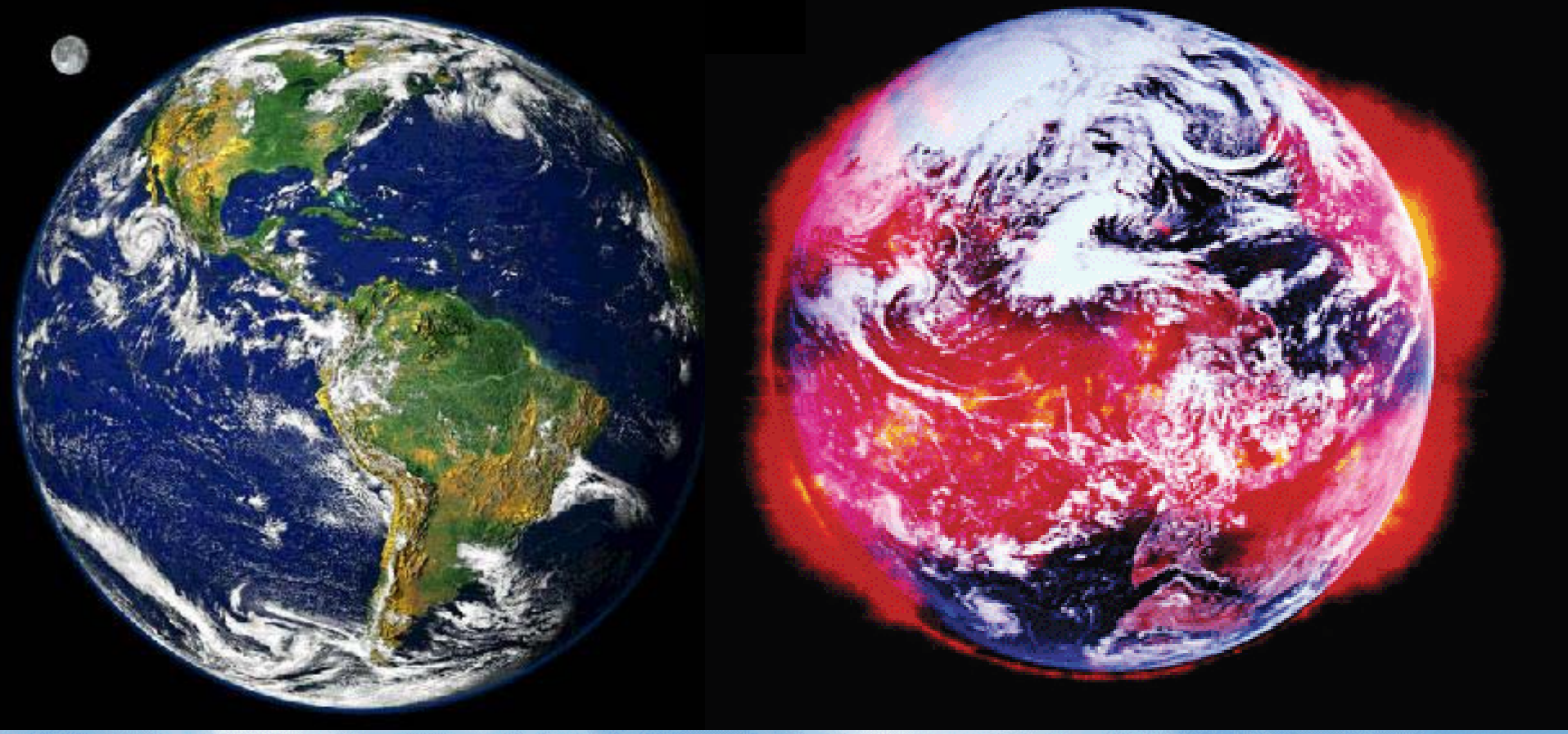

IPCC Workgroup 1 Assessment Report 4 (AR4)

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IPCC Work Group 1 Assessment Report AR4 Outline

1. Historical Overview of Climate Change Science
- Progress in observations
- Progress in understanding of radiative forcing, processes, and coupling
- Progress in climate modeling
- Advances in understanding uncertainties
- Appendix: Glossary of terms

2. Changes in Atmospheric Constituents and in Radiative Forcing
- Definition and utility of radiative forcing
- Recent changes in greenhouse gases
- Aerosols – Direct and indirect radiative forcing
- Radiative forcing due to land use changes
- Contrails and aircraft-induced cirrus
- Variability in solar and volcanic radiative forcing
- Synthesis of radiative forcing factors
- GWPs and other metrics for comparing different emissions
- Appendix: Techniques, error estimation, and measurement systems

3. Observations: Surface and Atmospheric Climate Change
- Changes in surface climate
- Changes in the free atmosphere
- Changes in atmospheric circulation
- Patterns of variability
- Changes in the tropics and sub-tropics
- Extra-tropical changes
- Changes in extreme events
- Synthesis: Consistency across observations
- Appendix: Techniques, error estimation, and measurement systems

4. Observations: Changes in Snow, Ice and Frozen Ground
- Changes in snow cover and albedo
- Sea ice extent and thickness changes
- Changes in glaciers and small ice caps
- Changes and stability of ice shelves
- Changes and stability of ice sheets
- Changes in frozen ground
- Appendix: Techniques, error estimation, and measurement systems

5. Observations: Oceanic Climate Change and Sea Level
- Changes in ocean salinity, temperature, heat Uptake, and heat content
- Biogeochemical tracers
- Changes in ocean circulation and water mass formation
- Sea Level: Global and regional changes
- Appendix: Techniques, error estimation, and measurement systems

6. Paleoclimate
- Proxy methods and their uncertainty
- Inferred past climate system change
- Abrupt climate change
- Paleoenvironmental model evaluation and sensitivity
- Synthesis: Insights into climate system behavior
- Appendix: Guide to the use of paleoclimatic information

7. Couplings Between Changes in the Climate System and Biogeochemistry
- Introduction to biogeochemical cycles
- The carbon cycle and the climate system
- Global atmospheric chemistry and climate change
- Air quality and climate change
- Aerosols and climate change
- The changing land surface and climate
- Synthesis: Interactions among cycles and processes

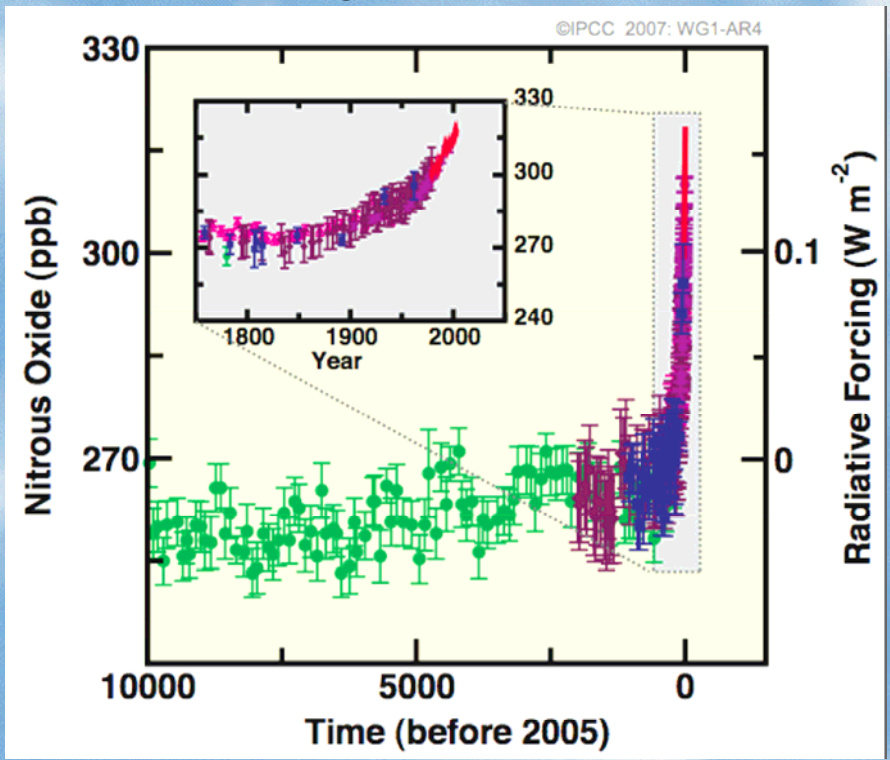
8. Climate Models and their Evaluation
- Advances in modeling
- Evaluation of contemporary climate as simulated by coupled global models
- Evaluation of large scale climate variability as simulated by coupled global models
- Evaluation of the key relevant processes as simulated by coupled global models
- Model simulations of extremes
- Climate sensitivity
- Evaluation of model simulations of thresholds and abrupt events
- Representing the global system with simpler models

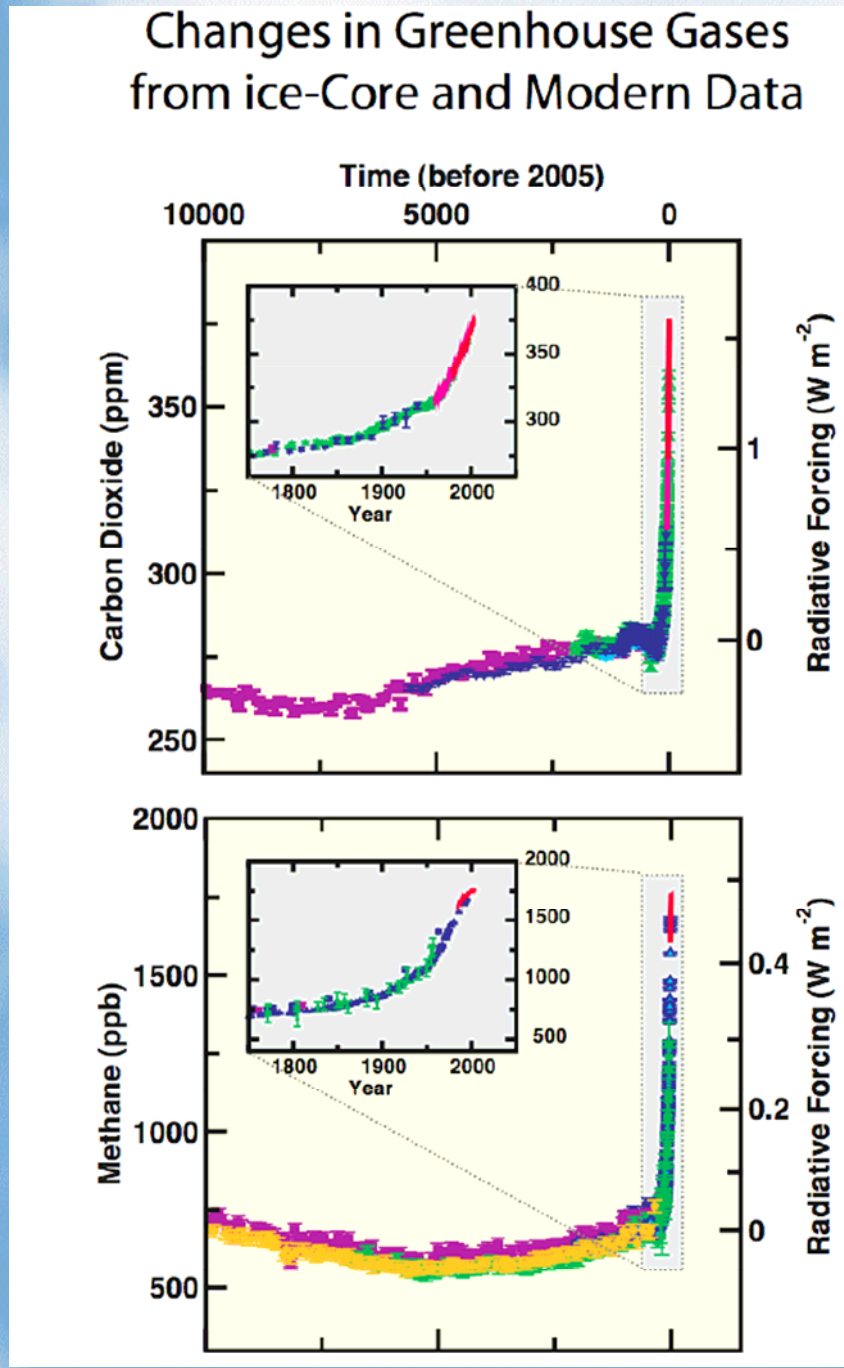
9. Understanding and Attributing Climate Change
- Radiative forcing and climate response
- Seasonal-to-interannual predictions of climate change and their reliability
- Understanding Pre-Industrial climate change
- Understanding climate change during the Instrumental era
- Appendix: Methods used to assess predictability
- Appendix: Methods used to detect externally forced signals (detection/attribution)

10. Global Climate Projections
- Projected radiative forcing
- Timescales of response
- Climate change to 2100 and beyond
- Sea level projections
- Scenarios and simple models
- Uncertainties in global model projections

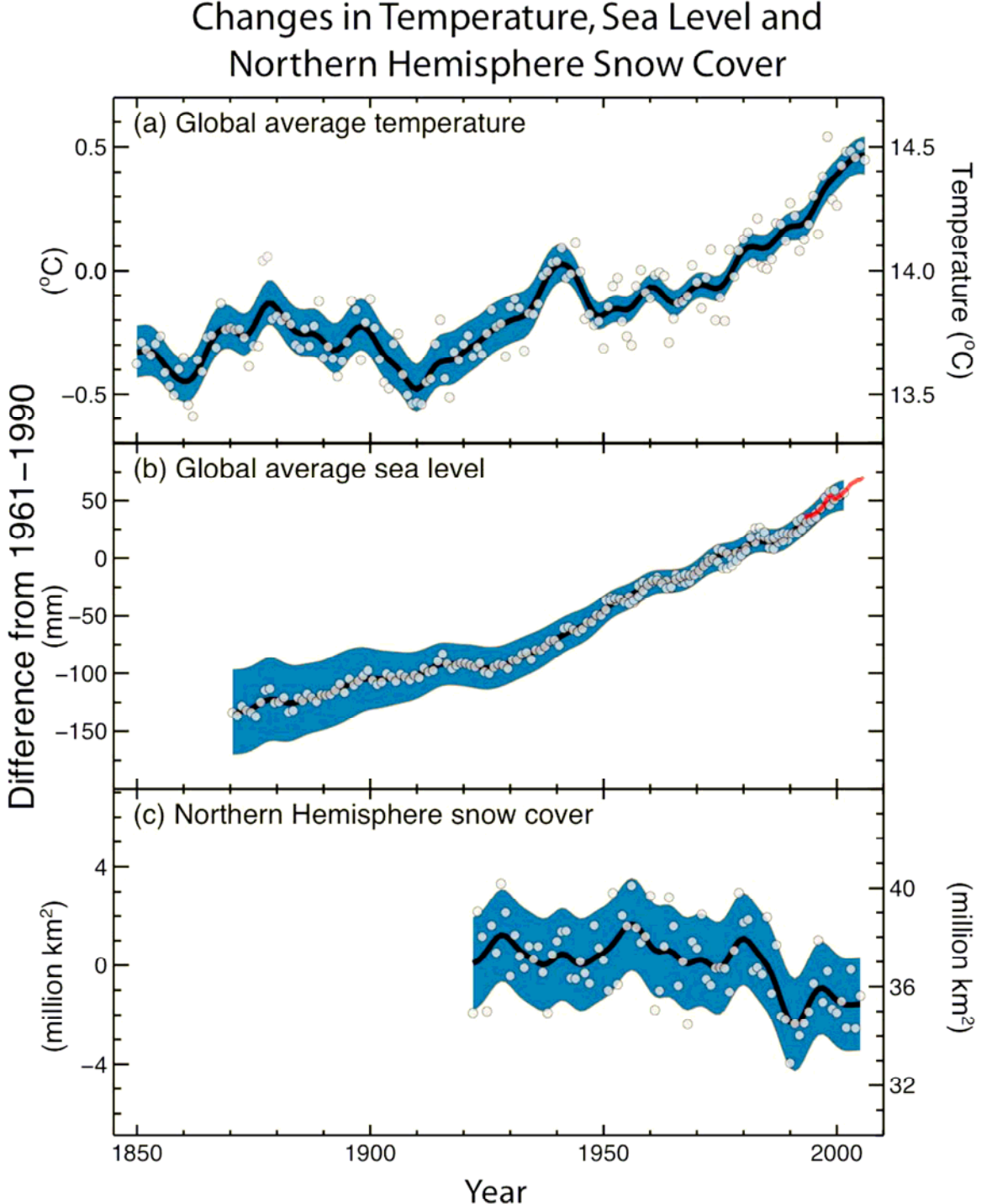
11. Regional Climate Projections
- Evaluation of regionalization methods
- Alternative simple methods
- Projections of regional climate changes
- Small islands
- Uncertainties in regional projections

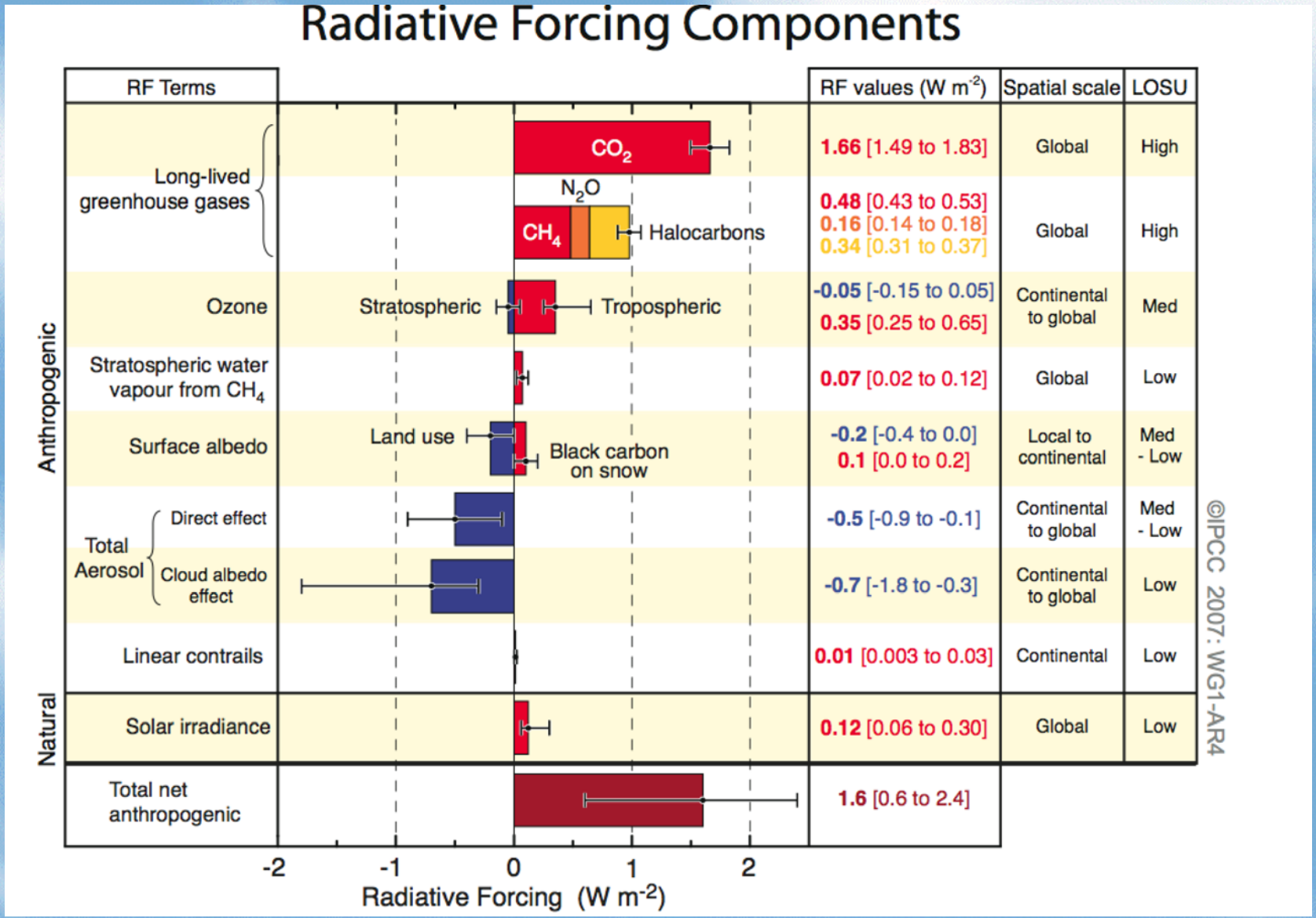
Atmospheric concentrations of carbon dioxide, methane and nitrous oxide over the last 10,000 years (large panels) and since 1750 (inset panels). Measurements are shown from ice cores (symbols with different colours for different studies) and atmospheric samples (red lines). The corresponding radiative forcings are shown on the right hand axes.



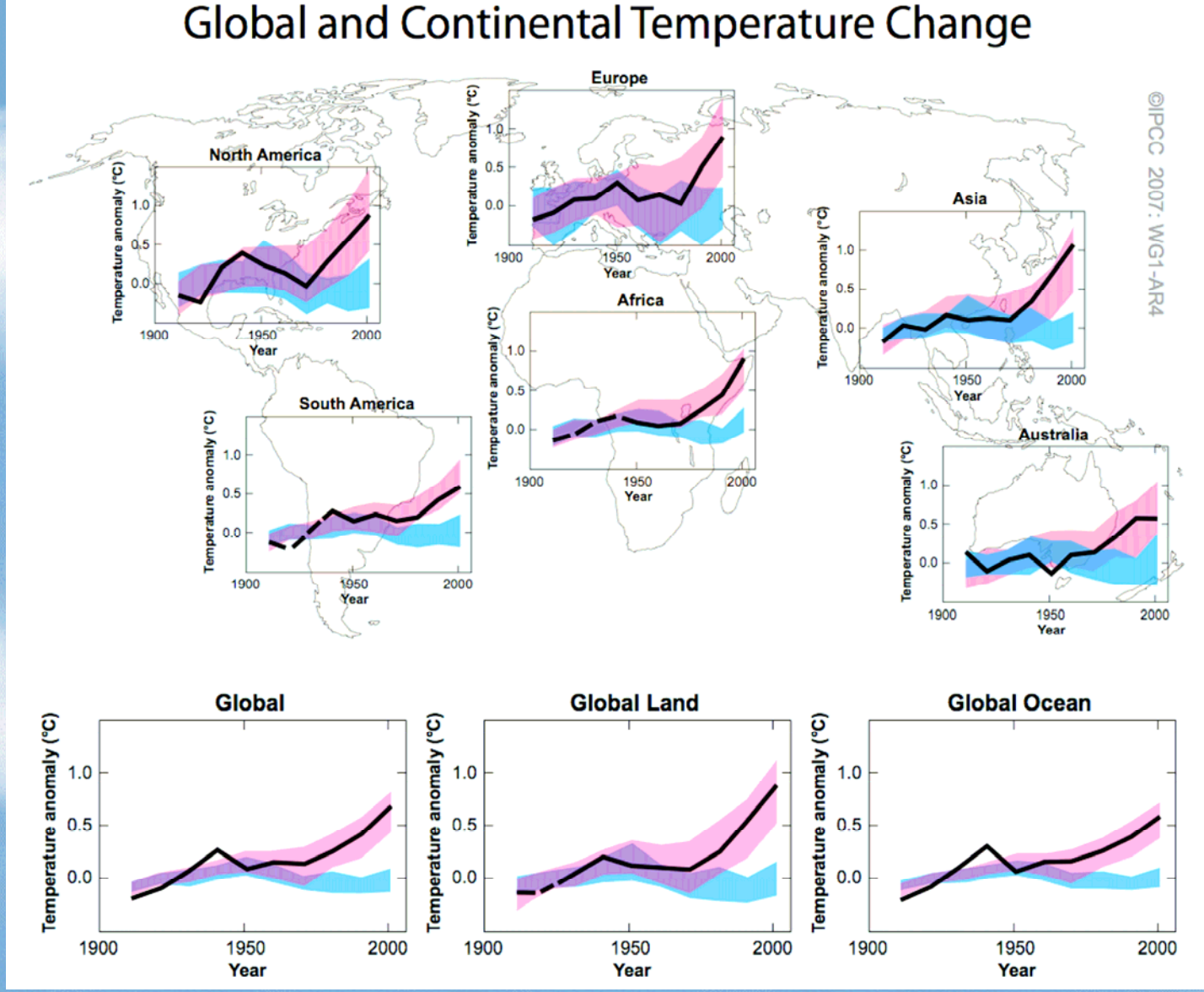


Observed changes in (a) global average surface temperature; (b) global average sea level rise from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All changes are relative to corresponding averages for the period 1961-1990. Smoothed curves represent decadal averaged values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties.

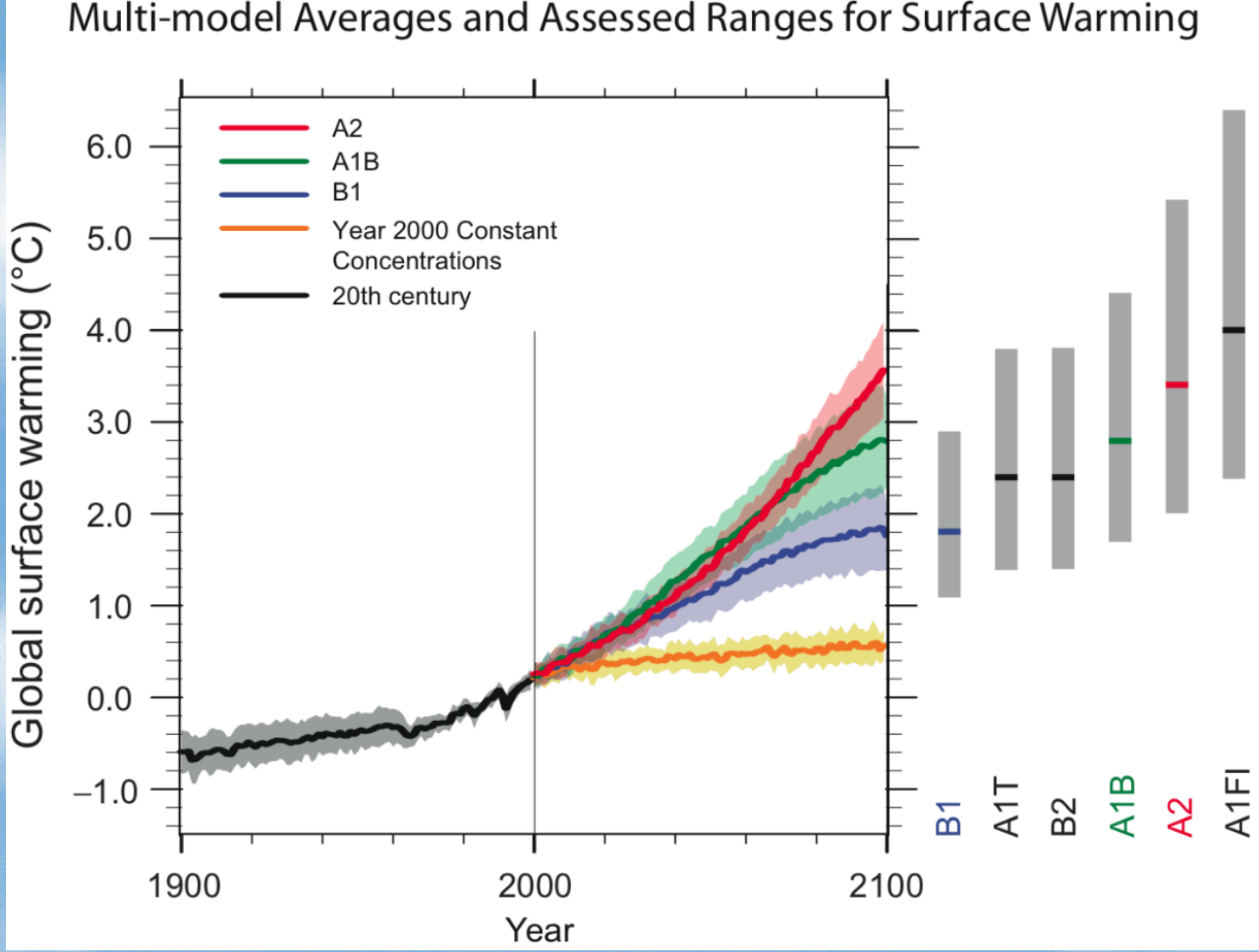




Global-average radiative forcing (RF) estimates and ranges in 2005 for anthropogenic carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and other important agents and mechanisms, together with the typical geographical extent (spatial scale) of the forcing and the assessed level of scientific understanding (LOSU). The net anthropogenic radiative forcing and its range are also shown. These require summing asymmetric uncertainty estimates from the component terms, and cannot be obtained by simple addition. Volcanic aerosols contribute an additional natural forcing but are not included in this figure due to their episodic nature.

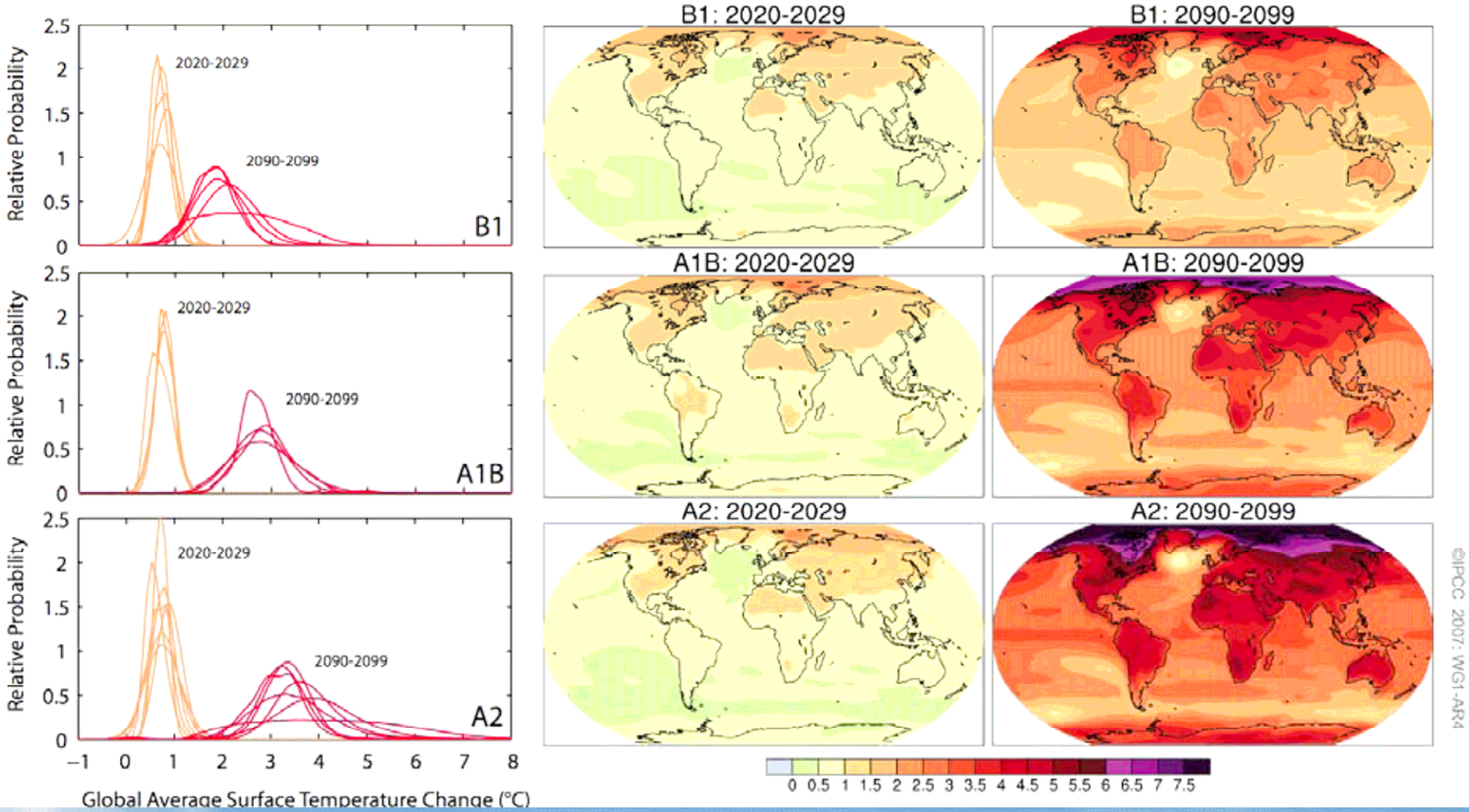


Comparison of observed continental- and global-scale changes in surface temperature with results simulated by climate models using natural and anthropogenic forcings. Decadal averages of observations are shown for the period 1906–2005 (black line) plotted against the centre of the decade and relative to the corresponding average for 1901–1950. Lines are dashed where spatial coverage is less than 50%. Blue shaded bands show the 5–95% range for 19 simulations from 5 climate models using only the natural forcings due to solar activity and volcanoes. Red shaded bands show the 5–95% range for 58 simulations from 14 climate models using both natural and anthropogenic forcings.

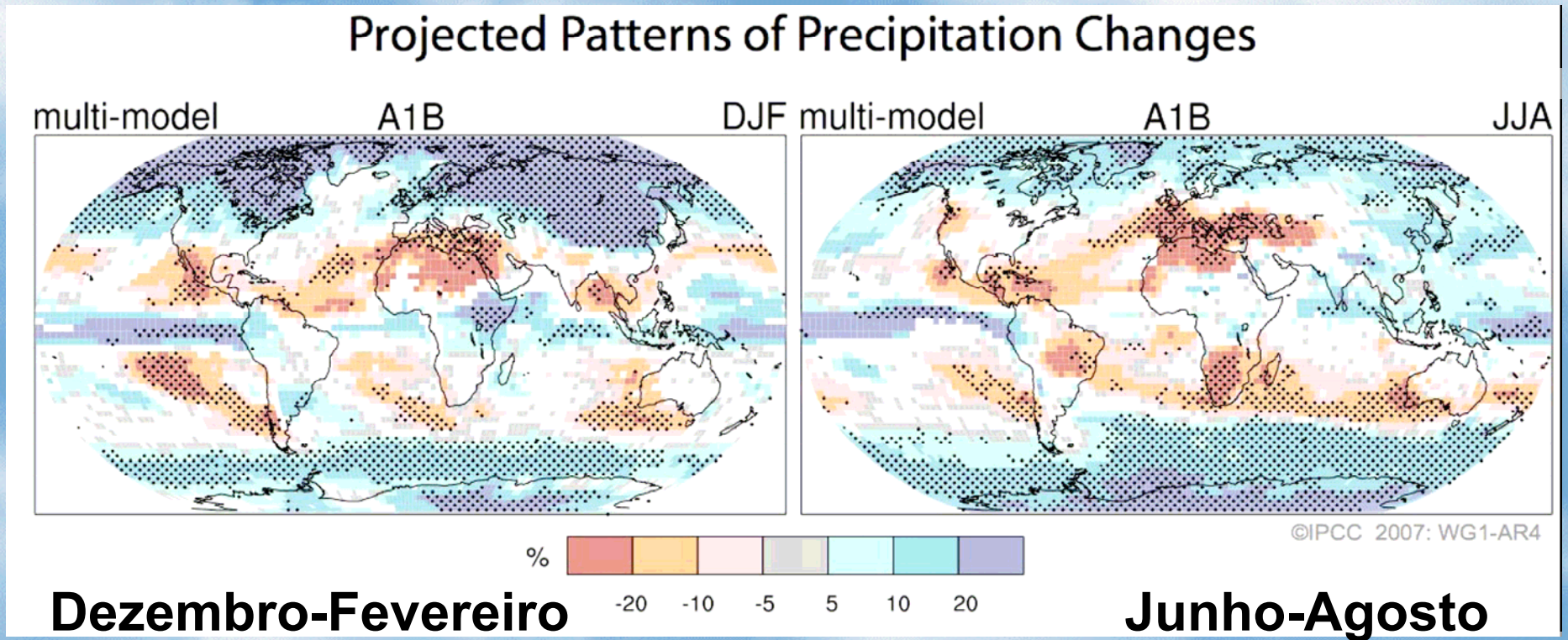


Solid lines are multi-model global averages of surface warming (relative to 1980-99) for the scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. Shading denotes the plus/minus one standard deviation range of individual model annual averages. The orange line is for the experiment where concentrations were held constant at year 2000 values. The gray bars at right indicate the best estimate (solid line within each bar) and the *likely* range assessed for the six SRES scenarios. The assessment of the best estimate and *likely* ranges in the gray bars includes the AOGCMs in the left part of the figure, as well as results from a hierarchy of independent models and observational constraints.

AOGCM Projections of Surface Temperatures



Projected surface temperature changes for the early and late 21st century relative to the period 1980–1999. The central and right panels show the Atmosphere-Ocean General Circulation multi-Model average projections for the B1 (top), A1B (middle) and A2 (bottom) SRES scenarios averaged over decades 2020–2029 (center) and 2090–2099 (right). The left panel shows corresponding uncertainties as the relative probabilities of estimated global average warming from several different AOGCM and EMICs studies for the same periods. Some studies present results only for a subset of the SRES scenarios, or for various model versions. Therefore the difference in the number of curves, shown in the lefthand panels, is due only to differences in the availability of results.

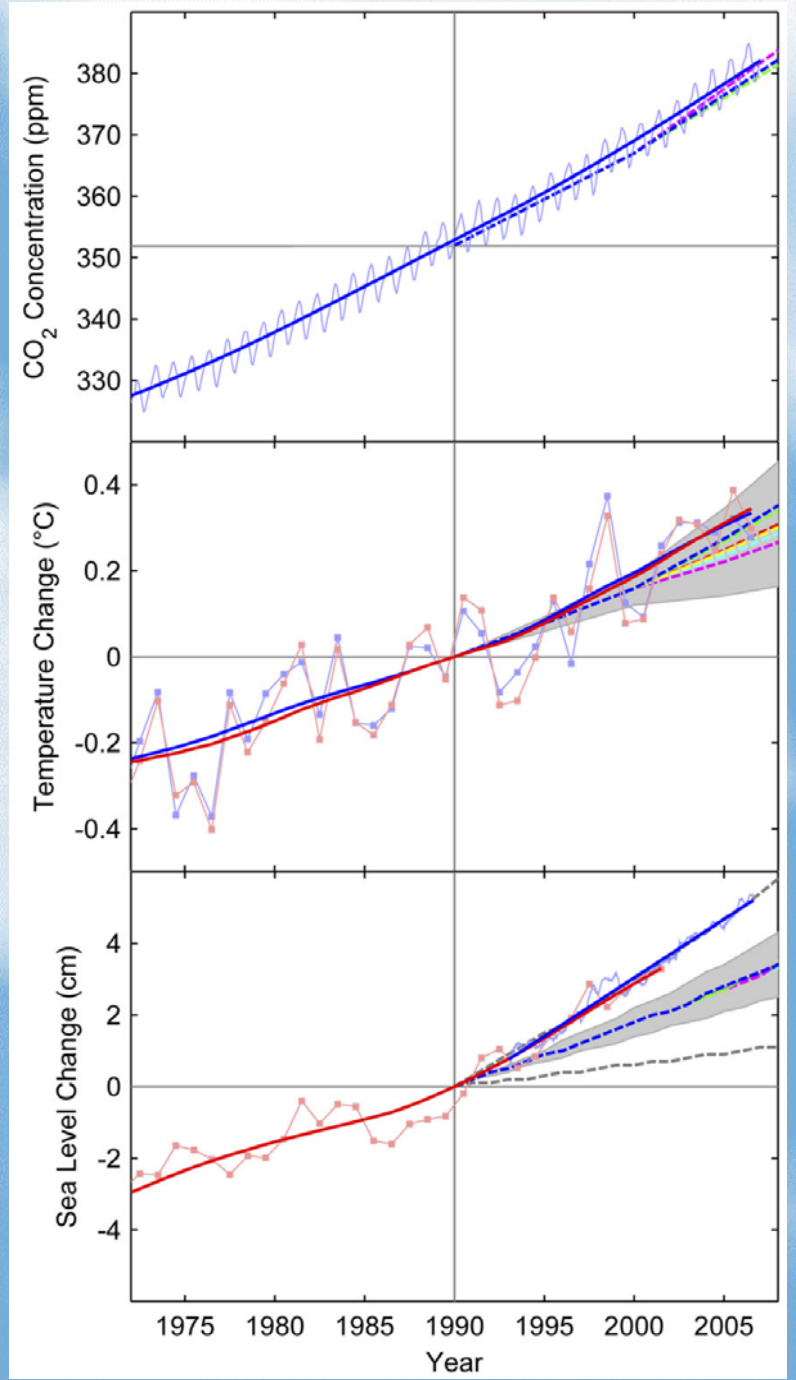


Relative changes in precipitation (in percent) for the period 2090–2099, relative to 1980–1999. Values are multi-model averages based on the SRES A1B scenario for December to February (left) and June to August (right). White areas are where less than 66% of the models agree in the sign of the change and stippled areas are where more than 90% of the models agree in the sign of the change.

Previous IPCC projections have not exaggerated but may in some respects even have underestimated the change.

Changes in key global climate parameters since 1973, compared to the scenarios of the IPCC [shown as dashed lines (A1FI, light blue; A1B, purple; A1T, blue; A2, red; B1, yellow; and B2, green) and gray ranges in all panels]. **(a)** Monthly carbon dioxide concentration and its trend line at Mauna Loa, Hawaii (blue) up to January 2007, from Scripps in collaboration with NOAA. **(b)** Annual global-mean land and ocean combined surface temperature from GISS (red) and the Hadley Centre (blue) up to 2006, with their trends. **(c)** Sea-level data based primarily on tide gauges (annual, red) and from satellite altimeter (blue) and their trends. All trends are non-linear trend lines and are computed with an embedding period of 11 years and a minimum roughness criterion at the end, except for the satellite altimeter where a linear trend was used because of the shortness of the series. For temperature and sea level, data are shown as deviations from the trend-line value in 1990, the base year of the IPCC scenarios.

Science, Feb 2007




Ainda há muito a ser feito …
Obrigado pela atenção !!!