Aerosols, Climate and what's happening at the USS Hornet Sea, Air and Space Museum

What are the studies on the USS Hornet Flight Deck Costal Atmospheric Aerosol Research and Engagement (CAARE) Facility?

In order to better study how particles interact with the atmosphere, a team of scientists from the University of Washington have developed tools for generating particles (also called aerosols) of salt from sea water and for measuring their progression through the local atmosphere - the Cloud Aerosol Research Instrument, or CARI (the blue instrument at the end of the Flight Deck). and the scissor lifts on the deck for the instruments. They have developed this on the USS Hornet so that the people could learn more about this kind of research and its relationship to understanding climate change.

CARI generates a plume of mist that travels down the flight deck of the Hornet where measurements are taken using specialized instruments to measure the particles' size and position. The measurements of particles at this localized scale are used to improve models that project how the atmosphere might respond to much larger quantities of aerosol particles at much larger scales.

What is being sprayed, where does it go, and does it affect the environment or climate?

CARI takes pressurized air and salt water as inputs, and generates a plume of tiny droplets of water and salt from its nozzles. The salt inside these droplets are ~1/1000th the width of a human hair. The droplets generated by CARI are 96.5% water and 3.5% sea salt, the same proportion as ocean water. The plume looks like mist, as seen here, because most of its content is water.

The number of salt particle droplets being generated by CARI at the Hornet are enough to be useful for studying their size and how they move through the atmosphere along the deck of the Hornet. There are not enough particles to impact the local environment, change clouds, the weather or climate.
The salt particles in the plume rapidly mix with the air and disperse so that the concentrations decrease rapidly along the Hornet flight deck and beyond.

For these studies, the CARI system is used to generate a sea salt plume briefly (usually 5-15 min and always less than 30 min) up to a few times a day – generally in the morning, when the wind conditions are better for our studies.

Why is this research important?

Clouds in the sky act like mirrors for the sun, reflecting sunlight back into space. By reflecting sunlight away from the Earth, clouds cool down areas directly below them and across the planet. Sometimes, clouds and particles(like salt particles from ocean spray, or pollution) mix together. When these particles mix into clouds, especially clouds floating over the ocean, they can make the clouds brighter. Brighter clouds are stronger mirrors for the sun, reflecting more sunlight back into space and providing more cooling on Earth.

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Today, particles from human pollution are mixing with clouds to create this cooling effect. This is keeping the planet cooler than it would otherwise be, but we do not know by exactly how much.

The Flight Deck studies are designed to understand how a plume of generated sea salt particles from CARI disperses and mixes in with the atmosphere from a source at the surface, as they are transported towards clouds. These studies will help us better model how particles evolve and mix into clouds. This will help us better understand the cooling effects of pollution particles on clouds and climate.

It will also help us research whether the cloud-brightening effects of pollution could be produced more safely and cleanly with sea salt spray delivered into clouds over the ocean, a concept called "marine cloud brightening". There is still a lot of research to be done to understand before we will know if marine cloud brightening is possible, or if it would be a good idea. Scientists are being very careful and patient as they research this topic, and we are excited that these small-scale studies on the Hornet could be helpful to improve and develop computer models that will help understanding of things that happen at larger scales.

Who is performing the science studies on the USS Hornet Flight Deck?

Atmospheric scientists from the University of Washington's College of the Environment Marine Cloud Brightening Program lead these efforts. The MCB Program is a collaboration of these scientists and other experts to study how clouds respond to particles — also called aerosols — in the atmosphere. The University of Washington was recently designated the leading institution for atmospheric science in the world. The overarching goal of their Program is to provide open, objective scientific information to help improve society's ability to understand the climate system and to address near-term climate risks.

The MCB Program is led by atmospheric scientists Robert Wood and Sarah Doherty at the University of Washington, and includes over 40 scientists, engineers and other experts from the UW, SRI International (formerly the Palo Alto Research Center) and non-profit organization SilverLining. The Program also collaborates with researchers at a range of other institutions, including the Pacific Northwest National Laboratory, University of Victoria (Canada), the Desert Research Institute, and the University of Exeter (UK).

How can I learn more?

It is the aim of the MCB Program to foster scientific collaboration and public engagement. With that, the launch of these studies also marks the launch of the Coastal Atmospheric Aerosol Research and Engagement facility, onboard the USS Hornet. We encourage all who are able to visit the CAARE facility at the USS Hornet Sea, Air and Space Museum to learn more about the research that is being conducted. Visitors to the museum can read the exhibit panel that is mounted on the middle shipping container on the Flight Deck, which explains more about the scientific questions that are being studied, the team that is conducting the research, and what is happening on the Flight Deck.

If you are curious to learn more beyond that, visitors can scan the QR code on that exhibit panel with their phone camera (located in the bottom of the leftmost section, next to LEARN MORE), or visit the webpage of the UW Marine Cloud Brightening Program:

https://atmos.uw.edu/faculty-and-research/marine-cloud-brightening-program/.