Climate Change Resource Centre: Science

SCIENCE & RESEARCH

Climate Change Resource Centre

Science Topics

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7.5 Uncertainty in Climate Change Science

Although recent studies have opened the door to a greater understanding of how the climate system operates, there is still much to learn. In predicting the future of climate change, scientists use models. But these models are not perfect and as a result, we cannot perfectly predict the behaviour of clouds, ocean circulation patterns and feedback loops, among other things. However, much has changed since the late 1970s when the first climate models appeared. More powerful computers, access to more sophisticated tools such as satellites, and a much better understanding of the global climate system all give scientists increased confidence that they can predict major trends with more certainty.

But given (a) the potential for major social, economic and environmental impacts of unchecked climate change, (b) the long time frame required to significantly reduce the uncertainty, and (c) the long time frame needed to stabilize climate, how much certainty do policy makers need in order to take action? The precautionary principle and the concept of risk assessment offer contrasting approaches.

It's easier to prevent pollution than to clean up messes such as this oil spill.

The precautionary principle versus risk assessment

In a nutshell the old adage "an ounce of prevention is worth a pound of cure" sums up the precautionary principle. We see, through things like water and soil contamination, that it is easier to prevent environmental damage than to fix it later. [127]

We use knowledge from many sources to solve problems. It would be nice to have perfect information and complete certainty about an environmental problem before starting to design and implement solutions, especially if the solutions may have a large economic cost. However, it is extremely challenging to gain a good understanding of the world around us and how it works, because of the huge number of components and complicated interacting processes. When we introduce new factors, like higher concentrations of greenhouse gases, the impacts of the resulting global warming on climate and weather, on the physical land base, and on society and the economy become highly uncertain. Scientists caution us that this uncertainty can work in two directions – either under-estimating the seriousness of the problem or over-estimating it. In the end, we are faced with the dilemma of having to act before we have complete certainty, because if we wait until certainty exists, the predicted damage from taking no action will have been done.

The precautionary principle states that: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." [128] In other words, even though damage may be unpredictable, uncertainty should not delay action. The United Nations Framework Convention on Climate Change (UNFCCC) acknowledges that uncertainty is no excuse for delaying action. The UNFCC writes in Article 3.3: parties should "take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures..." [129]

We regularly use the precautionary principle in our daily lives. We take out insurance policies against accidents, theft, fire and other potentially costly events, on the basis that the cost of insurance is worth the peace of mind it provides in case such events do occur.

What the precautionary principle doesn't do, is say when and to what extent mitigation or adaptation policies should be implemented. Deciding when and how to protect our climate becomes then, a difficult and challenging task for government leaders and policy-makers. [130]

Risk Assessment

Risk assessment aims to produce meaningful outcomes under conditions of high uncertainty [131] . Risk arises from both a hazard and from some uncertainty about its

effects. Hazards are sources of danger, and risk is the possibility or probability of loss from a hazard. [132]

Common definitions [132] of risk include:
(1) The expected number of fatalities per year resulting from the consequences of an accidental event.
(2) The probability of an injurious or destructive event generated by a hazard, over a specified period of time.
(3) The frequency at which certain numbers of acute fatalities are expected from accidents.

The risk assessment approach has been used mainly to identify human health effects that may result from exposure to a specified hazard. So assessing the risk associated with a complex global issue like climate change becomes a large complicated task. To calculate all risk involved, risk assessments should thoroughly address the wide-ranging impacts of climate change on our ecosystem, economy and community, which is not possible at this point. A major criticism of risk assessment is that it does not factor in equity between generations, a central part of sustainable development. [133] Another major criticism is that, as a quantitative process, risk assessment ignores completely hazards and risks that cannot be quantified.

Once assessed, the risks are managed by balancing them against benefits. If the benefits outweigh the risks, then present activity continues. Two problems arise, though, with risk/benefit policy. First, those who bear the risks often do not get the benefits. And second, benefits are much better known than the risks. [134] So in other words, because of the uncertainty of risk, one can never be sure how severe the consequences of climate change may be. If we underestimate the future damage of climate change, the cost of taking little or no action in the near term could be substantial.

For more information:
Union of Concerned Scientists

126. Source: Meadows, Donella: An Ounce of Precaution- The Precautionary Principle Versus Risk Management

127. Source: The Earth Summit, Rio de Janeiro, 1992

128. Source: UNFCCC

129. Source: Portney, 1998 in IPCC, Third Assessment Report, vol 3.

130. Source: IPCC. 2001. Climate Change 2001: Impacts, Adaptation and Vulnerability

131. Source: Mehta, Michael, D., Risk Assessment and Sustainable Development: Towards a Concept of Sustainable Risk

132. Source: Christoph Mandl and John W. Lathrop, "Risk and Decision," in Risk Analysis and Decision Processes, (H. C. Kunreuther et al., eds. 1983).

133. Source: Michael D. Mehta, Risk Assessment and Sustainable Development: Towards a Concept of Sustainable Risk

134. Source: Meadows, Donella: An Ounce of Precaution- The Precautionary Principle Versus Risk Management

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