What is the status of the Earth’s ozone layer? Is the Montreal Protocol working? How much time will be necessary for nature to restore the ozone layer? What are the human health effects of increased ultraviolet radiation associated with depletion of the ozone layer? Who is at risk?

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OVERVIEW: OZONE TRENDS AND STATUS

More than 25 years ago, scientists first hypothesized that human activities could harm the stratospheric ozone layer, which is our shield against solar UV-B radiation. Subsequently, research has focused on understanding the nature and make-up of the stratospheric ozone layer and its relationship with humankind. For example, the ozone-destroying role of several industrially-produced chemicals has been determined, the Antarctic “ozone hole” has been observed and explained, and the relation between ozone loss and increased surface UV-B radiation has been characterized. Ten years ago, world governments began to formulate international agreements to protect the ozone layer, with scientific understanding providing major support for these decisions. This seminar will summarize key points of our present scientific understanding of ozone depletion, what research results they are based upon, and the outlook for the future of our ozone layer.

-In the early 1970’s chemists Paul Crutzen and Harold Johnston described the effects of nitrogen oxides on stratospheric ozone chemistry. In 1974 chemists Mario Molina and Sherwood Rowland realized that human-produced chlorine compounds, particularly CFC’s, could deplete the Earth’s ozone layer. These scientists, together with Paul Crutzen, were recently awarded Nobel Prizes for their research.

-Large seasonal depletion of ozone (up to 100% at some altitudes) is observed each year over Antarctica, where the meteorology and extremely cold wintertime temperatures are enhancing the ozone-depleting chemistry of CFC’s and other human-produced chemicals.

-Downward trends of about 4-5% per decade have been observed at mid-latitudes in both hemispheres. Although the phenomenon is not yet fully understood, the weight of evidence indicates that these losses are due in large part to human-produced chemicals.
Ozone depletion is observed to cause an increase in UV-B radiation at the Earth's surface. Monitoring data show that the growth in concentrations of ozone-depleting chemicals in the atmosphere is slowing, consistent with the declining production required by international agreements. The maximum ozone depletion (and increase in UV-B radiation) is likely to occur within the next 10 years; thereafter, the ozone layer is expected to slowly recover over the next several decades.

Health Effects of Ultraviolet Radiation

The amount of UV-B radiation in natural sunlight is dependent upon the concentration of ozone molecules in the atmosphere. Any reduction in stratospheric ozone concentration will result in increased amounts of UV-B radiation reaching the surface. Even a small increase in UV-B radiation is likely to have important consequences for plant and animal life, and will almost certainly jeopardize human health. The best understood harmful effects of UV-B radiation on human health are basal and squamous cell cancers of the skin and eye damage, including cataracts, which can lead to blindness.

UV-B radiation also contributes to the development of melanoma skin cancer and perturbs the body's immune system in ways that can reduce immunity to infectious agents, although magnitude of the impacts cannot yet be estimated. UV-B radiation may also affect human health indirectly by interfering with the food chain. On a global scale, UV-B radiation may increase the infectious disease burden, cause blindness, and reduce the world's food supply.

The current pattern of ozone depletion will cause the incidence of skin cancer to continue to rise at least until the year 2050 and probably beyond. For each 1% reduction in ozone, the incidence of non-melanoma skin cancer will increase by 2%. This means that a sustained 10% decrease in the average ozone concentration would lead to about 250,000 additional non-melanoma skin cancers each year. Each 1% decrease in ozone concentration is estimated to increase the incidence of cataracts by about 0.5%.

Increased UV-B radiation could increase the severity of some infections in human populations. Furthermore, skin pigmentation does not seem to provide much protection against the immunosuppressive effects of UV irradiation in humans. Any lowering of immune defenses is likely to have a devastating impact on human health.

Biography of Dr. Daniel Albritton

Dr. Albritton is currently the Director of the Aeronomy Laboratory of NOAA's Environmental Research Laboratories in Boulder, Colorado, which he first joined in 1967. Aeronomy Lab research is focused on the chemistry and dynamics of the atmosphere. Dr. Albritton helped coordinate the drafting of the research plan for the US Global Change Research Program, and currently leads the Atmospheric Chemistry Project of NOAA's Climate and Global Change Program. Dr. Albritton has served as Co-chair of the United Nations Environment Programme's scientific assessments of stratospheric ozone. In this capacity Dr. Albritton played a key role in providing the scientific basis for the United Nation's Montreal Protocol on Substances that Deplete the Ozone Layer. Dr. Albritton is also a member of the Intergovernmental Panel on Climate Change science working group, and has served as science advisor on US delegations to international negotiations on greenhouse warming. He has received numerous awards for outstanding performance, including two...
Department of Commerce Gold Medal Awards, the Presidential Rank Distinguished Service Award, the 1993 Scientific Freedom and Responsibility Award from the American Association for the Advancement of Science, a special award from the American Meteorological Society, and the 1994 US Environmental Protection Agency's Stratospheric Ozone Protection Award.

Biography of Dr. Margaret Kripke

Dr. Kripke currently holds the Vivian L. Smith Chair in Immunology and is Professor and Chairman of the Department of Immunology at the University of Texas M.D. Anderson Cancer Center in Houston, Texas. Her research interests center on the immunology of skin cancer, particularly on the role of the immune system in UV carcinogenesis and on the effects of UV radiation on immune function. Her work has paved the way for the new field of research, photoimmunology. Dr. Kripke has served on numerous national and international panels for research and science policy. In 1984 she received the Lila Gruber Honor Award for Cancer Research from the American Academy of Dermatology. In 1992 she served as President of the American Association for Cancer Research, and 1994 received the Herman Pinkus Award from the American Society of Dermatopathology. Dr. Kripke has been a member of the Board of Scientific Counselors for the Division of Cancer Biology at the National Cancer Institute. She is presently a member of EPA's Science Advisory Board Executive Committee and chairs their Research Strategies Advisory Committee. She is a member of UNEP's panel to review the effects of stratospheric ozone depletion, and is a major contributor to the IPCC assessment process. She is Vice President of the International Association for Photobiology.