Sulfate-Coated Soot and its Impact on Global Climate

submitted to the National Institute for Climatic Change Research
by
Prof. Russell R. Dickerson, Principal Investigator
Co-Investigators: Jeffrey W. Stehr, Michael R. Zachariah
University of Maryland, College Park
Departments of Atmospheric & Oceanic Science, Chemistry and Mechanical Engineering
December 15, 2005

Abstract:
1) **Project Objectives**:
The climatic forcing from soot has recently drawn considerable attention, since light-absorbing aerosols like soot likely warm the globe in contrast with most aerosols that are thought to cool the globe. Because soot control is more economical than carbon dioxide control, it has been suggested that controlling soot might be a more cost-effective method of controlling global warming than controlling carbon dioxide. It also appears that atmospheric soot aerosols are not pure carbon, but are likely composed of a graphite-like core and a sulfate or organic carbon coating (e.g. Jacobson, 2000), suggesting the need to improve upon previous studies that had assumed no such coating. Such coated soot particles likely absorb more light than soot particles without coatings, as will be discussed later in this proposal. We propose to measure the effects of these coatings by producing custom soot particles representative of those found in the atmosphere. In this proposal, we demonstrate past success in generating soot particles of a specific size, coating those particles, and verifying their final composition and size. Our goal is to determine the single scattering albedo for a range of realistic coated soot particles relevant to global climate change.
2) **Project Location**: The University of Maryland's research laboratories in College Park, Maryland and at the National Institute of Standards and Technology laboratories in Gaithersburg, Maryland.
3) **Hypotheses to be Tested and Measurements to be Performed**: We propose to measure the effects of the coatings outlined above by producing custom soot particles representative of those found in the atmosphere. In this proposal, we demonstrate past success in generating soot particles of a specific size, coating those particles, and verifying their final composition and size.
4) **General Approach**: We will generate soots relevant to both global climate change and air pollution, by burning common fuels in rich and lean flames. Of particular interest will be soots from internal combustion engines, biomass burning, and other combustion processes. After carefully examining our production procedures by measuring the size and morphology of the particles we create, and analyzing their composition with quantitative single particle mass spectrometry, we will then on-the-fly determine the optical properties of these coated particles. Finally, we will vary the size of the core soot as well as the thickness of the coating to determine how those parameters affect the optical properties.
5) **Intent of Research**: Our goal is to determine the single scattering albedo for a range of realistic coated soot particles relevant to global climate change.