The Atmosphere As A Resource

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THE ATMOSPHERE AS A RESOURCE

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I wish to thank the organizers and sponsors of this meeting for inviting me to participate in this introductory session. I want to take this opportunity to remind you that climate is an attribute of the atmosphere, and to discuss briefly some of the important implications of that fact. My conclusion is that both nationally and internationally we should move towards a more integrated strategy of atmospheric management. The time is right, I believe, to begin to address the problem of dangerous interference with the climate system from the viewpoint or concept of a sustainable atmosphere and sustainable development.

The U.S. Country Studies Program, and the many scientists that participate in it, have focussed our efforts within the context of the United Nations Framework Convention on Climate Change. Quite rightly. It is our job to provide the scientific understanding and insights that can advance the implementation of the Convention. If it is to be successful however, the limitation of greenhouse gas emissions and the adaptation of society and ecosystems to a changing climate will have to take into account the whole atmosphere as a resource.

The justly famous Article 2 of the Framework Convention reads as follows:
The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production
is not threatened and to enable economic development to proceed in a sustainable manner.

If we wish to prevent "dangerous anthropogenic interference with the climate system" it is important to recognize that global warming is driven not only by carbon dioxide but also by other gases which play their part in acid precipitation, ozone layer depletion, and urban air pollution, sometimes called smog.

The connections between these four atmospheric issues are sometimes overlooked by scientists and policy makers who quite reasonably like to address one problem at a time. What is of concern to many citizens however, is the whole atmosphere. People understand that the atmosphere is a resource which sustains or should sustain human health. People in this beautiful city of Prague are surely aware of the serious problem of air pollution. At some level of awareness, perhaps by intuition or common sense, they also know that air pollution and climate change are part of the same larger problem. Everywhere in the world, not only in Prague, we have used the atmosphere as a sink and treated it as a free good, a common property resource of unlimited size.

The atmosphere is indeed large, and of the three great subsystems of the planet - terrestrial, aquatic and atmospheric - it is the only one that continuously envelopes and transcends the whole. Nothing is more pervasive than the atmosphere, and the consequences of changing it are therefore of concern to everyone.

In Table 1 six air pollutants and four air issues are identified. Some known connections between them are identified. For example CFC's (chlorofluorocarbons) deplete the ozone layer, and because they are radiatively active they also help to heat the atmosphere. Emissions of CFC's are now being reduced under the terms of the Montreal Protocol to the Vienna Convention on Substances which Deplete the Ozone Layer (Figure 1). Steps taken to protect the ozone layer have the additional benefit of helping to reduce global warming.
<table>
<thead>
<tr>
<th>Air Pollutants</th>
<th>Acid Precipitation</th>
<th>Ozone Layer Depletion</th>
<th>Smog</th>
<th>Climate Change</th>
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<tbody>
<tr>
<td>Carbon Dioxide (CO₂)</td>
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<td>Methane (CH₄)</td>
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<td>Nitrous Oxide (N₂O)</td>
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<td>CFC's</td>
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<tr>
<td>VOC's &amp; NOₓ</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>Sulphur Dioxide (SO₂)</td>
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Figure 1  Forecast Market Versus 1987 and 1990 Protocol

SOURCE: CCME, 1992
Unfortunately with sulphate particles the reverse is true. Data and analysis from the Hadley Centre show that model predictions of global temperature (Figure 2A) are substantially improved when sulphate particulates are taken into account (Figure 2B). Because sulphur dioxide causes acid precipitation major efforts are underway in some highly industrialized regions, especially in Europe and North America to reduce emissions. Emissions are indeed declining and so too are atmospheric concentrations (Figure 3A and 3B).

There is clearly a significant risk here. As the masking effect of sulphur dioxide emissions is removed there may be a rapid increase in the rate of global warming. This is a risk which needs to be better understood, and explained to public and policy makers.

Of course, I do not suggest that in order to reduce global warming, emissions of sulphur dioxide should be continued or increased! What I would suggest however is that atmospheric scientists devote more research effort to the interconnections between air pollutants. There is also an important point here about dangerous interference with the climate system. It is not sufficient to address greenhouse gases only in terms of their effect on climate. And clearly we have to extend our attentions to anti-greenhouse gases such as sulphur dioxide as well.

Where do all these questions lead? They lead back to the human activities which are the common sources of air pollutants. Figure 4 shows a diagrammatic, non-quantitative sketch of the main sources of pollutants and their relationship to air issues. Policy for the management of the atmosphere is changing from a focus on regulating emissions, and "end of pipe" technology, towards changing the economic activities themselves to make them more sustainable and friendly to the environment.

This is consistent with the long-term aim of the Brundtland Commission to change from a philosophy of react-and-cure to a philosophy of anticipate-and-prevent. Now the distinction that we have made in the global warming debate between limitation of greenhouse gas emissions and adaptation to climate change is no longer useful. We have to think in terms of adapting our economic activities in order to achieve sustainable development and a key component of that is a sustainable atmosphere.
Predicted (1860-2050) and Observed (1860-Present Day) Surface Air Temperature Changes (°C)
Predicted (1860-2050) and Observed (1860-Present Day)
Surface Air Temperature Changes (°C)
Ontario Sulphur Dioxide Emission Trend (1970 to 1990)

Source: MINISTRY OF THE ENVIRONMENT, 1990
Long Term Trend $SO_2$ in Ontario

SOURCE: MINISTRY OF THE ENVIRONMENT, 1990
FIGURE 4: POLLUTION SOURCES AND AIR ISSUES

[Diagram showing relationships between pollution sources and environmental issues]

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