The Climate Policy Dilemma. We want certainty, but science is about doubt

Classical science is all about hard facts. The speed of sound is 340.29 m/s; the formula for water is H2O; the Latin name for a tiger is Panthera tigris; water circulates through the environment via the hydrological cycle, and carbon circulates via the carbon cycle. Classical science is optimistic and has a confidence that with technological progress we will eventually come to understand the truth about nature. There is predictability in ecological cycles; they seem to rotate endlessly, just as do the seasons.

Modern science, is, however very different. Our technology and computers enable us to study the very small, the very large, and the very complex, and all we see is uncertainty. Uncertainty in time, position and just about everything permeates the study of the very small: quantum mechanics. Even our understanding of the fundamental building blocks of matter will have to be re-thought if the Large Hadron Collider fails to detect the Higgs Boson. In astronomy, galaxies seem to be too old, to have formed too soon after the Big Bang. Does "Dark Matter" exist, or are our theories of gravity wrong? String theory, which elegantly ties together the study of the very small and the very large into a unified theory of everything, is under fire because it does not predict anything, and cannot be tested.

Uncertainty also confuses the study of complex systems such as the earth's climate. It is currently impossible to reduce each tiny component of our climate's dynamic system to simple formulae and compute what will happen. The theories and mathematical tools required to better understand such systems are still being developed, and data upon which to use these tools are lacking.

The uncertain science of complex systems

No scientist can say with 100% certainty that current climate change is due to man-made carbon emissions, although most would say that the data strongly points to this conclusion, and that there is no feasible alternative explanation. This, however, is not good enough for politicians, nor for the general public, who want certainties. How many degrees of warming are safe? How much carbon can we safely emit? How much time do we have? Are you sure climate change is man-made?

The climate report used as the basis for the Copenhagen discussions was deliberately written for the layman, and it attempted to provide the hard figures needed by the negotiators, in spite of any reservations trained scientists might have about these figures. The report was based on ".... the most credible and significant peer-reviewed literature available at the time of publication"

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However, in the face of strong evidence, there is still doubt. A study published on Dec 18, 2009, showed that only 36% of people surveyed in the US believed that climate change is man-made.

The unpredictable behaviour of carbon sinks

Climatologists can only supply projections based on observations and measurements made in the past, with computer models which use these data to describe both past and future. Unfortunately there are many gaps in our basic understanding of how the climatic system works. Take for example the size and behaviour of Carbon Sinks (anything that absorbs more carbon that it releases). Plants on both land and sea absorb carbon dioxide through photosynthesis. Carbon dioxide also dissolves into the oceans. Between them, these sinks (plants and the oceans) absorb about 60% of man made CO2, leaving 40% to accumulate in the atmosphere. But how will they behave in the future?

Global warming will, for a while, increase photosynthesis, and trees will absorb more carbon. Warming will also cause forests to spread into polar areas currently covered by tundra and ice. The dark colour of their leaves will absorb more heat -white snow and ice reflect both light and heat-, resulting in further warming, and hence for a time, more carbon absorption, which may tend to slow the warming process. However decreased rainfall in sub-tropical areas will reduce the ability of forests in these regions to absorb carbon. Many scientists predict that the forests of the world will eventually become carbon sources rather than carbon sinks. If it comes to this point, global warming would become a runaway process that feeds on itself.

There are many confounding factors. For example, in Antarctica there is evidence that melting icebergs may actually help to trap carbon. The iron particles they release fertilise blooms of algae which absorb CO2. When the algae die, some of them drift to the ocean floor, locking up the carbon as sediment. Other data from Antarctica tell a different story. Depletion of the ozone layer, caused by man-made CFCs (chlorofluorocarbons -previously used as spray propellants, now banned) caused a shift in local wind patterns. Ironically this has shielded the Antarctic from the effects of global warming over the past 30 years. However, the same effect seems to have made the ocean less effective in absorbing CO2, because the winds blowing over the surface have caused CO2-rich waters to be brought up from the deep.

We can see from this that the behaviour of Carbon Sinks varies according to the interactions of many factors including the amount of CO2 in the atmosphere, changes in ocean currents, activities of plant and soil organisms, and, most importantly, the way these interactions change in the course of climate change. In some years, 80% of the emitted carbon is absorbed, in other years, none.

Carbon sinks have a limit

There are conflicting opinions on how these essential carbon sinks are behaving overall. Dr Corinne Le Quéré and her international colleagues suggest that they are absorbing less carbon dioxide than before and that the fraction of CO2 emissions which remains in the atmosphere has increased from 40% to 45% over the past 50 years.

However, Dr Wolfgang Knorr, using similar data, but making slightly different assumptions, concludes that the absorbed fraction of carbon dioxide has stayed approximately constant since 1850, despite emissions of CO2 having risen from about 2 billion tons a year in 1850 to 35 billion tons a year now. That is to say, by Dr Knorr's calculations the sinks continue to absorb carbon in a proportionate way, though since more of it is emitted, more accumulates in the atmosphere. This is not to say that this state of affairs will continue indefinitely. A sink, like a bucket, works fine until it is full to the brim and starts to spill over.

No time for assumptions

In most areas of research these differences of opinion would pass unnoticed to all but specialists in the field, and in time further research would resolve the matter. But in studies related to global warming, policy makers need definite answers here and now. If the carbon sinks fail, atmospheric carbon dioxide will accumulate more rapidly and global warming will be accelerated.

Time is a luxury we may not have, and so politicians are being forced to make decisions based on uncertainties. This goes against the grain. Why spend billions of dollars to prevent something which may never happen? For those who believe that global warming is man made, the Copenhagen agreement has been disappointing. Countries agreed only in principle to limit global warming to two degrees Centigrade -as if the world's temperature could be controlled like a thermostat! There are no binding commitments for cuts in carbon emissions.

Those who deny man made warming, point triumphantly at the uncertainties. Those who believe that warming is a reality, writhe in frustration. Unfortunately there is no "QED" (Quod erat demonstrandum) at the end of this on-going, critical experiment.

There should be no dilemmas for policy makers. Although the science is complex and uncertain, the situation is quite simple. This is a once only global event, no turning back the clock. We dare not gamble that the denialists are right, and that the majority of climatologists are wrong. If the countries of the world work together, there may be chance of avoiding the worst. Cost? A few billions of dollars. More money was lost in the recent banking crisis. The problem is not science, but the more difficult challenge of having the necessary political will.

by Christine Betterton Jones - BSc. (Zoology), PhD (Parasitology)

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