BNL-75151-2005-AB

RADIATIVE FORCING OF CLIMATE CHANGE BY AEROSOLS: WHY THIS IS SO IMPORTANT AND HOW WELL IT NEEDS TO BE KNOWN

S. E. Schwartz
Environmental Sciences Dept./Atmospheric Sciences Div.
Brookhaven National Laboratory
Upton, NY 11973-5000

Presented at the
Australian Aerosol Workshop
University of New South Wales
Sydney, Australia
March 30 - April 1, 2005

September 2005

ABSTRACT

The atmospheric concentration of carbon dioxide is expected to reach double its pre-industrial value during the lifetime of many who are alive today. The resultant enhancement of the so-called greenhouse effect is expected to increase global mean temperature, but the magnitude of this increase is quite uncertain, in large part because of uncertainty in Earth's climate sensitivity, the change in global mean temperature that would result from a given change in global mean radiative flux.

Current estimates of this sensitivity indicate a temperature increase from CO_2 doubling ranging from 1.5 to 4.5°C; a sensitivity at the high end of this range would lead to a temperature change comparable to that between the glacial ice ages and the present temperate period, 6°C.

Approaches to estimate Earth's climate sensitivity include use of climate models and empirical estimates based on the increase in temperature over the industrial period. However both approaches must take into account other forcings that have occurred over this period, most importantly forcings due to increases in concentrations of atmospheric aerosols (microscopic and submicroscopic particles suspended in air). Increased concentrations of aerosol particles, which scatter light and serve as the seed particles on which cloud droplets form, exert a cooling influence on climate by increasing planetary reflectance, thereby decreasing the amount of incident solar energy that is absorbed by the Earth-atmosphere system.

The climate forcing of anthropogenic aerosols is thought to be comparable in magnitude to that of the increased greenhouse gases but is much less accurately known. This forcing thus offsets an uncertain but perhaps substantial fraction of the warming influence of increased greenhouse gases. If the aerosol offset to the greenhouse gas forcing is substantial, Earth's climate sensitivity maybe much greater than is indicated by the warming that has occurred thus far. This talk presents an overview of these aerosol influences and the reasons that aerosol forcings are so uncertain.

These considerations also lead to an estimate of the accuracy of aerosol forcing that is required to decrease uncertainty in estimates Earth's climate sensitivity sufficiently to meaningfully inform policy making on greenhouse gas emissions.
