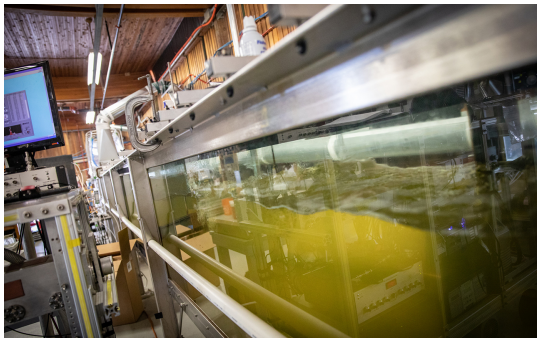
UC San Diego
UC San Diego News Center

September 10, 2018 | By Robert Monroe

NSF Awards $20 Million for Continued Study of Aerosols at UC San Diego

UC San Diego's largest center gets five-year extension

The National Science Foundation (NSF) has renewed a groundbreaking University of California San Diego atmospheric chemistry research program with a $20 million grant that will support operations for a second five-year period.



Aerosol research at wind-wave tank at Scripps Institution of Oceanography at UC San Diego. Researchers are planning to install a larger, more sophisticated tank at the Scripps Hydraulics Lab in coming years.

The grant will enable the NSF Center for Aerosol Impacts on Chemistry of the Environment (CAICE) to launch new studies into how pollution interacts with natural ocean-produced aerosols such as sea salt and microbes to influence the chemistry of the atmosphere, particularly in an era of rapid climate change such as the planet is currently experiencing.

CAICE, the largest federally funded center in the history of UC San Diego, developed a novel laboratory facility in its first five years of existence. There it has reproduced the physical, biological and chemical complexity of the ocean-atmosphere system. The CAICE approach of bringing the real world ocean-atmosphere into the laboratory has enabled focused studies on one of the largest natural sources of aerosol particles. When waves break, salts and other other living material including viruses and bacteria are launched in the form of sea spray aerosols into the atmosphere. Scientists are interested in better understanding the role of these particles in controlling climate by forming clouds over oceans that cover nearly three-quarters of the earth's surface.

With this extension, center leaders say that the next phase of research will include experiments to determine how pollution from human activities interact with natural ocean emissions and change the chemical composition of the atmosphere. CAICE fundamental aerosol studies will

provide insights into how ocean biological emissions are influencing atmospheric temperatures which are leading to heat waves, as well as intense weather extremes leading to drought and flooding.

“In the first five years, we have established a unique approach for studying the complex ocean-atmosphere system by delving deeply into how natural ocean biology processes affect the chemical composition and evolution of our atmosphere,” said CAICE Director Kim Prather, Distinguished Chair in Atmospheric Chemistry and a faculty member at Scripps Institution of Oceanography and the Department of Chemistry and Biochemistry at UC San Diego. “We are now poised to take the next step and add in the effects of human activities, directly addressing which processes most strongly influence the composition of our atmosphere. Our renewed funding enables us to use an ocean-atmosphere ‘time machine’ to perform experiments, which can help us better predict how our planet will evolve if we continue on the current trajectory.”

The NSF funding comes at a critical time when scientists are grappling with understanding how human emissions are contributing to the steady increase in extreme weather events and the number of wildfires. The year 2018 has showcased the climate instability that many scientists have predicted since the 1980s. Heat records in several regions across the planet have been shattered this year, and some areas have experienced floods and droughts that are unprecedented in recorded history. In the Arctic Ocean, the thickest areas of sea ice are melting for the first time in the observational record. At Scripps Oceanography, the Shore Stations Program measured the warmest sea surface temperatures ever recorded at the Scripps Pier in its 102-year history.

Along with these environmental changes, the chemistry and the biology of the oceans are changing, with seawater becoming more acidic and warming temperatures leading to increased toxic algal blooms and other potentially hazardous events. CAICE scientists will explore how these changes in the ocean manifest themselves in the atmosphere. These new atmospheric chemical mixtures have the potential to change how clouds form and where rain falls.

Ocean emissions could also profoundly affect the health of people living along coastlines because of more frequent exposure to viruses, bacteria, and potentially toxic compounds created when air pollution mixes with ocean emissions. Upcoming studies will directly begin to address the products of these complex chemical reactions in the unique CAICE facilities.

“As a public research university, UC San Diego is committed to conducting investigations that unlock mysteries, advance the frontiers of knowledge, and benefit our society and planet,” said UC San Diego Chancellor Pradeep K. Khosla. “This center has been a beacon of innovation in its first phase and now will take discovery to the next level in its second phase.”

“The NSF-Center for Aerosol Impacts of Chemistry of the Environment is dedicated to understanding fundamental molecular processes that impact the chemistry of our environment as these processes are often the key to unraveling global impacts,” said CAICE Co-Director Vicki Grassian. “Similar to the pioneering chemistry research of Nobel Prize winner and UC San Diego Professor Mario Molina on the stratospheric ozone hole, researchers within the center are focused on untangling the chemical complexity of the ocean-atmosphere interface, sea-spray aerosol and its chemical evolution once airborne, and the impact this has on the environment using state-of-the-art experimental and theoretical methods.”

The NSF designated CAICE as a Center for Chemical Innovation in 2013 when it granted the center an initial $20 million award for its first five years of operation. The center now partners with 10 other institutions including three in the University of California system.

CAICE researchers are now able to reproduce realistic sea-spray aerosols and study how their composition as well as those of marine gases emitted into the atmosphere evolve during phytoplankton blooms. Most recently, CAICE researchers determined for the first time how only certain microbes in the form of viruses and bacteria are selectively transferred from the ocean into the atmosphere.

In the next phase, CAICE scientists plan to couple a smog chamber to a new state-of-the art wind-wave channel under construction that is slated for initial operation in 2020. Called the Scripps Ocean Atmosphere Research Simulator (SOARS), the facility will enable studies of how winds, temperature, sunlight, and pollution from humans are changing the ocean, and in turn the composition of the atmosphere, clouds, and climate. It will be the only facility in the world capable of simulating future atmospheres with increasing pollution under different ocean conditions to better understand how humans are impacting climate by perturbing the balance of the delicate ocean-atmosphere system, Prather said.

MEDIA CONTACT

Robert Monroe, 858-534-3624, scrippsnews@ucsd.edu

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