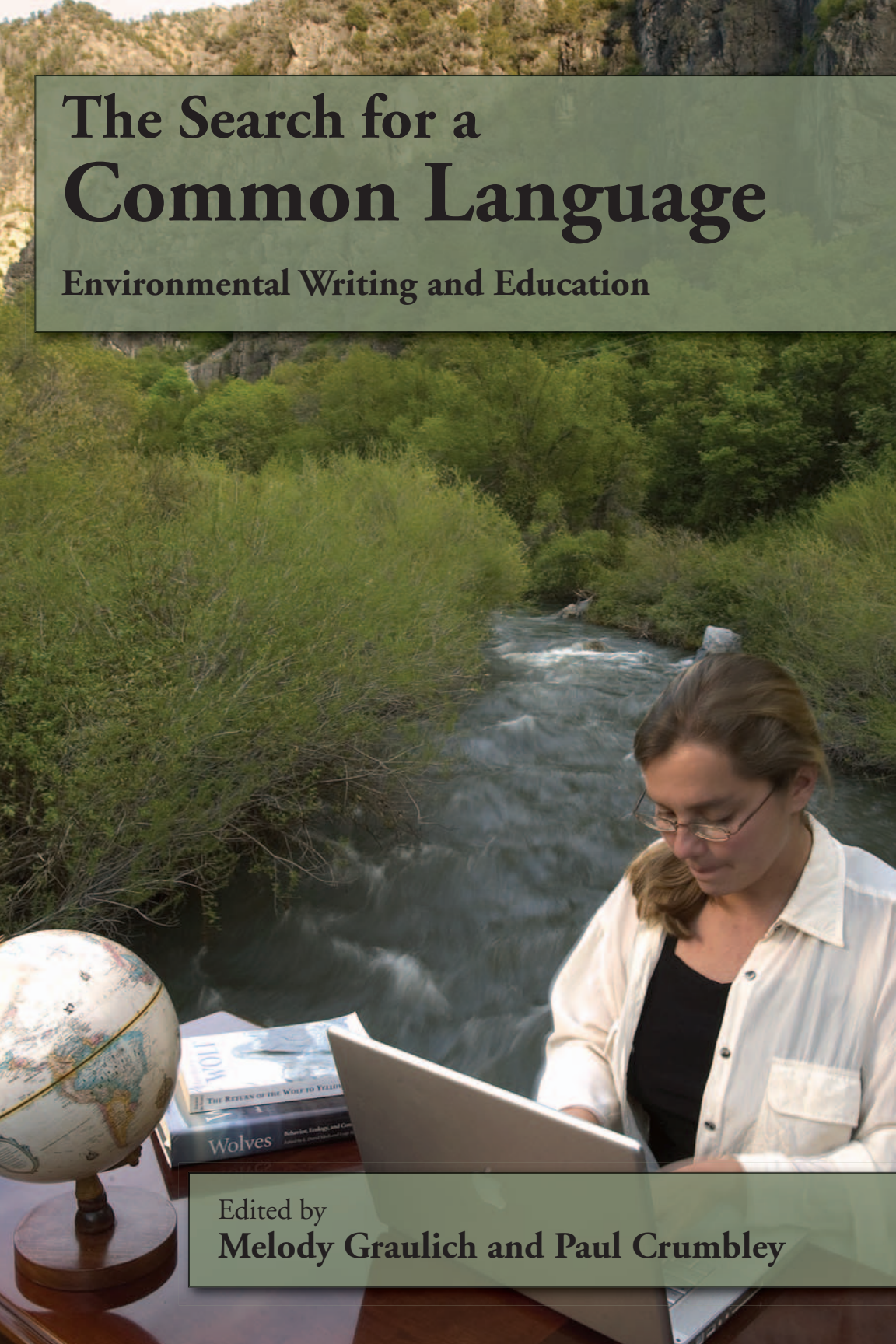
The Search for a Common Language

Environmental Writing and Education



Edited by

Melody Graulich and Paul Crumbley

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How Science and the Public Can Lead to Better Decision Making in Earth System Management

Hartmut Grassl

Hartmut Grassl is a member of the Max-Planck-Institute für Meteorologie in Hamburg. His publications include We Climate-Makers: Escape Routes from the Global Greenhouse *and "Radiation in Polluted Atmospheres and in Clouds," and he is the coauthor of* Climate of the 21st Century: Changes and Risks.

My title is very much in line with my belief that the public must be educated and engaged in international debates surrounding global environmental issues, particularly climate change. I see a major difference emerging that separates both sides of the Atlantic when dealing with global change: Europeans have assumed nominal leadership, while the United States has remained inactive. Europe has not actively sought this leadership role, but rather it has been imposed upon her by virtue of the United States' refusal to assume the responsibility that logically falls to it. This represents a significant transfer of leadership.

A logical procedure, then, is to address environmental trends now visible in the global community and their potential consequences. First of all, I want to look at the reaction by scientists, specifically how they have created global-change research programs, as well as the responses so far expressed by society. At this point, I would have to say that public awareness is slowly rising—I would emphasize the "slow" aspect. Then I will discuss the ideal structure for a productive societal debate on global change. Here I will focus special attention on the ways the scientific view of reality conflicts with political and social realities. I will conclude by both proposing steps for improved communication and recommending structural changes.

I was the director of the World Climate Research Program from 1994 to 1999, and I realized while in this position how important effective administrative structures are. This program is very successful, mainly because of its organizational structure, not its individual directors. It engages thousands of scientists worldwide in large part because it is supported by United Nations agencies and a very big nongovernment organization called the

Council for Science; this broad support makes our organization attractive to the scientific community and those around the globe who are responsible for managing public services tied to environmental change. This combination of services plus scientific communities leads to a successful program. That is why I will be emphasizing the need for the sorts of structural change that can bring the environmental debate forward through entities like the United Nations. I will provide examples of how this work has already begun to advance, and then I will speculate about the prospects for a major environmental summit in Johannesburg.

Your country has not yet energetically participated in the debates to take place at Johannesburg, and some of you may not know what I'm referring to. Johannesburg is the World Summit for Sustainable Development scheduled to take place in August and September of 2002. The entire world, with the probable exception of the United States, is looking forward to this conference. We view it as an opportunity to advise governments about the way they should deal with those parts of the environmental debate where little progress has occurred over the ten-year period since the last summit.

Let me now address the most pressing anthropogenic environmental trends. One is the increase in greenhouse gases; the other is a loss of biodiversity that is a byproduct of atmospheric change. The increase in greenhouse gases is just one of a handful of major trends, but it is the biggest, and I put it on top. The loss of biodiversity is more serious than all the other effects because if we extinguish certain species, then we have to wait millions of years until the niches they inhabited in various ecosystems are once again filled. This is extreme long-term damage.

A second point, the degradation and loss of soils, is also a long-term problem that will persist beyond fluctuations in greenhouse gases. Through our continued burning of fossil fuels, we destroy fuel-producing soils that have built up over ten thousand years in some places, twenty thousand in others. And I have heard that you had a mud rain here in Utah recently, a phenomenon that I do not believe occurs naturally in this region very frequently. This is an anthropogenic, or anthropogenically influenced, phenomenon because of the desertification process going on in your country due to counterproductive agricultural practices.

A third point, changed atmospheric composition, has already led to four global effects. Nearly all citizens worldwide know the first two; these are enhanced greenhouse effects and increases in photochemical smog. Increases in greenhouse gasses translate as global warming and stratospheric ozone depletion, which has contributed to a major debate in the United States because Americans are very scared about cancer. With good reason. Skin cancers will indeed increase when we further deplete stratospheric ozone. Photochemical smog has become a global concern as we in the developed

countries of Europe deliver it into eastern Europe and central Asia. You in North America similarly deliver photochemical smog to us in Europe during the winter months. Loss of biodiversity, changes in soil composition, and biochemical fog have become global phenomena now because of the abundant production of nitrogen oxides and hydrocarbons.

Enhanced stability in acid deposition is also a serious global concern. This particular debate has calmed down in the United States and partly in Europe because of governmental measures to reduce destructive emissions, but if you go to China and India, you will discover a very serious persistence of acid deposition that is negatively influencing the entire continent.

Pollution by ecotoxicological compounds represents a fourth atmospheric change that deserves serious attention worldwide. Many countries choose to ignore this problem, but if you investigate the meat of the penguins in the Antarctic, you will discover evidence of nearly all the pesticides used in the Northern Hemisphere. These pesticides are long-lived, and their destructive influence will persist. We already have evidence of their impact on wildlife in many places, even inside our national parks.

Now to the consequences, and here I mean *observed consequences.* I am not primarily concerned with potential consequences. If you pile up what we have observed already, you realize how much alteration has already taken place and how many people are now suffering from global environmental change. And those who are suffering most are by and large not the population responsible for having caused the problem. This is a major international debate. Can you imagine what it means for an Indian—not an American Indian, but an Asian Indian—if the United States withdraws from the Kyoto Protocol? An average Indian emits a volume of pollutants one-twentieth of that generated by an average American, yet the American president tells the Indian he should make the same sacrifices expected of Americans.

Let us now consider observed consequences:

- Recent global warming and the enhanced greenhouse effect. There is no doubt that part of this change results from actions taken in the developed world; whether all are from us is a matter of current debate—we may have caused even more change than we have yet detected, as acknowledged in the Intergovernmental Panel on Climate Change report. We don't know the exact extent of the change because natural variability is large and not fully understood. We do know that we have intensified precipitation. Scientists in your country were the first to detect such change over the United States. This is, for a physicist like me, a "no-brainer." If surface temperatures warm,

there is more water vapor per unit volume in the atmosphere; and if at the same time the vertical speed remains constant, there must be more intense rain. This is an entirely natural phenomenon. Everybody knows there is more concentrated precipitation per storm in summertime than wintertime.

- Higher UVB (ultraviolet B) levels on Earth's surface. This development has eradicated what used to be the gradient of UVB radiation in the Southern Hemisphere in late spring. On a sunny day, twenty-four-hour doses of ultraviolet B radiation are as high in southern Argentina as in tropical northern Australia. There is no difference because of the influence of the Antarctic ozone hole.
- Reduction in agricultural yields. Photochemical smog is dangerous for agriculture because crop yields are reduced. This has been shown in several countries. But at the same time, if we look around the world, we discover increased yields in many places due to indirect fertilization by CO_2. If a farmer gives enough fertilizer and water to his crop, he will have high yields simply because of an enhanced carbon dioxide concentration in the atmosphere, provided he raises plants like wheat and sugar beets. When farmers plant maize or sorghum, this is not the case because these plants do not react as strongly to enhanced CO_2 fertilization.
- Acidification of soil and inland waters. This was once a burning problem for the United States and Scandinavia, but it is not so great a problem now because of measures these countries have taken to reduce sulfur dioxide and nitrogen oxide emissions.
- Changes in ecosystem composition. This topic is totally neglected in public discourse. If you have plants reacting differently to CO_2 and you enhance the concentration of CO_2, the competition among plants alters, and the ecosystem composition must change. Colleagues in several parts of Switzerland have documented this change.
- Coastal erosion. Approximately 80 to 90 percent of all coasts presently experience erosion because the sea level is rising. If there were no rise in the sea level, we would have almost no coastal erosion because of naturally occurring deposits that build up along coastlines. If the rate of sea level rise is small or stagnant, then we have a buildup of coastlines, not erosion.
- Frequent melting of permafrost. This is clearly visible in Alaska and Siberia, and it poses major problems for the Siberians because they do not have the money to reconstruct houses and roads. For countries like the United States, this is not a major problem because they can divert a percentage of the gross national product to Alaska and absorb the reconstruction expenses. This is not the case for the Siberians.

- Habitat fragmentation and destruction. Soil degradation and increased land use are the main causes, which comes back to the point I made earlier about biodiversity loss. As far as potential consequences go, I have listed only three items here, though I could expand the list to five, six, or seven.
- Changed ocean conveyor belt. This is a hot topic, but it is only a hypothesis because we scientists are not able to prove by measurements that change has actually taken place; we are not yet able to observe continuously the interior of the Atlantic. Only recently, during the World Ocean Circulation Experiment, a project of the World Climate Research Program, was the first survey attempted with the aim of monitoring the entire world ocean. The United States was very, very active in this project, and now there is an emerging new observation system for oceanographers, within which NOAA plays a key role. We will soon have a fully developed observation system, but until then we can proceed on hypothesis only. How do we at this time explain such developments as the stasis of deep water within the deepest reaches of the north Atlantic—a development that has in the past occurred only when we had major changes in ice: melting or surges. Now there is not enough ice on the globe to create this dynamic. If the so-called Gulf Stream should stop, we would need another physical mechanism—a redistribution of fresh water, perhaps. But I repeat, such speculation is purely a hypothesis; it is not proven.
- Many new weather extremes. This is a giant response to all these trends and may be viewed as an obvious outcome. If we change the distribution function—shift it, broaden it, or narrow it—we will produce extremes. If we narrow the distribution function, we will reduce the probability for extremes. In the case of precipitation, we see that distribution has broadened, so we have on both sides new extremes; droughts extend for longer periods, as do periods of intense precipitation. But as this is not true for all global regions, we have to look carefully at those places where it is happening. In the United States, where the best evaluations were formulated quite early, increases in flash flooding are easily observed.
- Spreading of infectious diseases. Studies have demonstrated the spread of diseases in Africa, where measures like those taken against malaria are normally inadequate and natural boundaries to epidemics develop slowly. Here in your country, boundaries restricting the spread of malaria are in place. Why don't you have malaria? Because the health system takes measures against it; but in countries where such measures do not exist, there have been major changes in the spread of infectious diseases.

Just over a year ago, I was invited to the so-called Amsterdam Conference—the conference held last July for all the global-change research programs—to talk on water, especially projected precipitation changes caused by further global warming. Scientists now know that global rainfall averages are increasing because of an intensified water cycle. Scientists rate this knowledge under the category "we are certain." But how does my stating we will have greater rainfall globally help you in Utah? It will not necessarily be of much immediate value. You may be in an area where rainfall has actually declined because of circulation changes. The current global trend is for more rain in humid and subhumid areas, with the most significant increases in high northern latitudes. A good example of this is Norway. Despite strong warming in Norway, some of the mountain glaciers now reach the forest again because wintertime precipitation has increased by 30 to 40 percent during the twentieth century. Now there is so much snow per winter that even higher temperatures in summer and winter cannot melt it sufficiently to compete with the precipitation increase, so the glaciers advance.

In the Alps, where we have nearly stable precipitation but higher temperatures, we have a massive decline of glacierized areas. Strange as it may seem, in many semiarid or arid areas, the intensification of the water cycle can lead already dry areas to become even drier. Intense precipitation in areas with historically stable or slightly decreasing annual rates can lead to an increase in flash floods and higher erosion rates. This is a major threat for a country like China. I was recently in China, and I saw the countermeasures taken against sandstorms and desertification. In preparation for the 2008 Olympic Games, for instance, the Chinese want to plant a forest around Beijing. They have already started to reforest vast swaths of land in a tremendous attempt; not tens of thousands but hundreds of thousands of people are working against desertification. At the same time, however, the increasing numbers of farmers in inner Mongolia, which is an outermost province of China, have greatly expanded the number of cashmere goats (China is the main exporter of cashmere wool). And these goats start the sandstorms because they don't just eat the grass but deroot it. And we saw the effects of this practice when we were suddenly halted in just such a sandstorm.

Next in my list is the first response taken by the scientific community. When the question arose as to whether or not humans influence global climate, the World Meteorological Organization (WMO), jointly with the International Council for Science, called for the creation of relevant scientific unions, starting with the World Climate Research Program in 1980. In 1986 the International Geosphere-Biosphere program was created. In 1992 Diversitus was established to deal specifically with biodiversity on

our planet, and in 1996 the International Human Dimensions Program on Global Environmental Change (IHDP) came into existence. And I would be pleasantly surprised if I learned that more than a handful of readers of this essay have ever even heard of these last two environmental programs. Doesn't this tell us a story? We are absolutely failing in our twin obligations to communicate major topics and ask for enough money to build the infrastructure capable of coordinating international research programs. In this context, your country plays a key role. Yours is the only country that could in principle work without the cooperation of the others because you are large enough and sufficiently developed. Much to my disappointment, I learned when I was director for the World Climate Research Program that the major research nations do not consider it productive to deal with international programs because they can manage to a large extent by themselves. But even the smaller countries are not integrated to the extent which I would like to see. For example, Austria, Germany's neighboring country, is all but absent from most of these international programs.

Fortunately, despite these disappointments, the World Climate Research Program has many success stories. Our infrastructure is solid and old enough to produce some valuable breakthroughs, like El Nino prediction or the first survey of global ocean circulation. The IHDP has also enjoyed some major successes; for example, the creation of a CO_2 flux net now operating on all continents. It is still not dense enough, but it marks the beginning of an important future observation system built entirely from research money. For this achievement, infrastructure has been critical. Diversitus lost out because of lack of infrastructure. Even though one of the funding sources is UNESCO, a huge organization, funds sufficient to support one full position working for Diversitus could not be generated. Now several countries have taken action to create an infrastructure in Paris. It is starting. Yet ten years after the creation of the program, we still have no real infrastructure for it. IHDP represents a good start, but it is still not fully accepted in all social-science communities. Natural-science communities are eager to participate in these international programs, but the social sciences are still not in the position to cooperate as strongly as the meteorologists have done for a long time. It is worth noting, however, that the meteorologists are forced to become involved because of one single geophysical parameter: the high speed of air five kilometers above our heads.

Perhaps the best example of this more or less compulsory cooperation came about as a result of the devastation by Lothar, a storm that hit Europe on the 26 December 1999. This catastrophic storm wreaked havoc on France, southern Germany, and Switzerland, producing the highest winds ever measured, but it did not appear in the German Meteorological Service forecast because of the lack of a single radiosonde measurement

from Sable Island in Canada. The team on Sable Island had to restart the radiosonde because the first one, attempted under very severe conditions, did not work. The German Meteorological Service was therefore not in a position to note this later broadcast, but the French and the British were, and they successfully forecast the storm. This indicates the time-sensitive nature of weather forecasting: predicting a storm for tomorrow afternoon requires a measurement taken three or four thousand kilometers away in the western part of the Atlantic from an island off the coast of Canada. Meteorologists cooperate because they must, not because they possess superior characters.

Now the reaction by society. What has society done after learning about all the global-change problems? We see a slowly rising awareness of global responsibility, but only in Organization for Economic Cooperation and Development (OECD) countries and in most cases only in a minority of the population that does not extend to the seats of government. I am a European, so I should bash Europeans first. Looking to our southern neighbors, the Spanish, I can quickly see that they have other problems that take priority, despite the fact that they suffer strongly from desertification and a change in the North Atlantic oscillation. Global change is not an important topic for them, but for Scandinavians, the Dutch, the Germans, and the British, it is.

One serious impediment to a more active European response is a misguided early statement. We suffer from the slogan coined by environmentalists in the late sixties and early seventies which said that environmental protection requires a reduced living standard. This misperception still hampers the progress in environmental methods. *We have seen instead that technical innovation plays a key role for environmentally less-damaging lifestyles while supporting a rising standard of living.*

I can give you some examples that convey the different approaches adopted on both sides of the Atlantic:

- In European public buildings, florescent bulbs for lighting are nearly obligatory, while this environmental measure is progressing slowly in the United States, either because you have more energy or you believe you can acquire more energy.
- In Europe, natural gas is replacing coal. This was a major event for the British, who have reduced $C0_2$ emissions over the entire country by 6 to 7 percent since the 1990s just because they said coal was too expensive. Low-energy houses are no longer more costly. You can build a new house with one-third of the energy consumption of the standard American home and spend no more than you would pay for a less efficient home. I don't know how the prices are here; efficient homes may still be more costly.

- In Europe, CFC-free refrigerators and freezers were pushed by environmental groups, not by governments. Greenpeace created the first CFC-free refrigerator in cooperation with a company in Dresden, Germany, and now it's delivered on a global scale.
- Wind power is booming in Europe. During a typical windy night, there is at present surplus electric current. What is done with the surplus? Because we have what are called "feed-in laws," all current flows into the grid and hydropower plants in Sweden are directed to stop production when available current exceeds demand. The plants tell each other to stop because when the wind blows, they get less money per kilowatt-hour. So two renewable sources of energy "shake hands" in Europe.
- Fuel-cell cars driven by hydrogen from solar power are about to emerge in Europe. In a year or two, we will have the first examples on our roads from European and American companies. There is very strong competition among Chrysler, BMW, and Ford. They want to be the first with these cars on our roads.

What, then, is the most appropriate structure for the current societal debate on global change? First, we must agree to pursue the ideal even though we will never succeed in reaching it. Seeking the ideal is the way we do things on our planet. All our policy making, all our organization in life, is directed to approximating an ideal. In science, we need the ideal to assess new findings and determine which old and new questions to keep open. And here I see a major difference between my country and the United States. Our government would never invite only two or three scientists to a hearing before a Senate committee. The German government always consults multiple representative groups because when you are making decisions as a politician, you should base them on the best available information, and you get that type of feedback from independent groups. You don't get balanced information from those who are very near to your party.

Society should have a debate that includes representatives from all sectors, not just environmental groups, not just churches, not just the media, but a combination of all interests. We of the highly developed countries are a minority on the globe. From the point of view of the number of heads we possess, we are a real minority. And we have to deal with the Indians, the Chinese. They are the majority, and OECD countries often forget this fact.

Decision makers should be open minded. We say in Germany that we scientists have an honorable duty to serve the public. We have to tell the policy makers what we know, but they have the duty of accepting what we tell them. And both sides have to cooperate. The scientists must tell what

they know, the politicians must accept what they hear, and together they must place the debate before society.

Productive innovation must take environmental concerns into account. When you create new equipment, you should not just look at your consumer; you must at the same time ask how it affects the environment. In some countries, incentives have been useful, such as offering reduced tax rates for lower levels of pollution. Unfortunately, many countries still provide a subsidy for fossil fuels. Take the Germans. We subsidize our own coal industry to the tune of three billion euros per year. This amount is declining, but we still underwrite fossil fuel. Can you imagine such a thing existing in the country that at the same time has the feed-in law, whereby any kilowatt-hour from wind and biogas has to go into the grid? Conversely, our coal-fired power plants don't pay taxes at all but rather receive three billion euros per year.

More than anything else, we must establish an agreed-upon, long-term global debate about earth system management. But perhaps you don't agree with the phrase "earth system management." I know many environmental groups that have a difficult time accepting earth system management in spite of the fact that the concept has been proven in practice. What have we done to protect the ozone layer? We have used earth system management. We found out through science what the causes of ozone depletion were, and we motivated nations to act in a global manner. This is earth system management. The Kyoto Protocol is the next attempt at earth system management. If you understand the problem, then you know what to do. At present, scientific understanding is too rudimentary to provide clear advice about how to reduce emissions. At present as scientists, we can say, "Yes, that is due to emissions," but then nations have to reduce, and the level of required reduction is debatable until the facts are in.

Think again about the meteorologists. There will soon be a very major debate over where the butterflies are. Science is good enough now to forecast weather as far as six, eight, or even nine days in advance. Computers are big enough to have so-called ensemble forecasts. So you start your model sixty-four times with slightly changed fields and then see how the forecasts deviate from each other. You will see in days three or four that there must be something happening in the near future because the forecasts diverge largely. If you run the program again and again with new information, you may find the place where additional observations are needed to distinguish between diverging forecasts. If you find this place, you then send an airplane to specific drop zones where more precise data is gathered, enabling you to revise the forecasts and conclude with confidence, "Okay, it's going this way." Isn't this a place where all people will go to find the wings of the butterfly? To slightly change the cloud cover and then let the hurricane go

to Cuba instead of Florida? This may sound like an absurd overstatement, but there will soon be a debate requiring international agreements to prevent precisely these sorts of efforts.

Now the reality. Reality in science is only partially organized. The Intergovernmental Panel on Climate Change is a good example. We have no international panels for land and soils which would help combat desertification. Neither is there an intergovernmental panel on biodiversity. So these trends are not studied. We have no authoritative procedure to assess knowledge. Society suffers from both a lack of information and a reluctance to accept the knowledge it does have. Poorer countries are not normally interested in the debate we are having today. Churches are often indifferent; they could have an influence on the people, but they are for the most part not interested in addressing global change.

When it comes to decision makers, you can view Gerhard Schroder the same way you view George W. Bush: both are occupied by crisis management partly caused by neglect of global change. And lobbyists use their resources to launch disinformation campaigns. This is the typical setting. We will not avoid this, but we can exert counterpressure through sound information. This can be an effective strategy because our politicians make decisions when they see that there is sufficient minority public opinion to override the pressure mounted by lobbyists. In Germany, we witnessed a wonderful example of how this works when our government had to react to ozone depletion. This came about because conservative climatologists, among them Herman Flown, the famous German climatologist, and my colleague, Klaus Hasselman, all signed a pamphlet produced by Greenpeace and the largest environmental-protection group in Germany. Only then did the politicians agree that something must be going on; why else would these old guys sign a pamphlet produced by Greenpeace? And from this day on, the government attitude toward the chlorofluorocarbon phaseout changed dramatically.

How to improve the international response to global change? We need structural changes, as I have said, as well as international political cooperation. For this to happen, we must have international assessment agencies, as well as an environmental organization in the United Nations. At present, we have a program that is extremely unstable because it is entirely dependent on donations. For example, in March 2001 the wealthy nation Austria withdrew its support for the United Nations Environmental Program (UNEP), provoking its executive director to ask me, "What shall I do now? I have to lay people off." He is uncertain what money he will receive to fund his already-understaffed operation. Four hundred people are simply not enough to run a global environmental program. We need an environmental organization that receives payments from member countries the same

way that the WMO does. In the WMO, if a country doesn't pay, it loses its voting rights. Can you imagine how the money flows in before the meteorological congress? This is the only way for a strong organization to exist.

Scientists also have responsibilities. We have to provide solid research information according to four categories of certainty: "We know"; "We calculate with confidence"; "Our best judgment is"; and "We do not know." We always have to give all four parts. Normally we start with "we calculate with confidence" and "our best judgment is." We skip the last one and the first one, but the politicians need to know what we know in a form that enables them to make informed decisions.

Finally, we must engage positively and productively with the media. I have been working to make scientific knowledge available to the public since 1986, and in the years since then, I have gathered valuable experience. My advice to scientists is to avoid specialized environmental venues. Environmentalists are already on board. Try to get onto popular TV shows watched by millions of people. Then you stand a chance of reaching the public. Set up interviews on TV, the radio, through the newspapers, and on good Web sites. There is indeed a lot to do, but you need not fear your involvement will demand all of your time. I'm giving about one-third of my entire time to public relations, like talking to the German Advisory Council for the government. I see giving advice to the government as a significant public-relations activity. And I also speak to associations of housewives in small counties throughout Germany. If I can squeeze it in, I do that because the housewives are more thankful for good information than the bosses of industry.