Report calls aerosol research key to improving climate predictions

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Scientists need a more detailed understanding of how human-produced atmospheric particles, called aerosols, affect climate in order to produce better predictions of Earth's future climate, according to a NASA-led report issued by the U.S. Climate Change Science Program on Friday.

"Atmospheric Aerosol Properties and Climate Impacts," is the latest in a series of Climate Change Science Program reports that addresses various aspects of the country's highest priority climate research, observation and decision-support needs. The study's authors include scientists from NASA, the National Oceanic and Atmospheric Administration and the Department of Energy.

"The influence of aerosols on climate is not yet adequately taken into account in our computer predictions of climate," said Mian Chin, report coordinating lead author from NASA's Goddard Space Flight Center in Greenbelt, Md. "An improved representation of aerosols in climate models is essential to more accurately predict the climate changes."

Aerosols are suspended solid or liquid particles in the air that often are visible as dust, smoke and haze. Aerosols come from a variety of natural and human processes. On a global basis, the bulk of aerosols originate from natural sources, mainly sea salt, dust and wildfires. Human-produced aerosols arise primarily from a variety of combustion sources. They can be the dominant form of aerosol in and downwind of highly populated and industrialized regions, and in areas of intense agricultural burning.

Although Earth's atmosphere consists primarily of gases, aerosols and clouds play significant roles in shaping conditions at the surface and in the lower atmosphere. Aerosols typically range in diameter from a few nanometers to a few tens of micrometers. They exhibit a wide range of compositions and shapes, but aerosols between 0.05 and 10 micrometers in diameter dominate aerosols' direct interaction with sunlight. Aerosols also can produce changes in cloud properties and precipitation, which, in turn, affect climate.

Current predictions of how much Earth's average surface temperature will increase in the future fall in a wide range. If the amount of carbon dioxide and other greenhouse gases double from the levels in the atmosphere in 1990, the increase in temperature is expected to be from 2.2 to 7.9 degrees Fahrenheit, according to the U.N. Intergovernmental Panel on Climate Change. The role of greenhouse gases in global warming is fairly well established, but the degree to which the cooling effect of human-produced aerosols offsets the warming is still inadequately understood. The report states that scientists should strive to improve their understanding of aerosols' climate influences with the goal of cutting that range of uncertainty by nearly two-thirds.

The report states that to achieve the goal of reducing uncertainties in aerosol impacts on climate, an advanced, multi-disciplinary approach that integrates surface, aircraft, and space-based measurements with models will have to be developed. Scientists have made gains in modeling aerosol effects, but this capability has not yet been fully incorporated into climate simulations, according to the report.

The report advocates the development of new space-based, field, and laboratory instruments and the incorporation of more realistic simulations of aerosol, cloud, and atmospheric processes into climate models. The United States faces the challenge of maintaining and enhancing its existing aerosol monitoring capability from space.

Satellites have been providing global aerosol observations since the late 1970s, with major improvements in accuracy since the late 1990s. But some of these missions, such as NASA's suite of Earth Observing System satellites, are reaching or exceeding their design lives, the report notes.

The complete report is available at:
www.climatescience.gov/Library … p/sap2-3/default.php

Source: NASA's Goddard Space Flight Center