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Preface: Global Atmospheric Change and Human Health

On November 6–7, 1989, the National Institute of Environmental Health Sciences (NIEHS) held a Conference on Global Atmospheric Change and Human Health. Since this conference, presented papers have been transformed and revised as articles that address several potential impacts on human health of global warming. Coming when it did, this was a very important conference. At the present time, there is still much uncertainty about whether or not global warming is occurring and, if it is, what effect it will have on human health. All the participants in this conference recognized this uncertainty and addressed potential impacts on human health if surface temperatures continue to rise and greater amounts of shorter wavelength ultraviolet (UV) radiation continue to reach the earth's surface as a result of depletion of the ozone layer. Because global warming and ozone depletion will occur over many decades, adverse impacts on human health and the environment may not be reversible. In short, we are in the midst of a huge geophysical experiment with global climate, and we will not know what the outcome will be for many years.

In all these articles, there is a recognition that global warming is more than increasing surface temperatures as a result of increasing atmospheric concentrations of CO_2 and other greenhouse gases. The greenhouse effect as a result of gases in the atmosphere that absorb infrared (IR) radiation emitted from the earth's surface is responsible for maintaining within a narrow range surface temperatures throughout the year and at all latitudes. These greenhouse gases act like a blanket of insulation that keeps the earth's surfaces from cooling off rapidly when the sun goes down. Because surface temperatures are regulated by the concentrations of greenhouse gases in the atmosphere, increasing these concentrations will slow the loss of heat as IR radiation from the earth's surface and increase surface temperatures.

The major greenhouse gas in the atmosphere is CO_2, and its presence in the atmosphere is the result of oxidation of organic matter. The oxidation of carbon in organic matter and the production of CO_2 are important processes in the natural cycling of carbon in the environment. The concentrations of CO_2 appear to vary over a cycle of about 100,000 years as a result of changes in the shape of the orbit and the angle of rotational tilt of the earth as it orbits the sun. From ice core data, CO_2 concentrations in the atmosphere appear to cycle between a low of 190 ppm to a high of about 300 ppm over the last 160,000 years. Since the industrial revolution began about 150 years ago, however, atmospheric concentrations of CO_2 have increased to 350 ppm. The combustion of fossil fuels is a method of rapid oxidation of organic matter, and at current rates of consumption of fossil fuels for transportation and electrical energy production, CO_2 concentrations in the atmosphere are predicted to increase to 600 ppm by the year 2030. As a result, it is estimated that surface temperatures will increase 1 to 2.5°C by 2030. At the present time, because of increased combustion of fossil fuels, the rate of entry of CO_2 into the atmosphere exceeds the rate of CO_2 removal. Combustion of fossil fuels also produces SO_2, NO_2, and particulate matter. Therefore, as atmospheric concentrations of CO_2 increase, so too will concentrations of chemicals that cause urban air pollution and acid rain.

Other important greenhouse gases are the chlorofluorocarbons (CFCs). At ground level, these are biologically and environmentally unreactive chemicals that have been used as heat transfer fluids in air conditioners and as expanding agents in plastic foam production. Because of their low chemical reactivity and volatility, they have very long residence times in the lower atmosphere (troposphere). In the troposphere, they are effective absorbers of IR radiation, making them important greenhouse gases. In the upper atmosphere (stratosphere) they are photodegraded by shorter wavelength UV radiation, producing reactive free radicals that combine with ozone (O_3), forming chemicals that do not absorb shorter wavelength UV radiation. The absorption of UV radiation by O_3 in the stratosphere causes this region of the atmosphere to be much warmer than the upper portion of the troposphere, an upper atmospheric temperature inversion. Ozone depletion could result in cooling of the stratosphere. It is not at all clear what effect the cooling of the stratosphere will have on the heat balance in the troposphere and ultimately on surface temperatures. Ozone in the lower atmosphere is considered an air pollutant. Ozone in the upper atmosphere absorbs shorter wavelength UV radiation, preventing it from reaching the earth's surfaces, and serves an important role in regulating surface temperatures. Prolonged human exposure to shorter wavelength UV radiation has been associated with greater risks of nonmelanoma skin cancers, cataracts, and possible adverse effects on immune function.

The CFCs are involved not only in global warming in the troposphere but in depletion of the ozone layer in the stratosphere. As a result of these concerns over ozone depletion, the production of CFCs is being phased out over the next 10 years in industrialized countries, and over the next 20 years in underindustrialized countries. Replacement chemicals are being developed (the hydrochlorofluorocarbons), but little is known about their global warming potentials or their toxicities.

The papers of this conference are arranged to start by providing background on the geophysical aspects of global warming, e.g., what are the environmental phenomena involved in global warming and the impacts of global warming on air pollution, air

pollution health effects, acid rain, and the mobilization of mercury in lakes and sediments. Second, the impacts of global warming on biodiversity and infectious diseases are considered. This is followed by effects of increased exposure to UV radiation and the toxicity evaluation of chemicals proposed as replacement chemicals for the CFCs. Finally, research needs identified by individual authors and conference coordinators are summarized.

At this time, it is not possible to determine if global warming is occurring or not and if it is what impacts it will have on human health and the environment. The papers produced from this conference warn that many of these impacts on human health and the environment may not be favorable. In light of these warnings which are based on a large number of observations and accumulated experience, it would seem prudent to initiate national and international policies that would slow the increase of atmospheric CO_2 concentrations. Energy conservation and reduced consumption of the CFCs will allow time to develop necessary global warming predictive models to understand better how increases in CO_2, other greenhouse gases, and ozone layer depletion will affect global warming. Until there is a much better understanding of what global warming is and what it will mean in terms of human health and the environment, it should not be business as usual.

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