

Climate Skepticism: The Top 10

What are some of the reasons why "climate skeptics" dispute the evidence that human activities such as industrial emissions of greenhouse gases and deforestation are bringing potentially dangerous changes to the Earth's climate?

As the Intergovernmental Panel on Climate Change (IPCC) finalises its landmark report for 2007, we look at 10 of the arguments most often made against the IPCC consensus, and some of the counter-arguments made by scientists who agree with the IPCC.

1. EVIDENCE THAT THE EARTH'S TEMPERATURE IS GETTING WARMER IS UNCLEAR

Skeptic

Instruments show there has been some warming of the Earth's surface since 1979, but the actual value is subject to large errors. Most long-term data comes from surface weather stations. Many of these are in urban centres which have expanded in both size and energy use. When these stations observe a temperature rise, they are simply measuring the "urban heat island effect". In addition, coverage is patchy, with some regions of the world almost devoid of instruments. Data going back further than a century or two is derived from "proxy" indicators such as tree-rings and stalactites which, again, are subject to large errors.

Counter

Warming is unequivocal. Weather stations, ocean measurements, decreases in snow cover, reductions in Arctic sea ice, longer growing seasons, balloon measurements, boreholes and satellites all show results consistent with the surface record of warming. The urban heat island effect is real but small; and it has been studied and corrected for. Analyses by Nasa for example use only rural stations to calculate trends. Recently, work has shown that if you analyse long-term global temperature rise for windy days and calm days separately, there is no difference. If the urban heat island effect were large, you would expect to see a bigger trend for calm days when more of the heat stays in the city. Furthermore, the pattern of warming globally doesn't resemble the pattern of urbanisation, with the greatest warming seen in the Arctic and northern high latitudes. Globally, there is a warming trend of about 0.8C since 1900, more than half of which has occurred since 1979.

2. IF THE AVERAGE TEMPERATURE WAS RISING, IT HAS NOW STOPPED

Skeptic

Since 1998 - almost a decade - the record, as determined by observations from satellites and balloon radiosondes, shows no warming.

Counter

1998 was an exceptionally warm year because of the strong El Nino event. Variability from year to year is expected, and picking a specific warm year to start an analysis is "cherry-picking"; if you picked 1997 or 1999 you would see a sharper rise. Even so, the linear trends since 1998 are still positive.

3. THE EARTH HAS BEEN WARMER IN THE RECENT PAST**Skeptic**

The beginning of the last Millennium saw a "Mediaeval Warm Period" when temperatures, certainly in Europe, were higher than they are now. Grapes grew in northern England. Ice-bound mountain passes opened in the Alps. The Arctic was warmer in the 1930s than it is today.

Counter

There have been many periods in Earth history that were warmer than today - if not the MWP, then maybe the last interglacial (125,000 years ago) or the Pliocene (three million years ago). Whether those variations were caused by solar forcing, the Earth's orbital wobbles or continental configurations, none of those causes apply today. Evidence for a Mediaeval Warm Period outside Europe is patchy at best, and is often not contemporary with the warmth in Europe. As the US National Oceanographic and Atmospheric Administration (Noaa) puts it: "The idea of a global or hemispheric Mediaeval Warm Period that was warmer than today has turned out to be incorrect". Additionally, although the Arctic was warmer in the 1930s than in the following few decades, it is now warmer still.

4. COMPUTER MODELS ARE NOT RELIABLE**Skeptic**

Computer models are the main way of forecasting future climate change. But despite decades of development they are unable to model all the processes involved; for example, the influence of clouds, the distribution of water vapour, the impact of warm seawater on ice-shelves and the response of plants to changes in water supply. Climate models

Counter

Models are simply ways to quantify understanding of climate. They will never be perfect and they will never be able to forecast the future exactly. However, models are tested and validated against all sorts of data. Over the last 20 years they have become able to simulate more physical, chemical and biological processes, and work on smaller spatial scales. The 2007 IPCC report produced

follow the old maxim of "garbage in, garbage out".

regional climate projections in detail that would have been impossible in its 2001 assessment. All of the robust results from modelling have both theoretical and observational support.

5. THE ATMOSPHERE IS NOT BEHAVING AS MODELS WOULD PREDICT

Skeptic

Computer models predict that the lower levels of the atmosphere, the troposphere, should be warming faster than the Earth's surface. Measurements show the opposite. So either this is another failing of the models, or one set of measurements is flawed, or there are holes in our understanding of the science.

Counter

Lower levels of the troposphere are warming; but measuring the exact rate has been an uncertain process, particularly in the satellite era (since 1979). Readings from different satellites need to be tied together, and each has its own problems with orbital decay and sensor drift. Two separate analyses show consistent warming, one faster than the surface and one slightly less. Within the uncertainties of the data, there is no discrepancy that needs to be dealt with. Information from balloons has its own problems but the IPCC concluded this year: "For the period since 1958, overall global and tropical tropospheric warming estimated from radiosondes has slightly exceeded surface warming".

6. CLIMATE IS MAINLY INFLUENCED BY THE SUN

Skeptic

Earth history shows climate has regularly responded to cyclical changes in the Sun's energy output. Any warming we see can be attributed mainly to variations in the Sun's magnetic field and solar wind.

Counter

Solar variations do affect climate, but they are not the only factor. As there has been no positive trend in any solar index since the 1960s (and possibly a small negative trend), solar forcing cannot be responsible for the recent temperature trends. The difference between the solar minimum and solar maximum over the 11-year solar cycle is 10 times smaller than the effect of greenhouse gases over the same interval.

7. A CARBON DIOXIDE RISE HAS ALWAYS COME AFTER A TEMPERATURE INCREASE NOT BEFORE

Skeptic

Ice-cores dating back nearly one million

Counter

This is largely true, but largely irrelevant.

years show a pattern of temperature and CO₂ rise at roughly 100,000-year intervals. But the CO₂ rise has always come after the temperature rise, not before, presumably as warmer temperatures have liberated the gas from oceans.

Ancient ice-cores do show CO₂ rising after temperature by a few hundred years - a timescale associated with the ocean response to atmospheric changes mainly driven by wobbles in the Earth's orbit. However, the situation today is dramatically different. The extra CO₂ in the atmosphere (35% increase over pre-industrial levels) is from human emissions. Levels are higher than have been seen in 650,000 years of ice-core records, and are possibly higher than any time since three million years ago.

8. LONG-TERM DATA ON HURRICANES AND ARCTIC ICE IS TOO POOR TO ASSESS TRENDS

Skeptic

Before the era of satellite observation began in the 1970s, measurements were ad-hoc and haphazard. Hurricanes would be reported only if they hit land or shipping. Arctic ice extent was measured only during expeditions. The satellite record for these phenomena is too short to justify claims that hurricanes are becoming stronger or more frequent, or that there is anything exceptional about the apparent shrinkage in Arctic ice.

Counter

The Arctic Climate Impact Assessment project notes that systematic collection of data in parts of the Arctic began in the late 18th Century. The US National Hurricane Center notes that "organised reconnaissance" for Atlantic storms began in 1944. So although historical data is not as complete as one might like, conclusions can be drawn. And the IPCC does not claim that global warming will make hurricanes more frequent - its 2007 report says that if anything, they are likely to become less frequent, but more intense.

9. WATER VAPOUR IS THE MAJOR GREENHOUSE GAS; CO₂ IS RELATIVELY UNIMPORTANT

Skeptic

The natural greenhouse effect keeps the Earth's surface about 33C warmer than it would otherwise be. Water vapour is the most important greenhouse gas, accounting for about 98% of all warming. So changes in carbon dioxide or methane concentrations would have a relatively small impact. Water vapour concentrations are rising, but this does not necessarily increase warming - it

Counter

Water vapour is essentially in balance with the planet's temperature on annual timescales and longer, whereas trace greenhouse gases such as CO₂ stay in the atmosphere on a timescale of decades to centuries. The statement that water vapour is "98% of the greenhouse effect" is simply false. In fact, it does about 50% of the work; clouds add another 25%, with CO₂ and the other greenhouse gases contributing the remaining

depends how the water vapour is distributed.

quarter. Water vapour concentrations are increasing in response to rising temperatures, and there is evidence that this is adding to warming, for example in Europe. The fact that water vapour is a feedback is included in all climate models.

10. PROBLEMS SUCH AS HIV/AIDS AND POVERTY ARE MORE PRESSING THAN CLIMATE CHANGE

Skeptic

The Kyoto Protocol will not reduce emissions of greenhouse gases noticeably. The targets were too low, applied only to certain countries, and have been rendered meaningless by loopholes. Many governments that enthuse about the treaty are not going to meet the reduction targets that they signed up to. Even if it is real, man-made climate change is just one problem among many facing the world's rich and poor alike. Governments and societies should respond proportionately, not pretend that climate is a special case. And some economists believe that a warmer climate would, on balance, improve lives.

Counter

Arguments over the Kyoto Protocol are outside the realms of science, although it certainly will not reduce greenhouse gas emissions as far or as fast as the IPCC indicates is necessary. The latest IPCC Working Group 2 report suggest that the impact of man-made climate change will on balance be deleterious, particular to the poorer countries of the tropics, although colder regions may see benefits such as increased crop yields. Investment in energy efficiency, new energy technologies and renewables are likely to benefit the developing world.