**EXHIBIT A**

**SCOPE OF WORK**

☒ Contract ☐ Grant

Does this project include Research (as defined in the UTC)? ☒ Yes ☐ No

**PI Name:** Amato Evan

**Project Title:** Dust on the Horizon: Assessing Current and Projecting Future Health Risks from the Shrinking Salton Sea

**Project Summary/Abstract**

Dust storms are common in the Imperial and Coachella Valleys, where the arid landscape conspires with frequently gusty winds to loft dust into the atmosphere. However, the shrinking Salton Sea is driving increasing dust emissions from the growing playa. This represents a unique challenge for the communities of the Imperial and Coachella Valleys, particularly since dust emitted from the playa may be enriched with contaminants from historical agricultural and industrial activity. This project will address the following critical research questions:

1) What communities are exposed to dust from the Salton Sea playa?

2) What is the composition of the dust from the most emissive parts of the playa and what are the potential health impacts from exposure to this dust?

3) How will exposure to playa dust change as the sea continues to shrink and the climate continues to warm?

4) In which regions of the playa would dust suppression activities be most effective in terms of protecting human health?

5) What steps can people take to effectively reduce their exposure to dust?

The research team is comprised of researchers at the University of California, San Diego (UCSD), University of California Berkeley (UCB), University of California Davis (UCD), University of California, Los Angeles (UCLA), University of California Merced, (UCM), University of California, Riverside (UCR), and San Diego State University (SDSU). The research team, in consultation with the California Air Resources Board (CARB), will identify and engage with a Community Based Organization (CBO), (“community partner”) in the Salton Sea area which, together, will comprise the project team.

The project will answer the research questions by combining in-situ measurements, laboratory analysis, advanced numerical modeling, and a health exposure assessment. At the end of this project, the research team will identify potential contaminants of concern in the playa dust, identify the potential health effects associated with exposure to this dust, provide vulnerable communities recommendations to reduce their exposures, and estimate how exposure and the potential health risks will change in the future, with the goal of proposing mitigation strategies to agencies aimed at minimizing public health risk. The project team will collaborate in engaging people living in Salton Sea-area communities in research activities. The public benefit of this work will create better-informed communities in terms of health risks associated with dust exposure,

and describe how those risks are likely to change in the future, while promoting more data informed decisions to reduce those health risks. The benefit to the State of California will be new information that can be used to guide current dust suppression efforts on the playa, and an assessment of how dust in the area is likely to change in the future, providing critical information for long-term planning.

**If Third-Party Confidential Information is to be provided by the State:**

☐ Performance of the Scope of Work is anticipated to involve use of third-party Confidential Information and is subject to the terms of this Agreement; ***OR***

☐ A separate CNDA between the University and third-party is required by the third-party and is incorporated in this Agreement as Exhibit A7.

## Statement of Significance

Airborne dust poses a significant health risk, as particulate matter (PM) can penetrate deep into the lungs, and the smallest particles can enter the bloodstream, causing oxidative stress, inflammation, and immune response issues.[1–3] Epidemiological evidence links dust exposure to respiratory illness (e.g., difficulty breathing, coughing, decreased lung function, exacerbated asthma, chronic obstructive pulmonary disease (COPD)) and cardiovascular disease (e.g., heart attacks, strokes).[2,4–7] Dust may also contribute to allergic and atopic conditions, including eye diseases, by acting as an allergic adjuvant and enhancing allergic responses.[2,5] Additionally, dust is a complex mixture and can includes toxic pesticides and heavy metals like lead, arsenic, and cadmium, leading to chronic toxicity, endocrine disruption, and increased cancer risks.[8] These contaminants can accumulate in the body, affecting neurological development, immune function, kidney health, and blood cell production.[9–12] Emerging research also associates dust exposure with adverse birth outcomes, affecting infant health and development.[13–19] One growing source of dust in Southern California is the Salton Sea. This terminal lake was accidentally created in 1905 during an attempt to irrigate the southern portion of the Imperial Valley. But after decades of the lake level being largely maintained by agricultural runoff, the volume of the sea has been declining due to a 2003 water transfer agreement that resulted in diversion of water from the sea, with climate change (e.g. drought, extreme heat) simultaneously exacerbating water loss from the Salton Sea. Consequently, the size of the Salton Sea is rapidly declining[20], and the resulting growth in exposed playa is leading to increasing concentrations of dust throughout the region[21]. Consequently, the size of the Salton Sea is rapidly declining[20], and the resulting growth in exposed playa is leading to increasing concentrations of dust throughout the region[21]. Dust from the expanding Salton Sea playa, potentially enriched with contaminants like pesticides and heavy metals, poses unique and under-studied health risks. Limited epidemiological research suggests elevated incidence of respiratory issues in the surrounding populations, such as asthma and COPD, especially among children.[6,7,22] This finding reinforces the need to better quantify the health impacts of playa dust exposure. Identifying vulnerable groups, including children, the elderly, those with pre-existing health conditions, and socioeconomically disadvantaged communities, is particularly important due to their potentially higher exposure levels and susceptibility to the playa dust's adverse effects. Comprehensive research is essential to understand these specific health impacts and guide public health interventions and policies for at-risk populations.

This work speaks directly to the Emission Reduction Strategies for the Imperial Valley described in the CARB Research Division's 2021-2024 Triennial Research Plan. More specifically, this project will improve understanding of the contribution of playa, desert, and agricultural

## Technical Plan

The main goals of the project are to identify current and to estimate future health impacts of dust in the Imperial and Coachella Valleys. The work plan consists of three overlapping components: (i) modeling playa

and desert dust emissions, (ii) measuring the inorganic and organic characteristics of soil and dust, and (iii) assessing the potential for health impacts associated with dust exposure. The goals of each of these three components, their interconnected goals, and their relationship to the main project goal is illustrated in Figure. 1. Describes the project methodology, which is organized by discrete tasks.

**Task 1: Literature Review**

The research team will conduct a literature review to identify relevant published work and databases on dust emissions, public health issues and contamination of environmental media related to the Salton Sea region. The research team's initial literature review will include a review of the general impacts of dust exposure and dust storms on human health, and another review of studies conducted in the region of interest (Imperial and Coachella Valleys). The literature review will be conducted using online databases, such as Google Scholar, PubMed, and Web of Science. Keywords will be developed based on the research team's expertise. Backward and forward snowballing will be employed to identify other relevant studies that do not appear in the keyword search. Preliminary inclusion criteria include peer-review journal articles published within the last ten years and written in English.

In summary, the planned search criteria for the literature review as follows:

1. Databases
   a. PubMed,
   b. Google Scholar,
   c. Web of Science, and
   d. Snowballing

2. Keywords will include:
   a. Dust Storm,
   b. Salton Sea,
   c. Health Impacts,
   d. Environmental Impacts,
   e. Dust Composition,
   f. Soil Composition, and
   g. Others to be identified by the research team

3. Inclusion Criteria
   a. Published in peer-reviewed journal,
   b. Published in last ten years, and
   c. Written in English

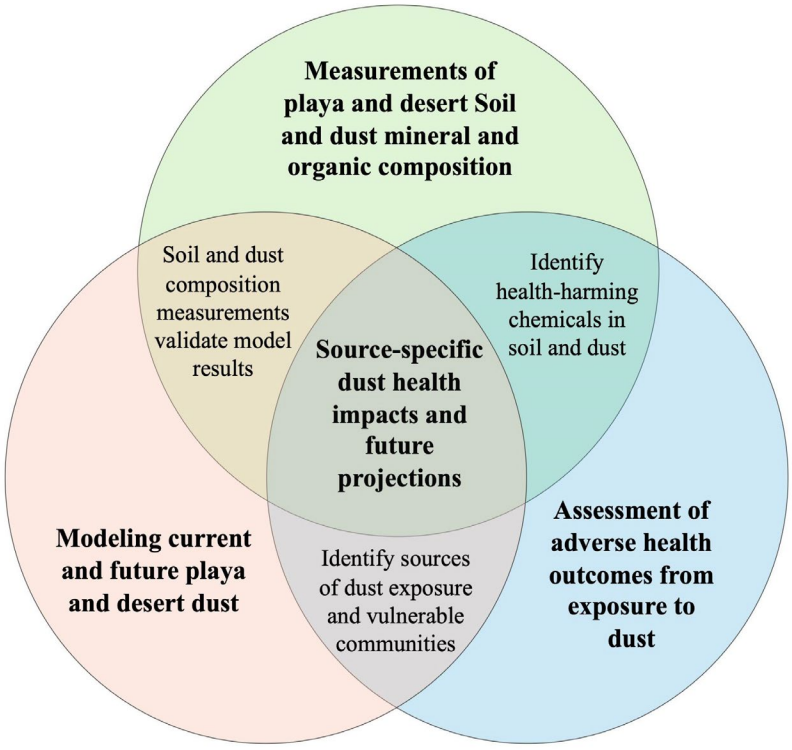



**Figure 1.** Venn diagram showing how the modeling (orange), measurement (green), and health assessment (blue) components of the project work together to achieve the main project goal of estimating source-specific dust health impacts.

**Task 1: Deliverable**

The research team will provide CARB with an Endnote database of the articles used in the literature review.

**Task 2: Community Engagement Plan**

In accordance with the principles of Community-Based Participatory Research, the research team will meet with and solicit input from members of the public, academic researchers, and community partners during project planning, implementation, and conclusion of the project.

**Task 2a: Development of Community Partnership**

The research team, in consultation with CARB, will identify and engage with a community-based organization in the Salton Sea area with the goal of mutual sharing of information about the research project. The CBO will serve as the local point-of-contact for residents seeking information about the research project. The CBO and research team) will maintain open communication during the project. The research team, in consultation with CARB will identify the CBO. The research team and CBO will create a written agreement outlining the different roles and responsibilities of the CBO and research team during the project period. The research team will also create a timeline of the public meetings to be held during the project period.

**Task 2a Deliverables**

The research team will submit to CARB a written agreement outlining the different roles and responsibilities of the CBO and research team.

The research team will also submit to CARB a timeline of the public meetings.

**Task 2b: Public Meetings and Community Outreach**

The research team and CBO will develop, advertise, promote, and deliver online public meetings to engage with residents of communities in the Salton Sea-area about the research project during project planning, implementation, and completion phases. During the online public meetings, the project team will solicit input on residents' specific questions and concerns about exposure to dust from Salton Sea, including health-related concerns. At the end of this project, the project team will convene an online public meeting where research findings and relevant exposure mitigation strategies based on community-identified areas of need will be discussed.

The research team will also actively seek out and identify other opportunities to present information about the research project to residents and other stakeholders in the Salton Sea region, including, but not limited to Assembly Bill 617 Workgroup and local air district meetings, during the early stages of and at the completion of the project.

The CBO will assist the research team in the development of public meeting agendas and informational materials about the research project, including Spanish translation as needed. Public meeting agendas and informational materials, including PowerPoint presentations, will be provided to CARB at least one week prior to the public meeting. The CBO will write develop a summary of each public meeting to CARB and the research team within one week following the meeting and will record the online public meetings via YouTube.

**Task 2b: Deliverables**

The project team will submit to CARB public meeting agendas and informational materials, including PowerPoint presentations, at least one week prior to the public meeting.

The CBO will submit to CARB the meeting summary of each online public meetings and a link to the YouTube recordings to CARB and the research team no later than one week after the online public meetings.

**Task 2c: Data Collection and Information Reporting**

As needed, the research team and CBO will collaborate to develop research materials, such as questionnaires or surveys, and assist with the development and maintenance of informational materials, such as flyers and webpages.

The research team and CBO will also collaborate to identify and develop the pathways for information dissemination to affected communities in the Salton Sea area. Plain-language Frequently Asked Questions,

project webpage(s), and other information resources will be developed in response to information needs identified in the public meetings and other stakeholder interactions.

**Task 2c: Deliverables**

The project team will provide CARB with a copy of any research materials, such as questionnaires or surveys, flyers and links to webpages at least one week prior to the public meeting. The project team will submit to CARB with a copy of the plain-language frequently asked questions, all other information resources developed in response to information needs identified in the public meeting and other stakeholder interactions.

The CBO will provide CARB and the research team a final report that is a summary document describing their activities as part of the project, an overview of input from meeting participants, and any "lessons learned" from the experience of working with CARB and the research team.

**Task 3: Data Acquisition Plan**

**Task 3a: Existing Data Sources to be Used in the Project**

1. The research team will collect data from a number of sources for use in the project. The sources include: Meteorological and air quality data from: CARB Air Quality and Meteorological Information System, Borrego University of California, Irvine dust monitoring network, Identifying Violations Affecting Neighborhoods environmental monitoring system, MesoWest, Department of Water Resources, UCSD Salton Sea digital archive.

2. Surface characteristics measurements and emission estimates from the Salton Sea Air Quality Mitigation Program Data Portal. The research team will also explore obtaining soil composition data from sources listed in the 2024 Salton Sea Monitoring Implementation Program Annual Work Plan.

3. National Oceanic and Atmospheric Administration (NOAA) Environmental Satellite data of dust and clouds, useful for model validation, which are available through the Comprehensive Large Array-data Stewardship System.

4. Zip code-level daily emergency department (ED) visits for the Salton Sea region covering 2015-2022 from the from the California Department of Health Care Access and Information (HCAI). These data include counts of ED visits for all International Classification of Diseases -10 causes, including respiratory illness (asthma, COPD, acute respiratory infection), cardiovascular illness (heart failure, myocardial infarction), cerebrovascular conditions, infectious diseases, allergic skin and eye conditions, accidental injury, mental health, neurodevelopment, endocrine diseases (diabetes), and others. ED visit counts are stratified by age, sex, and race/ethnicity. The research team will obtain access to the HCAI data through a research request. Because the data is de-identified and aggregated to the zip-code resolution, it will be exempt from UCSD Institutional Review Board (IRB) approval.

5. The research team will leverage cleaned, in-hand data from the Study of Outcomes in Mothers and Infants (SOMI), a retrospective administrative cohort that characterizes all births in California from 2005 to present.23,24 The SOMI dataset details maternal health history during pregnancy, birth outcomes, early-life outcomes, and residential address in California over an approximate 18-year period, beginning in 2005, with additional years of new data added as they become available. The research team will extract information on maternal education, payment type for delivery, self-reported race/ethnicity, nativity, parity, and access to prenatal care.

6. Zip code and census tract level demographic and socioeconomic data will be obtained from the American Community Surveys (ACS) 25, including urbanicity, age structure, race/ethnicity composition, median household income, income inequality, highest educational attainment, percent unemployed, percent at

7. poverty level, and households with public assistance income. The research team will utilize the Social Vulnerability Index (SVI),26 which ranks areas based on 16 social factors, and CalEnviroScreen, which identifies communities that are most affected by many sources of pollution and where communities are often especially vulnerable to environmental hazards.

For all health data that is subject to privacy restrictions, the research team will only share county and year-level summary data for the study region from 2015-2022.

**Task 3a Deliverable** The research team will submit to CARB a spreadsheet that includes existing data that will be collected, processed and permanently archived and metadata text, and a new UCSD Library Digital Collection for the project where project data will be permanently archived.

**Task 3b: Soils and Dust Sampling Plan**

The research team will identify eight approximate locations for soil sampling on the dry lakebed designed to include areas where playa growth is significant, dust emission is likely, and/or that are near the major drainages into the sea, including the Whitewater, Alamo, and New Rivers (cyan markers in Figure. 2). Sampling at each location will follow typical procedures (creating a grid, collecting four randomly located samples within each quadrant, mixing the samples). The research team will also identify additional off-playa locations that are representative of the major non-playa dust sources in the region (orange markers in Figure 2). The research team will collect soil samples from three off-playa locations to be determined based on satellite identification of major dust sources in the area. The research team will perform a coordinated investigation of surface soils within each selected field area using a randomized sampling approach. The soils investigation will include site descriptions and the collection of field-based soil measurements as performed previously by the research team[27]. Surface soil samples (zero to ~two centimeters [cm] in depth) will be collected for subsequent soil measurements in the laboratory including soil chemical, physical, and mineralogical analyses given prior research that identified interactions among select pesticides, soil minerals, and soil organic matter.[28–30] For pesticide analysis (organic), soil and dust samples will be collected in United States Environmental Protection Agency certified free of chemical residue amber glass jars. The research team will identify soil morphological properties for the collected surface soil samples (i.e., soil color, structure, rock fragment percent) according to protocols from the Natural Resources Conservation Service[31]. Soil samples (i.e., soil color, structure, rock fragment percent) according to protocols from the Natural Resources Conservation Service[31]. Soil samples will be air-dried and sieved to < two millimeters (mm) to represent the fine-earth fraction required for analysis[32]. Rock fragment percent (> two mm) will also be quantified[32]. Soils will be subsampled for organic carbon and nitrogen analysis, Potential hydrogen (pH), particle size distribution (percent sand, silt, clay), and bulk mineralogical analysis. Total Carbon and Total Organic Carbon will be analyzed by the UCD Analytical Laboratory, and the bulk mineralogical analyses will be assessed using X-Ray Diffraction by the UCD Pedology & Mineralogy Laboratory. Soil pH and particle size distribution will be measured by the Oregon State University Soil Health Laboratory.

The chemical composition of the sampled playa soils may be distinct from that of the emitted dust[33], and thus the research team will assess the potential for contaminants of concern to become airborne via two methods. Firstly, the research will use a dust generator apparatus[34,35] to collect and analyze dust emitted by playa sediment. Soil samples placed in the apparatus are agitated, resulting in dust generation. This dust is then drawn by a vacuum pump from the dust generator into a settling chamber, where $PM_{10}$ and $PM_{2.5}$ are measured, after which the dust collects in a tray for subsequent geochemical analysis. Secondly, the research team will collect airborne dust samples using a Tisch Environmental high volume air sampler at multiple locations in the Imperial and Coachella Valleys. The research team will work with the community partner to identify locations to host the Tisch samplers (Task 2). The research team will also reach out to other facilities (e.g., Sonny Bono National Wildlife Refuge) where the samplers could also be located. The research team will train community members on collection and replacement of filter samples. Dust collected by the air sampler will undergo the same geochemical analysis as for the parent soil, allowing for a source-to-sink analysis of contaminants of concern.

**Task 3b Deliverables** The research team will submit to CARB a spreadsheet of source-specific soil physical and bulk chemical properties obtained from the site and soils analysis, and relevant metadata, which will be permanently archived.

The research team will also submit to CARB a spreadsheet of site-specific $PM_{10}$ per unit soil mass via the dust generator, which will also be permanently archived.

**Task 3c: Possible Contaminants of Concern and Analytical Methods**

Table 1 presents a list of contaminants of concern that may be present in dust emitted from the Salton Sea playa, along with their potential health impacts and the methods used to identify them in soil and dust samples. As agricultural runoff is a major source of water for the Salton Sea, pesticides are a primary concern. Among these, organochlorine pesticides are most likely to be present due to their extreme persistence in the environment and high lipophilicity (strong tendency to bind to organic matter). The organochlorine pesticides listed in Table 1 are well-known persistent organic pollutants with documented toxicities. Three organophosphate pesticides are also included due to their acute neurotoxicity, although their presence may be limited due to rapid degradation. Heavy metals are included due to their persistence and toxicity. Other contaminants of concern to be analyzed may be identified during the literature review.

While the research will focus on measuring the specific contaminants listed in Table 1, the research team will also conduct a non-targeted analysis on the samples to ensure other potential toxic organic contaminants in large abundances are identified. This non-targeted analysis utilizes a comprehensive two-dimensional gas chromatography coupled to time-of-flight mass spectrometry (GCxGC/TOF-MS). Developed by Dr. Eunha Hoh's laboratory at SDSU, this method has proven successful in environmental contaminant monitoring for discovering novel contaminants and performing comprehensive chemical analyses[36]. The method collects and analyzes thousands of chromatographic features with full-scan mass spectra, enabling the screening and identification of hundreds to thousands of organic chemicals in a single sample. A detailed description of the method can be found in previous studies by the Hoh research group.[37–40] Following the non-targeted analysis of a subset of dust samples, a final list of organic contaminants will be determined. Organic contaminants (primarily organohalogen pesticides and potentially some organophosphate pesticides) will then be analyzed by gas chromatography/mass spectrometry, while heavy metals (excluding mercury) will be analyzed by

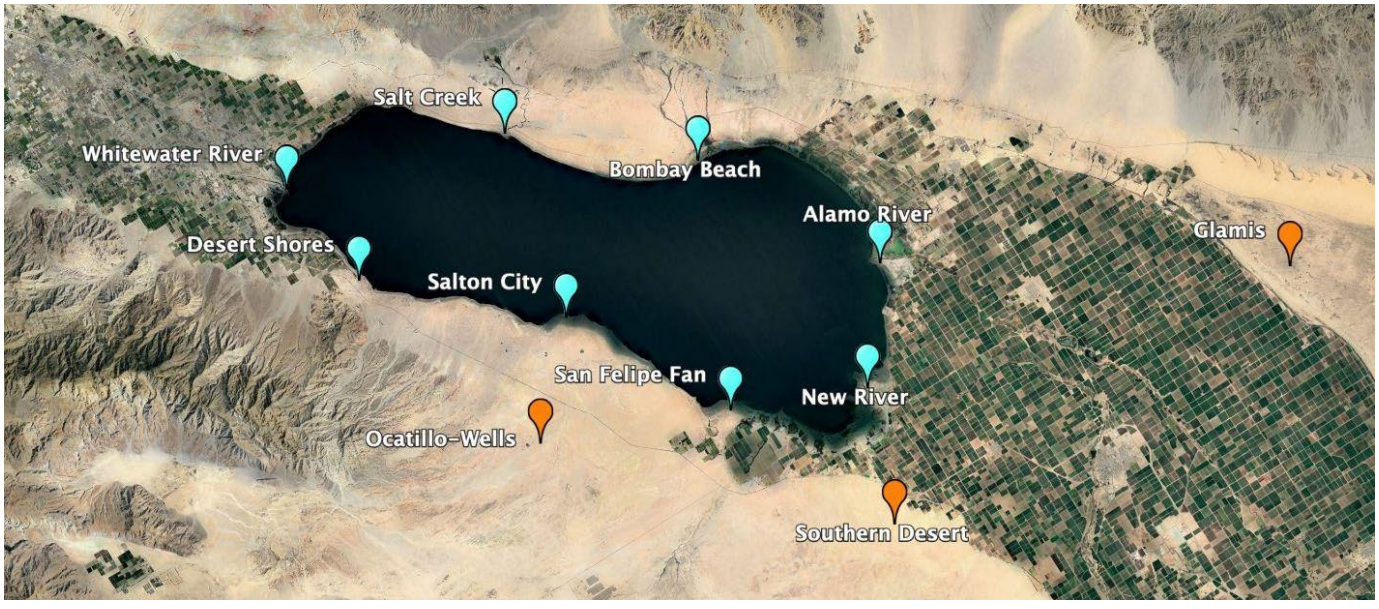



**Figure 2.** Shown are approximate locations where soil sampling from playa dust sources (cyan markers) and off-playa dust sources (orange markers) will take place. Off-playa markers indicate major dust source regions and not precisely where sampling will occur. Exact locations for soil sampling will be based on conditions when the sampling takes place. Airborne dust samples will also be collected at TBD locations surrounding the Salton Sea via two Tisch high volume air samplers.

| Category | Contaminant | Potential Health Impacts |
|---|---|---|
| Legacy Pesticides | DDT, chlordane, heptachlor, Hexachlorobenzene, toxaphene, mirex, lindane, dieldrin | Linked to cancer, reproductive and developmental toxicity, immunotoxicity, and endocrine disruption |
| Organophosphate pesticides | chlorpyrifos, diazinon, malathion | Neurotoxicity, cognitive deficits, developmental delays, and potential links to cancer |
| Heavy metals | arsenic, cadmium, copper, chromium, lead, molybdenum, nickel, zinc, mercury, and selenium | Respiratory and cardiovascular disease, neurotoxicity, cancer, kidney damage, immunotoxicity, reproductive and developmental toxicity |

Table 1. List of regional contaminants of concern (based on literature review) and their potential health impacts.

Inductively Coupled Plasma Mass Spectrometry (ICP-MS) in Dr. Hoh's laboratory at SDSU.[41–43] Mercury will be analyzed at the Scripps Institution of Oceanography via Direct Mercury Analyzer.

**Task 3c Deliverables**

The research team will submit to CARB a spreadsheet indicating the collection-site specific quantitation of the target analyses (including pesticides and heavy metals, Table 1) in the dust and soil samples, along with the relevant metadata. These will be permanently archived in the UCSD Digital Collection for the project.

**Task 4: Health Risk Characterization**

**Task 4a: Dust Emission and Transport Modeling**

Using regionally categorized emissive sources derived in part based on soil sampling and modeling performed in Task 3, the research team will run regional Weather Research and Forecasting (WRF-Chem) chemical transport modeling simulations focused on windblown dust emissions and transport in the study domain.[44] While atmospheric chemistry will not be a focus of the modeling efforts, the chemical transport model aspect of this coupled platform will allow the research team to track the emissions and transport of dust in the model domain, using online dynamics provided by the underlying WRF platform. Beginning with historical dust events for model evaluation and optimization, the research team will then run simulations to cover the full study period, providing support and context for study period dust emissions and observations.

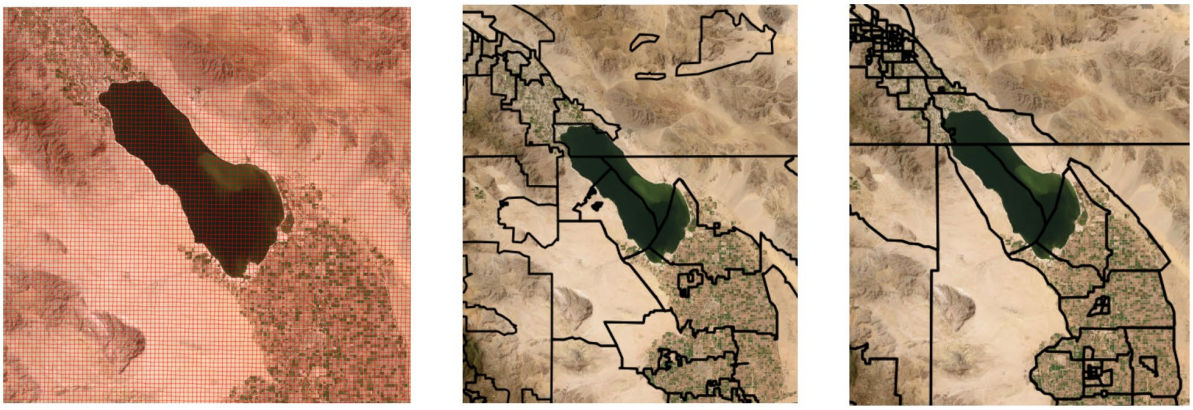



**Figure 3. Salton Sea study region.** The daily WRF-modeled source-specific dust concentrations will be estimated at the 1km grid resolution. Daily counts of emergency department visits are provided by HCAI at the zip code resolution. Neighborhood-level vulnerability indicators, including from SVI and CalEnviroScreen, will be obtained at the census tract resolution.

As with previous modeling efforts[45], the research team will use a nested domain approach to increase modeled resolution (down to one kilometer [km] for innermost domain) over regions of particular interest for

spatially resolving emissions and exposure estimates, while also including emission and transport processes over more remote locations. Note that these nested domains will be coupled, allowing dust emitted from those remote locations to travel into the smaller, more finely resolved nests, and for these sources to be included in the resulting analyses. Starting with a previous version of the model that has been used to study dust in the region,[45,46] the research team will update land surface properties using current in situ and remote sensing data products, optimize and validate atmospheric dynamics, evaluate dust emission and physics parameterizations, and separate modeled dust by source region and surface type to obtain a source-specific windblown dust data product. These improvements will address previously identified issues with modeled dust emissions and transport in the region. The research team will validate and optimize resulting dust exposure estimates using total and speciated mass concentrations collected at existing surface monitoring stations to quantify improvements and areas of remaining bias or uncertainty. As the underlying surface properties relevant to windblown dust emissions typically vary at scales much finer than the one km nested domain, the research team will test and tune parameterized emissions schemes to capture this important sub grid variability. Resulting optimized model output will allow the research team to not only predict total size-resolved mass concentrations by receptor location, but also initial dust origins, in particular targeting and tracking dust originating from dried lakebed surfaces surrounding the Salton Sea.

**Task 4a Deliverables**

The research team will submit to CARB modified input files and aggregated and summarized chemical transport model output available as netcdf files, and text files indicating model code changes, simulation setting and namelist files.

The research team will submit to CARB relevant metadata for these data, which will be permanently archived in the UCSD Digital Collection for the project.

**Task 4b: Estimating Dust Concentrations and Exposures**

To estimate daily dust concentrations for each zip-code in the study region from 2015-2022, the research team will utilize the WRF-modeled source-specific dust $PM_{10}$ and $PM_{2.5}$ concentration (in micrograms per cubic meter ($\mu g/m^3$) as described Task 4a and observed daily concentrations of $PM_{10}$ and $PM_{2.5}$ from long-term monitoring stations across the region. The research team will use the WRF model to estimate concentrations of dust originating from the playa, agricultural, and desert regions. The research team will assign dust concentration (playa, non-playa) to each zip code using the WRF-model one km square grid cells that intersect with the zip code (see Figure 3). To estimate monthly dust exposure for each individual throughout pregnancy, the research team will assign modeled dust concentration using the one km square grid cell in which the residential address of the mother is located. To account for the fact that dust exposure may have occurred outside the home, the research team will conduct sensitivity analyses that assign exposures based on likely time use patterns drawing upon data on commuting patterns and road networks.[47] The research team will also produce maps at the census tract resolutions describing dust activity, including average and maximum dust concentrations, and frequency of extreme dust events.

**Task 4b Deliverables**

The research team will submit to CARB a dataset of source-specific dust concentrations for each census tract in the study region from 2015-2022.

The research team will also submit to CARB copies of maps at the census tract resolutions describing dust activity, including average and maximum dust concentrations, and frequency of extreme dust events.

### Task 4c: Modeling Future Changes in Dust

The research team will lastly use WRF-Chem to estimate how dust concentrations will change in the future due to the rapidly shrinking Salton Sea. The research team will conduct one set of simulations where the level of the Salton Sea has dropped sufficiently such that the exposed playa is double its current size, and then another set of simulations where the playa has again doubled in area. These projections are intended to provide a broad range of air quality impacts and are not necessarily representative of likely future outcomes. That being said, assuming a current surface area of exposed playa of approximately 75 square km, using the 2017-2023 Salton Sea height trend of approximately one mile per four years (calculations based on lake surface height measurements made by the United States Geological Survey at the Westmoreland monitoring station, not shown), and based on bathymetry data, the exposed playa areas of 150 square km and 300 square km would be realized in 2033 and 2057 (not shown). These simulations will be used to develop ranges of potential future emissivity states to encompass a full spectrum of potential policy and climate-driven outcomes (Task 5).

### Task 4c Deliverables

The research team will submit to CARB a comma separated values format dataset of modeled source-specific dust concentrations for each census tract in the study region associated with the shrinking Salton Sea simulations.

The research team will also submit to CARB copies of maps at the census tract resolutions describing simulation-specific modeled dust activity, including average daily dust concentrations and maximum dust concentrations.

## Task 5: Health Impacts Assessment

### Task 5a: Estimating Association between Dust Exposure and Cause-Specific Emergency Department Visits

To estimate the overall association between playa and non-playa dust concentrations and emergency room (ED) visits in the study region, the research team will use a two-stage distributed lag nonlinear modeling (DLNM) approach. Distributed lag nonlinear models are applied in time-series studies where the effect of an exposure may occur over several time-periods.[48,49,50] The research team will split the study area into regions based on similarities in modeled exposure to playa dust. In the first stage, the research team will construct DLNMs for each region to estimate region-specific, non-linear, and time-lagged effects of Salton Sea dust exposure on ED visits. The research team will regress daily counts of zip-code level cause-specific ED visits (see Task 3a for details on data) against daily estimates of zip-code level dust exposure lagged by zero to 14 days, to allow for delayed health impacts of dust exposure. The research team will run separate models for each cause-specific category of ED visits, including all-cause, respiratory illness (e.g. asthma, COPD, acute respiratory infection), cardiovascular illness (e.g. heart failure, myocardial infarction, cerebrovascular conditions), infectious diseases, allergic skin and eye conditions, accidental injury, mental health, neurodevelopment, endocrine diseases (e.g. diabetes), and reproductive health.

| Simulation | Model Domain | Other Notes |
|---|---|---|
| Case Studies | Nested 15/5/1 km spatial grids with parent domain covering the western US and innermost domain centered on Salton Sea region; temporal domain spanning days around individual dust events | Tagged windblown dust by source region |
| Historical Simulations | Spatial domain as above using full 2015-2022 temporal domain, reinitialized regularly from input meteorology | As above |
| Future Scenario Simulations | Spatial domain as above using historical meteorology and modified surface properties based on extrapolated sea level projections | As above, with two cases representing playa surface areas at 2x and 4x current conditions |

**Table 2.** Description of planned WRF-Chem simulations.

To control for possible long-term, seasonal, and day of the week patterns in ED visits, the research team will include indicator variables for month and year. The research team will control for mean temperature, latitude and longitude of zip code, and possible confounding census tract socio-economic status (SES) characteristics (e.g., percentage poverty, median house value). In the second stage, the research team will perform a meta-analysis of region-specific estimates to calculate pooled estimates of the exposure-response and lag-response relationship for cause-specific ED visits. Cumulative exposure-response relationships will be interpreted as the relative increase in cause-specific ED visits associated with increasing exposure to playa or non-playa dust during all the lagged days. In doing so, the research team will be able to understand the relative impacts of exposure to playa dust vs. non-playa dust on ED visits, indicating whether dust originating from the Salton Sea playa is differentially hazardous for cause-specific health outcomes.

**Task 5a Deliverables**

The research team will submit to CARB a Health Impact Report that details the associations between source-specific dust concentrations and cause-specific ED visits across the study region during the 2015-2022 period.

**Task 5b: Estimate the Associations between Dust Exposure and Adverse Birth Outcomes**

The research team will analyze the association between maternal dust exposure and preterm birth (PTB; delivery prior to 37 completed weeks of gestation) and low birth weight (LBW; infants born less than 2,500 grams). To estimate the overall association between dust concentrations and adverse birth outcomes in the study region, the research team will use a two-stage DLNM approach, similar to that described in Task 5a. However, given the birth outcomes data structure, the research team will use log binomial generalized linear mixed models which allows us to interpret exponentiated coefficients as risk ratios. The research team will construct DLNMs for each region to estimate non-linear, and time-lagged effects of dust exposure on PTB and LBW. In separate models, the research team will regress individual-level PTB and LBW outcomes against weekly estimates of maternal dust exposure lagged by zero to 40 weeks before the birth. Including all lags enables the models to capture the effect of dust across the duration of the pregnancy and identify critical windows of exposure. The research team will also include exposures that occur zero to eight weeks post birth, which have been used as a negative control approach to test for residual confounding. To control for possible long-term and seasonal patterns in PTB and LBW, the research team will include indicator variables for month and year. The research team will also control for mean temperature, latitude and longitude of residential census tract centroid, individual-level maternal characteristics (e.g., race/ethnicity, education, nativity, access to prenatal care), and possible confounding census tract SES characteristics (e.g., percentage poverty, median house value).

**Task 5b Deliverable**

The research team will submit to CARB a Health Impact Report that details the associations between source-specific dust concentrations and adverse birth outcomes across the study region during the 2015-2022 time period.

**Task 5c: Identify Communities Vulnerable to Health Effects from Dust Exposure**

The research team will investigate effect modification of the dust-health relationships using an interaction method applied to the DLNM models described in Task 5a. This method allows for direct comparisons of the dust-health relationships across measures of social vulnerability and economic deprivation, enabling identification of communities most vulnerable to the health impacts of playa and non-playa dust exposure. Potential modifying variables will include zip code-level (for ED analyses) and census tract-level (for birth outcomes analyses) measures of neighborhood social vulnerability (e.g., median income, health care access, poverty, SVI themes). The research team will also conduct stratification analyses by age groups, sex, income

level and race/ethnicity to investigate individual-level factors that may confer increased risk. For the birth outcomes analyses, the research team will also include potential modifying maternal characteristics (e.g., race/ethnicity, education, nativity, access to prenatal care). Lastly, the research team will compare and map region-level estimates of dust-ED visit associations to identify geographical hotspots of high risk. These results will identify specific subgroups and geographical locations that may be at highest risk for playa dust related health impacts. The deliverables for Task 5c will be generated in consultation with communities, both to address any sensitivities around mapping (consent) and generate the products most desired by stakeholders (utility).

**Task 5c Deliverables**

The research team will submit to CARB maps that identify high-risk communities for health impacts (ED visits

The research team will submit to CARB a vulnerability report, which will detail how dust-health relationships

**Task 5d: Estimating Health Impacts of Future Dust Exposure**

The research team will estimate the fractional change in surface PM associated with changes in the height of the Salton Sea via analysis of the WRFChem simulations described in Task 4c. Using the estimated exposure-response relationships from the health analyses described in Task 5a, the research team will project the changes in health outcomes due to changes in dust levels associated with the shrinking sea. This work is critical for understanding the health impacts of the significant environmental change occurring in this region and for informing policy, public health, and healthcare actions to mitigate adverse health outcomes among vulnerable communities.

**Task 5d Deliverables**
The research team will submit to CARB census tract level maps that estimate future high-risk areas for health impacts due to changes in dust exposure from shrinking Salton Sea scenarios.

The research team will submit to CARB a vulnerability report that details how future increases in dust exposure may interact with existing vulnerability factors to put specific communities at highest risk for adverse health outcomes.

**Task 5e: Risk Characterization Analyses Related to Chemicals Detected in Soil and Dust Samples**

Once the chemical concentrations in the soil and airborne dust samples are determined, we will assess whether any of the detected chemicals are potential contaminants of concern for human health. For each chemical, the research team will review and summarize relevant toxicology literature to identify potential adverse health impacts and established dose-response relationships for these health outcomes. The research team will then provide discussion and recommendations for further data and research needed to fully characterize human exposures and health risks associated with contaminants in the dust originating from the playa. Integrating our observations of contaminants in soil and air airborne dust samples with the WRF model simulations, the research team will identify regions and communities potentially at risk for exposure to these chemicals in airborne dust. The results will provide important evidence to determine if further resources should be allocated for detailed health risk assessments, including biomonitoring and epidemiological studies, in the Salton Sea region that account for cumulative exposures and resultant health outcomes of the research teams' detected contaminants.

**Task 5e Deliverables**

The research team will submit to CARB maps indicating sampling locations where potential contaminants of concern were detected in soil and airborne dust samples.

**Task 6: Project Reporting, Final Public Meeting, CARB Final Seminar and Training on WRF-Chem Model Application**

The research team will meet with CARB staff quarterly and submit quarterly progress reports using the CARB-designated template, and an invoice for the same period will accompany each progress report.
Six months prior to the end of the study, the research team will submit a draft final report (DFR), which will include the results of the study and the additional deliverables identified in Exhibit A1, Schedule of Deliverables. The DFR will also include a synthetization of all data and results, the collected and permanently archived data (quantitative and qualitative), health risk characterization, predicted impacts from climate and regional environmental change on dust storms in the region, and potential mitigation strategies. The DFR will also identify key areas where mitigation measures could be implemented to reduce dust emissions from playa. Identify measures people can take to reduce their exposure to dust as identified in Task 5e. The research team will also identify future research or community-based projects that could help fill gaps in knowledge and/or promote community resilience. The Draft Final Report shall be copy-edited before being sent to CARB for review and the Principal Investigator shall attest that the Final Report has been reviewed and approved.

The DFR will be submitted in accordance with the Final Report format and will be reviewed by CARB staff. CARB's comments will be sent to UCSD and after receiving the reviewer's comments, UCSD shall modify and resubmit the modified DFR to the CARB Project Manager. The modified DFR will be subject to formal review by the Research Screening Committee (RSC). Once accepted by the RSC, the research team will revise the modified draft final report addressing the RSC comments and any remaining concerns from CARB staff and will submit the revised final report to CARB. If CARB has additional comments on the report, the research team will be notified so appropriate changes can be made; otherwise, CARB will accept the revised final report as the final.

The research team will submit the final report in an Americans with Disabilities (ADA) compliant format. A notation in the Final Report task should denote that the University will incorporate a one-page Public Outreach Document into the Final Report, that will be widely used to communicate, in clear and direct terms, the key research findings from the study to the public. The format for the Public Outreach Document is outlined in Exhibit A1, Section 2. CARB's standard for ADA compliance requires that the submitted document adhere to the Web Content Accessibility Guidelines (WCAG) 2.1 AA (https://www.w3.org/TR/WCAG21/) and Federal Section 508 (https://www.section508.gov/).

The research team will also include an Equity Implications Section into the Final Report, that will summarize how the research results inform disparate impacts of policies, regulations, or programs on priority communities. The Final Report shall be copy-edited before being sent to CARB and the CBO for review and the Principal Investigator shall attest that the Final Report has been reviewed and approved.

The project team will convene a final online public meeting to present research findings and relevant exposure mitigation strategies based on community-identified areas of need.

The UCSD Principal Investigator (PI) will also conduct a final scientific research seminar for CARB staff and members of the public and will include results of the project and recommendations for future research.

The PI will also hold a technical training session for CARB staff/management to discuss the technical aspects of the numerical model (WRF-Chem) as they apply to simulating historical and predicting future changes in dust storms, including possible training on its use. The project team will also identify future research or community-based projects that could help fill gaps in knowledge and/or promote community resilience.

**Task 6 Deliverables**

The research team will submit to CARB DFR six months prior to the contract close

The research team will submit to CARB the final report two weeks prior to the contract close.

**Project Schedule**

Task 1: Literature Review

Task 2: Community Engagement Plan
- Task 2a: Development of Community Partnership
- Task 2b: Public Meetings and Community Outreach
- Task 2c: Data Collection and Information Reporting

Task 3: Data Acquisition Plan
- Task 3a: Existing Data Sources to be Used in the Project
- Task 3b: Soils and Dust Sampling Plan
- Task 3c: Possible Contaminants of Concern and Analytical Methods

Task 4: Health Risk Characterization
- Task 4a: Dust Emission and Transport Modeling
- Task 4b: Estimating Dust Concentrations and Exposures
- Task 4c: Modeling Future Changes in Dust

Task 5: Health Impacts Assessment
- Task 5a: Estimating Association between Dust Exposure and Cause-Specific Emergency Department Visits
- Task 5b: Estimate the Associations between Dust Exposure and Adverse Birth Outcomes
- Task 5c: Identify Communities Vulnerable to Health Effects from Dust Exposure.
- Task 5d: Estimating Health Impacts of Future Dust Exposure
- Task 5e: Risk Characterization Analyses Related to Chemicals Detected in Soil and Dust Samples

Task 6: Project Reporting, Final Public Meeting, CARB Final Seminar and Training on WRF-Chem Model Application

| | **Year 1** | | | | | | | | | | | | **Year 2** | | | | | | | | | | | | **Year 3** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 |
| **Task 1** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 2** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 2a** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 2b** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 2c** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 3a** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 3b** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 3c** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 4a** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 4b** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | Year 1 | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 |
| **Task 4c** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 5a** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 5b** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 5c** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 5d** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 5e** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Task 6** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | m | | mp | | | mp | | | mp | | | mp | | | mp | | | mp | | | mp | d | | mp | | | m | | | fs c |

m = meeting with CARB staff; p: quarterly progress report; d = deliver draft final report, f=final report; s: final seminar for CARB staff, c: final online public meeting with project team

## Meetings

A. Initial meeting. Before work on the contract begins, the Principal Investigator and key personnel will meet with the CARB Contract Project Manager and other staff to discuss the overall plan, details of performing the tasks, the project schedule, items related to personnel or changes in personnel, and any issues that may need to be resolved before work can begin.

B. Progress review meetings. The Principal Investigator and appropriate members of his or her staff will meet with CARB's Contract Project Manager at quarterly intervals to discuss the progress of the project. This meeting may be conducted by phone.

C. Community Engagement and/or Technical Advisory Committee Meetings (If Applicable). For community engagement efforts, including meetings with a Technical Advisory Committee (TAC), the Contractor must co-create meeting materials, including presentation slides, flyers, and speaking notes with CARB staff. The Contractor will work with CARB to understand policies and agree to accurately represent those policies or defer for follow-up. CARB will participate in community meetings and TAC meetings, unless mutually agreed upon with CARB and the PI, in cases where it could impact community engagement efforts negatively.

D. Technical Seminar. The Contractor will present the results of the project to CARB staff and a possible webcast at a seminar at CARB facilities in Sacramento or El Monte.

## CONFIDENTIAL HEALTH DATA AND PERSONAL INFORMATION

CARB will not be provided access to and will not receive any confidential health data or other confidential personal information under this contract. Further, CARB will have no ownership of confidential health data or other confidential personal information used in connection with this contract. The entities conducting the research in this contract will follow all applicable rules and regulations regarding access to and the use of confidential health data and personal information, including the Health Insurance Portability and Accountability Act (HIPAA) and requirements related to the Institutional Review Board (IRB) process. CARB

will not be a listed entity with authorized access to confidential information pursuant to the IRB process for this contract.

## HEALTH AND SAFETY

Contractors are required to, at their own expense, comply with all applicable health and safety laws and regulations. Upon notice, Contractors are also required to comply with the state agency's specific health and safety requirements and policies. Contractors agree to include in any subcontract related to performance of this Agreement, a requirement that the subcontractor comply with all applicable health and safety laws and regulations, and upon notice, the state agency's specific health and safety requirements and policies.

## GENERATIVE ARTIFICIAL INTELLIGENCE (GENAI) TECHNOLOGY USE & REPORTING

During the term of the contract, Contractor must notify the State in writing if their services or any work under this contract includes, or makes available, any previously unreported GenAI technology, including GenAI from third parties or subcontractors. Contractor shall immediately complete the GenAI Reporting and Factsheet (STD 1000) to notify the State of any new or previously unreported GenAI technology. At the direction of the State, Contractor shall discontinue the use of any new or previously undisclosed GenAI technology that materially impacts functionality, risk or contract performance, until use of such GenAI technology has been approved by the State.

Failure to disclose GenAI use to the State and submit the GenAI Reporting and Factsheet (STD 1000) may be considered a breach of the contract by the State at its sole discretion and the State may consider such failure to disclose GenAI and/or failure to submit the GenAI Reporting and Factsheet (STD 1000) as grounds for the immediate termination of the contract. The State is entitled to seek any and all relief it may be entitled to as a result of such non-disclosure.

**The State reserves the right to amend the contract, without additional cost, to incorporate GenAI Special Provisions into the contract at its sole discretion and/or terminate any contract that presents an unacceptable level of risk to the State.**

### Project Management Plan

The research team consists of the main project leadership, institutional Co-PIs, and other project investigators. Below is a summary of the roles and responsibilities of the project personnel in each research team (modeling, measurements, health assessment).

Project Organization Chart. Project personnel are subdivided into research teams that focus on modeling (orange, measurements (green), and health impacts (blue).

Project Leadership

The project leadership team consists of Lead PI Professor Amato Evan (UCSD), Co-PI Professor William Porter (UCR), and Co-PI Professor Alexandra Heaney (UCSD). Professor. Evan is responsible for overall project management, ensuring that all project milestones and deliverables are met in a timely manner, and will lead the final project report and technical briefing at the close of the project. Each member of the leadership team is responsible for the activities within their respective research team, ensuring milestones and deliverables are met in a timely fashion, as well as communicating main results by contributing to the draft and final reports. The leadership team will also organize community outreach activities.

### Co-Principal Investigators

The project Co-PIs are also institutional PIs, and include Professor Jasper Kok (UCLA), Professor Adeyemi Adebiyi (UCM), Shu-Hua Chen (UCD), Eunha Hoh (SDSU), and Paolo D'Odorico (UCB). Each professor is responsible for the administration of the project at their respective institutions and for contributing to the project deliverables, draft and final report.

**Other Project Investigators**

A number of additional investigators are included in this project due to their unique areas of expertise.

**Modeling Team:** A TBD Postdoctoral Scholar will work 50 percent with the modeling team under the supervision of Professor Porter. The Postdoctoral Scholar will assist with model development and evaluation, analysis of output, and generating products for the health impacts assessment.

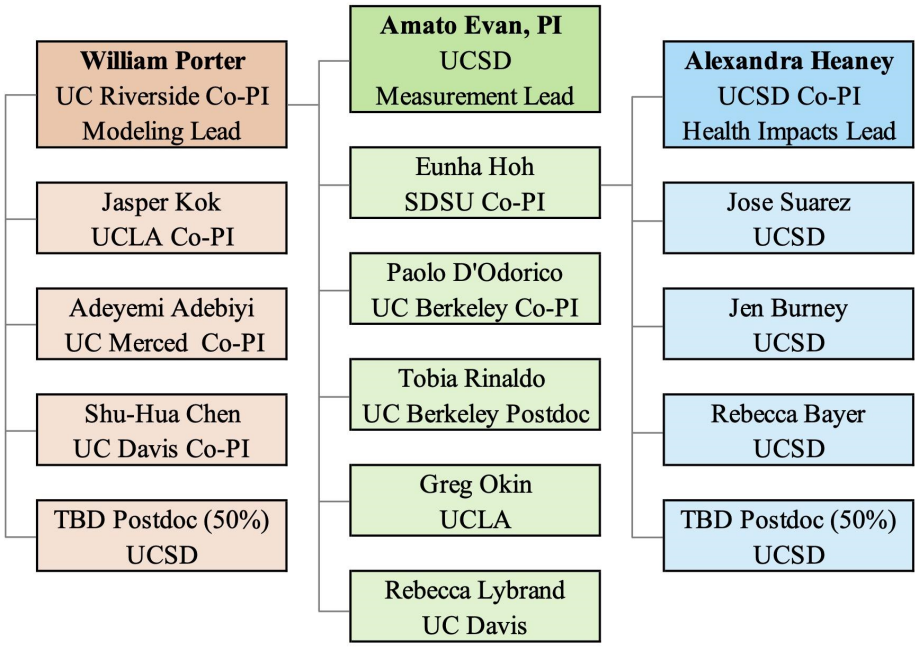
**Measurement Team**: Professor Greg Okin (UCLA) has extensive field experience characterizing soil conditions as they relate dust emission and will contribute to the development of the soil and dust sampling plan. Professor Rebecca Lybrand (UCD) is a soil geochemist and will lead the soil sampling and bulk characterization work. The UCB Postdoctoral Scholar, TBD, will conduct the dust generation experiments from the soil samples under the supervision of Professor Paolo D'Odorico (UCB).

**Health Impacts Team:** Professor Jose Suarez (UCSD) is part of the School of Public Health and has expertise in understanding the impacts of environmental contaminants, especially pesticides, on human health. Professor Suarez will assist the health impacts team on interpretation of the soil and dust composition measurements. Professor Jennifer Burney (UCSD) is part of the School of Global Policy and Strategy and has expertise in public policy related to the environment and climate. Professor Burney will assist the health impacts team with the risk characterization. Dr. Rebecca Baer (UCSD) is part of the SOMI and will generate SOMI data for the analysis. A Postdoctoral Scholar, TBD, will work 50 percent with the health impacts team under the supervision of Professor Heaney, and will assist with the analysis of the model output and health outcomes data.

**Facilities**

**UCSD**

**Office and Lab Space:** PI Evan's research lab in Nierenberg Hall at SIO is an approximately 500 square foot dry lab with an attached 100 square foot office. This lab will be available for testing, maintenance and storage of all equipment used in this project and any sample preparation for laboratory analysis. The lab will also




Project Organizational Chart. Project personnel are subdivided into research teams that focus on modeling (orange), measurements (green), and health impacts (blue).

serve as a staging area for field work and any required maintenance activities. The PI's office is in the same building as the lab space and additional office space will be made available to the Postdoctoral Scholar, which will be in close proximity to the lab and the PI's office. Nierenberg Hall also contains three meeting rooms with equipment for teleconferencing and videoconferencing. All office and lab space is wirelessly connected to the Internet. Dr. Heaney has dedicated office space in the Medical Teaching Facility Building at UCSD.

**Computational Resources**: Dr. Evan, the PI, has computational resources that can be utilize for the project, which includes a Dell PowerEdge R540 rack-mounted server with 16 Terabytes of storage, 128 Gigabytes of Random Access Memory, and four six-core Intel processors) with network support housed in a climate-controlled server room. This server will be used to store and backup digital data generated by this project, analyze data and model output, and generate archivable data sets. Server access is only available through two-step authentication.

**Other Instrumentation, Tisch High Volume Air Sampler:** Two Tisch High Volume Air Samplers will be utilized to collect dust samples during the first 12-18 months of the project. These air samplers are portable and collect PM10 particles on the 8″ x 10″ quartz filter paper, allowing for chemical analysis of the dust. UCSD Health Information Services provides uniform Information Technology Services to all of Health Sciences personnel and investigators, including desktop/laptop and peripherals support, security software and protocols, data storage, and website hosting. To mitigate the specific risk profile of a highly connected environment, Health Information Services ensures that all PIs and personnel operate in a highly secure desktop, application, and server environment with dedicated and highly trained support, including a 24/7 helpline. Personnel and programs have access to software via licensing agreements at UCSD, including ArcGIS, Microsoft Office, Photoshop, etc.

To help with computing power, Dr. Heaney will have access to the **San Diego Supercomputer Center (SDSC)**. The SDSC, a leader in data-intensive computing and cyberinfrastructure, provides resources, services, and expertise to UC campuses as well as the national research community including academia, industry, and government. Core services available via recharge to UC researchers include high performance research computing and data storage; Information Technology equipment co-location services; and advanced user support including scientific and application programming, parallel programming, code optimization, etc. High Performance Computing systems range from the large-scale “Comet” and “Expanse” systems to the medium scale “Triton Shared Computing Cluster.” Storage recharge services include Universal Scale Storage (Qumulo) for open data and Sherlock for compliance data management.

**SDSU**

**Lab Space:** SDSU’s Hoh’s Environment Health Laboratories are well-equipped for various environmental studies, including heavy metal detection, organic chemical analysis, clinical assays, and toxicological research. Key equipment includes advanced mass spectrometry systems (comprehensive two-dimensional gas chromatography coupled to time-of-flight mass spectrometry (comprehensive two-dimensional gas chromatography coupled to time-of-flight mass spectrometry (GC×GC/TOF-MS), gas chromatography with mass spectrometry (GC-MS), liquid chromatography with liquid chromatography triple quadrupole mass spectrometry (LC/MS/MS), liquid chromatography with quadrupole time of flight mass spectrometry (LC-Q/TOF), and ICP-MS, biological safety cabinets, and chemical fume hoods. The lab also features six computer workstations with specialized software and mass spectral libraries for data analysis. Sample preparation tools include an automatic evaporation system, microwave extraction, muffle furnace, centrifuges, ultrasonic bath, evaporator, grinder, balances, solid phase extraction manifolds, and a pressurized liquid extractor. Storage facilities include a walk-in freezer, four upright freezers, and two refrigerators. This comprehensive instrumentation supports the proposed research within budget.

**UCR**

Computational Resources: Chemical transport modeling for this project will be performed on “aldo”, a small high performance computing cluster (HPCC) built and maintained by Co-PI Porter. This cluster features 16 compute nodes with 576 computational cores, over 200 TB of available storage, and up-to-date compilers and libraries capable of building and running current chemical transport modeling applications. Model simulations, data extraction, data backups, and initial analysis tasks will all be performed on aldo under Co-PI Porter’s supervision.

**UCB**

**Lab Space**: Co-PI D’Odorico manages a soil laboratory equipped with balances, ovens, sieves, sonic sieves, potentiometers, grinders, particle size analyzers, loggers that will be used in the experimental analyses included in this scope of work.. The soil lab is also equipped with a dust generator apparatus. The Dust Generator consists of a 2.5cm x 2.5 cm aluminum tube (in which the soil sample is placed), 50 cm long. The sample tube rotates 13 times per minute with a 4 second pause after each 180 0 rotation. When the tube is in motion, the sediment repeatedly falls to the base of the tube, thereby generating dust. Dust laden air is drawn by a vacuum pump at a rate of 0.014 m 3 min -1 from the dust generator into a settling chamber 45 cm tall with a 30 cm square base. The settling chamber is fitted with a dust sensor attached to an aerosol spectrometer (Grimm®, Model 1.108), which provides real time measurements of dust concentrations within different size classes. The data units recorded by the Grimm spectrometer are in particle count per liter for particles ranging between 0.3 to 20 micrometer in diameter.

**UCD**

**Computational Resources:** Co-PI Chen manages a Linux-based Dell Precision Workstation 530 with eight processors, 20 GB RAM, and a 10 TB hard disk, one Dell Precision Workstation with 16 cores, 128 GB RAM, and a 20 TB hard disk, and a computing cluster with 32 dual processor nodes, with 1GB RAM on each node, which are available for this project at no cost. These machines will be used primarily for code development, algorithm tests, shell script development, and model results analysis.

**Lab Space**: Project Investigator Lybrand’s laboratory contains large benchtop work stations; cabinetry; house lines for vacuum, gas, and air; drying ovens for drying soil samples; centrifuges for soil pre-treatments, processing, and preparing samples for mineralogical analysis; a dilute acid bath for cleaning labware; microscopes for examining bulk soils and performing grain counts; and 3 5-foot fume hoods. The soil preparation areas contain equipment for soil pre-treatments (removal of organic matter and iron oxides) including platform shakers and sieve shakers. Departmental resources include designated soil processing rooms, walk-in ovens, and cold room storage (4, -20, -80 degrees C), a Badger rock crusher, ball mills for soil sample grinding, a Virtis large-chamber freeze-drier, and Sorvall high-speed centrifuges, among other resources. Storage rooms provide cabinetry space to securely store samples, field equipment, educational materials, and other supplies needed for this project.

**The Landscape Pedology and Mineralogy Laboratory at UCD** is a 695 square foot facility consisting of a main laboratory (541 sq. ft.) and 1 adjoining room with additional designated fume hood space (154 square. foot.). The adjoining room houses the controlled laboratory environmental chambers proposed for use here. The Mineralogy Laboratory consists of a main laboratory (549 sq. ft.) and 1 adjoining room (129 sq. ft.) which houses a Bruker D8 ADVANCE X-Ray Diffractometer. The lab spaces serve as a state-of-the-art soil and geochemical preparation and analysis facility that would be available for use in this project. The lab space provides ample space for students and scientists to dry, photograph, process, pretreat, and analyze collected samples. The lab also has desktop computers equipped with dual monitors. All computers contain the data entry, sample analysis, statistical analysis, and graphing software required for use in this project. UCD provides unlimited online storage space for faculty, staff, postdoctoral researchers, and students that will be utilized in combination with a secure shared research drive for the lab to be used as a collaborative work space for data transfer, storage, and archiving purposes.

**The UC Davis Analytical Laboratory** is an institute within the College of Agriculture and Environmental Sciences. The facility is a 5,800 sq. ft. laboratory located in Hoagland Hall on campus. The laboratory performs analyses on selected chemical constituents of soil, plant, water and wastewater, and feed in support of agricultural and environmental research. Relevant to this study, the laboratory houses two Inductively Coupled Plasma Optical Emission Spectrometers (iCAP 6500, Thermo Scientific) that are capable of analyzing a broad suite of cations. The laboratory also has a Skalar Formacs Combustion Analyzer for carbon and nitrogen analysis.

**Data Management Plan**

**Archiving New Data:** Data generated for this project will be permanently archived as objects in a dedicated digital collection within the UCSD Library. The collection will be specifically established for this project to ensure data set preservation and accessibility of the data sets. The archived data sets will include a database of the surface soil characteristics and mineralogy, and location-specific results from the soil and dust geochemical analysis. Metadata and documentation will accompany the data sets to provide comprehensive information for their proper understanding and utilization.

**Storing Model Output:** Model output generated from the WRF-Chem simulations will be archived throughout the project's duration and for additional time as needed on Co-PI Porter's computational cluster storage system at UC-Riverside. Proper organization, labeling, and documentation will accompany the archived model output for ease of use and interpretation.

**Data Sharing and Availability to the Research Community:** All data generated by this project will be made available to the broader research community once corresponding publications describing the data have been accepted for publication, or by the end of the period of performance, whichever comes first. Open and unrestricted access to the data will promote collaboration, transparency, and further scientific advancement.

The research team will not be sharing any raw data that includes personal identifying information and will handle the privacy, rights, and confidentiality of human research participants with great care. In designing and sharing data summaries and results, the research team will closely follow all guidelines from the California Health and Human Services Data De-identification Guidelines.

**Software Management**: The code developed as part of this project, including modifications to the treatment of dust within WRF-Chem, will be archived on GitHub. The code repository will be publicly accessible and regularly maintained to ensure long-term availability and version control. Detailed documentation and instructions will accompany the code to facilitate its understanding and reuse by the research community.

**SOMI**: These data were generated from health care encounters and are maintained by the California Department of Public Health and the Centers for Medicare and Medicaid Services. All linkages between data sources are performed behind State firewalls, and only de-identified data are made available to SOMI project staff., Established confidentiality precautions regarding patient sample analysis are in place and include locked storage cabinets, password access protection of computer-based files, and read/write protection. The data files containing personal health information are protected by a password required for entry known only to the SOMI data manager required to access this information. De-identified, limited use data sets will be used for analysis to further project against risk of identification. The research team will not be sharing any raw data that includes personal identifying information and will handle the privacy, rights, and confidentiality of human research participants with great care. In designing and sharing data summaries and results, the research team will closely follow all guidelines from the California Health and Human Services Data De-identification Guidelines (https://chhsdata.github.io/dataplaybook/documents/CHHS-DDG-V1.0-092316.pdf).

**HCAI ED Visit Data:** The project team will obtain zip-code level counts of all ED visits for each International Classification of Diseases coded category from 2015-2022. As such, the research team will not have access to any personal identifying information. The research team will store the data on encrypted, password-protected servers with access limited to authorized personnel only, maintaining integrity and confidentiality throughout the study. In designing and sharing data summaries and results, the research team will closely follow all guidelines from the California Health and Human Services Data De-identification Guidelines.

**References**


1. Tong, D. Q. *et al.* Health and Safety Effects of Airborne Soil Dust in the Americas and Beyond. *Reviews of Geophysics* **61**, e2021RG000763 (2023).
2. Lwin, K. S. *et al.* Effects of Desert Dust and Sandstorms on Human Health: A Scoping Review. *GeoHealth* **7**, e2022GH000728 (2023).
3. Fussell, J. C. & Kelly, F. J. Mechanisms underlying the health effects of desert sand dust. *Environment International* **157**, 106790 (2021).
4. Kanatani, K. T. *et al.* Desert Dust Exposure Is Associated with Increased Risk of Asthma Hospitalization in Children. *Am J Respir Crit Care Med* **182**, 1475–1481 (2010).
5. Khammar, A. *et al.* Dust Storm Effect and Climatological Factors on Cardiovascular and Cerebrovascular Respiratory Diseases: A Literature Review. *Archives of Hygiene Sciences* **12**, 99–104 (2023).
6. Johnston, J. E., Razafy, M., Lugo, H., Olmedo, L. & Farzan, S. F. The disappearing Salton Sea: A critical reflection on the emerging environmental threat of disappearing saline lakes and potential impacts on children's health. *Science of The Total Environment* **663**, 804–817 (2019).
7. Jones, B. A. & Fleck, J. Shrinking lakes, air pollution, and human health: Evidence from California's Salton Sea. *Science of The Total Environment* **712**, 136490 (2020).
8. Kim, K.-H., Kabir, E. & Jahan, S. A. Exposure to pesticides and the associated human health effects. *Science of The Total Environment* **575**, 525–535 (2017).
9. Chen, L. C. & Lippmann, M. Effects of Metals within Ambient Air Particulate Matter (PM) on Human Health. *Inhalation Toxicology* **21**, 1–31 (2009).
10. Jia, Z., Li, S. & Wang, L. Assessment of soil heavy metals for eco-environment and human health in a rapidly urbanization area of the upper Yangtze Basin. *Sci Rep* **8**, 3256 (2018).
11. Mahurpawar, M. Effects of heavy metals on human health. *Int J Res Granthaalayah* **530**, 1–7 (2015).
12. Sall, M. L., Diaw, A. K. D., Gningue-Sall, D., Efremova Aaron, S. & Aaron, J.-J. Toxic heavy metals: impact on the environment and human health, and treatment with conducting organic polymers, a review. *Environ Sci Pollut Res* **27**, 29927–29942 (2020).
13. Kanatani, K. T. *et al.* Birth cohort study on the effects of desert dust exposure on children's health: protocol of an adjunct study of the Japan Environment & Children's Study. *BMJ Open* **4**, e004863 (2014).
14. Moreira, I. *et al.* Short-term effects of Saharan dust intrusions and biomass combustion on birth outcomes in Spain. *Science of The Total Environment* **701**, 134755 (2020).
15. Viel, J.-F. *et al.* Impact of Saharan Dust on Severe Small for Gestational Births in the Caribbean. *Am J Trop Med Hyg* **102**, 1463–1465 (2020).
16. Altindag, D. T., Baek, D. & Mocan, N. Chinese Yellow Dust and Korean infant health. *Social Science & Medicine* **186**, 78–86 (2017).
17. Jones, B. A. After the Dust Settles: The Infant Health Impacts of Dust Storms. *Journal of the Association of Environmental and Resource Economists* **7**, 1005–1032 (2020).
18. Fu, Z. & Xi, S. The effects of heavy metals on human metabolism. *Toxicology Mechanisms and Methods* **30**, 167–176 (2020).
19. Lentini, P. *et al.* Kidney and heavy metals – The role of environmental exposure (Review). *Molecular Medicine Reports* **15**, 3413–3419 (2017).
20. Poudel, U., Ahmad, S. & Stephen, H. Studying the Intra-Annual Variability in Surface Area and Volume of Salton Sea, California, Using Remote Sensing-Based Water Indices and GIS. In *World Environmental and Water Resources Congress 2021* 769–783 (American Society of Civil Engineers, Virtual Conference, 2021). Doi:10.1061/9780784483466.070.
21. Parajuli, S. P. & Zender, C. S. Connecting geomorphology to dust emission through high-resolution

mapping of global land cover and sediment supply. *Aeolian Research* **27**, 47–65 (2017).
22. Doede, A. L. & DeGuzman, P. B. The Disappearing Lake: A Historical Analysis of Drought and the Salton Sea in the Context of the GeoHealth Framework. *GeoHealth* **4**, e2020GH000271 (2020).
23. Bandoli, G. *et al.* Maternal, infant, and environmental risk factors for sudden unexpected infant deaths: results from a large, administrative cohort. *The Journal of Maternal-Fetal & Neonatal Medicine* **35**, 8998–9005 (2022).
24. Bandoli, G. *et al.* Risk factors for neonatal encephalopathy in late preterm and term singleton births in a large California birth cohort. *Journal of Perinatology* **42**, 341–347 (2022).
25. United States Census Bureau. *American Community Survey 5-Year Data (2009-2019).*
26. Centers for Disease Control and Prevention/ Agency for Toxic Substances and Disease Registry/ Geospatial Research, Analysis, and Services Program. CDC/ATSDR Social Vulnerability Index Database California.
27. Lybrand, R. A. & Rasmussen, C. Linking soil element-mass-transfer to microscale mineral weathering across a semiarid environmental gradient. *Chemical Geology* **381**, 26–39 (2014).
28. Barchańska, H., Czaplicka, M. & Kyzioł-Komosińska, J. Interaction of selected pesticides with mineral and organic soil components. *Archives of Environmental Protection* (2023) doi:10.24425/aep.2020.134538.
29. Meite, F., Granet, M. & Imfeld, G. Ageing of copper, zinc and synthetic pesticides in particle-size and chemical fractions of agricultural soils. *Science of The Total Environment* **824**, 153860 (2022).
30. Buck, B. J., King, J. & Etyemezian, V. Effects of Salt Mineralogy on Dust Emissions, Salton Sea, California. *Soil Science Society of America Journal* **75**, 1971–1985 (2011).
31. *Field Book for Describing and Sampling Soils*. (National Soil Survey Center, Natural Resources Conservation Service, U.S. Department of Agriculture, Lincoln, Nebraska, 2012).
32. Staff, Soil Survey. *Keys to Soil Taxonomy*. (United States Department of Agriculture. Natural Resources Conservation Service, Washington, D.C., 2014).
33. Lawrence, C. R. & Neff, J. C. The contemporary physical and chemical flux of aeolian dust: A synthesis of direct measurements of dust deposition. *Chemical Geology* **267**, 46–63 (2009).
34. Gill, T. E., Zobeck, T. M. & Stout, J. E. Technologies for laboratory generation of dust from geological materials. *Journal of Hazardous Materials* **132**, 1–13 (2006).
35. Singer, A., Zobeck, T., Poberezsky, L. & Argaman, E. The PM10and PM2·5 dust generation potential of soils/sediments in the Southern Aral Sea Basin, Uzbekistan. *Journal of Arid Environments* **54**, 705–728 (2003).
36. Hoh, E. *et al.* Nontargeted Comprehensive Two-Dimensional Gas Chromatography/Time-of-Flight Mass Spectrometry Method and Software for Inventorying Persistent and Bioaccumulative Contaminants in Marine Environments. *Environ. Sci. Technol.* **46**, 8001–8008 (2012).
37. Richardot, W. H. *et al.* Novel chemical contaminants associated with thirdhand smoke in settled house dust. *Chemosphere* **352**, 141138 (2024).
38. Stack, M. E. *et al.* Assessing Marine Endocrine-Disrupting Chemicals in the Critically Endangered California Condor: Implications for Reintroduction to Coastal Environments. *Environ. Sci. Technol.* **56**, 7800–7809 (2022).
39. Shaul, N. J. *et al.* Nontargeted Biomonitoring of Halogenated Organic Compounds in Two Ecotypes of Bottlenose Dolphins ( *Tursiops truncatus* ) from the Southern California Bight. *Environ. Sci. Technol.* **49**, 1328–1338 (2015).

40. Johnson, J. L. *et al.* Comparison of Trace Organic Chemical Removal Efficiencies between Aerobic and Anaerobic Membrane Bioreactors Treating Municipal Wastewater. *ACS EST Water* **4**, 1381–1392 (2024).
41. Trego, M. L. *et al.* Contaminant Exposure Linked to Cellular and Endocrine Biomarkers in Southern California Bottlenose Dolphins. *Environ. Sci. Technol.* **53**, 3811–3822 (2019).
42. Hoh, E. & Hites, R. A. Sources of Toxaphene and Other Organochlorine Pesticides in North America As Determined by Air Measurements and Potential Source Contribution Function Analyses. *Environ. Sci. Technol.* **38**, 4187–4194 (2004).
43. Matt, G. E. *et al.* Tobacco smoke is a likely source of lead and cadmium in settled house dust. *Journal of Trace Elements in Medicine and Biology* **63**, 126656 (2021).
44. Grell, G. a. *et al.* Fully coupled “online” chemistry within the WRF model. *Atmospheric Environment* **39**, 6957–6975 (2005).
45. Evan, A. T., Porter, W. C., Clemesha, R., Kuwano, A. & Frouin, R. Characteristics of Dust Storms Generated by Trapped Waves in the Lee of Mountains. *Journal of the Atmospheric Sciences* **80**, 743–761 (2023).
46. Evan, A. T., Porter, W., Clemesha, R., Kuwano, A. & Frouin, R. Measurements of a Dusty Density Current in the Western Sonoran Desert. *JGR Atmospheres* **127**, e2021JD035830 (2022).
47. Perchoux, C., Chaix, B., Cummins, S. & Kestens, Y. Conceptualization and measurement of environmental exposure in epidemiology: Accounting for activity space related to daily mobility. *Health & Place* **21**, 86–93 (2013).
48. Gasparrini, A., Armstrong, B. & Kenward, M. G. Distributed lag non-linear models. *Statist. Med.* **29**, 2224–2234 (2010).
49. Flanders, W. D., Strickland, M. J. & Klein, M. A New Method for Partial Correction of Residual Confounding in Time-Series and Other Observational Studies. *Am J Epidemiol* **185**, 941–949 (2017).
50. Gasparrini, A. A tutorial on the case time series design for small-area analysis. *BMC Med Res Methodol* **22**, 129 (2022).

## EXHIBIT A1

## SCHEDULE OF DELIVERABLES

If use of any Deliverable is restricted or is anticipated to contain preexisting Intellectual Property with any restricted use, it will be clearly identified in Exhibit A4, Use of Preexisting Intellectual Property & Data.

Unless otherwise directed by the State, the University Principal Investigator shall submit all deliverables to State Contract Project Manager, identified in Exhibit A3, Authorized Representatives.

| Deliverable | Description | Due Date |
|---|---|---|
| Racial equity/implicit bias training | The Principal Investigator and key personnel must demonstrate that they have taken, or will take, cultural competency training, implicit bias training, or racial equity training, whichever is administered at their institution. Training certificates or certificates of completion completed within one (1) year prior to the agreement start date will be accepted. If the training has not been completed within one (1) year prior to the agreement start date, then the Principal Investigator and key personnel must demonstrate that they have scheduled the training within 30 days of the agreement start date and shall complete the training within 90 days of the agreement start date. | Within 90 days of the agreement start date. |
| Initial Meeting | Principal Investigator and key personnel will meet with CARB Contract Project Manager and other staff to discuss the overall plan, details of performing the tasks, project schedule, items related to personnel or changes in personnel, and any issues that may need to be resolved before work can begin. | Month 1 |
| Progress Reports & Meetings | Quarterly progress reports and meetings throughout the agreement term, to coincide with work completed in quarterly invoices | Quarterly |
| Task 1: Literature Review | An Endnote database of the articles used in the literature review | Month 3 |
| Task 2: Community Engagement Plan | A written agreement outlining the different roles and responsibilities of the CBO and research team. | Month 3 |
| Task 2a: Development of Community Partnership | A timeline of the public meetings. | Month 3 |
| Task 2b: Public Meetings and Community Outreach | Public meeting agendas and informational materials, including PowerPoint presentations, at least one week prior to the public meeting.<br>The CBO will submit to CARB the meeting summary of each online public meetings and a link to the YouTube recordings to CARB. | Month 3 |

| Deliverable | Description | Due Date |
|---|---|---|
| Task 2c: Data Collection and Information Reporting | The project team will provide CARB a copy of any research materials, such as questionnaires or surveys, flyers and links to webpages<br><br>The project team will submit to CARB with a copy of the plain-language frequently asked questions, all other information resources developed in response to information needs identified in the public meeting and other stakeholder interactions.<br><br>The CBO will provide CARB and the research team a final report that is a summary document describing their activities as part of the project, an overview of input from meeting participants, and any "lessons learned" from the experience of working with CARB and the research team. | Months 4-30 |
| Task 3: Data Acquisition Plan<br><br>3a: Existing Data Sources to be Used in the Project | Spreadsheet of collected and archived existing data and a UCSD Library Digital Collection for the project where project data will be permanently archived and metadata text. | Month 30 |
| 3b: Soils and Dust Sampling Plan | A spreadsheet of source-specific soil physical and bulk chemical properties obtained from the site and soils analysis, and relevant metadata.<br><br>A spreadsheet of site-specific $PM_{10}$ per unit soil mass via the dust generator, which will also be permanently archived. | Month 30<br><br>Month 30 |
| 3c: Possible Contaminants of Concern and Analytical Methods | A spreadsheet indicating the collection-site specific quantitation of the target analyses (including pesticides and heavy metals in the dust and soil samples, along with the relevant metadata. | Month 30 |
| Task 4: Health Risk Characterization<br><br>4a: Dust Emission and Transport Modeling Dust Emissions and Transport Modeling. | 4a: Modified input files and aggregated and summarized chemical transport model output available as netcdf files, and text files indicating model code changes, simulation setting and namelist files.<br><br>4b: Dataset of source-specific dust concentrations for each census tract in the study region from 2015-2022. | Month 30<br><br>Month 30 |
| 4b: Estimating Dust Concentration and Exposure | Maps at the census tract resolutions describing dust activity, including average and maximum dust concentrations, and frequency of extreme dust events. | Month 30 |
| 4c: Modeling Future Changes in Dust | 4c: Dataset of modeled source-specific dust concentrations for each census tract in the study region associated with the shrinking Salton Sea simulations. | Month 30 |

| Deliverable | Description | Due Date |
|---|---|---|
| Task 5: Health Impacts Assessment | | |
| 5a: Estimating Association between Dust and Cause-Specific ED Visits | Health Impact Report that details the associations between source-specific dust concentrations and cause-specific ED visits across the study region during the 2015-2022 period. | Month 30 |
| 5b: Estimate the Associations between Dust Exposure and Adverse Birth Outcomes | Health Impact Report that details the associations between source-specific dust concentrations and adverse birth outcomes across the study region during the 2015-2022 period. | Month 30 |
| 5c: Identify Communities Vulnerable to Dust Exposure. | Vulnerability report describing how dust-health relationships vary by social vulnerability and economic deprivation across different communities.<br><br>Maps that identify high-risk communities for health impacts (ED visits and adverse birth outcomes) due to dust exposure. | Month 30<br><br>Month 30 |
| Task 5d: Estimating Health Impacts of Future Dust Exposure | Maps that identify high-risk communities for health impacts (ED visits and adverse birth outcomes) due to dust exposure.<br><br>A vulnerability report will also be produced that details how future increases in dust exposure may interact with existing vulnerability factors to put specific communities at highest risk for adverse health outcomes. | Month 30<br><br>Month 30<br><br>Month 30 |
| Task 5e: Risk Characterization Analyses Related to Chemicals Detected in Soil and Dust Samples | 5e: Maps indicating sampling locations where potential contaminants of concern were detected in soil and airborne dust samples. | |
| Draft Final Report | Draft version of the Final Report detailing the purpose and scope of the work undertaken, the work performed, the results obtained and conclusions, and a Public Outreach Document and an Equity Implications Section. The Draft Final Report shall be copy-edited before being sent to CARB for review and the Principal Investigator shall attest that the Final Report has been reviewed and approved. The Draft Final Report shall be submitted in an Americans with Disabilities Act compliant format. CARB's standard for ADA compliance requires that the submitted document adhere to the Web Content Accessibility Guidelines (WCAG) 2.1 AA (https://www.w3.org/TR/WCAG21/) and Federal Section 508 (https://www.section508.gov/). | Six (6) months prior to the agreement end date. |

| Deliverable | Description | Due Date |
|---|---|---|
| Data | Data compilations first produced in the performance of this Agreement by the Principal investigator or the University's project personnel. | Two (2) weeks prior to agreement end date. |
| Final Online Public Meeting | | Month 30 |
| Technical Seminar | Presentation of the results of the project to CARB staff and a possible webcast at a seminar at CARB facilities in Sacramento or El Monte. | On or before agreement end date. |
| **The following Deliverables are subject to paragraph 19. Copyrights, paragraph B of Exhibit C** | | |
| Final Report | Written record of the project and its results. The Final Report shall be submitted in an ADA compliant format. CARB's standard for ADA compliance requires that the submitted document adhere to WCAG 2.1 AA (https://www.w3.org/TR/WCAG21/) and Federal Section 508 (https://www.section508.gov/). The Public Outreach Document and Equity Implications Section, as described in Exhibit A1, Section 2, shall be incorporated into the Final Report. All comments and edits to the from CARB on the draft final report should be addressed and/or resolved prior to submission of the final report. | Two (2) weeks prior to agreement end date. |

**1. Reports and Data Compilations**

A. With respect to each invoice period University shall submit, to the CARB Contract Project Manager, one (1) electronic copy of the progress report. When emailing the progress report, the "subject line" should state the contract number and the billing period. Each progress report must accompany a related invoice covering the same billing period. Each progress report will begin with the following disclaimer:

> *The statements and conclusions in this report are those of the University and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products*.

B. Each progress report will also include:

1. A brief summary of the status of the project, including whether the project is on schedule. If the project is behind schedule, the progress report must contain an explanation of reasons and how the University plans to resume the schedule.

2. A brief narrative account of project tasks completed or partially completed since the last progress report.

3. A brief discussion of problems encountered during the reporting period and how they were or are proposed to be resolved.

4. A brief discussion of work planned, by project task, before the next progress report. and

5. A graph or table showing percent of work completion for each task.

C. Six (6) months prior to Agreement expiration date, University will deliver to CARB an electronic copy of the draft final report in both PDF and Microsoft Word formats. The draft final report will conform to Exhibit A1, Section 2 – Research Final Report Format.

D. Within forty-five (45) days of receipt of CARB's comments, University will deliver to CARB's Contract Project Manager an electronic copy of the final report incorporating all reasonable alterations and additions. Within two (2) weeks of receipt of the revised report, CARB will verify that all CARB comments have been addressed. Upon acceptance of the amended final report approved by CARB in accordance to Exhibit A1, Section 2 – Research Final Report Format, University will within two (2) weeks, deliver to CARB an electronic copy of the final report in both PDF and Microsoft Word formats.

E. As specified in Exhibit A1, Section 2, Final Report will be submitted in an Americans with Disabilities Act compliant Format.

F. Together with the final report, University will deliver a set of all data compilations as specified in Exhibit A1 – Schedule of Deliverables.

G. University's obligation under this Agreement shall be deemed discharged only upon submittal to CARB of an acceptable final report in accordance to Exhibit A1, Section 2 – Research Final Report Format, all required data compilations, and any other project deliverables.

**2. Research Final Report Format**

The research contract Final Report (Report) is as important to the contract as the research itself. The Report is a record of the project and its results and is used in several ways. Therefore, the Report must be well organized and contain certain specific information. The CARB's Research Screening Committee (RSC) reviews all draft final reports, paying special attention to the Abstract and Executive Summary. If the RSC finds that the Report does not fulfill the requirements stated in this Exhibit, the RSC may not recommend release, and final payment for the work completed may be withheld. This Exhibit outlines the requirements that must be met when producing the Report.

Note: In partial fulfillment of the Final Report requirements, the Contractor shall submit a copy of the Report in PDF format and in a word-processing format, preferably in Word – Version 6.0 or later. The electronic copy file name shall contain the CARB contract number, the words "Final Report", and the date the report was submitted.

*Accessibility.* To maintain compliance with California Government Code Sections 7405 and 11135, and Web Content Accessibility Guidelines, Assembly Bill No. 434, the final Report must be submitted in an Americans with Disabilities Act compliant format. The Final Report will be posted on the CARB website and therefore must be in an accessible format so that all members of the public can access it.

*Watermark.* Each page of the draft Report must include a watermark stating "DRAFT." The revised report should not include any watermarks.

Title. The title of the Report should exactly duplicate the title of the contract. However, minor changes to the title may be approved provided the new title does not deviate from the old title. These minor changes must be approved in writing by the contract manager. Significant changes to the title would require a formal amendment.

*Page size.* All pages should be of standard size (8 ½" x 11") to allow for photo-reproduction.

*Corporate identification.* Do not include corporate identification on any page of the Final Report, except the title page.

*Unit notation.* Measurements in the Reports should be expressed in metric units. However, for the convenience of engineers and other scientists accustomed to using the British system, values may be given in British units as well in parentheses after the value in metric units. The expression of measurements in both systems is especially encouraged for engineering reports.

*Section order.* The Report should contain the following sections, in the order listed below:

Title page
Disclaimer
Acknowledgment (1)
Acknowledgment (2)
Table of Contents
List of Figures
List of Tables
Abstract
Public Outreach Document
Executive Summary
Equity Implications Section
Body of Report
References
List of inventions reported and copyrighted materials produced
Glossary of Terms, Abbreviations, and Symbols
Appendices

*Page numbering.* Beginning with the body of the Report, pages shall be numbered consecutively beginning with “1”, including all appendices and attachments. Pages preceding the body of the Report shall be numbered consecutively, in ascending order, with small Roman numerals.

*Title page.* The title page should include, at a minimum, the contract number, contract title, name of the principal investigator, contractor organization, date, and this statement:
"Prepared for the California Air Resources Board and the California Environmental Protection Agency"

*Disclaimer.* A page dedicated to this statement must follow the Title Page:

> The statements and conclusions in this Report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

*Acknowledgment (1).* Only this section should contain acknowledgments of key personnel and organizations who were associated with the project. The last paragraph of the acknowledgments must read as follows:

> This Report was submitted in fulfillment of [CARB contract number and project title] by [contractor organization] under the [partial] sponsorship of the California Air Resources Board. Work was completed as of [date].

*Acknowledgment (2).* Health reports should include an acknowledgment to the late Dr. Friedman. Reports should include the following paragraph:

> This project is funded under the CARB's Dr. William F. Friedman Health Research Program. During Dr. Friedman's tenure on the Board, he played a major role in guiding CARB's health research program. His commitment to the citizens of California was evident through his personal and professional interest in the Board's health research, especially in studies related to children's health. The Board is sincerely grateful for all of Dr. Friedman's personal and professional contributions to the State of California.

*Attestation.* A page dedicated to this attestation statement must follow the Acknowledgement(s). The Principal Investigator (PI) must digitally sign below the following statement:

> The Final Report for CARB Agreement No. [contract number] titled "[Enter project title]" has been copy-edited for grammar, style, and format and is reviewed and approved by the Principal Investigator (PI), [title and name of PI] of [Contractor Name]. The signature below attests that the PI has completed a thorough review of this Final Report and approves it for submission to the California Air Resources Board.
>
> PI Signature
> Date

*Table of Contents.* This should list all the sections, chapters, and appendices, together with their page numbers. Check for completeness and correct reference to pages in the Report.

*List of Figures.* This list is optional if there are fewer than five illustrations.

*List of Tables.* This list is optional if there are fewer than five tables.

*Abstract.* The abstract should tell the reader, in nontechnical terms, the purpose and scope of the work undertaken, describe the work performed, and present the results obtained and conclusions. The purpose of the abstract is to provide the reader with useful information and a means of determining whether the complete document should be obtained for study. The length of the abstract should be no more than about 200 words. Only those concepts that are addressed in the executive summary should be included in the abstract.

Example of an abstract:

A recently developed ground-based instrument, employing light detecting and ranging (lidar) technology, was evaluated, and found to accurately measure ozone concentrations at altitudes of up to 3,000 meters. The novel approach used in this study provides true vertical distributions of ozone concentrations aloft and better temporal coverage of these distributions than other, more common methods, such as those using aircraft and ozonesonde (balloon) techniques. The ozone and aerosol measurements from this study, in conjunction with temperature and wind measurements, will provide a better characterization of atmospheric conditions aloft and the processes involved in the formation of unhealthful ozone concentrations than can be achieved with traditional ground-based monitors.

*Public Outreach Document.* The public outreach document is a one-page document that will be widely used to communicate, in clear and direct terms, the key research findings from the study to the public. CARB will be translating the document into other languages. This document must adhere to the following guidelines:

- Single space, limited to one-page or about 500 words.
- Use narrative form and active voice.
- Incorporate a graphic that it is easy to interpret and captures the results' central message.
- Avoid jargon and technical terms. Use a style and vocabulary level comparable to that of sixth grade reading level.
- The document should contain a title and the following five sections: Issue/s, Main Question, Key Research Findings, Conclusion/s, and More Information. Guidance on how to write these sections is described below.

  TITLE: Adopt a short, non-technical title to make the topic clear and concise. The title will likely differ from the original title of the contract.

  ISSUE/S: In one to two paragraphs, describe why the project was needed. In this section, identify the problem leading to this study and what the study was set to accomplish to help address the problem. Reference any history that is relevant such as a regulation, legislation, program, law, or other. Without going into detail and disclosing the research findings, mention the methods used in the study and how it informed the results.

  MAIN QUESTION: Present a concise central research question driving this project.

  KEY RESEARCH FINDING/S: This section covers the key research findings. List key points and or findings.

  CONCLUSION/S: In one to two paragraphs, discuss how the results could be used. Mention its relevance to policies, rules, regulations, legislations, or CARB programs. Include suggestions for next steps, additional research, or other actions.

  MORE INFORMATION: In two to three short sentences provide specifics about the study. This section should include the full title of the study, sponsor, authors, and where the full report can be found (the final report will be posted on the CARB website). In addition to a direct contact to gain more information (author and CARB contract manager).

*Executive Summary.* The function of the executive summary is to inform the reader about the important aspects of the work that was done, permitting the reader to understand the research without reading the entire Report. It should state the objectives of the research and briefly describe the experimental methodology[ies] used, results, conclusions, and recommendations for further study. All of the concepts brought out in the abstract should be expanded upon in the Executive Summary. Conversely, the Executive Summary should not contain concepts that are not expanded upon in the body of the Report.

The Executive Summary will be used in several applications as written; therefore, please observe the style considerations discussed below.

Limit the Executive Summary to two pages, single spaced.

Use narrative form. Use a style and vocabulary level accessible to the general audience. Assume the audience is being exposed the subject for the first time.

Do not list contract tasks in lieu of discussing the methodology. Discuss the results rather than listing them.

Avoid jargon.

Define technical terms.

Use passive voice if active voice is awkward.

Avoid the temptation to lump separate topics together in one sentence to cut down on length.

The Executive Summary should contain four sections: Background, Objectives and Methods, Results, and Conclusions, described below.

THE BACKGROUND SECTION. For the Background, provide a one-paragraph discussion of the reasons the research was needed. Relate the research to the Board's regulatory functions, such as establishing ambient air quality standards for the protection of human health, crops, and ecosystems; the improvement and updating of emissions inventories; and the development of air pollution control strategies.

THE OBJECTIVES AND METHODS SECTION. At the beginning of the Objectives and Methods section, state the research objectives as described in the contract. Include a short, one or two sentences, overview of what was done in general for this research.

The methodology should be described in general, nontechnical terms, unless the purpose of the research was to develop a new methodology or demonstrate a new apparatus or technique. Even in those cases, technical aspects of the methodology should be kept to the minimum necessary for understanding the project. Use terminology with which the reader is likely to be familiar. If it is necessary to use technical terms, define them. Details, such as names of manufacturers and statistical analysis techniques, should be omitted.

Specify when and where the study was performed if it is important in interpreting the results. The findings should not be mentioned in the Objectives and Methods section.

THE RESULTS SECTION. The Results section should be a single paragraph in which the main findings are cited, and their significance briefly discussed. The results should be presented as a narrative, not a list. This section must include a discussion of the implications of the work for the Board's relevant regulatory programs.

THE CONCLUSIONS SECTION. The Conclusions section should be a single short paragraph in which the results are related to the background, objectives, and methods. Again, this should be presented as a narrative rather than a list. Include a short discussion of recommendations for further study, adhering to the guidelines for the Recommendations section in the body of the Report.

*Equity Implication Section.* The equity implications section should summarize how the research results inform disparate impacts of policies, regulations, or programs on priority communities. [1] This section should summarize how sociodemographic factors were examined in this research. Given the data used or collected, which populations are excluded or overrepresented? How were relevant communities engaged in the research effort and/or how were existing data gaps identified and ground-truthed during the research project? If

[1] Priority communities here encompasses various terms CARB uses such as priority populations[2], communities of concern[3], protected classes[4], or disadvantaged communities[5].
[2] Priority Populations — California Climate Investments
[3] Referenced from the California Public Utilities Commission Environmental and Social Justice Plan an effort resulting from California's Capitol Collaborative on Race & Equity.
[4] Protected Classes | California State Senate
[5] SB-535-Designation-Final.pdf (ca.gov) ; California Climate Investments to Benefit Disadvantaged Communities | CalEPA; CalEnviroScreen 4.0 | OEHHA

ground-truthed data were found to not accurately reflect the lived experiences of community members, what future research projects could address this disconnect. The research results should inform existing or future CARB programs and the equity implications section should discuss how the research results may inform programs to close disparities in health outcomes, pollutant exposure or climate adaptation, etc., for priority communities. This section should be limited to a maximum of two (2) pages, single spaced and shall include the following sections.

HISTORICAL ANALYSIS. Provide an overview of the inequities and disparities observed in the existing data or data gathered during the research and how it ties to historic policies. For example, what is the root-cause of the disparity being experienced by the community or population central to this research?

MATERIALS AND METHODS. Describe how this research project examines racial equity. Some methods can include but are not limited to: examining the potential for existing data to address racial inequalities, ground-truthing existing data, engaging priority communities, assessments for racial and ethnic subgroups in the development of data and approaches, identifying data gaps and filling those gaps.

RESULTS AND DISCUSSION. Describe how the results improve our understanding of the equity issues identified or interventions to address those inequalities.

*Body of Report.* The body of the Report should contain the details of the research, divided into the following sections:[2]

INTRODUCTION. Clearly identify the scope and purpose of the project. Provide a general background of the project. Explicitly state the assumptions of the study.

Clearly describe the hypothesis or problem the research was designed to address. Discuss previous related work and provide a brief review of the relevant literature on the topic.

MATERIALS AND METHODS. Describe the various phases of the project, the theoretical approach to the solution of the problem being addressed, and limitations to the work. Describe the design and construction phases of the project, materials, equipment, instrumentation, and methodology.
Describe quality assurance and quality control procedures used. Describe the experimental or evaluation phase of the project.

RESULTS. Present the results in an orderly and coherent sequence. Describe statistical procedures used and their assumptions. Discuss information presented in tables, figures, and graphs. The titles and heading of tables, graphs, and figures, should be understandable without reference to the text. Include all necessary explanatory footnotes. Clearly indicate the measurement units used.

DISCUSSION. Interpret the data in the context of the original hypothesis or problem. Does the data support the hypothesis or provide solutions to the research problem? If appropriate, discuss how the results compare to data from similar or related studies. What are the implications of the findings?

Identify innovations or development of new techniques or processes. If appropriate, discuss cost projections and economic analyses.

[2] Note that if the research employs multiple distinct methods, analyses, etc., the final report can include separate materials/methods, results, and discussion sections to allow for coherent discussion of each set of analyses and findings. However, the executive summary and conclusions sections should synthesize the collective findings of the entire study.

SUMMARY AND CONCLUSIONS. This is the most important part of the Report because it is the section that will probably be read most frequently. This section should begin with a clear, concise statement of what, why, and how the project was done. Major results and conclusions of the study should then be presented, using clear, concise statements. Make sure the conclusions reached are fully supported by the results of the study. Do not overstate or overinterpret the results. It may be useful to itemize primary results and conclusions. A simple table or graph may be used to illustrate.

RECOMMENDATIONS. Use clear, concise statements to recommend (if appropriate) future research that is a reasonable progression of the study and can be supported by the results and discussion.

*References.* Use a consistent style to fully cite work referenced throughout the Report and references to closely related work, background material, and publications that offer additional information on aspects of the work. Please list these together in a separate section, following the body of the Report. If the Report is lengthy, you may list the references at the end of each chapter.

*List of inventions reported and publications produced.* If any inventions have been reported, or publications or pending publications have been produced as a result of the project, the titles, authors, journals or magazines, and identifying numbers that will assist in locating such information should be included in this section.

*Glossary of terms, abbreviations, and symbols.* When more than five of these items are used in the text of the Report, prepare a complete listing with explanations and definitions. It is expected that every abbreviation and symbol will be written out at its first appearance in the Report, with the abbreviation or symbol following in parentheses [i.e., carbon dioxide (CO2)]. Symbols listed in table and figure legends need not be listed in the Glossary.

*Appendices.* Related or additional material that is too bulky or detailed to include within the discussion portion of the Report shall be placed in appendices. If a Report has only one appendix, it should be entitled "APPENDIX". If a Report has more than one appendix, each should be designated with a capital letter (APPENDIX A, APPENDIX B). If the appendices are too large for inclusion in the Report, they should be collated, following the binding requirements for the Report, as a separate document.

The contract manager will determine whether appendices are to be included in the Report or treated separately. Page numbers of appendices included in the Report should continue the page numbering of the Report body. Pages of separated appendices should be numbered consecutively, beginning at “1”.

**3. Other Deliverables**

A. Any other deliverables shall be provided in a mutually agreed upon format unless the deliverable format is already specified in Exhibit A.

**EXHIBIT A2**

**KEY PERSONNEL**

| Last Name, First Name | Institutional Affiliation | Role on Project |
|---|---|---|
| **Principal Investigator (PI):** | | |
| Evan, Amato | UCSD | • Responsible for overall project management, ensuring that project milestones and deliverables are met in a timely manner,<br>• Lead the project's field measurements and soil/dust sampling, including identifying sampling locations, deployment of instrumentation, and shipment of samples to labs for further analysis,<br>• Organization of community outreach efforts and presentations, and<br>• Lead project final report and present main results at project-end meeting. |
| **Co-Principal Investigators (Co-PI):** | | |
| Heaney, Alexandra | UCSD | • Responsible for management of the project health impacts assessment activities,<br>• Co-supervise postdoctoral scholar working on the health assessment,<br>• Participate in community outreach meetings, and<br>• Contribute to project reports. |
| Porter, William | UCR | • Responsible for management of the project modeling activities,<br>• Co-supervise postdoctoral scholar working on the modeling activity,<br>• Participate in community outreach meetings, and<br>• Contribute to project reports. |
| **Other Key Personnel:** | | |
| Adebiyi, Adeyemi | UCM | • UCM Institutional Principal Investigator (PI),<br>• Contribute to model evaluation, with a focus on dust emission from croplands, and<br>• Contribute to project reports. |

| Last Name, First Name | Institutional Affiliation | Role on Project |
|---|---|---|
| Chen, Shu-Hua | UCD | • UCD Institutional PI,<br>• Contribute to model development and evaluation, focusing on dust and boundary layer parameterizations, and<br>• Contribute to project reports. |
| D'Odorico, Paolo | UCB | • UCB Institutional PI,<br>• Responsible for dust generation from soil samples and interpreting results from the soil and dust chemical analyses, and<br>• Contribute to project reports. |
| Hoh, Eunha | SDSU | • SDSU Institutional PI,<br>• Responsible for the soil and dust analysis for potential contaminants of concern,<br>• Lead the interpretation of measurement results,<br>• Contribute to the health impacts assessment and risk characterization, and<br>• Contribute to project reports. |
| Kok, Jasper | UCLA | • UCLA Institutional PI,<br>• Contribute to model emission scheme setup and evaluation of the model output, and<br>• Contribute to project reports. |

## EXHIBIT A4

## USE OF PREEXISTING INTELLECTUAL PROPERTY & DATA

*If either Party will be using any third-party or pre-existing intellectual property (including, but not limited to copyrighted works, known patents, trademarks, service marks and trade secrets) "IP" and/or Data with restrictions on use, then list all such IP and the nature of the restriction below. If no third-party or pre-existing IP/Data will be used, check "none" in this section.*

A. State: Preexisting Intellectual Property (IP)/Data to be provided to the University from the State or a third party for use in the performance in the Scope of Work.

☐ None or ☒ List:

| Owner (State Agency or 3rd Party) | Description | Nature of restriction: |
|---|---|---|
| California Department of Public Health and Centers for Medicare and Medicaid Services | The Study of Outcomes in Mothers and Infants (SOMI) dataset details maternal health history during pregnancy, birth outcomes, early-life outcomes, and residential address in California over an approximate 18-year period, beginning in 2005, with additional years of new data added as they become available. The research team additionally will extract information on maternal education, payment type for delivery, self-reported race/ethnicity, nativity, parity, and access to prenatal care. | All linkages between data sources are performed behind State firewalls, and only de-identified data are made available to project staff. Established confidentiality precautions regarding patient sample analysis are in place and include locked storage cabinets, password access protection of computer-based files, and read/write protection. The data files containing personal health information are protected by a password required for entry known only to the SOMI data manager required to access this information. De-identified, limited use data sets will be used for analysis to further project against risk of identification. The research team will not be sharing any raw data that includes personal identifying information and will handle the privacy, rights, and confidentiality of human research participants with great care. In designing and sharing data summaries and results, the research team will closely follow all guidelines from the California Health and Human Services Data De-identification Guidelines |

| Owner (State Agency or 3rd Party) | Description | Nature of restriction: |
|---|---|---|
| California Department of Health Care Access and Information | The research team will obtain zip-code level counts of all emergency department visits for each International Classification of Diseases coded category from 2015-2022. | The research team will not have access to any personal identifying information. The research team will store the data on encrypted, password-protected servers with access limited to authorized personnel only, maintaining integrity and confidentiality throughout the study. In designing and sharing data summaries and results, the research team will closely follow all guidelines from the California Health and Human Services Data De-identification Guidelines. |

B. University: Restrictions in Preexisting IP/Data included in Deliverables identified in Exhibit A1, Deliverables.

☒ None or ☐ List

| Owner (University or 3rd Party) | Description | Nature of restriction: |
|---|---|---|
| | | |
| | | |

C. Anticipated restrictions on use of Project Data.

D. If the University PI anticipates that any of the Project Data generated during the performance of the Scope of Work will have a restriction on use (such as subject identifying information in a data set), then list all such anticipated restrictions below. If there are no restrictions anticipated in the Project Data, then check "none" in this section.

☒ None or ☐ List

| Owner (State Agency or 3rd Party) | Description | Nature of restriction: |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**EXHIBIT A5**

**RÉSUMÉ / BIOSKETCH**

# Curriculum Vitae – Amato Evan

EDUCATION/TRAINING

| INSTITUTION AND LOCATION | DEGREE | END DATE | FIELD OF STUDY |
|---|---|---|---|
| Oregon State University, Corvallis, Oregon | BS | 06/2003 | Physics |
| University of Wisconsin - Madison, Madison, Wisconsin | MS | 06/2005 | Oceanic and Atmospheric Sciences |
| University of Wisconsin - Madison, Madison, Wisconsin | PHD | 06/2009 | Oceanic and Atmospheric Sciences |

## A. Personal Statement

Professor Amato Evan is part of the Climate, Atmospheric Science and Physical Oceanography Division at the Scripps Institution of Oceanography. His area of expertise is the physics of dust storms and since 2019 he has operated a research station near the western shoreline of the Salton Sea, where he makes meteorological and radiometric measurements during dust storms there. Professor Evan is the founder and Director of UC Dust, a multi-disciplinary center consisting of 11 faculty from 6 different UCs. The main goals of UC Dust are to develop and implement adaptation and mitigation strategies that address current and likely future dust storms in California (ucdust.ucsd.edu). Prof. Evan is also a member of the California Department of Natural Resources Salton Sea Management Program Science Committee.

## B. Positions and Scientific Appointments

| | |
|---|---|
| 2022 - | Professor, University of California San Diego, Scripps Institution of Oceanography, La Jolla, CA |
| 2019 - 2022 | Director, Climate Atmospheric & Physical Oceanography Division, University of California San Diego, Scripps Institution of Oceanography, La Jolla, CA |
| 2016 - 2022 | Associate Professor, University of California San Diego, Scripps Institution of Oceanography, La Jolla, CA |
| 2012 - 2016 | Assistant Professor, University of California San Diego, Scripps Institution of Oceanography, La Jolla, CA |
| 2012 - 2013 | Research Fellow, Institute Pierre Simon Laplace, Universite Pierre et Marie Curie, Paris |
| 2009 - 2012 | Assistant Professor, University of Virginia, Department of Environmental Sciences, Charlottesville, VA |

## C. Contribution to Science

1. Publications most relevant to this project (*postdocs*, graduate students)

   a. Kuwano A, Evan A, Walkowiak B, Frouin R. Quantifying the dust direct radiative effect in the Southwestern United States: findings from multiyear measurements. Atmospheric Chemistry and Physics Discussions, 2024 February; 1–39. DOI: 10.5194/acp-2024-1.

   b. Evan A, Porter W, Clemesha R, Kuwano A, Frouin R. Characteristics of Dust Storms Generated by Trapped Waves in the Lee of Mountains. Journal of the Atmospheric Sciences. 2023 March; 80(3):743-761. DOI: 10.1175/JAS-D-22-0128.1

c. Evan A, Porter W, Clemesha R, Kuwano A, Frouin R. Measurements of a Dusty Density Current in the Western Sonoran Desert. Journal of Geophysical Research: Atmospheres. 2022 April 24; 127(8). DOI: 10.1029/2021JD035830

d. McElroy S, Dimitrova A, Evan A, Benmarhnia T. Saharan Dust and Childhood Respiratory Symptoms in Benin. International Journal of Environmental Research and Public Health. 2022 April 14; 19(8):4743. DOI: 10.3390/ijerph19084743

e. Evan A, Walkowiak B, Frouin R. On the Misclassification of Dust as Cloud at an AERONET Site in the Sonoran Desert. Journal of Atmospheric and Oceanic Technology. 2022 February; 39(2):181-191. DOI: 10.1175/JTECH-D-21-0114.1

2. Other relevant publications

a. Kuwano A, Evan A. A Method to Account for the Impact of Water Vapor on Observation-Based Estimates of the Clear-Sky Shortwave Direct Radiative Effect of Mineral Dust. Journal of Geophysical Research: Atmospheres. 2022 August 29; 127(17). DOI: 10.1029/2022JD036620

b. Voss K, Evan A, Ralph F. Evaluating the Meteorological Conditions Associated With Dusty Atmospheric Rivers. Journal of Geophysical Research: Atmospheres. 2021 December 10; 126(24). DOI: 10.1029/2021JD035403

c. *Mascioli N*, Evan A, Ralph F. Influence of Dust on Precipitation During Landfalling Atmospheric Rivers in an Idealized Framework. Journal of Geophysical Research: Atmospheres. 2021 November 16; 126(22). DOI: 10.1029/2021JD034813

d. Voss K, Evan A, Prather K, Ralph F. Dusty Atmospheric Rivers: Characteristics and Origins. Journal of Climate. 2020 November 15; 33(22):9749-9762. DOI: 10.1175/JCLI-D-20-0059.1

e. Evan A. Downslope Winds and Dust Storms in the Salton Basin. Monthly Weather Review. 2019 July 01; 147(7):2387-2402. DOI: 10.1175/MWR-D-18-0357.1

# Curriculum Vitae – Alexandra Heaney

Alexandra K. Heaney

## Education

**Columbia University, PhD** — New York, NY
Environmental Health Sciences, 2019

**Stanford University** — Stanford, CA
B.A. with honors, Human Biology, 2014

## Positions

| | | |
|---|---|---|
| 2023 - present | **Assistant Professor**<br>University of California San Diego<br>Herbert Wertheim School of Public Health and Human Longevity Sciences | San Diego, CA |
| 2021 – 2023 | **Lecturer**<br>University of California, Berkeley<br>School of Public Health; Division of Environmental Health Sciences | Berkeley, CA |
| 2019 – 2023 | **Postdoctoral Scholar**<br>University of California, Berkeley<br>School of Public Health; Division of Environmental Health Sciences | Berkeley, CA |

## Select Publications

- Head, JR; Sondermeyer-Cooksey, G; **Heaney, AK**; T Yu, Alexander; Jones, I; Bhattachan, A; Campo, SK; Wagner, R; Mgbara, W; Phillips, S; Keeney, N; Taylor, J; Eisen, E; Lettenmaier DP; Hubbard, A; Okin, GO; Vugia, DJ; Jain, S; Remais, JV. (2022) Effects of Precipitation, Heat, and Drought on Incidence and Expansion of Coccidioidomycosis in Western USA: a Longitudinal Surveillance Study. *The Lancet Planetary Health*. 6(10)
- **Heaney, AK**; Stowell, J; Liu, J; Marlier, M; Basu, R; Kinney, P. (2022) Impacts of Fine Particulate Matter from Wildfire Smoke on Respiratory and Cardiovascular Health in California. *GeoHealth*. 6(6).
- Phillips, S; Jones, I; Sondermeyer-Cooksey, G; Yu, A; **Heaney, AK**; Zhou, B; Bhattachan, A; Weaver, AK; Campo, SK; Mgbara, W; Wagner, R; Taylor, J; Lettenmaier, D; Okin, G; Jain, S; Vugia, D; Remais, JV; Head, JR. "Association between wildfires and coccidioidomycosis incidence in California, 2000-2018: a synthetic control analysis." *Environmental Epidemiology* 7 (2023): e254.
- **Heaney, AK;** Head, JR; Broen, K; Click, K; Taylor, J; Balmes, J; Zelner, J; Remais, JV. (2021) Coccidioidomycosis and COVID-19 Co-Infection, United States, 2020. *Emerging Infectious Diseases*. 27(5).
- **Heaney, AK**; Alexander, K; Shaman, J. (2019) El Niño-Southern Oscillation and Under-5 Diarrhea in Botswana. *Nature Communications.* 10, 5798.
- **Heaney, AK**; Carrión, D; Burkhart, K; Lesk, C; Jack, DW. (2019) Climate change and physical activity: Estimated impacts of ambient temperature on bikeshare usage in New York City. *Environmental Health Perspectives.* 127(3). Alexander, K; **Heaney, AK**; Shaman, J. (2018) Hydrometeorology and flood pulse dynamics drive diarrheal disease outbreaks and increase vulnerability to climate change in surface-water-dependent populations: A retrospective analysis. *PLoS Medicine.* 15(11).
- **Heaney, AK**; Little, E; Ng, S; Shaman, J. (2016) Meteorological variability and infectious disease in Central Africa: A review of meteorological data quality. *Annals of the New York Academy of Sciences*. 1382(1), 31-34.

## Select Grant Support

2023 NIH-NIAID R01AI176770 ($3,944,289 total costs) 09/01/2023 – 08/30/2028

| | |
|---|---|
| | “Using massive, multi-regional EHR data to estimate the impacts of climate change on fungal disease epidemiology in the U.S.”<br>Role: equivalent to co-I but not eligible in 2022 |
| 2019 | NIH-NIAID R01AI148336 ($3,750,012 total costs) 12/09/2019 – 11/30/2024<br>“Integrating epidemiologic and environmental approaches to understand and predict Coccidioides exposure and coccidioidomycosis emergence”<br>Role: equivalent to co-I but not eligible in 2019 |

# William C. Porter

*Assistant Professor*
*Department of Environmental Sciences, University of California, Riverside*

## APPOINTMENTS

**Assistant Professor**
University of California, Riverside • Riverside, CA
**Postdoctoral Associate** 2017 to present

Massachusetts Institute of Technology • Cambridge, MA 2013 to 2017

## EDUCATION

**Ph.D., Applied Physics**, Portland State University, Portland, OR 2013
**M.S., Physics**, Portland State University, Portland, OR 2012
**B.S., Physics**, Portland State University, Portland, OR 2008
**B.A., Comparative Literature,** University of Oregon, Eugene, OR 2001

## RESEARCH INTERESTS

- modeling of atmospheric interactions with human and natural systems
- statistical analysis of modeled and observed air-quality events
- human health and environmental justice consequences of air pollution

## SELECT RECENT PUBLICATIONS

Evan, A, **W.C. Porter**, R Clemesha, A Kuwano, R Frouin. (2022). Measurements of a Dusty Density Current in the Western Sonoran Desert. *Journal of Geophysical Research: Atmospheres*.

Miao, Y., **W. C. Porter**, K. Schwabe, & J. LeComte-Hinely. (2022). Evaluating health outcome metrics and their connections to air pollution and vulnerability in Southern California's Coachella Valley. *Science of The Total Environment.*

Bradley, T., Ajami, H., & **Porter, W. C.** (2022). Ecological transitions at the Salton Sea: Past, present and future. *California Agriculture.*

**Porter, W.C.**, J.L. Jimenez, & K.C. Barsanti (2021). Quantifying Atmospheric Parameter Ranges for Ambient Secondary Organic Aerosol Formation. *ACS Earth Space Chem*.

Yañez, C. C., Hopkins, F. M., & **Porter, W. C.** (2020). Projected impacts of climate change on tourism in the Coachella Valley, California. *Climatic Change.*

## OUTREACH AND SERVICE POSITIONS

UCR Salton Sea Task Force • *Director* 2023 to present
GEOS-Chem Steering Committee • *Aerosols working group Co-chair* 2022 to present
ENSC Diversity, Equity, and Inclusion Committee • *Chair and member* 2020 to present

# Curriculum Vitae – Adeyemi Adebiyi

**Adeyemi Adebiyi**
*Assistant Professor,*
Department of Life and Environmental Sciences
University of California — Merced
aaadebiyi@ucmerced.edu

## EDUCATION AND TRAINING

2011-2016 PhD – Meteorology and Physical Oceanography, University of Miami, FL.
2010-2011 MSc-Eq. Diploma – Earth System Physics, International Centre for Theoretical Physics, Italy.
2009-2010 MSc-Eq. Diploma – Basic Physics, International Centre for Theoretical Physics, Italy.
2003-2008 BSc. – Physics, Federal University of Technology Akure, Nigeria.

## RESEARCH AND PROFESSIONAL EXPERIENCE

2021-Present Assistant Professor, University of California - Merced.
2019-2021 UC President's Postdoctoral Fellow, University of California – Los Angeles.
2017-2019 Post-doctoral Research Scholar, University of California – Los Angeles.
2017 Post-doctoral Research Associate, Department of Atmospheric Sciences, University of Miami.

## SYNERGISTIC ACTIVITIES

- Member, Committee on Atmospheric Chemistry, American Meteorological Society - Science and Technology Advisory Commission (STAC) - 2021-Present.
- Program Chair, Symposium on Aerosol–Cloud–Climate Interactions, American Meteorological Society Annual Meeting (2022-present).
- Participant, NASA ORACLES (ObseRvations of Aerosols above CLouds and their intEractionS) field campaign over the southeast Atlantic. (2016)

## RELEVENT PUBLICATIONS

- Ha, S., Abatzoglou, J. T., **Adebiyi, A.**, Ghimire, S., Martinez, V., Wang, M., & Basu, R. (2024). Impacts of heat and wildfire on preterm birth. Environmental Research, 119094.
- **Adeyemi A. Adebiyi**, Akintomide Akinsanola, and Osinachi Ajoku: The misrepresentation of Southern African Easterly Jet in models and its implication for aerosol, clouds, and precipitation distributions. Journal of Climate, 1-48, 2023
- **Adebiyi, Adeyemi A.**, Yue Huang, Bjørn H. Samset, and Jasper F. Kok Observations suggest that North African dust absorbs less solar radiation than models estimate. Nature Communications Earth & Environment, 2023
- Chang, I., Gao, L., Flynn, C. J., Shinozuka, Y., Doherty, S. J., ….Others…., Adeyemi A Adebiyi, Wood, R., Zuidema, P., Christopher, S. A., and Redemann, J.: On the differences in the vertical distribution of modeled aerosol optical depth over the southeastern Atlantic, Atmos. Chem. Phys., 23, 4283–4309, 2023
- Kok, J. F., Storelvmo, T., Karydis, V. A., **Adeyemi A. Adebiyi**, Mahowald, N. M., Evan, A. T., He, C. & Leung, D. M. (2023). Mineral dust aerosol impacts on global climate and climate change. Nature Reviews Earth & Environ., 1-16.
- **Adebiyi, A. Adeyemi**, Kok, J.F., Murray, B.J., Ryder, C.L., Stuut, J.-B.W., Kahn, R.A., Knippertz, P., Formenti, P., Mahowald, N.M., García-Pando, C.P., Klose, M., Ansmann, A., Samset, B.H., Ito, A., Balkanski, Y., Biagio, C.D., Romanias, M.N., Huang, Y., Meng, J., 2023. A review of coarse mineral dust in the Earth system. Aeolian Research 60, 100849.

· Meng, J., Huang, Y., Leung, D. M., Li, L., **Adebiyi, A. Adeyemi**, Ryder, C. L., ... & Kok, J. F. (2022). Improved Parameterization for the Size Distribution of Emitted Dust Aerosols Reduces Model Underestimation of Super Coarse Dust. Geophysical Research Letters, e2021GL097287.
· Ito, A., **Adebiyi, A. Adeyemi**, Huang, Y., and Kok, J. F.: Less atmospheric radiative heating by dust due to the synergy of coarser size and aspherical shape (2021), Atmos. Chem. Phys., 21, 16869–16891.
· Kok, J. F., **Adebiyi, A. Adeyemi**, Albani, S., Balkanski, Y., Checa-Garcia, R., Chin, M., Colarco, P. R., Hamilton, D. S., Huang, Y., Ito, A., Klose, M., Li, L., Mahowald, N. M., Miller, R. L., Obiso, V., Pérez García-Pando, C., Rocha-Lima, A., and Wan, J. S. (2021): Contribution of the world's main dust source regions to the global cycle of desert dust, Atmos. Chem. Phys., 21, 8169–8193.
· Kok, J. F., **Adebiyi, A. Adeyemi**., Albani, S., Balkanski, Y., Checa-Garcia, R., Chin, M., Colarco, P. R., Hamilton, D. S., Huang, Y., Ito, A., Klose, M., Leung, D. M., Li, L., Mahowald, N. M., Miller, R. L., Obiso, V., Pérez García-Pando, C., Rocha-Lima, A., Wan, J. S., and Whicker, C. A. (2021): Improved representation of the global dust cycle using observational constraints on dust properties and abundance, Atmos. Chem. Phys., 21, 8127–8167.
· Huang, Y., **Adebiyi, Adeyemi A**., Formenti, P., & Kok, J. F. (2021). Linking the different diameter types of aspherical desert dust indicates that models underestimate coarse dust emission. Geophys. Res. Lett., 48(6), doi:10.1029/2020GL092054.
· **Adebiyi, Adeyemi A.**, Zuidema, P., Chang, I., Burton, S. P., and Cairns, B. (2020): Mid-level clouds are frequent above the southeast Atlantic stratocumulus clouds, Atmos. Chem. Phys., 20, 11025-11043.
· **Adebiyi, Adeyemi A.**, and Jasper F. Kok (2020): Climate models miss most of the coarse dust in the atmosphere. Science Advances, 6(15), eaaz9507, doi:10.1126/sciadv.aaz9507.
· Huang, Y., Kok, J. F., Kandler, K., Lindqvist, H., Nousiainen, T., Sakai, T., **Adebiyi Adeyemi**, and Jokinen, O.: Climate Models and Remote Sensing Retrievals Neglect Substantial Desert Dust Asphericity (2020): Geophysical Research Letters, 47(6), doi:10.1029/2019GL086592
· **Adebiyi, Adeyemi A**., Kok, J. F., Wang, Y., Ito, A., Ridley, D. A., Nabat, P., & Zhao, C. (2020). Dust Constraints from joint Observational-Modelling-experiMental analysis (DustCOMM): comparison with measurements and model simulations. Atmospheric Chemistry and Physics, 20(2), 829-863.

# Curriculum Vitae – Shu-Hua Chen

Professor
Department of Land, Air & Water Resources
University of California, One Shields Avenue
Davis, CA 95616

## EDUCATION

National Taiwan University, Taipei, Taiwan (1993) Atmospheric Sciences, B.S.
Purdue University, West Lafayette, IN, Atm. Sciences, M.S. (1995), Ph.D. (1999)
National Center for Atmospheric Research, Boulder, CO (12/1999 – 09/2001)
Mesoscale modeling and data assimilation, Postdoctoral Associate

EDUCATION
National Taiwan University, Taipei, Taiwan (1993) Atmospheric Sciences, B.S.
Purdue University, West Lafayette, IN, Atm. Sciences, M.S. (1995), Ph.D. (1999)
National Center for Atmospheric Research, Boulder, CO (12/1999 – 09/2001)
Mesoscale modeling and data assimilation, Postdoctoral Associate

## APPOINTMENTS

Assistant Professor, University of California, Davis. 09/2001 – 06/2007
Associate Professor, University of California, Davis. 07/2007 – 06/2013
Professor, University of California, Davis. 07/2013 – present

## SELECTED PUBLICATIONS

· Li, J. and S.-H. Chen, 2023: Dust impacts on Mongolian cyclone and cold front in East Asia: a case study during 18–22 March 2010. Front. Environ. Sci. 11:1167232. doi: 10.3389/fenvs.2023.1167232.
· Bercos-Hickey, E., T. R. Nathan, and S.-H. Chen, 2022: Effects of Saharan dust aerosols and West African precipitation on the energetics of African easterly waves, J. Atmos. Sci., 79(7), 1911-1926.
· Zhao, Z., Z., P. Di, S.-H. Chen, J. Avise, A. Kaduwela, 2021: Assessment of climate change impact on wintertime meteorology over California using dynamical downscaling method with a bias correction technique, Clim Dyn. https://doi.org/10.1007/s00382-021-05718-8.
· Chen, S.-H., B. McDowell, C.-C. Huang, T. R. Nathan, 2021: Formation of a low-level barrier jet and its modulation by dust radiative forcing over the Hexi Corridor in Central China on March 17, 2010. Q. J. R. Meteorol. Soc., 1– 19. https://doi.org/10.1002/qj.4000.
· Chen, S.-H., C.-C. Huang, Y.-C. Kuo, Y.-H. Tseng, Y. Gu, K. Earl, C.-Y. Chen, Y. Choi, K.-N. Liou, 2021: Impacts of Saharan mineral dust on air-sea interaction over North Atlantic Ocean using a fully coupled regional model. Journal of Geophysical Research: Atmospheres, 126, e2020JD033586. https://doi.org/10.1029/2020JD033586
· Kumar, A., Zapata, C., Yeh, S., Yang, C., Ogden, J., & Lee, H.-H., et al., 2020: Effects of low-carbon energy adoption on airborne particulate matter concentrations with feedbacks to future climate over California. Journal of Geophysical Research: Atmospheres, 125, e2020JD032636. https://doi.org/10.1029/2020JD032636 . Editor's Highlight in Eos.
· Bercos-Hickey, E., T. R. Nathan, and S.-H. Chen, 2020: On the Relationship between the African Easterly Jet, Saharan Mineral Dust Aerosols, and West African Precipitation. J. Climate, 33, 3533–3546. https://doi.org/10.1175/JCLI-D-18-0661.1
· Lee, H.-H., S.-H. Chen, A. Kumar, H. Zhang, and M. J. Kleeman, 2020: Improvement of aerosol activation/ice nucleation in a source-oriented WRF-Chem model to study a winter storm in California. Atmospheric Research, 235, p.104790.
· Zhao, Z., P. Di, S.-H. Chen, J. Avise, A. Kaduwela, and J. DaMassa, 2020: Assessment of climate change impact over California using dynamical downscaling with a bias correction technique: method validation and analyses of summertime results. Clim. Dyn. 54, 3705–3728. https://doi.org/10.1007/s00382-020-05200-x
· Grogan, D. F. P., T. R. Nathan, and S.-H. Chen, 2019: Structural Changes in the African Easterly Jet and Its Role in Mediating the Effects of Saharan Dust on the Linear Dynamics of African Easterly Waves. J. Atmos. Sci., 76, 3351–3365, https://doi.org/10.1175/JAS-D-19-0104.1.

- Nathan, T. R., D. F. P. Grogan, and S.-H. Chen, 2019: Saharan dust transport during the incipient growth phase of African easterly waves. Geosciences, 9, 388. doi:10.3390/ geosciences 9090388.
- Huang C.-C, S.-H. Chen, Y.-C. Lin, K. Earl, T. Matsui, H.-H. Lee, I-C Tsai, J.-P. Chen, and C.-T. Cheng, 2019: The Comparison of Dust-Radiation versus Dust-Cloud Interactions on the Development of an MCS over North Africa. Mon. Wea. Rev., 147, 3301–3326. https://doi.org/10.1175/MWR-D-18-0459.1
- Bercos-Hickey, E., T. R. Nathan, and S.-H. Chen, 2017: Saharan Dust and the African Easterly Jet-African Easterly Wave System: Structure, Location, and Energetics. Quart. J. Roy. Meteor. Soc., DOI: 10.1002/qj.3128.
- Nathan, T.R., D.F. Grogan, and S. Chen, 2017: Subcritical Destabilization of African Easterly Waves by Saharan Mineral Dust. J. Atmos. Sci., 74, 1039–1055.
- Grogan, D. F. P., T. R. Nathan, and S.-H. Chen, 2017: Saharan Dust and the Nonlinear Evolution of the African Easterly Jet-African Easterly Wave System. J. Atmos. Sci., 74, 24-47, DOI: 10.1175/JAS-D-16-0118.1.
- Hu, J. Hu, S. Jathar, H. Zhang, Q. Ying, S.-H. Chen, C.D. Cappa, and M.J. Kleeman, 2017: Long-term particulate matter modeling for health effect studies in California – Part 2: Concentrations and sources of ultrafine organic aerosols. Atmos. Chem. Phys., 17, 5379-5391, DOI: 10.5194/acp-17-5379-2017.
- Lee, H.-H., S.-H. Chen, M. J. Kleeman, H. Zhang, S. P. DeNero, and D. K. Joe, 2016: Implementation of warm-cloud processes in a source-oriented WRF/Chem model to study the effect of aerosol mixing state on fog formation in the Central Valley of California. Atmos. Chem. Phys., 16, 8353-8374, DOI: 10.5194/acp-16-8353-2016.
- Hu, J., H. Zhang, Q. Ying, S.-H. Chen, F. Vandenberghe, and M. J. Kleeman, 2015: Long-term particulate matter modeling for health effect studies in California – Part 1: Model performance on temporal and spatial variations. Atmos. Chem. Phys., 15, 3445-3461, DOI: 10.5194/acp-15-3445-2015.
- Chen, S.-H., Y.-C. Liu, R. R. Nathan, C. Davis, R. Torn, N. Sowa, C.-T. Cheng, and J.-P. Chen, 2015: Modeling the effects of dust-radiative forcing on the movement of Hurricane Helene (2006). Q.J.R. Meteorol. Soc.. 141, 2563-2570, DOI: 10.1002/qj.2542
- Hu, J., H. Zhang, S.-H. Chen, Q. Ying, C. Wiedinmyer, F. Vandenberghe, and M.J. Kleeman, 2014: Identifying PM2.5 and PM0.1 Sources for Epidemiological Studies in California. Environmental Science and Technology, 48 (9), 4971-4979.
- Hu, J., H. Zhang, S.-H. Chen, C. Wiedinmyer, F. Vandenberghe, Q. Ying, M.J. Kleeman, 2014: Predicting Primary PM2.5 and PM0.1 trace composition for epidemiological studies in California. Environmental Science and Technology, 48 (9), 4971-4979, DOI: 10.1021/es404809j.
- Joe, D.K., H. Zhang, S.P. DeNero, H.-H. Lee, S.-H. Chen, B.C. McDonald, R.A. Harley, and M.J. Kleeman, 2014: Implementation of a high-resolution WRF/Chem model at the port of Oakland. Atmospheric Environment, 82, pp351-363.
- Zhang, H., S.P. DeNero, D.K. Joe, H. Lee, S.-H. Chen, J. Michalakes, and M.J. Kleeman, 2014: Development of a source oriented version of the WRF/Chem model and its application to the California regional PM10/PM2.5 air quality study. Atmospheric Chemistry and Physics, 14, 485-503. DOI: 10.5194/acp-14-485-2014.
- Zhang, H., G. Chen, J. Hu, S.-H. Chen, C. Wiedinmyer, M. Kleeman, and Q. Ying, 2014: Evaluation of a seven-year air quality simulation using the Weather Research and Forecasting (WRF)/Community Multiscale Air Quality (CMAQ) models in the eastern United States. Science of the Total Environment, 473, 275-285, DOI: 10.1016/j.scitotenv.2013.11.121.
- Zhao, Z., S.-H. Chen, and M. J. Kleeman, 2011: The impact of climate change on air quality related meteorological conditions in California. Part II: Present versus Future Time Simulation Analysis. J. Climate., 24, 3362-3376, DOI: 10.1175/2010JCLI3850.1.
- Zhao, Z., S.-H. Chen, M. J. Kleeman, M. Tyree, and D. Cayan, 2011: The impact of climate change on air quality related meteorological conditions in California. Part I: Present time simulation analysis. J. Climate., 24, 3344-3361.

# Curriculum Vitae – Paolo D'Odorico

Thomas J. Graff Professor of Natural Resources
Department of Environmental Science, Policy, and Management,
Department of Civil and Environmental Engineering
University of California, Berkeley
133 Mulford Hall #3114, Berkeley, CA94720-3114, USA

History of Employment
Professor, Environmental Science, Policy & Management Dept., Univ. of California, Berkeley, USA, 2016-.
Adjunct Professor of Civil & Environmental Engineering, University of California, Berkeley, USA, 2018-.
Ernest H. Ern Professor of Environmental Sciences, University of Virginia, Charlottesville, USA, 2010-.
Associate Professor, Department of Environmental Sciences, University of Virginia, USA, 2006-2010.
Assistant Professor, Department of Environmental Sciences, University of Virginia, USA, 2001-2006.
Assistant Professor, Department of Civil Engineering, Texas A&M Univ., College Station, USA, 1999-2001.
Research Associate, Department of Civil and Environmental Engineering, Princeton University, USA, 1999.

Education
Ph.D., Hydraulic Engineering, University of Padova, Italy (1994-1998)
M.S. (Laurea), Civil Engineering, University of Padova, Italy (1988-1994.

Research experience
Eco-hydrology, water sustainability, surface hydrology, stochastic modeling of hydrologic processes, soil moisture dynamics, aeolian processes, savanna ecology, regional water cycle, soil erosion, desertification, water and food security, socio-environmental networks, critical transitions, noise-induced phenomena.

Honors and Awards
Highly Cited Researcher (Web of Science, Clarivate); Hydrological Science Medal (American Meteorological Society, 2023); Fellow, American Meteorological Society (2023); Fellow, American Association for the Advancement of Science (2022); Paul Witherspoon Lecture, American Geophysical Union (2016); Fellow, American Geophysical Union (2016); Guggenheim Fellowship (2011); Fulbright Distinguished Lecturer (2011); Sustainability Science Award (Ecological Society of America, 2009).

Editorial Boards and Other Service
Editor, Reviews of Geophysics (2019-); Editor-in-Chief, Advances in Water Resources (2014-2022); -Editorial Board, Oxford Encyclopedia of Environmental Sciences (2014-); Editor, Drylands (2024-); Editor, Geophysical Research Letters (2009-2013); Editorial Board, Advances in Water Resources, (2012-Present); Associate Editor, Water Resources Research, (2004-2009); -Member, Salton Sea Scientific Advisory Board, 2017-

Selected Publications
Khatei, G., T. Rinaldo, S. Van Pelt, P. D'Odorico, and S. Ravi (2024). "Wind erodibility and particulate matter emissions of salt-affected soils: The case of dry soils in a low humidity atmosphere", J. Geophys. Res., 129, e2023JD039576.
Karimzadeh S., D.D.Chiarelli, S. Hartman, M.C. Rulli, and P.D'Odorico, (2024), "The tradeoff between water savings and salinization prevention in dryland irrigation", Adv. Water Resour. 183, 104604, ISSN 0309-1708.
Bhattachan, A, K. Dintwe, M. Tatlhego, P. D'Odorico, and G.S. Okin (2022), "Evaluation of dust production efficiencies in sandy sediments", Earth Surface Processes and Landforms, 1–9.
Jiao, W., L. Wang, W. K. Smith, Q. Chan, H. Wang, P. D'Odorico (2021), "Observed increasing water constraint on vegetation growth over the last three decades", Nat. Comm., doi: 10.1038/s41467-021-24016-9.

Tatlhego M., A. Bhattachan, G. S. Okin, P. D'Odorico (2020). "Mapping areas of the Southern Ocean where productivity likely depends on dust-delivered iron", J. Geophys. Res.–Atmospheres, 125, e2019JD030926;.
Hassani A., A. Azapagic, P. D'Odorico, A. Keshmiri , N. Shokri, (2020). "Desiccation crisis of saline lakes: A new decision-support framework for building resilience to climate change", STOTEN, 703(10), 134718.
Okin, G., P. D'Odorico, and J. Liu, (2018). "A mechanism of land degradation in turf-mantled slopes of the Tibetan Plateau", Geophys. Res. Lett. 45(9), 4041-4048.
Bhattachan, A., L. Wang, M. F. Miller, K. J. Licht, and P. D'Odorico (2015), "Antarctica's Dry Valleys: A potential source of soluble iron to the Southern Ocean?" Geophys. Res. Lett., 42, 1912–1918.
Bhattachan, A., P. D'Odorico, and G.S. Okin, (2015). "Biogeochemistry of Dust Sources in Southern Africa", Journal of Arid Environments., 117: 18-27.
Bhattachan, A. and P. D'Odorico, (2014)."Can land use intensification in the Mallee, Australia increase the supply of soluble iron to the Southern Ocean?", Sci. Rep. 4, 6009; DOI:10.1038/srep06009.
Bhattachan, A., P. D'Odorico, K. Dintwe, G.S. Okin, and S.L. Collins, (2014)., "Resilience and Recovery of the Kalahari dunes", Ecosphere, 5(2): 1-14.
Bhattachan, A., P. D'Odorico, K. Dintwe, and G.S. Okin, (2013). "Potential dust emissions from the Southern Kalahari's dunelands", J. Geophys Res. Earth Surface, 118, 1–8, doi:10.1002/jgrf.20043, 2013.
D'Odorico P., A. Bhattachan, K.F. Davis, S. Ravi, C.W. Runyan, (2013). "Global desertification: drivers and feedbacks", Adv. Water Res., 51, 326-344.
Wang L., P D'Odorico, J. P. Evans, D. Eldridge, M. F. McCabe, K. K. Caylor, E. G. King, (2012). "Dryland ecohydrology and climate change: critical issues and technical advances", Hydrol. Earth Syst. Sci., 16, 2585–2603, doi:10.5194/hess-16-2585-2012.
Bhattachan, A., P. D'Odorico, M.C. Baddock, T.M. Zobeck, G.S. Okin, N. Cassar, (2012). "The Southern Kalahari: A potential new dust source in the southern hemisphere?", Environm. Res. Lett., 7, 024001.
D'Odorico, P, G.S. Okin, and B.T. Bestelmeyer. (2012). "A synthetic review of feedbacks and drivers of shrub encroachment in arid grasslands", Ecohydrology, 5(5), 520–530 doi : 10.1002/eco.259.
Ravi, S., P. D'Odorico, D. D. Breshears, J. P. Field, A. S. Goudie, T. E. Huxman, J. Li, G.S. Okin, R. J. Swap, A.D. Thomas, S. Van Pelt, J.J. Whicker, and T.M. Zobeck, (2011). "Aeolian processes and the biosphere", Rev. of Geophys. doi:10.1029/2010RG000340.
Ravi, S., D.D. Breshears, T.E. Huxman, and P. D'Odorico, (2010). "Land degradation in drylands: interactions among hydrologic-aeolian erosion and vegetation dynamics", Geomorphology, 216, 236-245.
Ravi, S., T.E. Huxman, S.L. Collins, and P. D'Odorico, (2010). "Interactions between Soil Erosion Processes and Fires: Implications for Rangeland Management in Arid and Semi Arid Regions", Rangeland Ecology and Management, 63(3) 267-274.
Ravi. S., P. D'Odorico, L. Wang, C.S. White, G.S. Okin, S.A. Macko and S.L. Collins, (2009). "Post-fire resource redistribution in desert grasslands: A possible negative feedback on land degradation", Ecosystems, 12(3), 434-444, doi 10.1007/s10021-009-9233-9.
Ravi, S. P. D'Odorico, T.M. Zobeck, T.M Over (2009). "The effect of fire-induced hydrophobicity on wind erosion in a semiarid grassland", Geomorphology, 105, 80-86.
Ravi, S., T.M. Zobeck, G.S. Okin, T.M. Over, and P. D'Odorico, (2006). "On the effect of wet-bonding forces in air-dry soils on the threshold friction velocity of wind erosion", Sedimentology, 1-13, 2006
Ravi, S. and P. D'Odorico (2005). "A field-scale analysis of the dependence of wind erosion threshold velocity on air humidity", Geophys. Res. Lett. 32(21) L21404 10.1029/2005GL0236 75.
Ravi, S., P. D'Odorico, T.M. Over, and T.M. Zobeck, (2004)., "On the effect of air humidity on soil susceptibility to wind erosion: The case of air-dry soils", Geophys. Res. Lett., 31, Lo9501, doi: 10.1029/2004GL019485.

# Curriculum Vitae – Enuha Hoh

**Eunha Hoh, PhD, MSES.**
Professor of Environmental Health, School of Public Health
San Diego State University, San Diego, CA, 92182-4162

## a. Professional Preparation

| | | |
|---|---|---|
| Korea Advanced Institute of Science and Technology (KAIST), South Korea | Chemistry | B.S. 1995 |
| KAIST, South Korea | Chemistry | M.S. 1997 |
| Indiana Univ, Bloomington | Environmental Science | MSES. 2003 |
| Indiana Univ, Bloomington | Environmental Science | Ph.D. 2006 |
| USDA Agricultural Research Service, Wyndmoor, PA | Postdoc | 2006-2008 |

## b. Personal Statement

Dr. Eunha Hoh is an environmental health scientist and expert in the field of environmental chemistry. She has extensive experience characterizing environmental and biological samples for contaminants using both targeted and non-targeted approaches. Her research focuses on three key areas: 1) The fate of organic contaminants in both global and microscopic environments, including environmental and biological tissues; 2) The identification of previously unknown and novel contaminants and their sources, and 3) Developing mass spectrometry-based high-throughput assays for exposure assessment. A prime example of her work is the first-time identification of novel halogenated flame retardants in sediment and air samples from the Great Lakes. She also developed a novel non-targeted analytical method to identify various classes of organic toxicants in biological tissues and environmental samples. This method is instrumental in discovering novel organic contaminants and assessing exposure. Dr. Hoh is a recognized pioneer in non-targeted analysis. Utilizing non-targeted analysis, her research group discovered hundreds of halogenated organic compounds, including over 45 DDT-related compounds, for the first time in wildlife from the Southern California Bight. In this study, Dr. Hoh and her team will employ GC/MS and ICP-MS to measure organohalogen and organophosphate pesticides and metals proposed. Prior to this, they will perform their in-house developed non-targeted analysis based on GC×GC/TOF-MS on a subset of samples to identify any toxic contaminants not included in the proposed target list. This comprehensive screening approach ensures they capture a wider range of potential contaminants.

## c. Professional Appointments

| | |
|---|---|
| 2018-2023 | Division Head of Environmental Health, School of Public Health, San Diego State University, San Diego, CA |
| 2017- | Professor, Public Health, San Diego State University |
| 2012-2017 | Associate Professor, Public Health, San Diego State University |
| 2014-2016 | Interim Division Head, Division of Environmental Health, Public Health, San Diego State University |
| 2009-2012 | Assistant Professor, Public Health, San Diego State University |

## d. Additional Appointments

| | |
|---|---|
| 2013-present | Advisory Board Member of *Environmental Science and Technology Letters* |
| 9/2018-2023 | California Environmental Contaminant Biomonitoring Program Scientific Guidance Panel (appointed by Speaker of the Assembly) |
| 7/2019-present | California Ocean Protection Council's Science Advisory Team |
| 8/2023-present | Ocean Research Advisory Panel (that advises the Ocean Policy Committee and provides independent recommendations to the Federal Government on matters of ocean policy). |

## e. Selected Publications Relevant to this work (out of 98 peer-reviewed publications)

1. Stack ME, Richardot WH, Garcia R, Nguyen T, Choy CA, Jensen PR, Gutleben J, Dodder NG, Aluwihare, LI, Hoh E. Identification of DDT+ in deep ocean sediment and biota in the southern California Bight. Environ Sci Technol Letters. 2024, 479-484.
2. Richardot WH, Hamzai L, Ghukasyan T, Dodder NG, Quintana PJE, Matt GE, Sant KE, Lopez-Galvez N, Hoh E. Novel chemical contaminants associated with thirdhand smoke in settled house dust. Chemosphere. 2024, 141138.
3. Stack ME, Cossaboon JM, Tubbs CW, Vilchis I, Felton RG, Johnson JL, Danil K, Heckel G, Hoh E, Dodder NG. Assessing Marine Endocrine-Disrupting Chemicals in the Critically Endangered California Condor: Implications for Reintroduction to Coastal Environments. Environ Sci Technol. 2022, 56, 7800–7809.
4. Trego ML, Hoh E, Whitehead A, Keller NM, Lauf M, Datuin DO, Lewison RL. Contaminant Exposure Linked to Cellular and Endocrine Biomarkers in Southern California Bottlenose Dolphins. Environ Sci Technol. 2019, 53, 3811-3822.
5. Mackintosh SA, Dodder NG, Shaul NJ, Aluwihare LI, Maruya KA, Chivers SJ, Danil K, Weller DW, Hoh E. Newly Identified DDT-Related Compounds Accumulating in Southern California Bottlenose Dolphins, Environ Sci Technol. 2016;*50:* 12129-12137.
6. Shaul NJ, Dodder NG, Aluwihare LI, Mackintosh SA, Maruya KA, Chivers SJ, Hoh E. Nontargeted biomonitoring of halogenated organic compounds in two ecotypes of bottlenose dolphins (Tursiops truncatus) from the Southern California Bight. Environ Sci Technol. 2015;*49*: 1328–1338.
7. Rochman CM, Hoh E, Hentschel BT, Kaye S. Long-term field measurement of sorption of organic contaminants to five types of plastic pellets: implications for plastic marine debris. Environ Sci Technol. 2013;*47*: 1646–1654.
8. Rochman CM, Browne MA, Halpern BS, Hentschel BT, Hoh E, Karapanagioti HK, et al. Policy: Classify plastic waste as hazardous. Nature. 2013;*494*: 169–171.
9. Manzano C, Hoh E, Simonich SLM. Improved separation of complex polycyclic aromatic hydrocarbon mixtures using novel column combinations in GC×GC/ToF-MS. Environ Sci Technol. 2012;*46*: 7677–7684.
10. Hoh E, Dodder NG, Lehotay SJ, Pangallo KC, Reddy CM, Maruya KA. Nontargeted comprehensive two-dimensional gas chromatography/time-of-flight mass spectrometry method and software for inventorying persistent and bioaccumulative contaminants in marine environments. Environ Sci Technol. 2012, *46,* 8001–8008.
11. Hoh E, Zhu LY, Hites RA. Dechlorane Plus, a Chlorinated Flame Retardant, in the Great Lakes. Environm Sci Technol. 2006, 40, 1184-1189.
12. Hoh E, Hites RA. Brominated Flame Retardants in the Atmosphere of the Eastern United States. Environ Sci Technol. 2005, 39, 7794-7802.
13. Hoh, E, Hites R.A. Sources of Toxaphene and Other Organochlorine Pesticides in North America As Determined By Air Measurements and Potential Source Contribution Function Analysis. Environ Sci Technol. 2004, 38, 4187-4194.

**f. Slected Presentations**

1. July 2022 – “DDX Accumulation in Regional Marine Mammals and Wildlife” at California Stakeholder DDT+ Research Needs Workshop by NOAA Sea Grant/USC and California (Invited Keynote Speaker)
2. May 2016 – “An Analytical Framework for the Discovery of Bio-accumulative Organic Compounds” (Invited Keynote Speaker) at first International Non-Target Analysis Workshop, Ascona, Switzerland
3. August 2015 – “Non-targeted Biomonitoring of Halogenated Organic Compounds in Marine Species” at EPA Non-Targeted Analysis Workshop (Invited Keynote Speaker)

# Curriculum Vitae – Jasper Kok

*Professor, Department of Atmospheric and Oceanic Sciences*
*University of California, Los Angeles (UCLA)*

## Education

2009 Ph. D. (awarded Distinguished Dissertation Award), Applied Physics, Univ. of Michigan
2003 Professional Science Master's (PSM), Applied Physics, Univ. of Arizona
2001 B.S., Physics, Leiden University, The Netherlands

## Professional experience (post – Ph.D.)

2021 - present Full professor, Department of Atmospheric and Oceanic Sciences, UCLA
2017 - 2021 Associate professor, Department of Atmospheric and Oceanic Sciences, UCLA
2013 - 2017 Assistant professor, Department of Atmospheric and Oceanic Sciences, UCLA
2011 - 2013 NSF Postdoctoral Research Fellow, Cornell University
2009 - 2011 Postdoctoral Fellow, Advanced Study Program (ASP), NCAR

## Honors and awards

2019 Received the **AMS Henry Houghton Early Career award** for "novel approaches to studying the physics of dust emissions into the atmosphere and the interactions of dust aerosols with Earth's climate and beyond"

2016 Received an **NSF CAREER award**
2009 Received the 2009 **Distinguished Dissertation Award** from the University of Michigan
2007 Received **Outstanding Student Paper Award** at AGU Fall Meeting

## Research activities and interests:

Professor Kok's main research interests are the physics of dust aerosol emission and aerosol-climate interactions. He has developed parameterizations of dust emission that are used in many current chemical transport and climate models, and he has used theory, measurements, and modeling to quantify dust effects on past, present, and future climate.

## Most relevant publications (*postdocs*, graduate students)

Leung, D. M., **J. F. Kok**, L. Li, N. M. Mahowald, D. M. Lawrence, S. Tilmes, E. Kluzek, M. Klose, and C. Pérez García-Pando, A new process-based and scale-aware desert dust emission scheme for global climate models–Part II: evaluation in the Community Earth System Model (CESM2), *Atmospheric Chemistry and Physics,* Atmos. Chem. Phys., 24, 2287–2318, https://doi.org/10.5194/acp-24-2287-2024, 2024.

Leung, D. M., **J. F. Kok**, L. Li, G. S. Okin, C. Prigent, M. Klose, C. Pérez García-Pando, L. Menut, N. M. Mahowald, D. M. Lawrence, and M. Chamecki, A new process-based and scale-respecting desert dust emission scheme for global climate models – Part I: description and evaluation against inverse modeling emissions, *Atmospheric Chemistry and Physics,* 23, 6487–6523, https://doi.org/10.5194/acp-23-6487-2023, 2023.

**Kok, J. F.**, T. Storelvmo, V. A. Karydis, *A. A. Adebiyi*, N. M. Mahowald, A. T. Evan, C. He, and D. M. Leung (2023), Mineral dust aerosol impacts on global climate and climate change, *Nature Reviews Earth & Environment*, 4, 71-86, https://doi.org/10.1038/s43017-022-00379-5.

**Kok, J. F.**, et al. (2021), Contribution of the world's main dust source regions to the global cycle of desert dust, *Atmospheric Chemistry and Physics*, 21, 8169-93, https://doi.org/10.5194/acp-21-8169-2021.

**Kok, J. F.**, et al. (2021), Improved representation of the global dust cycle using observational constraints on dust properties and abundance, *Atmospheric Chemistry and Physics*, 21, 8127-67, https://doi.org/10.5194/acp-21-8127-2021.

Adebiyi, A. A., and **J. F. Kok** (2020), Climate models miss most of the coarse dust in the atmosphere, *Science Advances,* 6, eaaz9507.

Comola, F., **J. F. Kok**, M. Chamecki, and R. L. Martin, The intermittency of wind-driven sand transport and dust emission, *Geophysical Research Letters,* 46, 13,430-13,440, https://doi.org/10.1029/2019GL085739.

**Kok, J. F.**, D. S. Ward, N. M. Mahowald, and A. T. Evan (2018), Global and regional importance of the direct dust-climate feedback, *Nature Communications*, 9, 241.

**Kok, J. F.**, D. A. Ridley, Q. Zhou, R. L. Miller, C. Zhao, C. L. Heald, D. S. Ward, S. Albani, and K. Haustein (2017), Smaller desert dust cooling effect estimated from analysis of dust size and abundance, *Nature Geoscience*, 10, 274-8.

Martin, R. L., and **J. F. Kok** (2017), Wind-invariant saltation heights imply linear scaling of aeolian saltation flux with shear stress, Science Advances, 3, e1602569.

**Kok, J. F.,** N. M. Mahowald, G. Fratini, J. A. Gillies, M. Ishizuka, J. Leys, M. Mikami, M.-S. Park, S.-U. Park, R. S. Van Pelt, and T. M. Zobeck (2014), An improved dust emission model – Part 1: Model description and comparison against measurements, *Atmospheric Chemistry and Physics,* 14, 13,023-41.

**Kok, J. F.**, E. J. R. Parteli, T. I. Michaels, and D. Bou Karam (2012), The physics of wind-blown sand and dust, *Reports on Progress in Physics*, 75, 106901 (72 pp).

**Kok, J. F**. (2011), A scaling theory for the size distribution of emitted dust aerosols suggests climate models underestimate the size of the global dust cycle, *Proceedings of the National Academy of Sciences (PNAS)*, 108(3), 1016-021.

**Recent Collaborators**

Samuel Albani, Milan University, Italy
Yves Balkanski, IPSL/LSCE, France
Peter Colarco, NASA GSFC, USA
Mian Chin, NASA GSFC, USA
Lauren Zamora, NASA GSFC, USA
Amato Evan, UCSD, USA
Ian Eisenman, UCSD, USA
Carlos Perez Garcia-Pando, Barcelona Supercomputing Center, Spain
Douglas Hamilton, North Carolina State University, USA
Natalie Mahowald, Cornell University, USA
Adeyemi Adebiyi, University of California – Merced, USA
Trude Storelvmo, Oslo University, Norway
Michael Schulz, Norwegian Meteorological Institute
Vlassis Karydis, Forschungszentrum Jülich, Germany
Ron Miller, NASA GISS, USA

**EXHIBIT A6**

**CURRENT AND PENDING SUPPORT**

| **PI: Amato Evan** | | | | | |
|---|---|---|---|---|---|
| **Status** | **Award #** | **Source** | **Project Title** | **Start Date** | **End Date** |
| PENDING APPROVAL | 24RD001 | CARB | Dust on the Horizon: Assessing Current and Projecting Future Health Risks From the Shrinking Salton Sea | TBD | TBD |
| CURRENTLY CTIVE | M23PL5960 | UCOP | UC-Dust: Addressing Future Changes in California Dust Storms | 1/1/2023 | 12/31/2024 |
| CURRENTLY ACTIVE | 2336111 | NSF | Advancing Understanding of Super-Coarse and Giant Dust Particles via Novel Measurements of Emission and Transport | 1/1/2024 | 12/31/2026 |
| CURRENTLY ACTIVE | 51671 | NSF | Winds of Change: Exploring the Meteorological Drivers of Global Dust | 3/22/2024 | 3/21/2027 |
| CURRENTLY ACTIVE | 80NSSC24K0864 | NASA | Assessing the Impact Dust from Ephemeral Lakes on Earth's Weather and Climate | 3/15/2024 | 2/28/2027 |
| CURRENTLY ACTIVE | SFI-MPS-SRM-00005221 | Simons Foundation International | Exploring the Potential for Regionally Cooling the Earth by Seeding Wintertime Mixed-Phase Clouds | 2/1/2024 | 1/31/2027 |

| **Co-PI: Alexandra Heaney** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |
| PENDING APPROVAL | 24RD001 | CARB | Dust on the Horizon: Assessing Current and Projecting Future Health Risks From the Shrinking Salton Sea | TBD | TBD |
| CURRENTLY ACTIVE | 1P20TW012709 | NIH | Global Center on Climate Change and Water Energy Food Health Systems | 9/18/2023 | 7/31/2026 |

| **Co-PI: Alexandra Heaney** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |
| CURRENTLY ACTIVE | 5R01AI148336 | NIH | Integrating epidemiologic and environmental approaches to understand and predict Coccidioides exposures and coccidioidomycosis | 12/09/2019 | 11/30/2024 |

| **Co-PI: William Porter** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |
| PENDING APPROVAL | 24RD001 | CARB | Dust on the Horizon: Assessing Current and Projecting Future Health Risks From the Shrinking Salton Sea | TBD | TBD |
| CURRENTLY ACTIVE | 2155192 | National Science Foundation (NSF) | Collaborative Research: Understanding the drivers and air-quality implications of marine gas-phase emissions in urban coastal regions | 7/1/2022 | 6/30/2025 |
| CURRENTLY ACTIVE | 1759448 | National Science Foundation (NSF) | Riverside Air Monitoring Project | 2/15/2019 | 1/31/2025 |
| CURRENTLY ACTIVE | 80NSSC24K0864 | National Aeronautics and Space Administration (NASA) | Assessing the Impact of Dust from Ephemeral Lakes on Earth's Weather and Climate | 2/1/2024 | 1/31/2027 |
| CURRENTLY ACTIVE | 23-009-180 | California State Water Resources Control Board | Microplastics in Newport Bay - Phase 2: Fate and Transport Modeling | 7/1/2023 | 6/30/2026 |

| **Co-PI: Adeyemi Adebiyi** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |

| **Co-PI: Adeyemi Adebiyi** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |
| PENDING APPROVAL | 24RD00X | CARB | Dust on the Horizon: Assessing Current and Projecting Future Health Risks From the Shrinking Salton Sea | TBD | TBD |
| CURRENTLY ACTIVE | DE-SC0024281 | DEPARTMENT OF ENERGY | Investigating the overlooked longwave impacts of mineral dust on warm boundary-layer clouds | 9/1/2023 | 2/28/2025 |
| CURRENTLY ACTIVE | DE-SC0024238 | DEPARTMENT OF ENERGY | San Joaquin Valley Climate Resilience Center: Informing Equitable Climate Outcomes through Collaborative and Interdisciplinary Science | 9/1/2023 | 8/31/2024 |
| CURRENTLY ACTIVE | | UC MERCED | Adaptation pathways for agricultural land repurposing in the San Joaquin Valley and their impacts on heat and air quality extremes on vulnerable communities | 6/1/2023 | 6/30/2025 |
| CURRENTLY ACTIVE | M23PL5960 | UCOP/UCSD | UC-Dust: Addressing Future Changes in California Dust Storms | 1/1/2023 | 12/31/2023 |
| CURRENTLY ACTIVE | DE-SC0023033 | DEPARTMENT OF ENERGY | Building collaboration to advance our understanding of regional climate impacts of dust in California's San Joaquin Valley | 9/1/2022 | 5/14/2025 |

| **Co-PI: Eunha Hoh** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |
| PENDING APPROVAL | 24RD001 | CARB | Dust on the Horizon: Assessing Current and Projecting Future Health Risks From the Shrinking Salton Sea | TBD | TBD |
| CURRENTLY ACTIVE | T33IR6723 | California Tobacco Related Disease Research Program | Microplastic pollution from cigarette filters: Assessment of fate, transport, and toxicity | 7/2023 | 6/2026 |

| **Co-PI: Eunha Hoh** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |
| CURRENTLY ACTIVE | T32PT6244 | California Tobacco Related Disease Research Program | THS Environmental Lab Core (Part of the Core of THS Consortium) | 12/2022 | 11/2025 |
| CURRENTLY ACTIVE | T301P0974 | California Tobacco Related Disease Research Program | Pilot Investigation of Tobacco, E-Cigarette, and Cannabis Contaminants in an Urban Natural Reserve | 9/2019 | 8/2024 |
| CURRENTLY ACTIVE | R01ES030743-01 | NIH/NIEHS | Prevalence and Clinical Correlates of Thirdhand Smoke Exposure in a Pediatric Patient Population | 7/2019 | 6/2024 |
| CURRENTLY ACTIVE | T32IR5208 | California Tobacco Related Disease Research Program | Silicone wristbands to measure secondhand exposure to tobacco, e-cigarettes, and cannabis | 7/2022 | 6/2025 |
| CURRENTLY ACTIVE | T32IP5382 | California Tobacco Related Disease Research Program | Environmental Toxicity of Electronic Cigarette and Heated Tobacco Product Components and Waste | 7/2022 | 6/2024 |
| CURRENTLY ACTIVE | T32PT6042 | California Tobacco Related Disease Research Program | Thirdhand Smoke Disparities, Harm and Risk in Children | 12/2022 | 11/2025 |
| CURRENTLY ACTIVE | T32PT6260 | California Tobacco Related Disease Research Program | THS in Homes: Fate, Characterization, and Remediation | 12/2022 | 11/2025 |
| CURRENTLY ACTIVE | 706185 | California Sea Grant | Hazard assessment of deep ocean DDT disposal: Defining biomagnified DDT+ chemical profiles and investigating the health impacts on sentinel wildlife species and humans | 6/2023 | 11/2024 |

| **Co-PI: Eunha Hoh** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |
| CURRENTLY ACTIVE | B29IB6799 | CBCRP 2023 - Innovative, Developmental, and Exploratory Award (IDEA) | Assessing environmental & social factors influencing breast cancer prevention in Latina farmworkers | 8/2023 | 1/2025 |
| CURRENTLY ACTIVE | 2327008 | NSF | Sunlight and tire wear particles – a toxic combination? Evaluating mechanisms for mobilization and degradation of tire particle compounds | 9/2023 | 8/2026 |
| CURRENTLY ACTIVE | KK2433 | California Sea Grant | Foundational Research for Deep Ocean Dumping of DDT+ Wastes: How much is out there, where is it, and what is it doing today? | 6/2023 | 11/2024 |

| **Co-PI: Jasper Kok** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |
| PENDING APPROVAL | 24RD001 | CARB | Dust on the Horizon: Assessing Current and Projecting Future Health Risks From the Shrinking Salton Sea | TBD | TBD |
| CURRENTLY ACTIVE | | Simons Foundation | Exploring the potential for regionally cooling the Earth by seeding wintertime mixed-phase clouds | 2/1/2024 | 1/31/2027 |
| CURRENTLY ACTIVE | | University of California Office of the President | UC-Dust: Addressing future changes in California dust storms | 1/1/2023 | 12/31/2024 |
| CURRENTLY ACTIVE | | National Science Foundation | Constraining the direct radiative forcing of desert dust | 5/1/2022 | 4/30/2025 |
| CURRENTLY ACTIVE | | National Science Foundation | Advancing Understanding of Super-Coarse and Giant Dust Particles via Novel Measurements of Emission and Transport | 1/1/2024 | 12/31/2026 |
| PENDING APPROVAL | | Department of Energy | Observationally constraining the indirect effect on mixed-phase clouds due to historical increase in mineral dust | 8/1/2024 | 7/31/2027 |

| **Co-PI: Paolo D'Odorico** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |
| PENDING APPROVAL | 24RD001 | CARB | Dust on the Horizon: Assessing Current and Projecting Future Health Risks From the Shrinking Salton Sea | TBD | TBD |
| CURRENTLY ACTIVE | 20232222-01 | NASA | Fire impacts on precipitation through land-atmosphere interactions in savannas | 8/2023 | 7/2026 |
| CURRENTLY ACTIVE | 2053857 | NSF | Collaborative research: Wind erodibility of salt-affected soils | 8/2021 | 7/2025 |

| **Co-PI: Paolo D'Odorico** | | | | | |
|---|---|---|---|---|---|
| **Status** (currently active or pending approval) | **Award #** (if available) | **Source** (name of the sponsor) | **Project Title** | **Start Date** | **End Date** |
| CURRENTLY ACTIVE | 80NSSC22K1831 | NASA | The Impact of Agricultural Practices on Subseasonal and Seasonal Predictability | 7/2022 | 6/2025 |
| CURRENTLY ACTIVE | M23PL5960 | UCOP | UC-Dust: Addressing Future Changes in California Dust Storms | 1/2023 | 12/2024 |
| CURRENTLY ACTIVE | 20232222-01 | NASA | Fire impacts on precipitation through land-atmosphere interactions in savannas | 8/2023 | 7/2026 |

## EXHIBIT A7

## THIRD PARTY CONFIDENTIAL INFORMATION REQUIREMENT

## CONFIDENTIAL NONDISCLOSURE AGREEMENT

*(Identified in Exhibit A, Scope of Work – will be incorporated, if applicable)*

*If the Scope of Work requires the provision of third party confidential information to either the State or the Universities, then any requirement of the third party in the use and disposition of the confidential information will be listed below. The third party may require a separate Confidential Nondisclosure Agreement (CNDA) as a requirement to use the confidential information. Any CNDA will be identified in this Exhibit A7.*