

TOPIC #16 Wrap-Up

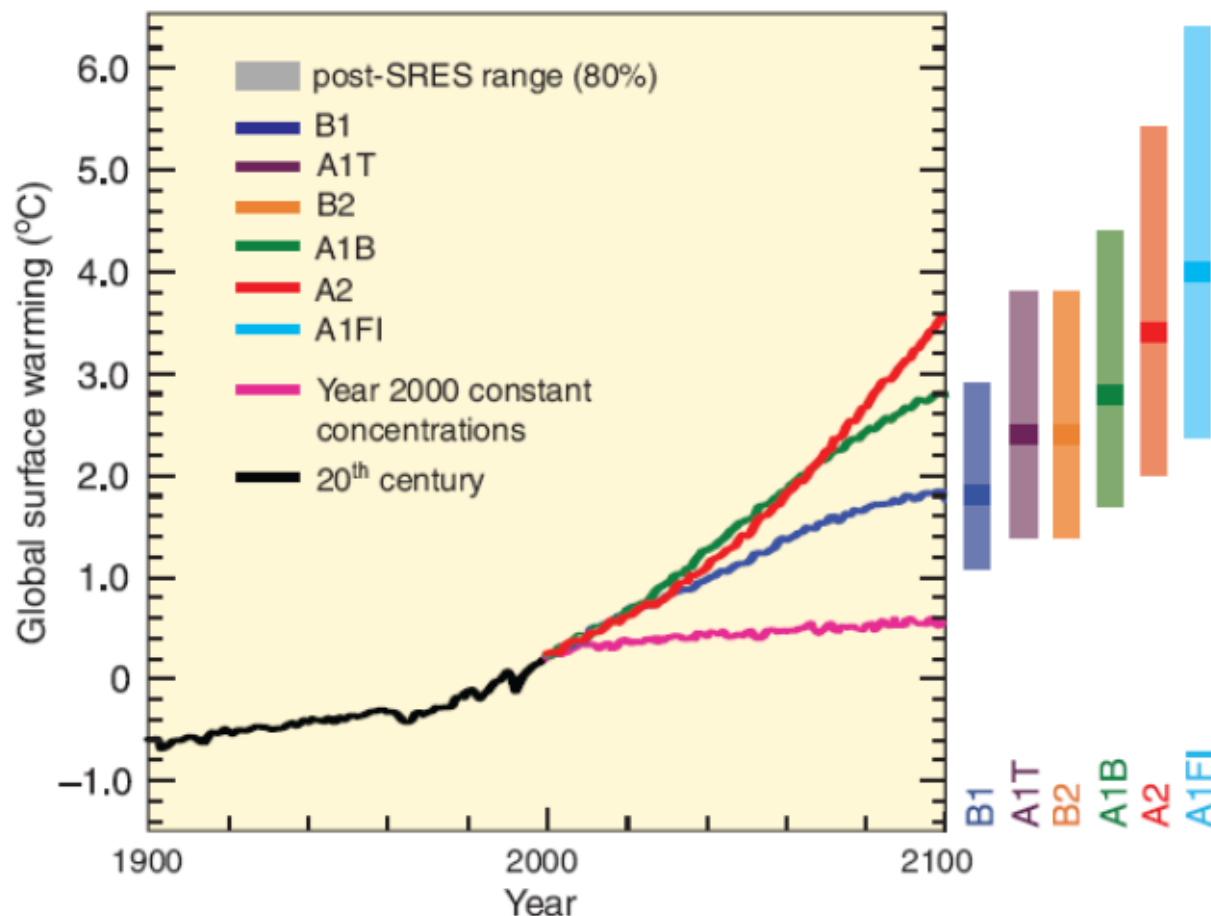
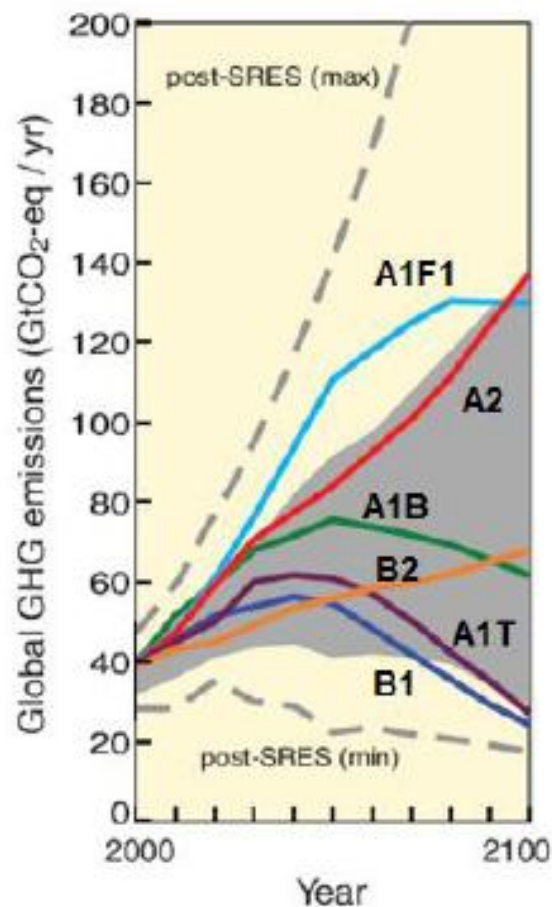
CLIMATE CHANGE: IMPACTS & ISSUES & WHAT AWAITS US!!

pp 89-90 in Class Notes

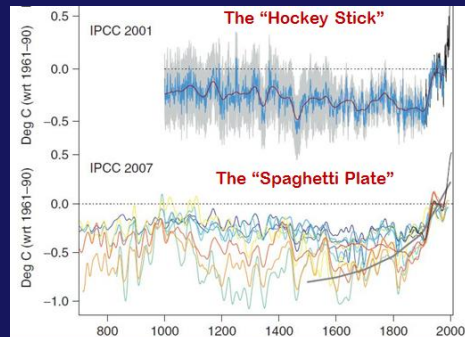
New Projections of Climate Change based on **state-of-the-art computer model results** and **revised SCENARIOS**:

Projected Climate Change for Different Scenarios of GHG Emissions

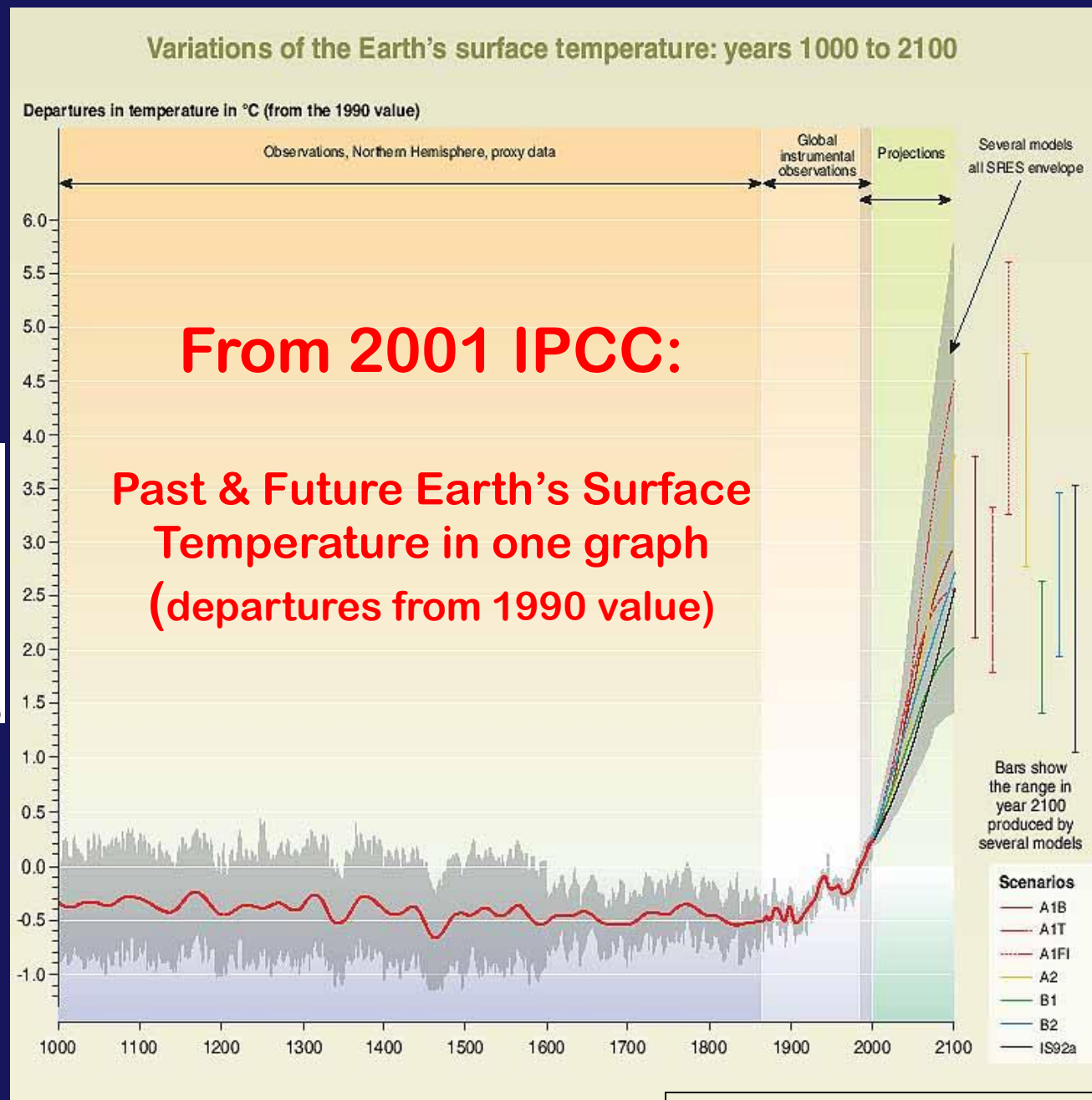
Scenarios for GHG emissions from 2000 to 2100 (in the absence of additional climate policies) and projections of surface temperatures



Improved
“Hockey
Stick”
(from 2001 Third
Assessment)
→ Spaghetti
Plate



**GLOBAL
SURFACE
TEMPERATURE
CHANGE
(° C)**
(compared to
1990 value)



From Self test 8

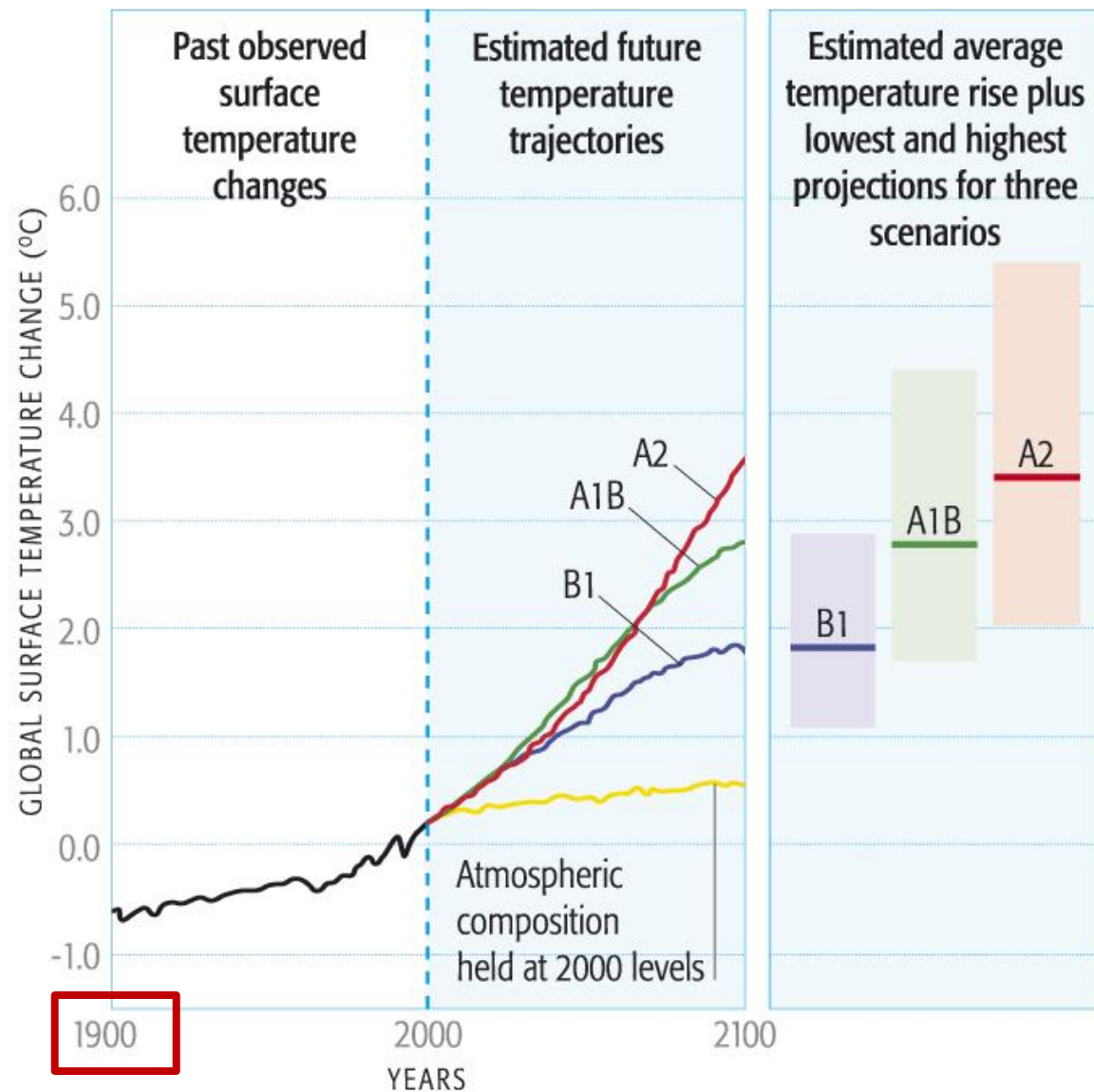
Updated version in AR4:

2007 IPCC FOURTH ASSESSMENT REPORT

GLOBAL
SURFACE
TEMPERATURE
CHANGE
(° C)

Compared to
1980-1999
period

POSSIBLE PATHS OF FUTURE GLOBAL WARMING



Starts in 1900

© 2009 Pearson Education, Inc.

RANGE OF POSSIBLE TRAJECTORIES FOR FUTURE CLIMATE CHANGE

CO₂ in ATMOSPHERE
(due to emissions)

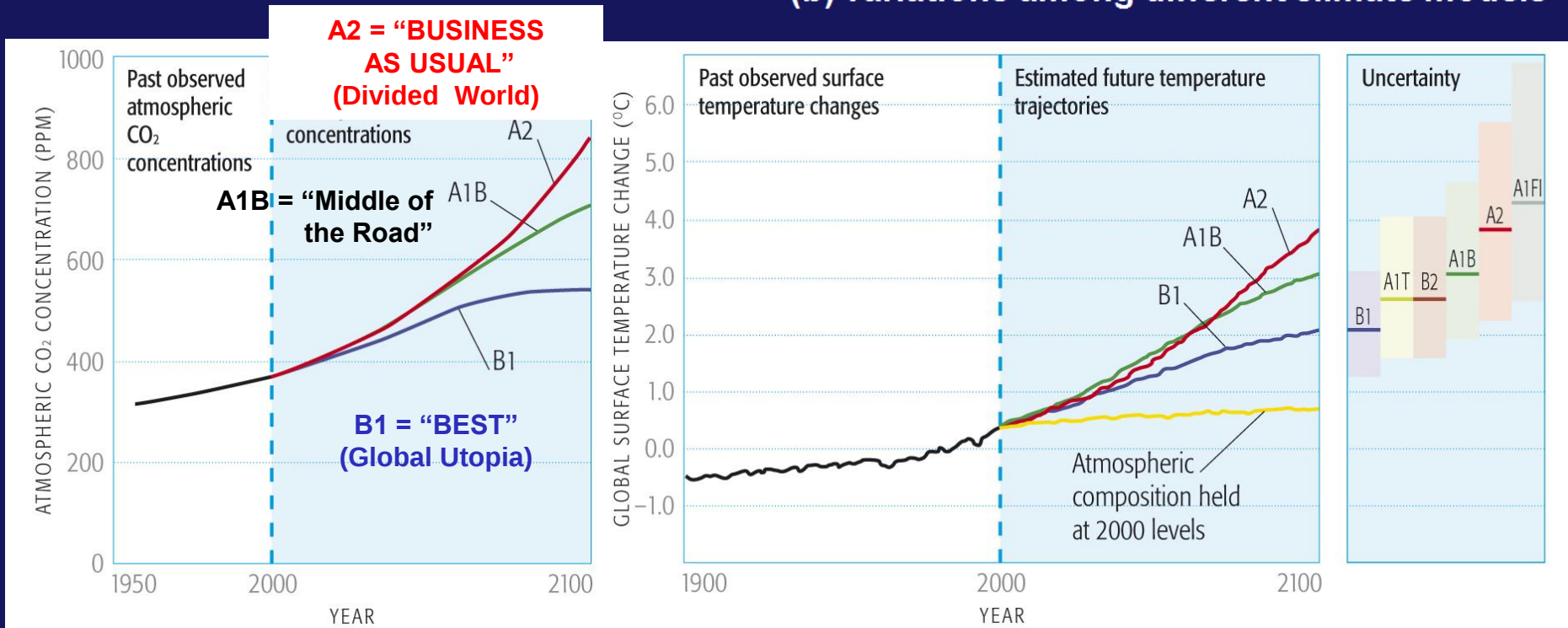


RESULTING WARMING:
TEMPERATURE INCREASE

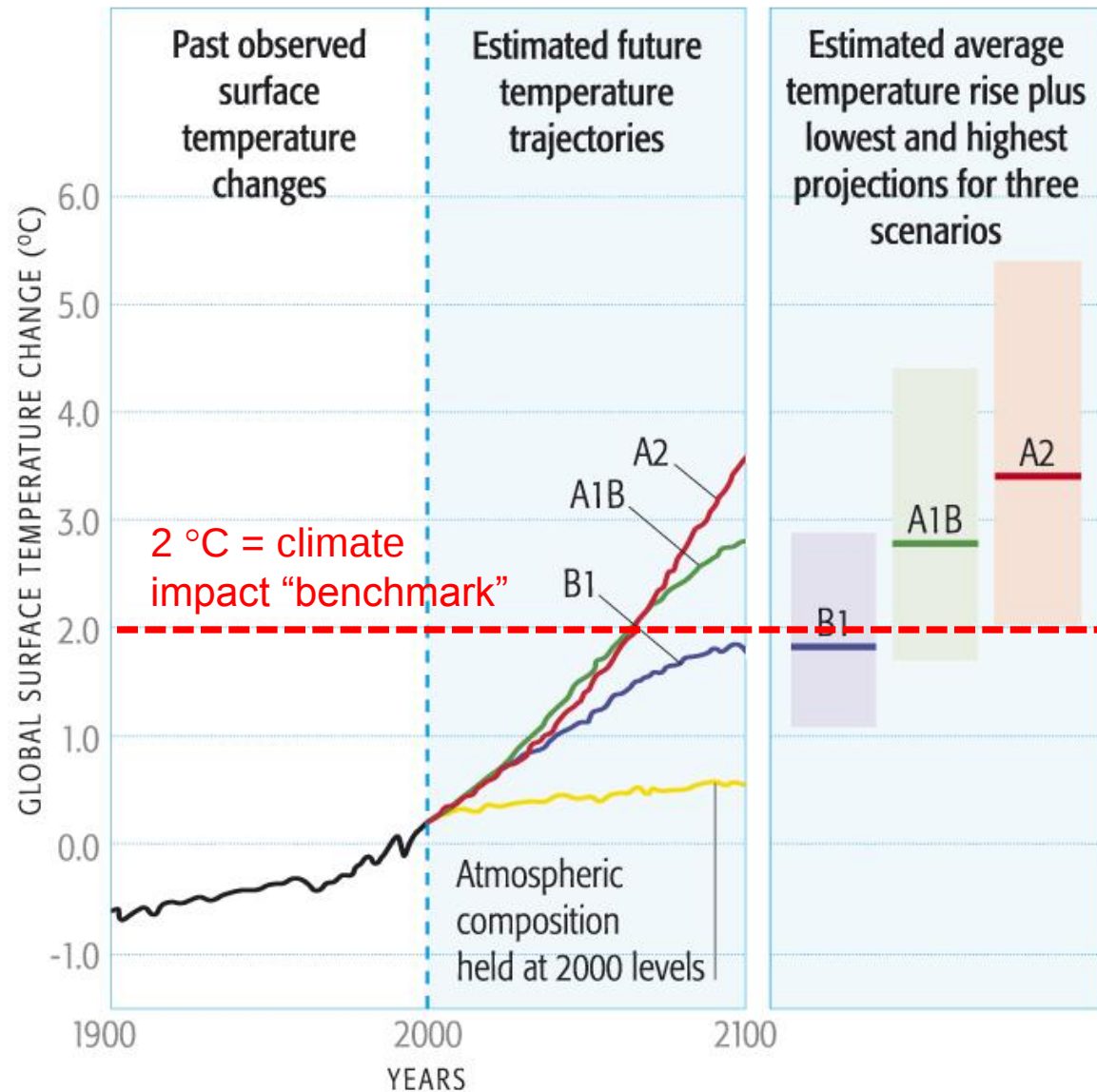


Spread of results due to:

- (a) which future emission scenario used
- (b) variations among different climate models



POSSIBLE PATHS OF FUTURE GLOBAL WARMING



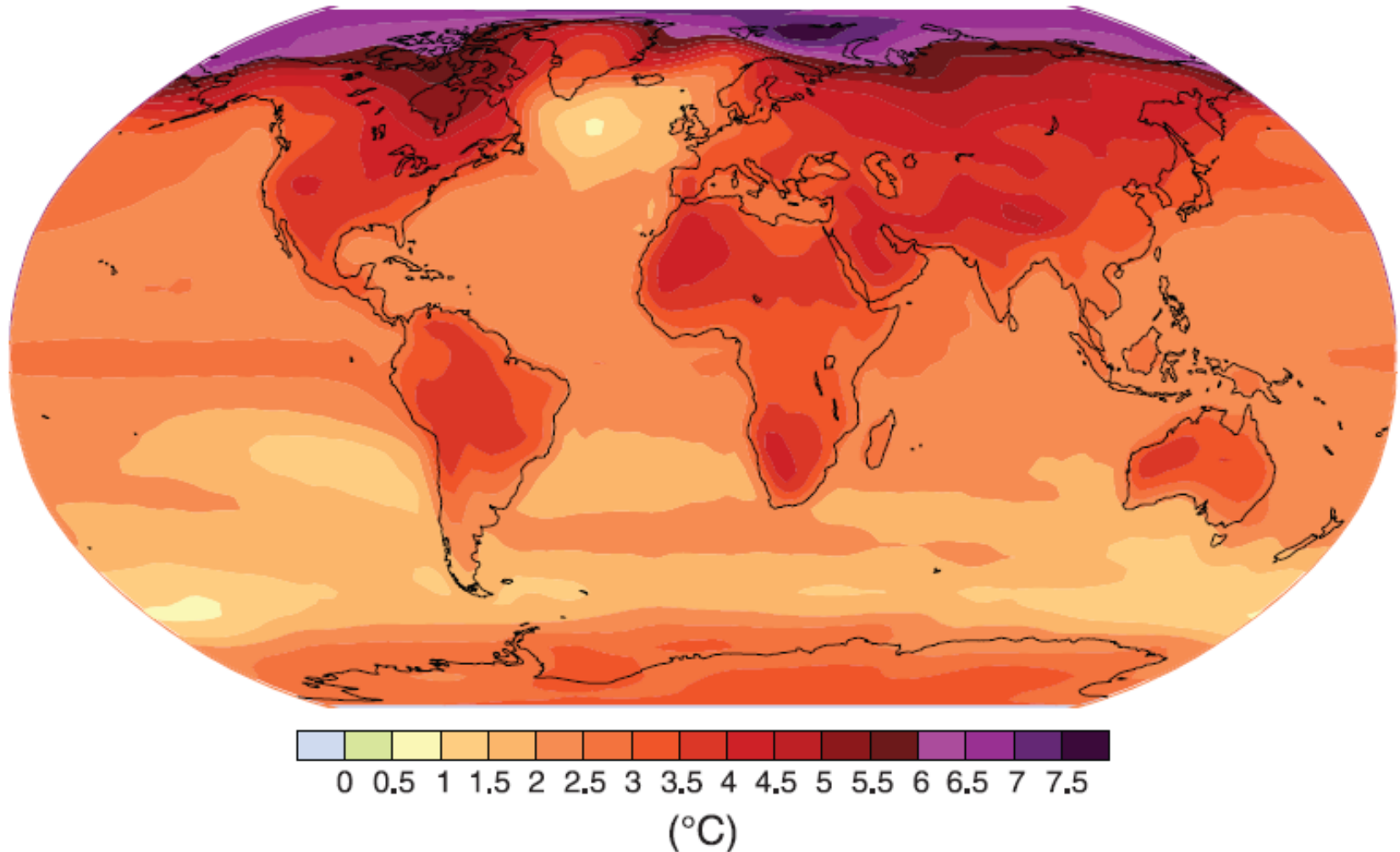
© 2009 Pearson Education, Inc.

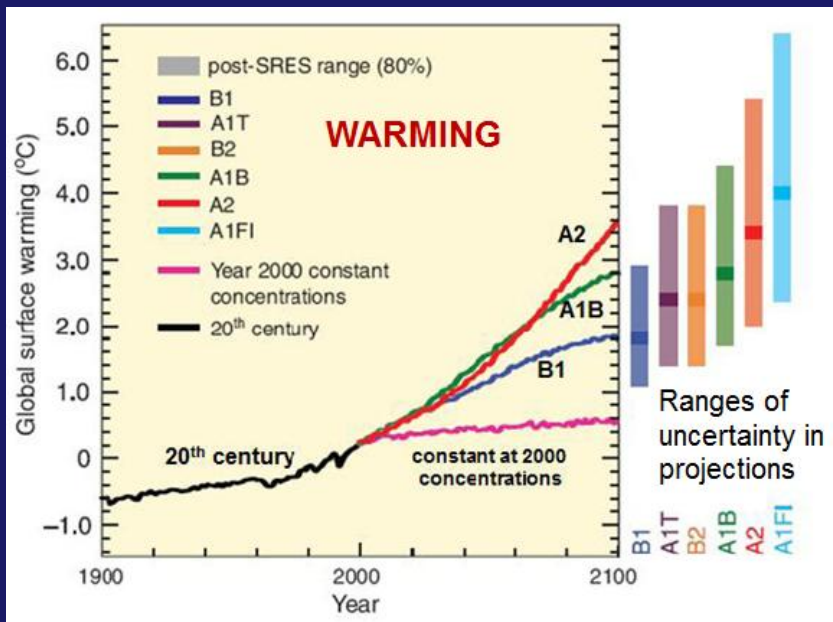
From *Dire Predictions* (p 20)

GLOBAL
SURFACE
TEMPERA-
TURE
CHANGE
(° C)

Projected Warming by Late 21st Century (2090-2099) based on the A1B “Middle of the Road” Scenario

Geographical pattern of surface warming





The TABLE below shows the computer model estimates of temperature change for each of the scenarios on
 ← this graph

Table SPM.1. Projected global average surface warming and sea level rise at the end of the 21st century. {Table 3.1}

Case	Temperature change (°C at 2090-2099 relative to 1980-1999) ^{a, d}		Sea level rise (m at 2090-2099 relative to 1980-1999)
	Best estimate	Likely range	Model-based range excluding future rapid dynamical changes in ice flow
Constant year 2000 concentrations ^b	0.6	0.3 – 0.9	Not available
B1 scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI scenario	4.0	2.4 – 6.4	0.26 – 0.59

We are already on a path that is close to the A2 scenario or WORSE!!

← This is much faster than was expected when the 2007 IPCC first came out!

November 3, 2011

HOME / NEWS / SCIENCE

AP Associated Press

Biggest jump ever seen in global warming gases

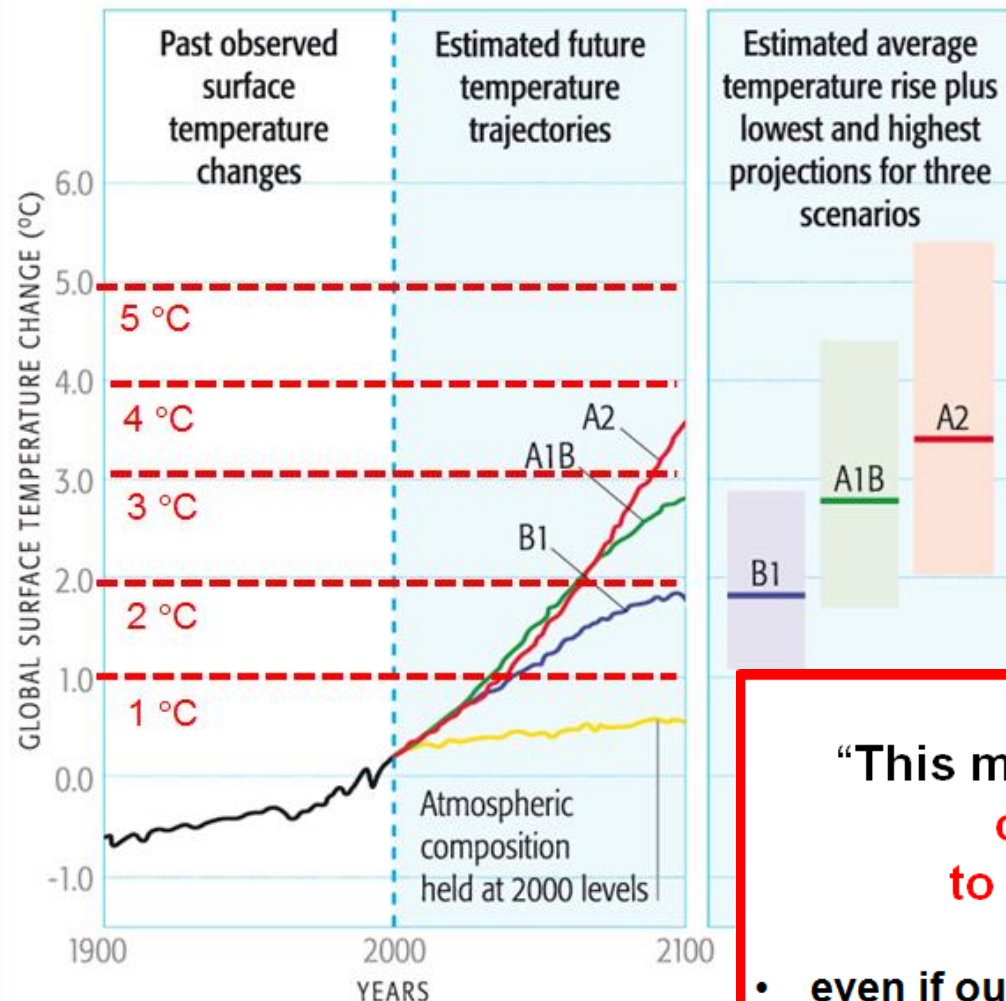


http://www.boston.com/news/science/articles/2011/11/03/biggest_jump_ever_seen_in_global_warming_gases/

The latest figures put global emissions on track with the worst case projections from the Intergovernmental Panel on Climate Change (IPCC) 2007 report.

↑
GLOBAL
SURFACE
TEMPER-
ATURE
CHANGE
(° C)

POSSIBLE PATHS OF FUTURE GLOBAL WARMING



The I-2D LESSON 4 ONLINE TUTORIAL

has an excellent
section that will help
you understand these
graphs!

“This means that **we will have no choice but to adapt to a change in climate**”

- even if our mitigation actions place us on a low emissions pathway (such as B1) or . . .
- even if emissions are stopped entirely (which would be impossible)

From *Dire Predictions* (p 20)

And now . . .

the
DIRE PREDICTIONS
based on the
science summarized
by the IPCC



(with **probability** /
likelihood assigned
to each projected
future impact)

IPCC PROJECTIONS FOR THE 21ST CENTURY

- Cold days and nights will be warmer and less frequent over most land areas
- Hot days and nights will be warmer and more frequent over most land areas

VIRTUALLY CERTAIN 99%

- If the atmospheric CO₂ level stabilizes at double the present level, global temperatures will rise by more than 1.5°C
- The warming over inhabited continents by 2030 will be about double the observed variability during the 20th century
- There will be an observed increase in methane concentration due to human activities
- The rate of increase in atmospheric CO₂, methane, and nitrous oxide will reach levels unprecedented in the last 10,000 years
- The frequency of warm spells and heat waves will increase
- The frequency of heavy precipitation events will increase
- Precipitation amounts will increase in high latitudes
- The ocean's conveyor-belt circulation will weaken or shut down abruptly

VERY LIKELY 90%

- If the atmospheric CO₂ level stabilizes at double the present level, global temperatures will rise by between 2°C and 4.5°C
- The future increase in global average surface temperature will be between -40% and +60% of the values predicted by climate models
- Areas affected by drought will increase
- The number of frost days will decrease, and growing seasons will lengthen
- Intense tropical cyclone activity will increase, with greater wind speeds and heavier precipitation
- Extreme high-sea-level events will increase, as will ocean wave heights of mid-latitude storms
- Precipitation amounts will decline in the subtropics
- The loss of glaciers will accelerate in the next few decades
- Climate change will promote ozone-hole expansion, despite an overall decline in ozone-destroying chemicals

LIKELY 66%

- The West Antarctic ice sheet will pass the melting point if global warming exceeds 5°C

ABOUT AS LIKELY AS
NOT 35-50%

- Antarctic and Greenland ice sheets will collapse due to surface warming

UNLIKELY

- The ocean's conveyor-belt circulation will suffer an abrupt transition
- If the atmospheric CO₂ level stabilizes at double the present level, global temperatures will rise by less than 1.5°C

VERY UNLIKELY 10%

0 10 20 30 40 50 60 70 80 90

PROBABILITY (%)

From *Dire Predictions* (p 21)

IPCC PROJECTIONS FOR THE 21ST CENTURY

VIRTUALLY CERTAIN 99%

- Cold days and nights will be warmer and less frequent over most land areas
- Hot days and nights will be warmer and more frequent over most land areas

VIRTUALLY CERTAIN 99%

0 10 20 30 40 50 60 70 80 90
PROBABILITY (%)

- Over most land areas:
HOT DAYS & NIGHTS will be **WARMER;**
and **MORE FREQUENT**



Recurrence Interval = measure of frequency

An event happening “once in 50 years”
in the future, might happen “once in 10 years”
(or have a “1 in 10” chance of occurring in any year)

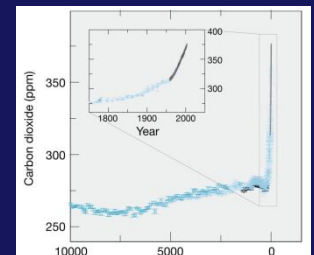
IPCC PROJECTIONS FOR THE 21ST CENTURY

VERY LIKELY 90%

- If the atmospheric CO₂ level stabilizes at double the present level, global temperatures will rise by more than 1.5°C
- The warming over inhabited continents by 2030 will be about double the observed variability during the 20th century
- There will be an observed increase in methane concentration due to human activities
- The rate of increase in atmospheric CO₂, methane, and nitrous oxide will reach levels unprecedented in the last 10,000 years
- The frequency of warm spells and heat waves will increase
- The frequency of heavy precipitation events will increase
- Precipitation amounts will increase in high latitudes
- The ocean's conveyor-belt circulation will weaken or shut down abruptly

VERY LIKELY 90%

- the **RATE of increase** of **GHG's** will be **UNPRECEDENTED** in past 10,000 yrs
- Frequency of **HEAVY PRECIPITATION EVENTS** will INCREASE



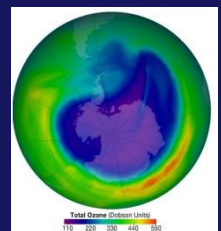
IPCC PROJECTIONS FOR THE 21ST CENTURY

LIKELY 66%

- If the atmospheric CO₂ level stabilizes at double the present level, global temperatures will rise by between 2°C and 4.5°C
- The future increase in global average surface temperature will be between –40% and +60% of the values predicted by climate models
- Areas affected by drought will increase
- The number of frost days will decrease, and growing seasons will lengthen
- Intense tropical cyclone activity will increase, with greater wind speeds and heavier precipitation
- Extreme high-sea-level events will increase, as will ocean wave heights of mid-latitude storms
- Precipitation amounts will decline in the subtropics
- The loss of glaciers will accelerate in the next few decades
- Climate change will promote ozone-hole expansion, despite an overall decline in ozone-destroying chemicals

LIKELY 66%

- Extreme **HIGH SEA LEVEL** events will increase
- **SUBTROPICS** (that's us!) will experience **PRECIPITATION DECLINE**
- Stratospheric cooling → **ozone hole persistence** even **WITH** ban of CFC's!



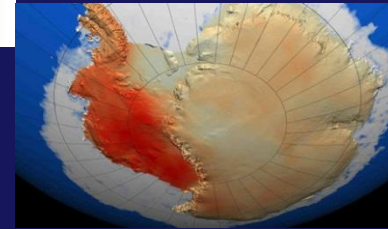
IPCC PROJECTIONS FOR THE 21ST CENTURY

AS LIKELY AS NOT 35 - 50%

- The West Antarctic ice sheet will pass the melting point if global warming exceeds 5°C

ABOUT AS LIKELY AS
NOT 35-50%

- **W. ANTARCTIC ICE SHEET MELTING** (if Temp > 5° C)



UNLIKELY 35%

- Antarctic and Greenland ice sheets will collapse due to surface warming

UNLIKELY

- **ANTARCTIC & GREENLAND ICE SHEETS COLLAPSE**

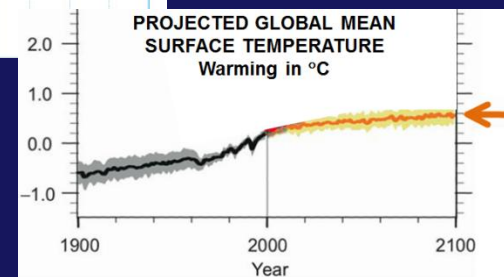


VERY UNLIKELY 10%

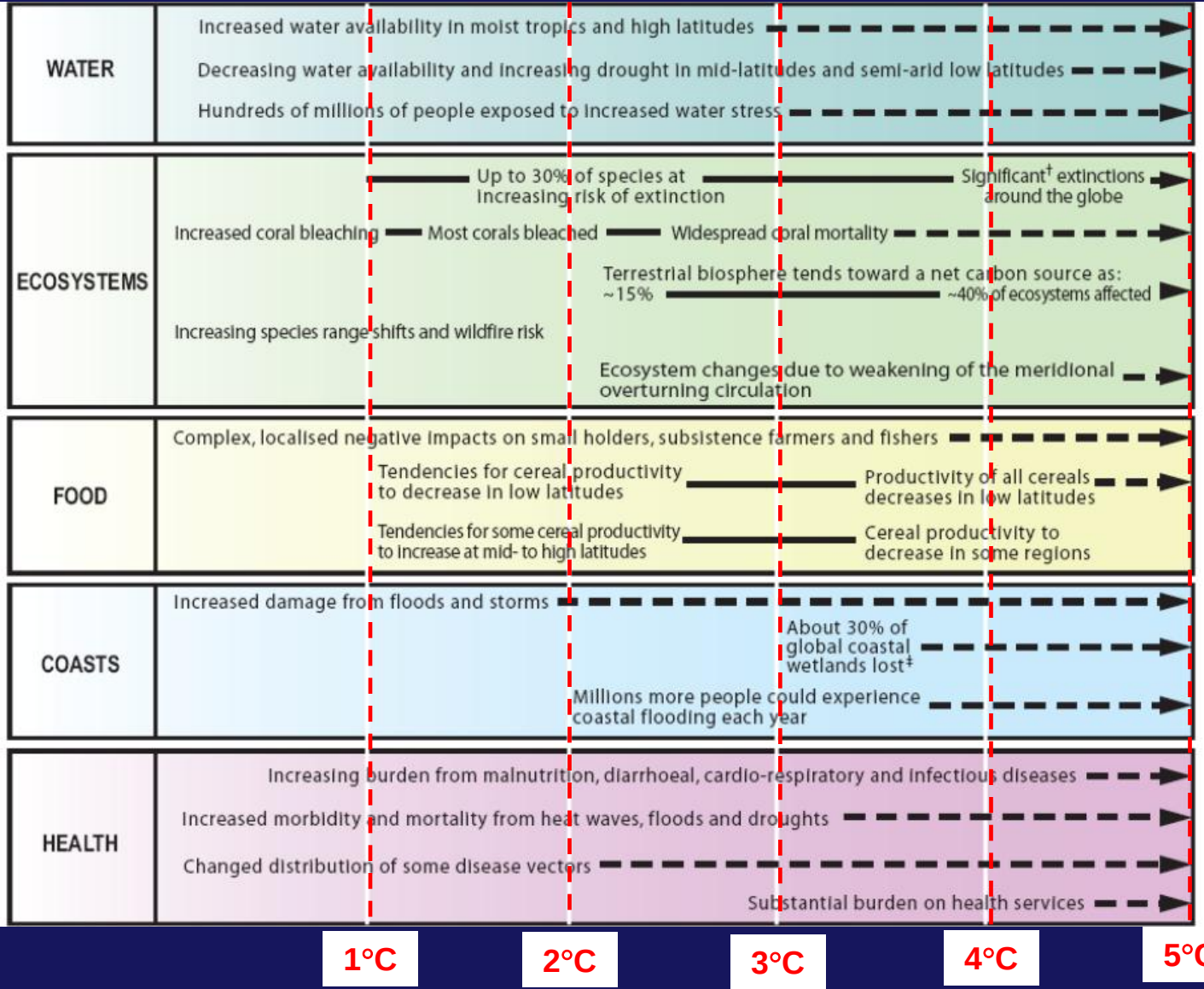
- The ocean's conveyor-belt circulation will suffer an abrupt transition
- If the atmospheric CO₂ level stabilizes at double the present level, global temperatures will rise by less than 1.5°C

VERY UNLIKELY 10%

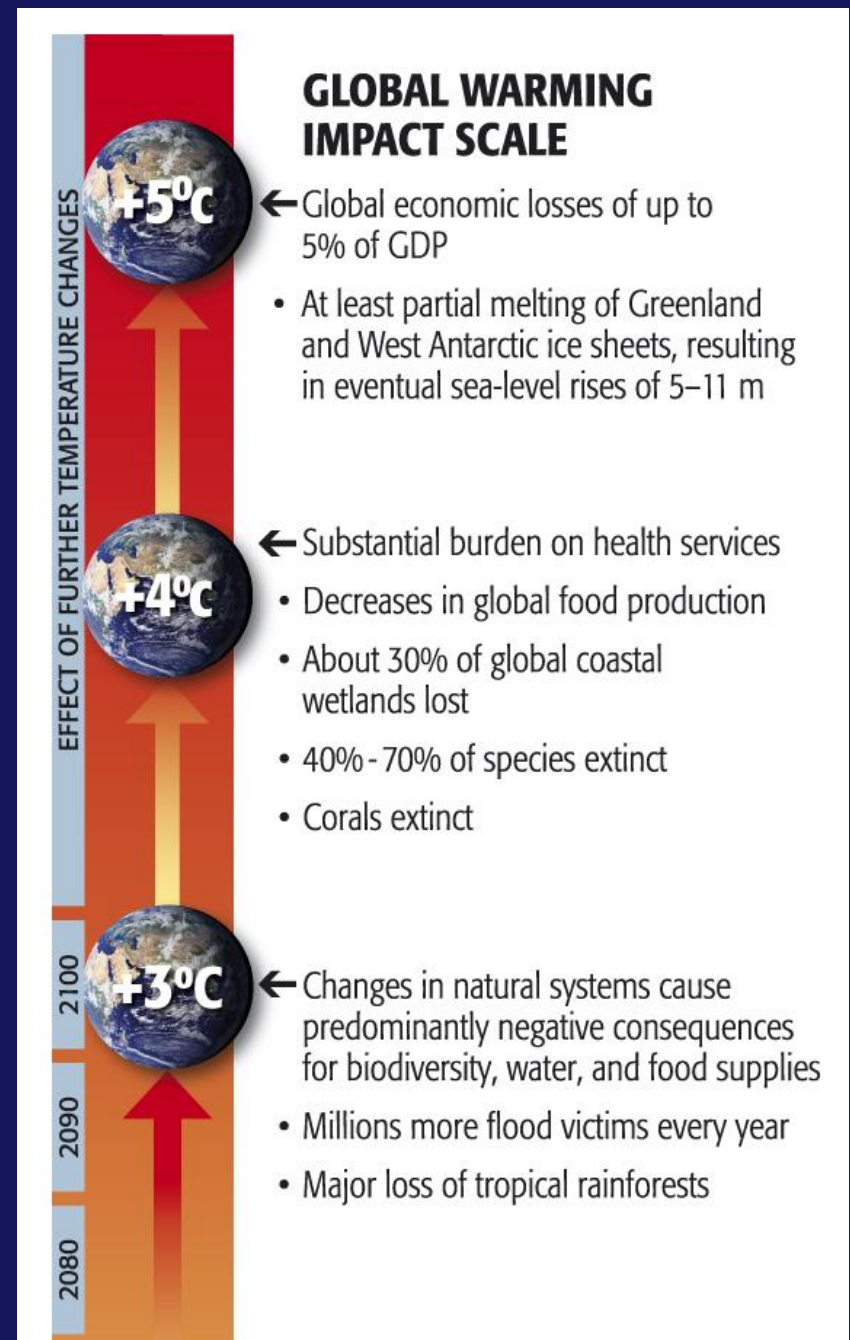
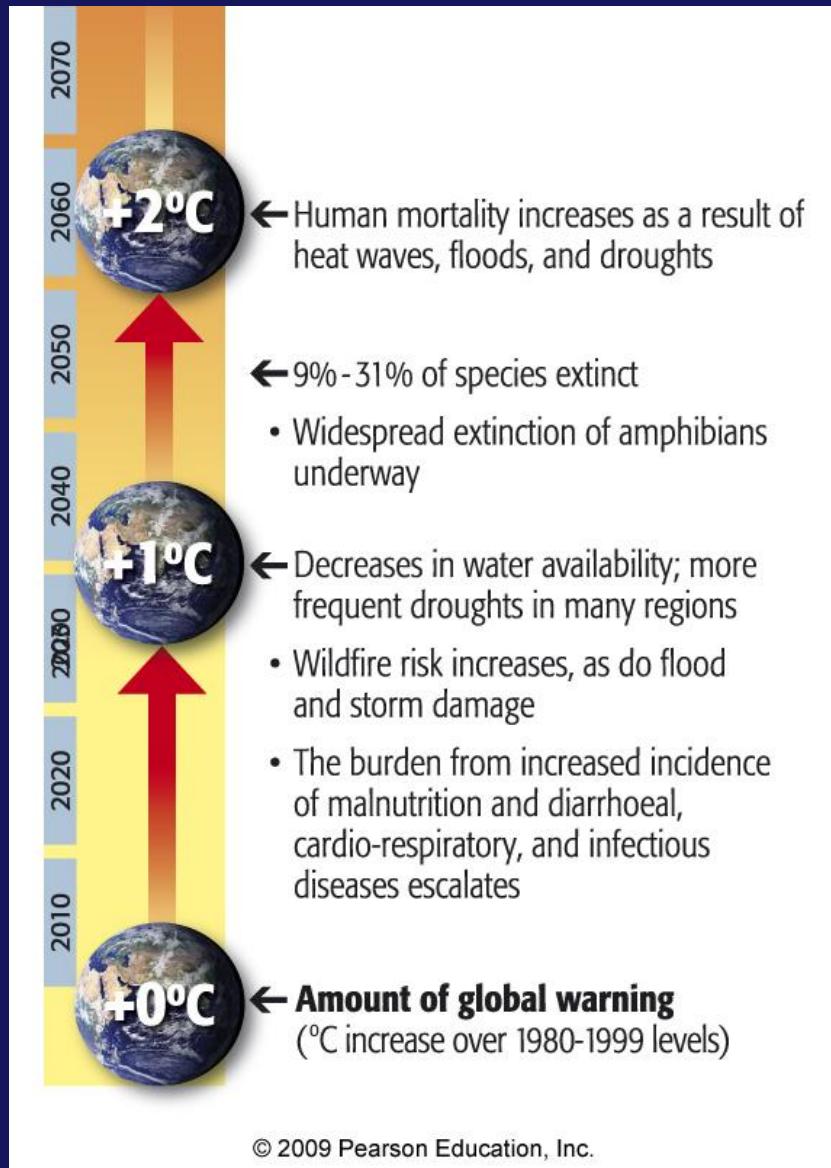
- **GLOBAL TEMPERATURES** will rise by LESS than 1.5° C (if CO₂ stabilizes at 2x)



Examples of IMPACTS associated with global average annual temperature change (relative to 1980-1999 average temperature)



GLOBAL WARMING IMPACT SCALE





GLACIOLOGY

Experts Agree Global Warming Is Melting the World Rapidly

One more chip. West Antarctica is losing ice at an accelerating rate as glaciers rush to the sea.

radar measurements of the speed of flowing glaciers.

In the end, reconciling the diverse ice-loss estimates proved to be more straightforward than had been feared. It turned out that gains and losses of ice can vary greatly from season to season and from place to place. So surveys made over different, albeit over-

lapping, time periods and regions yielded rather different loss rates. Once the data were adjusted to uniform regions and periods and a few other modifications were made, "there's no reason to believe the data sets are

TODAY'S ARIZONA DAILY STAR:

Ice sheets melting far faster than in 1990s, study finds

Recommend 2

Tweet 0

+1 0

Share 1

Print Email

WASHINGTON - Fueled by global warming, polar ice sheets in Greenland and Antarctica are now melting three times faster than they did in the 1990s, a new scientific study says.

So far, that's only added about half an inch to rising sea levels, not as bad as some earlier worst case scenarios. But the melting's quicker pace, especially in Greenland, has ice scientists worried.

One of the biggest wild cards in climate change has been figuring out how much the melting of the massive sheets of ice at the two poles would add to the seas. Until now, researchers haven't agreed on how fast the mile-thick sheets are thawing - and if Antarctica was even losing ice.

The new research concludes that Antarctica is melting, but points to the smaller ice sheet in Greenland, which covers most of the island, as the bigger and more pressing issue. Its melt rate has grown from about 55 billion tons a year in the 1990s to almost 290 billion tons a year recently, according to the study.

"Greenland is really taking off," said National Snow and Ice Data Center scientist Ted Scambos, a co-author of the paper released Thursday by the journal Science.



IAN JOUGHIN / THE ASSOCIATED PRESS

10-foot-deep canyon that was carved over the course of a melt lake in Greenland.

So what do we do about it???

**NEXT WEEK: ADAPTATION,
MITIGATION & SOLUTIONS**

**POLICIES & POSSIBLE ACTIONS
TO SLOW
GLOBAL WARMING . . .**



**THE FALL 2012
CLASS
CLIMATE ACTION
DEBATE**

THE QUESTION:

**Should the United States
take aggressive and
immediate action to slow
global warming?**

(e.g. sign the International
Climate Treaty, reduce or tax
GHG emissions, etc. etc.)

**You're invited & encouraged to
continue the debate on the D2L
discussion board, with friends,
family, etc**

