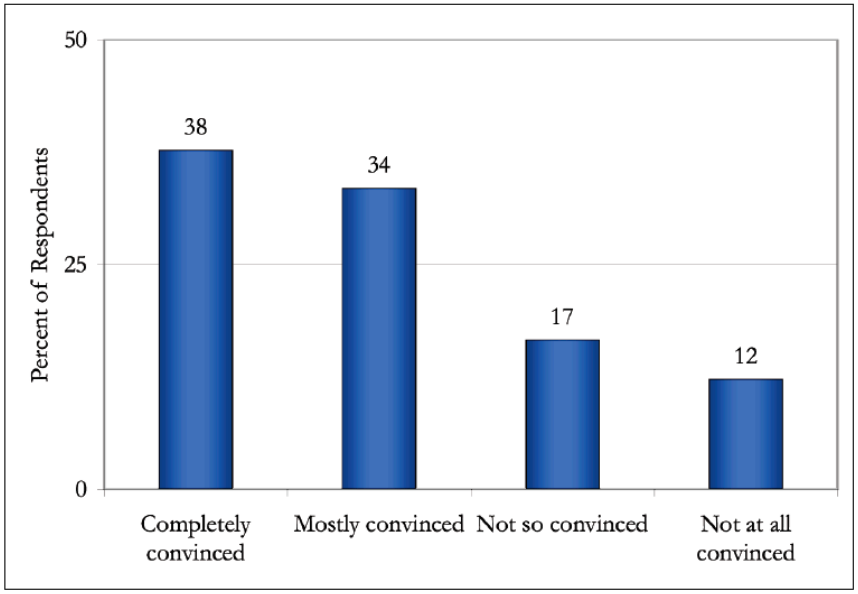
PHY392S
Physics of Climate

Lecture 22

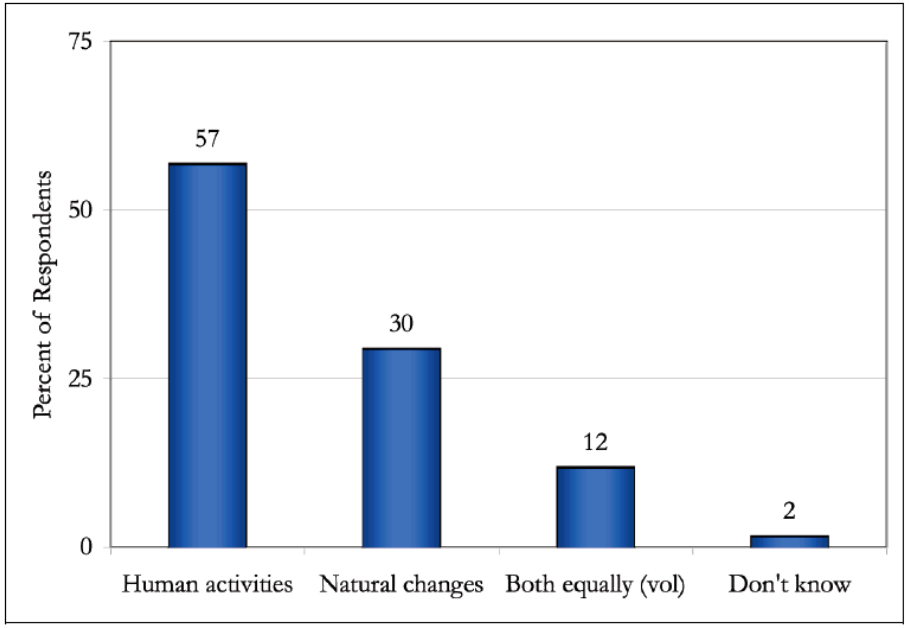
Survey on "American opinions on global warming" by Dr. A. Leiserowitz (Yale)

"How convinced are you that global warming is happening -- would you say you are -- completely convinced, mostly convinced, not so convinced, or not at all convinced?"



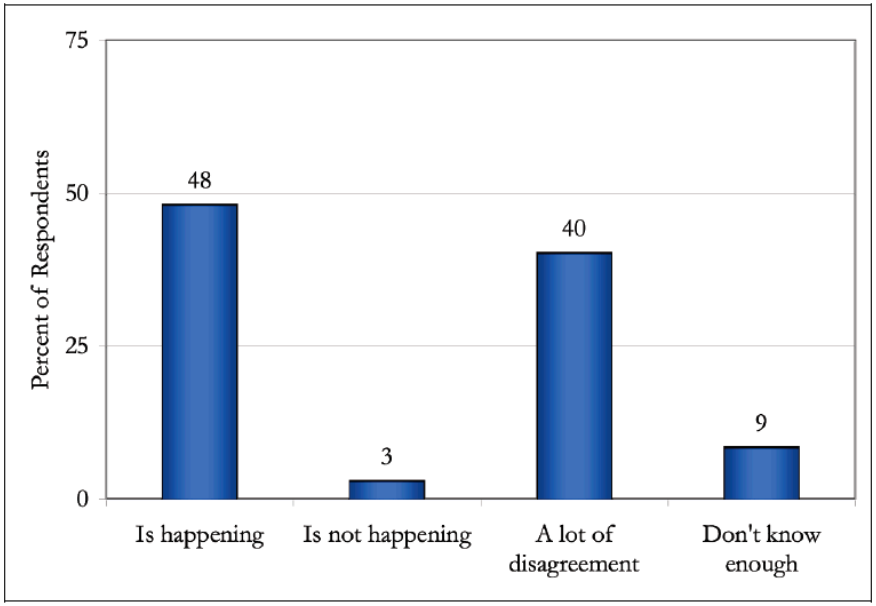
Survey on "American opinions on global warming" by Dr. A. Leiserowitz (Yale)

"If global warming is happening, do you think it is -- caused mostly by human activities, (or) caused mostly by natural changes in the environment?"



Survey on "American opinions on global warming" by Dr. A. Leiserowitz (Yale)

"Which comes closer to your own view -- most scientists think global warming is happening, (or) most scientists think global warming is not happening, or there is a lot of disagreement among scientists about whether or not global warming is happening, or do you not know enough to say?"



Observed Changes in the Climate System

Is the Earth's climate changing? Yes.

Based upon observations of:

- temperature (atmosphere and ocean)
- precipitation and atmospheric moisture
- snow cover, glaciers, extent of land and sea ice
- sea level
- patterns in atmospheric and oceanic circulation
- extreme weather and climate events
- overall features of the climate variability

Causes of Climate Change

- Increasing atmospheric concentrations of greenhouse gases
- Increasing atmospheric concentrations of aerosols (microscopic airborne particles or droplets)
- Land surface properties
- Variations in solar activity

Human Influence on Climate Change - 1

The attribution of climate change to anthropogenic causes involves statistical analysis and the careful assessment of multiple lines of evidence to demonstrate, within a pre-specified margin of error, that the observed changes are:

- unlikely to be due entirely to internal variability;
- consistent with the estimated responses to the given combination of anthropogenic and natural forcing; and
- not consistent with alternative, physically plausible explanations of recent climate change that exclude important elements of the given combination of forcings.

Human Influence on Climate Change - 2

- It is likely that increases in greenhouse gas concentrations alone would have caused more warming than observed because volcanic and anthropogenic aerosols have offset some warming that would otherwise have taken place.

- The observed widespread warming of the atmosphere and ocean, together with ice mass loss, support the conclusion that it is extremely unlikely that global climate change of the past fifty years can be explained without external forcing, and very likely that it is not due to known natural causes alone.

- Warming of the climate system has been detected in changes of surface and atmospheric temperatures, temperatures in the upper several hundred metres of the ocean and in contributions to sea level rise.

Human Influence on Climate Change - 3

- Attribution studies have established anthropogenic contributions to all of these changes. The observed pattern of tropospheric warming and stratospheric cooling is very likely due to the combined influences of greenhouse gas increases and stratospheric ozone depletion.

- It is likely that there has been significant anthropogenic warming over the past 50 years averaged over each continent except Antarctica. The observed patterns of warming, including greater warming over land than over the ocean, and their changes over time, are only simulated by models that include anthropogenic forcing. The ability of coupled climate models to simulate the observed temperature evolution on each of six continents provides stronger evidence of human influence on climate than was available in the TAR.

Remaining Uncertainties

- Difficulties remain in reliably simulating and attributing observed temperature changes at smaller scales.
- On these scales, natural climate variability is relatively larger making it harder to distinguish changes expected due to external forcings.
- Anthropogenic forcing is likely to have contributed to changes in wind patterns, affecting extra-tropical storm tracks and temperature patterns in both hemispheres. However, the observed changes in the Northern Hemisphere circulation are larger than simulated in response to 20th century forcing change.
- Uncertainty in the reconstructions of solar and volcanic forcing which are based on proxy or limited observational data for all but the last two decades.
- Cloud feedbacks remain the largest source of uncertainty.