We began with some slides with
info and logistics
on end-of-the-semester tasks . . .

ASSIGNMENTS WRAP-UP

All remaining items to be submitted are highlighted with their due dates on the **D2L Assignments** page ➔

I-3 and I-4 are the two primary assignments still to be submitted

The other items to wrap up . . .
(e.g., ***G-6, I-2D Lesson 4 & Self Test+RQ-9****)*
will **help you prepare I-4** and **study** for the **Final Exam**

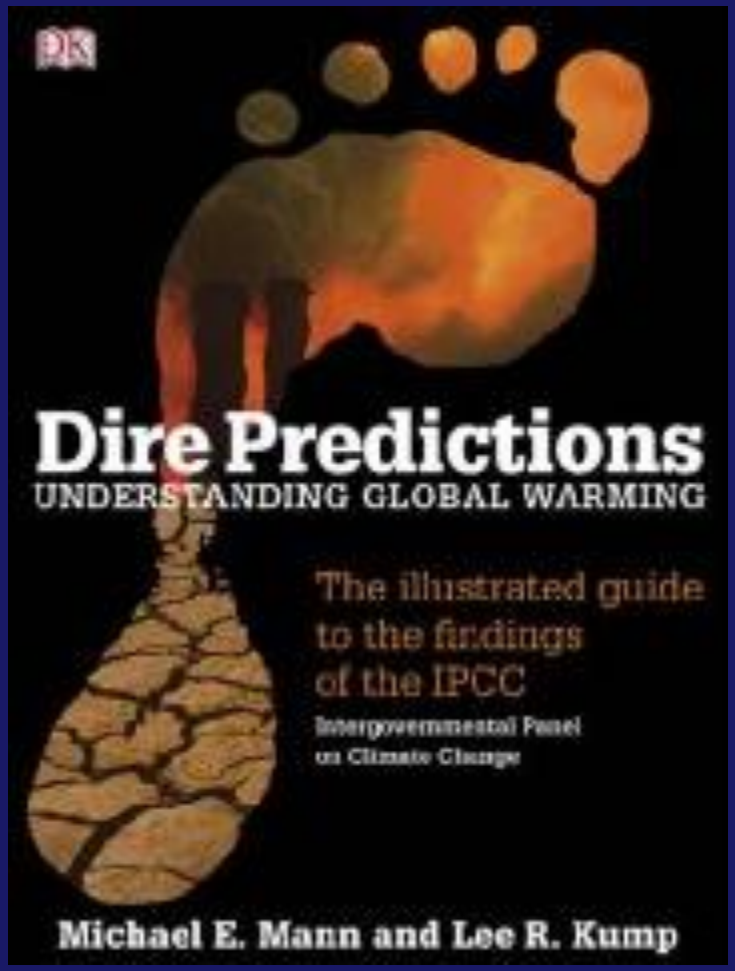
GROUP ASSIGNMENTS *(in-class activities)*	INDIVIDUAL ASSIGNMENTS *(homework assignments)*
G-1 Understanding Absorption Curves *in class on Sep14* *(worth 5 pts)*	**I-1 Thinking More Deeply** *Due date was Sep 12th* *(worth 10 pts)*
G-2 Energy Efficiency *in class on Sep30th* *(worth 5 pts)*	**I-2 Climate Science Basics** *varying due dates* *(5- 10 pts for each section)* I-2D due Dec 8th or earlier!
G-3 Tree-Ring Wood Kits *in class on Oct 7th* *(worth 5 pts)*	**I-3 Linking-to-Life Personal Project** **Threre are 2 Deliverables:** **#1 Film Review Posts** Due date was *Nov 14th* *(worth 10 pts)* **#2 Project Report** *(worth 25 pts)** Final Deadline = Wed Nov 30th *(the slide is no longer required!)*
G-4 Applying the Energy Balance Terms *in class on Oct 14 & 17th* *(worth 5 pts)*	
G-5 Volcanism & Climate *in class on Oct 31 & Nov 2* *(worth 5 pts)*	**I-4 Class Debate Preparation** *(worth 20 pts)** Due Tue Dec 6th -- *in dropbox* *& Wed Dec 7th in class for debate participation*
G-6 Carbon Footprints in class on Friday Dec 2nd bring your completed FOOTPRINT QUIZ RESULTS *(worth 5 pts)*	**SELF TEST & RQ-9** due anytime before the FINAL EXAM

DECEMBER							
	27	**28** #15-Climate Change: Impacts & Issues - II	29	**30** #15-Climate Change: Impacts & Issues - III **I-3 Project Report DUE**	DEC 1	**2** #16-Climate Change Adaptations & Solutions **Bring Footprint Quiz results to class for G-6**	3
	4	**5** #16-Climate Change: Adaptations & Solutions	6 **I-4 Debate Prep DUE**	**7** *Last day of classes* Global Change Wrap-Up **Bring I-4 "script" to class for debate**	8 *Reading Day* **I-2D Lesson 4 Tutorial DUE**	9 **FINAL EXAM** **Sec 3 + 4** 3:30 - 5:30 pm	10
	11	12 **FINAL EXAM** **Sec 1 + 2** 10:30 am - 12:30 pm	13	14	**15** *Finals End*	16	17 *Semester Ends*

❑ SELF TEST & RQ 9 – Global Change Recap - DUE any time before FINAL EXAM

Needed for
Friday's G-6 activity . . .

YOUR FOOTPRINT!



For FRIDAY Dec 2nd:
Bring in the results of your FOOTPRINT QUIZ for our last GROUP ASSIGNMENT (worth 5 pts)

- http://www.footprintnetwork.org/en/index.php/GFN/page/calculators/

The LAST ASSIGNMENT is I-4 Global Warming Debate Preparation The debate will take place at our last class.

BEFORE YOU LEAVE TODAY, GET YOUR GROUP FOLDER & GET SIGNED UP FOR YOUR I-4 DEBATE ROLE

Be sure someone in your group has taken the IPCC Scientist Role & someone has taken the Denier Role

The Debate Question:

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

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

Climate summit begins today, seeks new curbs on emissions

The Associated Press The Associated Press | Posted: Monday, Nov

Buy this photo

AARON FAVILA / THE ASSOCIATED PRESS
Climate-change activists rallied outside the U.S. Embassy in Manila, the Philippines, on Thursday ahead of the U.N. summit in Durban, South Africa, which starts today.

DURB
official
make
countr
reduce
gases.

Amid fresh warnings of climate-related disasters in the future, delegates from about 190 countries were gathering in Durban for a two-week conference beginning today. They hope to break deadlocks on how to curb emissions of carbon dioxide and other pollutants.

Christiana Figueres, head of the U.N. climate secretariat, said the stakes for the negotiations are high, underscored by new scientific studies.

Under discussion was "nothing short of the most compelling energy, industrial, behavioral revolution that humanity has ever seen," she said.

"Under discussion was nothing short of the most compelling energy, industrial, behavioral revolution that humanity has ever seen . . ."

THE FINAL EXAM:

For SEC 1+2

MONDAY DEC 12th 10:30 am -12:30 pm

IN THIS CLASSROOM ← NOTE earlier start time!!

For SEC 3

FRIDAY DEC 9th 3:30 - 5:30 pm

IN THIS CLASSROOM ← NOTE different start time!!

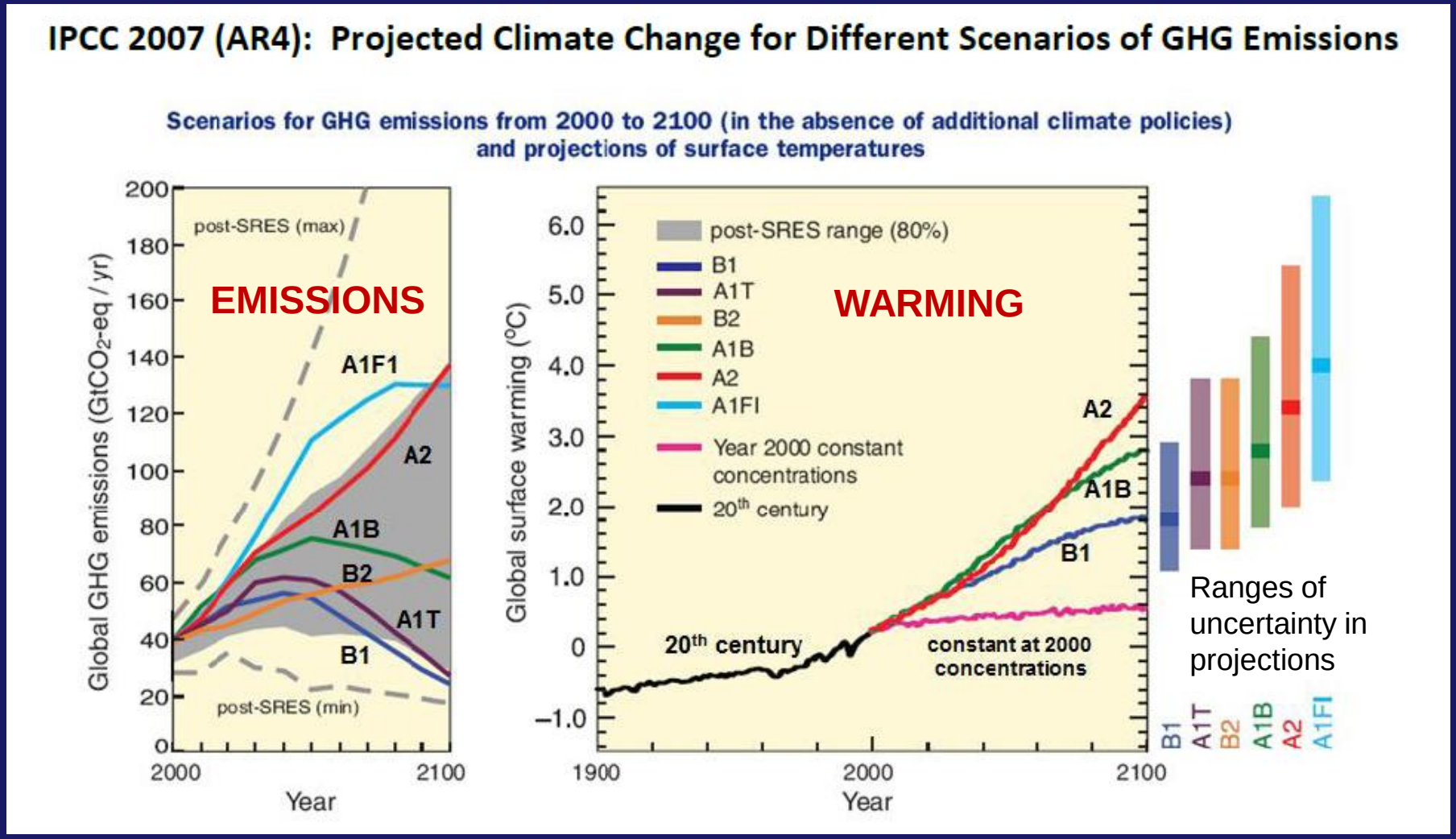
- **Worth 115 pts: about 30 multiple choice Q's, plus short answer, make-a-sketch, & short essay Q's**
- **Q's will focus on material since the MIDTERM EXAM, but some concepts will carry over** (these will be spelled out on Study Guide)
- **STUDY GUIDE with practice questions** will be provided next week (similar to guide for Midterm Exam)
- **PRECEPTORS** will hold **STUDY SESSIONS**, TBA

TOPIC #15 (cont)

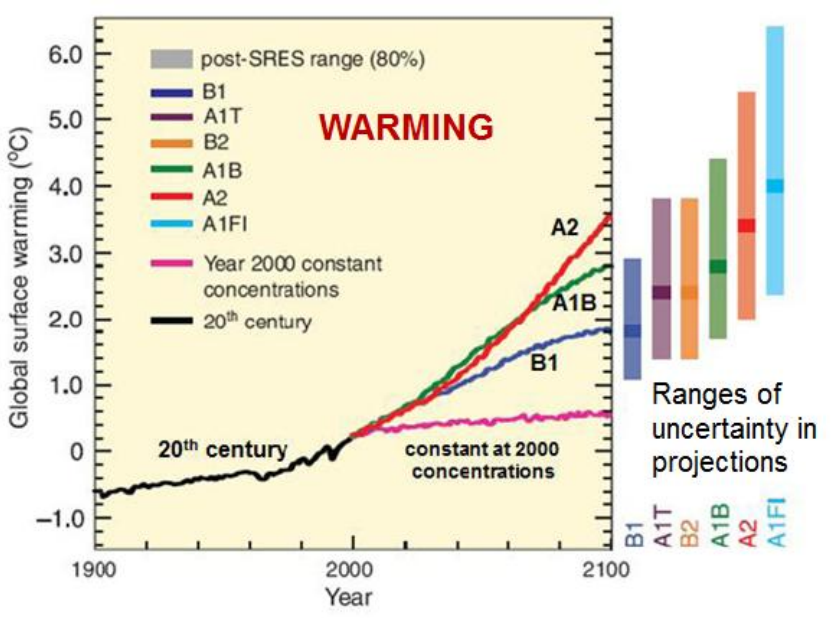
CLIMATE CHANGE: IMPACTS & ISSUES – Part II
WHAT AWAITS US!!

pp 89 in Class Notes

Last week we covered the IPCC computer model projections based on different scenarios:



CO2 EMISSIONS (going INTO the atmosphere) ➔ Resulting 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 !!

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

November 3, 2011

HOME / NEWS / SCIENCE

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.

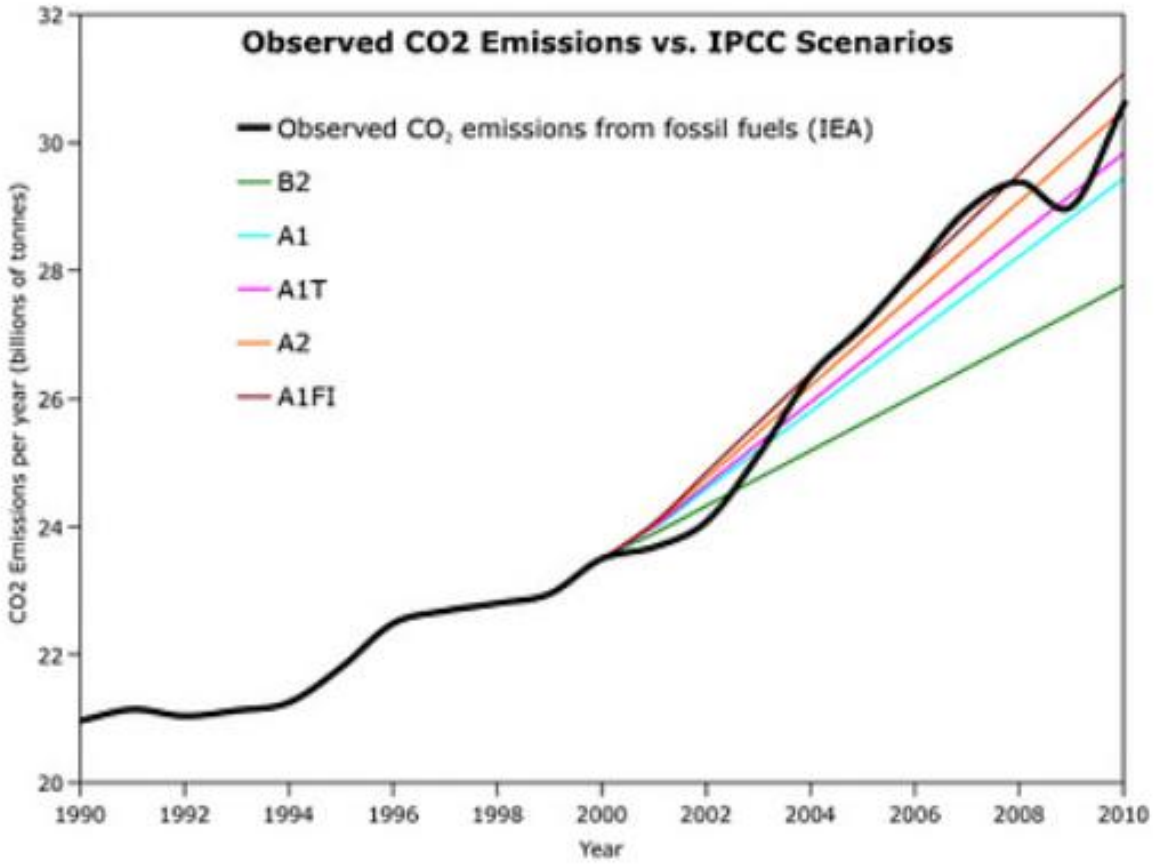
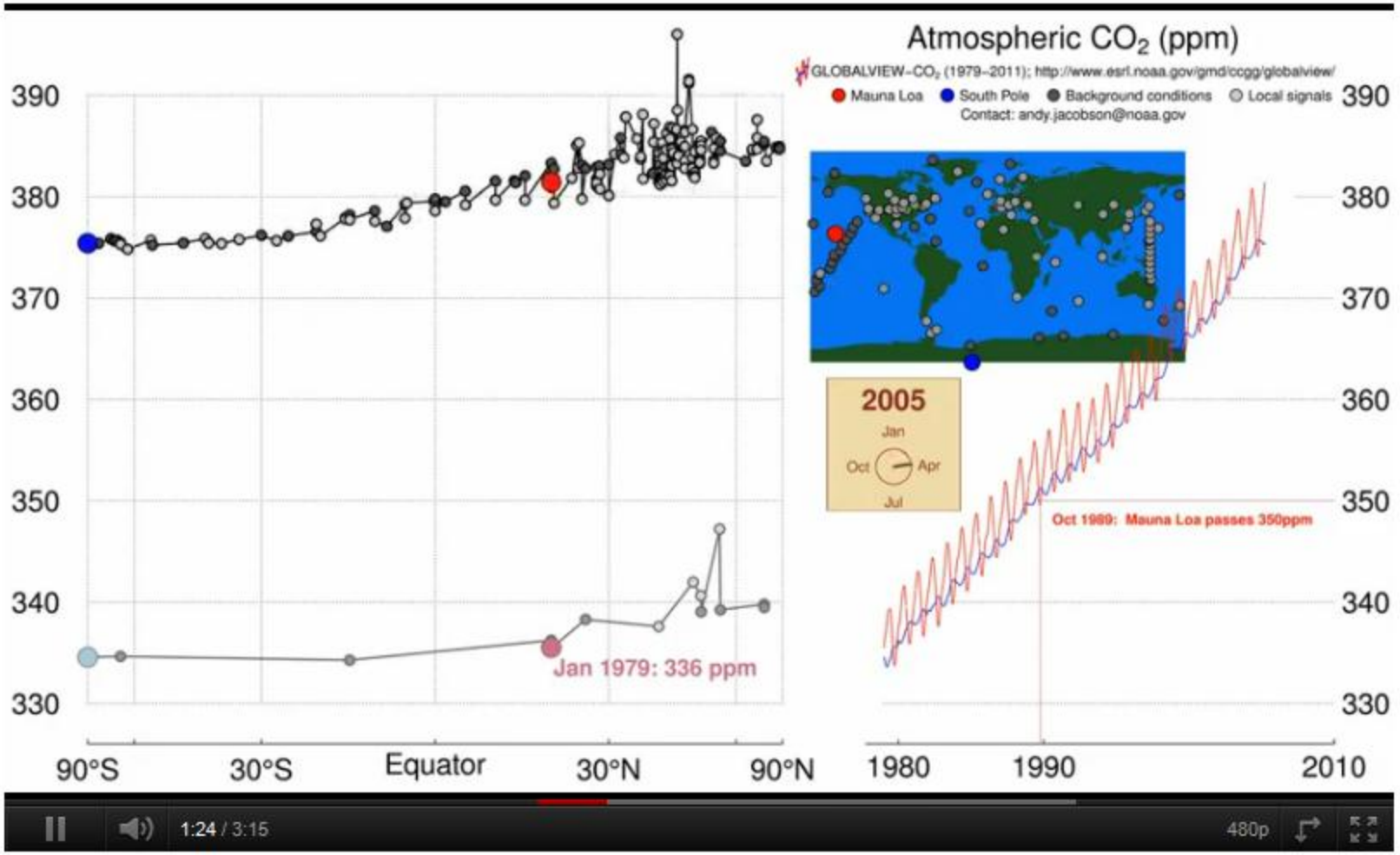


Figure 1: IEA global human CO2 annual emissions from fossil fuels estimates vs. IPCC SRES scenario projections. The IPCC Scenarios are based on observed CO2 emissions until 2000, at which point the projections take effect.

Time history of atmospheric CO2 (2011 update)

CarbonTracker 6 videos Subscribe

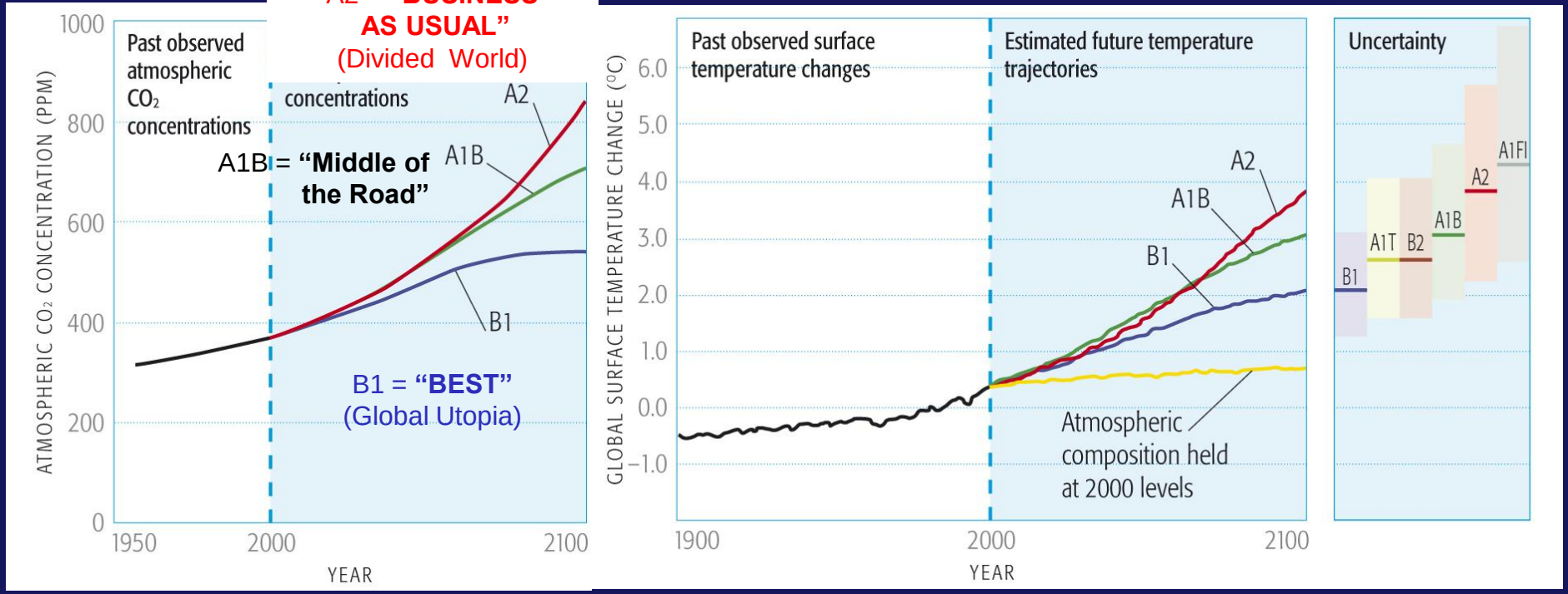


http://www.youtube.com/watch?v=bbgUE04Y-Xg&feature=player_embedded#!

RANGE OF POSSIBLE TRAJECTORIES FOR FUTURE CLIMATE CHANGE

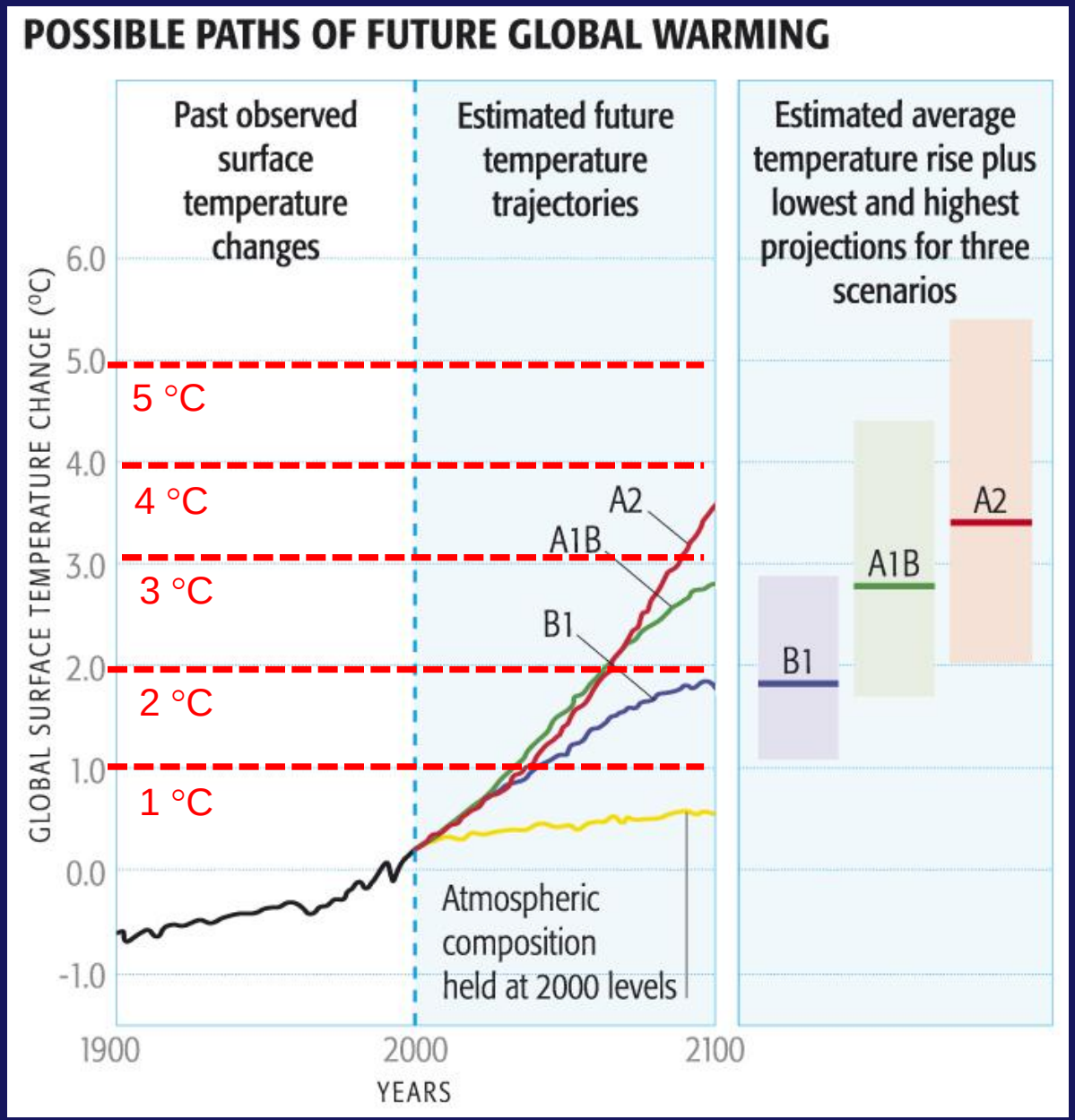
CO2 in ATMOSPHERE
(due to emissions)

RESULTING WARMING: TEMPERATURE INCREASE



From *Dire Predictions* (p 88)

GLOBAL SURFACE TEMPERA-TURE CHANGE (° C)

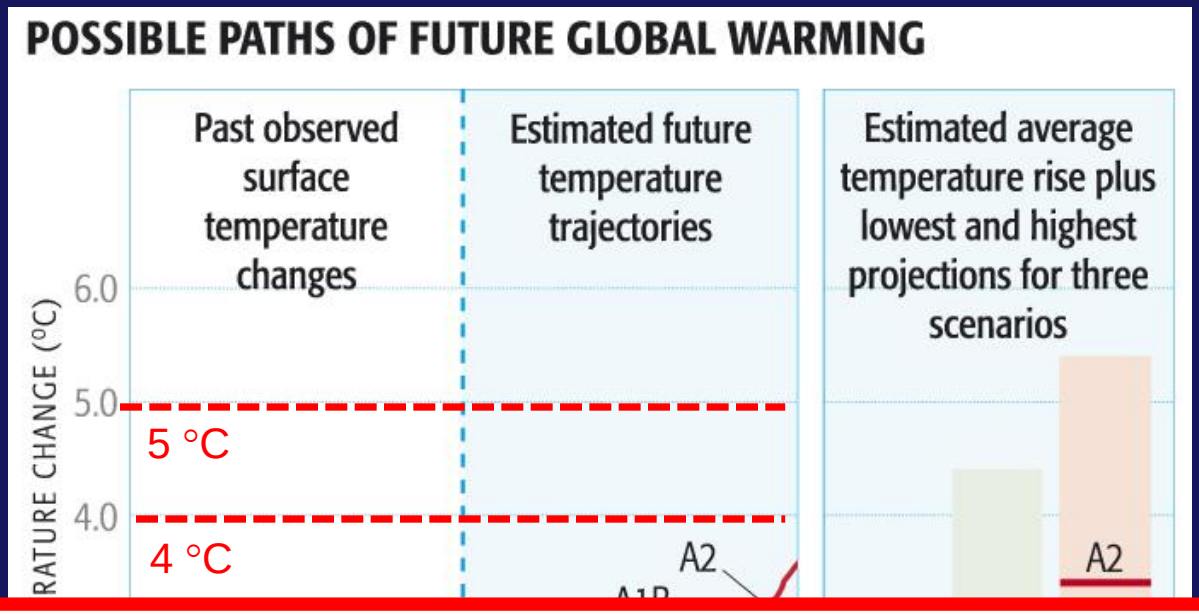


Pacific Institute for Climate Solutions
Knowledge. Insight. Action.

The I-2D LESSON 4 ONLINE TUTORIAL

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

From *Dire Predictions* (p 20)



GLOBAL SURFACE TEMPERATURE CHANGE (° C

"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)

Lesson 4 Climate Science Basics Tutorial

Pacific Institute for Climate Solutions
Knowledge. Insight. Action.

The I-2D LESSON 4 ONLINE TUTORIAL

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

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 CO_2 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 CO_2, 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 CO_2 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 conveyer-belt circulation will suffer an abrupt transition ▪ If the atmospheric CO_2 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

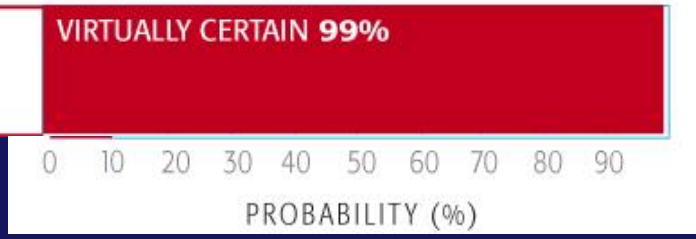
PROBABILITY (%)

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



- **Over most land** areas:

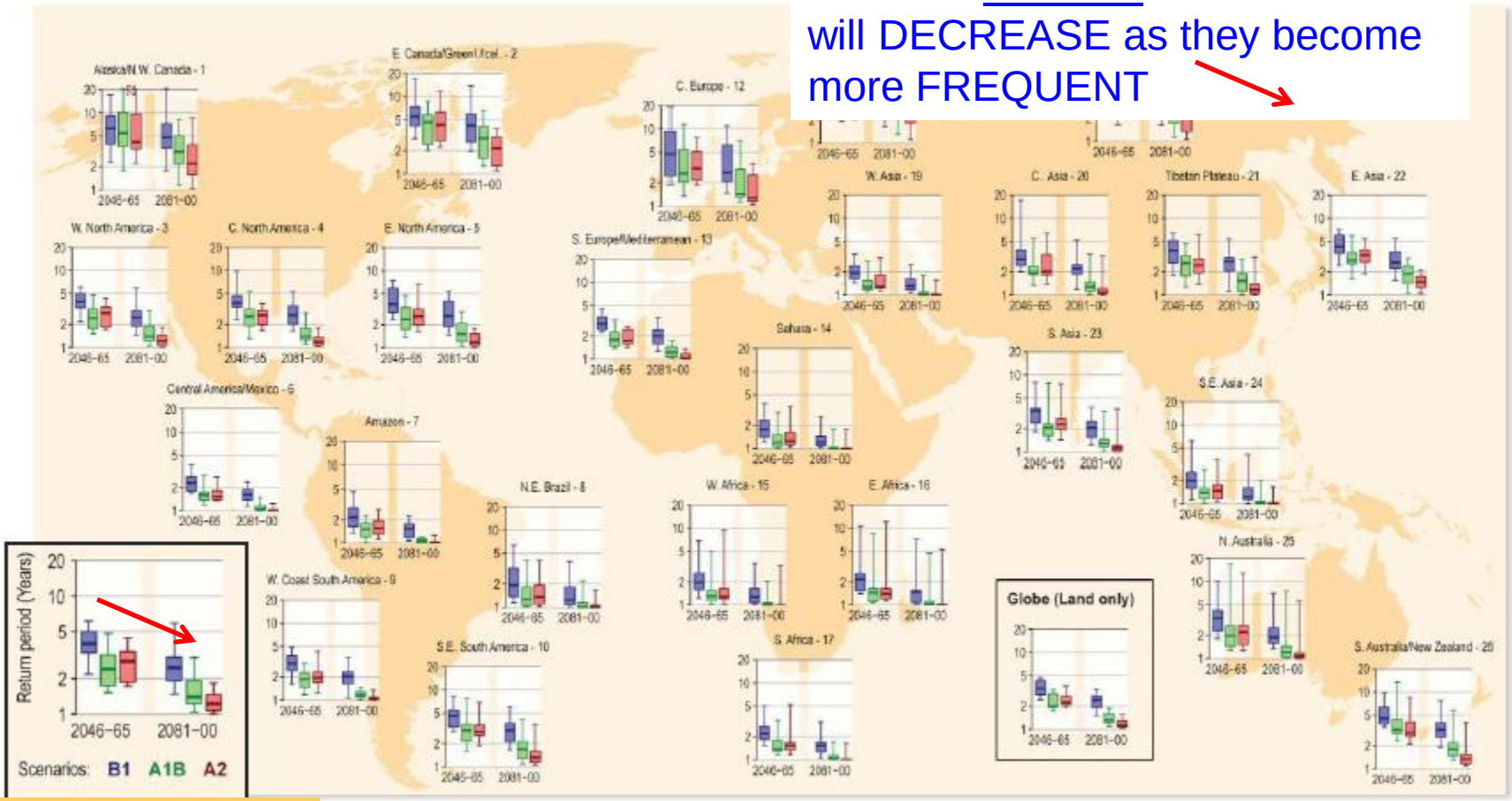
HOT DAYS & NIGHTS will be WARMER;
and MORE FREQUENT

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)

Climate models project more frequent hot days throughout the 21st century

The time between extreme events will DECREASE as they become more FREQUENT



Recurrence Intervals for each scenario over time

In many regions, the time between "20-year" (unusually) warm days will decrease

ipcc

IPCC PROJECTIONS FOR THE 21ST CENTURY

VERY LIKELY 90%

- If the atmospheric CO_2 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
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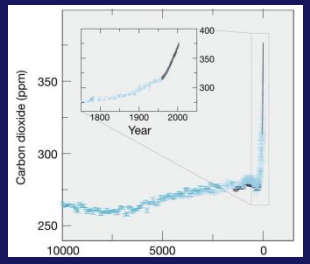
- The frequency of warm spells and heat waves will increase
- The frequency of heavy precipitation events will increase
- Precipitation amounts will increase in high latitudes
- The ocean's conveyor-belt circulation will weaken or shut down abruptly

VERY LIKELY **90%**

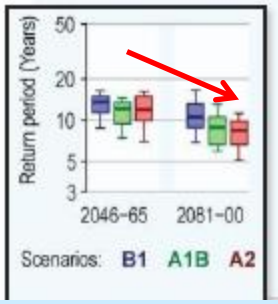
- **the RATE of increase of GHG's will be UNPRECEDENTED in past 10,000 yrs**



- **Frequency of HEAVY PRECIPITATION EVENTS will INCREASE**

Climate models project there will be more heavy rain events throughout the 21st century

The time between extreme events will DECREASE as they become more FREQUENT



Recurrence Intervals for each scenario over time

In many regions, the time between "20-year" (unusually intense) rainstorms will decrease

ipcc

Impacts like these have already been observed!

Since 1950, extreme hot days and heavy precipitation have become more common

IPCC PROJECTIONS FOR THE 21ST CENTURY

LIKELY 66%

- If the atmospheric CO_2 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
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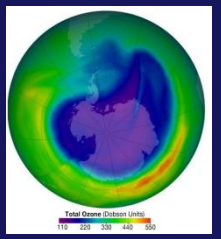
- Precipitation amounts will decline in the subtropics
- The loss of glaciers will accelerate in the next few decades
- Climate change will promote ozone-hole expansion, despite an overall decline in ozone-destroying chemicals

- **Extreme HIGH SEA LEVEL events will increase**

- **SUBTROPICS (that's us!) will experience PRECIPITATION DECLINE**

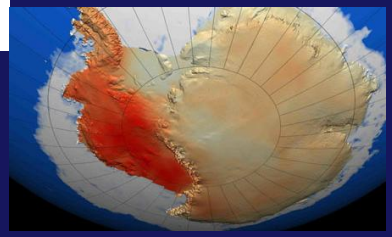
- **Stratospheric cooling ➔ ozone hole persistence even WITH ban of CFC's!**



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)**

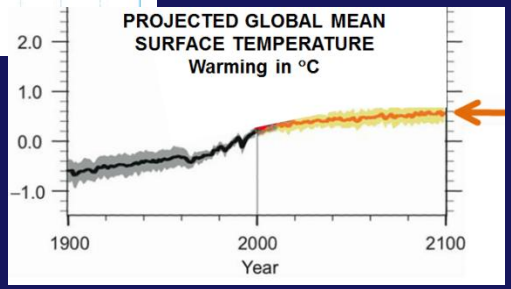
UNLIKELY 35%

▪ Antarctic and Greenland ice sheets will collapse due to surface warming	UNLIKELY

- **ANTARCTIC & GREENLAND ICE SHEETS COLLAPSE**

VERY UNLIKELY10%

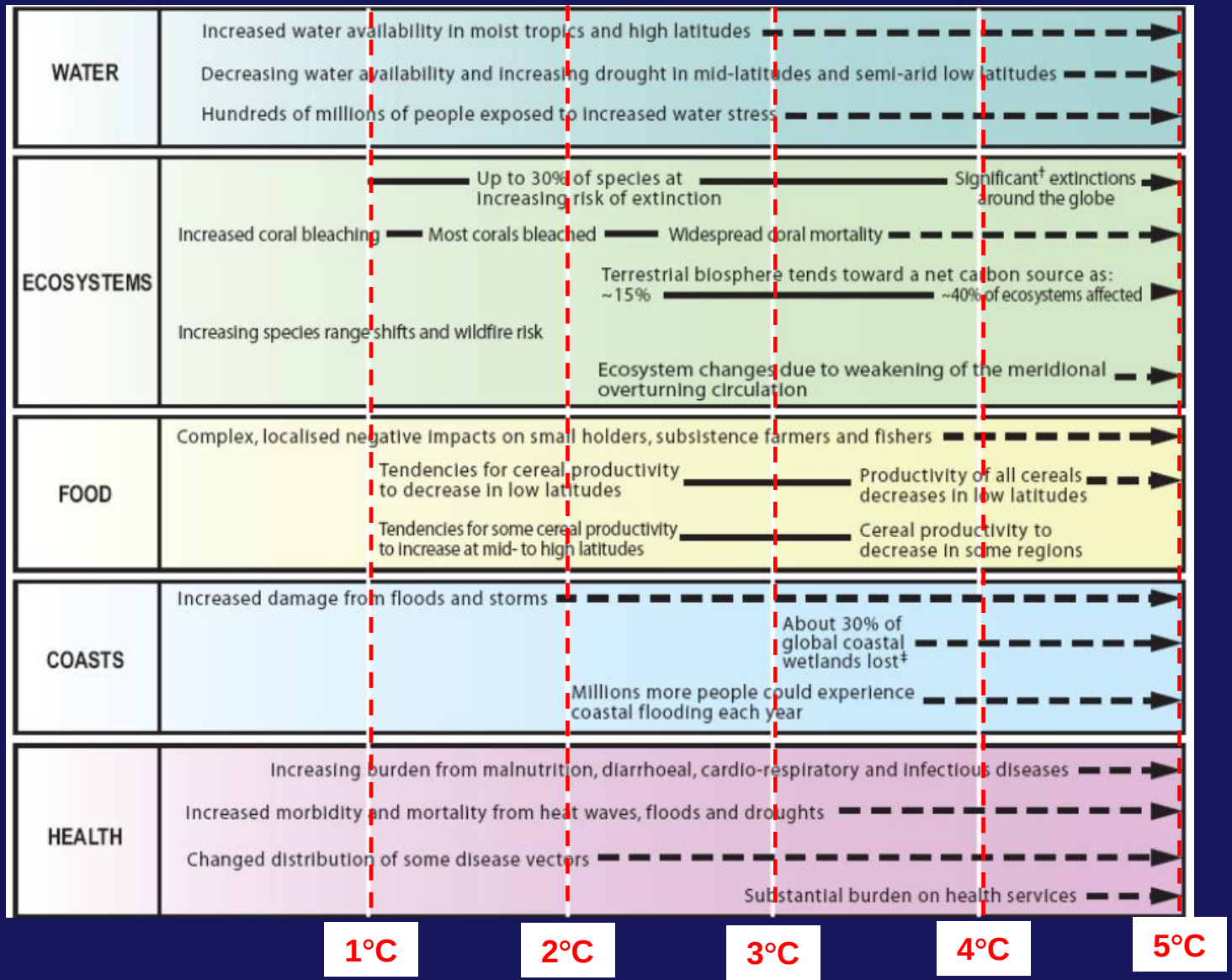
▪ The ocean's conveyer-belt circulation will suffer an abrupt transition ▪ If the atmospheric CO_2 level stabilizes at double the present level, global temperatures will rise by less than 1.5°C	VERY UNLIKELY **10%**



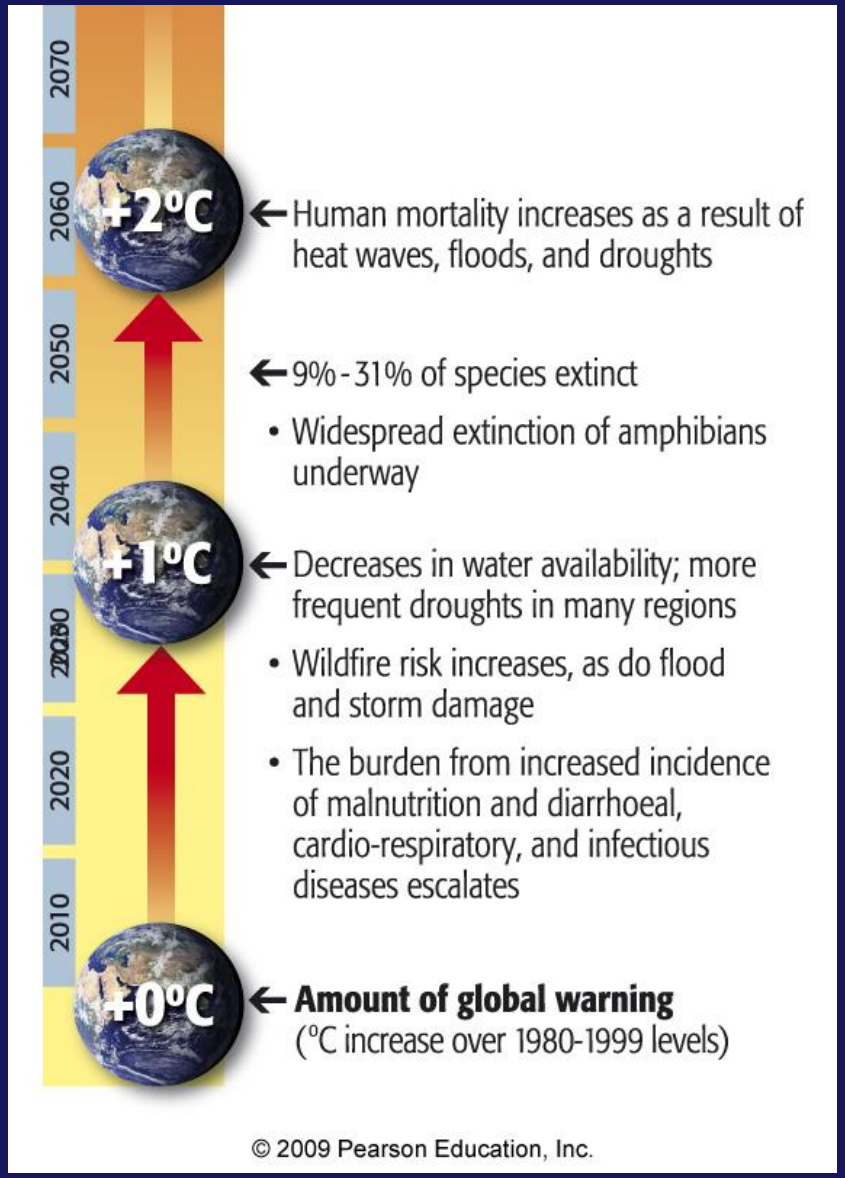
- **GLOBAL TEMPERATURES will rise by LESS than 1.5° C (if CO_2 stabilizes at 2x)**

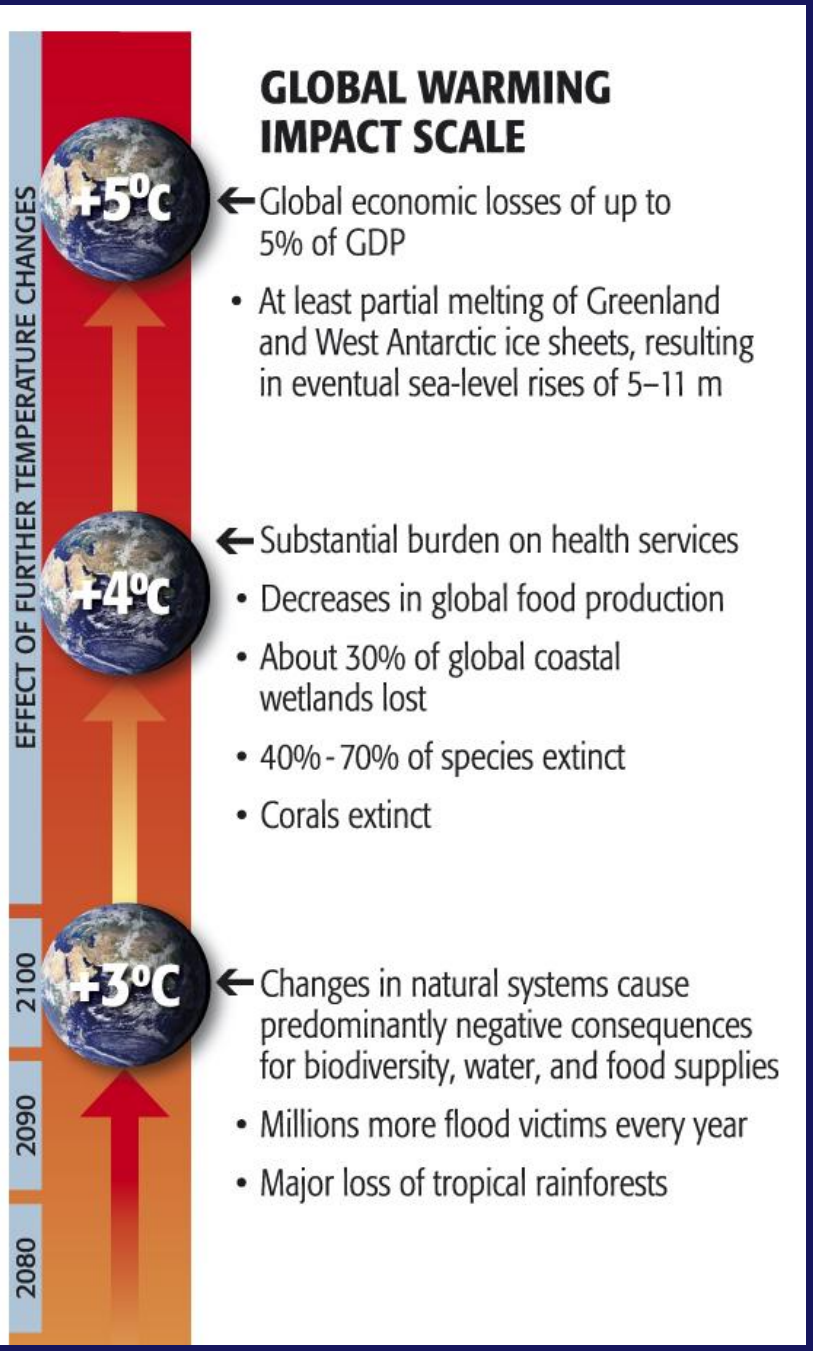
Examples of IMPACTS associated with global average annual temperature change

(relative to 1980-1999 average temperature)



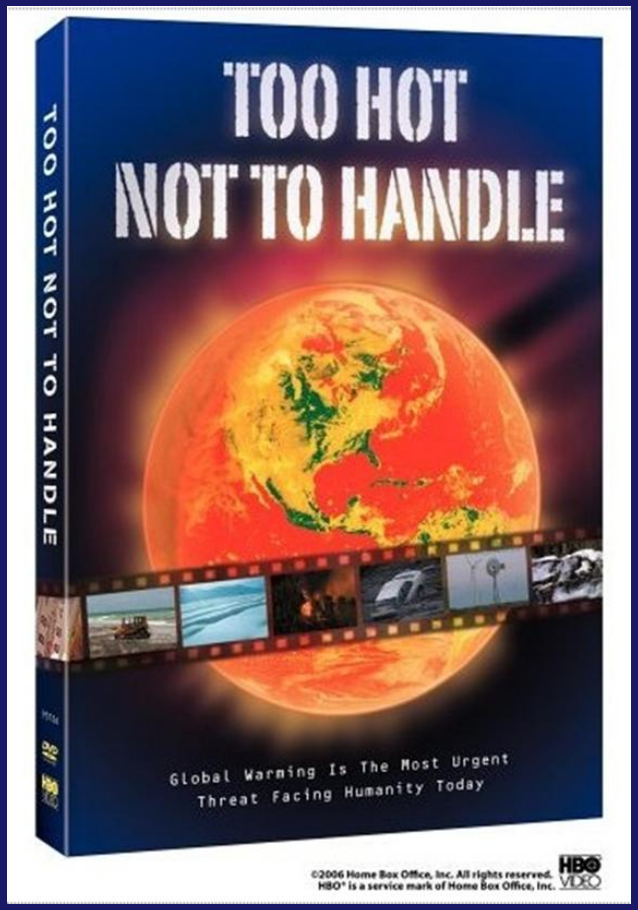
GLOBAL WARMING IMPACT SCALE





From *Dire Predictions* (p 108)

And now . . .



The final segment!