SBIR

Small Business Innovation Research Program

ABSTRACTS OF PHASE I AWARDS FOR FISCAL YEAR 2024

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

INTRODUCTION

The Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), through the Small Business Innovation Research (SBIR) program, has awarded 31 Phase I grants for FY 2024. These awards are up to $175,000 each totaling approximately $5.3 million. The awards are for a six-month effort to demonstrate the feasibility of innovative approaches to the research topics identified in the “NOAA SBIR FY 2024 Phase I” Notice of Funding Opportunity. Abstracts of the successful Phase I proposals submitted under this solicitation, and brief comments on their anticipated results are provided in this publication.

The SBIR program is highly competitive. A total of 217 proposal submissions were received by DOC/NOAA in response to its FY 2024 solicitation. Internal and external scientists and/or engineers independently reviewed the proposals. With the funds available, 31 were selected for an award. Final selection was based upon the results of the reviews, and the project’s potential for commercialization.

Fiscal Year 2024 Phase I List of Awardees

Award Number	Company Name	Topic Number
NA24OARX021G0003	American Veritas Engineering, LLC.	9.1
NA24OARX021G0019	AnySignal, Inc.	9.5
NA24OARX021G0008	Aperi Computational Mechanics Consulting LLC	9.1
NA24OARX021G0025	AquaRealTime Inc	9.2
NA24OARX021G0026	ARMADA Marine Robotics, Inc.	9.3
NA24OARX021G0028	BeamSea Associates LLC	9.3
NA24OARX021G0022	Brandon Wong/ Hyfi, LLC	9.1
NA24OARX021G0007	Butterfly Photonics, Inc.	9.6
NA24OARX021G0009	Carbon Solutions LLC	9.6
NA24OARX021G0030	Care Weather Technologies, Inc.	9.1
NA24OARX021G0012	ECCO Scientific, LLC	9.4
NA24OARX021G0024	Gulf Wind Technology, LLC.	9.1
NA24OARX021G0006	IONICSCALE LLC	9.3
NA24OARX021G0029	L.Garde, Inc.	9.5
NA24OARX021G0016	Live Advantage Bait LLC	9.3
NA24OARX021G0002	Loggerhead Instruments Inc.	9.3
NA24OARX021G0023	MarineSitu, Inc	9.3
NA24OARX021G0032	Quantitative BioSciences, Inc	9.2
NA24OARX021G0027	Rapid Radicals Technology	9.2
NA24OARX021G0010	RESILIFT, Inc.	9.2
NA24OARX021G0004	Sediment	9.2
NA24OARX021G0014	Steve Bitterly (Pure Spun Innovations)	9.4
NA24OARX021G0021	SUBTIDAL, INC.	9.6
NA24OARX021G0017	Sun Dog Scientific LLC	9.5
NA24OARX021G0018	Synthetik Applied Technologies, LLC	9.6
NA24OARX021G0013	TCarta Marine LLC	9.3
NA24OARX021G0011	Trident Sensing LLC	9.1
NA24OARX021G0020	Tridentis Advanced Marine Vehicles LLC	9.2
NA24OARX021G0005	Vega MX Inc	9.1
NA24OARX021G0015	VISIMO, LLC	9.4
NA24OARX021G0001	Zeteo Tech, Inc.	9.2

FY 2024 PHASE I AWARD WINNER

FIRM:	American Veritas Engineering, LLC 50 Putney Rd Leverett, MA 01054
AWARD:	$175,000.00
PHONE:	508-599-0737
E-MAIL:	beaubien1964@gmail.com
PRINCIPAL INVESTIGATOR (PI):	Mark Beaubien
TITLE OF PROJECT:	Development of a Low cost, Dual-Polarization Pulse Coded Doppler Phased Array Weather Radar for NEXRAD network near surface gap augmentation
TOPIC NUMBER:	9.1

TECHNICAL ABSTRACT:

NOAA's Next-Generation Weather Radar (NEXRAD) network has improved over the years. However, a combination of the curvature of the earth's surface, complex terrain and ~200 km spacing between sites blocks line-of-sight scanning of microwave beams across ~70% of America. NEXRAD beams miss significant volumes within the lower troposphere, where people live and work. Tornadic activity or heavy rain thus occurs outside of NEXRAD's radar sampling volume, particularly within rural communities. The result is a significant number of small-yet-severe weather events are missed down near the surface.

We propose leveraging advances in solid state electronics and digital signal processing to develop low cost, micro dual-polarization Doppler weather radars, operating at "Community Scale" that are affordable to local and state emergency management agencies. Systems will be compact enough to be mounted atop "towers-of-opportunity", including municipal water tanks or ubiquitous two-way radio communications towers. Each radar would perform its own local front end data processing and preliminary quality control screening for ground clutter removal and other interference, and relay data via internet or 5G mobile to NOAA. Importantly, these radars would supplement NEXRAD operations, filling in near surface gaps and enabling local rapid response to pop-up severe storms, all at very low acquisition cost.

SUMMARY OF ANTICIPATED RESULTS:

NEXRAD radar spatial coverage limitations. Annual property damage from storms varies, but exceeds several billion. The market is for local and state fire/police emergency response organizations desiring to provide constituents with early warning capability of close to the ground severe weather.

FY 2024 PHASE I AWARD WINNER

FIRM:	AnySignal, Inc. 111 Eucalyptus Dr El Segundo, CA 90245
AWARD:	$84,270.00
PHONE:	386-453-0111
E-MAIL:	john@anysignal.com
PRINCIPAL INVESTIGATOR (PI):	John Malsbury
TITLE OF PROJECT:	Feasibility Study for GNSS Radio Occultation from an Integrated Sensing and Communications Platform
TOPIC NUMBER:	9.5

TECHNICAL ABSTRACT:

AnySignal is introducing a solution to overcome the trade-off between coverage area, revisit rate, data timeliness, and data volume in earth observation satellite systems as specifically applied to radio occultation data collection. This proposal involves a novel hardware approach, employing an Integrated Sensing and Communications (ISaC) software-defined radio (SDR) named Iris. Iris, housed aboard large satellites weighing 200 kg or more, aims to stand out by uniquely combining communication and radiofrequency (RF) sensing capabilities into a single platform.

It is proposed that host satellites will procure Iris for robust data links (space-to-ground, ground-to-space, and space-to-space), whilst AnySignal concurrently leverages the unique ability of Iris to collect RF datasets. While Iris currently serves as a standalone communications product for satellite customers, its potential as an RF sensing platform remains in the early stages of R&D.

SUMMARY OF ANTICIPATED RESULTS:

Anticipated results of this Phase I effort is a systems-level feasibility study for GNSS-RO data capture based on an ISaC platform equipped on host satellites. Outputs of this study include a proposed data processing architecture; an assessment on the use of satellite data relay to enable real-time transfer; a modeled host satellite cost function; an estimated number of daily soundings; a comparison of modeled GNSS-RO fidelity metrics like signal-to-noise-ratio and measurement frequency to NOAA requirements; and an assessment of the viability of the current Iris hardware architecture for GNSS-RO capture.

FY 2024 PHASE I AWARD WINNER

FIRM:	Aperi Computational Mechanics Consulting LLC 34 Riverside Dr. Peralta, NM 87042
AWARD:	$174,835.00
PHONE:	505-366-7201
E-MAIL:	jake.koester@apericmc.com
PRINCIPAL INVESTIGATOR (PI):	Jacob Koester
TITLE OF PROJECT:	Mitigating the Impact: Advancing Extreme Event Simulations with Machine Learning-Enhanced Meshfree Methods
TOPIC NUMBER:	9.1

TECHNICAL ABSTRACT:

We aim to develop software facilitating accurate and efficient simulations of extreme events, providing analysts with the tools they need to make better-informed decisions faster. In a world shaped by climate change, high-fidelity physical simulations have the potential to revolutionize disaster preparedness and infrastructure resilience. However, the computational expense and complexity of handling physical intricacies have posed significant barriers to the broader adoption of simulation. To overcome these challenges, we will integrate machine learning for data-driven material modeling with modern meshfree computational methods. Our initial focus will be on landslide simulations.
In Phase I, our goal is to create proof-of-concept, modern, meshfree software by implementing Thermodynamically Consistent Recurrent Neural Network (TCRNN) models. This will address the challenges of modeling complex materials, marking a pivotal advancement for the next generation of extreme event simulation tools. By effectively tackling key challenges in extreme event simulation, our software facilitates the application of cutting-edge technology in government agencies and industries, expediting its use in addressing climate-related challenges.

SUMMARY OF ANTICIPATED RESULTS:

Our software will be marketed to climate research institutions, insurance companies, civil engineering firms, public agencies, mining operations, and manufacturing companies. Analysts in these industries seek simulation tools to provide them with detailed insight into physical events so they can make informed decisions, but they struggle to make use of existing software as it is too slow to be useful, not robust enough to simulate extreme events, and requires too much work to create the simulations. Our product aims to address these issues and accelerate the use of simulation in these industries. Merging machine learning with meshfree methods in cloud-ready software supports NOAA's artificial intelligence and cloud services goals. Beyond understanding extreme events, it aids coastal resilience, guides mitigation efforts, and caters to a growing market in manufacturing, earthmoving, mining, safety analysis, and biomechanics. This innovative product, unlocking new possibilities, is poised to drive innovation across diverse sectors for a resilient global community.

FY 2024 PHASE I AWARD WINNER

FIRM:	AquaRealTime Inc 2510, 47th street, Suite 209 Boulder, CO 80301
AWARD:	$174,974.00
PHONE:	720-980-0809
E-MAIL:	chris@aquarealtime.com
PRINCIPAL INVESTIGATOR (PI):	Chris Lee
TITLE OF PROJECT:	A Low-cost, multispectral buoy for HAB detection capable of algal class discrimination
TOPIC NUMBER:	9.2

TECHNICAL ABSTRACT:

Harmful Algal Blooms (HABs) are caused by overgrowth of algae in oceans and rivers. They release dangerous toxins, affect real-estate prices, and kill marine life/poison shellfish. This costs $17B annually in economic damage. Ocean monitoring for HABs uses satellites, but these cannot see some types of HABs against the background of natural algae until they are well developed/already dangerous. They also don't work well near shorelines where humans encounter HABs. Our solution to this is OceanAlgaeTracker (OAT), a sensor buoy that will be capable of measuring the levels of the 5 major groups of algae independently by fluorescence. This will allow OAT to detect HABs earlier and will help correct satellite data. OAT will be low COGs (~$3000), light (10lbs), easy to set up and will have sophisticated anti-biofouling systems. It will be designed to minimize recalibration and to be 'hot swappable' with a new unit instead of doing maintenance on the water, reducing costs as a single boat can swap-out dozens of units.

SUMMARY OF ANTICIPATED RESULTS:

It will communicate with shore via satellite connection and be solar powered. Customers in water remediation, tribal, municipal, and state ocean monitoring agencies are the target market and have expressed interest.

FY 2024 PHASE I AWARD WINNER

FIRM:	ARMADA Marine Robotics, Inc. 77 McCallum Drive Falmouth, MA 02540
AWARD:	$174,798.00
PHONE:	540-239-4488
E-MAIL:	jeff.kaeli@armadamr.com
PRINCIPAL INVESTIGATOR (PI):	Jeff Kaeli
TITLE OF PROJECT:	A Scalable Solution to Monitoring Our Changing Oceans
TOPIC NUMBER:	9.3

TECHNICAL ABSTRACT:

ARMADAhasaboldplan to become the “SpaceX of the sea” with a scalable solution that reduces the carbon footprint of in situ ocean monitoring while eliminating single-use sensor waste. Today’s tools are largely based around crewed research vessels that service moorings, Autonomous Underwater Vehicles (AUVs), and expendable sensing packages. These tools scale poorly, continue our reliance on fossil fuels, and contribute to marine waste, all of which are unsustainable. We address scalability in three key ways:

1. Combine innovative propulsion and ballast technologies to create a new class of uncrewed underwater sensing platform with both mobility and persistence that is fundamentally simpler to produce and achieve economies of scale.
2. An operations strategy that leverages the platform’s unique capabilities to selectively ride ocean currents, enabling a constellation of platforms to achieve “dynamic persistence” through full life cycles of deployments and recoveries from shore locations.
3. Colocate manufacturing and launch facilities upstream of major currents and position recovery infrastructure in regions that minimize platform energy consumption to reach.

ARMADAwill use this Phase I SBIR to study the feasibility of our operations strategy through ocean current and energy budget modeling to inform the design of a prototype platform in Phase II.

SUMMARY OF ANTICIPATED RESULTS:

Climate change is rapidly driving increased frequency and severity of extreme weather events and is changing regional environmental conditions with a wide array of impacts ranging from insurability of properties to viability of agricultural production to regional stability. To better understand these processes and predict future outcomes we must understand the drivers of long-term weather patterns and climatic shifts. Improved data products will enable forecasting and improved certainty of predictions that will have vast economic implications. While the AUV market is projected to grow from $1B in 2023 to $9B in 2030 at an outstanding CAGR of nearly 25%, the global Public Safety and Security market is expected to grow from $433.6 billion in 2022 to $707.2 billion by 2027. Leveraging ocean data to make high-accuracy long term predictions of regional economic viability and security is likely to represent the largest addressable market that will be enabled by this technology.

FY 2024 PHASE I AWARD WINNER

FIRM:	BeamSea Associates LLC 2823 Kazee Rd, Lox, FL 33470
AWARD:	$174,982.00
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E-MAIL:	wbritton@beam-sea.com
PRINCIPAL INVESTIGATOR (PI):	Walter Britton
TITLE OF PROJECT:	A Species-level Automated Monitoring Tool for Coral Reef Ecosystem Management
TOPIC NUMBER:	9.3

TECHNICAL ABSTRACT:

We propose to develop a new fluorescence-enhanced, AUV mounted, high resolution 3D laser imaging system for coral reef ecosystem management and research. Advantages of this system will include: enhanced automated discrimination of bottom cover type (e.g., live standing coral, dead standing coral, coral rubble, algae); detection and counting of coral recruits, direct determination and mensuration of 3D reef structure; autonomously repeatable survey tracks for long term recovery, resilience and growth studies.
Several studies have demonstrated that fluorescence imaging of reefs can provide enhanced automated discrimination between dead and live coral and algae cover, and potentially also of other seafloor organisms based on distinctive fluorescence properties. The combination of the fluorescence spectral signal with shape and structure information from the 3D imaging LiDAR data collection and the use of machine learning will provide a powerful multidimensional tool for bottom cover classification. The system will build upon our existing AUV compatible single-channel 3D laser imager. Since classification is done to the pixel level, area coverage can be assessed with many more data points than can be achieved by conventional diver-based survey techniques, and with more automated classification than existing color video analysis approaches. Making repeated surveys at user-selected time intervals will enhance the ability to monitor changes in reef community and physical structure.

SUMMARY OF ANTICIPATED RESULTS:

Per NOAA's Coral Reef Conservation Program, the annual economic value of coral reefs for the US is over $3.4 billion and over 500 million people depend on coral reefs for food, income, and coastal protection. Because of the large threat to coral reefs from pollution, global warming, overfishing, and disease, it is imperative that larger coral reef areas be periodically monitored for early detection of decay and thus to take mitigation measures, if possible, to prevent the decline of the reef. The lack of a sensor that is capable of large area survey specifically targeting coral reef ecosystem management and research provides a huge opportunity for this product.

FY 2024 PHASE I AWARD WINNER

FIRM:	Brandon Wong/ Hyfi, LLC 3648 Frederick Drive Ann Arbor, MI 48105
AWARD:	$174,933.00
PHONE:	858-603-3796
E-MAIL:	brandon@hyfi.io
PRINCIPAL INVESTIGATOR (PI):	Dr. Brandon Wong
TITLE OF PROJECT:	Enhancing Flood Resilience in Manufacturing Hubs through Advanced Sensing and AI
TOPIC NUMBER:	9.1

TECHNICAL ABSTRACT:

Flooding stands as the foremost cause of property damage in the United States, surpassing all other natural hazards combined. Our goal is to protect coastal and riverine manufacturing hubs against the escalating threats of flooding, extreme weather, and climate change. There is a massive risk of manufacturing companies leaving America's "Industrial Heartland"– especially across the Great Lakes– driven away by the inability of many under-resourced host communities to manage ongoing and recurring wet-weather disruptions. In this SBIR proposal, we will combine artificial intelligence (AI) with state-of-the-art wireless sensing technologies to transform the ability of municipal managers to safeguard facilities and the vital workforce that underpins local manufacturing hubs.The incorporation of AI is critical for ensuring that our solution is accessible for communities that lack the financial resources or technical expertise to develop and maintain complex manual systems, thereby democratizing access to advanced flood management technologies. Leveraging a wireless sensor pilot network in Dearborn, MI, we will work closely with municipal managers to test the project outputs in a manufacturing-centric community at the frontlines of US climate adaptation.

SUMMARY OF ANTICIPATED RESULTS:

The cornerstone of this project is the research & development (R&D) of a novel analytics toolchain, designed to deliver early warnings for debris jams in urban drainage systems, streams, and rivers. The specific objectives of this project include: 1) research for Transfer Learning algorithms to support automated anomaly detection from wireless water level sensors, 2) optimizing anomaly detection through Dynamic Thresholding algorithms, and 3) real-world application and user testing in a real sensor network testbed. We will leverage our own densely-deployed sensor networks to localize the value delivered by NOAA's data sources, including the National Water Model and meteorological services. The final outcome will reduce frequent occurrences of flooding and enable entirely new adaptation strategies that ensure manufacturing facilities and communities alike remain minimally disrupted by intensifying weather patterns. This project builds toward a broader Phase II goal of advancing commercial solutions to robustly protect manufacturing hubs, supply chains, and transportation systems against flooding.

FY 2024 PHASE I AWARD WINNER

FIRM:	Butterfly Photonics, Inc. 1106 Bryant St. Palo Alto, CA 94301
AWARD:	$175,000.00
PHONE:	650-504-6518
E-MAIL:	joshua.paul@butterflyphotonics.com
PRINCIPAL INVESTIGATOR (PI):	Dr. Joshua Paul
TITLE OF PROJECT:	Low-cost solar spectrometer network for wide-scale greenhouse gas monitoring
TOPIC NUMBER:	9.6

TECHNICAL ABSTRACT:

Climate change is the most pressing threat to humanity, and understanding the sources of greenhouse gases (GHGs) such as CO2 and methane is critical to effectively tackling this problem. Indeed, finding and fixing methane leaks, in particular, is widely viewed as one our best options for slowing global warming in the near term. While the technology for monitoring this critical greenhouse gas has certainly advanced over the past decade, there continues to exist an acute need for an approach that can monitor wide geographic regions reliably and at low-cost to both further our understanding of climate science and to ensure regulatory compliance in the coming years.

In response to this need, Butterfly Photonics, Inc. proposes to develop a novel, low-cost, internet-cloud connected solar spectrometer network capable of measuring methane, CO2, and water over wide geographic regions with little or no human intervention. The small, solar-powered remote sensors will be simple to install, and centrally managed and controlled using cloud-based services. The data from this network will be combined with state-of-the-art atmospheric transport models to locate and quantify greenhouse gas concentrations across entire cities, fracking basins, and other geographic regions of interest.

SUMMARY OF ANTICIPATED RESULTS:

In Phase I, three autonomous, networked, sun-tracking spectrometers will be co-located and rigorously tested. Models for fitting the data from the sensor network will be developed to ultimately produce maps of GHG gases at the basin scale. Based on the results of the Phase I effort, preliminary designs, specifications, and assessments for the envisioned much larger Phase II network will be developed. The primary commercial applications for this technology are anticipated to include regulatory compliance and atmospheric analysis over regions encompassing cities, towns, agricultural centers, and natural gas infrastructure of all types. The proposed sensor network will be designed to run for years, or even decades, continuously monitoring methane and other greenhouse gases over wide-regions with little or no human intervention or additional cost. If successful, the proposed sensor networks would provide an enormous public benefit by helping to mitigate methane emissions and slow down global warming.

FY 2024 PHASE I AWARD WINNER

FIRM:	Carbon Solutions LLC 1041 Grand Ave., #142 Saint Paul, MN 55105
AWARD:	$175,000.00
PHONE:	401-871-4958
E-MAIL:	carl.talsma@carbonsolutionsllc.com
PRINCIPAL INVESTIGATOR (PI):	Carl Talsma
TITLE OF PROJECT:	MethanE DART: The Methane Emissions-Detection, Analysis, and Resource management Tool
TOPIC NUMBER:	9.6

TECHNICAL ABSTRACT:

Increases in methane emissions over the past decade have outpaced other greenhouse gases. Methane, a potent greenhouse gas, is vital to understanding climate change and mitigation strategies. Fugitive emissions from the natural gas industry represent the most preventable of anthropogenic emissions and will be the target of a direct tax penalty under the Inflation Reduction Act. Newly available satellite data from several missions provide an opportunity to monitor methane emissions from space at finer spatial resolutions. We propose a new geospatial analysis platform, the Methane Emissions-Detection, Analysis, and Resource Management Tool (MethanE DART), which will empower researchers and policymakers to effectively utilize the emerging satellite datasets, enabling the rapid identification, analysis, and categorization of point-source methane emissions. The software will incorporate three separate machine learning (ML) processes consisting of (1) an object-detection ML analysis to identify distinct point-source emitters, (2) a supervised neural network to estimate the flux of methane attributable to the point-source, and (3) a classification ML analysis to identify the industry of the identified emitters. The proposed analysis platform will provide an unparalleled view of global-scale industry-wide methane emissions, empowering natural gas operators, federal oversight entities, and researchers to make informed decisions and develop effective mitigation strategies.

SUMMARY OF ANTICIPATED RESULTS:

Phase I research and development will result in an AI-powered geospatial monitoring and analysis platform that will provide insights into point-source methane emissions as well as industry-level and regional emissions data. The software product will allow the user to analyze methane emissions over time at a single facility or, alternatively, analyze emissions over an entire region or across an entire industry. Bridging industry and regional scale analysis with fine-scale facility analysis will fill a significant gap in both the scientific literature and current commercially available products. This geospatial intelligence platform will be readily commercializable in the natural gas industry to prevent fugitive emissions and will be useful for larger scale methane emissions research.

FY 2024 PHASE I AWARD WINNER

FIRM:	Care Weather Technologies, Inc. 144 W 400 N Provo, UT 84601
AWARD:	$175,000.00
PHONE:	801-227-4740
E-MAIL:	patrick@careweather.com
PRINCIPAL INVESTIGATOR (PI):	Michael Patrick Walton

TITLE OF PROJECT:	Veery Fledgling Nanosatellite Pathfinder for Coarse Sea Wind
TOPIC NUMBER:	9.1

TECHNICAL ABSTRACT:

This proposal by Care Weather presents the development of Veery, a nanosatellite-based scatterometer, to significantly enhance global ocean surface vector winds (OSVW) monitoring. The current daily refresh rate of OSVW is insufficient to capture the dynamic changes occurring on hourly scales, crucial for understanding synoptic air-sea interactions and extreme weather phenomena. Veery proposes to achieve a near-hourly refresh rate, thereby filling critical gaps in our understanding of atmospheric phenomena like tropical cyclones and extratropical systems. The innovation lies in miniaturizing and cost-reducing scatterometer technology, traditionally large and expensive, into a nanosatellite form factor. This is accomplished through a vertically-integrated satellite system, designed specifically for scatterometry. The proposed Phase I project aims to demonstrate the feasibility of key improvements in Care Weather's attitude determination and control systems (ADCS), radio, and radar technologies, paving the way for Fledgling Veery, a pathfinder capable of demonstrating nanosatellite measurement of limited OSVW. This project represents a significant leap in satellite scatterometry, promising a cost-effective, scalable approach to global OSVW monitoring.

SUMMARY OF ANTICIPATED RESULTS:

The anticipated results of this Phase I project include the successful prototyping and testing of key improvements to Care Weather's advanced nanosatellite scatterometer systems, specifically in the areas of attitude determination and control systems (ADCS), radio, and radar. This prepares for a Phase II follow-on to develop Fledgling Veery, a pathfinder scatterometer, and demonstrate the feasibility of nanosatellite measurements of OSVW through an orbital flight test. This breakthrough has significant implications for meteorological science and operational weather forecasting. The ability to provide near-hourly global OSVW data will greatly enhance the understanding of atmospheric dynamics, particularly in the tracking and forecasting of severe weather events such as tropical cyclones, squall lines, and bomb cyclones.

FY 2024 PHASE I AWARD WINNER

FIRM:	ECCO Scientific, LLC 553 NW 39th Drive Gainesville, FL 32607
AWARD:	$174,007.00
PHONE:	305-510-7560
E-MAIL:	miles.medina@gmail.com
PRINCIPAL INVESTIGATOR (PI):	Miles Medina
TITLE OF PROJECT:	Tracing Non-Point Source Pollution Signals with Accelerated Causal Inference
TOPIC NUMBER:	9.4

TECHNICAL ABSTRACT:

Effective management of water quality requires rigorous scientific understanding of the causal mechanisms driving changes over time, but reliably inferring and modeling these mechanisms is challenging due to the diffuse nature of nonpoint source pollution and the dynamic complexity of pollution and its downstream effects. Recently developed empirical methods based on nonlinear dynamics theory offer a reliable means of inferring causality by tracing downstream conditions (e.g., eutrophication) to upstream pollution sources, to guide targeted investments in restoration projects and water infrastructure upgrades. Studies published by the PI demonstrate the methods' scientific validity and practical utility in systems whose flows are controlled by engineered structures, but the method is untested in naturally flowing rivers (unregulated flow). During Phase I, ECCO Scientific will evaluate the validity of the methodology in this setting, through a case study benchmarked against existing results of a conventional method (watershed modeling or stable isotope tracing). Further, existing software implementations lack a cohesive, computationally efficient, quality-controlled workflow conducive to performing causal analyses on a large scale. During Phase I, ECCO Scientific will evaluate the technical benefits of optimizing the code base for parallel execution on a graphics processing unit (GPU), by estimating the associated reduction in execution time.

SUMMARY OF ANTICIPATED RESULTS:

ECCO Scientific anticipates that the Phase I effort will (1) demonstrate the scientific validity and practical utility of the causal inference methodology in the unregulated-flow setting and (2) estimate execution-time acceleration on the order of 100x with GPU parallelization (compared to execution on a CPU). The GPU-accelerated software will massively expand the number and scope of feasible causal investigations, in terms of the number of river/hydrological systems that can be analyzed, the number of variables per river system, and the size of the data per variable. Application of the proposed software will provide scientific insights to (1) inform the development and targeting of interventions for effective management and restoration of water quality, (2) identify patterns of unintended consequences of past and ongoing management actions, and (3) inform refinement of existing process based models by identifying real-world causal mechanisms that are inadequately represented or entirely absent in model formulations.

FY 2024 PHASE I AWARD WINNER

FIRM:	Gulf Wind Technology, LLC. 5100 River Rd Avondale, LA 70094
AWARD:	$174,890.00
PHONE:	864-328-4919
E-MAIL:	murray.fisher@gulfwindtechnology.com
PRINCIPAL INVESTIGATOR (PI):	Murray Fisher
TITLE OF PROJECT:	Quantification of the Risk of Extreme Weather for Wind Energy Systems for Insurance Markets
TOPIC NUMBER:	9.1

TECHNICAL ABSTRACT:

Gulf Wind Technology proposes to develop a Hurricane Wind Turbine Risk Analysis method intended for use by the energy insurance industry. This work will combine inputs from the Risk Assessment Framework for Tropical Cyclones model into aeroelastic simulations of representative design load cases, into a confidence-weighted ensemble averaging approach to assess turbine damage. The body of work seeks to overcome industry-wide challenges related to numerical and other instabilities in the simulation of these load cases through novel aerodynamic approaches and ensemble averaging methods common today in meteorology. If awarded, Phase II would yield further refinement of the proof-of-concept Phase I model based on state-of-the-art understanding of the hurricane boundary layer and simulation tools, a broader library of wind turbines, as well as wind tunnel modeling for improved inputs.

SUMMARY OF ANTICIPATED RESULTS:

The results of the proposed work will provide the energy insurance industry, particularly for offshore wind projects, with a data-based method for assessing asset risk, consistent with Goal 5 of NOAA's Blue Economy Strategic Plan. Today, insurers rely on data from European wind farms, onshore wind farms, standard industrial curves, and building codes to determine the risk profile for a proposed project and set premiums. This data is not representative either due to the differing climate risk profiles of European offshore projects or U.S. onshore projects, or fundamental differences in risk between a building and a wind turbine, but they nonetheless are the best available data sources. Gulf Wind Technology's proposed method would provide location-specific damage profiles based on the probability of different intensity storms impacting the site.

FY 2024 PHASE I AWARD WINNER

FIRM:	IONICSCALE LLC 501 Boulevard PL NE Unit A Atlanta, GA 30308
AWARD:	$175,000.00
PHONE:	404-980-4725
E-MAIL:	wade@ionicscale.com
PRINCIPAL INVESTIGATOR (PI):	Wade Rellergert
TITLE OF PROJECT:	CHIP-SCALE MASS ANALYZERS FOR LOW-COST UNDERWATER MASS SPECTROMETERS
TOPIC NUMBER:	9.3

TECHNICAL ABSTRACT:

IonicScale LLC is developing the world's most compact, novel mass spectrometry-based chemical analyzers. These instruments will have wide ranging applications in environmental pollution monitoring, personalized medicine, food safety, biomanufacturing, forensics and law enforcement, defense, and space exploration. With an appropriate sampling system, these instruments can even be used underwater for several purposes including to detect leaks in offshore oil and gas structures; detect, locate and identify toxic industrial chemicals dumped in our oceans; and study various important aspects that impact the health of ocean ecosystems, such as dissolved inorganic carbon (DIC) levels. To enable these important applications, this Phase I award will enable the design of the submersible enclosure and a novel membrane inlet sampling interface to enable ocean-based in-situ deployment of the IonicScale Gen I mass-analyzer system.

SUMMARY OF ANTICIPATED RESULTS:

By conclusion of this Phase I award, we will have prototype enclosure and sampling systems capable of interfacing with our first-generation instruments and will have measured important properties that will demonstrate the performance and capabilities of our products. We will also have identified industry and research partners that specialize in ROVs, AUVs, etc, to help complete an enclosure design that could interface with a target demonstration platform. Coupled with follow-on Phase II development of the electronics, software, and compatible pressure vessel to realize a full prototype instrument, this will allow for testing in an operationally relevant environment. The initial commercial applications of this instrument will include superior leak detection technology for offshore oil and gas platforms and underwater pipelines, and detection of toxic industrial chemicals dumped in our oceans.

FY 2024 PHASE I AWARD WINNER

FIRM:	L.Garde, Inc. 15181 Woodlawn Avenue Tustin, CA 92780
AWARD:	$174,976.00
PHONE:	714-259-0771 x237
E-MAIL:	linden_bolisay@lgarde.com
PRINCIPAL INVESTIGATOR (PI):	Linden Bolisay
TITLE OF PROJECT:	SOLSTICE Test Program
TOPIC NUMBER:	9.5

TECHNICAL ABSTRACT:

L.Garde proposes the SOLSTICE test program to advance the Technology and Manufacturing Readiness Level (TRL & MRL) of its vectored solar sailcraft from 4 to 6 to provide a commercially viable solution to NOAA's unmet requirements for solar wind data from 0.98AU to enable advanced solar storm warning. This test program advances the current NOAA/Aerospace Space Weather study with L.Garde to design the SOLSTICE vehicle and mission to sub-L1. During the proposed 6-month period of performance the L.Garde led team will build a full scale engineering test unit of the SOLSTICE vehicle based on the current study design for ground deployment testing and to serve as a manufacturing pathfinder for the subsequent commercial flight program. The SOLSTICE vehicle is capable of achieving and maintaining this duty station for a minimum 5-year mission. As a cost-effective platform, SOLSTICE expands upon NOAA's Uncrewed Systems Strategy of collecting critical and time sensitive data from terrestrial aircraft and maritime systems by placing a UxS able to provide a new commercial solar wind data source at the edge of cislunar space.

SUMMARY OF ANTICIPATED RESULTS:

Deliverables from the 6-month effort are the ground demonstration vehicle, deployment data, and detailed cost and schedule data to begin building the SOLSTICE flight vehicle as a commercial effort.

FY 2024 PHASE I AWARD WINNER

FIRM:	Live Advantage Bait LLC 2210 N Old Dixie Highway Fort Pierce, FL 34946
AWARD:	$175,000.00
PHONE:	561-818-0173
E-MAIL:	nkirchhoff@gmail.com
PRINCIPAL INVESTIGATOR (PI):	Nicole Kirchhoff
TITLE OF PROJECT:	Optimizing Manufacturing Efficiency for a Hormone Implant to Facilitate Maturation and Spawning in Fish
TOPIC NUMBER:	9.3

TECHNICAL ABSTRACT:

Hatchery production is one of the largest costs and restraints to fin fish aquaculture and conservation fisheries, therefore spawning aids are ranked as a high priority drug by the Association of Fish and Wildlife Agencies-Drug Approval Working Group. Project PI has successfully developed and demonstrated superiority of our slow release spawning implants in a large number of fish species and has been able to gain FDA eligibility for Indexing. However, the current manufacturing methodology, while safe and effective, is very labor & time intensive, and therefore a hurdle to scaling. This proposal investigates a new manufacturing technology, innovative for veterinary drugs (including the aquaculture industry) and for our hormone active ingredient. Three research trials must be completed to submit an amendment to our FDA Indexing approvals and for commercialization: (1) demonstrate the manufacturing methodology can produce an analytically stable hormone implant; demonstrate (2) target animal safety and (3) efficacy of the new implant in fish. Target animal safety and efficacy trials will be completed at project PI Live Advantage Bait hatchery, and manufacturing trials and analytics will be completed by an FDA approved facility.

SUMMARY OF ANTICIPATED RESULTS:

The ability to spawn fish in captivity will result in expansion of the commercial aquaculture and fisheries conservation industries. Currently the U.S. has a $17 billion seafood trade deficit, with nearly 90% of the seafood we eat coming from abroad and over half of that from aquaculture (NOAA Fisheries, 2022). Climate change and the changing ocean will only increase our dependency on aquaculture to fulfill this seafood gap and to aid in the conservation of imperiled species. With the assistance of spawning aids, U.S. aquaculture production can become more competitive domestically as well as internationally, reducing our trade deficit and increasing GDP. Currently there are no FDA approved spawning aids for non-ornamental fish on the market. If successful, this project will enable switching our FDA Indexed spawning implant to a new manufacturing technology, resulting in cheaper and more efficient commercialization. From current estimates of spawning aid use and wholesale purchase cost, we estimate the spawning aids are a $30million market, of which we feel our implant will capture 30% or more.

FY 2024 PHASE I AWARD WINNER

FIRM:	Loggerhead Instruments Inc. 5627 Country Walk Lane Sarasota, FL 34233
AWARD:	$175,000.00
PHONE:	941-266-2908
E-MAIL:	dmann@loggerhead.com
PRINCIPAL INVESTIGATOR (PI):	David Mann
TITLE OF PROJECT:	Low-cost scalable passive acoustic autonomous vehicle with AI
TOPIC NUMBER:	9.3

TECHNICAL ABSTRACT:

Passive acoustic recording on underwater gliders has shown promise to map fisheries, locate marine mammals, and detect vessels in protected areas. Gliders cannot operate in shallow water, necessitating offshore deployment/retrieval and restricting mapping to deeper waters; their initial purchase price and operational costs limit the number of simultaneous deployments, and post-retrieval audio file processing requirements add expense and slow scientific discovery.

SUMMARY OF ANTICIPATED RESULTS:

We propose developing Pogo, a low-cost underwater vehicle for passive acoustic recording which can be deployed and recovered from near shore, allowing collection of high-quality audio recordings in shallow waters via inexpensive and simultaneous deployments, and removing the need for ongoing operational support. A hybrid profiler with vertical and horizontal transit capability and GPS and inertial sensor navigation, Pogo will transit to its targeted location, sink and passively station on the bottom to record audio, then surface on a programmed schedule to transmit summary data and location via satellite. Pogo will use artificial intelligence and a small, customizable neural net to automatically detect signals of interest, including fish, marine mammals, or vessels, thus eliminating the need for post-retrieval audio file processing, while a cloud system and data dashboard will allow users to visualize data and manage simultaneous Pogo deployments.

FY 2024 PHASE I AWARD WINNER

FIRM:	MarineSitu, Inc 909 NE Boat Street Seattle, WA 98105
AWARD:	$175,000.00
PHONE:	360-477-2901
E-MAIL:	James@MarineSitu.com
PRINCIPAL INVESTIGATOR (PI):	James Joslin
TITLE OF PROJECT:	Rapid Coastal Survey Automation Using an AI-Supported Low-Cost ROV
TOPIC NUMBER:	9.3

TECHNICAL ABSTRACT:

The changing ocean requires new tools for rapid assessment, especially in complex marine environments such as coral reefs. Current survey methods have significant limitations and data processing is slow and labor intensive. Specialized AI tools still need to be developed to deal with the complexity of marine image data. MarineSitu offers affordable and customized underwater monitoring systems to the growing blue economy.

SUMMARY OF ANTICIPATED RESULTS:

In this project, we will develop a complete low-cost survey system, including hardware components [a stereo camera enabled ROV] and software components [with AI enabled object detection and 3D reconstruction]. Working with the University of Hawai'I, we will do paired surveys using the new ROV system and traditional dive methods. The collected images will be ground truthed using the current labor intensive labeling, and that data will train machine learning (ML) models for object detection, 3D positioning, and 3D reconstruction. The AI enabled software systems will be validated for automated detection of coral bleaching, invasive species, and fish diversity assessments. We expect to significantly improve the resolution, accuracy, and data processing efficiency for benthic marine surveys, offering a complete, low-cost, unmanned survey system for a multitude of monitoring applications including fisheries assessment, aquaculture management, ecotourism, and disaster assessments.

FY 2024 PHASE I AWARD WINNER

FIRM:	Quantitative BioSciences, Inc 6185 Cornerstone Ct E, Ste 107 San Diego, CA 92121
AWARD:	$175,000.00
PHONE:	858-344-7490
E-MAIL:	nick.csicsery@qbisci.com
PRINCIPAL INVESTIGATOR (PI):	Nicholas Csicsery
TITLE OF PROJECT:	A Customizable Nanobody-Based Biosensor For Real-Time Cyanotoxin Detection
TOPIC NUMBER:	9.2

TECHNICAL ABSTRACT:

Climate change is having a profound and concerning effect on aquatic ecosystems, with coastal waters experiencing progressive warming, acidification, and deoxygenation, and the impacts of damaging events such as Harmful Algae Blooms (HABs) are expected to increase over the coming century. HABs have the potential to not only drastically impact public health but also to devastate recreation, tourism, aquaculture, and the overall ecosystem. The development of a sensitive sensor platform for the continuous monitoring of water for cyanotoxins would facilitate the early detection and prediction of HAB events, enabling early action and reducing the costs, environmental damage, and economic damage commonly associated with HABs. We will develop a nanobody-based biosensor strain along with a continuous biosensor platform that will be able to detect and quantify the cyanotoxin microcystin in real time. Importantly, this approach will lead to a pipeline for developing sensors for countless toxins and contaminants, as once we have demonstrated proof of principle with the development of a sensor for microcystin detection, we can swap in new nanobodies to detect new targets of interest.

SUMMARY OF ANTICIPATED RESULTS:

Water pollution is a widespread problem that is growing in both impact and awareness, and there is an increasing need for in-line, location specific contaminant measurements to help localize problems, identify their sources, verify compliance with discharge limits, and monitor harmful events and remediation efforts. Therefore, the market for in-line contaminant sensors is multi-faceted, with potential customers in the food industry, environmental monitoring, drinking water safety, and wastewater remediation. Due to the customizable nature of our platform, we will pursue many industries as we expand our business, with a particular focus on water quality and safety testing. Importantly, our Phase I project will prove technical feasibility for this novel nanobody-based sensing approach, and in Phase II we will add the ability to detect additional toxins as well as refine the platform for commercial manufacturing and sales.

FY 2024 PHASE I AWARD WINNER

FIRM:	Rapid Radicals Technology 2520 E Ohio Avenue Milwaukee, WI 53207
AWARD:	$174,536.00
PHONE:	262-490-8634
E-MAIL:	ppeters@rapidradicals.com
PRINCIPAL INVESTIGATOR (PI):	Paige Peters
TITLE OF PROJECT:	Integrating decentralized wastewater treatment into municipal infrastructure for increased resilience during intense precipitation events
TOPIC NUMBER:	9.2

TECHNICAL ABSTRACT:

High-intensity storm events, which are occurring with more frequency and intensity, can overburden aging municipal infrastructure, forcing utility leaders in both urban and rural service areas to decide between overflowing untreated sewage into waterways (sewer overflows) or backing up basements with contaminated water. In the U.S., 850 billion gallons of untreated sewage are discharged into lakes, rivers, and oceans every year. Climate change, population growth, and aging infrastructure are only making matters worse, particularly within coastal regions. Utility decision-makers and the communities they serve require new solutions to address this growing concern. Rapid Radicals' patent-pending catalytically enhanced advanced oxidation process can treat wastewater to the same quality or greater than conventional treatment 20 times faster in 95% less space.

SUMMARY OF ANTICIPATED RESULTS:

This proposal focuses on innovating two key technical milestones required for municipal deployment of the core technology: (1) determining the feasibility of applying a scalable catalyst to the process to decrease treatment time and improve energy efficiency and (2) integrating machine learning models into the automated system for more energy-efficient and reliable decentralized wastewater treatment. Advancing these technical milestones will increase the Rapid Radicals system's ability to help utility decision-makers be more agile and responsive in building climate resilience.

FY 2024 PHASE I AWARD WINNER

FIRM:	RESILIFT, Inc. 241 Middle Street Apt. 11 Portsmouth, NH 03801
AWARD:	$175,000.00
PHONE:	201-965-7366
E-MAIL:	marcus@resilift.com
PRINCIPAL INVESTIGATOR (PI):	Marcus Landers
TITLE OF PROJECT:	Elevation Plane Residential Lifting Safety Sensor System
TOPIC NUMBER:	9.2

TECHNICAL ABSTRACT:

RESILIFT will develop a house-lifting technology, the Residential Lifting Safety Sensor System (RLS3), that will provide an improved and more accessible flood mitigation option for homeowners. The innovation uses custom sensing nodes to lift houses in a faster, cheaper, safer, and more efficient manner. 14.6M properties in the 100-year floodplain have a 26% cumulative risk of flooding over the lifetime of a standard mortgage, thus these floodplain-based homeowners have a one in four chance of total asset loss. Structural lifting processes mitigate the risk of flood damage, but the current process is rife with operational inefficiencies and safety hazards due to an overreliance on human labor. Our team of experts will address critical research questions under the following objectives: 1) Identify the optimal set of components to provide real-time data on the lifting plane; 2) Develop a working prototype of the RLS3; 3) Test the RLS3; and 4) Establish market feasibility and a commercial strategy. This project responds to Research Topic 9.2 Coastal Resilience. The project addresses the objectives to manage inundation and improve community preparedness in response to coastal hazards. We believe the best way to prepare a community for flooding is by scaling access to structural lifting services.

SUMMARY OF ANTICIPATED RESULTS:

In 2023, new construction is expected to level, making room for the improvement of existing structures. With RLS3, RESILIFT can unlock immense value by moving the market from reconstruction to mitigative retrofits of existing buildings. Climate change is a scientific reality that will demand investment in structural lifting services, which is underscored by a substantial total addressable market (TAM). Of the 14.6M homes at severe risk in the U.S., we estimate that up to 80% require elevation to mitigate potential flood damage. At $100,000 per lift, the TAM is $1.168T. RESILIFT will facilitate front-end financing and insurance brokerage services for homeowners and access marginal customers by making this service more affordable.

FY 2024 PHASE I AWARD WINNER

FIRM:	Sediment 500 Woodlawn Ave Greensboro, NC 27401
AWARD:	$174,693.00
PHONE:	215-858-3645
E-MAIL:	evan@sediment.science
PRINCIPAL INVESTIGATOR (PI):	Evan Goldstein
TITLE OF PROJECT:	Measuring coastal sediment grain size instantly using Instagrain, a hand-held camera with on-device machine learning
TOPIC NUMBER:	9.2

TECHNICAL ABSTRACT:

Much of the US coastal zone is covered in a veneer of mobile sediment, and the size of this sediment determines under what conditions it moves. Accurate measurement of coastal sediment grain size is critical for work on coastal erosion, shoreline change, total water level forecasting, storm impact predictions, planning, designing nature-based coastal protections, and other coastal resilience projects. Measurement of grain size is time consuming, costly, and requires a laboratory. Inaccurate measurements result in degraded performance of models, plans, predictions, and forecasts. To address slow measurement speed and high cost-per-sample, we have built a new handheld camera-based system that uses on-device machine learning, does not require calibration, and provides accurate field measurements of grain size within 1 second, ~1,000,000x faster than lab quotes of 2 weeks. We propose three research objectives to dramatically improve the performance of our technology for coastal sites of the US, regardless of sediment size, distribution, color, and composition: First, field collections to grow our training dataset; Second, machine learning model development to increase performance and reduce training data requirements; Third, targeted work to determine presence and percentage of specific minerals used for some coastal projects.

SUMMARY OF ANTICIPATED RESULTS:

We anticipate the proposed work will lead to the development of a device that: 1) can accurately measure all types of sediment present along the continental US coastline; 2) contains a new pretrained machine learning model - made using weak supervision - that will improve model results; and 3) detects the presence and weight percentage of specific minerals used in some coastal projects. Quantitative metrics will allow us to measure the success of each research objective. The implication of the proposed work is the development of a new instrument able to measure sediment grain size quickly and accurately in the field at any US coastal location.

FY 2024 PHASE I AWARD WINNER

FIRM:	Steve Bitterly (Pure Spun Innovations) 4615 Industrial Street, STE 1F Simi Valley, CA 93063
AWARD:	$174,769.00
PHONE:	818-388-6168
E-MAIL:	steve@PureSpunInnovations.com
PRINCIPAL INVESTIGATOR (PI):	Steve Bitterly
TITLE OF PROJECT:	Advancing Water Purification Solutions for a Resilient America
TOPIC NUMBER:	9.4

TECHNICAL ABSTRACT:

Water reuse is gaining support as a local, resilient solution. Wastewater recycling conserves resources by substituting treated effluent for potable sources in non-potable uses like irrigation and industrial processes. A key obstacle is the potential health risks from chemical contaminants that persist through treatment and pathogens that could evade disinfection. Recent contaminants of concern include pharmaceuticals, personal care product chemicals, and Per- and polyfluoroalkyl substances (PFAS). Conventional water treatment methods have limitations in removing emerging contaminants and can have high operational costs and environmental impacts. While advanced technologies address more contaminants, they are energy-intensive and expensive, providing limited options to address the current challenge of increasing accessibility to freshwater supplies. Pure Spun Innovations (PSI) is proposing a new methodology and technology to address the problem of water contamination by PFAS via an efficient and effective phase-change system. PSI's novel phase-change water/fluid purification technology uses a NASA-validated vapor compression distillation (VCD) unit, uniquely coupled with parallel concentric rotary-boilers/condensers. VCD systems are scalable from portable hand-carried purifiers up to industrial sized configurations to fulfill a critical unmet need in wastewater PFAS removal.

SUMMARY OF ANTICIPATED RESULTS:

The PSI's system will substantially reduce or eliminate PFAS into the environment through wastewater effluent. This will prevent further contamination of surface waters, groundwater, soils, and accumulation up the food chain. Wastewater treatment plants will also be able to comply with any regulatory limits on PFAS in effluent that are set in the future. Downstream drinking water sources that currently receive wastewater discharges will be safeguarded from PFAS contamination as the PSI system will remove the chemicals. PFAS treatment and capture will support the circular economy by preventing re-entry into environmental systems.

FY 2024 PHASE I AWARD WINNER

FIRM:	SUBTIDAL, INC. 62 Terrence Ave. East Falmouth, MA 02536
AWARD:	$174,597.00
PHONE:	510-459-5144
E-MAIL:	casey@subtidal.com
PRINCIPAL INVESTIGATOR (PI):	Casey Wilson
TITLE OF PROJECT:	Assessing Scalable, Autonomous Volumetric Carbon Flux for MRV of Ocean Carbon Dioxide Removal
TOPIC NUMBER:	9.6

TECHNICAL ABSTRACT:

Ocean carbon dioxide removal (CDR), with the potential for 5 Gigatons annual CO2 removals, will be crucial for removing the 10 Gigatons CO2 annually from the atmosphere by mid-century necessary to stay within 1.5-2°C of warming. The problem, however, is that commercially available tools for comprehensive MRV of ocean CDR do not yet exist, leaving ocean CDR developers, researchers, carbon credit buyers, and policymakers without the necessary instruments to assess the effectiveness, safety, and performance of ocean CDR strategies. Subtidal aims to address this critical gap by developing the Ocean Carbon Flux Grid, a technology that integrates real-time, three-dimensional, high-frequency carbonate chemistry sensing with novel Eulerian control-volume cloud-based carbon flux analytics frameworks to transform ocean carbonate chemistry concentration sensor measurements into continuous volumetric carbon flux measurements (or, “net carbon drawdown”). This technology has the potential to revolutionize the MRV of ocean CDR by offering the first accurate and scalable solution for measuring, reporting, and verifying ocean carbon removals.

SUMMARY OF ANTICIPATED RESULTS:

In this NOAA SBIR Phase I project, Subtidal proposes to develop, deploy, and validate its carbon flux analytics frameworks to transform three-dimensional high-resolution carbonate chemistry sensor data into continuous volumetric carbon flux measurements in a bi-directional tidal estuary. The Phase I research will also assess the scientific and commercial viability of using volumetric carbon flux to quantify atmospheric-ocean carbon drawdown for MRV of ocean CDR. Following a successful Phase I, Subtidal will leverage these carbon flux analytics frameworks and research learnings to develop a pilot-scale Ocean Carbon Flux Grid to validate, pilot, refine, and broaden the technology's applicability across ocean CDR approaches in preparation for commercial scaling in Phase III. The commercial potential is vast, with the estimated long-term annual carbon sequestration of ocean CDR approaches reaching up to 5 Gt CO2/year and $500 billion annually in carbon credit revenue.

FY 2024 PHASE I AWARD WINNER

FIRM:	Sun Dog Scientific LLC 1794 Wright Dr Erie, CO 80516
AWARD:	$174,788.00
PHONE:	720-903-5747
E-MAIL:	mphend@sundogscientific.com
PRINCIPAL INVESTIGATOR (PI):	Michael Henderson
TITLE OF PROJECT:	A REAL-TIME SPACE WEATHER ALERT AND ANALYSIS SYSTEM
TOPIC NUMBER:	9.5

TECHNICAL ABSTRACT:

A continuous data processing system is proposed to transform the raw magnetic field data produced by the existing MagStar magnetometer network into actionable, mission-relevant, and validated data products that can be used by all clients with interest in space weather conditions. This system will be unique in its ability to produce information that is both real- me and validated. Alerts that are produced while phenomena such as magnetic storms are active, as well as digests that are generated directly after such events will allow clients to consider space weather's effects on their own missions in an immediate way that currently does not exist. The alerts and digests have the ability to be generated based on geographic information, yielding localized information that is relevant to the client and not a "false alarm" about a distant area of the country. Architecture of this system will incorporate best practices for long-running software services, such as hybrid cloud and on-premises deployment with containerized run mes, ensuring a robust system that clients can count on for reliable delivery with no false positives. Clients will understand that space weather can be relevant to their mission, delivering information in a timely and reliable manner that is local, usable, tracible, and correct.

SUMMARY OF ANTICIPATED RESULTS:

SunDog Scientific previously has developed a framework for continuous data processing that can refine raw data into refined data products multiple times per minute on a raw real- time data stream. This project will use this framework to process the MagStar data in a production on-level environment. Clients will be able to self-register for alerts and digests, and the deployed system will be sufficient to serve a few dozen such clients. Although there will be technical innovation in order to deliver this system, the main goal of the effort is to evangelize the availability of real-time space weather information and to start understanding how it is best delivered to the client community. To this end, the ease of self registration and reliability of the data products are important project goals, in order to gain an initial set of space weather information consumers and understand their needs. The electrical power utilities already have an interest in the hazards to their transmission line infrastructure due to magnetic storms, including regulation such as TPL-007. The real me delivery of threats covered by this regulation could be a tailored output of the system for a commercial application.

FY 2024 PHASE I AWARD WINNER

FIRM:	Synthetik Applied Technologies, LLC 10900 Medfield Ct. Austin, TX 78739
AWARD:	$174,689.00
PHONE:	360-441-5010
E-MAIL:	hatfield@synthetik-technologies.com
PRINCIPAL INVESTIGATOR (PI):	Joshua Hatfield
TITLE OF PROJECT:	DeepCarbon: Machine learning-based software tool for characterization of carbon assets and impacts of land-use changes for informed planning and decision making.
TOPIC NUMBER:	9.6

TECHNICAL ABSTRACT:

During Phase I, We will demonstrate the feasibility of a proposed platform for automated characterization of carbon assets by developing foundational machine learning tools. This will include identification and validation of usable datasets for areas with known biomass density, and development of machine learning models linking multi-modal geospatial data, both on a pixel and regional level, with mappings of above-ground biomass. We will apply these mappings to validated historical data in order to develop predictive models based on long-short term neural networks, capable of forecasting biomass accumulation over time for vegetated areas. These models will be applied to existing predictions of land-use change in a demonstration region, identifying high-priority targets for conservation efforts and planning intervention. Combining historical data and accurate and automated measurement of carbon sequestration capacity with predictions of land use changes will serve to provide invaluable insight into priority areas that represent a high-risk of sequestered carbon loss on a regional scale. Additionally, such tools will enable rapid identification of the carbon cost of local actions impacting land use conversion, allowing examination of these impacts in consideration of the triple bottom line.

SUMMARY OF ANTICIPATED RESULTS:

We propose to develop a globally deployable region-focused platform to evaluate the current carbon storage and future sequestration potential of vegetated areas with enhanced spatial and temporal resolution. The platform will accurately predict the impact of forecasted land-use changes and support planning, mitigation, and conservation efforts. Policymakers and land-use management entities may employ the tool to directly evaluate the impact of planning decisions in terms of region-wide carbon goals. Commercial entities which own carbon assets, or which conduct activities impacting land use, may use such characterizations of carbon impact to meet environmental and climate regulations, or participate in carbon offset or carbon credit trading programs. Finally, as carbon sequestering assets become an insurable commodity, evaluation of their value and any potential risks will provide insurance providers direct value in managing portfolios.

FY 2024 PHASE I AWARD WINNER

FIRM:	TCarta Marine LLC 1015 Federal Blvd Denver, CO 80204
AWARD:	$175,000.00
PHONE:	303-284-6144
E-MAIL:	gt@tcarta.com
PRINCIPAL INVESTIGATOR (PI):	Graeme Timmeney
TITLE OF PROJECT:	Non-Invasive Quantification of Littoral Blue Carbon Habitats with Space-Based Hyperspectral Imaging
TOPIC NUMBER:	9.3

TECHNICAL ABSTRACT:

This project proposal addresses the pressing need to understand and quantify the discernable human impact on global climate, specifically focusing on the assessment of seagrass in coastal and intertidal ecosystems. Using innovative methods applied to high-resolution hyperspectral satellite imagery, TCarta aims to advance research on “The Changing Ocean” by providing detailed insights on the spatial and spectral dynamics of seagrass habitats. Traditional satellite sensors have lacked both the spatial and spectral resolution necessary for precise mapping of underwater changes at a local ecosystem level. Through a multi-sensor approach, leveraging Pixxel’s hyperspectral imagery, TCarta offers a breakthrough in benthic habitat classification and health assessment. This project outlines five key technical objectives, including the identification of optimal sensor bands, determination of water column properties, and the development of tools for efficient data processing and noise reduction. By developing automated analysis of hyperspectral imagery, TCarta aims to create accurate maps addressing critical ocean ecosystems such as seagrass beds, coral reefs and mangrove forests. The project’s significance lies in its potential to revolutionize marine habitat management, restoration, monitoring and risk assessment.

SUMMARY OF ANTICIPATED RESULTS:

Our oceans are in a state of great distress and rapidly changing. They are vast, inaccessible, costly and challenging environments to access. Our ability to broadly and finely assess the health of ocean ecosystems is limited. This project will develop novel methods of imaging and analyzing the nature of the seafloor in coastal areas using space-based hyperspectral imaging sensors in high resolution with exacting precision enabling remote health assessment, quantification and change detection of the ocean environment. The satellite-based sensor collection parameters will be modified to maximize seafloor imaging capability and imagery collection will be fine-tuned to collect specific bands that provide the best spectral distinction of seafloor types and density. Spectral response information derived from hyperspectral imagery will be fused with sub-meter resolution multi-spectral satellite imagery to produce 30 cm classification of the seafloor.

FY 2024 PHASE I AWARD WINNER

FIRM:	Trident Sensing LLC 8475 Weber Dr Oakley, UT 84055
AWARD:	$174,957.00
PHONE:	435-640-9236
E-MAIL:	steve.pollard@tridentsensing.com
PRINCIPAL INVESTIGATOR (PI):	Stephan Pollard
TITLE OF PROJECT:	Extreme event real-time modeling, data fusion and actionable information dissemination to decision makers and the general public
TOPIC NUMBER:	9.1

TECHNICAL ABSTRACT:

Extreme and cascading events are increasing in frequency and severity due to a warming and changing planet. The hazards are widespread, complex, and disproportionately affect underserved and disadvantaged communities. Innovative strategies and improved tools are needed to mitigate the growing impact of these extreme events, including improved modeling, forecasting, data fusion, and information distribution. Multiple federal agencies collect data, model, and forecast extreme events. But the data are spread across many systems and difficult for the public to assimilate. The goal of this SBIR is to perform data fusion and dissemination research that cuts across federal agencies. This research will develop an open architecture system that emphasizes data fusion and actionable information dissemination as the core capability. The Phase I feasibility demonstration will incorporate a wildfire module. Additional extreme event modules will be added in Phase II. Wildfire is an extreme event that poses significant cascading hazards to humans. At close range, wildfires are a threat to life, property, and infrastructure. But, the health impacts of smoke travel far and wide. Research will culminate with a feasibility demonstration of integrating real-time fire mapping with fire and smoke modeling, and actionable information distribution in real-time.

SUMMARY OF ANTICIPATED RESULTS:

The Extreme Event Modeling and Data Fusion for Decision Support system will provide actionable information to emergency managers and the public. As envisioned, emergency managers will be able to provide curated web page links through the Reverse-911 text message system. Greater access to information will allow the public to better prepare for evacuation or sheltering in place. The end goal is to save lives, property, and infrastructure. Phase I will provide lessons learned from a live feasibility demonstration that will guide the focus of the Phase II prototyping effort. The technology envisioned has broad commercialization potential. Emergency and risk management software is a growing market with extreme events occurring more frequently and with greater impact. Federal, state, and local agencies are target customers as well as private insurance companies and utilities.

FY 2024 PHASE I AWARD WINNER

FIRM:	Tridentis Advanced Marine Vehicles LLC 73-4460 Queen Kaahumanu Hwy, Ste 138 Kailua-Kona, HI 96740
AWARD:	$174,738.00
PHONE:	540-903-5544
E-MAIL:	william.latham@tridentis.com
PRINCIPAL INVESTIGATOR (PI):	William Latham
TITLE OF PROJECT:	Autonomous Coastal Monitor Ghost Pot Solution
TOPIC NUMBER:	9.2

TECHNICAL ABSTRACT:

Tridentis Advanced Marine Vehicles (AMV) will employ its Autonomous Coastal Monitor (ACM) technology and advanced data processing techniques currently being pioneered at the University of Delaware (UD) to address the ecological problem of derelict crab pots, or “ghost pots”. A 2016 study (Bilkovic, Slacum, Zaveta, & Jeffrey, 2016) sponsored by NOAA estimated 12-20% of the blue crab traps deployed annually in the Chesapeake Bay are lost, killing more than 3.3 million crabs, or 4.5% of the 2014 harvest. The study also quantified the positive effect of removal efforts, suggesting that, on average, harvests increased 868 lbs. for each removed pot. The key opportunity this research will pursue is to dramatically reduce the time and cost of ghost pot identification and location, so that a greater proportion of limited conservation resources may be dedicated to removal. The research will pursue the use of autonomous surveys of ghost pot hot spots to generate a dataset suitable for processing using UD techniques, with the goal of producing a data product to guide removal team efforts. Phase I will determine the feasibility of using the ACM to generate a dataset suitable for processing, with subsequent research oriented towards creating a viable data product.

SUMMARY OF ANTICIPATED RESULTS:

The 2016 Bilkovic study highlighted the high value of ghost pot removal efforts, estimating millions in harvest based economic gains, besides ecological improvements, in the Chesapeake region alone. However, crab pots are an ecological and economic issue throughout the U.S., representing a broad and diverse market, with potential expansion of the technology to other types of derelict fishing gear. AMV has a clear view of the development and commercialization of this technology. The research will mature selection and integration of the onboard systems, the craft’s operating parameters, and the techniques to transmit, process, and report data. This will guide development of a full-service crab pot search and recovery company. The customer base includes conservation groups, state and local government agencies, and aquaculture companies. AMV contemplates conducting fee-based surveys, and a fee for each pot removed. Because pots are lost each year, there is a sustainable long-term business revenue stream.

FY 2024 PHASE I AWARD WINNER

FIRM:	Vega MX Inc 11 Broadway 420 New York, NY 10004
AWARD:	$174,790.00
PHONE:	347-702-1659
E-MAIL:	vivekmital180@gmail.com
PRINCIPAL INVESTIGATOR (PI):	Vivek Mital
TITLE OF PROJECT:	Space based and In-situ measurement of pre-season soil moisture and land surface temperature to estimate wildfire extent and risk
TOPIC NUMBER:	9.1

TECHNICAL ABSTRACT:

Understanding the coupling among drought, water content of the soil, and forest fires is essential in the fire risk study framework. In this context, improved wildfires prediction tools, such as risk, severity, burnt area, are urgently needed and in this work, the use of remotely sensed and in-situ sensed Soil Moisture (SM) data, as well as Land Surface Temperature (LST) as key variables in the climate-wildfires relationship is explored. Therefore a vital need is to increase the quantity and quality of available information at relevant spatiotemporal scales, which will be accomplished through an integrated Space and Ground Sensing grid for estimating SM, LST, and other climate variables. Space data will consist of commercial data spanning Superspectral, Thermal IR, hyperspectral, SAR (microwave radar) as well as data provided by NASA.

SUMMARY OF ANTICIPATED RESULTS:

1. Understand the relationship between soil moisture and land surface temperature on wildfire risk and burnt area through statistical and AI / Deep learning methods
2. Determine stakeholder information requirements
3. Develop a real-time simulation window to disseminate ensembled model results to the users. Deliverables: Analytical Software, Report & Training to Fire Agencies.

FY 2024 PHASE I AWARD WINNER

FIRM:	VISIMO, LLC 520 E Main Street Suite 200 Carnegie, PA 15106
AWARD:	$174,747.00
PHONE:	412-528-4223
E-MAIL:	tyler.g@visimo.ai
PRINCIPAL INVESTIGATOR (PI):	Tyler Gaona
TITLE OF PROJECT:	FloodWise: Autonomous Geotagging for Disaster Response
TOPIC NUMBER:	9.4

TECHNICAL ABSTRACT:

VISIMO proposes a feasibility study for the development of FloodWise, an AI decision-support tool that will enable professionals to effectively prepare, adapt, and respond to flooding events. FloodWise will autonomously scrape and geotag social media images of flooding events to produce flood depth estimation maps in real time. VISIMO will create a custom algorithm that will geotag social media images and videos in the absence of Exif data. Unlike current models, VISIMO's model will pinpoint image locations with latitude/longitude coordinates, accurate to 20 meters, within narrow regions. VISIMO will seek to enhance and refine the custom flood depth estimation algorithm utilized in the BluPix flood response app. The BluPix model is not fully automated, and only estimates water depth using stop signs; VISIMO will expand this algorithm to apply to additional objects and process images containing reflections accurately. VISIMO's study will determine (1) the ability to autonomously geotag social media data; (2) the expansion and refinement of the BluPix flood depth estimation algorithm; and (3) the overall feasibility of the proposed final architecture. VISIMO will produce a demonstration that will show, for five locations, the pipeline's ability to accurately geotag social media images and videos as new observations for actionable flood intelligence.

SUMMARY OF ANTICIPATED RESULTS:

End users such as Federal Emergency Management Agency (FEMA) Federal Coordinating Officers, National Guard Emergency Management Officers, Emergency Management professionals in state and local departments of public safety and emergency management, geospatial information analysis, and geospatial intelligence (GEOINT) analysts may use VISIMO's tool to (1) respond to flooding in real-time using VISIMO's mobile app; (2) prepare optimally for future events using historical data saved within the app to visualize how flooding impacted their region during similar events; and (3) adapt to future flooding events using our tool's historic data to inform potential adaptation strategies, such as improving aging water infrastructure, modifying land use, and repairing and retrofitting facilities.

FY 2024 PHASE I AWARD WINNER

FIRM:	Zeteo Tech, Inc. 6935 Warfield Ave. Sykesville, MD 21784
AWARD:	$174,707.00
PHONE:	443-985-2052
E-MAIL:	emily.caton@zeteotech.com
PRINCIPAL INVESTIGATOR (PI):	Emily Caton
TITLE OF PROJECT:	Real-Time Aerosol Monitoring for Harmful Algal Blooms and Toxins via MALDI-TOF MS
TOPIC NUMBER:	9.2

TECHNICAL ABSTRACT:

Harmful algal blooms (HAB) detrimentally impact the health of populations and economies on a global scale. Toxins produced by these algae affect sources of food and water. Another less well understood result of HAB is the aerosolization of the toxins they produce. The initial consequences of toxin inhalation on human health are being revealed through elevated hospitalization rates in coastal regions during HAB events. Research in this area is hampered by the inability to accurately determine exposure levels due to the transient nature of aerosolized toxins. Screening the aerosol environment of coastal regions rapidly, accurately, and affordably for a wide range of algal toxins will provide relevant agencies with necessary real-time aerosol identification capabilities.

SUMMARY OF ANTICIPATED RESULTS:

Our proposed solution is a portable, fieldable, automated MALDI-TOF mass spectrometer that can act as an early warning system for coastal populations. The knowledge generated from this technology would enable local officials to make informed decisions on emerging algal blooms more quickly, better protecting coastal communities and industries. The system could revolutionize the discovery of emerging HAB, allowing aerosolized algae and toxins to be identified and quantified. This novel capability will empower future research into the impacts of aerosolized algal toxins on human health.