MARCH 2024

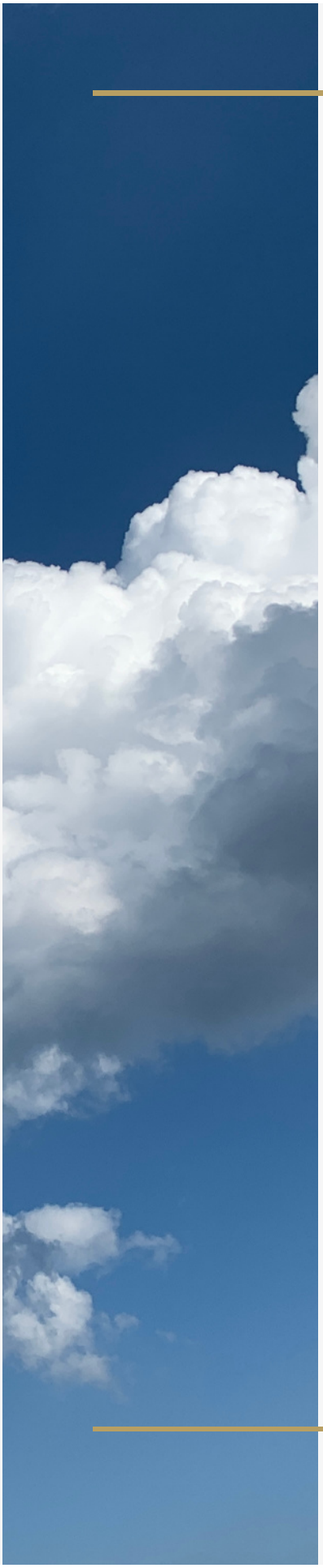
ASSESSMENT OF APPROVAL PROCESSES FOR SMALL-SCALE ATMOSPHERIC SEA SALT PROCESS STUDIES ON THE USS HORNET IN ALAMEDA, CALIFORNIA, UNITED STATES

PREPARED FOR

UNIVERSITY OF WASHINGTON
COLLEGE OF THE ENVIRONMENT

PREPARED BY

FARALLON STRATEGIES



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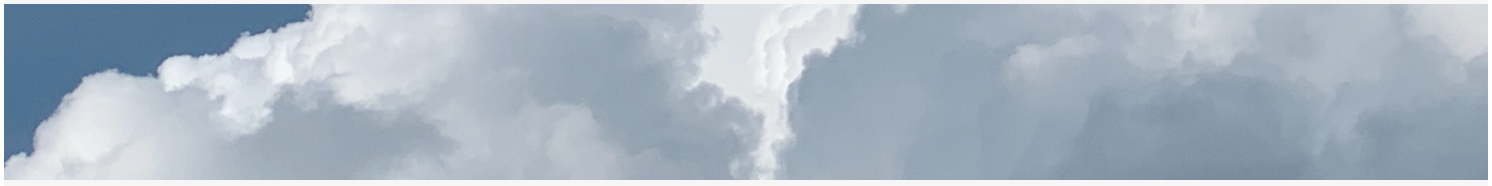
EXECUTIVE SUMMARY

The University of Washington, College of the Environment, Department of Atmospheric Sciences (University of Washington) asked Farallon Strategies (consulting team), a climate resilience focused consulting firm, to evaluate the permitting, regulatory, and process landscape for proposed small-scale atmospheric sea salt process studies located in Alameda, California. These small-scale (less than 100 tons of emissions per year) atmospheric sea salt process studies will involve measuring how a generated sea salt aerosol plume will evolve and be transported in the lower atmosphere. The consulting team supported the development of a preliminary assessment to understand the permitting, regulatory, and process landscape for small-scale atmospheric sea salt process studies. The team reviewed site characteristics, project proposals, operational characteristics, and existing permitting profiles for the San Francisco Bay Area and the proposed Study site in Alameda, California. The unique location and existing operational permits of the USS Hornet support the operation of this limited-scale Study within the existing permitted operations of the facility (14). If small-scale atmospheric sea salt process studies expand beyond the permitted operational boundaries of the United States Ship (USS) Hornet, members of the Study team may need to do additional review of the permitting, regulatory, and process landscape. Appendix A includes a general San Francisco Bay Area-wide assessment of possible approval processes and consultations that may be required or advised for expanded or subsequent studies. Few agencies have specific language related to permitting requirements for small-scale atmospheric sea-salt process studies. Small-scale studies in particular fall below certain regulatory thresholds (<100 tons annually)(12) and produce an aerosol perturbation of a scale that will not measurably alter local or regional weather or climate. Although this specific study falls below the threshold for required permits from the EPA, the research teams seeking to do more studies should continue to work collaboratively with agencies to co-develop more specific permitting language as atmospheric sea salt process studies potentially grow in scale and geographic extent.



STUDY DESCRIPTION

The University of Washington proposes a multi-phase evaluation of the effects of sea salt aerosols on cloud creation, dispersion, and brightness. Each phase will build on the conclusions of the prior phases. This Assessment of site specific considerations evaluates the first phase of the multi-phase study, which includes a temporary, intermittent, small-scale (less than 100 tons annually) series of atmospheric sea salt process studies (Study) located on the USS Hornet. This assessment includes both the activities associated with initiating the Study, and the operational characteristics of the Study. The USS Hornet is a Smithsonian Institute affiliated retired aircraft carrier containing a museum, educational facility, and event space, located in Alameda, California. Educational programs, public events, and opportunities for the research community to engage with the Study will occur in coordination with the University of Washington. Study operational details can be found in Appendix B and C. The proposed Study will measure the effects of sea salt aerosol between 10 to 200 meters from the spray nozzles temporarily affixed to the flight deck of the USS Hornet. Researchers will monitor the effects of the Study within the 0.0024 square mile Study area (the flight deck of the USS Hornet) by attaching sensors to scissor lifts on the deck of the USS Hornet. The Study will not measurably alter local or regional weather or climate. The Study team may place additional temporary sensors within the area of possible dispersion within the property boundary of the USS Hornet and beyond the permit area to monitor any possible effects that may occur outside of the Study area of the USS Hornet.

The first phase of the Study, as outlined in Appendix C, is to measure the effects of sea salt aerosol within a hyperlocal area of the permitted boundaries of the USS Hornet. If the assumed limited geographic extent of the Study differ during the Study period from the anticipated extent (i.e. outside of the property boundary of the USS Hornet), the Study team should consult with appropriate local, regional, and state regulatory agencies to determine applicability of existing permit requirements. If the Study is proposed for expansion, researchers will need to re-evaluate permitting and process requirements. As outlined by Appendix B, the unique location and history of the USS Hornet allows for existing permits that apply to planning, siting, operating, and monitoring related activities to also be applied to the proposed studies. The broader context of possible approval pathways for future or expanded studies in the Bay Area beyond this more streamlined operational dynamic on the USS Hornet is discussed in Appendix A.

DETERMINATION

The following table outlines the agency, approval process point, whether the specific approval process point was required for this specific Study location and scope, and the brief description of why the determination was made. As outlined in the letter from the USS Hornet in Appendix B, the USS Hornet, Sea, Air, and Space Museum is an existing facility with permits that allow for the ongoing operation of the facility as a museum, educational facility, and event space supporting the engagement of an average of 14,000 students and members of the public every year (14). As outlined in Appendix B, the USS Hornet considers the proposed small-scale atmospheric sea salt process Study to be included within their existing permitted operational characteristics. (14). The USS Hornet Staff"...do not have any concerns about any effects to our staff, volunteers, or visitors (especially as visitors will be given the active choice to engage with the project should it be active during the Museum's public hours) or to our artifacts and historic vessel. This is due to the in-depth conversations that we have had with project representatives as well as the fact that the active material used is salt water—something the Museum is used to managing and mitigating on our historic Flight Deck. Nothing within this project exceeds a scale or use of machinery, power, or materials beyond the Museum's usual restoration and operational use or goes beyond the scope of our Use Permit as defined within our pier rental agreement with the City of Alameda." (14).

Table 1. The following approvals are specific to the Study area (Appendix C).

AGENCY	PERMIT OR PROCESS	DESCRIPTION
National Oceanic and Atmospheric Administration Weather Program Office	Initial Report on Weather Modification Activities	An initial report for the USS Hornet was submitted to NOAA Weather Program Office on March 22, 2024. See Appendix C.

Environmental Protection Agency - Clean Air Act and California Air Resources Board	Title V Operating Permit	This Study will be below the 100 ton threshold per year for saline droplets emitted. No permit is required.
Environmental Protection Agency - Clean Water Act	National Pollutant Discharge Elimination System (NPDES) permit	This Study is covered under the USS Hornet's existing permits (14). No waste discharge is anticipated. No additional permits are required.
California State Water Resources Control Board (SWRCB)	Report of Waste Discharge (ROWD)	Salt is not considered under SWRCB definition of "pollutant". No waste discharge is anticipated. No additional permits are required.
California Natural Resources Agency and the Council on Environmental Quality	California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA)	This Study is covered under the USS Hornet's existing operational characteristics and permits and as a result is not a project that triggers additional CEQA and NEPA review (14).
San Francisco Bay Conservation and Development Commission (BCDC)	Abbreviated Regionwide Permit No 3	This Study equipment and effects do not touch San Francisco Bay or any point along the Bay shoreline. No additional permits are required.
Bay Area Air Quality Management District	Permit to Operate (P/O) Certificate of Registration	This Study is covered under the USS Hornet's existing permits (14). No additional permits are required.
City or County Approval	Various City of Alameda and Alameda County permits and processes	This Study is covered under the USS Hornet's existing permits (14). No additional permits are required.

APPENDIX A: GENERAL APPROVALS

General Scope

Representatives from the Study team at the University of Washington asked Farallon Strategies to evaluate the permitting, regulatory, and process landscape for a proposed small-scale atmospheric sea salt process Study located in Alameda, California. The consultant team evaluated requirements for this Study in the context of the specific site characteristics ("Determination" section) and the general permitting landscape in the Bay Area (Appendix A). The general permitting landscape in the Bay Area overview is designed to offer guidance on the approval processes of small-scale atmospheric sea salt process studies for future research in the region, acknowledging site specific considerations will guide any determinations on these future approval processes. This preliminary assessment provides an opportunity to support the ongoing conversation between agencies and researchers about the approval process for small-scale atmospheric sea salt process studies.

Conceptual Study Description

Small-scale atmospheric sea salt process studies can involve using an aerosol source emitter to generate a plume of aerosol suitable for studying how aerosol particles affect cloud albedo, which in turn can affect Earth's surface temperature by altering sunlight reflection. Field studies involving measuring of these atmospheric aerosols can inform model simulations to understand cloud-aerosol effects on a larger scale. The goal of these studies is to better quantify key atmospheric processes that affect the interactions between aerosols and clouds in the climate system. Small-scale atmospheric sea salt process studies may be located in areas in environmental conditions comparable to those found in the open ocean in marine stratocumulus regions.

Process for Assessing Conceptual Studies

The consulting team supported the development of a preliminary assessment to understand the permitting, regulatory, and process landscape for small-scale atmospheric sea salt process studies in the San Francisco Bay Area. Using the general profile of the type of the study assessed in the main body of the report and as outlined in Appendix C, the team reviewed agency websites for permitting

guidelines, engaged with specific topical experts, and reviewed relevant literature to support the preliminary assessment.

The consulting team reviewed materials from the following organizations:

- Environmental Protection Agency (EPA)
- National Oceanic and Atmospheric Administration (NOAA)
- California Air Resources Board (CARB)
- SF Bay Area Air Quality Management District (BAAQMD)[1]
- SF Bay Conservation and Development Commission (BCDC)
- California Governor's Office of Planning and Research (OPR)
- White House Council on Environmental Quality (CEQ)
- International Maritime Organization (IMO)
- City/County/site specific regulations and approval processes

Few agencies have specific language related to permitting requirements for small-scale atmospheric sea-salt process studies. Small-scale studies in particular fall below certain regulatory thresholds (<100 tons annually) (12) and produce an aerosol perturbation of a scale that will not measurably alter local or regional weather or climate. Often permitting language was non-specific to the type of study. The consultant team included this information to establish a complete understanding of potentially applicable regulations. For those areas requiring additional clarity, the consultant team recommends working collaboratively with agencies to co-develop more specific permitting language as small-scale atmospheric sea salt process studies potentially grow in scale.

Recommendations for Future Studies

The following section contains details on the preliminary permitting, regulatory, and process assessment for future small-scale atmospheric sea salt aerosol process studies in the San Francisco Bay Area.

Environmental Protection Agency - Clean Air Act - Title V Operating Permit

Title V Operating Permits are required only if emissions, including particulate matter, from small-scale atmospheric sea salt aerosol process studies outlined in the description exceed 100 tons per year. Particulate matter is defined as a mixture of solid particles and liquid droplets found in the air. This applies to particulate matter (PM)

pollutants with a diameter of 10 microns or less (PM10). If any component of an aerosol solution is PM10 or less and exceeds 100 tons per year of emissions a Title V Operating Permit is required.

Environmental Protection Agency - Clean Water Act - National Pollutant Discharge Elimination System (NPDES) permit

National Pollutant Discharge Elimination System permits are required if a study is discharging pollutants from a point source into waters of the United States. The term "pollutant" is defined in the Clean Water Act as "… chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt… into water."(5) Researchers should consult with the EPA to determine whether the location, scale, and timeframe of future studies necessitates an NPDES permit.

NOAA Weather Program Office - Initial Report on Weather Modification Activities

According to the Department of Commerce and the National Oceanic and Atmospheric Administration, persons who engage in weather modification activities in the United States shall provide reports prior to and after the activity (6). Based on this Act, any activities must be reported with an initial report, if they include: "seeding or dispersing substances into clouds or fog to change drop size, produce ice crystals, affect hail or lightning, or influence cloud development; or modifying solar radiation exchange by releasing gases, dusts, liquids, or aerosols into the atmosphere."(6). Sea salt aerosol process studies are required to be submitted to NOAA for disclosure. Section (c) states: "The requirement for reporting shall not apply to activities of a purely local nature that can reasonably be expected not to modify the weather outside of the area of operation. This exception is presently restricted to the use of lightning deflection or static discharge devices in aircraft, boats, or buildings, and to the use of small heat sources, fans, fogging devices, aircraft downwash, or sprays to prevent the occurrence of frost in tracts or fields planted with crops susceptible to frost or freeze damage. Also excepted from the requirement for reporting are religious activities or other ceremonies, rites and rituals intended to modify the weather." (11). For future studies in the region, the consultant team recommends researchers contact relevant NOAA Weather Program officials for further clarification on the definition of "purely local in nature" for their specific study.

International Maritime Organization: London Convention and Protocol

The London Convention ("Convention") and Protocol ("Protocol") are international agreements to regulate the dumping of wastes and other matter into ocean waters to protect marine environments. The Convention prohibits the dumping of certain hazardous materials at sea, and the Protocol strengthens the regulations of the Convention by extending the prohibition of dumping to additional materials and imposing stricter controls on waste disposal. The water of San Francisco Bay is not considered ocean waters as defined in the Convention and Protocol and is is not applicable to studies within this specific geography (13).

Other Relevant Requirements for Future Studies

In addition to the processes outlined above, the following state and local agencies have permits that could be relevant to small-scale atmospheric sea salt process studies. The consultant team suggests researchers consult with agencies to discuss specific requirements and potentially improve clarity on policies. For California, the relevant agencies include the California State Water Resources Control Board (SWRCB), and the California Air Resources Board (CARB), but may include others depending on specific site characteristics, location of equipment, adjacent uses, time of operation, or other considerations.

For the California State Water Resources Control Board (SWRCB), the relevant process is the Report of Waste Discharge (ROWD). According to the SWRCB, if proposed activities result in discharges that could impact California's surface, coastal, or ground waters, the organization proposing the activities could need a permit from the Regional Water Quality Control Board. A complete list of activities that may require a permit can be found on the SWRCB website (10).

Depending on the funding source, location, scale, timeframe, and existing permits related to proposed study sites, some atmospheric sea salt process studies could be considered a project under the National Environmental Policy Act (NEPA) and/or the California Environmental Quality Act (CEQA). If found to be a project under NEPA and/or CEQA,

the project team would be required to complete an environmental assessment consistent with respective regulatory constructs and guidance from lead agencies to determine if there are any significant environmental impacts of the study on the environment. Each study site location would require site specific assessments to be conducted if the study is a project requiring environmental review/assessment as defined in the CEQA statute and NEPA Code of Federal Regulations. In some cases, if both CEQA and NEPA are required, a combined assessment may be appropriate to consider (1). Smaller scale atmospheric sea salt process studies may be considered exempt from environmental review or covered under existing permits and mitigations (14).

The San Francisco Bay Conservation and Development Commission (BCDC) may require an Abbreviated Regionwide Permit No. 3. The details of the permit indicate if an organization is planning to build or somehow pursue a project that touches San Francisco Bay or touches any point along the Bay shoreline in the following Bay Area counties (see list) the organization may need to apply for a permit from BCDC prior to commencing the project. An Abbreviated Regional Permit No. 3 may be needed for temporary installations in the San Francisco Bay, certain waterways, managed wetland, and shoreline band (9).

City or county regulations or approval may be required to plan, locate, or operate small-scale atmospheric sea salt process studies. The following city or county regulations and approval processes may apply depending on a variety of factors, including: planning permits, design review, noise contour studies and permits, special permits, historical review board evaluation, zoning board review, community workshops, building permits (including electrical, plumbing, wastewater, etc.), review by transportation agencies, assessment of fair share fees, and others. Research teams are encouraged to consult with local permitting authorities in advance of a project to have clarity on any possible approval processes required and refine study designs to accommodate these processes.

Additional Recommendations for Future Studies

This initial assessment focuses on the broader San Francisco Bay Area considerations for permitting, regulatory, and process requirements for researchers conducting small-scale atmospheric sea salt aerosol process studies. The consultant team recommends collaborating with agencies and policymakers to develop a shared understanding for future studies, using small-scale studies to inform permitting or process clarity that may be applied to future studies, both small-scale and larger scale in nature. This collaborative effort could involve engaging stakeholders, sharing research findings, and collectively shaping guidelines and regulations to govern the implementation of atmospheric sea-salt process studies. By proactively addressing permitting requirements, working closely with agencies, and fostering transparency these studies can move forward for the benefit of the research community and the policymakers that rely upon that science to make informed decisions.

APPENDIX B: USS HORNET SUPPORT LETTER

USS HORNET
Sea, Air & Space Museum Alameda, California

20 March 2024

To Whom it May Concern,

My name is Laura Fies and I am Executive Director of the USS Hornet Sea, Air & Space Museum, the host site for the Marine Cloud Brightening project being undertaken by the University of Washington, SilverLining, and other partners.

As the study has been described to us, creating a mist of salt water that will be monitored for the length of our Flight Deck (with additional monitoring stations potentially located in our visitor parking lot), the Hornet Museum is comfortable with the project operating during the hours that the Museum is closed to the public and while the Museum is open to the public so long as signage is posted alerting our visitors to the spray.

We do not have any concerns about any effects to our staff, volunteers, or visitors (especially as visitors will be given the active choice to engage with the project should it be active during the Museum's public hours) or to our artifacts and historic vessel. This is due to the in-depth conversations that we have had with project representatives as well as the fact that the active material used is salt water—something the Museum is used to managing and mitigating on our historic Flight Deck. Nothing within this project exceeds a scale or use of machinery, power, or materials beyond the Museum's usual restoration and operational use or goes beyond the scope of our Use Permit as defined within our pier rental agreement with the City of Alameda.

We are looking forward to hosting the Marine Cloud Brightening project, particularly in terms of their interest in outreach and education. The Museum sees an average of 14,000 students through our educational programming every year, and we are excited to integrate information about this groundbreaking research in accompaniment to our traditional STEM workshops.

Best,

Laura Fies
Executive Director
USS Hornet Sea, Air & Space Museum
Laura.Fies@uss-hornet.org

APPENDIX C: NOAA FORM AND SITE DETAILS

NOAA FORM 17-4 (4-81) — U.S. DEPARTMENT OF COMMERCE — NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Form Approved OMB Control No. 0648-0025
Expires 05/31/2021

INITIAL REPORT ON WEATHER MODIFICATION ACTIVITIES

This report is required by Public Law 92-205; 85 Stat. 735; 145 U.S.C. 330b. Knowing and willful violation of any rule adopted under the authority of Section 2 of Public Law 92-205 shall subject the person violating such rule to a fine of not more than $10,000, upon conviction thereof.

Complete in accordance with instructions on reverse and forward one copy to:
National Oceanic and Atmospheric Administration
Office of Oceanic and Atmospheric Research
1315 East-West Highway, WWMC-3, Rm 11216
Silver Spring, MD 20910

1. PROJECT OR ACTIVITY DESIGNATION, IF ANY
CAARE

2. DATES OF PROJECT
a. DATE FIRST ACTUAL WEATHER MODIFICATION ACTIVITY IS TO BE UNDERTAKEN: April 2, 2024
b. EXPECTED TERMINATION DATE OF WEATHER MODIFICATION ACTIVITIES: May 24, 2024

3. PURPOSE OF PROJECT OR ACTIVITY
Study sea salt plume evolution & transport in marine boundary layer

4. (a) SPONSOR

NAME	AFFILIATION	PHONE NUMBER	STREET ADDRESS	CITY	STATE	ZIP CODE
Sarah Doherty, PhD	UW College of the Environment	206-543-6674	Ocean Science Bldg, 1492 NE Boat St	Seattle	WA	98105

4. (b) OPERATOR

NAME	AFFILIATION	PHONE NUMBER	STREET ADDRESS	CITY	STATE	ZIP CODE
Same as Sponsor						

5. TARGET AND CONTROL AREAS (See Instructions)

TARGET AREA LOCATION	TARGET AREA SIZE OF AREA	CONTROL AREA LOCATION	CONTROL AREA SIZE OF AREA
Alameda, CA	.0024 SQ. MI	Alameda, CA	.0024 SQ. MI

6. DESCRIPTION OF WEATHER MODIFICATION APPARATUS, MODIFICATION AGENTS AND THEIR DISPERSAL RATES, THE TECHNIQUES EMPLOYED, ETC. (See Instructions)

A ground-based instrument will generates droplets of 3.5% sea salt water, made with a sea salt standard and purified water. Generated aerosols have dry aerosol size of peak=50nm, sigma=2.5. Emission rate: 200g/sec of saline droplets, or 7g/sec sea salt. System will typically run less than 30min at a time, for a total of 360 kg of saline droplets or 12.6 kg of salt. The generated aerosol size and concentration will be measured in-situ at distances approx. 15m, 100m & 200m downwind of the source, at heights of 2-30m above the surface, using miniSEMS & miniOPCs, and at one of the stations also with full-sized SEMS, OPS

7. LOG BOOKS *Enter name, affiliation, address, and telephone number of responsible individual from whom log books or other records may be obtained.*

NAME	AFFILIATION	PHONE NUMBER	STREET ADDRESS	CITY	STATE	ZIP CODE
Sarah Doherty, PhD	UW College of the Environment	206-543-6674	Ocean Science Bldg, 1492 NE Boat St	Seattle	WA	98105

8. SAFETY AND ENVIRONMENT

☐ YES	☑ NO	Has an Environmental Impact Statement, Federal or State, been filed? If yes, please furnish a copy as applicable.
☑ YES	☐ NO	Have provisions been made to acquire the latest forecasts, advisories, warnings, etc., of the National Weather Service, Forest Service, or others when issued prior to and during operations? If yes, please specify on a separate sheet.
☐ YES	☑ NO	Have any safety procedures (*operational constraints, provisions for suspension of operations, monitoring methods, etc.*) and any environmental guidelines (*related to the possible effects of the operations*) been included in the operational plans? If yes, please furnish copies or a description of the specific procedures and guidelines.

9. OPTIONAL REMARKS (See instructions. Use Separate Sheet).

CERTIFICATION: I certify that all statements in this report on this weather modification project are complete and correct to the best of my knowledge and are made in good faith.

NAME OF REPORTING PERSON: Sarah Doherty, PhD
AFFILIATION: UW College of the Environment
SIGNATURE: Sarah J. Doherty
STREET ADDRESS: Same as Sponsor
OFFICIAL TITLE: Program Director
CITY / STATE / ZIP CODE:
DATE: 3/22/2024
PHONE NUMBER: 206-543-6674

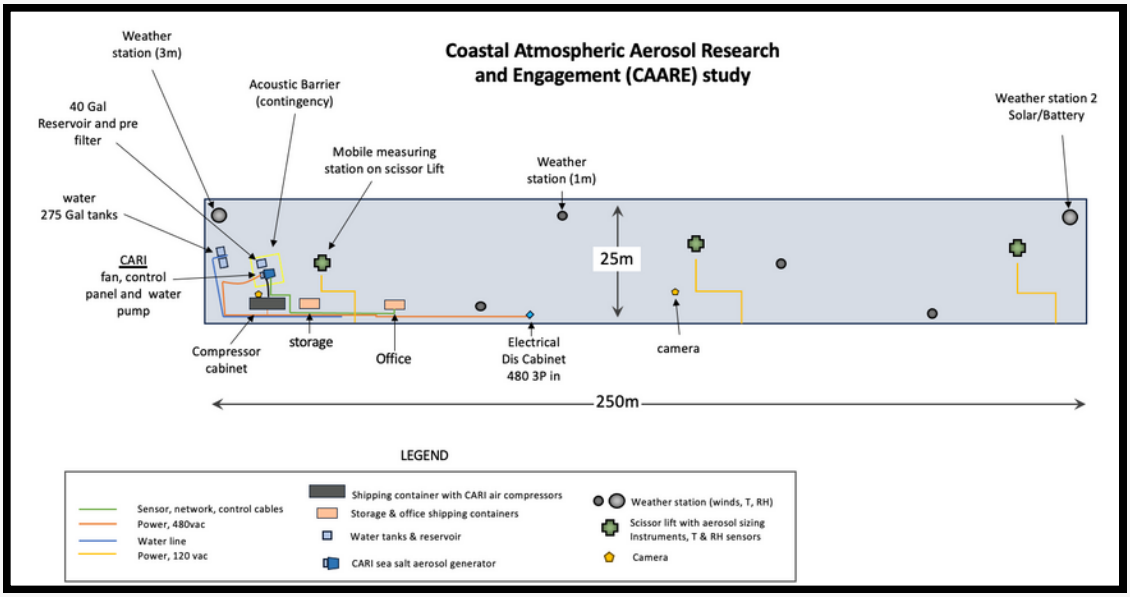


Image 1. **Coastal Atmospheric Aerosol Research and Engagement (CAARE) Study.** This diagram details the name and layout of instruments for a small-scale sea salt process study on the flight deck of the USS Hornet Ship, located in Alameda County.

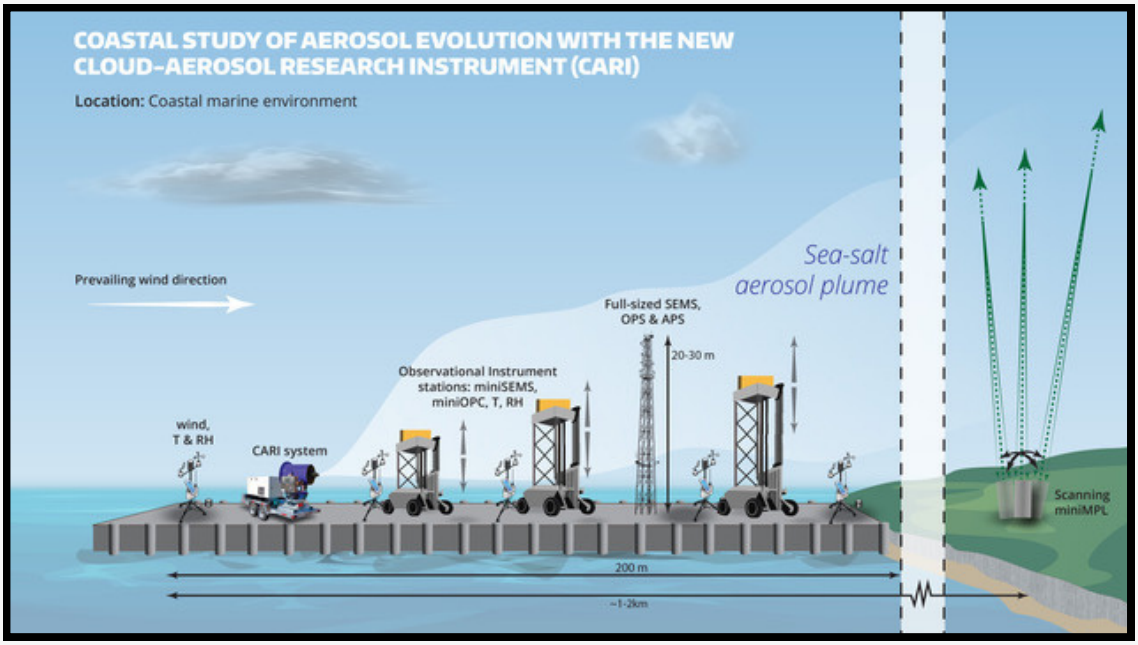


Image 2. **Coastal Study of Aerosol Evolution With The New Cloud-Aerosol Research Instrument (CARI).** This diagram shows the general layout of instruments for a small-scale sea salt process Study on a pier or similar surface in a coastal zone.

CITATIONS

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14. Email Correspondence with the USS Hornet Director