

Hypothesis Testing

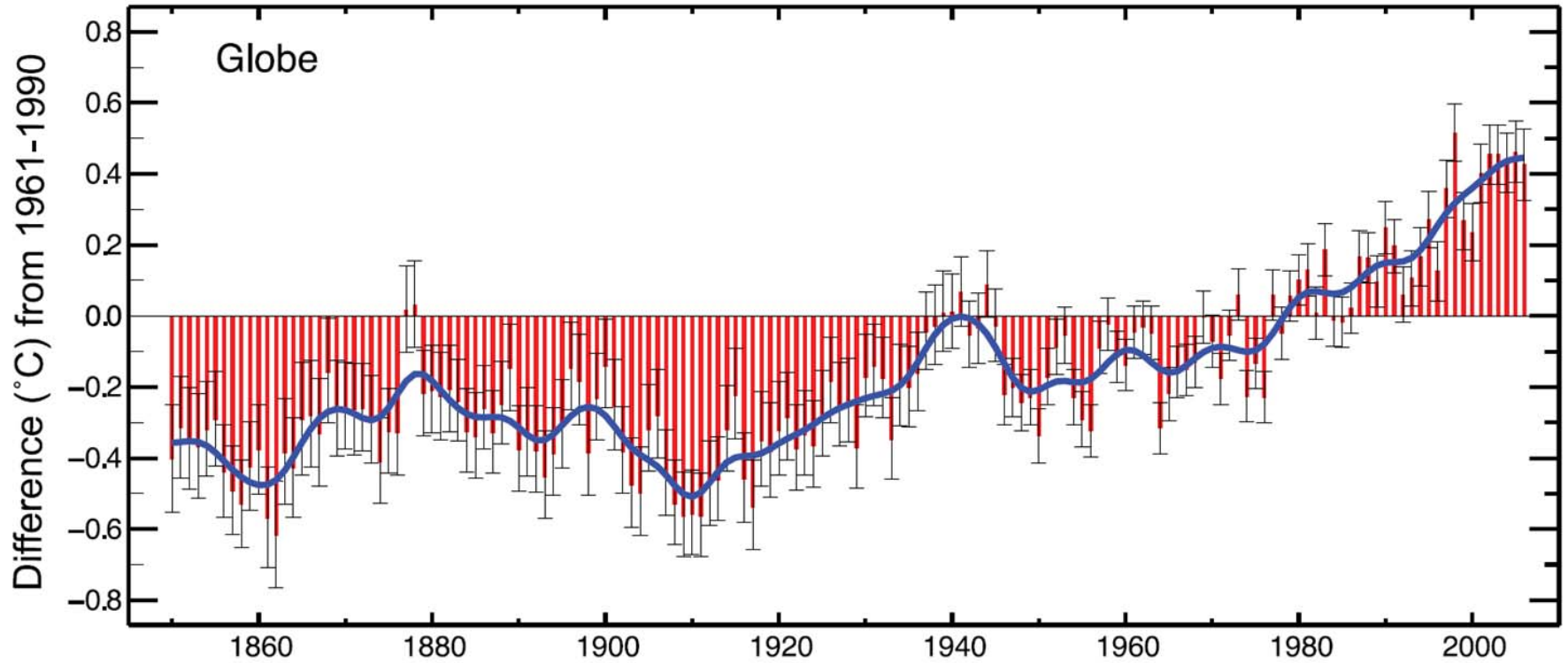
Was the effect produced by a real cause, or did it happen by coincidence or chance?

- *Null hypothesis: effect by chance*
- *Alternative hypothesis: a real cause*

What is the probability that the observed effect could have occurred by chance?

- *Low probability by chance: reject null hypothesis*
- *High probability by chance: reject alternative hypothesis*

Recent Temperature Increase



Recent Temperature Increase

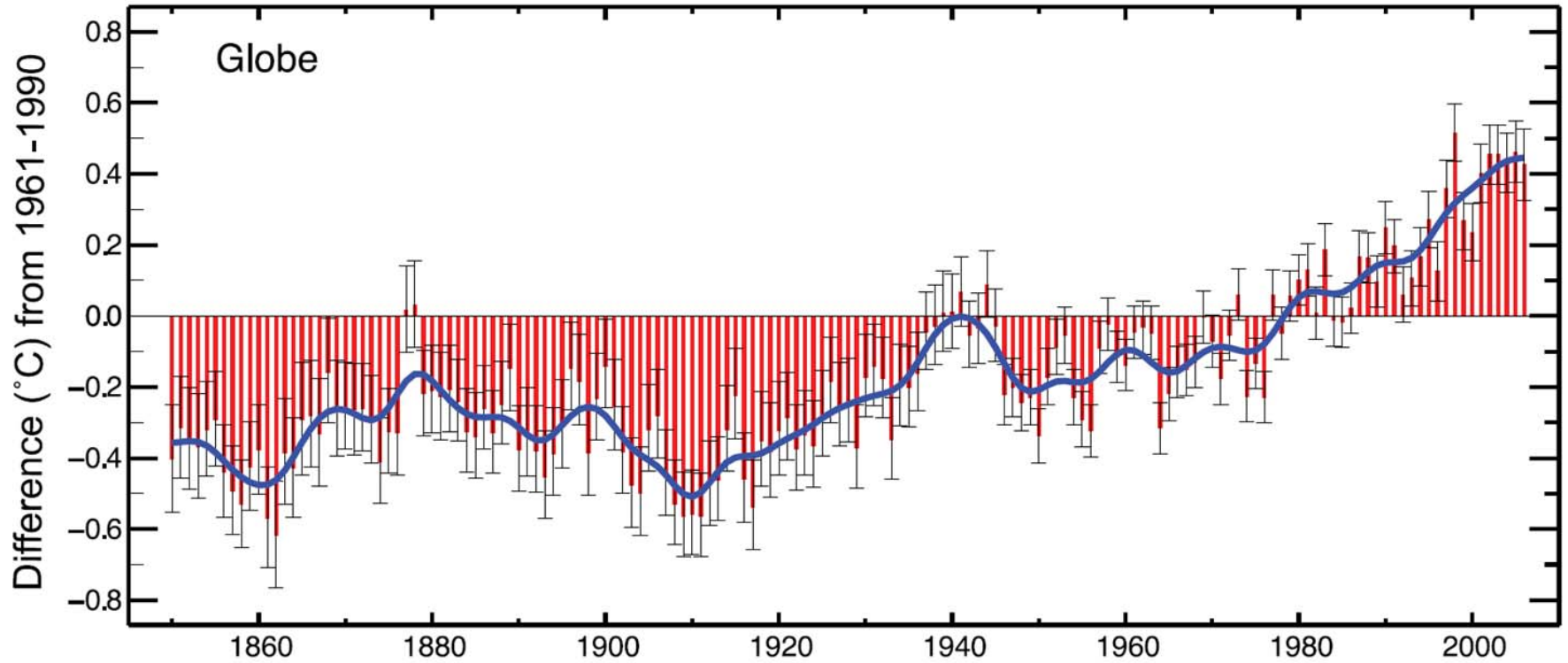
Is the recent temperature increase produced by an external cause or by natural temperature fluctuations?

- *Null hypothesis: natural random temperature fluctuations*
- *Alternative hypothesis: a systematic change/trend*

What is the probability that the temperature increase could have occurred by chance?

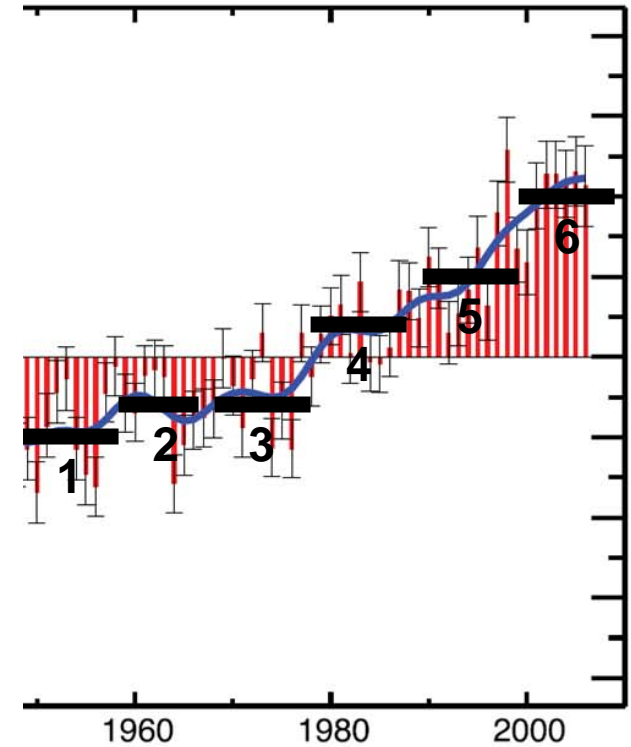
- *Low probability by chance: reject null hypothesis*
- *High probability by chance: reject alternative hypothesis*

Recent Temperature Increase

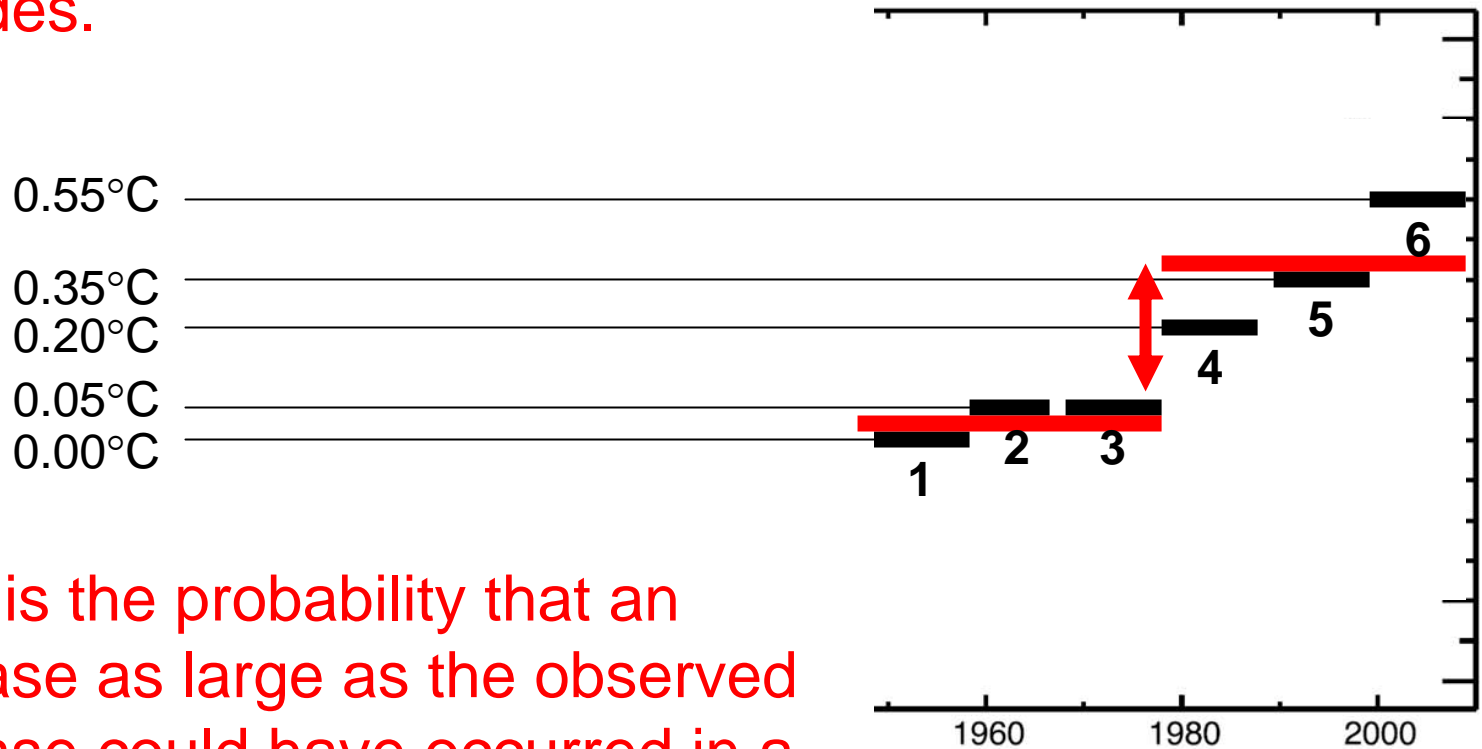


Create Statistical Model

- Focus on last 60 years
- Average temperature over each decade

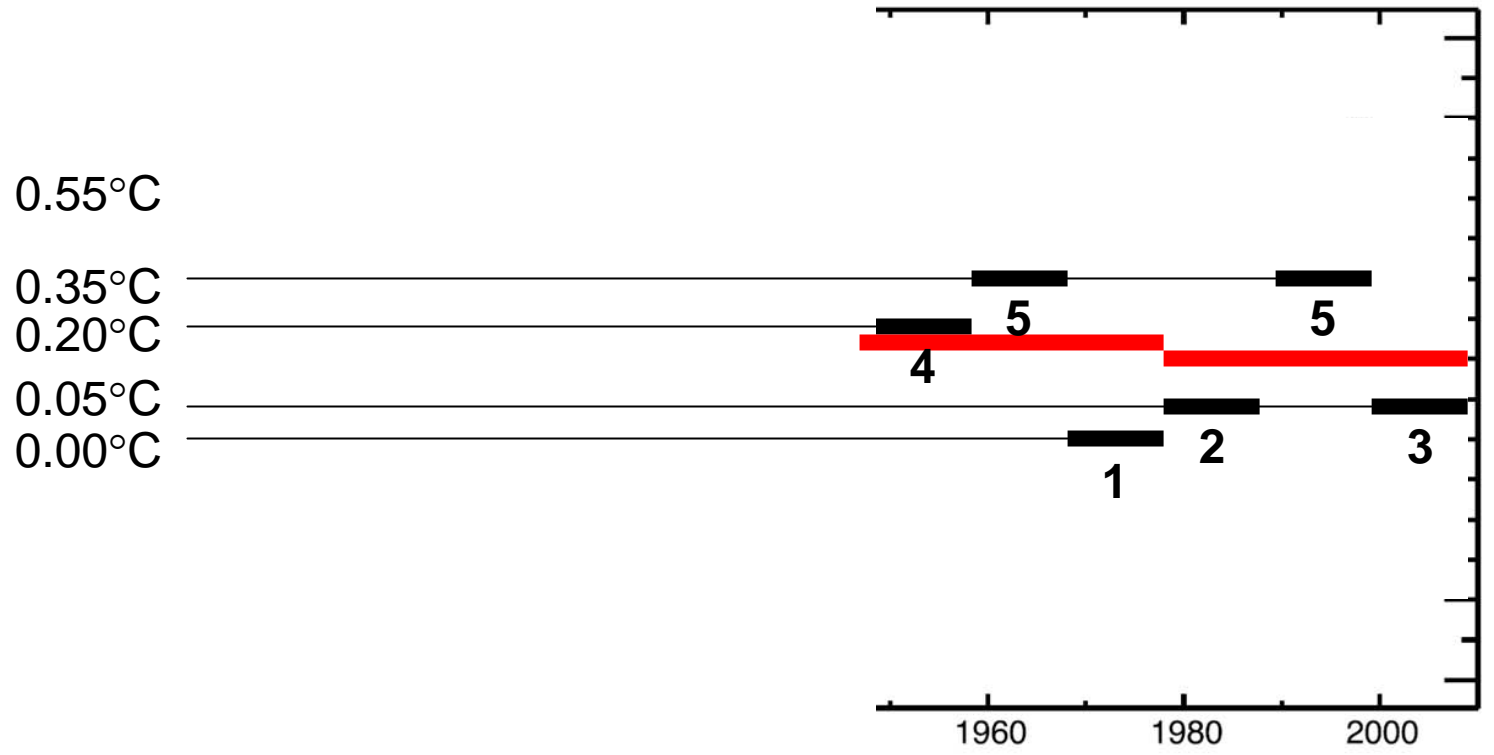


Calculate the increase from the first three decades to the last three decades.

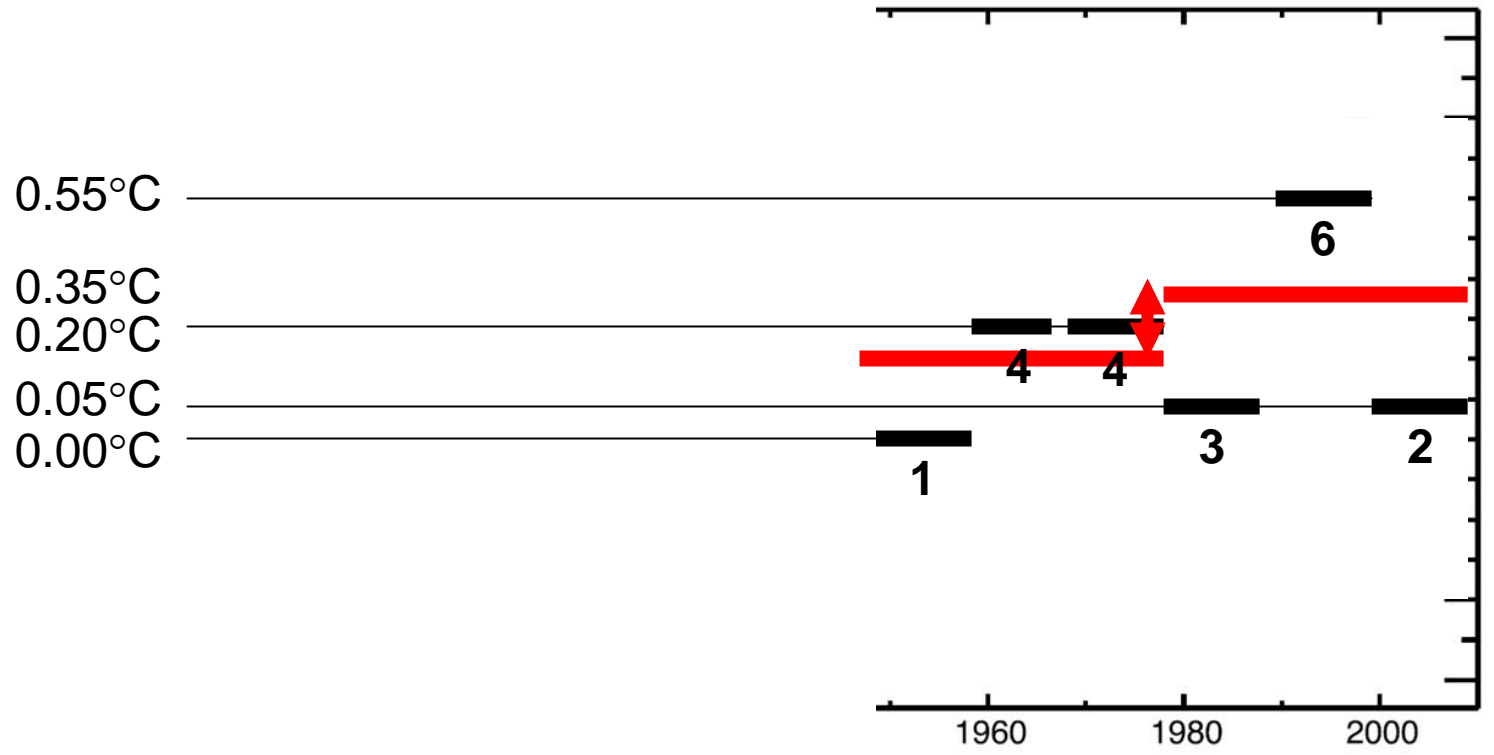


What is the probability that an increase as large as the observed increase could have occurred in a random sequence of decadal temperature values?

Random sequence 1



Random sequence 2



Monte Carlo Method

- Create 100 random sequences
- What fraction of sequences have a temperature increase smaller than the observed temperature increase?
- If 95% or more sequences have a smaller temperature increase, reject null hypothesis (observed increase is only random)
- Instead, observed increase is systematic