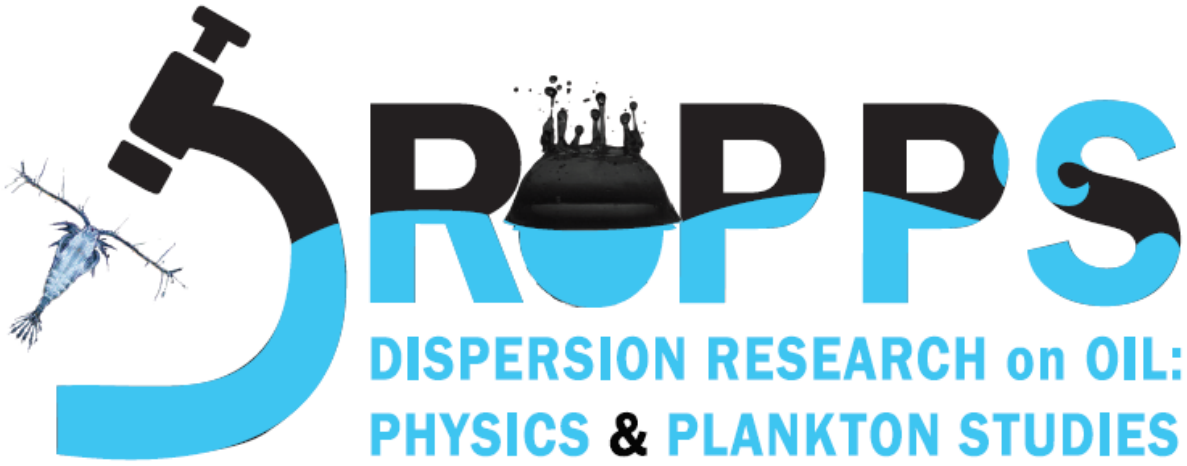
Data Management Plan

Dispersion Research on Oil: Physics and Plankton Studies (DROPPS)
Gulf of Mexico Research Initiative



SECTION 1: RESEARCH CONSORTIUM INFORMATION

1. Project Title:

Dispersion Research on Oil: Physics and Plankton studies (DROPPS)

2. Lead Principal Investigator and Contact Information:

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3. Data Manager and Contact Information:

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4. Data Manager Roles and Responsibilities

The Data Management Committee will consist of Lindsay Scheef and Genoa Black at UTMSI, and will address the most challenging data issues related to use of high speed digital holography, PIV, and modelling efforts. These individuals have experience collecting, organizing, and submitting data and metadata to online repositories, and are best equipped to work with GRIIDC to establish data protocols and metadata standards for these methods and activities. Lindsay and Genoa have participated in the three data management training sessions hosted by GRIIDC for RFP-VI, and Lindsay attended the GRIIDC data management workshop at the Gulf of Mexico Oil Spill and Ecosystem Science Conference 2018 in New Orleans. Lindsay and Genoa will each dedicate 10% effort to RC data management responsibilities.

5. Data Submission to GRIIDC

Principal investigators, co-principal investigators, and researchers working in their labs will submit Dataset Information Forms, package datasets, and submit datasets to GRIIDC directly. Lindsay Scheef is familiar with the submission procedures and will assist the researchers as necessary. She will serve as correspondent between GRIIDC and the researchers to help resolve any issues with DIF/dataset submission or dataset quality.

6. Data Management Training

Genoa Black is working with the DROPPSIII principal investigators, co-principal investigators, research associates, and postdocs to ensure all members of the consortium participate in the three required data management training sessions hosted by GRIIDC for RFP-VI. Genoa and Lindsay will work with GRIIDC to provide any additional training requested by members of the consortium.

7. Communicating Data Submission Requirements

Dissemination of GRIIDC dataset submission guidance to members of DROPPSIII will primarily be done as necessary by email. The data management team is familiar with the guidance

documents that have been prepared by GRIIDC for the various data types that will be produced by the consortium and can provide researchers with pdf versions of the documents or with links to the GRIIDC help pages.

8. Data Storage Backup

For DROPPS III the University of Texas at Austin has provided cost sharing funds for data management and storage at the Texas Advanced Computing Center (TACC) in Austin, Texas. TACC will manage, store, and set up a data exchange system for our data sets and provide access services. These services include web access for data sharing among member institutes (low security risk), FTP access for internal and external data sharing (medium risk), and user-based remote login access by permission (high risk). Note that each member is expected to establish its own storage for daily operations and to back up data daily.

9. Ethics and Compliance Information – Data Involving Human Research Subjects

No components of this project involve collecting data from human research subjects. There are therefore no Institutional Review Board or Health Insurance Portability and Accountability Act issues that might preclude sharing data.

SECTION 2: METHODS INFORMATION

1. Research Cruises

NA

2. Non-Cruise Field Work

NA

3. Environmental Sample Lab Analysis

NA

4. Microcosms/Mesocosms

a) Will your RC be performing any microcosm or mesocosm experiments?

YES

b) What microcosm or mesocosm experiments will your RC perform?

- Microcosm experiments involve microfluidic experiments. In microfluidic experiments the bottom channel is printed with oil microdroplets. The array of oil droplets will be the only carbon source for bacteria in these experiments. The bacteria suspension will continuously flow in the channel and the droplets will be exposed to the stream of bacteria. This will simulate the condition in the water column. Each experiment will last for 96-100 hours. (R6.x802.000:0011)
  - Movies will be recorded to study the activity at the oil-water interface.
  - Micrographs, using optical microscope, will be taken.
  - Pictures will be taken using high speed camera.
- Interactions of bacteria with single crude oil droplets in microfluidic devices (R6.x802.000:0009)

5. Pure Lab-Based Studies

a) Will your RC be performing any purely lab based work? (examples: measuring properties of standard chemicals, developing new dispersants, measuring flow rates of jets)

YES

b) What purely lab-based experiments will your RC perform?

- We evaluated the performance of Laser In situ Scattering Transmissiometry (LISST) instrument using standard microspheres. The LISST has been used to measure oil droplet size distribution. (R6.x802.000:0012)
- Fragmentation of index-matched oil plumes. The objective of this experiment is to use a refractive index-matched pair of fluids as a surrogate for crude oil and seawater. The two fluids involved, silicon oil and sugar water, have the same density and viscosity ratio, as well as interfacial tension as the original fluids. The oil is tagged with a fluorescent dye that is soluble only in the oil, and both phases are seeded with particles for particle image velocimetry measurements. This approach enables simultaneous measurements of the oil phase distribution and the velocity field over the entire domain. (R6.x802.000:0002)
- Quantifying the role of plankton communities in oily aerosol formation. Experiments will be conducted at the wave tank facility at Johns Hopkins University in fall of 2018. Natural seawater collected from Chesapeake Bay, MD

will be used to understand how plankton and the interaction with crude oil influences the formation of oily marine aerosols. Oily aerosol formation will be quantified with 3D high speed digital holography at the wave impact site and airborne nano-scale droplet distribution will be quantified with a scanning mobility particle sizer (TSI Inc) to characterize size distribution and quantity. (R6.x802.000:0007)

- Monitoring biofilm formation, change of film thickness, and bio consumption rate. Each bacteria isolate and the six consortia will be exposed to oil microdroplets, which is the only source of carbon. In our previous experiments we have seen the biofilm formation on the substrates exposed to bacteria consortia under non-flow condition, but we need to perform more experiments to confirm at what point the biofilm will start to grow and how thick the biofilm will be at the time of termination of the experiment. Additionally, the shape and volume of oil droplet should be determined after 96-100 hours (R6.x802.000:0011).
  - Movies will be taken to capture the biofilm formation throughout the experiment.
  - Optical microscope will be used to capture images of different stages of oil and biofilm change.
- The interfacial tension between a hexadecane drop and surrounding EPS suspension will be measured using a pendant drop tensiometer. EPS will be extracted from various microbial isolates and consortia and the EPS concentrations will be varied. Both time-dependent and equilibrium measurements will be made. (R6.x802.000:0010)
- Size distributions of airborne aerosols. Experiments will be performed in a wind - wave facility to characterize the airborne aerosols/droplets due to breaking wave splashing on crude oil-dispersant slicks. The size distributions of these sub-micron and micron-scale aerosols will be measured by a scanning mobility particle sizer and an aerodynamic particle sizer. The effect of wind-shear, wave strength, oil slick properties on airborne droplets will be investigated. (R6.x802.000:0004)
- Water samples will be collected during underwater oil release in a wave tank, and then analyze the oil concentration in the sea water and possibly Total Petroleum Hydrocarbon by GC/FID. On site, we will record oil plume development underwater and oil droplet formation in the oil plume (droplet size distribution). (R6.x802.000:0019)
- Experiments will involve observation of an oil-water interface under an optical microscope and by holographic imaging. The trajectories of the bacteria near and on the interface will be recorded. (R6.x802.000:0008)
- Quantification of *Crassostrea virginica* veliger kinematics, pediveliger settlement rates, pollutant induced larval inactivity, and adult clearance rates after acute exposures to ecologically relevant concentrations of water accommodated fractions of crude oil (WAF) and with a combination of chemical dispersant (CEWAF). (R6.x802.000:0015)

- To investigate the health impacts of crude-oil aerosols on human bronchial epithelial cells, a real-time oil aerosol exposure and imaging system will be developed. Fully-differentiated patient-derived primary bronchial epithelial cells will be exposed to aerosolized crude oil and crude oil-dispersant mixtures at various concentrations. Aerosols at realistic concentrations mimicking those produced by the breaking wave will be generated by a single-jet Collison nebulizer. The size distributions of these nano and micron-scale aerosols will be characterized by a scanning mobility particle sizer and an aerodynamic particle sizer. Experiments will be conducted to determine the paracellular permeability, protein abundance, and cell viability to assess the toxicity of aerosolized oil on bronchial epithelial cells (R6.x802.000:0003)
- Bubbles will be generated by injecting a bubble plume with controlled size distribution into a vertical seawater column. The plume of bubbles rises to the water surface contaminated with an oil slick at controlled thicknesses and eventually burst. Particle sizing instruments and a photoionization device will be used over the water surface for real-time monitoring of the particles (10 nm to 20 μm) and total volatile organic compounds (TVOC). Sensitivity analyses on the bubble diameter, slick thickness and the slick type (Louisiana light sweet crude oil and crude oil premixed with the dispersant Corexit 9500A with the ratio of 1:25) will be conducted. (R6.x802.000:0005)
- Dynamics of oil droplets crossing a liquid-liquid interface will be investigated. Experiments consist of using a refractive index-matched pair of fluids as a surrogate for crude oil and seawater. Three-dimensional velocity measurements will be conducted using inline holography to understand the fragmentation and dynamics of droplets crossing a liquid-liquid interface. (R6.x802.000:0006)
- Experiments will be performed to characterize the subsurface and the airborne droplets by breaking waves splashing on crude oil- dispersant slicks. Size distributions of airborne droplets in sub-micron and micron range will be measured by particle sizing instruments, and subsurface droplets will be characterized by submersible holography. Additionally, a series of experiments will be conducted to study the effect of wind shear on the generation of airborne droplets. (R6.x802.000:0017)

6. Modeling

a) Will your RC be conducting any numerical or computational modeling?

YES

b) What modeling activities will your RC perform?

- Use a publicly available Multiple-Path Particle Dosimetry model (MPPD Ver. 3.04) to facilitate dose estimation of deposited particulate matter in different regions of the human respiratory system. The MPPD applies an asymmetric geometry for the human lungs and computes deposition efficiency of insoluble airborne particulate matter ranging from 0.01 to 10 μm due to sedimentation, diffusion, and impaction mechanisms, separately in the upper respiratory tract (URT), tracheobronchial (TB), and pulmonary region (Alv). (R6.x802.000:0001)

- Estimation of the carcinogenic risk and non-carcinogenic toxicity using reference doses and potency factors provided by the Integrated Risk Information System under United States Environmental Protection Agency (USEPA – IRIS), the Agency for Toxic Substances and Disease Registry under United States Department of Health and Human Services (USHHS – ATSDR). The risks and hazard quotients are equal to multiplication of the emitted doses (with and without dispersant in the slick) and the reference doses/potency factors. (R6.x802.000:0016)
- Integration of the standard Navier-Stokes equation of fluid mechanics to model various phenomena involving bubbles and drops in an ambient fluid. No non-publicly available code will be used. (R6.x802.000:0018)
- Simulation of droplet size distribution. We will model the experimental work of underwater oil release described in 3, where droplet size distribution will be collected in the underwater oil plume. (R6.x802.000:0020)
- Oil particle interaction. Laboratory experiment of oil-particle interactions will be conducted (it is still under preparation, and the results will be used for model validation. (R6.x802.000:0021)
- Oil jets and plumes. A CFD model (e.g. FLUENT) will be used to model the oil jets and plumes for the experiments described in 3. (R6.x802.000:0022)
- Oil movement under wave actions. The oil droplet formation model will be integrated with CFD models to simulate the oil droplet formation under wave actions. Literature data will be used for model validation. (R6.x802.000:0023)
- Oil well flow rate mean and range values will be based on consultation with the Bureau of Ocean Energy management (BOEM) and review of government estimates for oil development areas in the most northern, deep Gulf of Mexico. (R6.x802.000:0014)

c) Do any of these models use non-publicly available code? If so, please list.

- VDROP, VDROP-J, A-DROP

7. Mapping

NA

8. Remote Sensing and Aerial Imagery

NA

9. Images

a) Will any of your RC activities produce images as data? (NOTE: This does not include images taken through education or outreach activities or photos of research work that are taken for use in presentations, etc.)

YES

b) What activities will produce images as data?

- Using high speed cameras to capture oil behavior in turbulent flow (R6.x802.000:0013)
- Flow visualizations of plumes (R6.x802.000:0002)
- Atomic force microscopy will produce images as data that will be used to determine the change of oil droplets. (R6.x802.000:0011)
- Optical microscopy micrographs. (R6.x802.000:0011)

- Microscopy in a laboratory (R6.x802.000:0009, R6.x802.000:0010)

10. Video

a) Will any of your RC activities produce videos as data? (NOTE: This does not include videos taken through education or outreach activities or videos of research work that are taken for use in presentations, etc.)

YES

b) What activities will produce video as data? (example: microscopy)

- Using high speed cameras to capture oil behavior in turbulent flows (R6.x802.000:0013)
- High speed video and holographic video of oily aerosol formation during breaking waves (R6.x802.000:0007)
- Time lapse experiments monitoring biofilm growth for bacteria isolates and bacteria consortia over oil water interface under constant flow and no flow condition. This will help to evaluate oil droplet alteration and biofilm formation under two conditions. Data will be movies of time lapse experiments each lasting 100 hours. (R6.x802.000:0011)

11. **Social Surveys and Interviews**

NA

12. Economics

NA

13. Other Methods and Data Types

NA

SECTION 3: DATASET INFORMATION FORMS

Dataset Title (in GRIIDC)	UDI	Primary Point of Contact
Health risk assessment modeling of the oil spill emissions	R6.x802.000:0001	Afshar-Mohajer, Nima
Break-up of oil plumes	R6.x802.000:0002	Katz, Joesph
Health Impact of crude oil-dispersant aerosols	R6.x802.000:0003	Katz, Joesph
Aerosolization of crude oil by wind waves	R6.x802.000:0004	Katz, Joesph
Aerosolization of oil-dispersant mixtures by bubble plumes	R6.x802.000:0005	Katz, Joesph
Oil-Water interfaces	R6.x802.000:0006	Katz, Joesph
The role of plankton communities on the formation of oily aerosols	R6.x802.000:0007	Gemmel, Brad
Trajectories of bacteria near an oil-water interface	R6.x802.000:0008	Stebe, Kathleen
Full flow field measurements of bacteria flowing past a stationary micro-scale crude oil droplet with attached microbial aggregates and streamers	R6.x802.000:0009	Sheng, Jian
Interfacial tension measurements between oil and aqueous suspensions of isolated extracellular polymeric substances (EPS)	R6.x802.000:0010	Sheng, Jian
Monitoring morphological changes of crude oil microdroplets by different bacteria species and consortia	R6.x802.000:0011	Sheng, Jian
Dataset for "Impact of particle concentration and out-of-range sizes on the measurements of the LISST"	R6.x802.000:0012	Boufadel, Michel
Visualization of oil behavior under the effect of dispersants in turbulent flows	R6.x802.000:0013	Boufadel, Michel
Potential range of oil well flow rates in northern central Gulf of Mexico	R6.x802.000:0014	Beegle-Krause, CJ
Sublethal Impacts of Crude Oil and Corexit 9500 on Crassostrea virginica at Multiple Life History Stages	R6.x802.000:0015	Garcia, Sara
Health risk assessment of inhaled oil spill emissions with and without Adding dispersant (due to volatile organic compounds)	R6.x802.000:0016	Afshar-Mohajer, Nima
Visualization, holography, and aerosol measurements in Johns Hopkins University wind-wave facility data	R6.x802.000:0017	Katz, Joseph
Interaction of oil drops and solid particles	R6.x802.000:0018	Prosperetti, Andrea

Underwater oil release to study the effects of gas on droplet formation	R6.x802.000:0019	Boufadel, Michel
Validation of VDROP-J model using data obtained from underwater oil plume	R6.x802.000:0020	Boufadel, Michel
Study of oil particle interaction	R6.x802.000:0021	Boufadel, Michel
CFD simulations of oil jets and plumes	R6.x802.000:0022	Boufadel, Michel
Oil droplet formation under wave actions	R6.x802.000:0023	Boufadel, Michel