A Remarkable Failure in the Governance of Expertise

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American Enterprise Institute, Washington, DC
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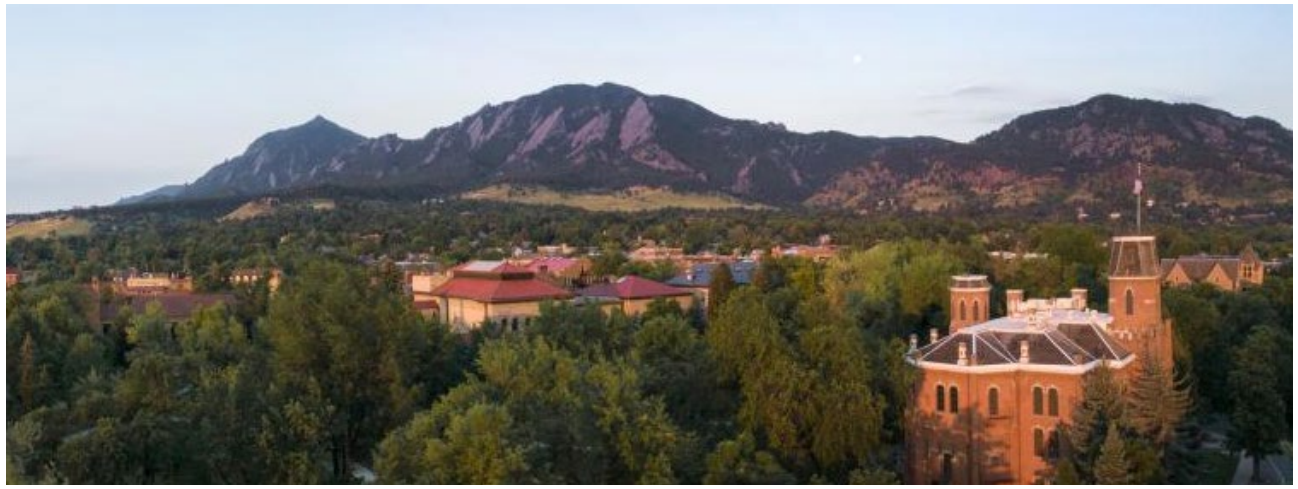
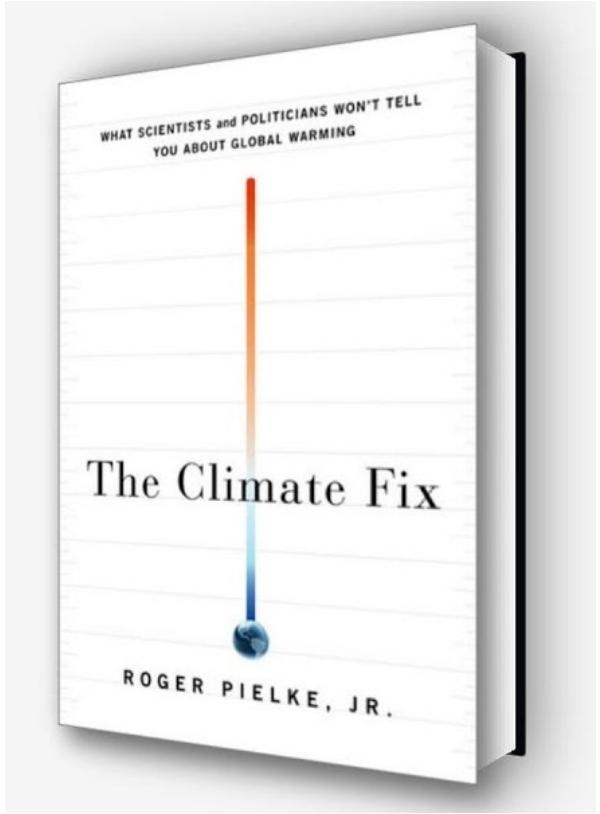


University of Colorado **Boulder**



My argument today is about a failure of expert institutions in climate science and policy

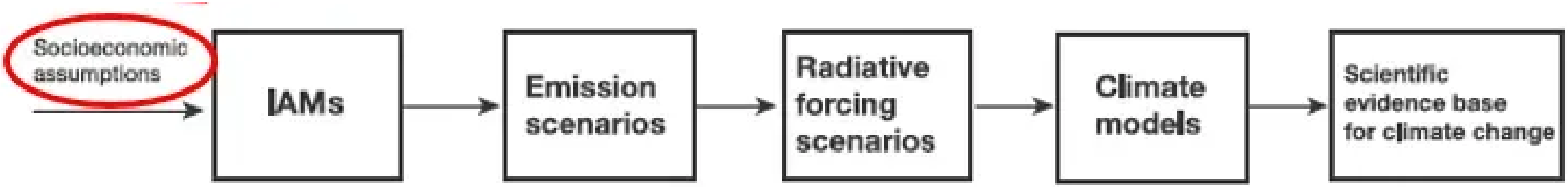
- **NOT about the reality of climate change (it is)**
- **NOT about whether climate change poses significant risks (it does)**
- **NOT about whether climate policy is worthwhile (it is)**

- **To understand <u>failures of expert institutions</u> requires a brief discussion of climate scenarios**

What criteria do we use to evaluate failures of expert institutions?

- Effectiveness (policy)
- Legitimacy (politics)
- Authority (science)

Projections of future climate start with socio-economic assumptions in the form of "climate scenarios"

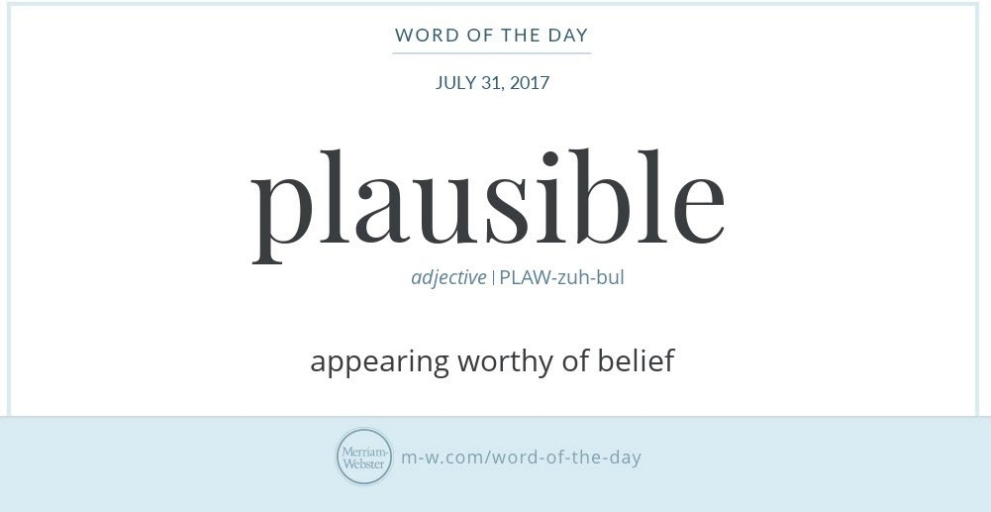


One step at a time – from socio-economic assumptions as inputs to climate model outputs

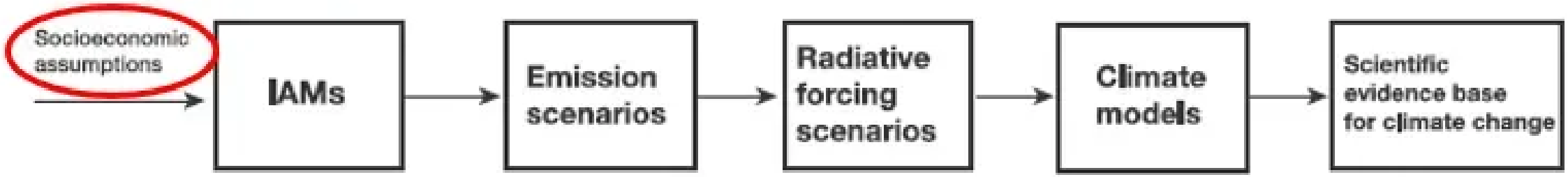
Source: adapted from IPCC SRES 2000

"Emissions scenario" (IPCC 2014)

"**A plausible representation of the future** development of emissions of substances that are potentially radiatively active (e.g., greenhouse gases, aerosols) based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and socioeconomic development, technological change, energy and land use) and their key relationships."



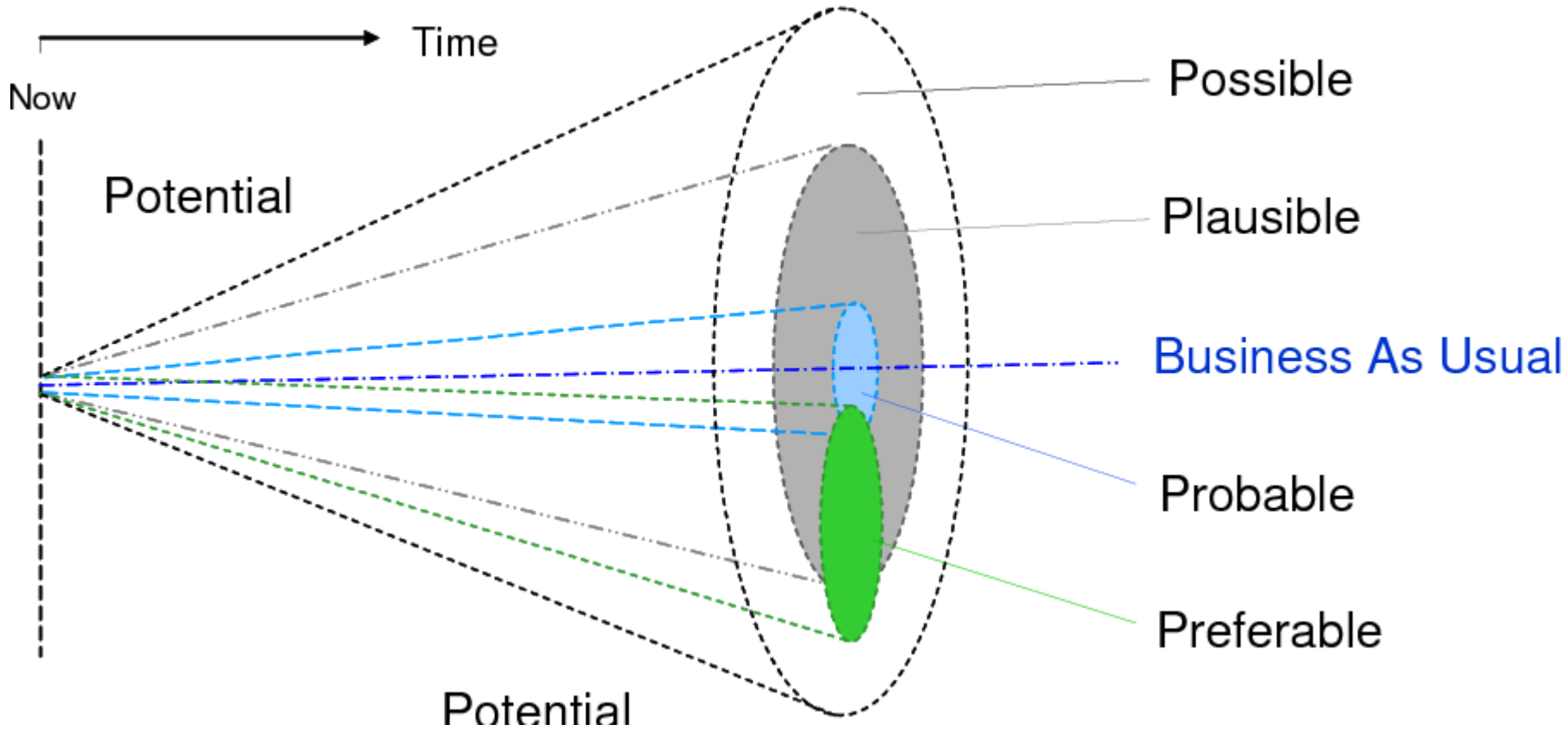
An evaluation of plausibility starts with evaluation of socio-economic assumptions that go into integrated assessment models. These include the future evolution of population, GDP, energy production and consumption.



One step at a time – from socio-economic assumptions as inputs to climate model outputs

Source: adapted from IPCC SRES 2000

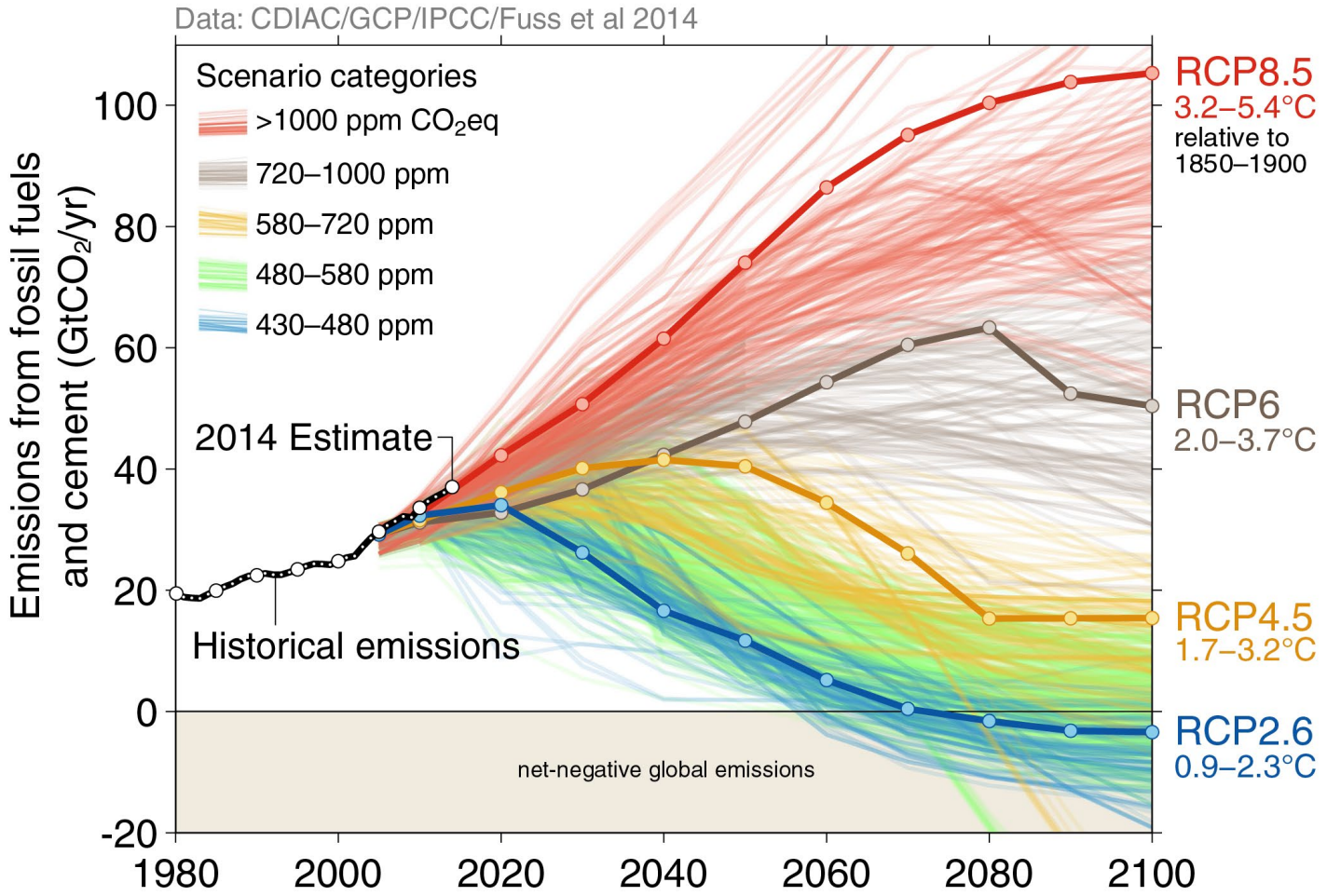
Scenario Space



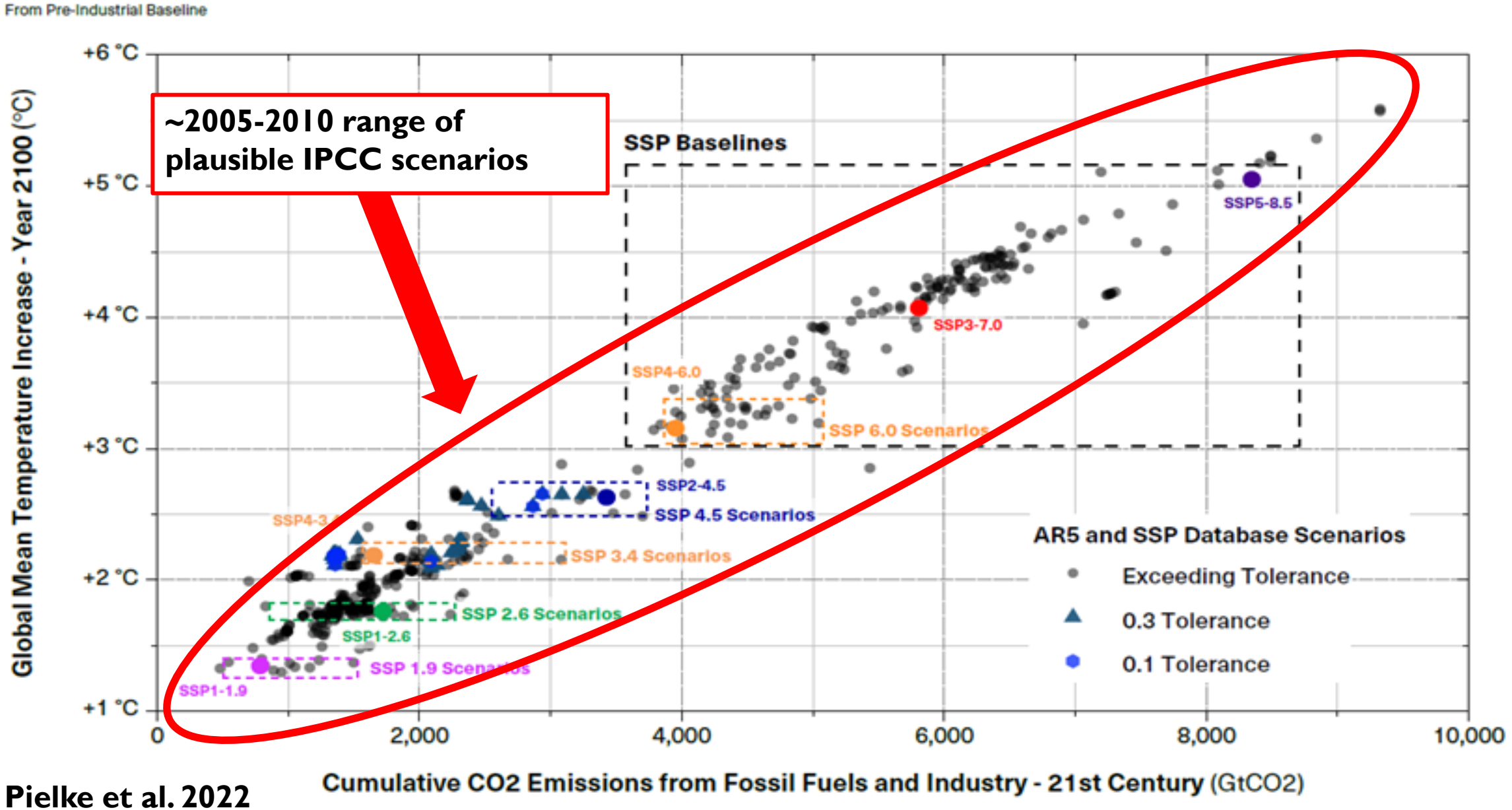
https://www.semanticscholar.org/paper/Title-%3A-A-generic-foresight-process-framework-Year-Voros/ffd5a52cc3dd7e5ed566f5ff199658f3eebca99b

Representative Concentration Pathway Scenarios

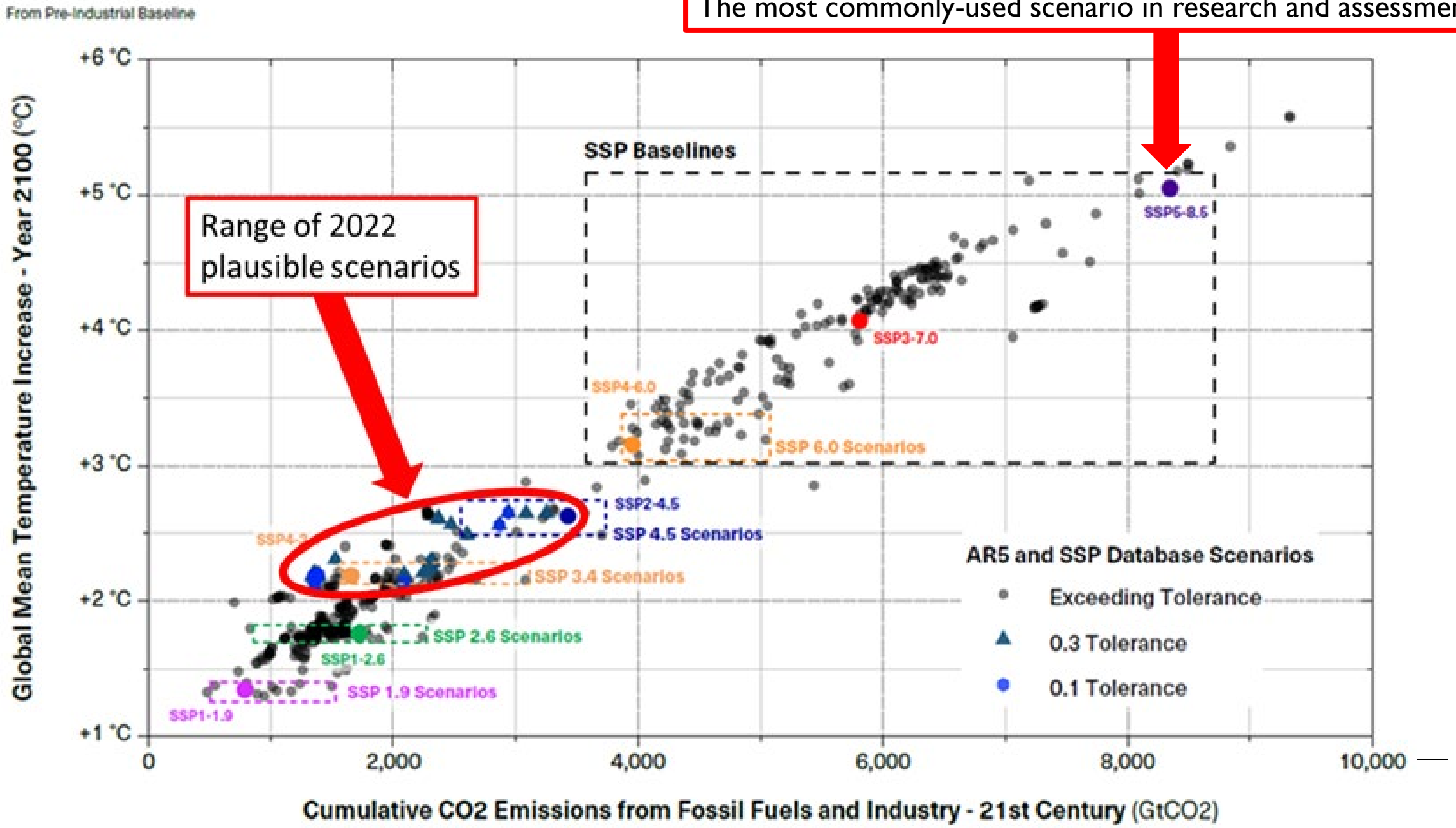
4 of the 1,184 IPCC AR5 Scenarios – from ~2005

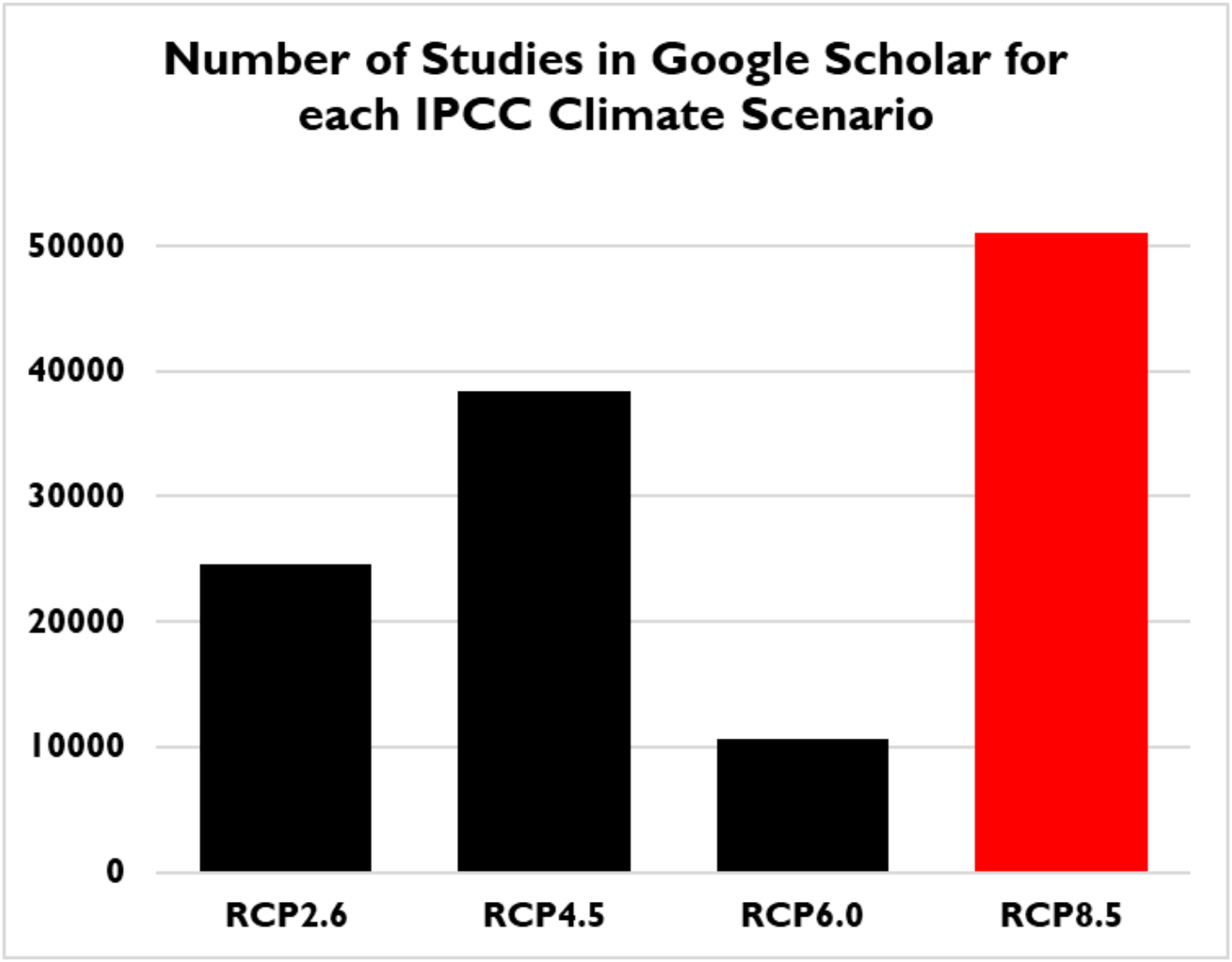


All the IPCC scenarios – Cumulative CO_2 vs Temperature in 2100

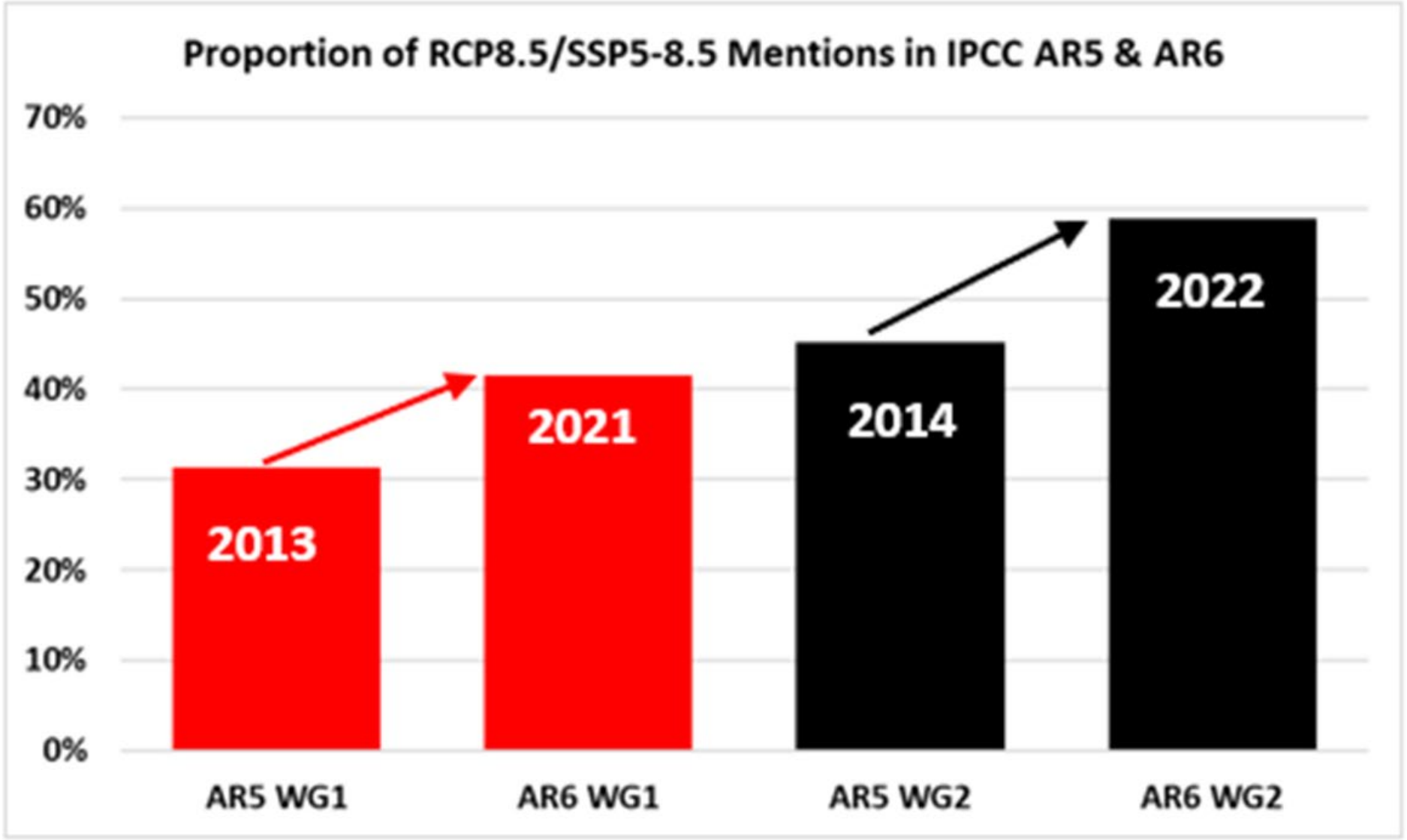


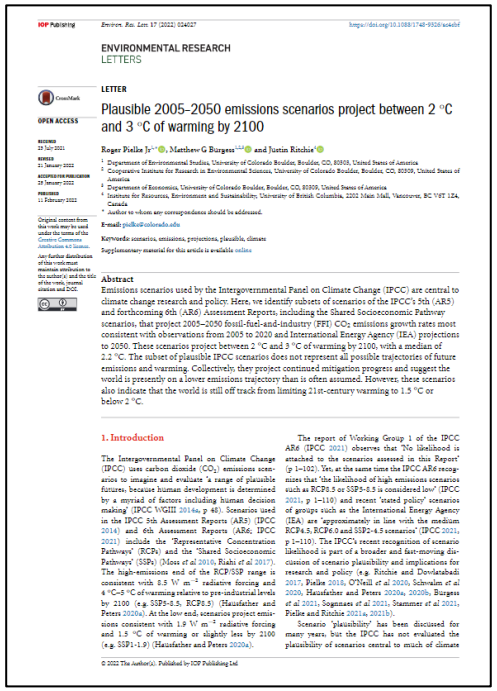
Pielke et al. 2022


From Pre-Industrial Baseline
The most commonly-used scenario in research and assessment
Range of 2022 plausible scenarios
SSP Baselines
SSP6-8.5
SSP3-7.0
SSP4-6.0
SSP 6.0 Scenarios
SSP2-4.5
SSP 4.5 Scenarios
SSP4-3.4
SSP 3.4 Scenarios
SSP 2.6 Scenarios
SSP1-2.6
SSP 1.9 Scenarios
SSP1-1.9
AR5 and SSP Database Scenarios
Exceeding Tolerance
0.3 Tolerance
0.1 Tolerance
+6 °C
+5 °C
+4 °C
+3 °C
+2 °C
+1 °C
0
2,000
4,000
6,000
8,000
10,000
Global Mean Temperature Increase - Year 2100 (°C)
Cumulative CO2 Emissions from Fossil Fuels and Industry - 21st Century (GtCO2)



Source: Google Scholar, 20 June 2025


Proportion of RCP8.5/SSP5-8.5 Mentions in IPCC AR5 & AR6
70%
60%
50%
40%
30%
20%
10%
0%
2013
2021
2014
2022
AR5 WG1
AR6 WG1
AR5 WG2
AR6 WG2



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ENVIRONMENTAL RESEARCH
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LETTER

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Plausible 2005–2050 emissions scenarios project between 2 °C and 3 °C of warming by 2100

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Keywords: scenarios, emissions, projections, plausible, climate

Supplementary material for this article is available online

Abstract

Emissions scenarios used by the Intergovernmental Panel on Climate Change (IPCC) are central to climate change research and policy. Here, we identify subsets of scenarios of the IPCC's 5th (AR5) and forthcoming 6th (AR6) Assessment Reports, including the Shared Socioeconomic Pathway scenarios, that project 2005–2050 fossil-fuel-and-industry (FFI) CO_2 emissions growth rates most consistent with observations from 2005 to 2020 and International Energy Agency (IEA) projections to 2050. These scenarios project between 2 °C and 3 °C of warming by 2100, with a median of 2.2 °C. The subset of plausible IPCC scenarios does not represent all possible trajectories of future emissions and warming. Collectively, they project continued mitigation progress and suggest the world is presently on a lower emissions trajectory than is often assumed. However, these scenarios also indicate that the world is still off track from limiting 21st-century warming to 1.5 °C or below 2 °C.

1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) uses carbon dioxide (CO_2) emissions scenarios to imagine and evaluate 'a range of plausible futures, because human development is determined by a myriad of factors including human decision making' (IPCC WGIII 2014a, p 48). Scenarios used in the IPCC 5th Assessment Reports (AR5) (IPCC 2014) and 6th Assessment Reports (AR6; IPCC 2021) include the 'Representative Concentration Pathways' (RCPs) and the 'Shared Socioeconomic Pathways' (SSPs) (Moss et al 2010, Riahi et al 2017). The high-emissions end of the RCP/SSP range is consistent with 8.5 W m^{-2} radiative forcing and 4 °C–5 °C of warming relative to pre-industrial levels by 2100 (e.g. SSP5-8.5, RCP8.5) (Hausfather and Peters 2020a). At the low end, scenarios project emissions consistent with 1.9 W m^{-2} radiative forcing and 1.5 °C of warming or slightly less by 2100 (e.g. SSP1-1.9) (Hausfather and Peters 2020a).

The report of Working Group 1 of the IPCC AR6 (IPCC 2021) observes that 'No likelihood is attached to the scenarios assessed in this Report' (p 1–102). Yet, at the same time the IPCC AR6 recognizes that 'the likelihood of high emissions scenarios such as RCP8.5 or SSP5-8.5 is considered low' (IPCC 2021, p 1–110) and recent 'stated policy' scenarios of groups such as the International Energy Agency (IEA) are 'approximately in line with the medium RCP4.5, RCP6.0 and SSP2-4.5 scenarios' (IPCC 2021, p 1–110). The IPCC's recent recognition of scenario likelihood is part of a broader and fast-moving discussion of scenario plausibility and implications for research and policy (e.g. Ritchie and Dowlatabadi 2017, Pielke 2018, O'Neill et al 2020, Schwalm et al 2020, Hausfather and Peters 2020a, 2020b, Burgess et al 2021, Sognnaes et al 2021, Stammer et al 2021, Pielke and Ritchie 2021a, 2021b).

Scenario 'plausibility' has been discussed for many years, but the IPCC has not evaluated the plausibility of scenarios central to much of climate

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Data: CDIAC/GCP/IPCC/Fuss et al 2014

Emissions from fossil fuels and cement ($GtCO_2$/yr)

Scenario categories
- >1000 ppm CO_2eq
- 720–1000 ppm
- 580–720 ppm
- 480–580 ppm
- 430–480 ppm

2014 Estimate

Historical emissions

net-negative global emissions

RCP8.5
3.2–5.4°C
relative to
1850–1900

RCP6
2.0–3.7°C

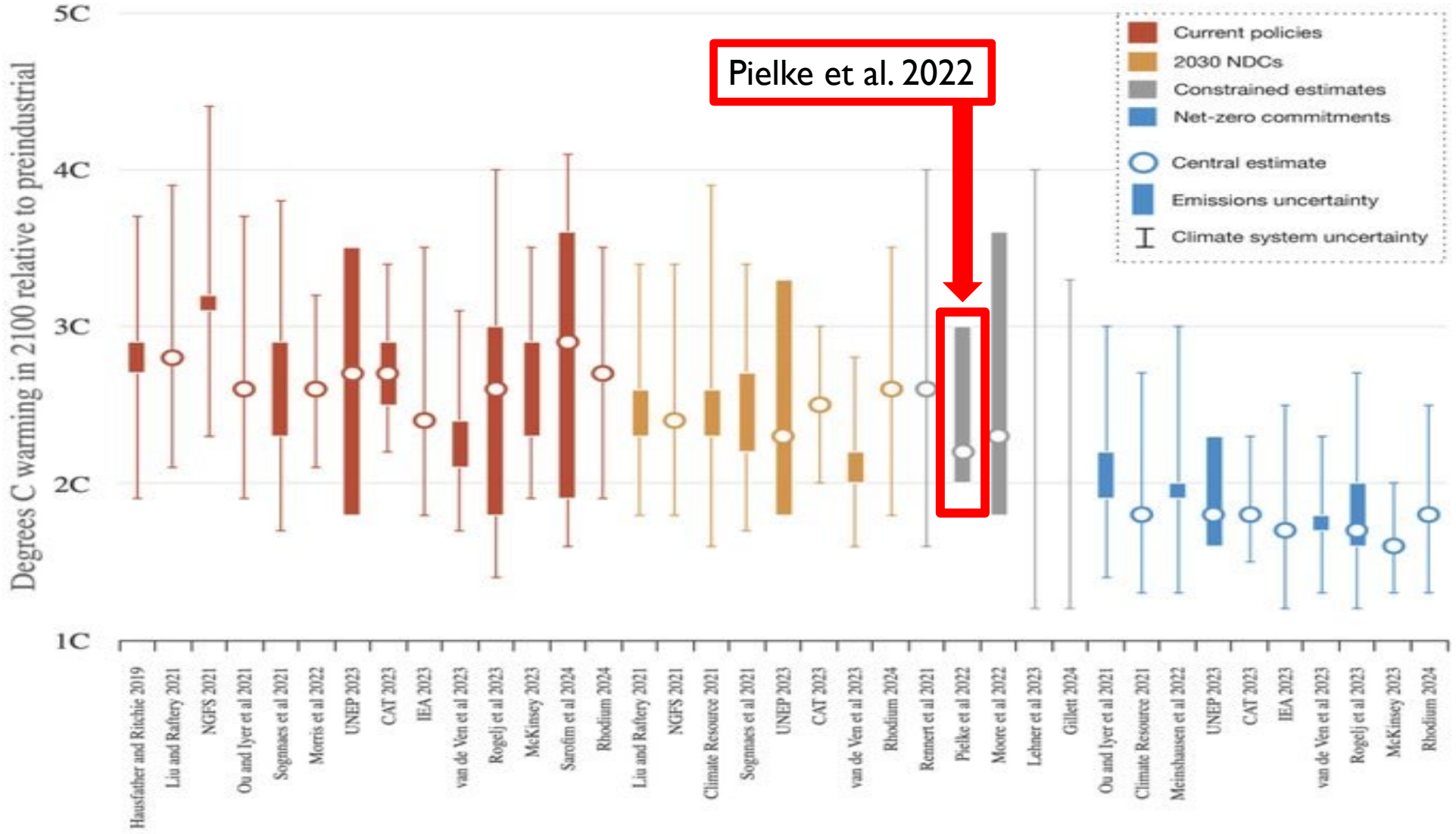
RCP4.5
1.7–3.2°C

RCP2.6
0.9–2.3°C

IMPLAUSIBLE

PLAUSIBLE

Upper end = RCP4.5
Reference (BAU) = SSP4-3.4
Goal = RCP2.6



https://x.com/hausfath/status/1879593730392440833

Climate scenarios matter for projected future climate change, but are also central to cost-benefit analyses, development of policy proposals, climate advocacy, litigation, tens of thousands of peer-reviewed papers in climate research, and IPCC assessments.

- **Who develops these scenarios?**
- **Who evaluates them for real-world plausibility?**
- **Is policy use or utility considered in their creation?**
- **To whom are they accountable?**

New climate scenarios are coming!

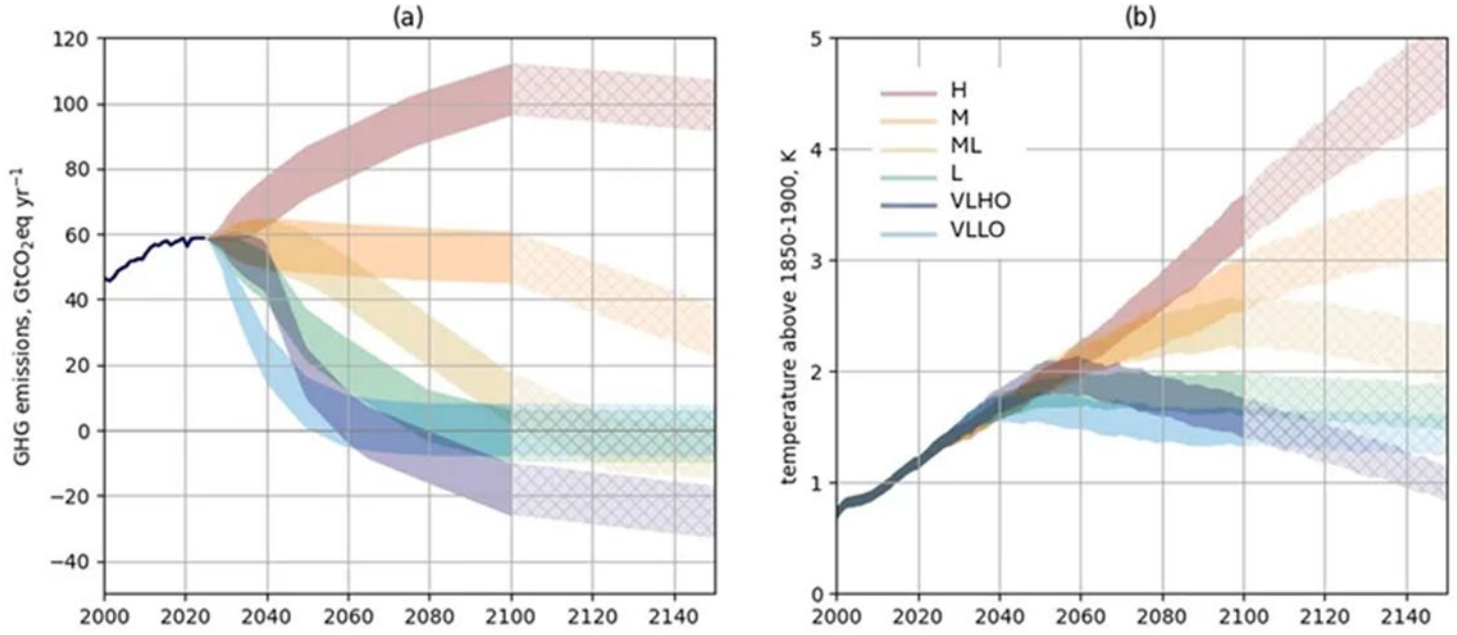
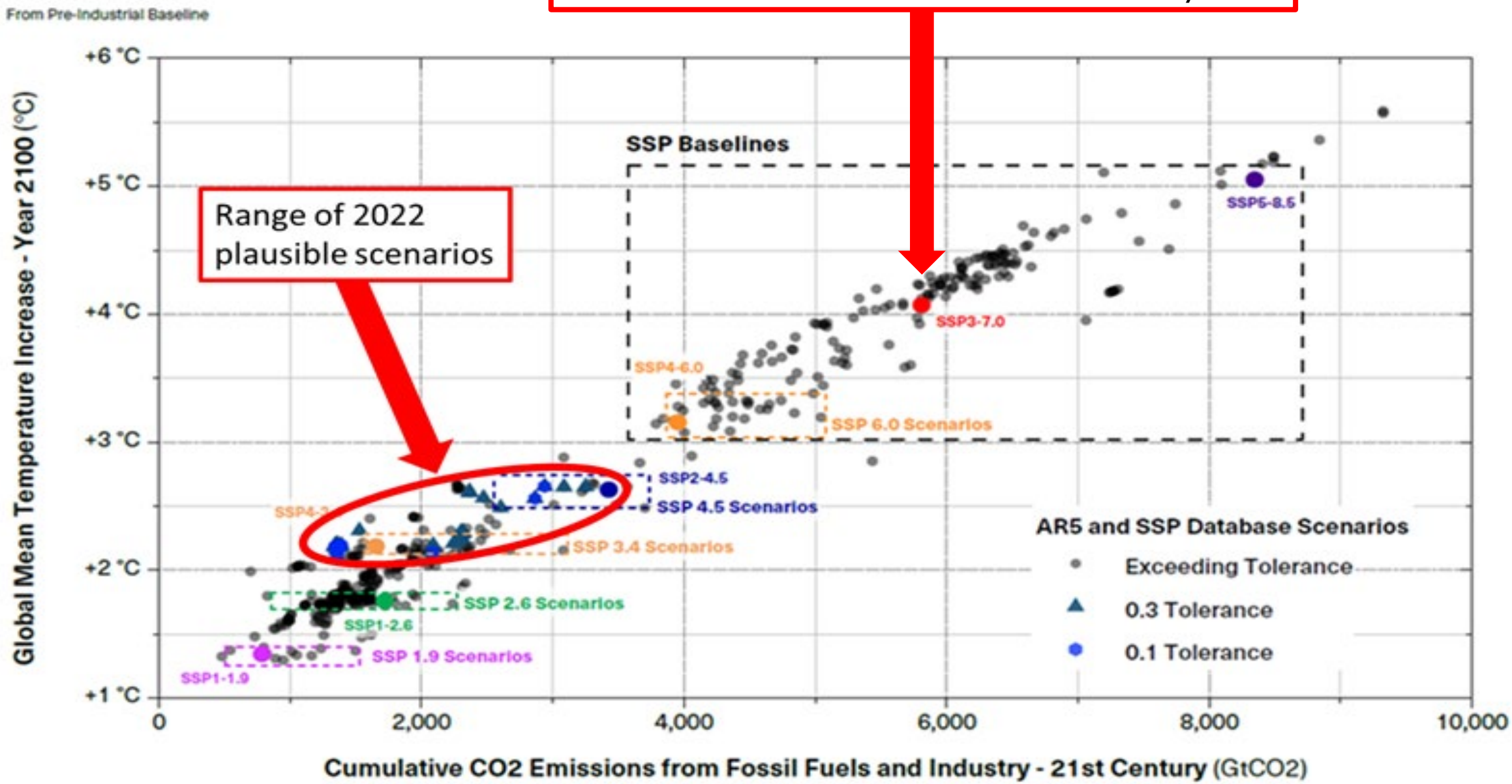


Figure 1: Draft scenarios for CMIP7 ScenarioMIP, showing (a) GHG emissions pathways as a function of time for each of the proposed scenarios (based on GWP-100) and (b) the expected global average temperature outcomes using the probabilistic FaIR ensemble used in IPCC AR6 (IPCC, 2021). Shaded regions for temperature outcomes show the 33-66 percentile range of the distribution while uncertainty bounds for emissions show +/-8 GtCO2 around the median. Scenarios are (H) High, (M) Medium, (ML) Medium-Low, (L) Low, (VLHO) Very Low after High Overshoot and (VLLO) Very Low with Limited Overshoot. The final emission trajectories will depend on IAM model runs and might differ from the illustrations provided here. The final temperature outcomes will be based on climate model runs, including, for instance, carbon cycle feedback. Textured regions are drawn for the 2100-2150 period (AD), where output is requested from Earth System Models, but emissions and forcings will be defined in the extension protocol.


The extreme scenario called "Current Policies" by IPCC
From Pre-Industrial Baseline
Global Mean Temperature Increase - Year 2100 (°C)
+6 °C
+5 °C
+4 °C
+3 °C
+2 °C
+1 °C
0
2,000
4,000
6,000
8,000
10,000
Cumulative CO2 Emissions from Fossil Fuels and Industry - 21st Century (GtCO2)
Range of 2022 plausible scenarios
SSP Baselines
SSP5-8.5
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SSP4-6.0
SSP 6.0 Scenarios
SSP2-4.5
SSP 4.5 Scenarios
SSP4-3
SSP 3.4 Scenarios
SSP 2.6 Scenarios
SSP1-2.6
SSP 1.9 Scenarios
SSP1-1.9
AR5 and SSP Database Scenarios
Exceeding Tolerance
0.3 Tolerance
0.1 Tolerance

Thank You!

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