IPCC Fourth Assessment Report: Summary and Key Findings

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Report Organization

1. Observed changes in climate and their effects
2. Causes of changes
3. Impact projections – near and long term
4. Adaptation and mitigation as related to sustainable development
5. Adaptation and mitigation over the long term
6. Robust findings and key uncertainties

Uncertainty - 3 approaches*

- “qualitatively”
- “more quantitatively”
- “using expert judgement and statistical analysis”

*See introduction of “Longer Report” for full text

“more quantitatively”

- Confidence expressed as “chances in 10”
  - Very high 9 (or 90% chance or probability of 0.9)
  - High 8
  - Medium 5
  - Low 2
  - Very low <1

“expert judgement and statistical analysis”

- Virtually certain >99%
- Extremely likely >95% (or 96 – 99% certain)
- Very likely >90%
- Likely >66%
- More likely than not >50%

- About as likely as not 33% – 66%
- Unlikely <33%
- Very unlikely <10%
- Extremely unlikely <5%
- Exceptionally unlikely <1%

1. Observed changes and their effects

1.1 “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.”

1.1 Specific findings

- 11 of 12 warmest years ever recorded occurred from 1995 – 2006
- Warming greater at higher northern latitudes
- Land warming faster than ocean
- Rate of sea level rise increasing
  - Thermal expansion
  - Melting glaciers and ice caps

1. Observed changes and their effects

1.2 “Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.”

System effects

- *Very high confidence* terrestrial biological systems are strongly affected (e.g., earlier leafing, bird migration)
- *High confidence* marine and freshwater biological systems are affected (e.g., earlier fish migration)
- *Medium confidence* for effects on human-related systems (e.g., ag and forestry management, heat-related mortality, infectious disease vectors)

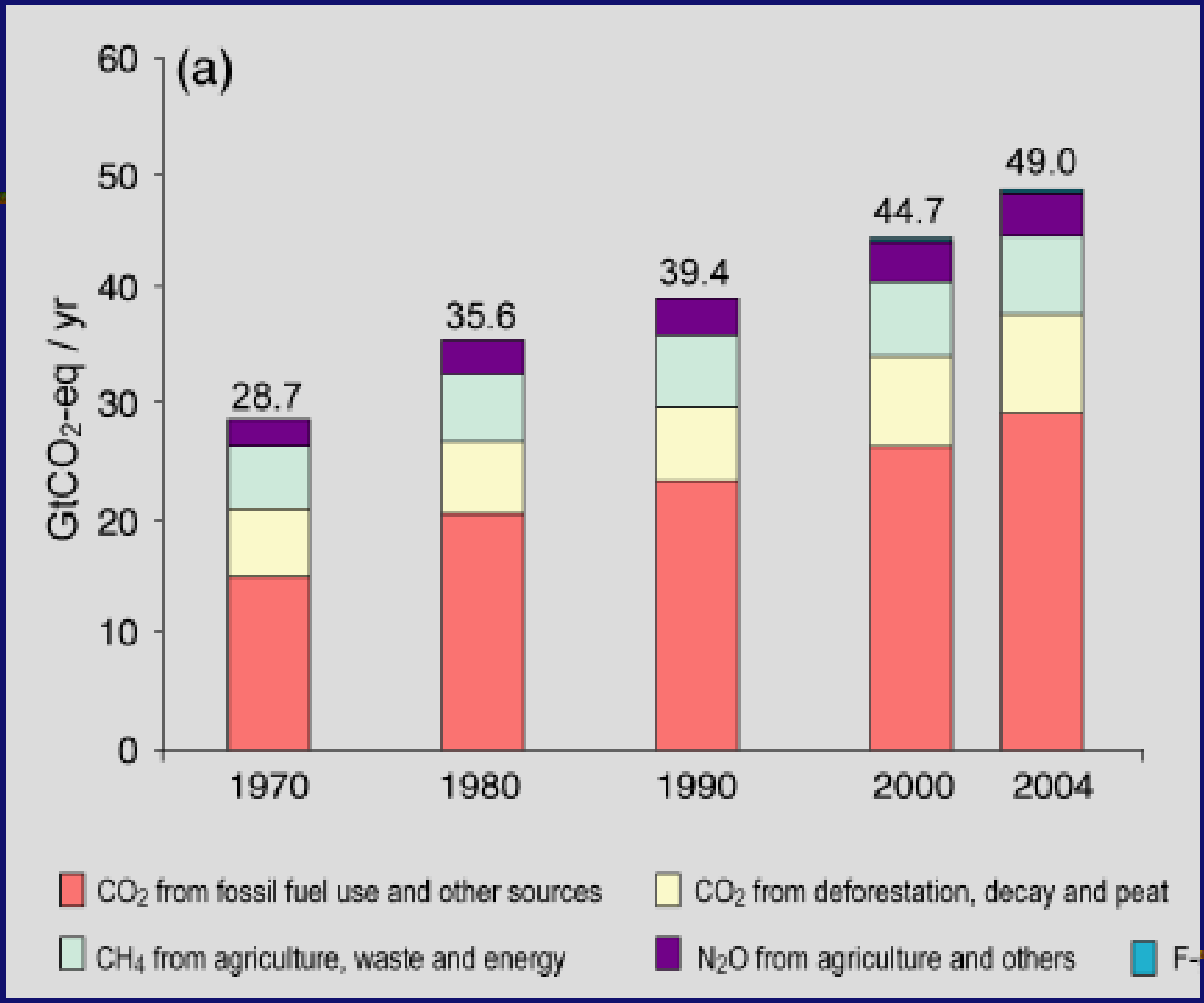
2. Causes of change

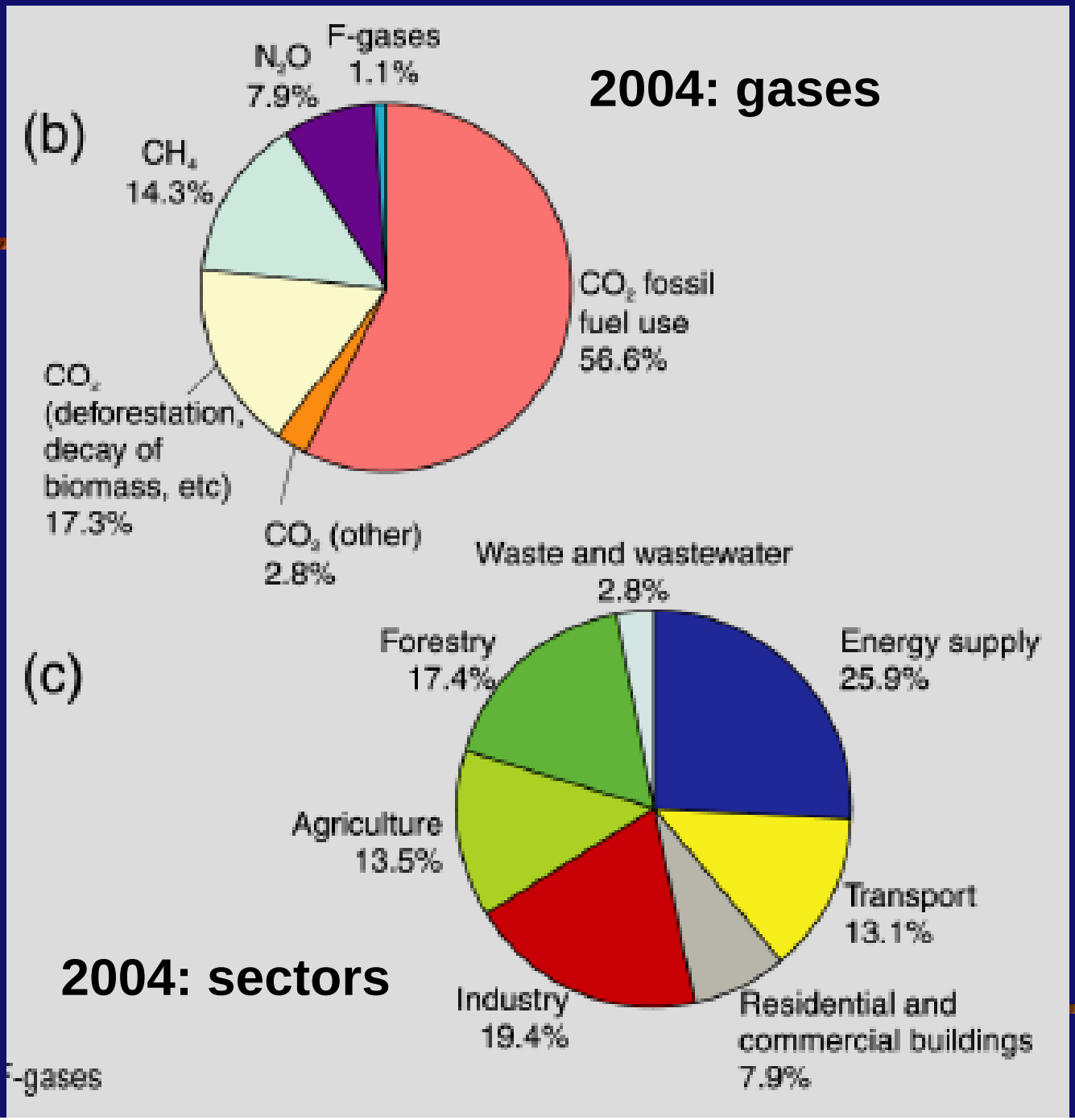
- Global GHG emissions from human activities have increased since pre-industrial times…
  - …with an increase of 70% between 1970 and 2004, primarily from energy supply, transport and industry
  - Emissions from ag, buildings and forestry (including deforestation) increased at a lower rate

Global atmospheric GHG concentrations resulting from anthropogenic emissions

- Methane ($CH_{4)}$ and carbon dioxide ($CO_{2)}$ concentrations are higher than any time in last 650,000 years

- Nitrous oxide (N_2O) has increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values spanning many thousands of years

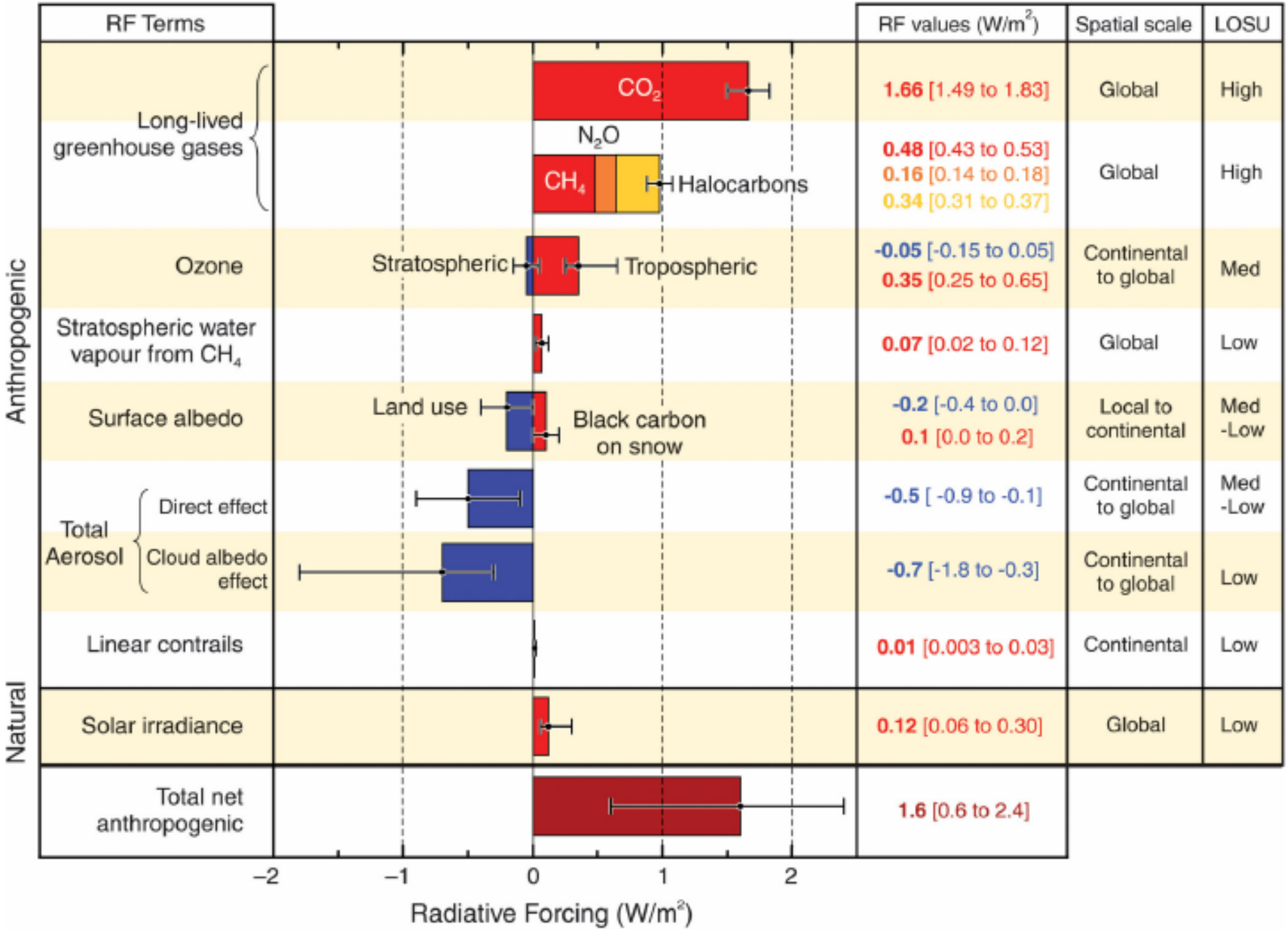

(a)
60
50
40
30
20
10
0
GtCO2-eq / yr
28.7
35.6
39.4
44.7
49.0
1970
1980
1990
2000
2004
CO2 from fossil fuel use and other sources
CO2 from deforestation, decay and peat
CH4 from agriculture, waste and energy
N2O from agriculture and others
F-


2004: gases
(b)
F-gases
1.1%
N_2O
7.9%
CH_4
14.3%
CO_2 fossil
fuel use
56.6%
CO_2
(deforestation,
decay of
biomass, etc)
17.3%
CO_2 (other)
2.8%
(c)
Waste and wastewater
2.8%
Forestry
17.4%
Energy supply
25.9%
Agriculture
13.5%
Transport
13.1%
Industry
19.4%
Residential and
commercial buildings
7.9%
2004: sectors
-gases

Effects

- There is *very high confidence* that the net effect of human activities since 1750 has been one of warming
- Warming of 0.2 ^{o}C (0.36 ^{o}F) per decade projected for next 2 decades
- Net effect due to human activities since the pre-industrial era are resulting in radiative forcing of +1.6 W/m2

Radiative forcing components



3. Climate change impacts

- Assuming current climate change mitigation policies and related sustainable development practices, GHG emissions will continue to grow over the next few decades.

  …but how will they grow?

6 Scenarios (assuming current policies and practices)

- 3 A1 scenarios assume
  - very rapid economic growth
  - mid-century population peak
  - rapid technology development

  - A1FI = fossil intensive
  - A1T = non-fossil intensive
  - A1B = “balance” across all sources

Scenarios cont.

- B1 = same population as A1 with more rapid transition to service- and information-based economies
- B2 = intermediate population and econ growth, emphasizing local solutions to sustainability
- A2 = high population growth, slow economic development and slow technological change

Scenarios for GHG emissions from 2000 to 2100 in the absence of additional climate policies

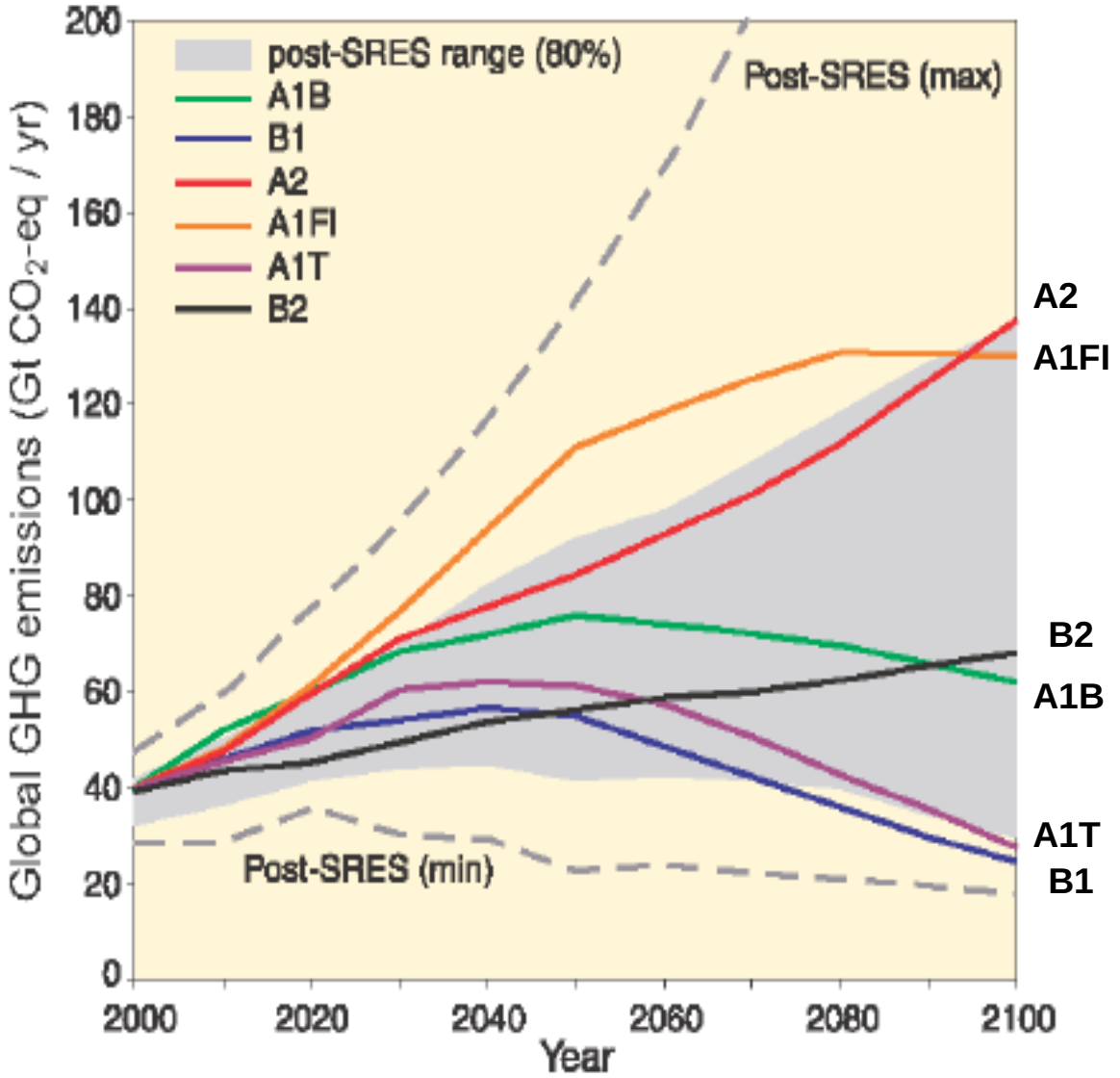
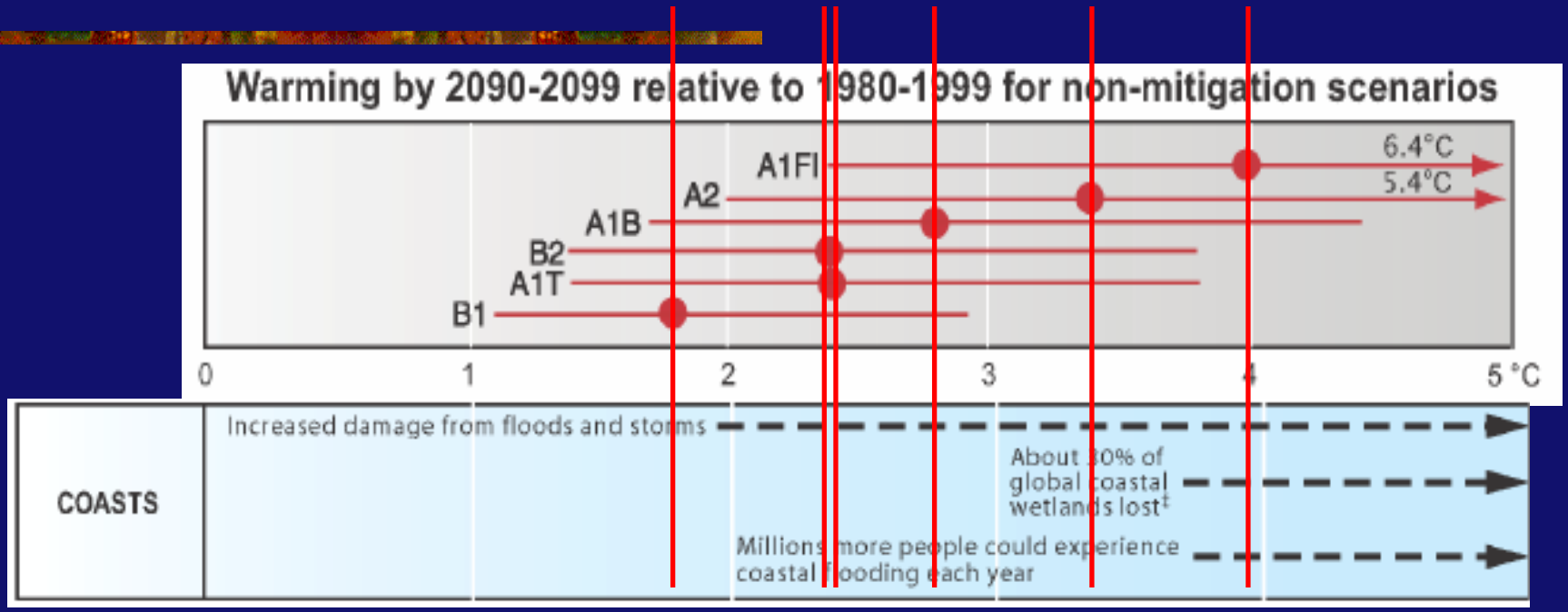


Figure 3.1. Global GHG emissions (in CO_2-eq per year) in the absence of additional climate policies: six illustrative SRES marker scenarios (coloured lines) and 80th percentile range of recent scenarios published since SRES (post-SRES) (grey shaded area). Dashed lines show the full range of post-SRES scenarios. The emissions cover CO_2, CH_4, N_2O, and F-gases. {WGIII 1.3, 3.2, Figure SPM.4}

- Note, previous graph is for emissions, not atmospheric GHG concentrations – which continue to rise under all above scenarios

	Temp change in °C (2090-99 relative to 1980-99)	Sea-level rise in m (same time period)
Case	Best estimate	Models exclude rapid changes in ice flow
Yr 2000 constant	0.6	Not available
B1	1.8 (3.24 °F)	0.18 – 0.38
A1T	2.4	0.20 – 0.45
B2	2.4	0.20 – 0.43
A1B	2.8	0.21 – 0.48
A2	3.4	0.23 – 0.51
A1FI	4.0 (7.2 °F)	0.26 – 0.59

Examples of impacts associated with global average temperature change

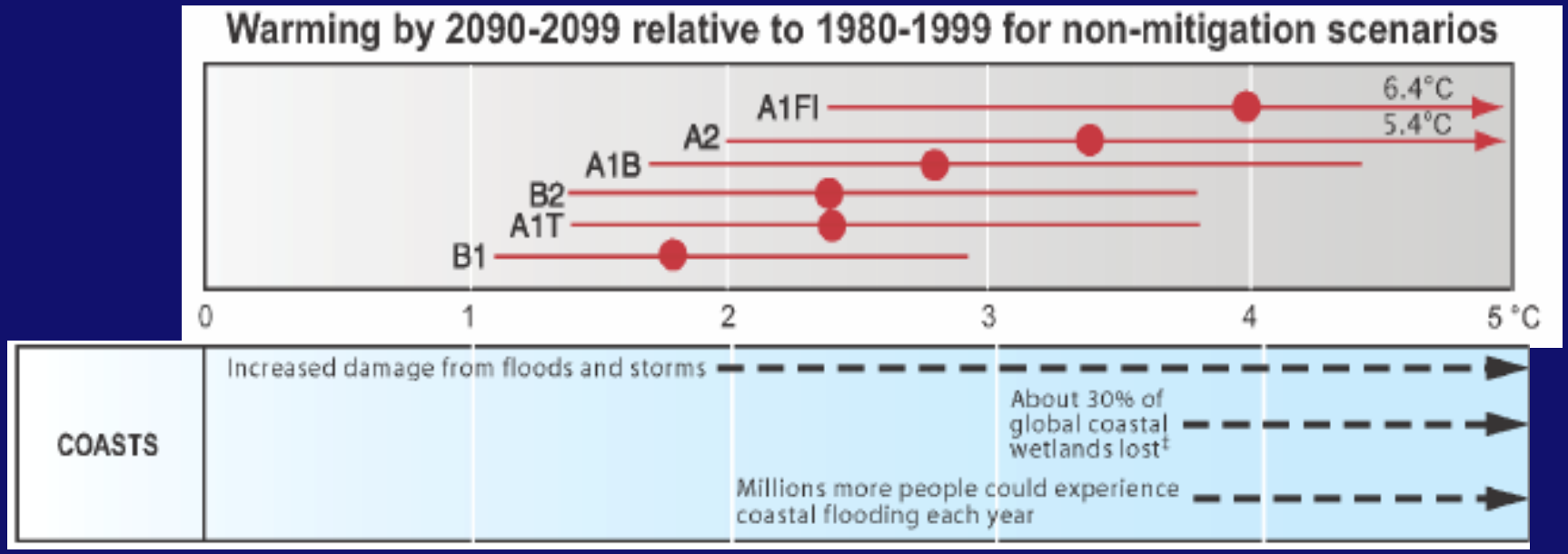


------- impacts continuing with increased temp

——— impacts are linked

Left hand side of text indicates temperature of impact onset

Impacts - Coast



Left hand side of text indicates temperature of impact onset

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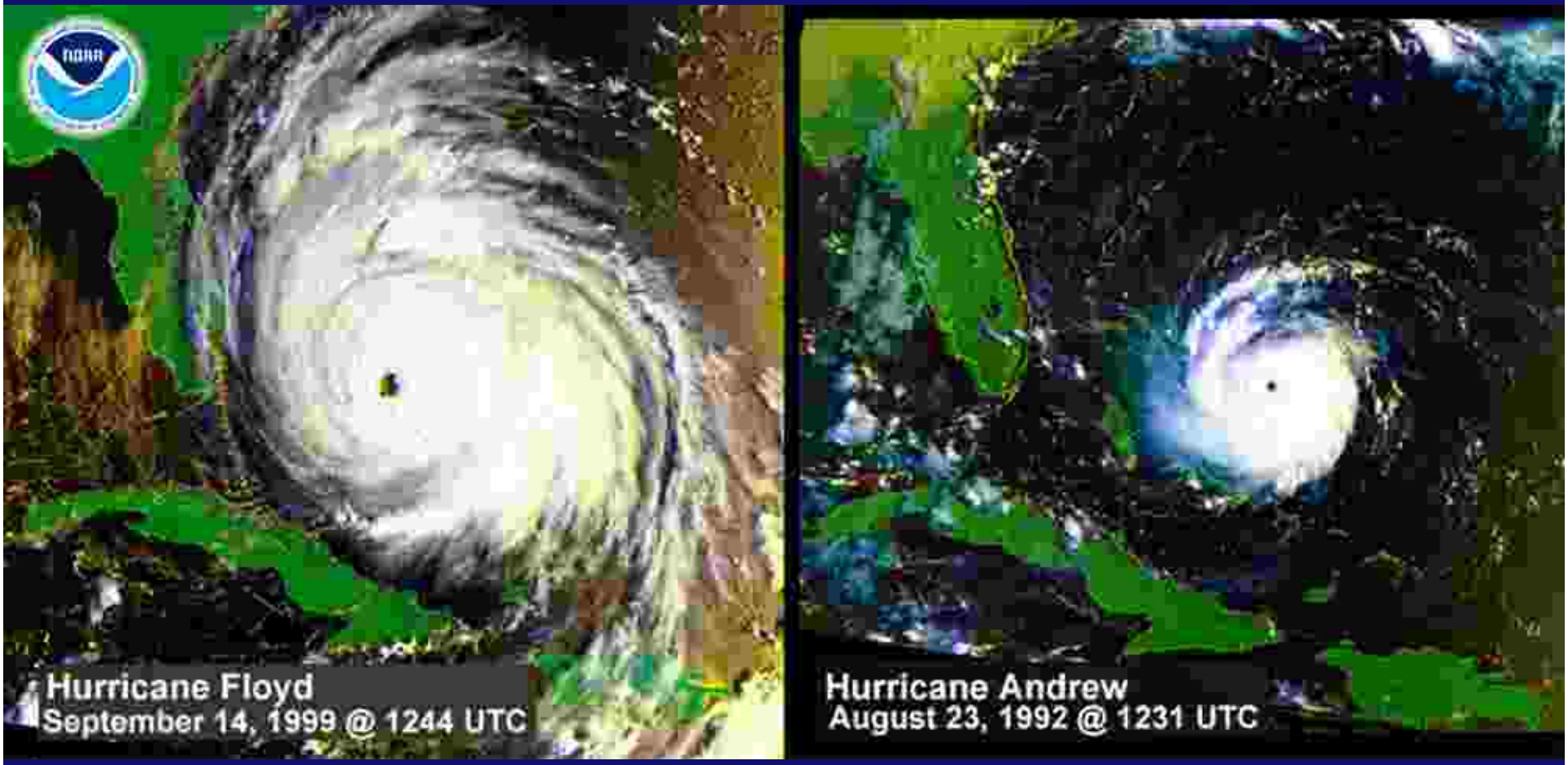
Likely increase in extreme high sea level

Appstate University

Possible increase in hurricane frequency and intensity

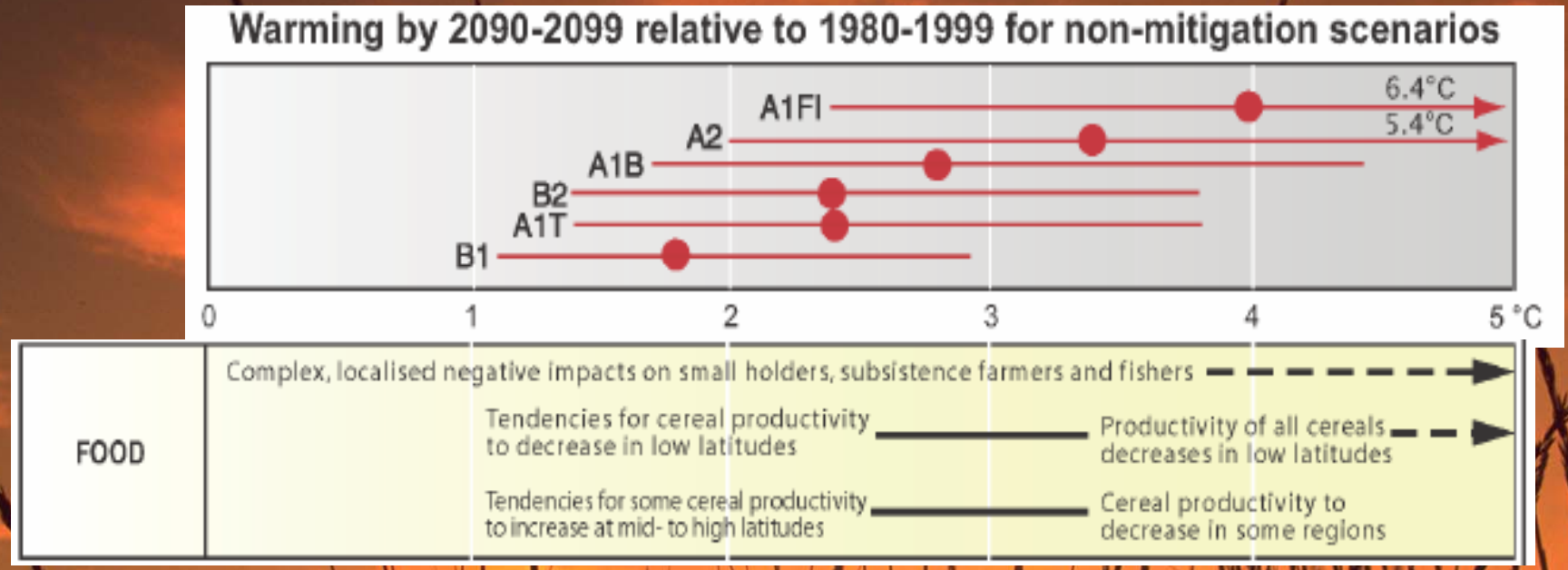


Earthobservatory NASA

Hurricane Floyd

NOAA

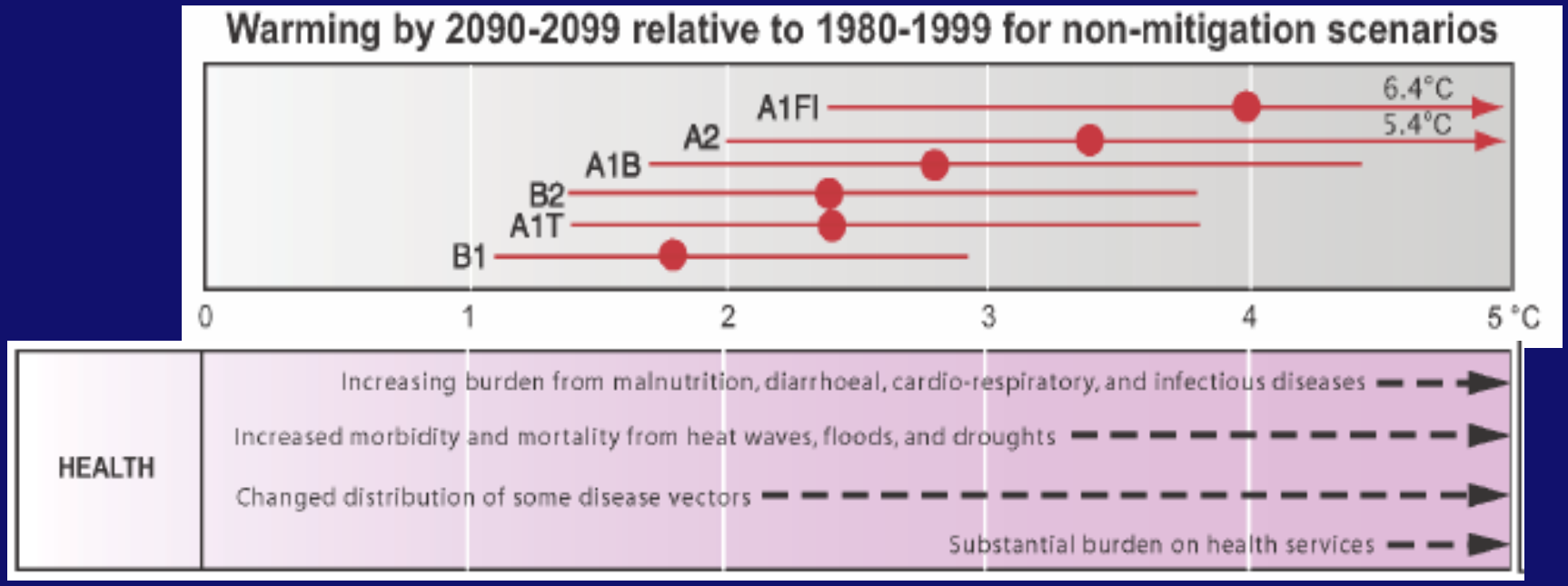
Impacts - Food



Other effects

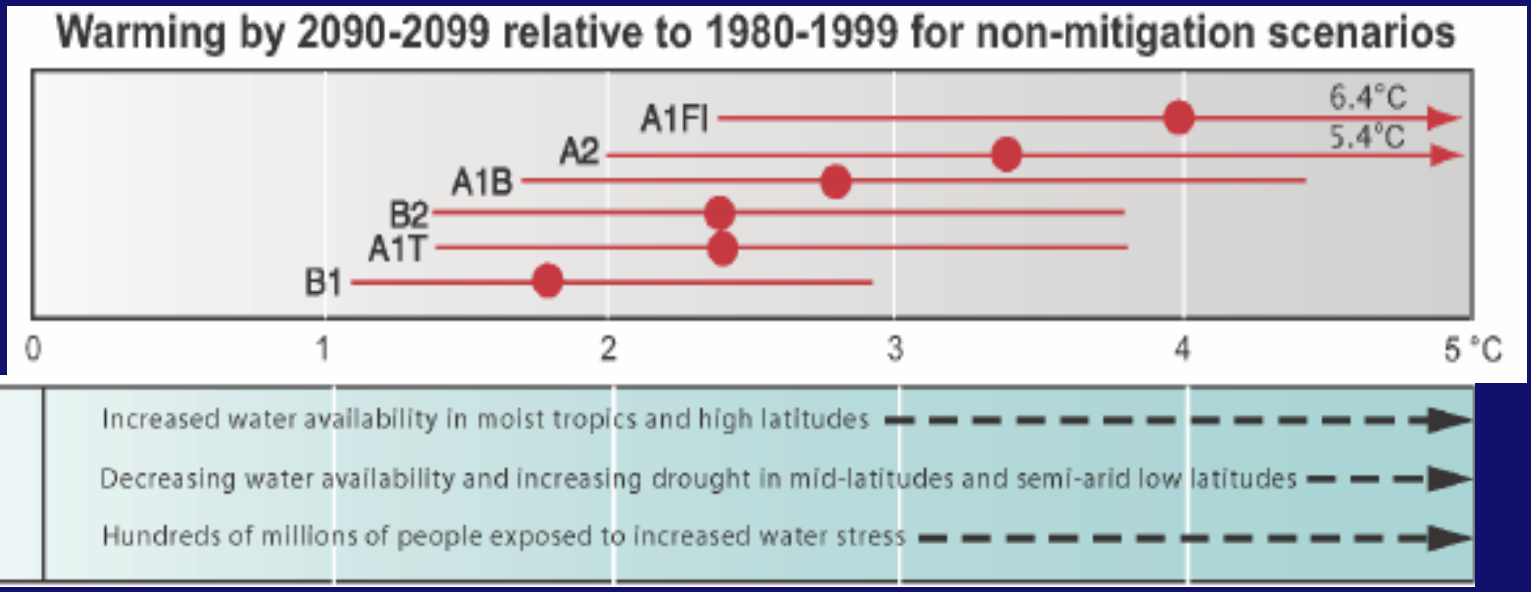
- shifts in areas suitable for various crops
- plant diseases
- plant pests
- animal diseases
- animal productivity
- crop productivity

Impacts - Health



- *Likely increase* in heat waves

Impacts - Water



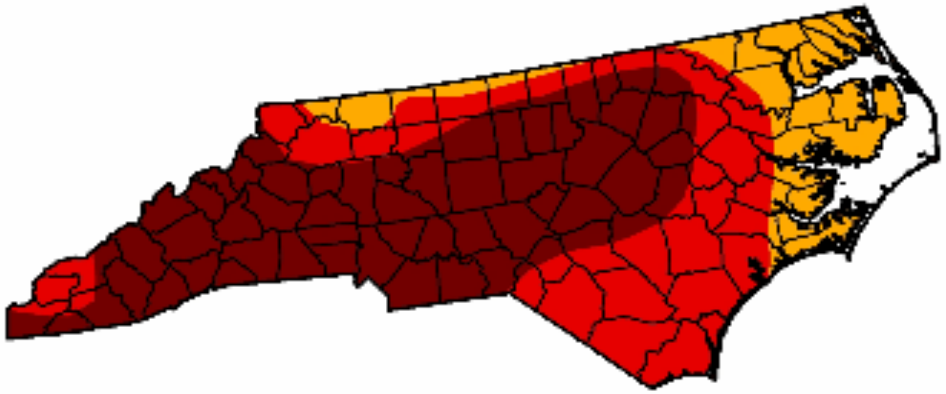
U.S. Drought Monitor

North Carolina

January 8, 2008
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.0	100.0	100.0	100.0	83.7	51.3
Last Week (01/01/2008 map)	0.0	100.0	100.0	100.0	83.7	51.3
3 Months Ago (10/16/2007 map)	0.0	100.0	100.0	100.0	84.6	54.3
Start of Calendar Year (01/01/2008 map)	0.0	100.0	100.0	100.0	83.7	51.3
Start of Water Year (10/02/2007 map)	0.0	100.0	100.0	92.8	79.4	37.7
One Year Ago (01/09/2007 map)	98.5	1.5	0.0	0.0	0.0	0.0



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

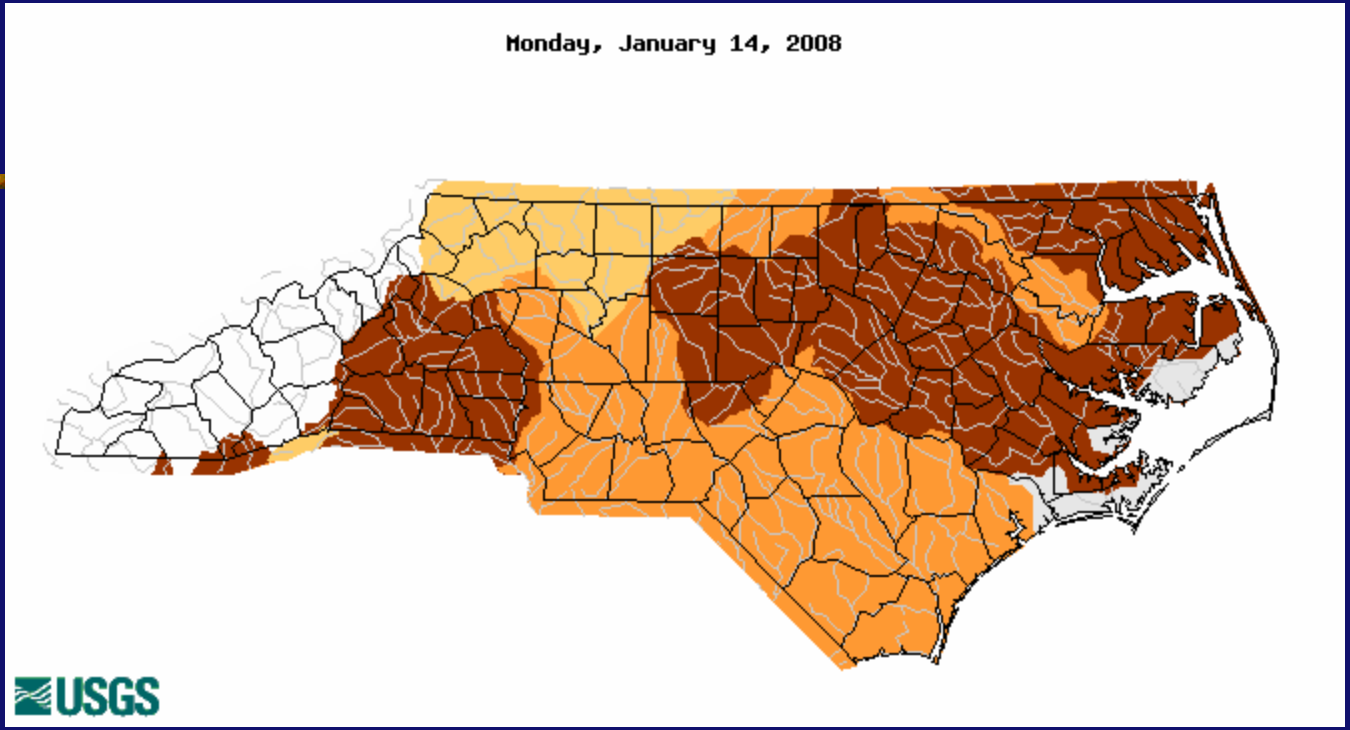
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

http://drought.unl.edu/dm

Released Thursday, January 10, 2008

Author: Rich Tinker, CPC/NOAA

Likely increase in area affected by drought



Stream flow - percentile classes

Low	<=5	6-9	10-24	Insufficient data
Extreme Hydrologic Draught	Severe Hydrologic Drought	Moderate Hydrologic Drought	Below normal	

Likely increase in heavy precipitation

Entrance to Biltmore

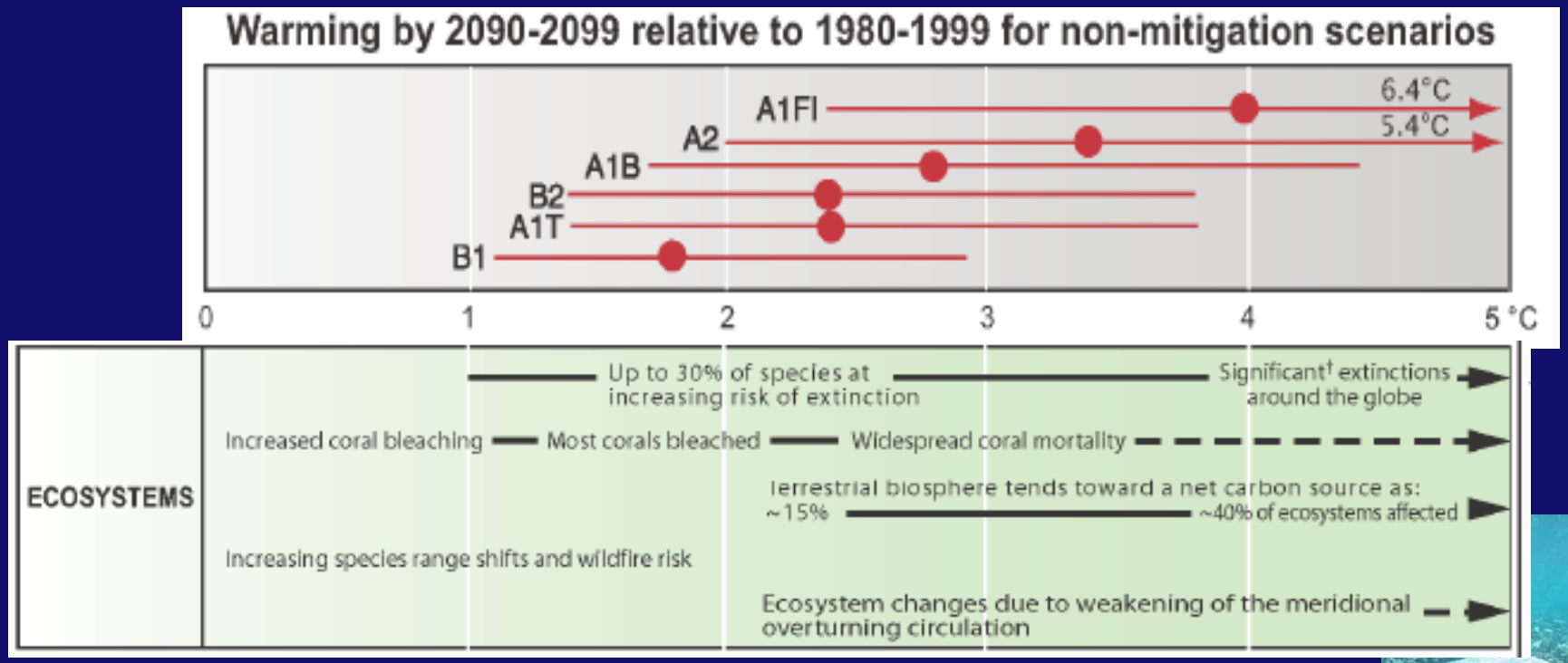
Remnant of hurricane Frances 2004
- flooding in Asheville, NC

High confidence systems related to snow, ice and frozen ground are affected

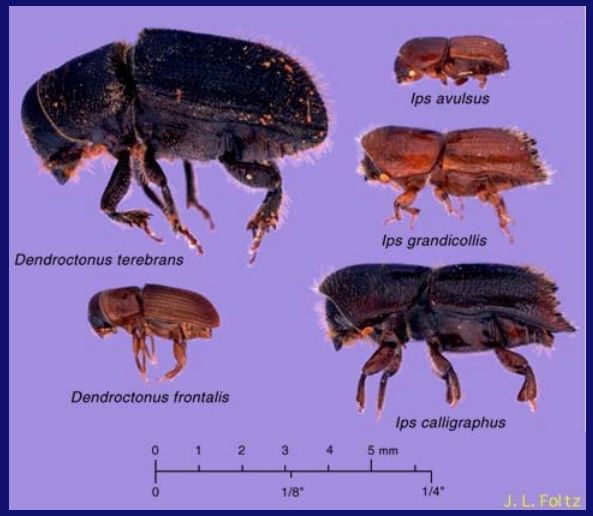
High confidence in increased runoff, earlier spring melting feeding snow- and glacier fed rivers, and warming of lakes

Stormwater. / PSAT, Shutterstock

Impacts - Ecosystems



Very likely decrease in cold days and nights



Mitigation and adaptation

- More adaptation is required to reduce vulnerability to climate change
- A wide range of mitigation options are currently available and expected to be available by 2030 for all sectors with costs averaging $12 per ton CO_2

In a nutshell…

- Climate change is happening
- Humans are the primary cause
- It will result in extensive, possibly catastrophic negative effects if no action is taken
- It is possible to significantly reduce the impact on humans and non-human systems

Key actions to reduce impacts

- Reduce fossil fuel combustion
  - expand alternatives, increase generation and distribution efficiency, low carbon energy sources
- Increase efficiency
  - cars, buildings, industry
- Reduce agriculture and waste emissions
- Increase sequestration
  - soil, forests and forestry products, deep injection
- Adaptation