ENQUIRY INTO THE SCIENCE OF CLIMATE CHANGE

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Abstract

Issues associated with enquiries into science are addressed. Issues include the need to establish an analytical framework before information is collected that takes account of the potential for multiple causes of global warming, and to separately address the preferred means of remediation.

Introduction

During the 2010 election campaign the 'in limbo' Australian Government announced a policy to conduct a commission to enquire into the science of climate change (a Commission of Enquiry). This received no public attention apart from two newspaper articles identifying the establishment of a Climate Change Commission to educate the public on climate change. This Climate Change Commission was to comprise five 'experts' on climate change.

The salaries of the suggested experts were identified as being in the mid range for highest level in public service salaries. The change in focus from enquiring into science to promoting existing views, and the concern for salaries, indicates that the policy had been hijacked by senior bureaucrats.

The new Department of Climate Change had mainly been staffed by economists employed to develop a carbon Emissions Trading Scheme (ETS). Compared with other Australian Government Departments a large number of positions were at very senior levels. The abandonment of an Australian ETS by both major parties resulted in many senior public servants having no foreseeable role. The lack of an operational Government during the election period was evidently seen as providing an opportunity to establish an entrenched position that benefited them. Promotion of CO2 as being the cause of climate change boosted their chances of being able to implement the planned ETS.

The main feature of the 2010 election was the lack of clear policies to address climate change when climate change was THE prime concern of voters. The Labour Party dismissed introducing an ETS, in the initial part of the election campaign at least, when the introduction of an ETS was the prime plank in their platform for the 2007 election. During the period between the 2007 and 2010 elections the Liberal Party changed positions from support for an ETS to NO ETS or carbon tax. In this period The Greens changed from supporting an ETS to advocating a carbon tax, at least as an interim measure prior to the introduction of an ETS.

The change in the position of the Labour Party followed the 'failure' of the United Nations sponsored Copenhagen meeting on climate change. The change in the position of the Liberal

Party occurred during negotiations on the ETS with the Labour Party and was associated with a change in party leader.

The suggested failure of the Copenhagen meeting arose because some countries identified the science of climate change as being flawed, particularly the Arabic speaking countries. Atmospheric carbon had been identified as being a symptom of climate change with the cause being identified as desertification due mainly to agriculture.

Ambient temperatures increase with desertification but the processes causing the change are largely driven by water. Two recent developments identify key processes. Plants obtain water directly from the atmosphere through a process termed indensation. The amount of water obtained by plants through indensation has yet to be determined but it is appreciable compared to rainfall. It will vary considerably depending on climate. Some plants, such as cacti, can grow using water obtained through indensation alone.

The second important process relates to the development of vegetation. Vegetation was previously thought to develop to a level determined solely by the physical environment. However, with processes such as indensation and nitrogen fixation, the greater the amount of vegetation the greater the amount of resources available for the vegetation to develop. There are positive feedbacks whereby the development of vegetation promotes further development. This situation is aided by the occurrence of interactions whereby the effect of one factor depends on the levels of other factors.

The positive feedbacks can result in lush vegetation where some factors are particularly limiting. The Brazilian rainforests, for example, mainly occur on nutrient poor substrates, but the development and accumulation of nutrients by vegetation over time has resulted in the development of abundant vegetation.

Removal of the rainforest vegetation results in gross loss of nutrients from the soil, and the replacement grassland has limited ability to replace them, particularly when grazed. Clearing and grazing result in an abrupt decline in the functionality of the system that greatly degrades its ability to acquire and retain nutrients and to obtain water through indensation.

The reduction in water accession through indensation feeds back into the hydrologic cycle through reduced transpiration of water by plants. The decreased input of water into the atmosphere across a region decreases the rainfall. Ongoing vegetation decline is promoted by the reduced indensation by plants reducing their transpiration reducing the rainfall which reduces the plants etc.

The above example evidences that the positive feedbacks that promote the development of vegetation can switch to promote its degradation. The vegetative system becomes non self-sustaining and eventually degrades into desert. While ongoing degradation is promoted by the continuance of land uses such as farming and grazing a point can be reached where the system continues to degrade without any such land use impacts.

Desertification produced by agriculture has occurred on all inhabited continents, and has been occurring for several thousands of years on all except Australia. Ancient Egypt is likely the first recorded example but the decline of many major civilizations can be linked to the decline of their agriculture. Attempts to maintain agricultural production with the onset of desertification exacerbate the situation and greatly accelerate the decline.

The social impacts of desertification are currently best evidenced in parts of northern Africa. Famine, wars, and the displacement of people are central. Early stages are evidenced in the Murray Darling Basin of Australia (MDBC). Farmers are becoming bankrupt and marginal

through drought, and stringent restrictions are being placed on irrigation. Attempts to address the irrigation issue by increasing water use efficiencies have been unsuccessful due to the continuous decline in water availably.

The available water resource in the MDBC is declining due to a large reduction in water accession through indensation. This situation has arisen through land management practices, and will exacerbate while the current practices continue.

The Logic of Science

The popularist view of science is that something is proven. The reality is that it is rare for anything to be proven as scientific tests serve only to identify if things are consistent with current knowledge.

The view that proof prevails appears to derive from mathematics where lessons involve the proof of theroms. In essence these demonstrate that a particular outcome is an inevitable consequence of certain assumptions. It represents a logic applied to an extremely simple artificial system.

Given the complexity of natural systems there can be no absolute proof or truth. Natural systems are characterised by interactions where interactions can produce a great diversity of outcomes even given simple constraints. Moreover, the logical situation arises that, even if there is a truth, there is no way of telling that it has been found. Tests in science serve only to examine how well new observations accord with current knowledge[1].

Where a test is failed the knowledge is altered to account for the observations. That is, the observations represent reality, and knowledge or theory are abstractions that have no value other than in the extent to which they reflect reality.

The progression in science has mainly been towards examining parts of systems as this facilitates the production of results. Simple systems are easy to understand and manipulate. However, the response of part of a system taken in isolation need be nothing like its response when interacting with other parts in a larger system. Conclusions based on examination of simple systems and parts of systems taken in isolation can be, and usually are, highly unreliable when applied to natural systems.

This poses a dilemma for disciplines such as ecology that involve the examination of the system as a whole. The issue is how can a proposition be tested? The best that is usually done is to test part of the system, and this is identified by Popper as being the best that can be done. However, the usual approach is to interpret results in relation to existing theory where this involves shoehorning them to fit an existing paradigm. The research promotes the development of mutually reinforcing views rather than testing their validity.

This situation arose with the renewed interest in dryland salinity in Australia, and has been central to the approach in addressing climate change. A decision was made by a small number of climate scientists that anthropogenic climate change was being caused by the increase in atmospheric CO2. The situation was, and still is, presented as being obvious. The earth is warming, the warming is caused through the greenhouse effect, CO2 is a greenhouse gas, and CO2 has been increasing appreciably in the atmosphere for around 50 years. A causal effect

[1] Current knowledge represents that addressed in the test, and is usually the prevailing knowledge by way of the generally accepted position. It is not necessarily the best available knowledge as past (prior) knowledge is increasingly being neglected through attempts to promote a particular position.

was ascribed to CO2 in climate change because of a simple correlation and a plausible mechanism.

The suggested effect of CO2 causing climate change has not and cannot be reliably tested. The suggested test that 'proves' the increase in atmospheric CO2 has caused climate change relies solely on the application of numerical models where these models serve only to represent the assumptions built into them. They are descriptive but use numbers rather than words to represent the system. None realistically address the impacts of land use on climate if only because they don't address changes in vegetation.

It appears that the proponents of results from models consider that a numerical representation is in some way scientifically superior to a verbal description when it need not be. The issues center on the reliability of the applicability of the physics and assumptions. While some the physics has some testing the assumptions do not. Indeed, the only test available to date is the reliability of the models in predicting changes, where they have failed. Changes are occurring much more rapidly than predicted. The failure of a test does not negate everything associated with the climate modeling but does identify a need for reconsideration.

The identification of CO2 as being the cause of climate change has been promoted by many with little or no knowledge of climate. Moreover, from my position all have little knowledge of land use impacts on physical processes. The promotion has arisen through control of funding for research. Climate change has been assigned the highest priority thus to obtain funds research has had to address climate change. To be accepted the research proposal had to accept the proposition that climate change is due to increases in greenhouse gasses, particularly CO2. Results of the research were therefore mutually reinforcing and supported the proposition that CO2 is the prime cause of climate change. The development of research reflects the development of a mutual admiration society with no one questioning the basic premise.

Those that dared question the role of CO2 in climate change were immediately labeled skeptics, where this term was used pejoratively. Research proposals by skeptics were not funded, and through peer review their papers were usually rejected for publication.

The deluge of scientific papers supporting the role of CO2 in climate change resulted in an establishment position even though this is contrary to basic requirements if science is to progress. The British Academy of Science lambasted skeptics, where the presentation of an Academy position was prompted by newspapers presenting the views of those identified as skeptics. The situation is illustrated by a UN sponsored climate change conference held in Australia in 2010 where a large banner displayed a slogan to the effect, while 2,000 scientists agree on the cause of climate change I need a second opinion. The proponents of CO2 being the cause of climate change are right, just ask them, but don't dare question.

The most recent reaction by a science academy is by the Australian Academy of Science. This Academy had previously given support to an Australian Government report on dryland salinity that promoted the official view that the dryland salinity was caused by rising groundwater. The report denigrated those saying it was not despite the existance of results that clearly negated the proposition. Extensive evidence was provided that dryland salinity arises through soil degradation.

The Australian Academy of Science has now published a report that purports to demonstrate that climate change is caused by greenhouse gasses, particularly CO2. The dilemma is that while atmospheric water produces more than 60% of the greenhouse effect, and while

atmospheric water vapour has been increasing at around 1 to 2% a decade, the author and his supporters have not evaluated its effect.

The comment on this issue to a newspaper by the author identified on the report was that people are being concerned with minor effects in water, and that while clouds can have an effect they are too complex to be addressed. They have gone for a simple secondary or tertiary effect as being the prime cause because they cannot realistically address the complex main effect.

The basic premise in presenting the report is that the processes associated with climate change are complex, hence the need to clearly and simply explain them to the Australian public. The proponents of the report assume they understand the said complexities when their modeling identifies the reverse.

Testing

Testing is only valid for the circumstances under which it is conducted. With natural systems all circumstances cannot be tested hence there is rarely if ever a definitive test or combination of tests. The best that can be done is to keep searching for situations that appear to conflict with existing paradigms and theory (exceptions).

The identification of exceptions requires good awareness of existing knowledge, and with ecology this awareness must encompass several disciplines. This spread across disciplines necessitates the development of a framework whereby the disparate information can be related. It is intrinsically a systems approach that to be effective must address processes.

The need to address processes arises because the enormous number of situations that occur cannot realistically be comprehended by remembering all of the detail. The information must be synthesised to produce a summary that is applicable to all situations, where such a synthesis is provided by processes. This systems approach is best evidenced by physics.

The above identifies how knowledge develops, but there is often still a need to make some judgment about the applicability of conclusions about the functioning of complex systems. The most effective means with biological systems involves the ability to reverse change. For example, if an increase in atmospheric CO2 is considered causal in climate change the lowering of CO2 should reverse the symptomatic changes.

This approach was used in identifying smoking as being causal with heart and lung disease. Many factors can produce heart and lung disease, but by making observations where the only factor being changed was smoking the role of smoking was clearly identified. Stop smoking and the condition improves. Restart smoking and the condition degrades.

Lowering the level of atmospheric CO2 would take considerable time. The issue then arises as to whether observed changes are due to the change in CO2 or to changes in other factors that would inevitably occur over an extended period. The ability to reverse an effect is not a failsafe means of identifying cause, but is usually the best bet.

While the suggested causal effect of CO2 in climate change cannot currently be reversed the changes associated with desertification have been. While reforestation in northern Central China likely represents the best example numerous examples exist around the world. However, none are ‘scientifically’ documented as the outcomes were not expected and many occurred by accident. The depopulation of areas in Africa due to AIDS, and the associated

predation of livestock by native animals, has resulted in the greening and watering of localised areas.

Certainty

Humans have great difficulty in coping with uncertainty and so seek certainty. The difficulty is that tests in science identify the level of uncertainty. Complete accordance, or 100% certainty, is not expected due to the number of factors that are unknown as well as errors in measurement and assessment. The public wants to hear that something is 100% certain when scientists are loath to make such statements. For all practical purposes a tag of 100% certainty may apply but for scientific purposes it is unacceptable.

In experiments the level of uncertainty is determined by repeating observations. In natural systems this is often impossible as each situation represents a unique combination of circumstances. It can be known that something can occur without knowing the probability of its occurrence.

A solution in ecology, where each situation examined can be unique, lies in developing knowledge of process. All observations should accord with knowledge of processes. Confidence is increased by examining the extent to which a suggested process accords with observations. Seeing if conclusions derived from Australian woodlands apply to forests in Central Sweden is such a test.

Public Enquiry into Science

Scientific examinations are usually conducted by small groups of scientists without the need to produce a general conclusion. Scientists exchange views and modify their work according to their perception as to what is correct. A consensus is not called for as it is seldom needed and is invariably undesirable in representing a constraint to thought. Committees and consensus are tools for administrators but not for research scientists. Science develops through dissent and depends on the drive and initiative of an individual.

Personal experience with Commissions of Enquiry into environmental land use issues involves being central to first one conducted in Australia and keeping track of a subsequent one conducted along the same lines. Both involved the Australian Department of Defence. The first was the most complex in addressing a conflict between Defence land use and mining proposals in the Shoalwater Bay Training Area (SWBTA) where the situation was opportunistically being used as a test case to demonstrate that mining could be safely conducted in heritage listed lands.

Most of the land in SWBTA is on the Register of the National Estate, and the remainder is World Heritage Listed. Most of the marine area is World Heritage Listed, and the remainder is State Marine Park. These designations applied before the initiation of the Commission of Enquiry apart from the State Marine Park. A large adjoining area of land was also declared as State park.

CSIRO had produced many reports on SWBTA through continuous involvement over an extended period. The Commission of Enquiry sponsored the development of numerous additional specialist reports while other reports were provided by interested parties. Reports by interested parties were generally provided by those using or wishing to use the area in some way, such as the fishing and mining industries, but they included a large encompassing report

by the Australian Bureau of Resource Economics which is part of an Australian Government Department.

All sponsored reports would generally be considered to be scientific but some addressed completely subjective issues such as landscape aesthetics. There was a very large amount of 'scientific' information on which the Commission could base its decision. The dilemma for the Commissioners was not a lack of information but the great abundance of disparate information. The Commissioners had no means of relating information from the diverse reports.

Without a framework for synthesising the information from the disparate reports there was no basis for making a logical decision on any land use issue. Information in the scientific reports did not rule out any options, nor did it identify a preferred option. Any decision was possible.

The final decision of the Commission of Inquiry into SWBTA could readily have been made without its conduct. The Commission served mainly to demonstrate that all issues had been addressed and taken into consideration, although it also served the political purpose of buying time.

The Commission of Enquiry was headed by a legal expert and, of the three Commissioners, only one was a scientist. The prominence assigned to administrative considerations may be considered appropriate where a Government has to make a decision but it has the effect of degrading the consideration of science. The higher priority assigned to administrative rather than scientific issues resulted in every issue that could conceivably be relevant being addressed without there being a means of using the information to draw a logical conclusion. The approach would be counterproductive in attempting to determine the science underpinning climate change.

The issue of how to combine information from disparate scientific studies is not trivial, and there are few successful examples. The issue is meant to be addressed by reports used to evaluate the environmental impact of development proposals but these typically end up focussing on a few key issues. They are used to identify key issues that need attention rather than provide a means of synthesising information.

The best Australian example of integration of disparate scientific information to address land use issues is the Land Systems approach developed by CSIRO. The success of this approach arises through all data being collected and referenced to a common base in a Land Systems map. The reference Land Systems map is developed before the participating botanist, soil scientist and geomorphologist jointly collect detailed field data. The reference map provides the framework essential for integration.

An upgraded approach is provided by the Landscape Futures developed by Carl Steinitz (Harvard). It applies basic scientific requirements to land use planning in identifying the issues that need to be addressed and the relationships between them before decisions are made on the acquisition of new information. The identification of interrelationships facilitates the integration and analysis of the disparate information.

The Landscape Futures method identifies all potentially relevant issues and reduces them to manageable proportions. The first subset identifies issues considered to be important by stakeholders, and the second identifies issues requiring new information. This greatly reduces the work involved in acquiring new information compared with the usual situation of collecting new information for all issues that could be potentially be relevant. It makes

complex problems tractable by greatly reducing the number of issues to be addressed as well as identifying the relationships between them.

Another key feature of the Landscape Futures approach is that it incorporates the essential public consultation. Identifying the issues considered important involves input from all stakeholders. In addressing the science of global warming the stakeholders would logically be scientists with relevant specialist knowledge. However, in addressing options for implementing actions to address global warming the public become the key stakeholders. Two separate Landscape Futures analyses would logically be conducted in developing actions to address global warming. The first would address the science and would identify options for remediation. The second would address public opinion as to the desirability of different options.

Conclusion

I have no hesitation in concluding that anthropogenic climate change (global warming) is occurring, and that it primarily arises through desertification caused by agriculture. The conclusions arise from the combination of changes rather than consideration of a single factor such as temperature. Observed changes such as the migration and loss of species, and extremes in weather, are integral to desertification. Increasing crop failures and locust plagues, as currently being experienced in the Murray Darling basin in Australia, are symptoms associated with the decline of Ancient Egypt where they occurred without the burning of fossil fuels. Where associations can be made all observed symptoms accord with global warming being caused by desertification.

The conclusions are reinforced by the relevance of the newly identified mechanisms. The decrease in transpiration due to agriculture is much greater than previously thought because of the large contribution of indensation to transpiration where transpiration is a key component in the earth's energy balance. Any consideration of global warming must comprehensively address the effects of current and potential future changes to vegetation on the earth's energy balance and not restrict the analysis to addressing CO2.

While desertification is identified as being the prime cause of global warming a detailed analysis of the science will find that anthropogenic changes in climate have arisen through multiple causes. While desertification primarily arises through denudation of vegetation humans have subjected the land to a much greater diversity of impacts that can produce changes in climate.

A known independent[2] impact on climate is caused by atmospheric particulate pollution where this results in the formation of droplets too small to fall as rain. As industries and vehicles are the prime source of the particulates this change is greatest in industrialised regions. Measures used to address desertification will not address atmospheric pollution. There will need to be a range of measures to counter the current deleterious changes to climate.

[2] The independence relates to the primary cause. Interactions cause secondary relationships, as with the reduced rainfall decreasing the vegetation.