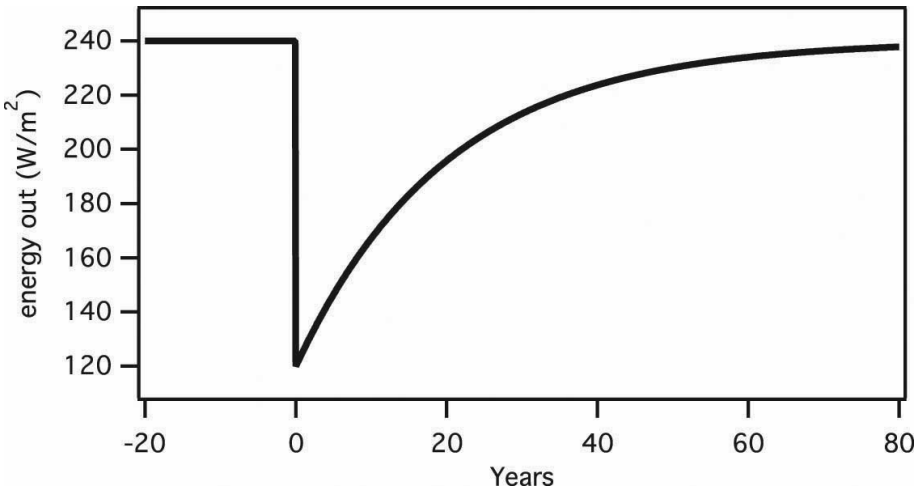
# What is Radiative Forcing?

- Imagine a planet with no atmosphere, with solar constant 240 W/m$^2$

  It's in equilibrium, so $E_{out}$ is also 240 W/m$^2$

- Now instantly add an atmosphere. What happens?

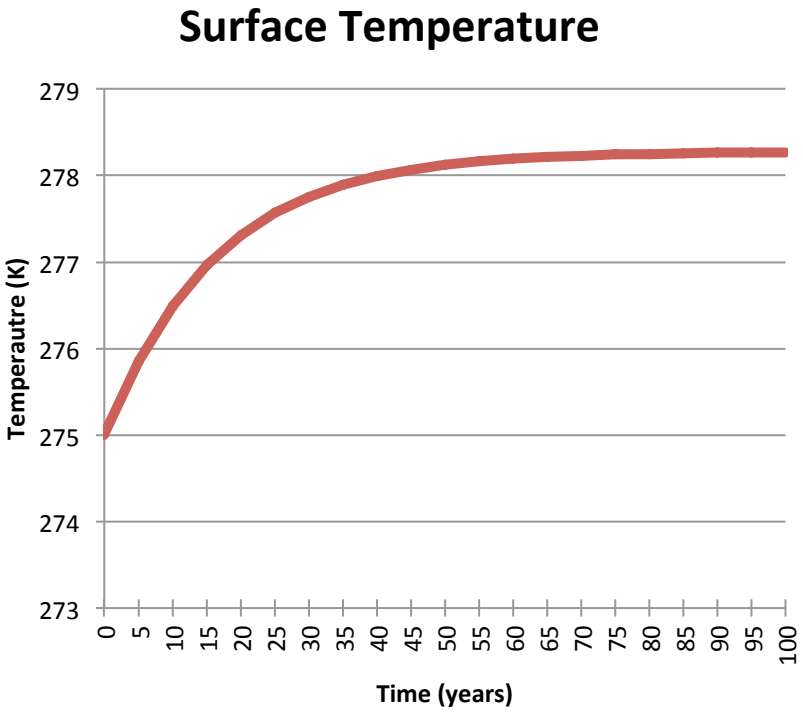



Forcing: An immediate imbalance when something disturbs the equilibrium (measured before equilibrium is restored)
Radiative Forcing is a disturbance of a planet's energy balance caused by a change in incoming or outgoing radiation

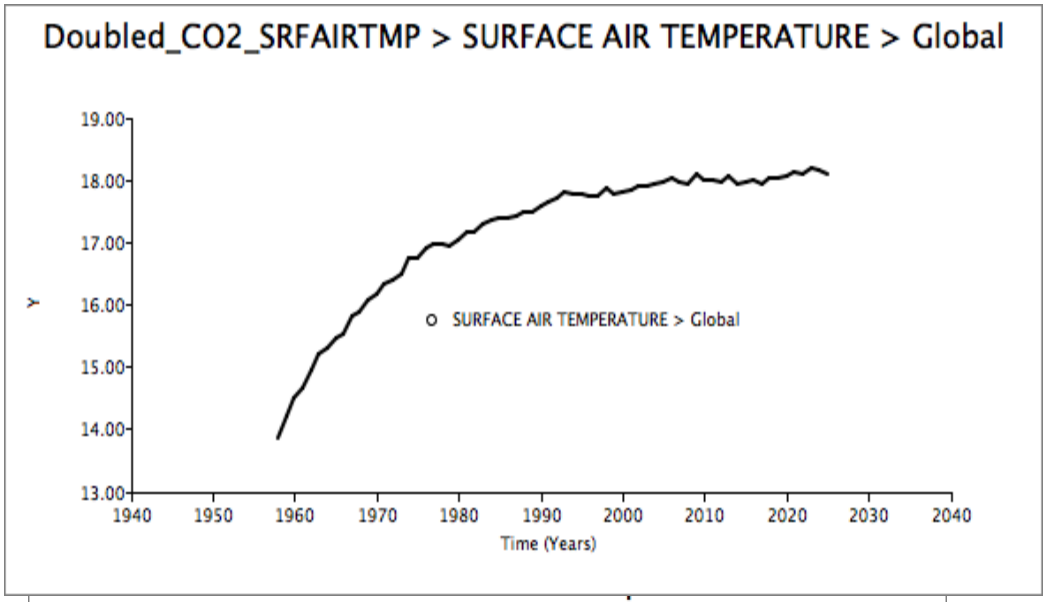
Image: Andrew Dessler, Introduction to Modern Climate Change, chapter 6.

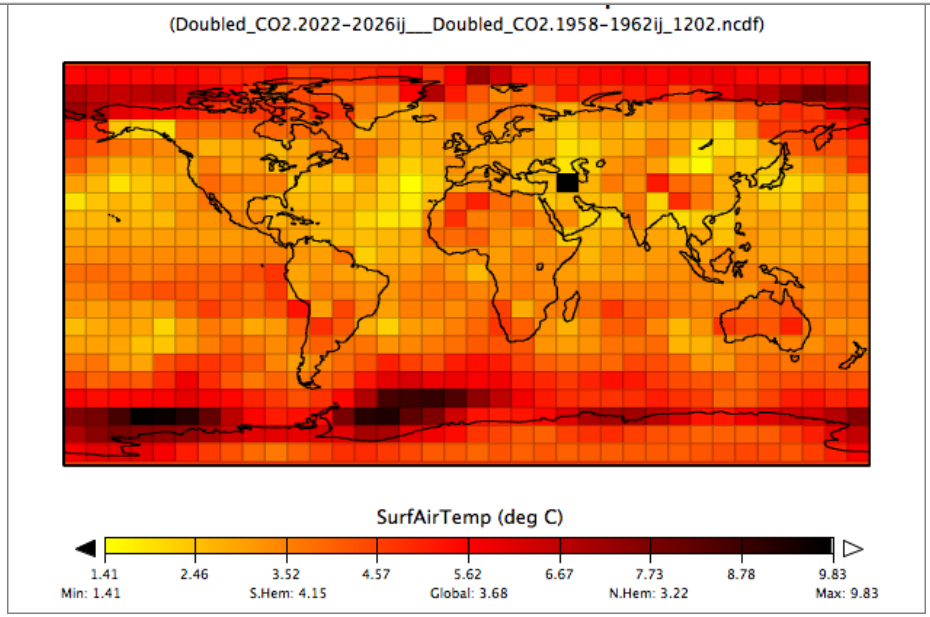
# What slows the warming?

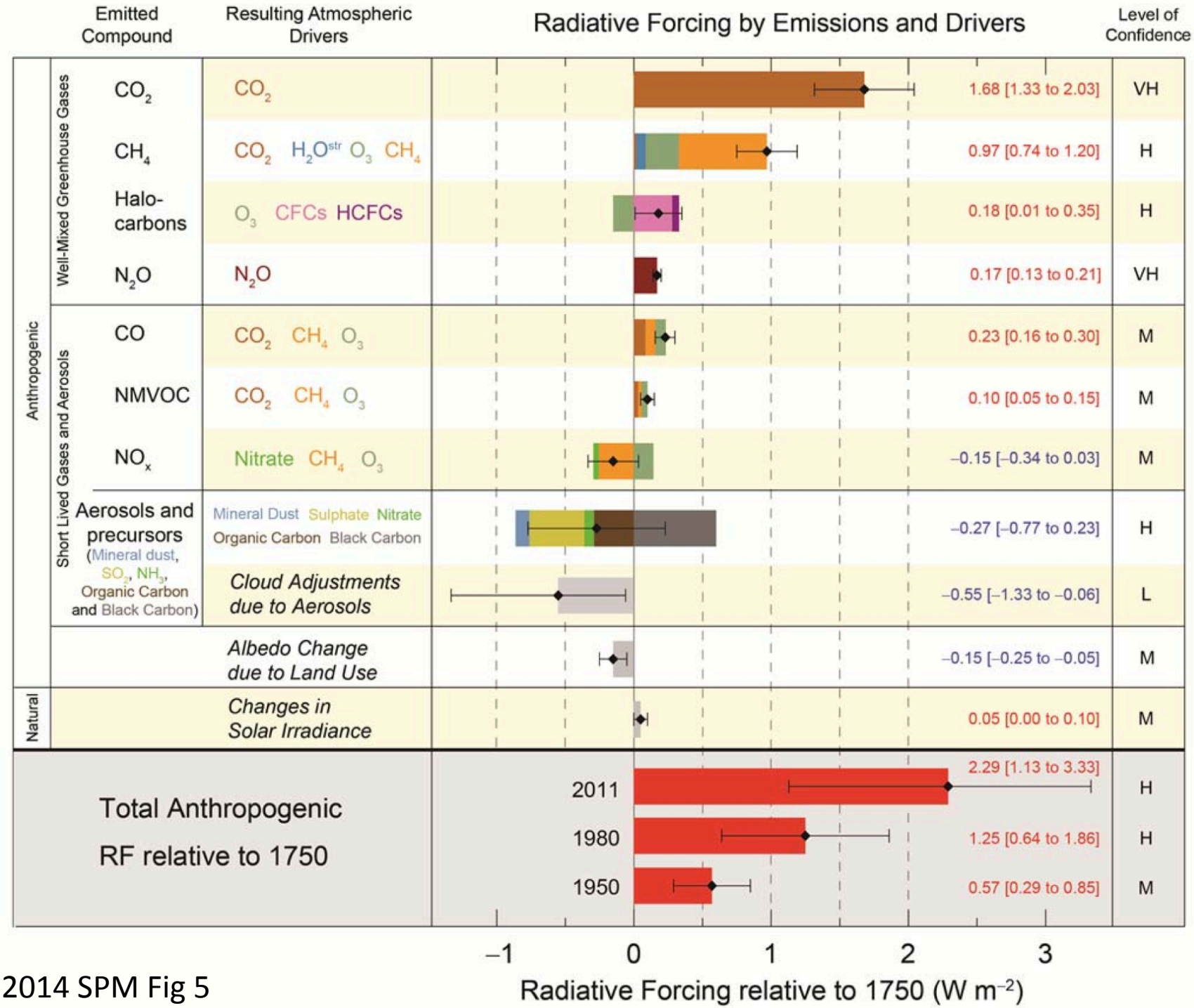
Simple spreadsheet simulation:




EdGCM simulation:

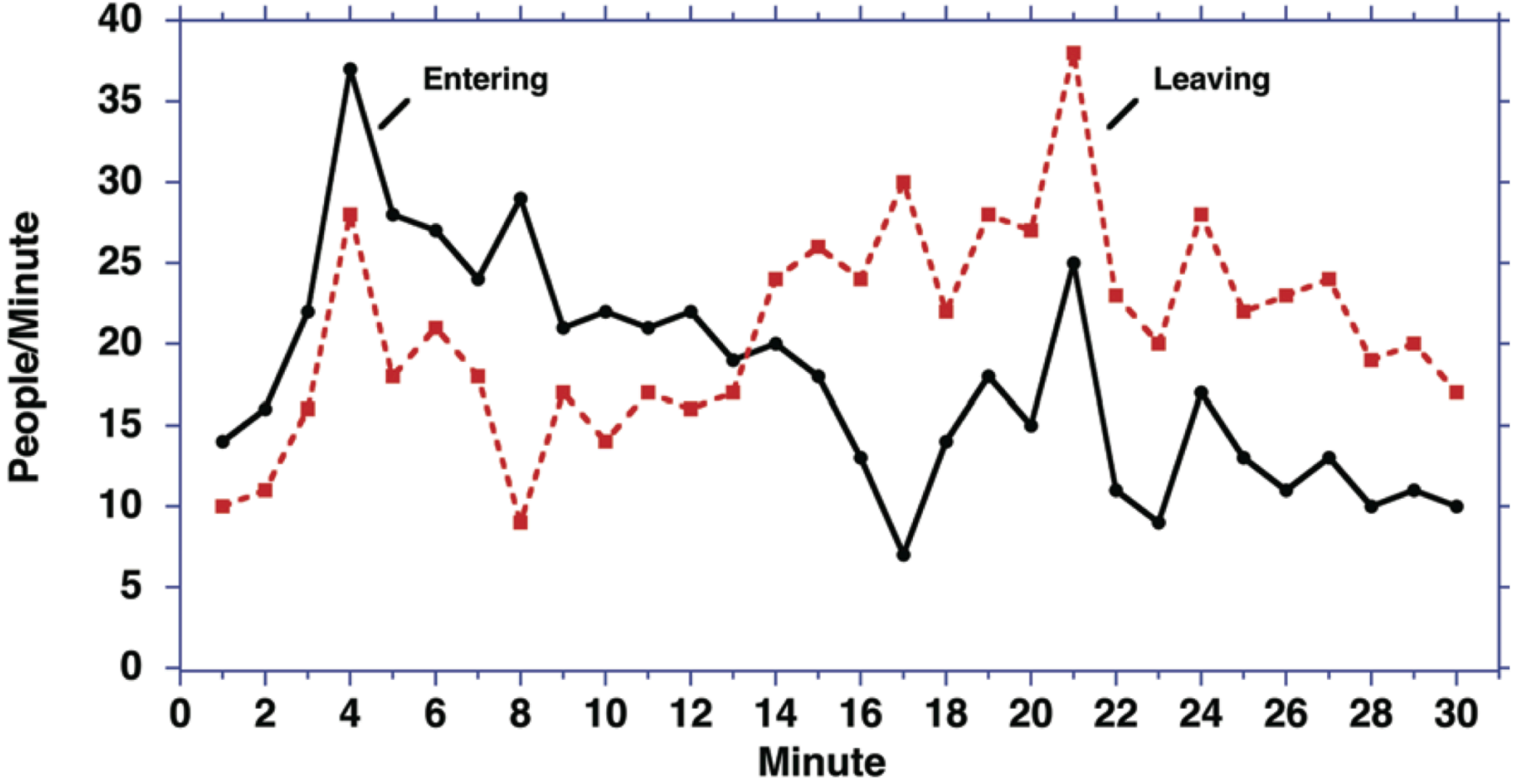


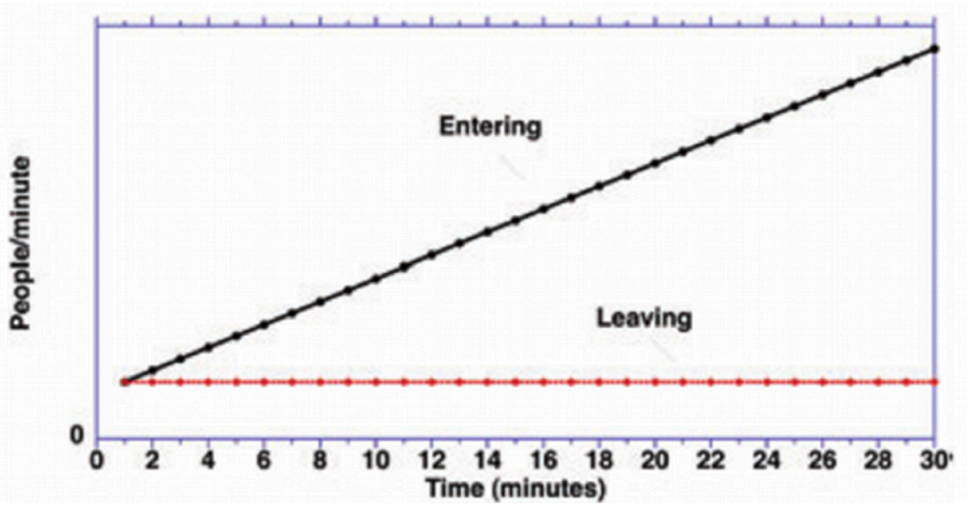



IPCC AR5 2014 SPM Fig 5

# Accumulation Exercise

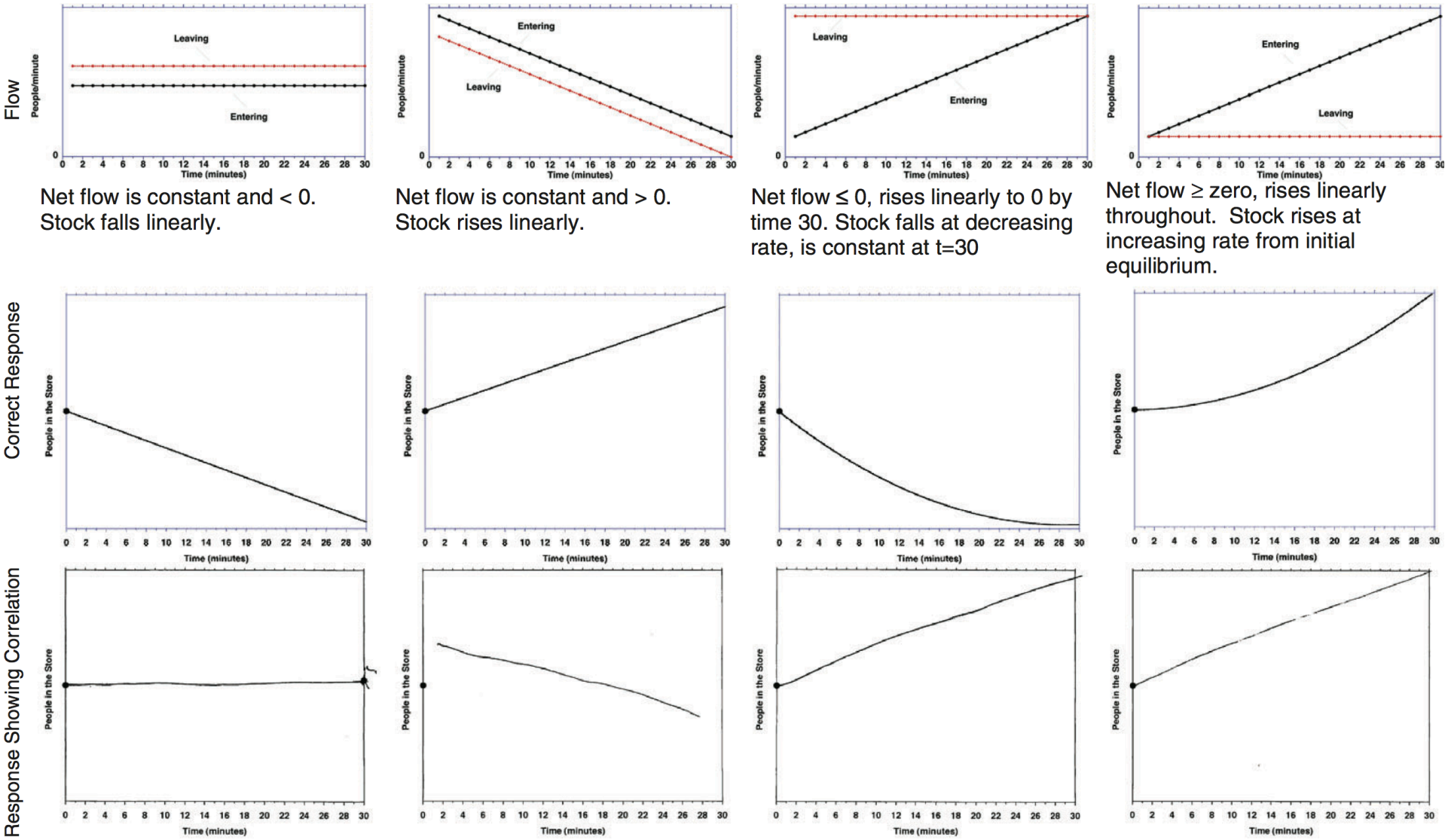



Source: Cronin, M., Gonzalez, C., & Sterman, J. D. (2009). Why don't well-educated adults understand accumulation? Organizational Behavior and Human Decision Processes, 108(1), 116–130.

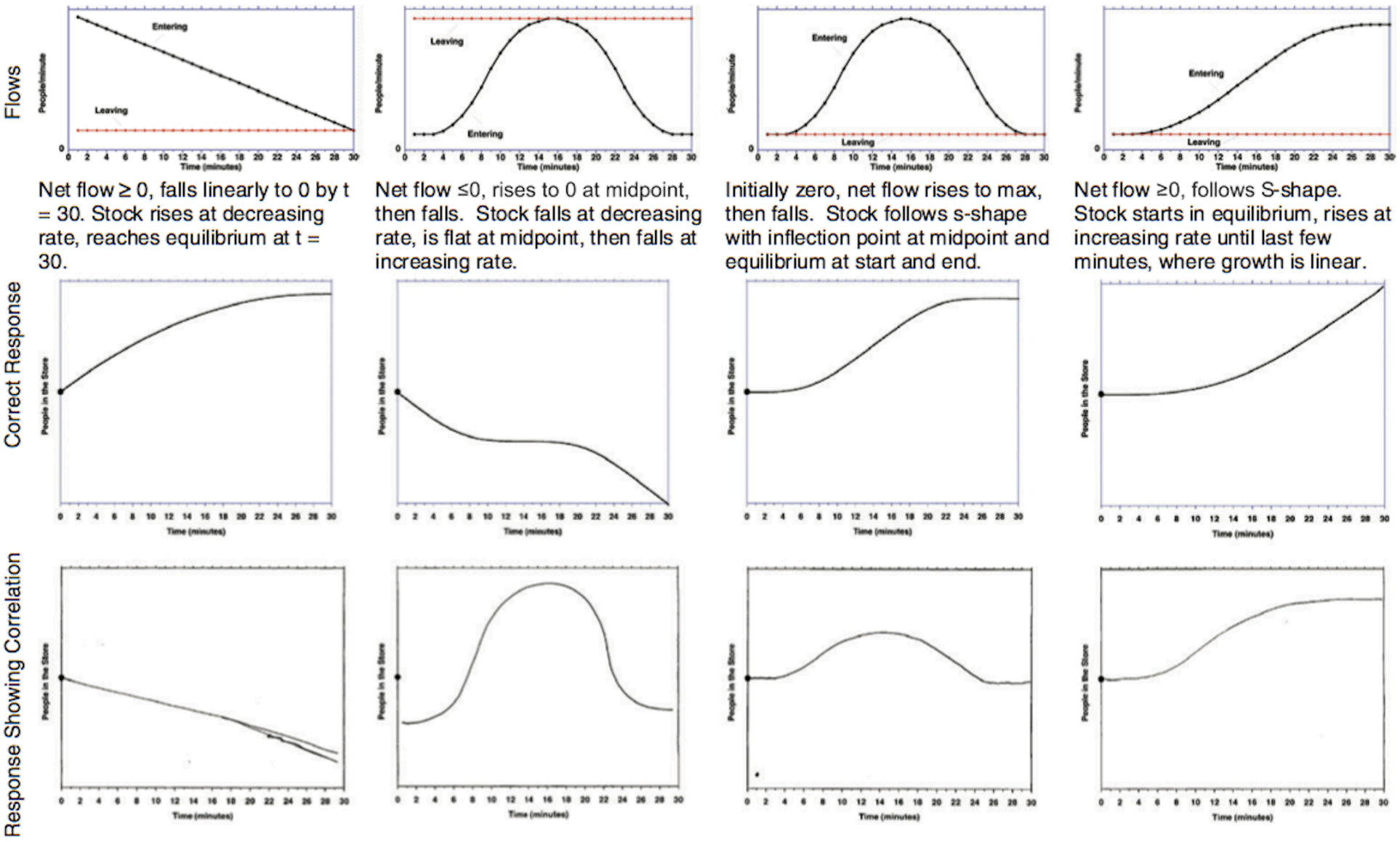



In the space below, graph the number of people in the store over the 30 minute interval. You do not need to specify numerical values. The dot at time zero shows the initial number of people in the store.


Source: Cronin, M., Gonzalez, C., & Sterman, J. D. (2009). Why don't well-educated adults understand accumulation? Organizational Behavior and Human Decision Processes, 108(1), 116–130.

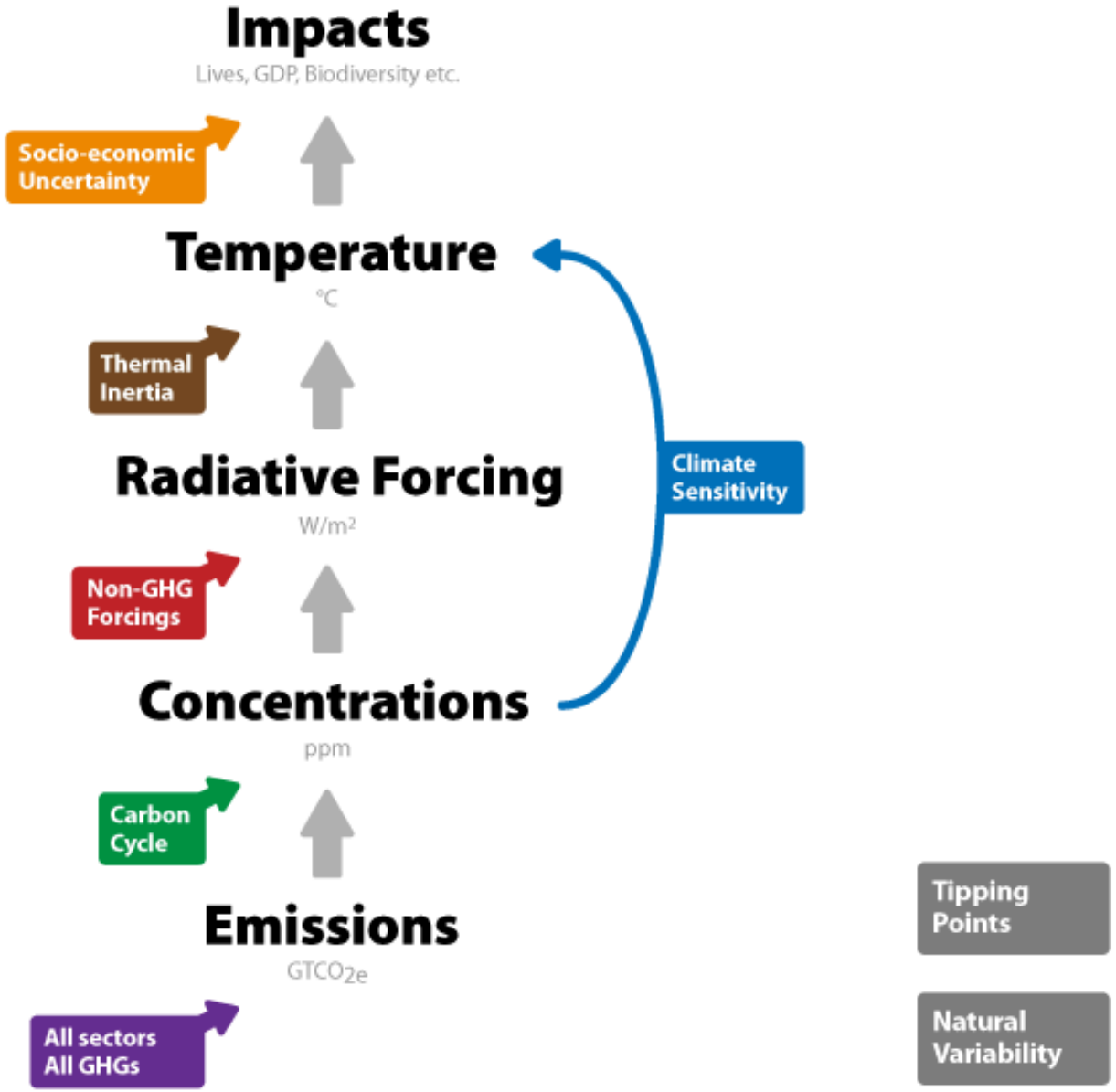



Source: Cronin, M., Gonzalez, C., & Sterman, J. D. (2009). Why don't well-educated adults understand accumulation? Organizational Behavior and Human Decision Processes, 108(1), 116–130.

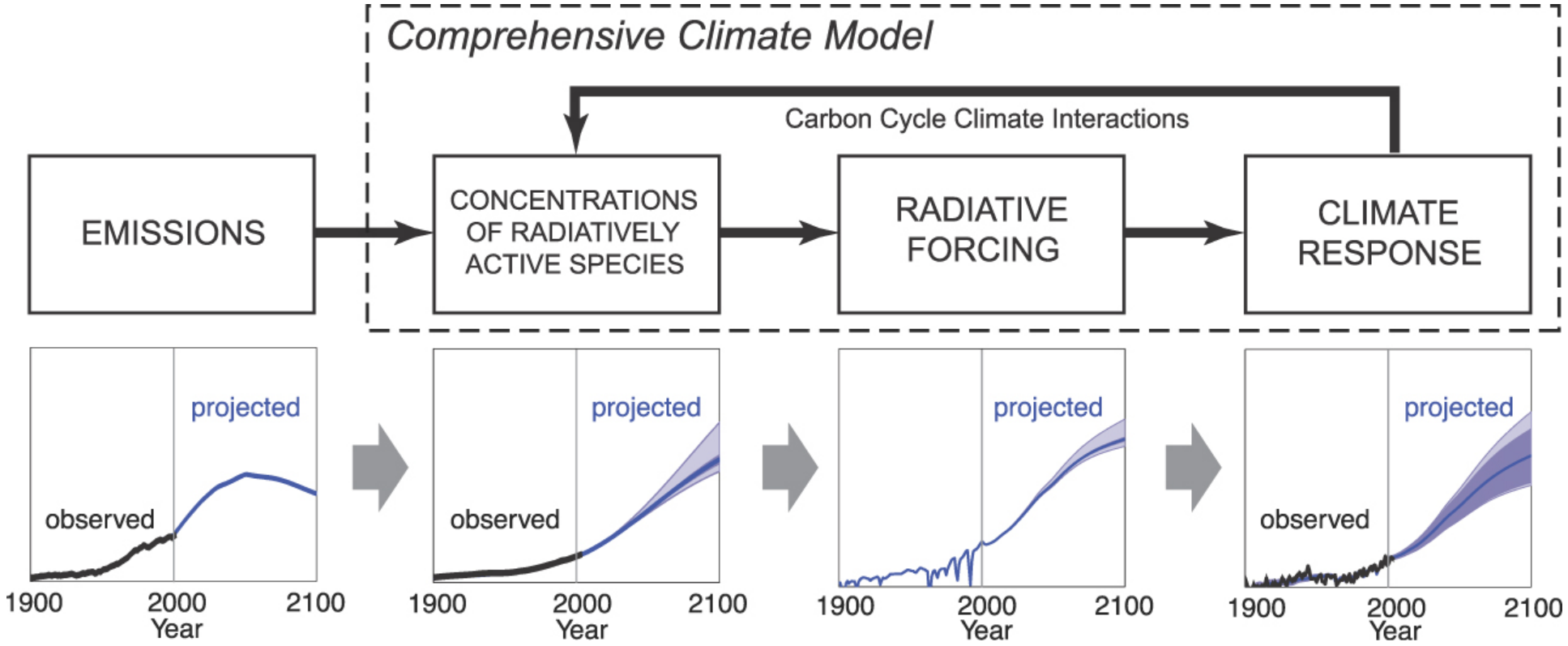



Source: Cronin, M., Gonzalez, C., & Sterman, J. D. (2009). Why don't well-educated adults understand accumulation? Organizational Behavior and Human Decision Processes, 108(1), 116–130.

# What do scientists do with the models?

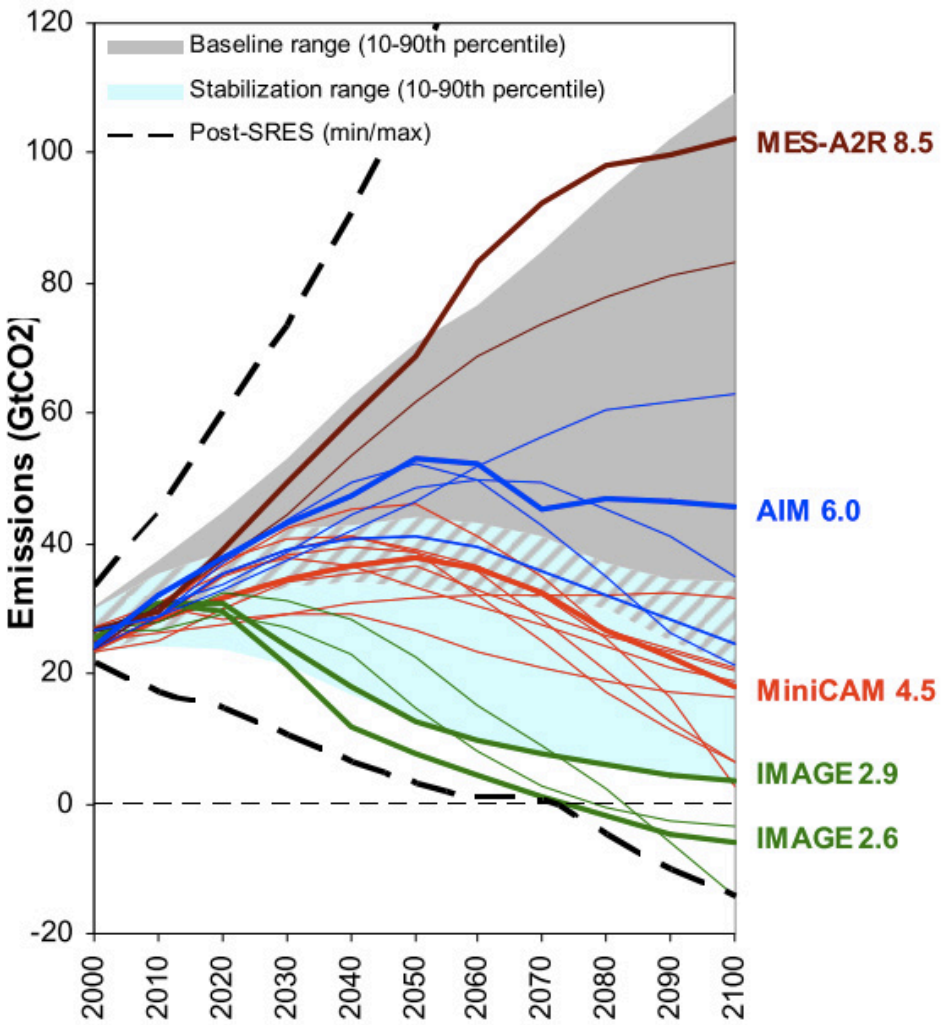


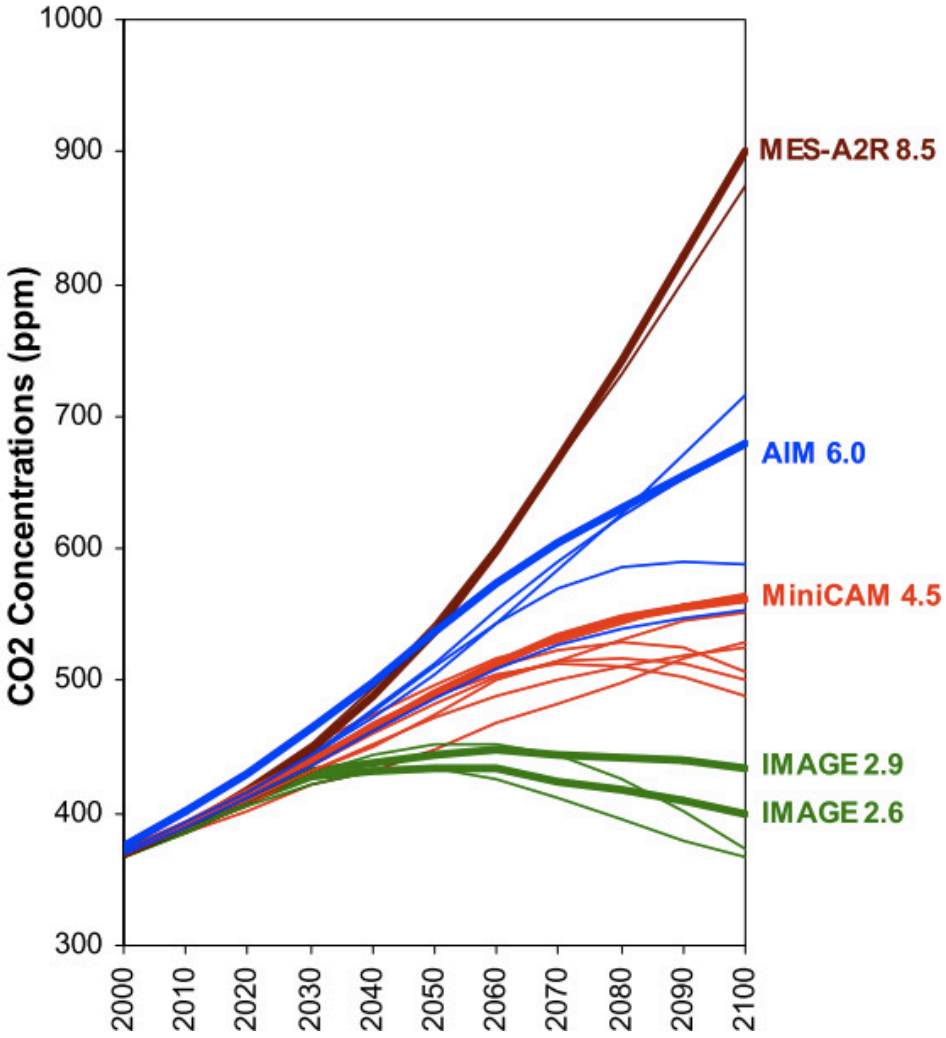
# How IPCC Scenarios work



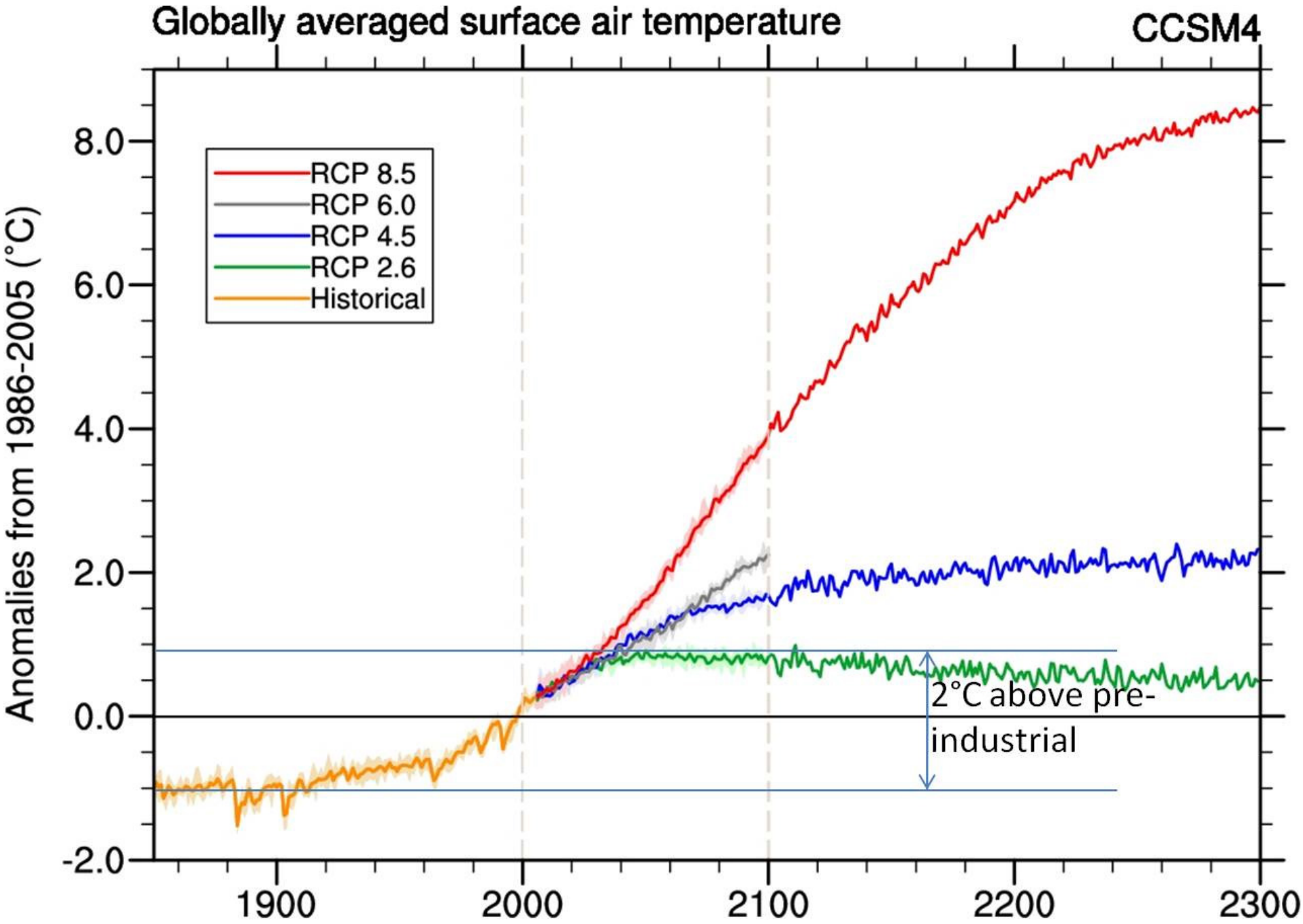

IPCC AR4 2007 WG1 Fig 10.4

# What are RCPs?

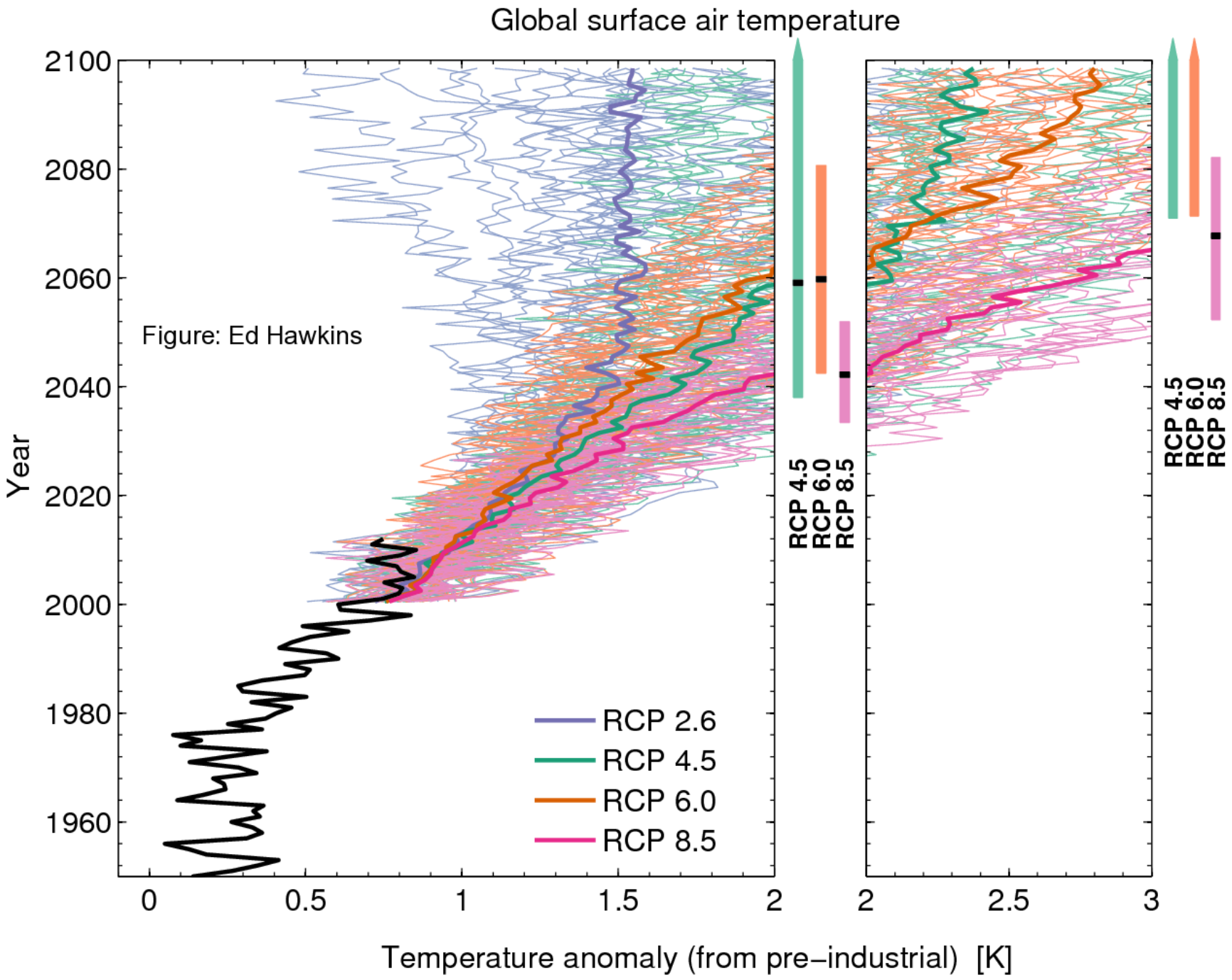


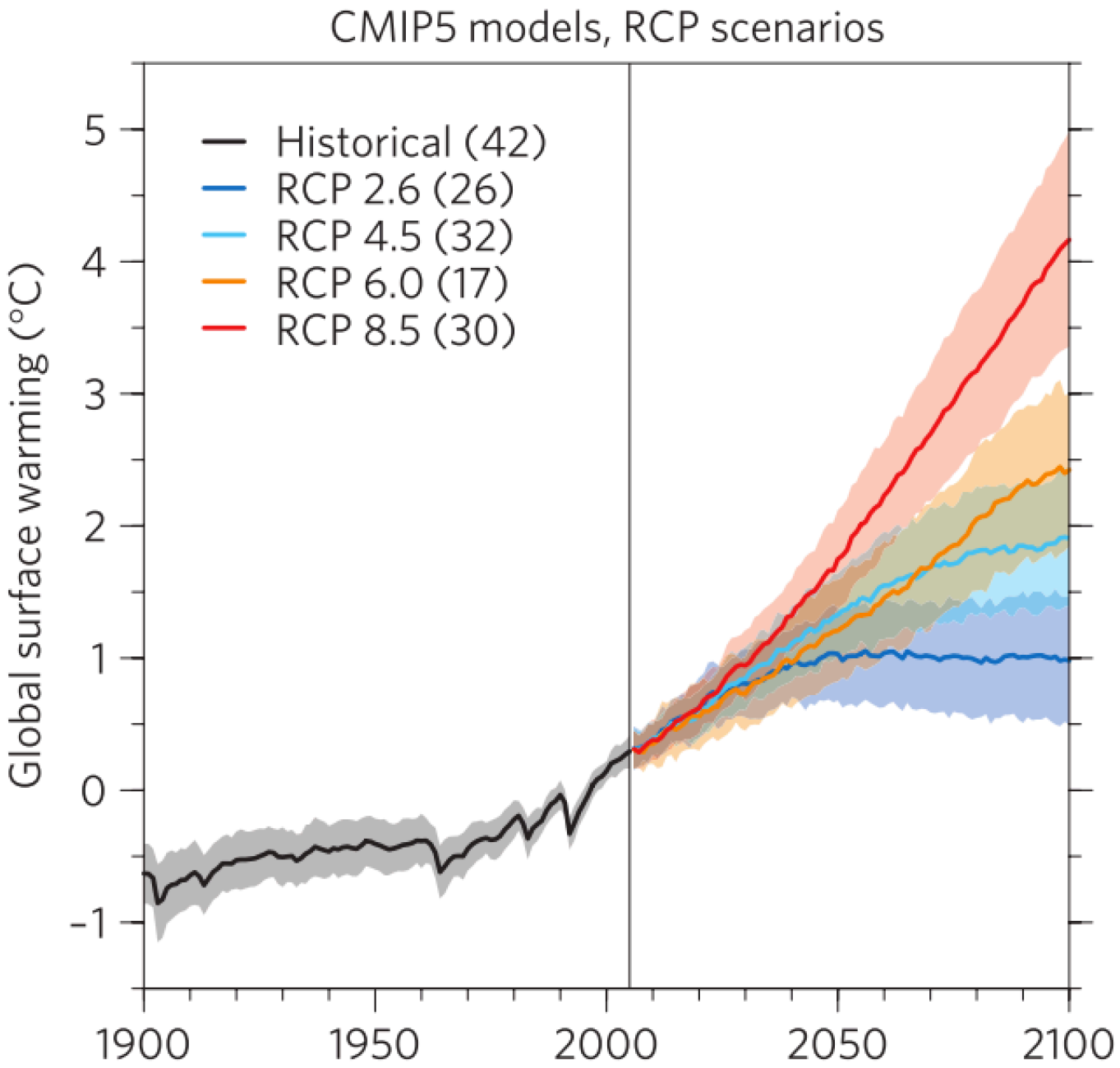

Moss, R. H. et. al. (2008). Towards new scenarios for analysis of emissions, climate change, impacts, and response strategies: IPCC Expert Meeting Report. IPCC. Geneva.


Globally averaged surface air temperature
CCSM4
RCP 8.5
RCP 6.0
RCP 4.5
RCP 2.6
Historical
Anomalies from 1986-2005 (°C)
8.0
6.0
4.0
2.0
0.0
-2.0
1900
2000
2100
2200
2300
2°C above pre-industrial

Source: NCAR

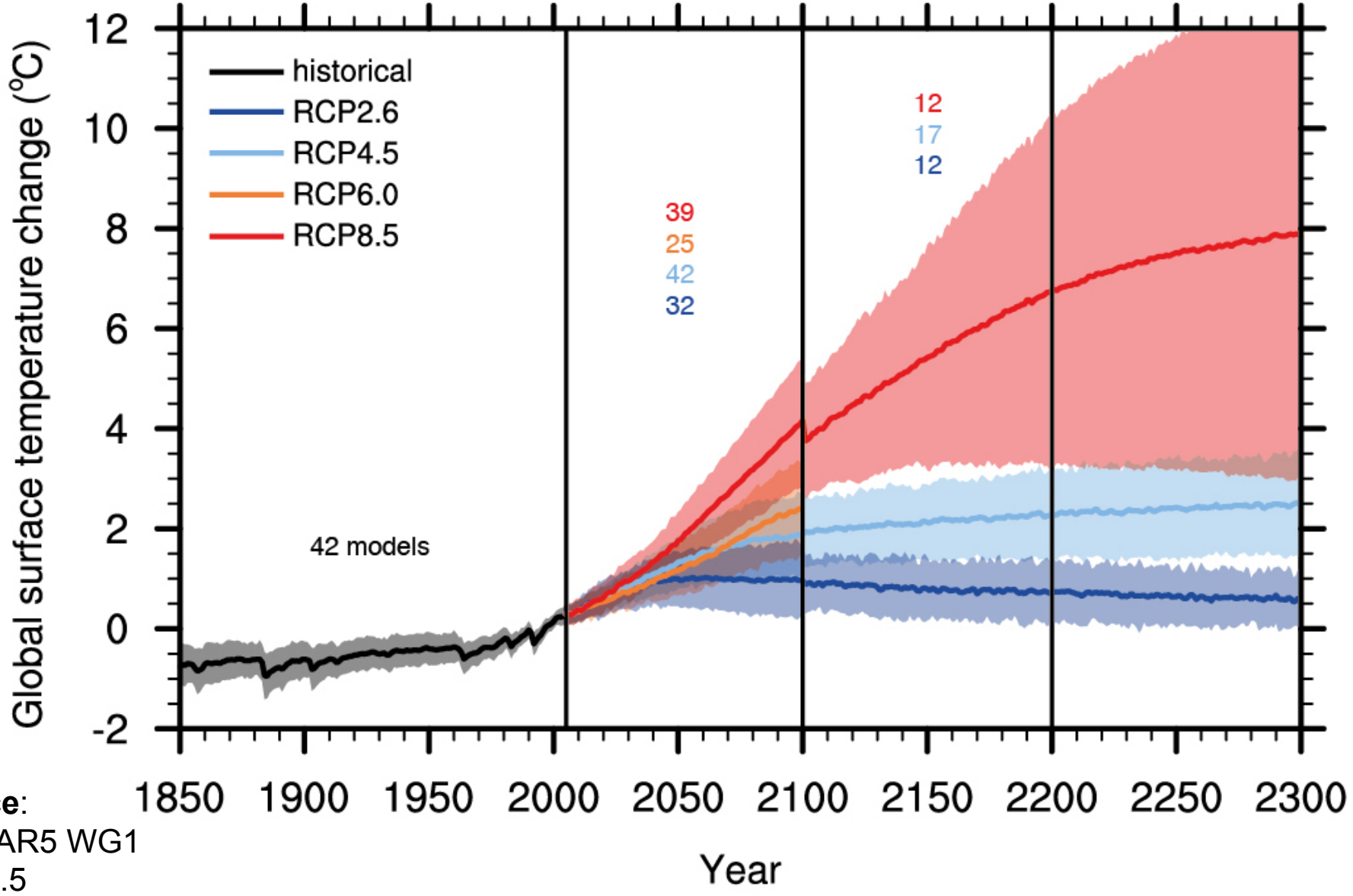



Source: http://www.climate-lab-book.ac.uk/2014/when-will-we-reach-2c/




From: Knutti, R., & Sedláček, J. (2012). Robustness and uncertainties in the new CMIP5 climate model projections. Nature Climate Change, (October), 1–5.

# Runs extended to 2300




**Source**:
IPCC AR5 WG1
Fig 12.5