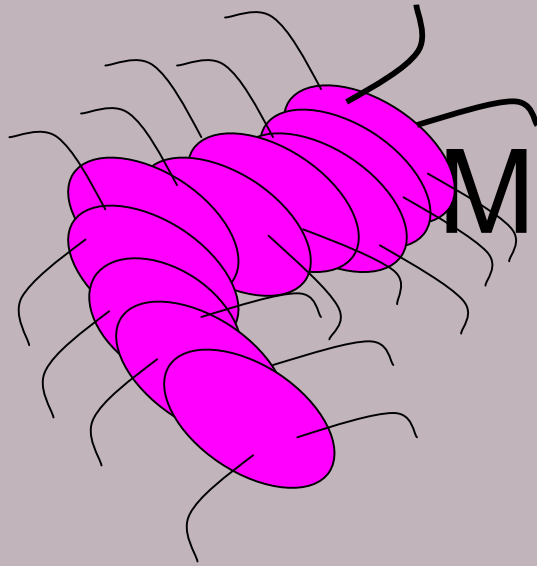


Move Like a Centipede

Vital Behavior 2:

Reduce your own greenhouse gas emissions in the coming year, and work with others to reduce theirs.

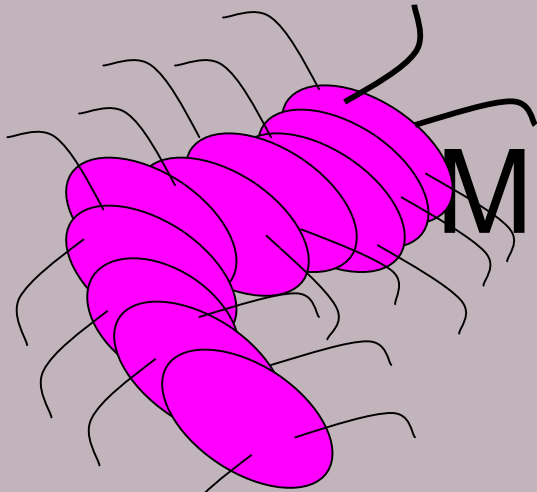
- What comes up for us emotionally, morally, and spiritually when we consider what is happening? When we consider changing the way we live?
- How do we change with joy?



Move Like a Centipede

Vital Behavior 3:

Find a solution that Intergovernmental Panel on Climate Change (IPCC) says is necessary and important, ideally one that makes you uncomfortable. Learn why policy analysts say it is necessary, and advocate for it.



Move Like a Centipede

Examine issues the public must begin to agree on before we can expect legislative leadership, the hard issues:

- Evaluating solutions: how much will come from solar? From nuclear? From biofuels? From transgenic/organic crops? Which sources of information do we trust and why?
- Addressing climate change costs money. Where does the money come from? What are our priorities? Who will pay for China and India?
- Finding ways to restrict individual choices. Does living with less mean living a diminished life? What specific laws would you accept or reject?

Blog and Web Sites

Intergovernmental Panel on Climate Change

<http://www.ipcc.ch>

Real Climate

www.RealClimate.org

A Musing Environment

<http://pathsoflight.us/musing>