SBIR

Small Business Innovation Research Program

ABSTRACTS OF PHASE II 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), awarded 17 NOAA SBIR Phase II contracts for FY 2024, through the Small Business Innovation Research (SBIR) program.

In Phase II, funding is provided for projects that are most promising after Phase I is completed from the previous year. These awards are up to $650,000 each, totaling approximately $11M in FY 2024. The awards are for a two-year effort to continue the research and development of the innovative approach they proposed during the Phase I project. Abstracts of successful Phase II proposals and comments on their anticipated results are also provided in this publication.

Fiscal Year 2024 Phase II List of Awardees

Award Number	Company Name	Topic Number
NA24OARX021G0037	Anuma Aerospace, LLC	9.1
NA24OARX021G0038	Applied Ocean Sciences	9.3
NA24OARX021G0054	Climate Forecast Applications Network, LLC (CFAN)	9.1
NA24OARX021G0049	Connectsix LLC	9.2
NA24OARX021G0045	Ensemble Government Services, LLC	9.5
NA24OARX021G0035	Hydrosat Inc.	9.4
NA24OARX021G0044	Jaia Robotics, Inc.	9.6
NA24OARX021G0040	LineSpect LLC	9.2
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NA24OARX021G0036	Orbotic Systems Inc.	9.5
NA24OARX021G0039	Pacific Hybreed, Inc.	9.3
NA24OARX021G0053	Salient Predictions, Inc.	9.4
NA24OARX021G0060	Space Balloon Technologies Corp. Spaceloon DBA	9.6
NA24OARX021G0052	Space Environment Technologies (SpaceWX DBA)	9.5
NA24OARX021G0046	Transcend Engineering and Technology, LLC	9.4
NA24OARX021G0042	WaiHome LLC	9.2
NA24OARX021G0033	Viable Gear LLC	9.3

FY 2024 PHASE II AWARD WINNER

FIRM:	Anuma Aerospace, LLC 720 Pebblebrook Drive Raleigh, NC 27609
AWARD:	$649,977
PHONE:	919-229-9748
E-MAIL:	jamie.little@anumaaerospace.com
PRINCIPAL INVESTIGATOR (PI):	Jamie Delaney Little
TITLE OF PROJECT:	Persistently Elevated Gas-free Aerostatic Sensor Utility System (PEGASUS)
TOPIC NUMBER:	9.1

TECHNICAL ABSTRACT:

Anuma Aerospace is developing the Persistently-Elevated, Gas-free, Aerostatic Sensor Utility System (PEGASUS), which will work like a data buoy in the sky, continuously collecting and transmitting weather data from the marine atmospheric boundary layer (ABL) with the data being made available via application programming interface (API) on the (internet) cloud. This is being accomplished through using Anuma Aerospace's patented, Partial-Vacuum Lift (PVL) cell as the aerostatic lift component with onboard photovoltaic equipment and batteries to provide power to onboard systems, including weather data sensors, communications equipment, vacuum pump for buoyancy control, and a semi-autonomous control system. The main technical advantages of the PVL cell are the ability to vary aerostatic lift and therefore altitude by varying the internal pressure, the ability to maintain long-term persistence, and the elimination of expensive, non-renewable helium lifting gas. PEGASUS is intended to remain aloft for up to two years between maintenance intervals with the semi-autonomous control system navigating winds and air currents to remain within predefined boundaries within the marine ABL.

SUMMARY OF ANTICIPATED RESULTS:

In Phase II, we anticipate being able to develop, bench test, and field test all of the required electric and electronic subsystems for the successful operation of PEGASUS, as well as develop primary PVL cell component test articles and evaluate them for their strength and integrity under load.

One of the primary implications of an airborne weather sensor platform having long-duration persistence while continuously recording and transmitting high-quality weather data from the marine ABL is that the meteorological and climate science communities will have never-before-available marine ABL data for assimilation into meteorological and climate models. The wider implications will be the ability to launch a global PEGASUS network that will provide a wealth of atmospheric weather data at various altitudes in quantities and at costs not attainable with helium balloons or heavier-than-air, unmanned aerial systems (UASs).

Development of this system will allow Anuma Aerospace to tap into the more than $13 billion global weather information market, as well as proving out our patented PVL cell technology, which has applications in the broader lighter-than-air industry.

FY 2024 PHASE II AWARD WINNER

FIRM:	Applied Ocean Sciences 11006 Clara Barton Drive Fairfax Station, VA 22039
AWARD:	$650,000
PHONE:	503-290-4581
E-MAIL:	katie.verlinden@appliedoceansciences.com
PRINCIPAL INVESTIGATOR (PI):	Katie Verlinden
TITLE OF PROJECT:	A Visibility Risk Assessment Tool for Maritime Operations
TOPIC NUMBER:	9.3

TECHNICAL ABSTRACT:

Visibility is a critical factor in maritime operations, impacted by various atmospheric conditions such as fog, heavy drizzle, large waves and spray under strong wind conditions, and other obstructions. Operational numerical weather prediction (NWP) models traditionally consider temperature, moisture, and aerosol concentrations (if available), and may struggle to accurately forecast visibility. Reduced visibility conditions impact maritime operations via decreased speed and safety in movement of commercial fleets, and increased costs through poor fuel load planning, longer transits, and restrictions of harbor operations. Applied Ocean Sciences (AOS) proposes advanced visibility forecast methods by incorporating additional environmental fields and leveraging machine learning techniques for improved accuracy. Phase II will continue the development of our visibility risk assessment tool, which utilizes ensemble forecasts of environmental variables alongside enhanced visibility conditions and risk assessment codes. A shipping economics model will be expanded to explore, quantify, and communicate the impacts of reduced visibility on maritime operations. The products from this R&D will include discretized spatial risk maps accessible via a cloud-based API and a user-friendly web interface. These tools will provide valuable insights for more informed planning, decision-making, and navigation.

SUMMARY OF ANTICIPATED RESULTS:

The commercial market for a reduced visibility risk assessment tool for maritime operations covers everything from recreational boaters to the cruise line industry to large commercial shipping companies. For example, reduced visibility in the Gulf of Mexico costs the cruise line industry millions of dollars annually; across maritime industries, poor visibility conditions cause delays and losses of hundreds of millions of dollars. Improved visibility forecasts created during these efforts and incorporated into our risk assessment frameworks will aid in routing, fuel loading, and safety planning. Resultant risk assessment data will be accessible in multiple formats for customers to purchase to view and/or integrate into their platforms. Risk assessment data will be licensed through a front-end agnostic cloud-based API and web-based risk maps will be available via a subscription service. The combination of regularly updating maps and streaming data will make this risk assessment tool available to the broadest audience and have the largest impact on increasing maritime safety and commerce

FY 2024 PHASE II AWARD WINNER

FIRM:	Climate Forecast Applications Network, LLC (CFAN) 20 Woodchuck Ct Reno, NV 89519
AWARD:	$649,493
PHONE:	678-772-3118
E-MAIL:	vtoma@cfanclimate.com
PRINCIPAL INVESTIGATOR (PI):	VioletaToma
TITLE OF PROJECT:	Applying AI to forecasting compound extreme weather events
TOPIC NUMBER:	9.1

TECHNICAL ABSTRACT:

We propose a high-impact innovation for weather forecasting that integrates global ensemble weather forecasts with an AI-driven post-processing model of extreme weather indices (XtremeCast). This innovation will provide the basis for skillful probabilistic forecasts of compound extreme weather events at extended lead times, and the ability to identify weather phenomena not resolved by the global models. Our proposed calibration methods and extreme event modules are easily adapted to the new AI-based global models, whereby AI global model outputs drive AI-based extreme event models. The project addresses specific needs for increased resilience of electric utilities in the face of compound extreme weather/climate events, including risks from the increasing penetration of renewable energy. In addition to extreme weather from severe convective systems and hurricanes, the proposed solution will incorporate forecasts of heat/cold waves, wind and solar droughts, and impacts on natural gas generation efficiency to identify compound events with the potential to push energy systems beyond capacity. An advanced user interface dashboard based on Visual Analytics will support interactive visual analysis for more rapid and insightful analysis to support complex, rapidly evolving decision making and direct integration into client-side systems.

SUMMARY OF ANTICIPATED RESULTS:

CFAN's clients in the energy and insurance sectors have communicated the need for probabilistic forecasts of compound severe weather events with greater granularity and longer lead times than is currently produced by NOAA and other market providers. CFAN’s proposed innovation responds to this need and will improve electric utility companies’ ability to manage the impacts of extreme weather and create more resilient systems through improved load planning. CFAN’s solution will further support decision making in the broader energy sector, including natural gas trading and wind farm operators and investors. There are also potential applications in insurance, emergency management, logistics, transportation, and construction sectors. Advanced online decision support tools trained with data-driven and human insights will empower algorithms and experts to continue to learn from and validate each other – this feedback will support operational adaptation to extreme weather events in a changing climate.

FY 2024 PHASE II AWARD WINNER

FIRM:	Connectsix LLC 4707 140th Avenue North Suite 212 Clearwater, FL, 33762
AWARD:	$649,991
PHONE:	727-348-9935
E-MAIL:	scott@sayweather.com
PRINCIPAL INVESTIGATOR (PI):	Dr. Scott Samson
TITLE OF PROJECT:	Time-Gated Optical Aquatic Sensors (TGOAS)
TOPIC NUMBER:	9.2

TECHNICAL ABSTRACT:

There is a need for more capable and affordable means to measure optical properties and biological constituents of marine and freshwater environments through the depth of the water. These measures are crucial for estimating the abundance of organisms such as those producing harmful algal blooms (HABs). The proposed research and development efforts combine proven indirect Time-of-Flight (iTOF) optical detectors with nanosecond pulsed light sources, to produce new high-sensitivity, low-noise optical sensing capabilities that can measure time-synchronized photons within an asynchronous ambient light field that includes scattered light (noise). Fluorescence produced by phytoplankton at a distance from the sensor will be determined by the time-of-flight and spatial distribution of the received photons from source-to-target-to-detector. The iTOF sensors will use on-chip capture and accumulation of the desired signal and ambient light “snapshots”. On-chip nano-second scale time-gated accumulation will improve signal-to-noise as compared to conventional instruments, which use photodiodes and off-chip processing. Further, the proposed designs and algorithms add the capability to measure multiple optical parameters simultaneously, several meters away from the instrument. The project will build and test prototypes using two types of iTOF optical detectors and mature the core iTOF technology and systems to produce commercially available water sensing systems.

SUMMARY OF ANTICIPATED RESULTS:

The proposed Phase II effort will produce and demonstrate prototype iTOF-enabled sensors as the next generation of optical water sensing instruments. Phase I, R&D demonstrated iTOF-based underwater optical detectors can have better performance, enhanced measurement capability, and can be made with lower system complexity and cost compared to today’s commercially available instruments. This effort will mature to commercial availability in-situ fluorometer instruments that have a unique depth-ranging capability. It is expected that the iTOF approach will provide range-resolved optical properties of the water column well beyond the nominal 1 cm range typical of today’s instruments. These results will aid coastal monitoring and modeling efforts in the detection of harmful algal blooms.

FY 2024 PHASE II AWARD WINNER

FIRM:	Ensemble Government Services, LLC 4005 Buchanan Street Hyattsville, MD 20781
AWARD:	$650,000
PHONE:	303-974-8986
E-MAIL:	ogerland@mcontreras@ensembleconsultancy.com
PRINCIPAL INVESTIGATOR (PI):	Oliver Gerland
TITLE OF PROJECT:	Developing a Neutral Density Monitoring and Alert Service for satellite operators.
TOPIC NUMBER:	9.5

TECHNICAL ABSTRACT:

In Phase II, Ensemble plans to develop an analytics service with the output of NOAA's Whole Atmosphere Model-Ionosphere Plasmasphere Electrodynamics (WAM-IPE) model, making it more accessible and useful for satellite operators and space situational awareness (SSA) providers. This phase is focused on the demonstration and evaluation of commercial potential for improved SSA decision-making with five objectives: 1) Customization of Density Output: Development of API services for operators to input or select satellite trajectory data, enabling customized neutral density outputs. This includes saving input parameters and accessing data essential for orbit propagation and flight control; 2) Enhanced 48 Hour Forecasting: Incorporating the model's forecasting output for up to 48 hours lead time to aid operational planning; 3) Validation of Model Outputs: Rigorous comparison with industry standards and measurements to validate the model's accuracy and reliability in collaboration with SWx TREC; 4) Quantification of Output Uncertainty: Analyzing forecast variance to provide error margins and confidence intervals, enhancing the model's reliability for users; 5) User Interface Improvements: Upgrading the interface to ensure easy access to model forecasts, SSA insights, and uncertainty quantification through a dashboard and REST API. These steps aim to refine the model output into a more potent tool for the space industry, offering reliable insights for operational planning.

SUMMARY OF ANTICIPATED RESULTS:

With a world-class team including CU Boulder's SWx-TREC, Ensemble shall demonstrate the value of functionalized space weather data for commercial space services. The anticipated results include the development of tailored insights and improved operational decision-making based on the space weather driven operational environments faced by commercial satellite operators and space situational awareness providers (SSA). Additionally, the proposed validation against industry standards and measurements will foster greater confidence among users in WAM-IPE's capabilities. Finally, the enhanced user interface will facilitate easier access to model forecasts, space weather insights, and uncertainty quantification, improving the usability of the model for operational planning. The implications of this work include protecting orbital assets, reducing risks associated with space weather events, and increasing revenue for the commercial satellite industry. This research has many potential commercial applications and benefits.

FY 2024 PHASE II AWARD WINNER

FIRM:	Hydrosat Inc. 1250 Connecticut Ave NW, Suite 700-09 Washington, DC 20036
AWARD:	$647,940
PHONE:	323-540-4569
E-MAIL:	jfisher@hydrosat.com
PRINCIPAL INVESTIGATOR (PI):	Josh Fisher
TITLE OF PROJECT:	Hydrosat: Commercial Onramp of Next-Generation Satellite Thermal Data for Major Societal Impact
TOPIC NUMBER:	9.4

TECHNICAL ABSTRACT:

Hydrosat is producing the highest spatiotemporal resolution global satellite thermal infrared data in existence. The applications of such cutting-edge data are far-reaching with particular relevance to NOAA across areas of drought, agriculture, aquaculture, wildfire, and urban heat. Our Phase I project enabled us to scope the potential technical impacts of our data across these areas (e.g., uncertainty reductions, ability to detect extremes) in addition to charting the relevant commercial opportunities. In so doing, we generated high interest across these sectors culminating in letters of support, interest, and commitment for utilizing Hydrosat data and analytics in major institutional and societal applications. Here, we propose to build on the success and results of Phase I towards maturing the commercial onramp of Hydrosat products, specifically focusing on the commercial and governmental institutions that provided letters of commitment. Our Phase II project has three main objectives: 1) apply a design-centered approach to map user/customer data requirements and decision-making; 2) develop the data and product creation and delivery mechanisms to meet those requirements; and, 3) evaluate the utility of our products to our customers through a quantitative impact assessment leading to the establishment of formal commercial relationships for long-term business.

SUMMARY OF ANTICIPATED RESULTS:

Our Phase I results demonstrated that Hydrosat has significant potential to improve uncertainties and hotspot detections—key to management and commercial operations—across all five focus areas: drought, agriculture, aquaculture, wildfire, and urban heat. For example, Hydrosat detects crop stress anomalies > four days before any other existing thermal product, and > ten days earlier than VNIR data for drought detection; this is critical for irrigation management and agricultural production, especially commercial differentiation. Commercially, we identified the greatest market opportunities in the agricultural sector: there is simultaneously massive market value ($5T/y) and large gains to be made through technology (49% yield increases). Consequently, our letters of commitment focus on the agricultural sector across both industry and government. Hydrosat signed a NDA with the US Department of Agriculture, who provided a strong letter of commitment in addition to a budget line for commercial satellite thermal data purchase ($500K/y). Companies such as 4EI and Suzano have started using Hydrosat test products. We expect to work closely with these partners and more in Phase II, delivering data that meet their requirements. We will assess the impact that we have on their own deliverables, and formalize contractual relations for sustainable growth and operations.

FY 2024 PHASE II AWARD WINNER

FIRM:	Jaia Robotics, Inc. 22 Burnside St, Ste 203 Bristol, RI 02809
AWARD:	$649,980
PHONE:	401-835-0411
E-MAIL:	ian@jaia.tech
PRINCIPAL INVESTIGATOR (PI):	Ian Estaphan Owen
TITLE OF PROJECT:	Sea Air Boundary Energy Transfer Measurements Using Micro-Sized UxVs
TOPIC NUMBER:	9.6

TECHNICAL ABSTRACT:

The project team will design and build a prototype, JaiaBot - STORM, which is air-deployable to collect atmospheric data from the launch point (3048 m) to the sea surface collecting wind speed, humidity, and temperature data, and then collect upper ocean data including temperature and salinity to depth and surface current vectors and wave heights. The data collected will be communicated wirelessly via satellite comms for use by agencies such as the National Weather Service to aid the prediction of storm entities and direction of travel. Deploying multiple JaiaBots to form a picket line along the forecasted hurricane track in front of the approaching tropical storm boundary will provide researchers with the data needed to visualize the spatial variability of ocean features and energy transfer over a wide area and the impacts of freshwater ocean layers on temperature transfer as the storm intensity increases. Five JaiaBot prototypes will be produced to support verification and validation of the design, including air launch demonstration, water entry survivability, atmospheric and aquatic data collection. Jaia will prepare for a launch from a NOAA aircraft working with the team at the Aircraft Operations Center (AOC).

SUMMARY OF ANTICIPATED RESULTS:

Five JaiaBot prototypes will be produced. Jaia will prepare for a launch from a NOAA aircraft working with the team at the Aircraft Operations Center (AOC) to validate the design, including air launch demonstration, water entry survivability, atmospheric and aquatic data collection. Prospective Jaia customers have provided positive feedback on the utility of an air launchable JaiaBot. The UK MET Office, ESSO - Indian National Centre for Ocean Information Services, and Australia's Bureau of Meteorology (BoM) value similar ocean/atmospheric data. In addition, the US DOD is mandated to define and apply the environment, from the bottom of the ocean to the stars, to ensure the U.S. Navy has the freedom of action to deter aggression, maintain freedom of the seas and win wars. NAVO, Jaia's biggest single customer, supports air launching Jaia Bots to collect data. The USMC has a stated desire to airdrop JaiaBots for Battlespace Shaping, Littoral Maneuver and ISR collection operations. There are opportunities for adoption worldwide with militaries and security / defense forces. The JaiaBot's open-source software and modularity enables new sensors to be easily integrated and behaviors configured to solve many different problems for a wide range of customers, domestically and overseas.

FY 2024 PHASE II AWARD WINNER

FIRM:	LineSpect LLC 100 Shoreline Hwy, Suite B275 Mill Valley, CA 94941
AWARD:	$650,000
PHONE:	408-647-4751
E-MAIL:	ikevc@linespect.com
PRINCIPAL INVESTIGATOR (PI):	Izak van Cruyningen
TITLE OF PROJECT:	HABCamera Harmful Algal Bloom Predictor
TOPIC NUMBER:	9.2

TECHNICAL ABSTRACT:

Harmful Algal Blooms (HAB) negatively impact the environment, fisheries, and health of waterfront communities. The earlier a potential bloom is detected, the more time there is to plan and execute a response, the smaller the remedial action required, and the less the expense and environmental impact. HABCamera is an artificial intelligence-enhanced combination of light sources, lenses, cameras, and sensors. It measures photosynthetic pigments and observes morphology to automatically identify and count HAB specimens in any water source. Environmental sensors for nutrients, temperature, light, and other growth variables provide a complete solution for the earliest possible prediction of bloom risk. The product is unique in taking in-situ multispectral images and analyzing them in real time. It brings the lab to the field in a compact form that scientists can deploy on moorings or autonomous underwater vehicles for constant monitoring.

SUMMARY OF ANTICIPATED RESULTS:

LineSpect anticipates producing a novel product that 1) predicts HAB bloom potential a week earlier than any other approach, 2) automates specimen counting to relieve the tedious practice of manual counting, 3) does not disturb the interactions between phytoplankton, zooplankton, and other components of the pelagic environment in their natural state, and 4) reduces cost to allow deployment of numerous instruments to increase spatial density of measurements. The HABCamera will provide earlier, more accurate, cost-effective HAB predictions. Adapting the flexible optics and retraining the core AI technology could also address numerous other environmental issues. These include detecting and quantifying ocean microplastics, detecting bacteria producing off-flavors in catfish farms, optimizing algae production, confirming wastewater treatment, testing water quality, and enhancing aquatic research.

FY 2024 PHASE II AWARD WINNER

FIRM:	NeXolve Holding Company 290 Dunlop Blvd SW Building 200 Huntsville, AL 35824
AWARD:	$649,967
PHONE:	256-836-7782
E-MAIL:	brandon.farmer@nexolve.com
PRINCIPAL INVESTIGATOR (PI):	Brandon Farmer
TITLE OF PROJECT:	Active Material Technology to Improve Solar Sail Performance for Space Weather Monitoring
TOPIC NUMBER:	9.5

TECHNICAL ABSTRACT:

Development of a reflectivity control and direction device (RCDD) is proposed. This innovative device will progress the state of the art for propulsion of solar sails used to fly space weather monitoring sensors for earlier warning times of destructive space weather events. A reflectivity control device (RCD) utilizes polymer dispersed liquid crystal (PDLC) material encapsulated between thin layers of clear polyimide film to create a material that can switch between opaque and transparent by applying an electrical voltage across the material. This RCD will be integrated with a flexible membrane diffraction grating that will change the direction of the incident light transmitted through the RCD.

SUMMARY OF ANTICIPATED RESULTS:

With this innovation, the device becomes an RCDD with the ability to produce forces on the sail in the sail out-of-plane and in-plane directions. This ability to produce in-plane and out-of-plane force means that the device can be used to support full six-degree-of-freedom (6DOF) control of the spacecraft compared to the RCD which has no roll control authority. This innovation will eliminate the need for heavy and complex opto-mechanical devices currently used for 6DOF sailcraft control. The resulting lighter weight of the sailcraft will allow for improved warning time for adverse space weather events.

FY 2024 PHASE II AWARD WINNER

FIRM:	Orbotic Systems Inc. 275 E Hillcrest Drive Thousand Oaks, CA 91360
AWARD:	$650,000
PHONE:	805-200-6888
E-MAIL:	admin@orboticsystems.com
PRINCIPAL INVESTIGATOR (PI):	Erik T. Long
TITLE OF PROJECT:	In-Situ Space Weather Analysis
TOPIC NUMBER:	9.5

TECHNICAL ABSTRACT:

The goal of this Phase 2 SBIR is for Orbotic Systems to continue the work in the Phase 1 SBIR. The result is an instrument capable of generating in-situ, global, ionospheric-thermospheric neutral density and wind ion data on a near real-time basis. Orbotic Systems is developing an instrument called WIND (Wind Ion Neutral Density) which will be finalized in Phase 2. This proposal leverages Technology Readiness Level (TRL) 7 and 8 hardware and software as the basis to develop a new generation of space-based space weather observation remote sensors inside of a CubeSat platform. As fully described in this proposal's Technical Content section, the WIND instrument builds on the earlier success of the space-qualified WINCS instrument (Wind Ion Neutral Composition Suite), flown on the following missions: GPIM, STPSat-3, SENSE (CubeSat), Politech.1 (CubeSat), CADRE (CubeSat). Recent Orbotic Systems discussions with NOAA's Space Weather Prediction Center (SWPC) show that there is a clear need to generate global atmospheric neutral density data on a real-time basis in the 200 km to 700 km altitude range. Orbotic Systems is responsive to this need and has identified a means to obtain in situ density readings to assist NOAA and the private sector in space weather forecasting efforts.

SUMMARY OF ANTICIPATED RESULTS:

In-Situ Space Weather Analysis is a low-cost solution that will enhance spacecraft orbit analysis and mitigate space debris risk thereby increasing mission success, reducing the threat of collisions, and protecting assets in space. Our WIND instrument will also provide data for SWPC to validate their models and other data-assimilation thermospheric models.

FY 2024 PHASE II AWARD WINNER

FIRM:	Pacific Hybreed, Inc. 10610 NE Manitou Park Blvd Bainbridge Island, WA 98110
AWARD:	$612,589
PHONE:	626-241-5325
E-MAIL:	francis@pacifichybreed.com
PRINCIPAL INVESTIGATOR (PI):	Francis Pan
TITLE OF PROJECT:	Production of high-yielding Manila clam seed through family-based breeding and polyploidy selection
TOPIC NUMBER:	9.3

TECHNICAL ABSTRACT:

Aquaculture of marine bivalves is a sustainable food system that provides high-quality animal protein while supporting the coastal environment. The U.S. is a top producer of the Manila clam (Ruditapes philippinarum). The production of clams, however, has largely relied on seeds from wild broodstock and natural recruitment, leaving the industry vulnerable to ocean change. We propose to develop a breeding program for Manila clams taking advantage of superior performances of female, triploid clams. In Phase I, we tested the feasibility of producing pair-mated families and identifying sex-ratios in embryos. Twenty-six distinct families were produced and grown to the seed stage and are in on-farm trials to determine the relationship between yields and sex-ratios between families. In the Phase II effort, we propose to produce female-biased triploid clams by (1) screening 200 pair-crosses for female-biased families; (2) identifying sex-ratios in embryos as a biomarker for better yield potentials; (3) inducing triploidy in high-yielding families; (4) conducting on-farm trials to evaluate yield for different crosses. The research will engage shellfish growers through direct participation in on-farm trials, enable commercialization of high-yielding seed clams, and pave the way for a long-term breeding program for the species for the U.S. shellfish aquaculture industry.

SUMMARY OF ANTICIPATED RESULTS:

Breeding programs for Manila clams are urgently needed for the shellfish aquaculture industry on the U.S. West Coast where the Manila clam is the second largest crop by volume behind the Pacific oyster. In Phase II, we anticipate developing family lines of Manila clams that have improved farm yields compared with generic seed, resulting from combining increased growth rates in female clams with superior production characteristics of triploids. On-farm trials are expected to demonstrate the higher yield and further refine improvement by incorporation of farm conditions and desired traits. The experimental approach is based on systematic separation of phenotypic variation in growth, survival, and sex-ratio into different clam families. We will use a known biomarker feasible for identifying sex-ratios in embryos and a genomic DNA staining procedure for checking ploidy in larvae for early screening for families with higher growth potentials. Improved seed clams from this proposed research could increase the farm yield by 30% in a single generation and will directly benefit shellfish growers through sales channels that Pacific Hybreed has developed. Improved broodstock will be made available to commercial hatcheries through partnerships for larger-scale production to reach more farms and boost locally produced seafood in the U.S.

FY 2024 PHASE II AWARD WINNER

FIRM:	Salient Predictions, Inc. 39 Gull Rd Falmouth, MA 02540
AWARD:	$649,935
PHONE:	508-566-1231
E-MAIL:	rschmitt@salientpredictions.com
PRINCIPAL INVESTIGATOR (PI):	Ray Schmitt
TITLE OF PROJECT:	Machine learning and ocean variables for improved predictions of water availability in the US
TOPIC NUMBER:	9.4

TECHNICAL ABSTRACT:

Salient proposes to develop technology for accurate subseasonal to seasonal (S2S) water availability forecasts so that communities may manage water resources in preparation for hazardous events like floods and droughts. Hydrological models face challenges related to data inputs, as climate change has been presenting weather patterns atypical from historical data. Without quality data inputs, the accuracy of the output from hydrological models suffers. To overcome these challenges, Salient proposes to use improved S2S forecasts as the weather input to Variable Infiltration Capacity (VIC) hydrological forecasts, thus providing improved water availability forecasts on the S2S timeframe. Salient's base S2S forecast technology uses machine learning and various oceanic, atmospheric, and land-based variables to make improved predictions of weather up to a year in advance. In Phase I, Salient developed a predictive hydrologic model for soil moisture and river flow by combining its weather forecasts with the VIC hydrologic model for the Central Valley of California. Phase II will address challenges related to 1) Downscaling Salient's forecasts for utilization as an input to the VIC model for improved soil moisture predictions, and 2) Improving scalability to make the deployment and execution of VIC hydrological models for the continental United States feasible.

SUMMARY OF ANTICIPATED RESULTS:

Successful completion of the proposed work will create a more efficient, scalable, and accurate version of the Phase I model and improve S2S forecast variables so that distributed hydrological models can more accurately forecast at the 2–52-week horizon for a variety of commercial applications. Many markets depend on water availability to thrive, including agriculture, energy, supply chain and logistics, disaster risk management, and the carbon market. At local scales, decision-makers depend on models like VIC to make strategic decisions based on hydrological responses to resource use. At present, the current VIC model does not account for human impacts from climate change, which directly affect water availability. Salient's S2S weather insights (currently available) and water insights (in development via this funding) help enterprise customers optimize performance, mitigate risk, improve resiliency, and plan initiatives up to a year in advance. Combining Salient's current technology with VIC will result in more useful hydrological models and water availability forecasts.

FY 2024 PHASE II AWARD WINNER

FIRM:	Space Balloon Technologies Corp. Spaceloon DBA 1, Aerospace Boulevard, MicaPlex Suite 210 Daytona Beach, FL 32114
AWARD:	$649,994
PHONE:	305-613-6709
E-MAIL:	pradeep.shinde@spaceloon.com
PRINCIPAL INVESTIGATOR (PI):	Pradeep Shinde
TITLE OF PROJECT:	Bi-directional Platform for data collection up to the Mesosphere
TOPIC NUMBER:	9.6

TECHNICAL ABSTRACT:

SpaceLoon is developing a novel Controlled Altitude Ballooning (CAB) platform to perform bi-directional sampling across multiple atmospheric layers, from the troposphere to the mesosphere. To date, state-of-the-art high-altitude platforms are limited to the stratosphere. National Weather Service (NWS), twice a day, globally uses unidirectional radiosonde and rawinsonde platforms for recording weather observations, creating a void in atmospheric observations on a daily time scale and at altitude scale. With five times increased observation at two times higher altitudes, CAB will enable new climate observing and monitoring capabilities and dramatically improve forecast modeling. SpaceLoon's patent-pending CAB technology is a hardware and software combination that alters and controls the balloon size within its burst limits, enabling the balloon's expansion and contraction multiple times in a single flight. CAB facilitates controlled ascent and descent throughout the atmosphere from the ground to the mesosphere. As opposed to conventional assumptions, the ascent rate changes with altitude and is correlated with the energy state and power management of the balloon. In Phase-I, we achieved CAB's control alteration capability for flight ascent profile, collecting atmospheric dynamic and thermodynamic measurements. In Phase-II, we will achieve control descent capability with flight recovery and perform mesospheric (>50 km) test flights.

SUMMARY OF ANTICIPATED RESULTS:

The proposed Phase-II research will result in a market-ready operational platform for novel measurement capabilities from the ground to the mesosphere above 50 km. Phase-II activities will build on the laboratory and field testing conducted in Phase-I, maturing our technology to be highly reliable and fully recoverable. Toward the end of PhaseII, we anticipate CAB carrying a payload of more than 3 kg. In a typical use scenario, the balloon will follow a defined profile during flight transport. The attached payload will collect the atmospheric observations along the flight path, and then completing the profile will bring the payload back to the ground. CAB will follow the profile pattern by performing controlled ascent to altitudes of more than 50 km followed by altitude descent of more than 10 km in one cycle. We anticipate CAB will perform three such cycles of controlled ascent and descent in a single flight and then, with complete control descent, bring down the attached payload to the ground safely. We anticipate the flights will be fully recoverable and retrievable.

FY 2024 PHASE II AWARD WINNER

FIRM:	Space Environment Technologies (SpaceWX DBA) 528 Palisades Dr. Ste 164 Pacific Palisades, CA 90272
AWARD:	$650,000
PHONE:	310-699-1477
E-MAIL:	ktobiska@spacewx.com
PRINCIPAL INVESTIGATOR (PI):	Kent Tobiska
TITLE OF PROJECT:	Nitric Oxide Measurements to improve Atmospheric Densities (NOMAD)
TOPIC NUMBER:	9.5

TECHNICAL ABSTRACT:

The Earth's upper atmosphere varies on spatial and temporal scales and this variation can have adverse effects on operational systems. To reduce the risks from uncertainties in these systems, we are building, testing, and demonstrating an instrument that will provide information about the state of the atmosphere during and after large geomagnetic storms. Our sensor, called NOMAD, will remotely observe nitric oxide (NO) that is a minor species produced during storms. NO leads to efficient cooling and collapse of the atmosphere, thus reducing densities that affect debris collision assessment. This work builds a sensor to observe NO and will be hosted on a stratospheric drone at 20 km for continuous monitoring for extended periods. We will finalize our design, develop, and test NOMAD in Phase II, integrate it into ARGOS, and develop/test the data collection/processing system. Three units will be integrated into our ARGOS aircraft with three viewing angles to observe NO dynamics in a 200–300 km region above ARGOS. This work expands observational tools that support short- and long-term space weather predictions and will provide decision makers with improved characterization and prediction of the timing, intensity, and impact of storm space weather events on critical infrastructure.

SUMMARY OF ANTICIPATED RESULTS:

For a fraction of satellite deployment and operations cost and for better temporal and spatial resolution, agency operators of space traffic management systems will be able to significantly increase their current epoch and forecast accuracy of thermospheric densities to reduce the hazard from debris collisions. NOMAD will directly support NOAA's mission to develop a space traffic management system through the Office of Space Commerce Traffic Coordination System for Space program. The TraCSS program will use data assimilative modeling to produce improved weather of thermosphere densities. This work will provide a NO sensor on a high-altitude UAV platform for the purpose of creating a 24/7 operational data stream of remotely sensed lower thermospheric NO. The NO above ARGOS is produced during and after geomagnetic storms and the observations of it can feed thermospheric density models.

FY 2024 PHASE II AWARD WINNER

FIRM:	Transcend Engineering and Technology, LLC 768 S Main St Unit 2 Bethel, VT 05032
AWARD:	$649,991
PHONE:	802-788-4154
E-MAIL:	sfarrington@transcendengineering.com
PRINCIPAL INVESTIGATOR (PI):	Stephen Farrington
TITLE OF PROJECT:	Increasing Water Use Efficiency by Addressing Sensor Cost Barriers Using Novel Technology
TOPIC NUMBER:	9.4

TECHNICAL ABSTRACT:

The project objective is to greatly reduce the cost of monitoring soil water content in a highly resolved vertical profile to promote increased adoption of more efficient water management tools. Cost is the most significant barrier to adoption of sophisticated data-driven irrigation management in permanent agriculture. Highly resolved vertical soil water profiles are needed to learn soil-specific hydraulic response and to accurately infer crop water uptake and deep drainage fluxes from monitored changes in the storage profile. Basing irrigation decisions on the time-varying soil hydraulic behavior learned in situ will enable the improvement of water and energy conservation, resource protection, and adaptability to climate change. The massive proliferation of wireless accessories has driven the cost of integrated circuit (IC) based programmable RF transceivers unprecedentedly low and usability unprecedentedly high. We propose to repurpose low-cost RF chips as soil water sensing devices arranged in a dense linear profile for high resolution vertical water content profiling. Electromagnetic waves transmitted through a material are affected by the dielectric permittivity of the material. Preliminary work has demonstrated a relationship between signal strength and permittivity of the surrounding material which is a strong indicator of soil water content. The new multi-level sensor will replace and improve on significantly more expensive multilevel soil moisture technologies currently on the market. Applying a machine intelligence (MI) we have developed, this and other multi-level sensors can accurately determine root uptake and deep drainage which form the basis for a sophisticated irrigation decision support system offered by our precision ag commercialization partner.

SUMMARY OF ANTICIPATED RESULTS:

The new soil water observation tool we propose directly addresses NOAA's Societal Challenge 9.4 by supporting increased efficiencies in water usage in the agriculture sector. The project objective is to overcome the most significant barrier to adoption of sophisticated data-driven irrigation management in permanent agriculture. The result will be unprecedented efficiency in the management and conservation of water used in irrigated agriculture, with concomitant benefits for soil health and groundwater quality.

FY 2024 PHASE II AWARD WINNER

FIRM:	WaiHome LLC 59-477 Hoalike Road Haleiwa, HI 96712
AWARD:	$650,000
PHONE:	808-979-6941
E-MAIL:	james@waihome.com
PRINCIPAL INVESTIGATOR (PI):	James Roberts
TITLE OF PROJECT:	Affordable Wastewater Disposal for Coastal Households Adapting to Sea Level Rise
TOPIC NUMBER:	9.2

TECHNICAL ABSTRACT:

Rising sea levels and king tide flooding in coastal areas across America are saturating onsite wastewater disposal systems (OSDS), resulting in the degradation of coastal ecosystems and 200,000+ illnesses annually. Many States are mandating system upgrades, with 88,000 upgrades required by 2050 in Hawaii alone. Unfortunately, existing upgrade options are unaffordable for 97% of Hawaiian homeowners and offer poor performance for coastal properties with high groundwater levels. In response to this pressing issue that will cost Hawaiian homeowners an estimated $1.75B between now and 2050, WaiHome LLC is developing an aboveground and affordable wastewater disposal system for coastal households adapting to sea level rise. Under this Phase II SBIR project, WaiHome will test the comparative performance of its RAIL proof-of concept prototype developed in Phase I relative to conventional absorption bed disposal in the six dominant soil texture groups in Hawaii. WaiHome will also investigate opportunities to refine its prototype design in preparation for commercial manufacturing and installation. Phase II research will culminate in a Design Validation Testing program that will see the installation and monitoring of demonstration units on three residential properties and one city wastewater treatment plant. This program is consistent with standard permitting pathways for new disposal products.

SUMMARY OF ANTICIPATED RESULTS:

This Phase II project will deliver a minimum viable product with design specifications, bill of materials, commercial manufacturing plan, and maintenance guidelines. Installation guidelines and recommended loading rates will be developed for six soil texture groups dominant in Hawaii. Performance relative to conventional gravel-based and leaching chamber absorption bed designs will be established to further inform the development of system loading standards. It is anticipated that by eliminating the groundwater infiltration and disturbances to the soil-water interface inherent to excavations, the RAIL will demonstrate reduced saturation of the soil-water interface and thereby reduced propensity for clogging. The results of this project will be presented to the Hawaii Department of Health (DOH) as WaiHome begins the process of entering design standards for the RAIL into the Hawaii Administrative Rules. The RAIL will cut the cost of disposal system installation in Hawaii by more than half and make new OSDS accessible for the 97% of Hawaiian cesspool owners who currently can’t afford to comply with the statewide upgrade mandate.

FY 2024 PHASE II AWARD WINNER

FIRM:	Viable Gear LLC 66 Parsons Rd. Portland, ME 04103
AWARD:	$650,000
PHONE:	207-975-2595
E-MAIL:	katie@viablegearco.com
PRINCIPAL INVESTIGATOR (PI):	Katie Weiler
TITLE OF PROJECT:	Manufacturing an innovative seaweed-based bioplastic to replace petroleum-based plastic used in fishing and aquaculture gear.
TOPIC NUMBER:	9.3

TECHNICAL ABSTRACT:

Viable Gear, LLC's (VG) Phase I delivered proof-of-concept prototype twine with innovative seaweed based bioplastic material technology. The Viable Gear team will further develop its prototype in Phase II, preparing to bring its first product to market: a marine degradable biotwine used for seed string in seaweed nurseries. This biotwine is intended to replace the petroleum-based nylon string that most seaweed nurseries use today, and to replace nylon tubular mesh used in fishing gear like lobster and crab bait bags. When plastic fishing and aquaculture gear is lost or discarded at sea, it persists for indefinite periods of time, slowly breaking down into smaller pieces, and continuing to catch and kill marine life longer after its intended use by ocean harvesters, a phenomenon otherwise known as ghost fishing. In fact, this ghost gear from the fishing and aquaculture industries constitutes the majority of the macroplastics floating in the ocean (Lebreton et al., 2022). These macroplastics contribute to injury and death of marine species via entanglement and ingestion as they break down further into smaller fragments – micro- and nanoplastics - and can also render toxic health effects for humans through the consumption of seafood. The proposed project addresses NOAA-SBIR research topic area 9.3 The Changing Oceans; particularly to, "Support increased protection and restoration of marine and coastal habitats to enhance vital ecosystems" and "Facilitate sustainable and productive aquaculture practices and facilities" (NOAA, 2023). In Phase II, Viable Gear will continue the development of its material technology to refine its prototype biotwine, including mechanical, thermal, and ocean testing for future use cases. It will also identify the appropriate equipment, manufacturing machinery, and partners needed to commercialize and scale this material technology.

SUMMARY OF ANTICIPATED RESULTS:

Phase II will deliver a minimum viable product (MVP) from Viable Gear's seaweed-based bioplastic material technology for a seeding biotwine for use in seaweed nurseries. Seeding twines – "seed string" - are commonly used as substrata for seeding, allowing growers to seed in high densities and then efficiently transplant the growing juvenile seaweed to sea farms. Once successfully commercialized, adoption of VG's biotwine by seaweed nurseries and farmers will eliminate the possibility of lost or discarded seed string resulting in marine mammal entanglement or plastic pollution as it is designed to be marine degradable. Furthermore, the circularity of using seaweed to create a product used to grow more seaweed reduces the environmental footprint of the seaweed industry while amplifying the ecosystem and social benefits of the practice.