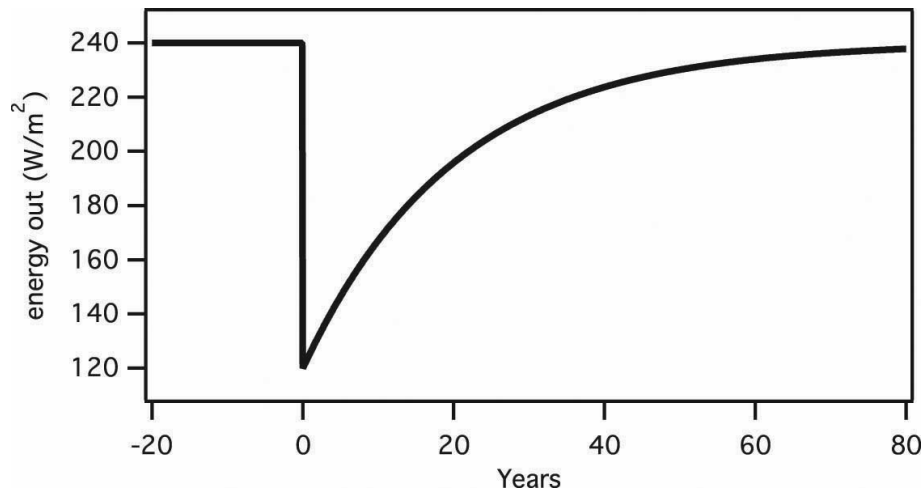


What is Radiative Forcing?

- 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)

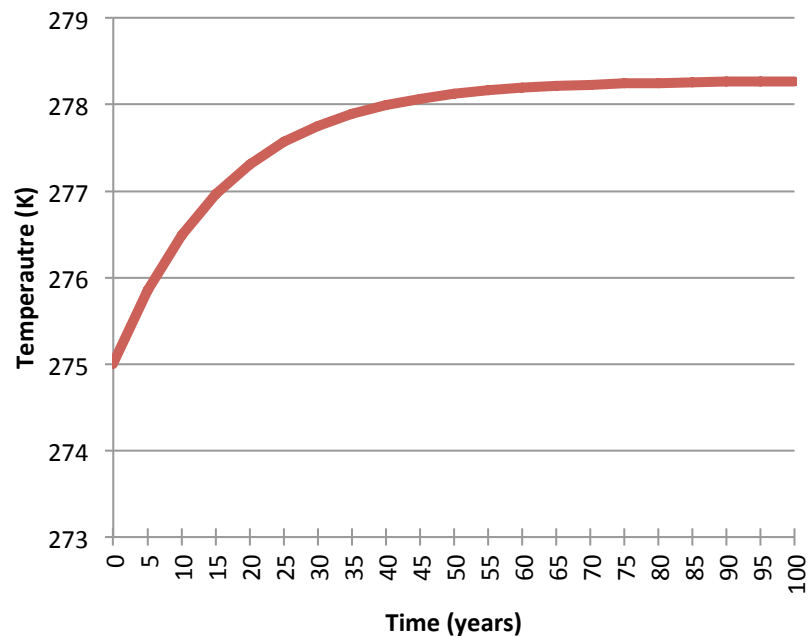
Radiative Forcing is a disturbance of a planet's energy balance caused by a change in incoming or outgoing radiation

What slows the warming?

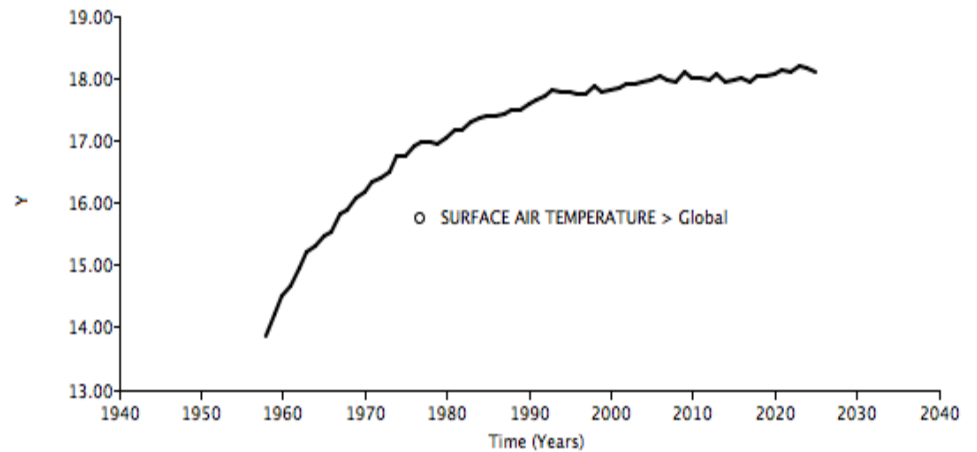
EdGCM simulation:

Simple spreadsheet simulation:

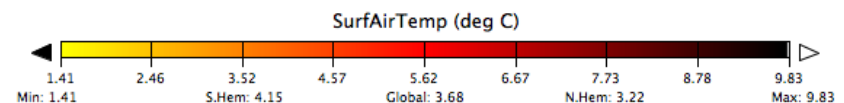
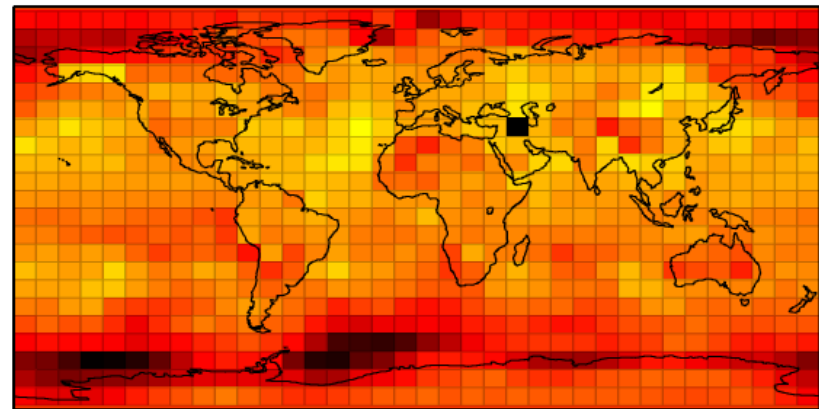
Surface Temperature

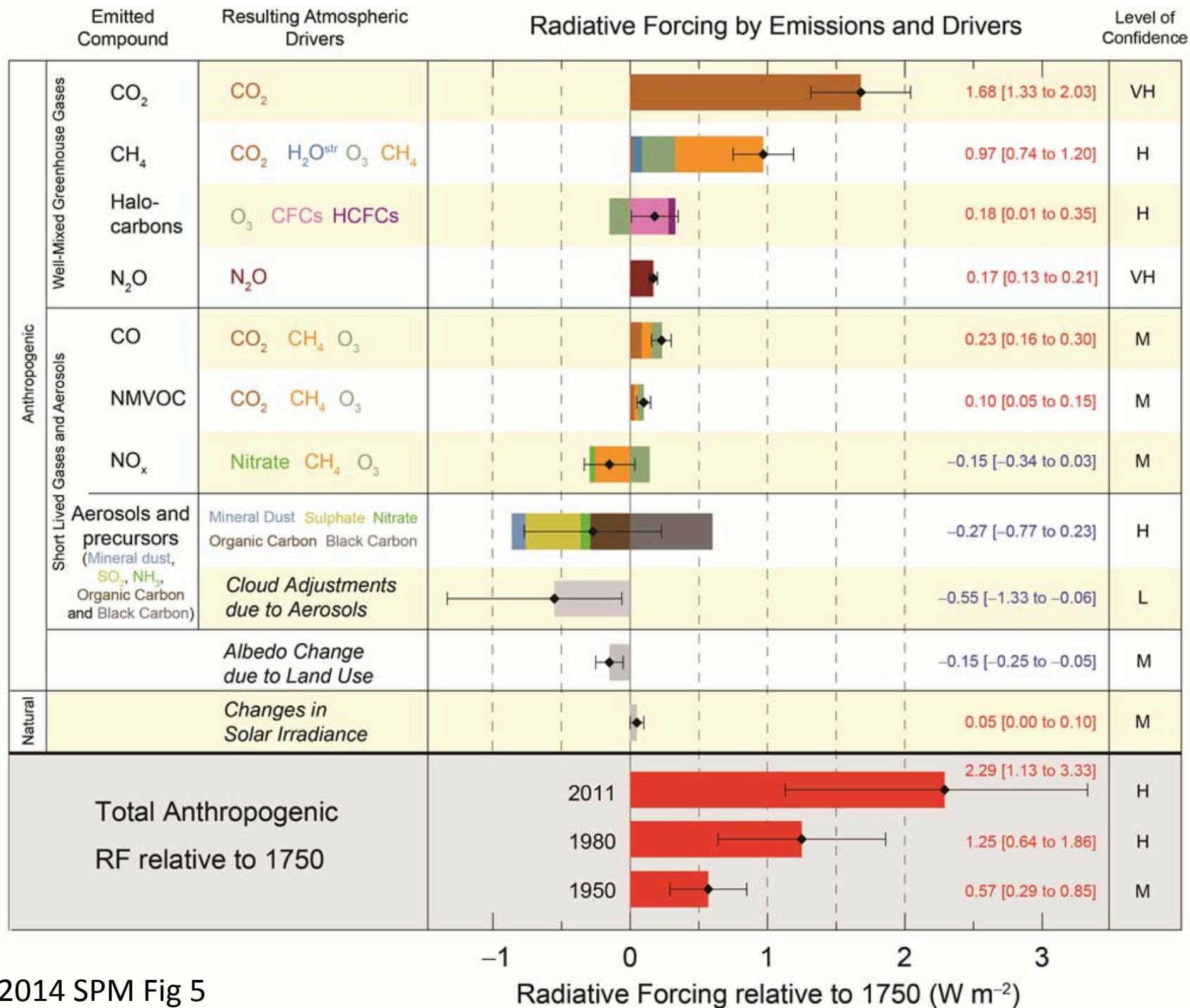


Doubled_CO2_SRFAIRTMP > SURFACE AIR TEMPERATURE > Global



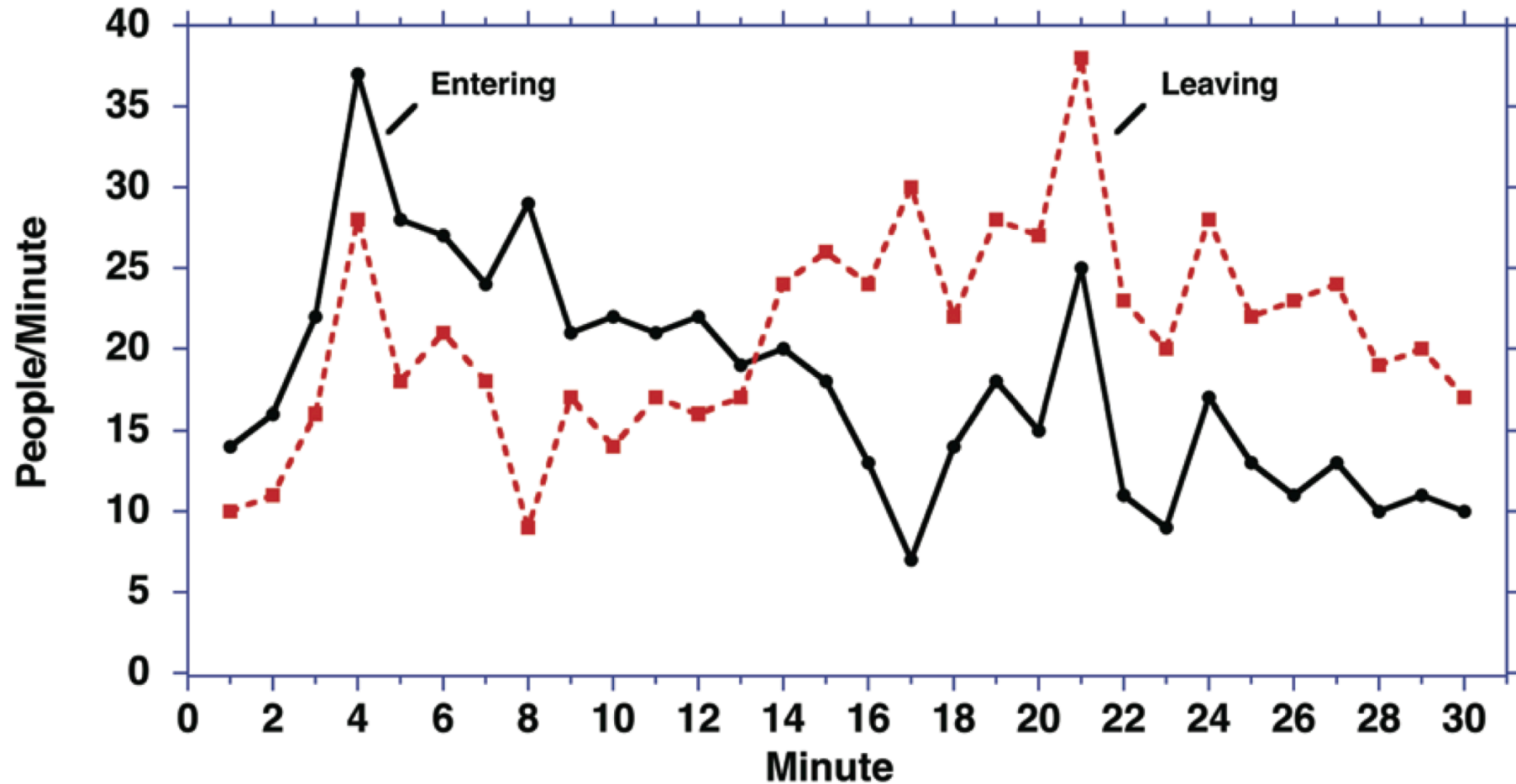
(Doubled_CO2.2022-2026ij__Doubled_CO2.1958-1962ij_1202.ncdf)



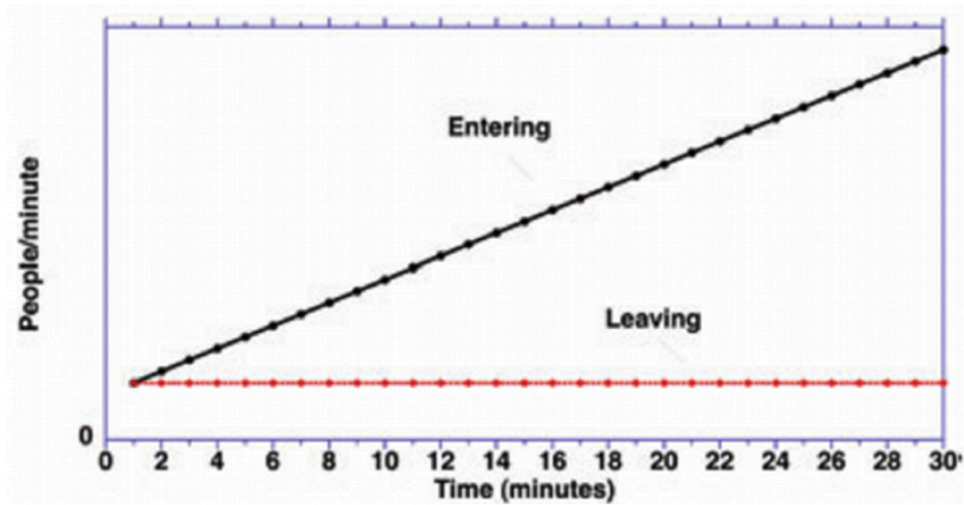


IPCC AR5 2014 SPM Fig 5

Accumulation Exercise



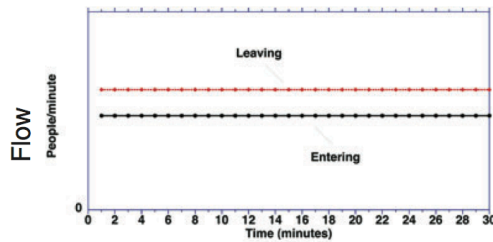
Source: Cronin, M., Gonzalez, C., & Sterman, J. D. (2009). Why don't well-educated adults understand accumulation? *Organizational Behavior and Human Decision Processes*, 108(1), 116–130.



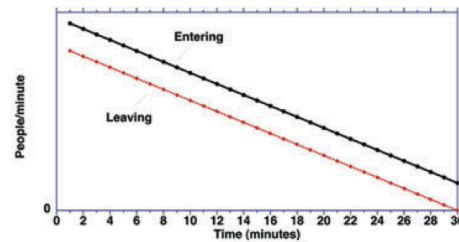
In the space below, graph the number of people in the store over the 30 minute interval. You do not need to specify numerical values. The dot at time zero shows the initial number of people in the store.



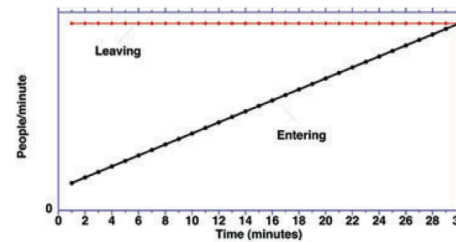
Source: Cronin, M., Gonzalez, C., & Stermann, J. D. (2009). Why don't well-educated adults understand accumulation? *Organizational Behavior and Human Decision Processes*, 108(1), 116–130.



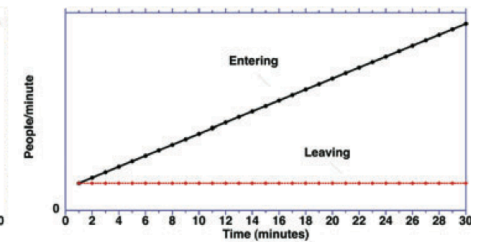
Net flow is constant and < 0 .
Stock falls linearly.



Net flow is constant and > 0 .
Stock rises linearly.

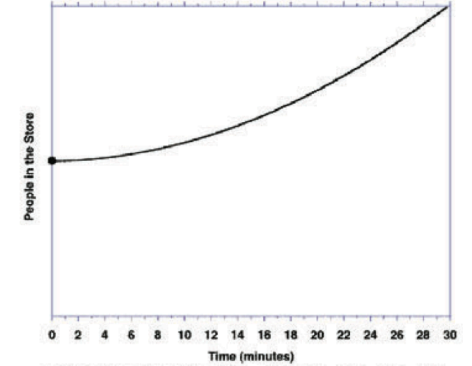
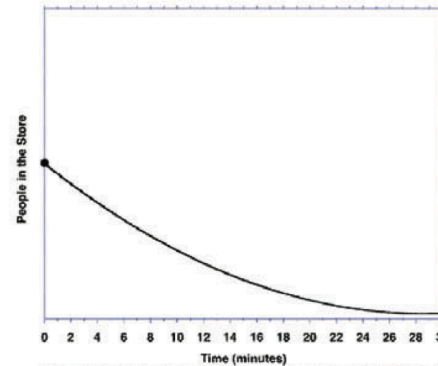
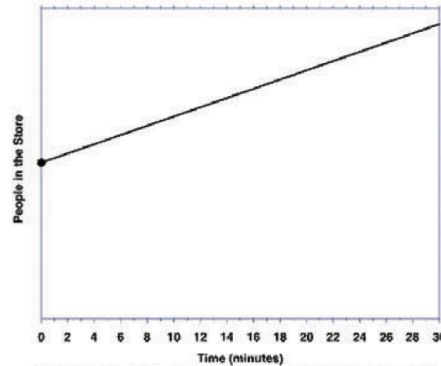
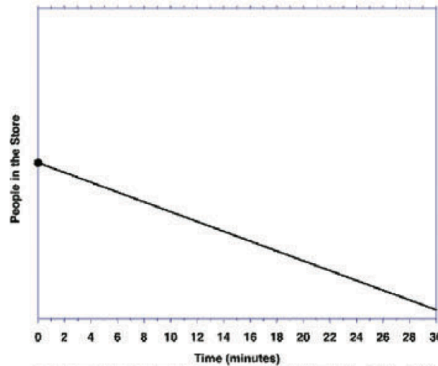


Net flow ≤ 0 , rises linearly to 0 by
time 30. Stock falls at decreasing
rate, is constant at t=30

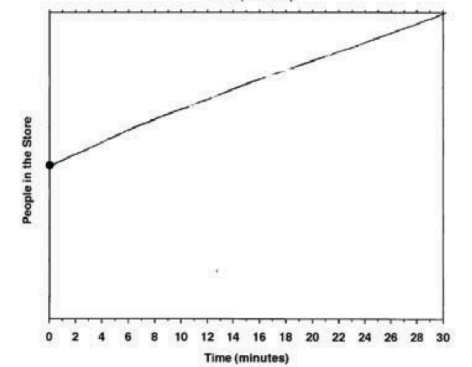
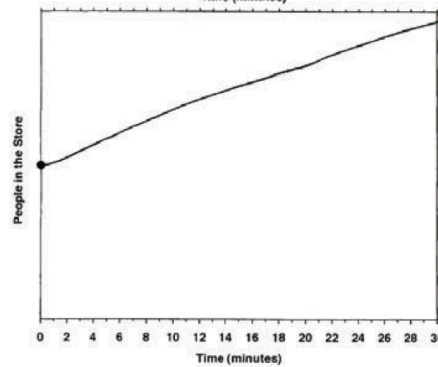
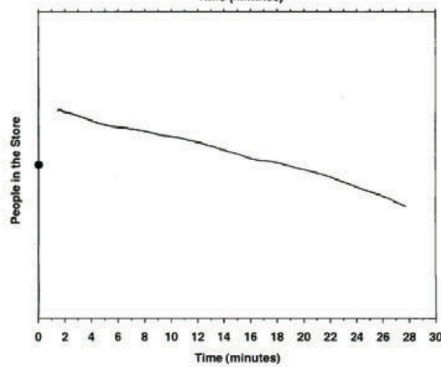
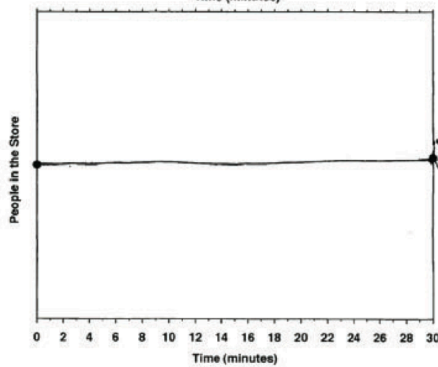


Net flow $\geq$ zero, rises linearly
throughout. Stock rises at
increasing rate from initial
equilibrium.

Correct Response

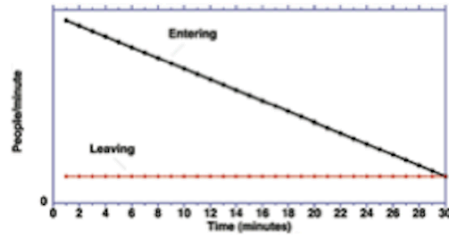


Response Showing Correlation

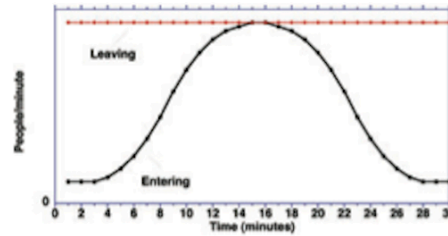


Source: Cronin, M., Gonzalez, C., & Stermann, J. D. (2009). Why don't well-educated adults understand accumulation? Organizational Behavior and Human Decision Processes, 108(1), 116–130.

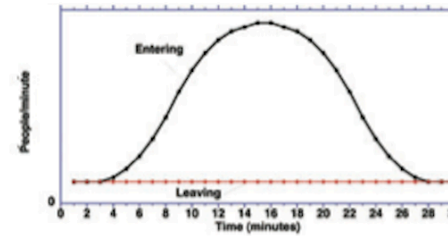
Flows



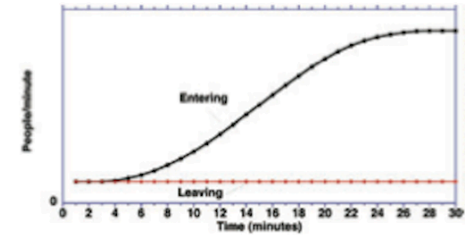
Net flow ≥ 0 , falls linearly to 0 by $t = 30$. Stock rises at decreasing rate, reaches equilibrium at $t = 30$.



Net flow ≤ 0 , rises to 0 at midpoint, then falls. Stock falls at decreasing rate, is flat at midpoint, then falls at increasing rate.

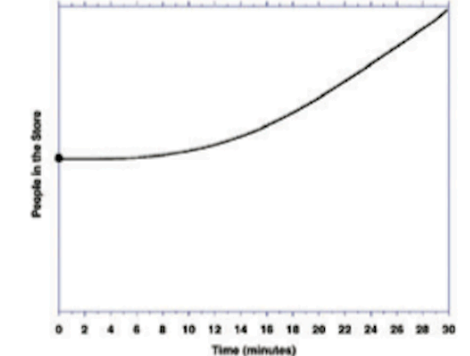
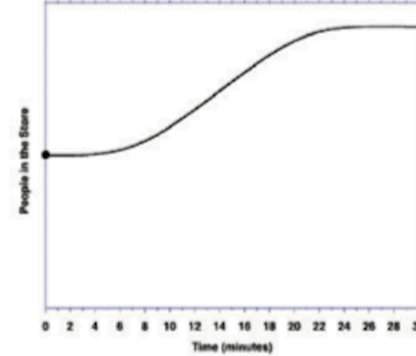
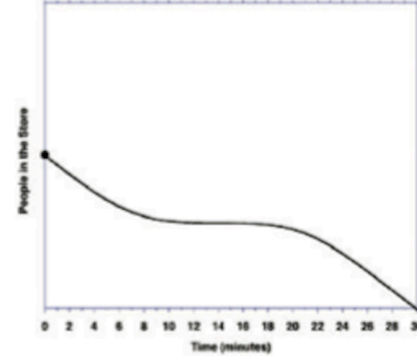
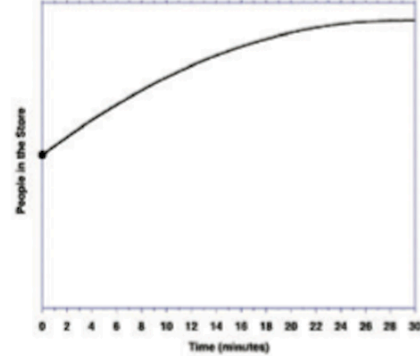


Initially zero, net flow rises to max, then falls. Stock follows s-shape with inflection point at midpoint and equilibrium at start and end.

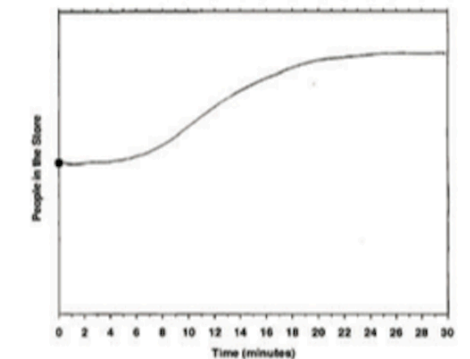
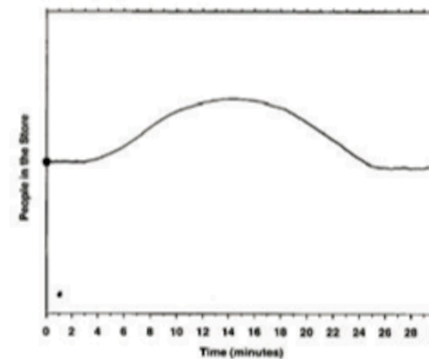
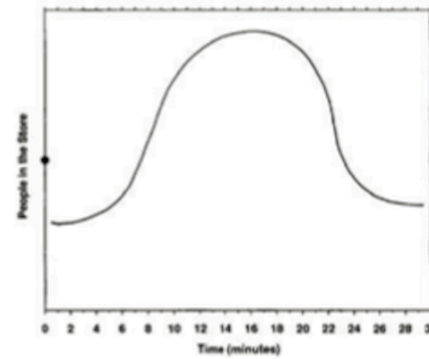
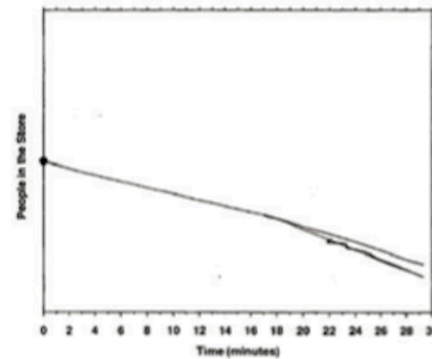


Net flow ≥ 0 , follows S-shape. Stock starts in equilibrium, rises at increasing rate until last few minutes, where growth is linear.

Correct Response

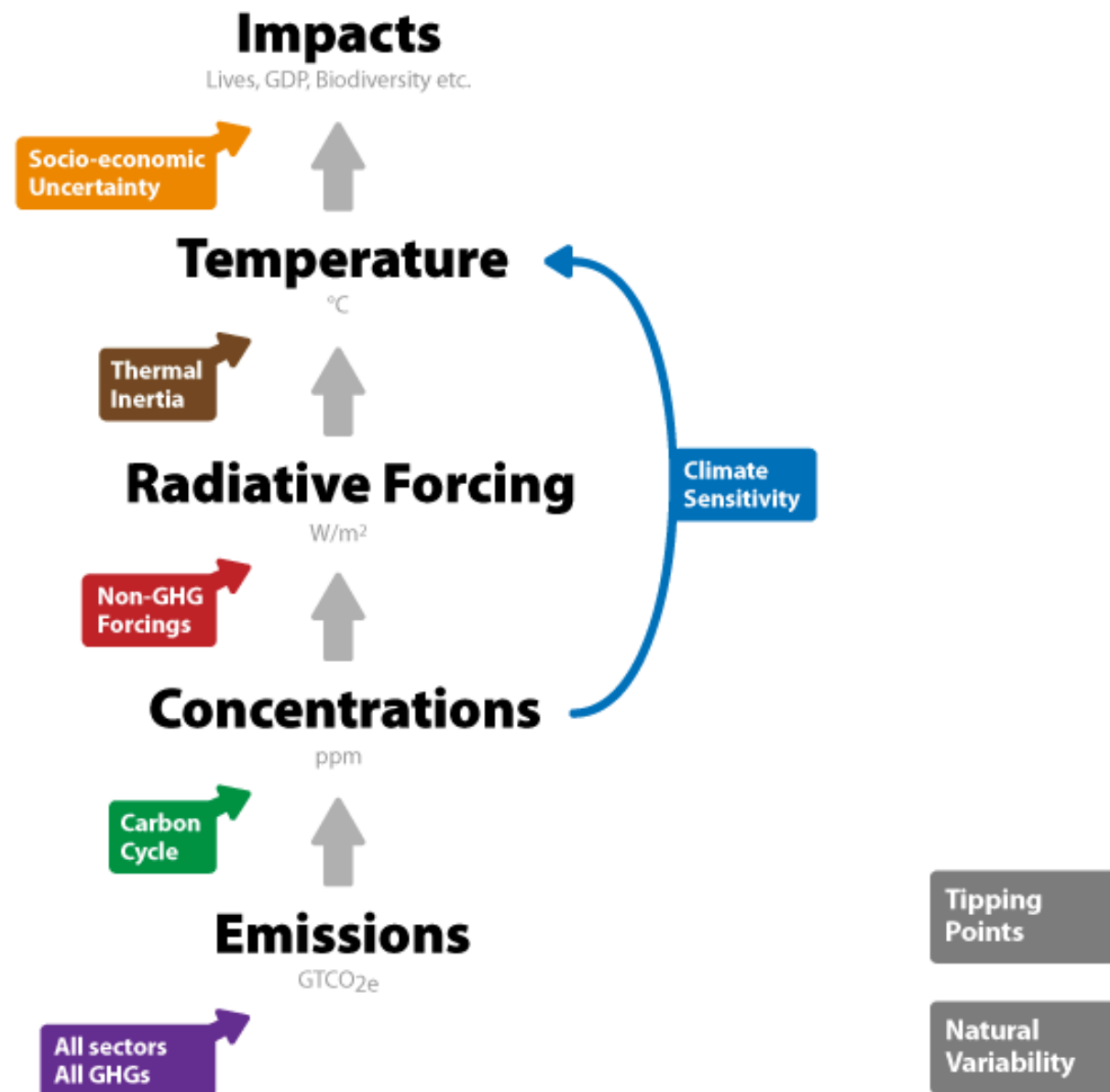


Response Showing Correlation

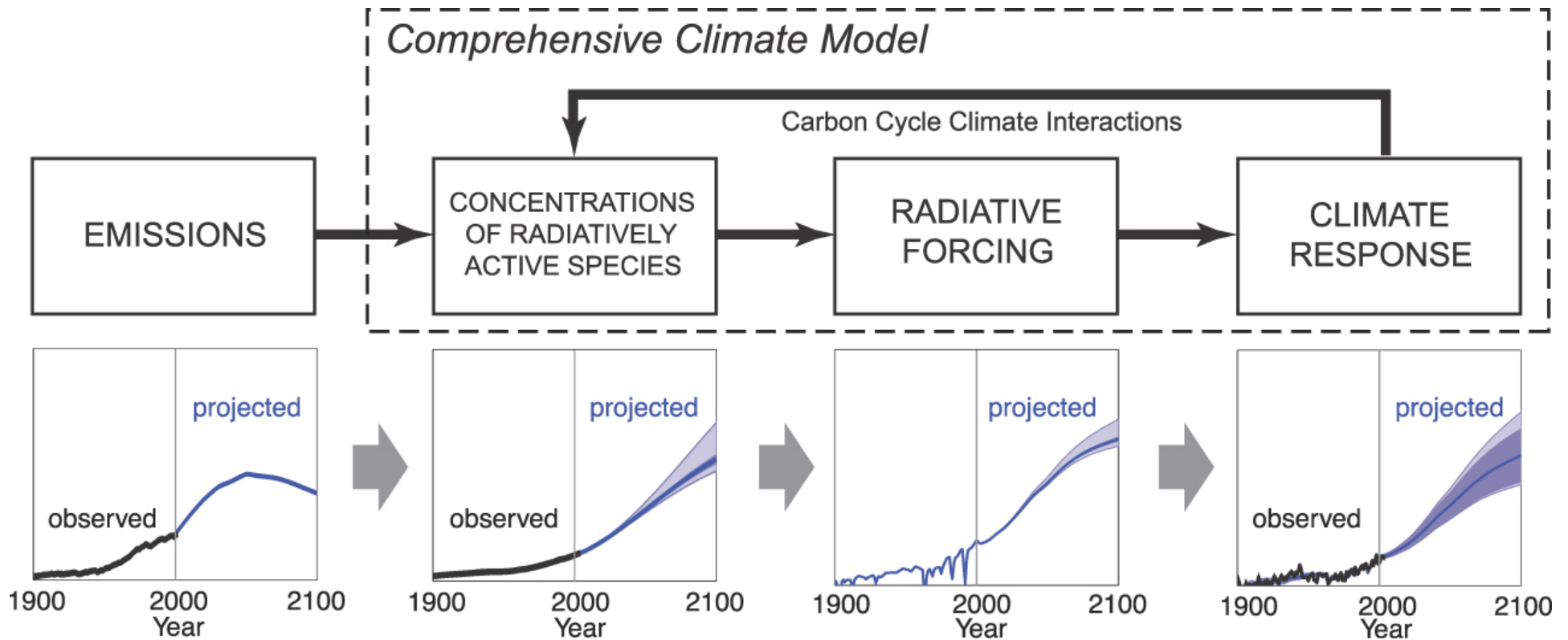


Source: Cronin, M., Gonzalez, C., & Stermann, J. D. (2009). Why don't well-educated adults understand accumulation? Organizational Behavior and Human Decision Processes, 108(1), 116–130.

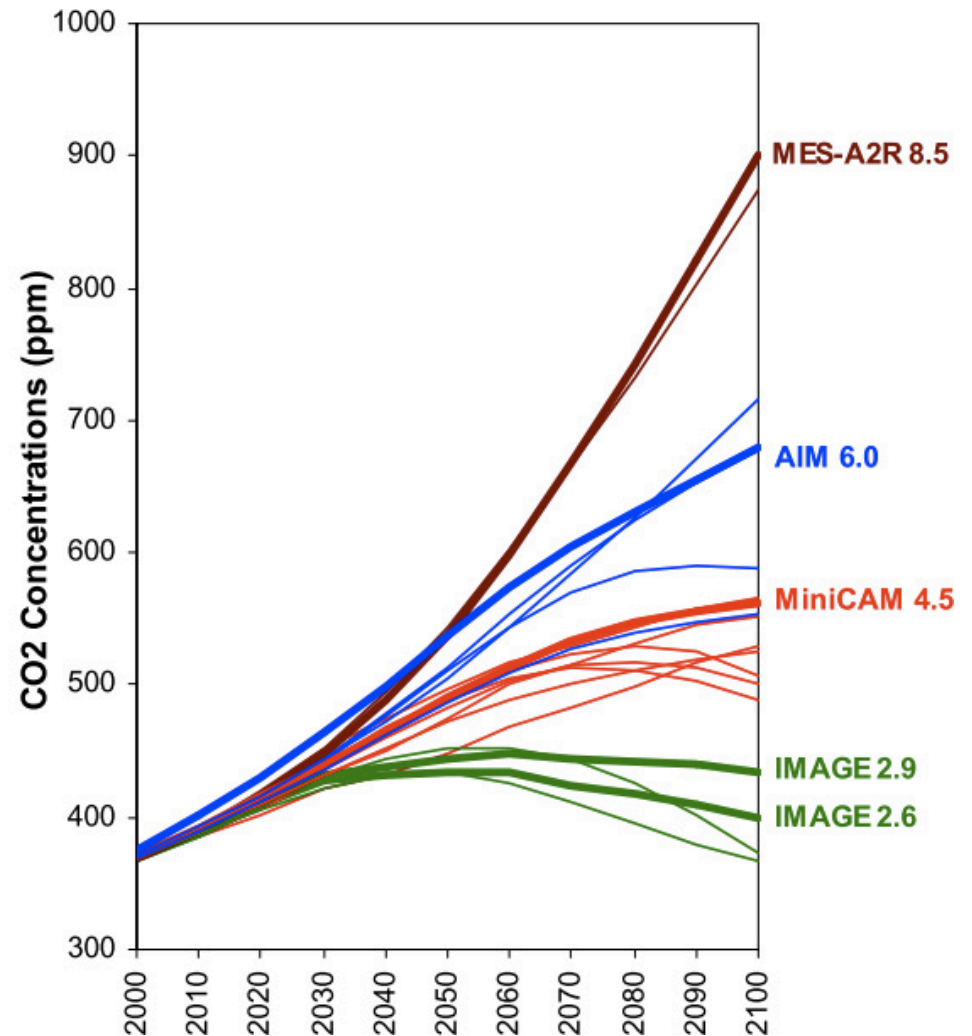
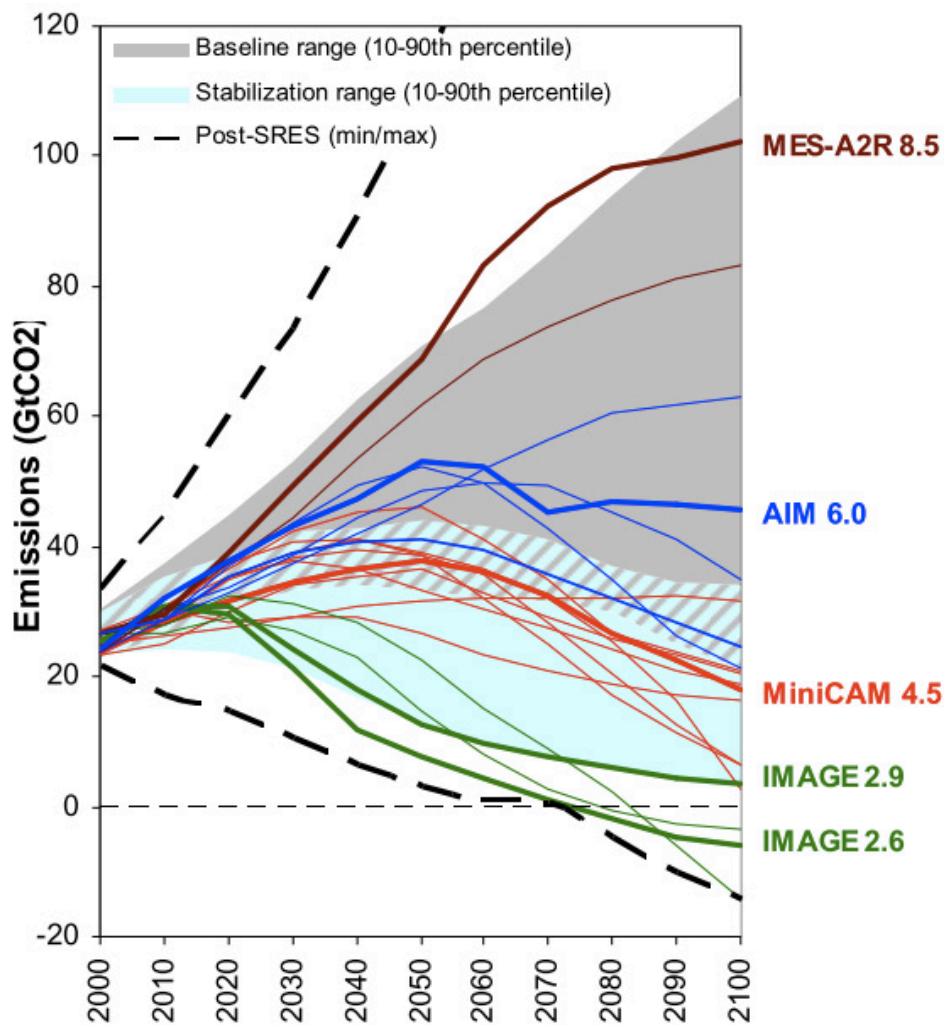
What do scientists do with the models?



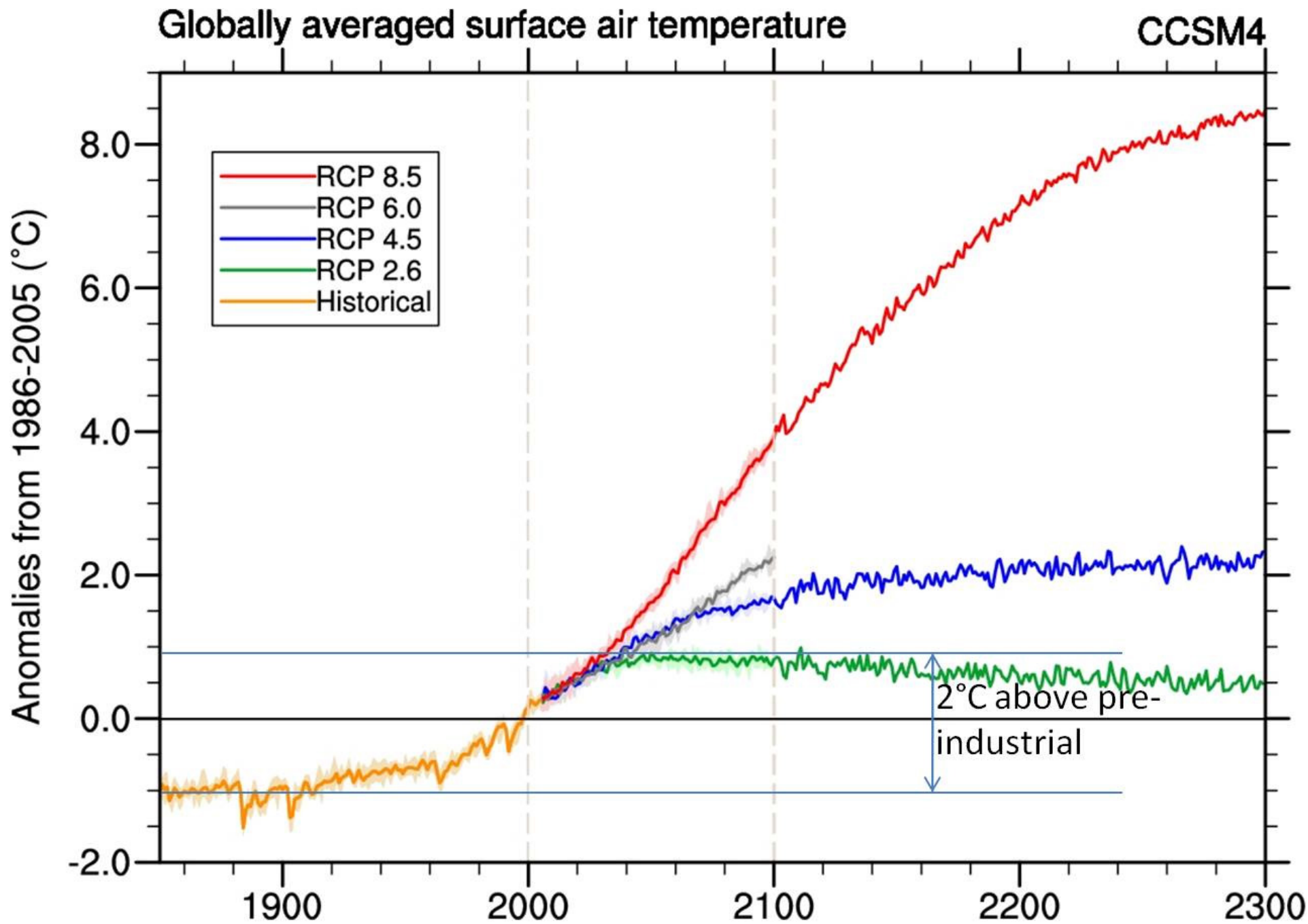
How IPCC Scenarios work



What are RCPs?

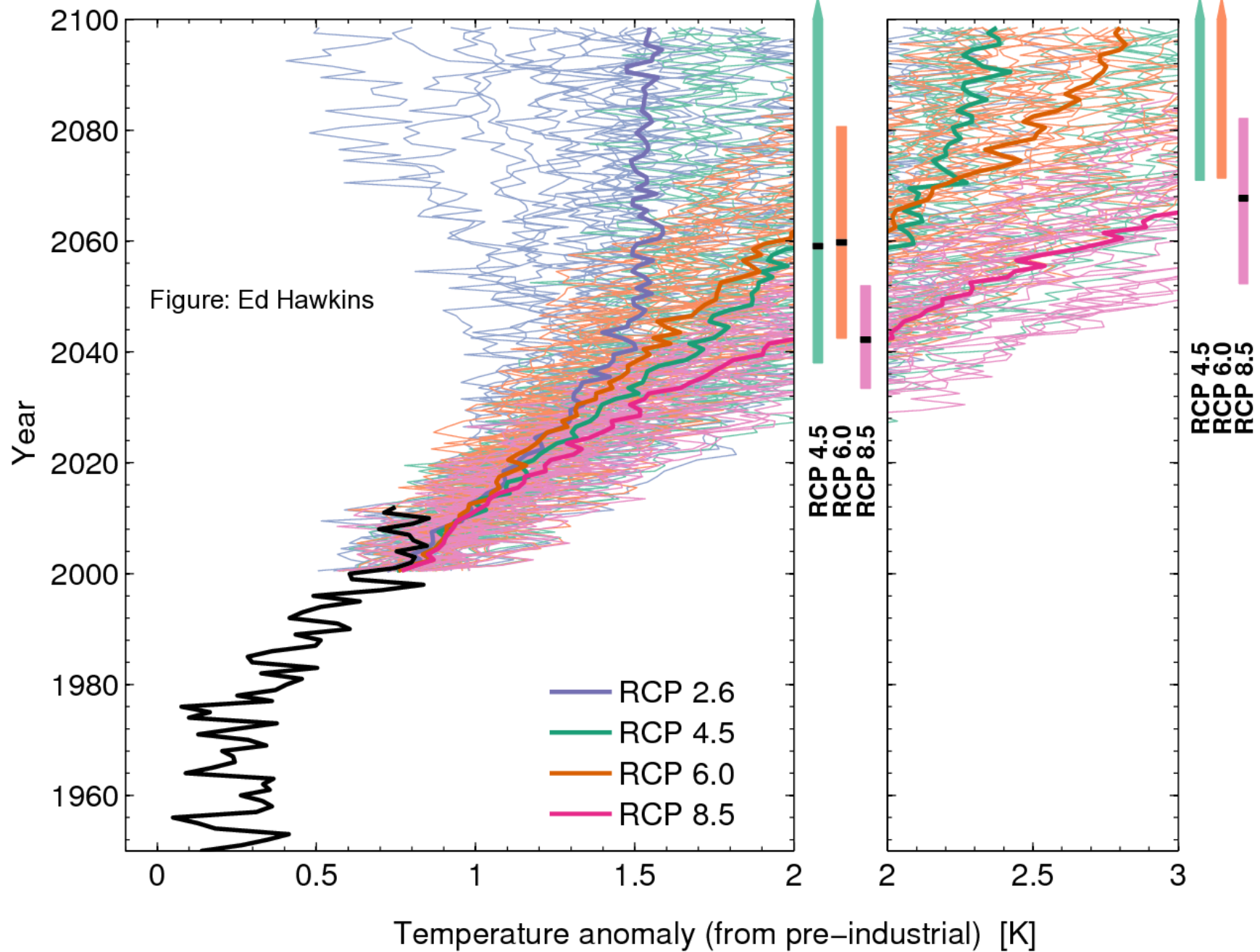


Moss, R. H. et. al. (2008). Towards new scenarios for analysis of emissions, climate change, impacts, and response strategies: IPCC Expert Meeting Report. IPCC. Geneva.

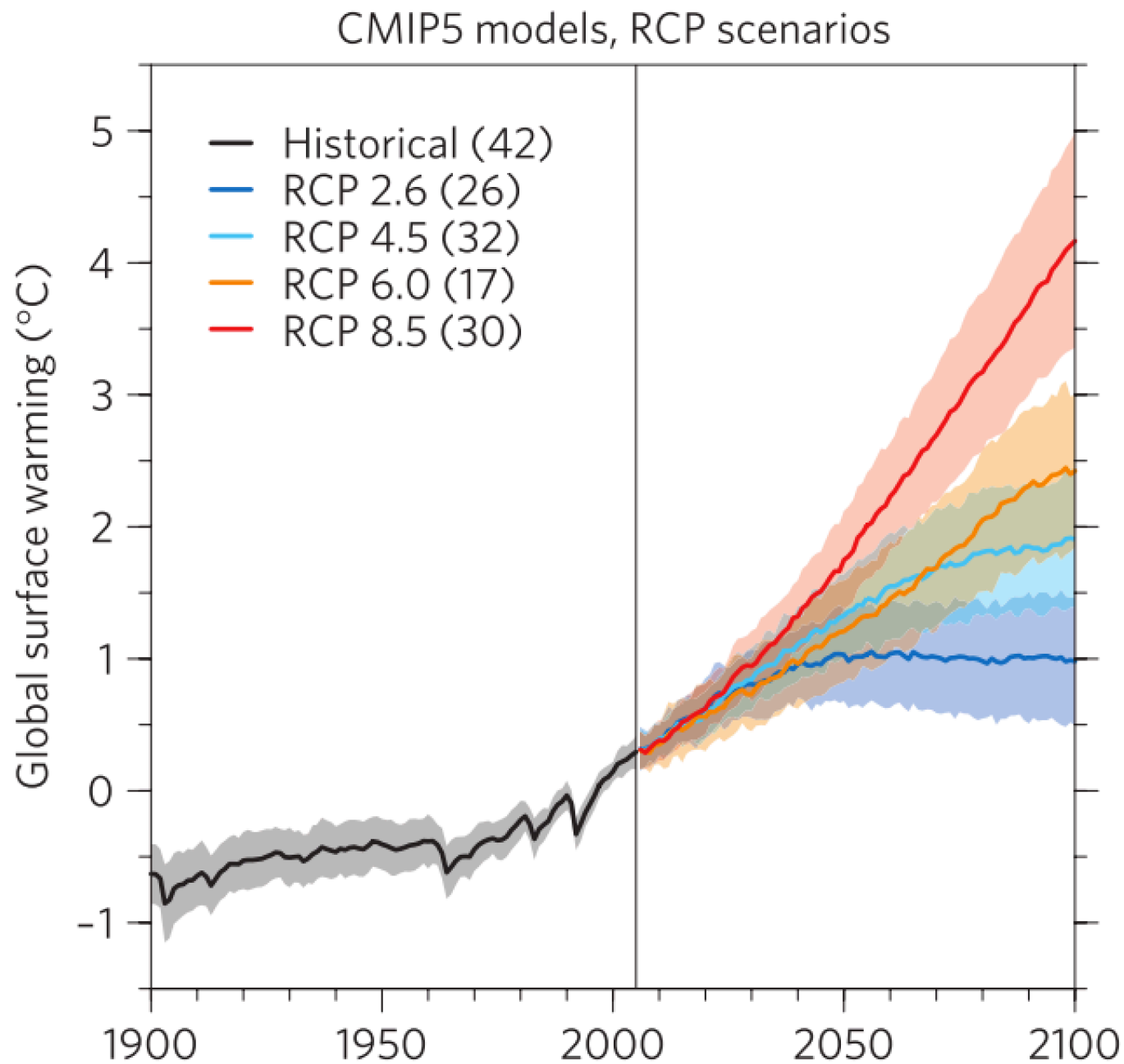


Source: NCAR

Global surface air temperature



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

