





20th-Century Temperatures

- Black lines show obs, yellow lines show each model, red line shows model mean T_{sfc}
- With all forcings, models capture much of historical record
- Bottom panel: models do not include greenhouse emissions



Each "storyline" used to generate 10 different scenarios of population, technological & economic development

- A1: Globalized, with very rapid economic growth, low population growth, rapid introduction of more efficient technologies
- A2: very heterogeneous world, with selfreliance and preservation of local identities. Fertility patterns across regions converge very slowly, resulting in high population growth. Economic development is regionally oriented and per capita economic growth & technology more fragmented, slower than other storylines.
- B1: convergent world with the same low population growth as in A1, but with rapid changes in economic structures toward a service and information economy, reductions in material intensity, introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, without additional climate initiatives.
- B2: local solutions to economic, social, and environmental sustainability. Moderate population growth, intermediate levels of economic development, and less rapid and more diverse technological change than in B1 and A1.





































Climate change, CO₂, and energy will likely be dominant themes in human history for centuries, much as religious wars, feudalism, colonialism, and industrialization in the previous millenium

Climate Skeptics

- Observed warming in the past is caused by something else
 - Natural cycles
 - (e.g., recovery from Little Ice Age)
 - Changes in the sun
 - Volcanos
 - Ftc
- · Climate system is too complicated to be predicted, and climate models are too simplistic to represent real physics
- "Conspiracy theories"

Responding to Skeptics

- Observed warming not caused by humans:
 - There hasn't been much warming yet, because CO₂ hasn't increased very much (about 30%)
 - Does that mean that there won't be warming when CO_2 increases by 300%?
- Models are insufficiently complicated:
 - Predictions of warming don't require complicated models, just simple physics
 - Predicting that climate will not change if we double or triple CO2 requires some kind of huge offsetting forcing ("follow the energy")
 - Complicated models don't show any such thing
 - Observations favor the simple solution