Unmanned aircraft to study Southern California smog and its consequences

May 6 2008

Technicians prepare an autonomous unmanned aircraft for launch at Edwards Air Force Base. The The Scripps-led California AUAV Air Pollution Profiling Study (CAPPS) used unmanned aircraft to make several types of meteorological measurements in the atmosphere. Data from CAPPS helped researchers characterize Southern California's smog and identify its many points of origin. Credit: Scripps Institution of Oceanography, UC San Diego

Using sophisticated unmanned aircraft, research scientists at Scripps Institution of Oceanography, UC San Diego hope to assess Southern California's potential for climate change and better understand the sources of air pollution.

Funded by the California Energy Commission, the California AUAV Air Pollution Profiling Study (CAPPS) uses autonomous unmanned aerial

vehicles (AUAVs) to gather meteorological data as the aircraft fly through clouds and aerosol masses in Southern California skies. The flights will take place at Edwards Air Force Base near Rosamond, Calif. The study began its first sortie of data-gathering flights in April 2008.

Scripps Atmospheric and Climate Sciences Professor V. Ramanathan, CAPPS's lead scientist, said the characteristics of Southern California climate and meteorology — ranging from its dry weather to its tendency to trap rather than export smog — could make it especially prone to climate change consequences of air pollution such as accelerated snowmelt and dimming at ground level.

"These monthly UAV flights will provide unprecedented data for evaluating how long range transport of pollutants including ozone, soot and other particulates from the northwest United States, Canada, east Asia and Mexico mix with local pollution and influence our air quality and regional climate including the early melting of snow packs," said Ramanathan.

Data collection began on April 2, 2008 and will continue through January 2009, offering researchers a chance to view seasonal variations in air pollution.

Ramanathan's team revolutionized the gathering of atmospheric data in 2006 when the researchers first successfully deployed the aircraft in the Maldives AUAV Campaign (MAC). Miniaturized instruments on the aircraft, which typically flew in formations of three, measured a range of properties such as the quantity and size of the aerosols on which cloud droplets form. The instruments also recorded variables such as temperature, humidity and the intensity of light that permeates clouds and masses of smog. It was the first time such comprehensive measurements were made at a cost that was very low relative to traditional manned flights.

The Scripps researchers have used data from MAC and other field campaigns to observe that a pervasive mass of air pollution in south and east Asia, commonly referred to as the "atmospheric brown cloud," can disrupt rainfall patterns and cause cooling at ground level but warming at higher altitudes. The cloud typically contains a mix of dust, sulfates and soot and other forms of black carbon. These aerosols are primarily the products of diesel combustion, agricultural biomass burning, use of wood- and cow dung-burning stoves in rural homes and the use of coal in home heating.

Ramanathan and his team linked the brown cloud to an observed acceleration of glacial melt in the Himalayas. Himalayan glaciers provide billions of people in Asia with their drinking water.

In CAPPS, the Scripps team hopes to determine how much of Southern California's air pollution comes from Asia, Mexico and from regions north of California. Scientists routinely observe aerosol masses traveling across the Pacific Ocean to the West Coast but are still trying to understand the effects of that pollution. The imported smog is only one of several sources of atmospheric aerosols in Southern California, joining local auto and industrial emissions and smoke from wildfires. Researchers have seen evidence that this air pollution can mix with falling snow and accelerate its melt when sunlight hits and warms the "dirty" snow in mountain watersheds.

"Black carbon and ozone are two major contributors to global warming, next to carbon dioxide," said Ramanathan. "We hope to document the vertical profiles of black carbon and ozone and their climate warming effects for the first time over California, and this data will likely help California reduce its global warming commitment."

The California Energy Commission's Public Interest Energy Research (PIER) program will employ CAPPS results in an analysis of the

potential future economic and ecological consequences of Southern California air pollution. Scientists also hope to combine CAPPS results with satellite data to better understand the role of aerosols at a larger regional scale.

“As we learn more about the air we breathe and seek solutions to reduce greenhouse gases, this important atmospheric research will help us address the serious challenges to California’s water resources, ecology, and the health of our residents,” said Energy Commissioner Arthur Rosenfeld. “With this study, California continues to demonstrate its commitment as a national leader in climate change research.”

The aircraft will profile atmospheric conditions at altitudes ranging between 2,000 and 12,000 feet. Because of Federal Aviation Administration regulations that prohibit unmanned aircraft from flying in public airspace, the flight paths will be limited to military airspace, which is exempted from FAA rules. The researchers hope to conduct the flights at least once a month or as often as every two weeks. The Scripps team also hopes to gather data on a situational basis such as during wildfires.

Source: University of California - San Diego