Climate Change Research: Evaluation and Policy Implications
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The Process of Developing Policy Based on Global Environmental Risk Assessment

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Introduction

I have been invited to give a short presentation on developing policy based on a global environmental risk assessment. I very much look forward to an exchange of views later in the morning about how policy and science interact, and what we have learnt from the process so far. For my part I am going to take the title literally and look at the global warming issue as if it were a formal problem in risk assessment. I want to use that framework to make one or two suggestions as to how the interaction of policy and research might evolve as the climate convention progresses.

Background

The Intergovernmental Panel on Climate Change which began its work in 1988 and gave its first report in 1990, was a landmark in the development of technically based global environmental policy. Of course the assessment process has moved on since then. The Framework Convention for Climate Change has come into force, and national plans by most Annex 1 countries have been sent to the interim secretariat. In Berlin this March the Conference of Parties will meet for the first time. Amongst its tasks will be to set up the Subsidiary Body on Science and Technology Assessment. Characteristic of the step-by-step approach of a modern international environmental instrument, the convention has set the Conference of Parties a review deadline of 1998 to set post 2000 goals. With all this new process coming on board, I very much commend the conference's wish to look at how interactions between policy and research can be improved.

IPPC90 as a Risk Assessment

The first IPPC process was in many ways a classic risk assessment

1) the report identified the **hazard** - IR absorption and the gases which exhibited this property

2) the **risk** of these gases accumulating in the atmosphere through scenarios and chemistry

3) assessed the **consequences** - the impacts on sea level, agriculture, health etc

4) looked at the options for **risk management**

This IPPC process, which in its formal risk assessment form is familiar to most of us handling micro-environment problems, has not been without its critics. Certainly, since 1990, the peer review process has been improved, but at the penalty of a much more time consuming process. Gone for ever are the pre-IPPC days when a small group of experts could sit down in Bellagio and write their conclusions up in an afternoon! There is the perennial problem of immediacy that plagues any risk assessment that is based on an active area of research. The early steps in the risk assessment can become outdated by the time that the final steps have been completed. IPPC90 you will recall had to use the earlier National Academy Science review for its consequence analysis because the IPPC90 risk assessment was still in progress. There was no opportunity to test the effect of the risk management responses in the climate and impact models.

Despite these criticisms the IPPC has proved a powerful tool to assemble and assimilate the state of research. Indeed it picks up an enviable number of citations in its own right in learned journals . Other global environmental areas, such as the state of the global oceans, may not be any poorer in underpinning science, but are disadvantaged because of this lack of synthesis machinery. While constructing a synthesis of the science is vital, it leaves the issue of how the science is to fed into the actions which might follow from it. The IPPC has more recently been wrestling with this aspect, and I will also focus on this issue.

Development of National Plans

In charting the development of international action, it would be wrong to ignore the development represented by the preparation of national plans under the convention. It is a common experience that risk management takes on a different character once we move from analysis to trying to actively manage the hazards. Those disadvantaged by the action exercise their right to question the risk assessment and consequences analysis. Often Governments or at least democratic Governments - find that they have inadequate instruments to deliver action by others unless they are equally convinced. The national plans submitted to the convention underline this point. Governments can set the framework for action, but they need the co-operation of others to deliver real changes in emissions trends. In that sense Dr Brenabo's paper on communications between scientists policy makers and society at large is especially important.

Hazard Identification and Risk Analysis

Most people I suppose ask 'Is climate change a problem?' and if the answer is yes 'what could I do that would have any effect?' These are not bad questions for the policy making process at any level. Answering these questions through risk assessment begins by establishing the hazard. No one has seriously challenged that the infra-red absorption

property of greenhouse gases is a hazard. Identification that there is a hazard in a risk assessment is usually sufficient to establish the case for 'best practice' in handling the hazard, or in climate change parlance 'no regrets' measures. I shall have something more to say about 'no regrets' when I come to risk management options. Hazard identification is only the start of the analysis. The next step. Risk analysis has proved more difficult.

Scenarios are Scenarios

In a traditional risk analysis, situations are envisaged which might realise the hazard. The probability of each situation is assessed and the overall probability of the hazard being realised computed. Superficially IPPC have worked in a similar manner . Four scenarios were exhibited in IPPC90. The number expanded in IPPC92 to six. To these might be added the scenarios developed by World Energy Council. IPPC have often been pressed to identify the most likely scenario, or attribute probabilities to the set of scenarios. This would certainly permit a conventional risk analysis. However close scrutiny of the time axis of these scenarios which extends to 2100 shows that IPPC would be right to stand its ground - a 'scenario is a scenario not a probability weighted forecast'.

Let me argue this point by looking at the oft quoted IS92a scenario. Suppose I were to treat this as a forecast. Then I can make a number of other deductions about the long term future. First, taking into account the implied cost of nuclear power in IS92a it would be clear that despite the passage of a 100 years and an ever widening technical and scientific base we had found no cure for cancer that trivialised incidence of the disease. The world, although incredibly richer would still not be at peace and would still be concerned at nuclear proliferation. Treating IS92a as a forecast we do not appear to have found a room temperature super-conductor which would of course have revolutionised energy storage and transport. No doubt with that knowledge we could save a guilder or two elsewhere in the Dutch national research budget! If the choice of technical revolutions look as if I am biasing IS92a downwards perhaps I might add it also implies that we do not seem to have cracked the biochemistry of ageing either in 100 years . If we had it would be difficult to guess what the population driver figures might look like.

Anyone of us could associate a subjective probability to these events. However the likelihood of consensus amongst 5 billion people as to what those subjective probabilities would be seems rather remote. This is in contrast to forecasts in the shorter term - or at least the shorter term to the climate scientist. These forecasts limit themselves to a time span in which even if these technical shocks were to be realised their probability of influencing the forecast is vanishingly small. For the sake of a name we might call the end of such a time span a Schumpeter horizon to acknowledge that beyond it Joseph Schumpeter's creative destruction implies that we can no longer rely in any sense on extrapolation. The recent IEA forecast for global carbon dioxide emissions, for example, falls within the Schumpeter horizon. Such a horizon is also the natural time span in which to set step by step legally binding commitments in conventions, at least for those who want to take their commitment seriously.

The scenario process is inescapably normative. This is less of a problem than might be supposed at the stage I have reached in the risk analysis. If for example you turn to the

Brundtland Commission Report you will find the development of a normative scenario for the economic development of the world's nations. It may not happen but the scenario embodies widely held aspirations for the future. Thus while IPPC could happily construct an infinite number of scenarios, it is only those that express our aspirations that we believe we want to see actively pursued that need be included in the initial risk analysis. The scenarios ought for example to show the property of sustainable development.

I deduce from this argument that the policy making process in the convention needs in due course to address which scenarios reflect the aspirations of its parties. It ought to be these scenarios which make up the feedstock of climate models and impact estimates. In the first stage of a risk assessment the key scenarios are those which reflect aspirations without being fettered by considerations of climate impact. It is a matter of taste whether the term 'business as usual' quite captures that flavour.

Consequence Analysis

It has become rather popular to open discussions on climate change with a recital of the uncertainties in climate modelling. From a risk assessment point of view this narrow focus is not altogether healthy. Admittedly the IPPC90 key index of modelling uncertainty - the climate sensitivity - ranges over a factor of 3 from lower to upper bound. But this is no larger than the range of climate forcings arising from the IS92a scenarios themselves. It is therefore not just a range of climate science possibilities that need to be explored. The point to note is that all but one of the scenarios have rising climate forcing, and that all estimates of climate sensitivity are positive non-zero. Thus under these scenarios the modelling uncertainty simply changes the time at which a certain climate change condition takes place. Uncertainties in climate modelling influence the risk management not the *initial* risk analysis.

The question that is seldom answered by professional sceptics is just what scale of climate change matters, and whether that degree of climate change is within the range of scenarios, taking into account uncertainty in climate sensitivity. These are key questions that the consequence analysis must address. The degree of precision that we need from climate modellers depends critically on the degree of precision required by the impact assessment.

Types of Impact Assessment

In collective environmental decision making, the 'least helpful' outcome for a consequence analysis is that changes are found to be gradual. It may be gard to find consensus on a trade-off. In contrast sharp changes, sometimes called corner solutions from optimisation theory, are very important findings for gaining a consensus. By their nature they bring together a coincidence of different interests. For example there may be a rate of change at which temperate forests decline, or a sea temperature at which the Antarctic ice sheet begins to shelve, or the thermohaline circulation stops. I hope that it not too self evident if I suggest that these classes of impacts deserve special priority in impact research as a basis for collective decision taking.

It may of course be that such sudden changes do not exist and that climate impacts are gradual in their effect. There have been some attempts to tackle gradualist change by normalisation to some valuation criteria as a basis for contracting trade-offs. The new IPPC assessment will be reviewing some of these approaches. Personally I have some doubts that we have fully worked out how to use this methodology in the context of a long term issue like climate change. In particular it is not clear how much prior context has to be agreed before the figures have a hope of gaining a consensus. However the approach teases out one difficulty in a reductionist approach to impacts. We simply do not know what it would feel like to be living during a time that climate change was so apparent that we lacked confidence in how the climate might change around us.

It is common experience in environmental policy that society's response to a consequence, changes once the consequence is realised. In climate change this state of mind presumably sets in when we are confident that we can detect the enhanced greenhouse gas signal in the global climate record. I would argue that will be an important marker in the development of the convention.

I conclude that impact studies have a special importance in a risk assessment because they define the precision demanded of climate models, and their structure determines the likelihood of a consensus to respond to the risk.

Risk Management - Yet to be Begun

What I have discussed so far is simply establishing the climate change consequences of pursuing our aspirational scenarios. For any scenario that breaches the conditions of the climate change convention - adaptable rate of change to a safe stable concentration - the risk management component of a risk assessment comes into play and requires us to revisit our scenario. It would certainly be true to say that we have hardly begun to articulate in the convention how the next steps in risk management analysis could be undertaken.

The conventional history of risk management in an environmental instrument starts with a few suspect hot spots. These lead to some generalised early action. By the end date of this agreed action the underlying science is clearer and usually substitute technology has been developed. The final stage of the instrument is then played out.

The parties in the climate convention are clearly struggling with the first stage, which we label hazard management. Countries with the technical and social means to devise ways of abating emission have drawn up national plans. The unusual aspect of the convention is its timescale. We may still have not detected man-made climate change by the early part of the next decade. Although there are some good ideas in the national plans the dream substitute technologies have yet to come into play.

It is of course difficult to judge how the Conference of Parties will take this issue forward. Most countries have found that the store of 'no regrets' measures is difficult to unlock, not least because those who have interests in the older policies often take a 'I regret nothing' stance. The Conference is therefore likely to be interested in looking

more closely at means of better co-ordinating national measures, possibly through a Protocol to the Convention. Germany has already submitted some ideas on these lines.

If risk management were to become the underlying principle through which the Conference of Parties developed its work, then progress would undoubtedly be step-by-step. Measures would be assembled to take effect over my Schumpeterian horizon against specific commitments. As each target end-date was reached, the Parties would review the effect of their measures, assess the improved knowledge of the climate science, and inspect the concentrations levels of greenhouse gases that had actually been reached.

Let us suppose in conclusion that the convention was to take this route through its subsequent meetings. What kind of dialogue with science might be needed? I would suggest on the basis of the points made:

For Improving Hazard Analysis

(1) Continuation of IPPC reviews of global atmospheric chemistry, as the convention attempts to treat greenhouse gases in a comprehensive fashion.

For Improving Risk Analysis

(2) Clear rationals from IPPC and SUBSTA for scienarios.

For Improving Consequence Analysis

(3) Continued Scouting for 'corner solutions' in impacts.

(4) Differential impacts analysis (i.e. comparing impacts between different risk management scenarios).

For improving Risk Analysis

(5) Analysis of the comparative performance of differing measures in national plans.

I have not meant to exclude work on either large scale climate modelling or extensive impacts research. I thought however that this important work might be referenced in a different context.

I pointed to the time when there was general agreement that man-made global warming had been detected in the climate record. It would be an important turning point in the development of the convention, but also in the nature of the public debate. It is difficult not to have noticed how extreme local climate events in the recent past have spurred public interest and debate in this issue. In the past our meteorological advisers have been able to re-assure us that these events were not distinguishable from natural variation. In the future it may be more difficult to make that assertion. The research into large scale

modelling enterprises may then become important not just for projecting future change, but interpreting the change that will be seen around us.

The views expressed in this paper are those of the author, and do not necessarily represent those of the UK Department of the Environment