ARCTIC DOMAIN
AWARENESS CENTER
A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

ADAC Information Brief to DoD Arctic S&T Synchronization Workshop

A presentation by

Arctic Domain Awareness Center
University of Alaska Executive Director

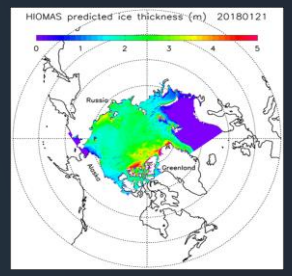
Advancing Arctic Domain Awareness…
In Support of the Arctic Operator

- It begins with: "What keeps the Commanders up at night?"
- The Arctic…impacts of time and distance!
- Few resources…smart investments!
- Information and awareness to support and potentially…drive operations.
- Solutions need to be reliable, reduce risk and increase decision precision.

Photo from Wikipedia

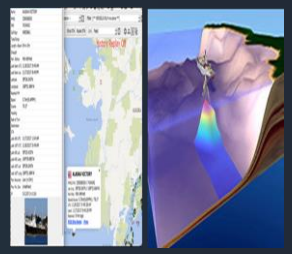
University of Alaska's Arctic Domain Awareness Center

ADAC is hosted by the University of Alaska, with work conducted at UA campuses in Anchorage and Fairbanks…and conducts research across a growing network of academic and industry partners.



Vision: The U.S. Department of Homeland Security Center of Excellence (DHS), providing networked and mission-focused support to the U.S. Coast Guard Operator in the High North.

Mission: To develop and transition technology solutions, innovative products and educational programs to improve situational awareness and crisis response capabilities related to maritime challenges posed by the dynamic Arctic environment.

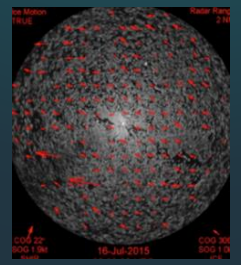


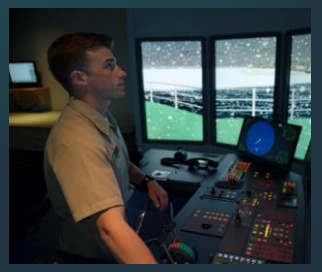
Strategy: Advance knowledge in relevant science and technology through conducting research and development in close collaboration with mission agencies' end users.

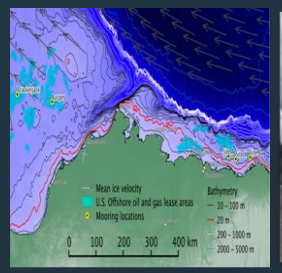
The Center also develops future leaders for the DHS enterprise through structured education programs.

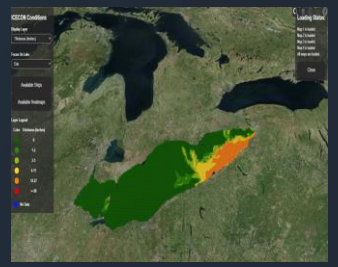
ADAC's principal customer: U.S. Coast Guard…in support of their Arctic search & rescue, disaster response, law enforcement and assistance missions.

ADAC works with an array of International, federal, state, local, tribal, industry and academic partners to advance domain awareness of the Arctic region.









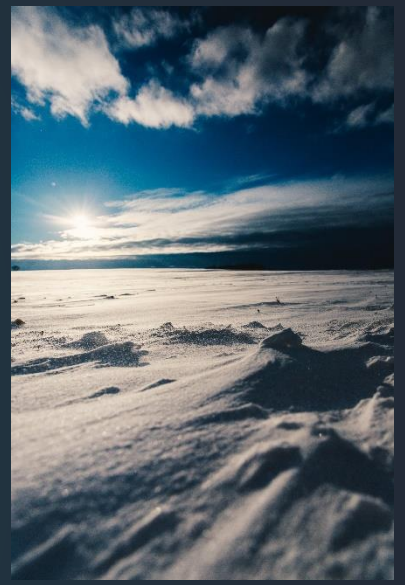
ADAC: Research for the Arctic Operator… For Today and For the Future

UNIVERSITY of ALASKA
Many Traditions One Alaska

ARCTIC DOMAIN AWARENESS CENTER
A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

In brief…ADAC activities include/have included:

- Autonomously controlled underwater and under-ice platforms for environmental sensing (in particular, oil spill characterization).
- Arctic Environmental modelling (with increasing fine scale):
  - Arctic oil spills.
  - Arctic Ocean, Sea-ice presence, thickness, movement and ridging.
  - Western Alaska coastal surge and flooding.
- Operator decision support tools.
  - Ice Conditions Index for Great Lakes mariners and soon for Bering, Chukchi and Beaufort Seas.
  - Sea-Ice and Weather Forecasting Tools to Improve Arctic Situational Awareness & Crisis Response.
  - Using Vessel Tracking Data to Prioritize Bathymetric Surveying in a Rapidly Changing Arctic.
- Support research to improve Arctic communications and other technologies.
  - Evaluation of Potential U.S. Coast Guard Use of Cube Satellites.
  - Low cost sensors for Arctic monitoring.
  - Maritime Domain Awareness and environmental factors information fusion.
  - Smart Camera Research in Arctic maritime regions.
- Research of suitability of High Fidelity Observers to support USCG information needs in Arctic waters/shorelines.
- Create and conduct workshops that advance research needs or targeted knowledge products for Arctic, Science and Technology, Future Strategy, and Arctic Security/Environmental Security.
- Develop the next generation for the Homeland Security Enterprise.



Thinking about “needed capabilities” for the Arctic…

What’s needed?

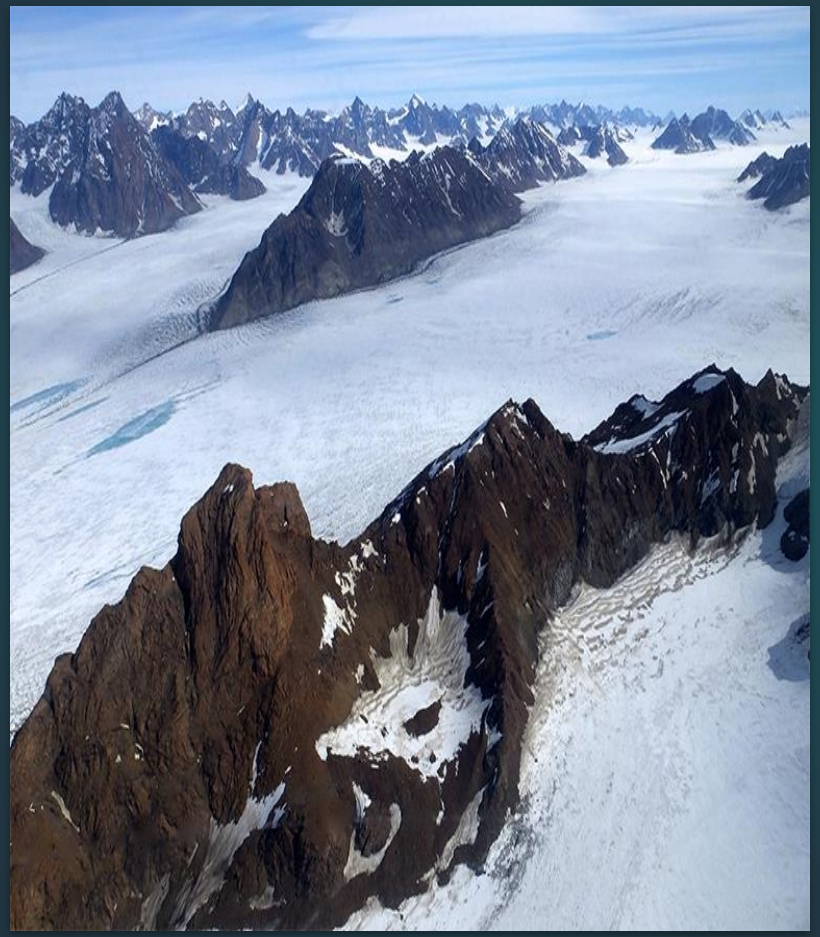
- Increased Domain Awareness across the Arctic.
- Improved ability to operate and communicate (and technologies that reduce risks to the operator).
- Smart infrastructure investments to enable “right sized” security presence to serve and protect…and secure U.S. Sovereign territory.
- Presence and ability to patrol and enforce U.S. laws across the U.S. Extended Economic Zone.
- Ability to know the hazards beneath the waves as marine traffic increases.
- Ability to protect ports and infrastructure investments in light of physical/environmental changes.
- Improved ability to respond to search and rescue, humanitarian assistance and disaster response…from small to large scale.

Understanding Drivers…Diminishing Sea Ice = The Arctic Catalyst

- Impact: Reduced Seasonal Barrier

  Allowing for increased human activity at lower threshold costs

  Yet, an even more Complex and Difficult Physical Environment



http://climate.nasa.gov

https://nsidc.org/cryosphere/seaice/index.html

"So, What is Domain Awareness?" (from a physical environment perspective)

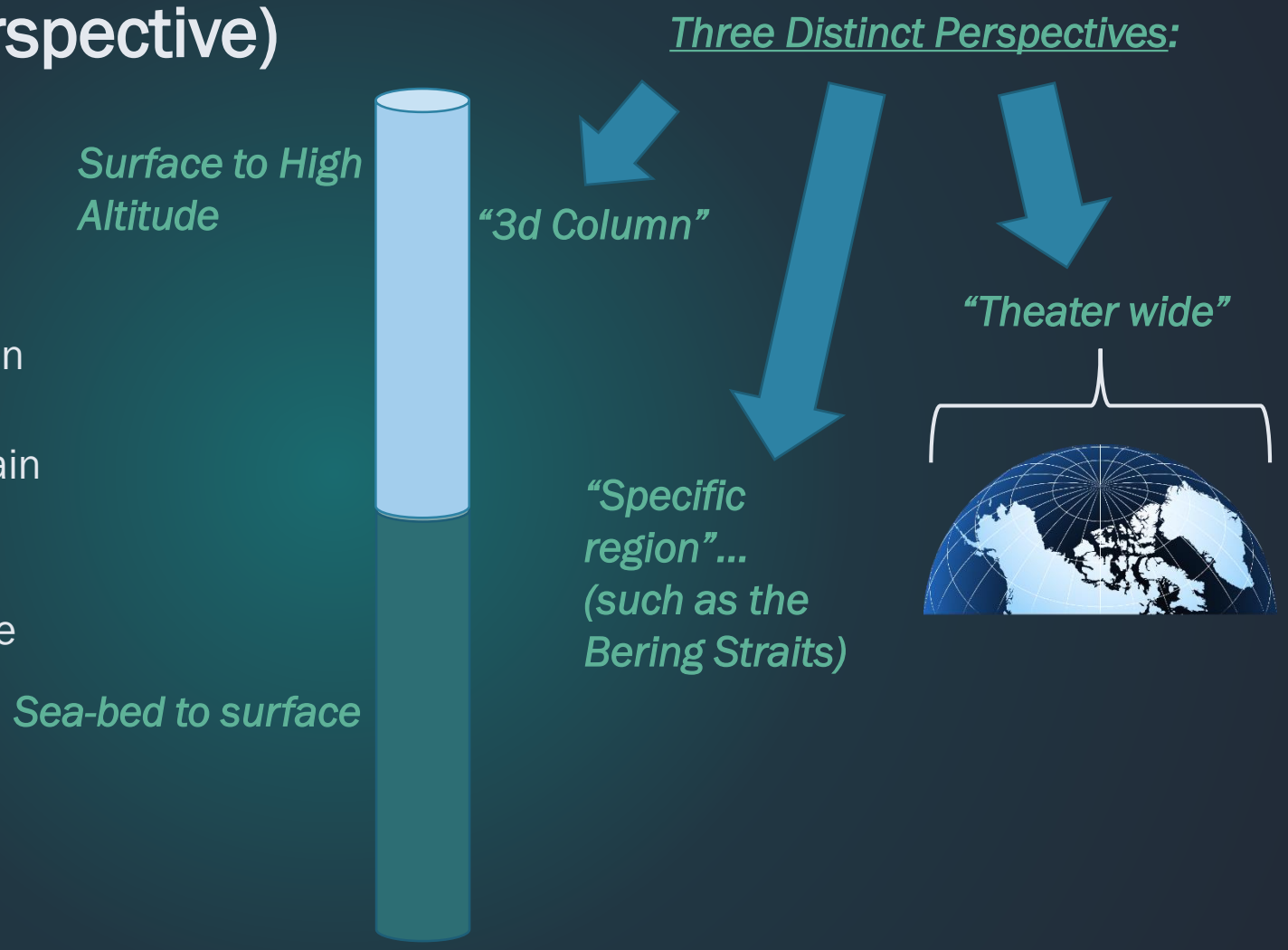
ADAC: is a Center of Maritime Research…focused to advance domain awareness…ultimately to Pan-Arctic

One illustration…a basic algebra equation of environmental factors:

a + b + c +…, etc. = "Approximate" Domain Awareness

Note…each environmental factor variable is changing, at an increasingly dynamic rate

…all across the High North!



How can researchers best help the Arctic operator?

Understand…it's about increasing mission success and reducing operator risk.

Let operators drive.

Listen and apply.

Partner and collaborate.

Seek a balanced research portfolio.

Think in both near and long term.

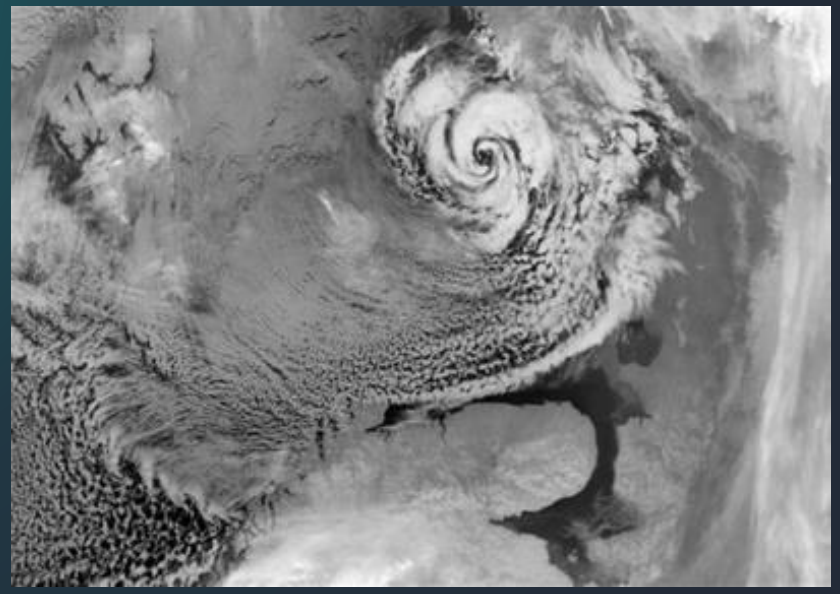
Integrate human factors and social science into S&T.

Seek to adapt to the Arctic that is presenting itself.

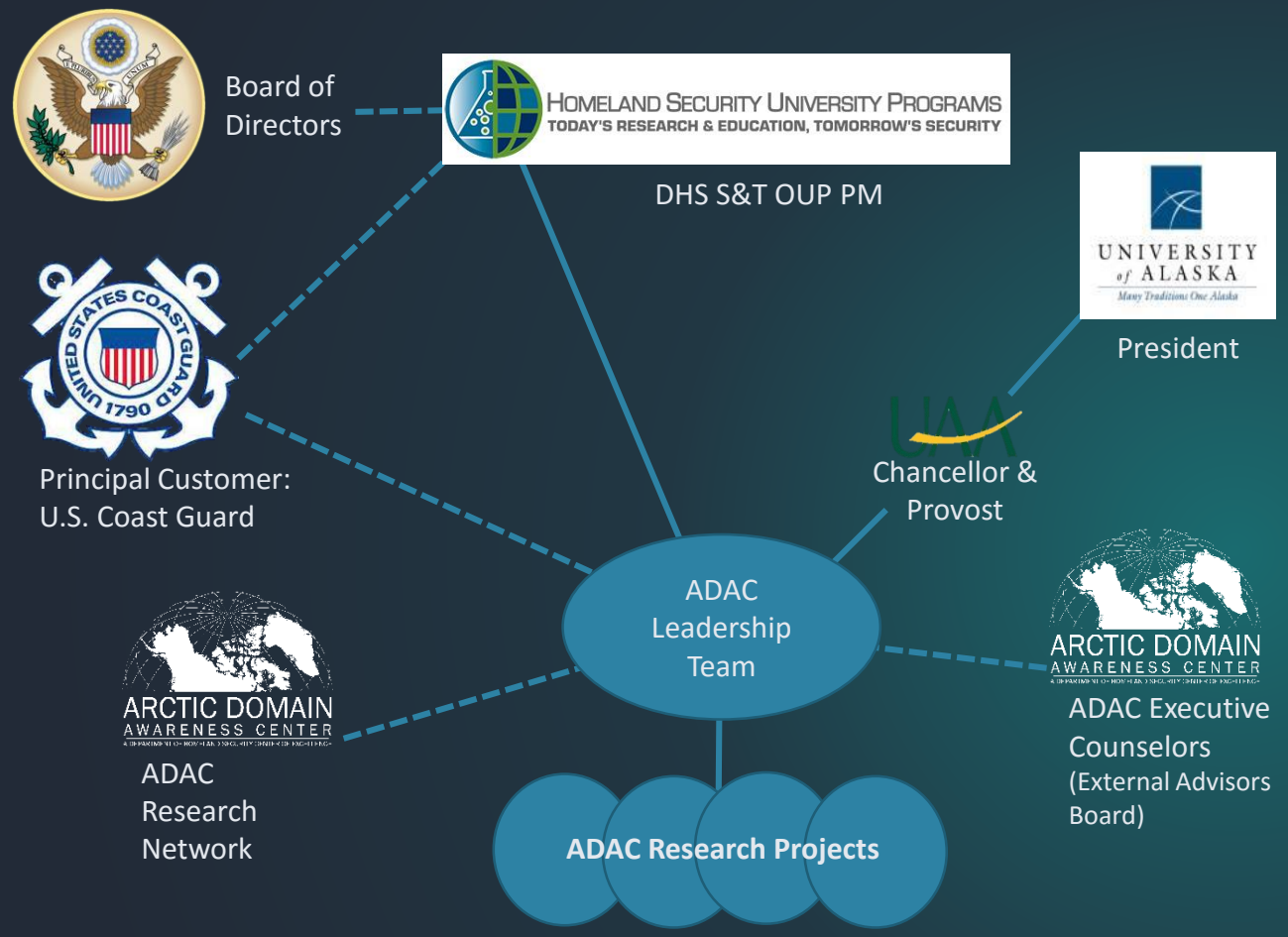
Deliver and transition.

It is much more than a new and/or better widget…

http://www.green4sea.com/wp-content/uploads/2016/02/Arctic-shipping.jpg



A polar low northeast of Scandinavia in the Barents Sea. Credit: Erik Kolstad/flickr



ADAC Organization and "web of control and coordination"

ADAC Leadership Team Composition:

- Principal Investigator.
- Research Director.
- Executive Director.
- Finance Director.
- Project Manager.
- Education and Administration Manager.
- Communications Officer.

ADAC's Executive Counselors. U.S and Canadian Leaders from:

- Research.
- Academics.
- Government.
- Industry.

ADAC's Research Network…of both current and completed investigations…contribute to building bridges and partnerships!

- ADAC's Research Network has been crucial in helping the Center advance in Building Agency Partnerships

AOOS Alaska Ocean Observing System
Alaska SeaLife Center Seward, Alaska
UAF University of Alaska Fairbanks
NOVA Corporation
MBARI Monterey Bay Aquarium Research Institute
Axiom Data Science
Marine Exchange of Alaska www.mxak.org
Geophysical Institute University of Alaska Fairbanks
The University of Texas at El Paso
Texas A&M University
Embry-Riddle Aeronautical University
UAA Business Enterprise Institute University of Alaska Anchorage
DUBAY Business Services
Applied Physics Laboratory University of Washington
Maine Maritime Academy 1941
UAA University of Alaska Anchorage
Woods Hole Oceanographic Institution
The University of New Mexico
ASRC Federal
Center for Arctic Study & Policy United States Coast Guard Academy
University of Idaho

Presenting to the community of Arctic and Maritime Research

- ADAC Leadership and research investigators presented and or participated in a large number of notable Arctic and/or Maritime Research or operator forums to advance Safety and Security over the past year.

8th Annual MARITIME RISK SYMPOSIUM

ARCTIC ENCOUNTER SYMPOSIUM

7th Symposium on the Impacts of an Ice-Diminishing Arctic on Naval and Maritime Operations
18-20 July 2017
Naval Heritage Center at the US Navy Memorial
Washington, DC
Co-hosted by the US National Ice Center and the US Arctic Research Commission

ALASKA MARINE SCIENCE SYMPOSIUM

COASTAL RESILIENCE CENTER
7th Annual Maritime Risk Symposium
November 14-15, 2016
Integrating Maritime and Coastal Resilience

5th ANNUAL MARITIME SECURITY WEST
September 20-22, 2017, Tacoma, WA

SEARCH RESCUE EUROPE

MASS 17 MARITIME & ARCTIC SECURITY & SAFETY CONFERENCE

PATUXENT DEFENSE FORUM

ARCTIC CIRCLE

CoSSaR
CENTER FOR COLLABORATIVE SYSTEMS FOR SECURITY, SAFETY & REGIONAL RESILIENCE
Leading innovation in the design, development and use of collaborative systems that support regional operations for security, safety and resilience.

YukonCollege

GLOBAL MARITIME FORUM 2016

OCEANS 17
MTS/IEEE ANCHORAGE, ALASKA, USA SEPTEMBER 18-21, 2017

NORTH PACIFIC RESEARCH BOARD

IARPC COLLABORATIONS
Accelerating the pace of Arctic Research

2016 ARCTIC SCIENCE SUMMIT WEEK
12-18 MARCH | FAIRBANKS, AK, USA

ARCTIC INTERCHANGE
MAY 8-12, 2017
FAIRBANKS · ALASKA · USA

UNIVERSITY of ALASKA
Many Traditions One Alaska

ARCTIC DOMAIN AWARENESS CENTER
A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

The Mission…Prosecuting Research

- ADAC has a comprehensive approach to conducting research,
  - Led by project teams executing DHS S&T OUP Approved Workplans.
  - Guided by Center leadership.
  - Communicated with the community of key stakeholders across the U.S. and Canada…Federal, State, Local, Tribal, Academic and Industry.
  - Advised by the Center's Executive Counselors.
  - Driven by Project Champions at HQ USCG.
  - Administered by DHS S&T OUP.

ARCTIC DOMAIN AWARENESS CENTER

17 October 2017

FINAL
Arctic IoNS 2017 Workshop Agenda
"Coping with the unthinkable…an Arctic maritime oil spill"
23-25 Oct 2017
University of Alaska Anchorage

Plan Overview

The following is the updated final draft agenda for ADAC's Arctic-related Incidents of National Significance (Arctic IoNS) Oil-spill focused workshop. The workshop theme is "*Coping with the unthinkable…an Arctic maritime oil spill.*"

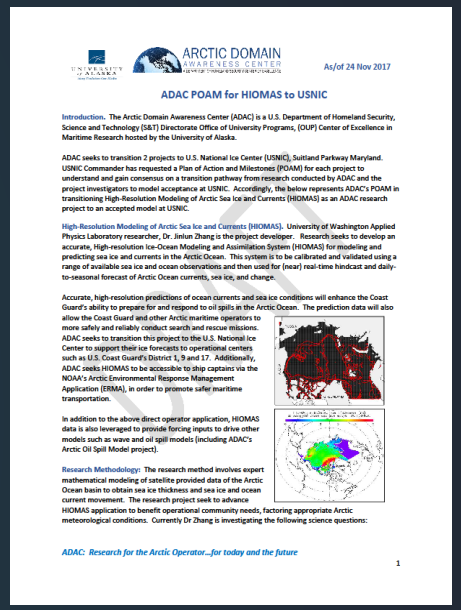
The Arctic IoNS workshop method is an expert researcher, operator and government official structured seminar, with breakout groups oriented to provide follow-on research to discover capability shortfalls. Arctic IoNS development begins with the Arctic operators providing specified areas of concern to investigate. Accordingly, U.S. Coast Guard has asked ADAC to address research concerns associated with logistically responding, and address science & technology of physically responding to an Arctic maritime oil spill.

In follow-up and as announced in prior teleconferences, ADAC is partnering this workshop with the Coastal Response Research Center (CRRC) Center for Spills and Environmental Hazards at the University of New Hampshire. Dr. Nancy Kinner and her team are true oil-spill experts and we in ADAC are very appreciative of their expertise and invaluable contributions. Dr. Kinner and ADAC Executive Director, Church Kee will co-facilitate the overall workshop. The UNH CRRC and ADAC have jointly planned the venue.

U.S. Coast Guard District 17, National Oceanic and Atmospheric Administration (NOAA) and other key Oil Spill responders have designed a scenario tailored to elicit the responses sought for understanding the challenges in logistically and operationally responding to a fictitious oil spill in the Beaufort Sea. The provided scenario is an Annex to the

Achieving Transition…Success Should be a Shared Endeavor

- Vital to gain consensus for research destination, & incorporate into research workplan.
- Engage destination team (in coordination w/USCG Project Champion) for acceptance.
- Equipped with destination requirements…establish overall "Plan of Action and Milestones (POAM)…and gain concurrence of the destination leadership team.
- Identifying and accounting for Intellectual Property is critical.
- Plan remaining research agenda to incorporate acceptance requirements and sequence of actions needed to achieve transition.
  - This includes items such as validation testing/accreditation, research documentation, operator training and onward tech support as desired by destination leaders and operators.
  - Milestones include research review to ensure conformance of current research approved plan.
  - Longer term transition allows for a partnership between the research and receiving teams.



ARCTIC DOMAIN AWARENESS CENTER

As/of 24 Nov 2017

ADAC POAM for HIOMAS to USNIC

Introduction. The Arctic Domain Awareness Center (ADAC) is a U.S. Department of Homeland Security, Science and Technology (S&T) Directorate Office of University Programs, (OUP) Center of Excellence in Maritime Research hosted by the University of Alaska.

ADAC seeks to transition 2 projects to U.S. National Ice Center (USNIC), Suitland Parkway Maryland. USNIC Commander has requested a Plan of Action and Milestones (POAM) for each project to understand and gain consensus on a transition pathway from research conducted by ADAC and the project investigators to model acceptance at USNIC. Accordingly, the below represents ADAC's POAM in transitioning High-Resolution Modeling of Arctic Sea Ice and Currents (HIOMAS) as an ADAC research project to an accepted model at USNIC.

High-Resolution Modeling of Arctic Sea Ice and Currents (HIOMAS). University of Washington Applied Physics Laboratory researcher, Dr. Jinlun Zhang is the project developer. Research seeks to develop an accurate, High-resolution Ice-Ocean Modeling and Assimilation System (HIOMAS) for modeling and predicting sea ice and currents in the Arctic Ocean. This system is to be calibrated and validated using a range of available sea ice and ocean observations and then used for (near) real-time hindcast and daily-to-seasonal forecast of Arctic Ocean currents, sea ice, and change.

Accurate, high-resolution predictions of ocean currents and sea ice conditions will enhance the Coast Guard's ability to prepare for and respond to oil spills in the Arctic Ocean. The prediction data will also allow the Coast Guard and other Arctic maritime operators to more safely and reliably conduct search and rescue missions. ADAC seeks to transition this project to the U.S. National Ice Center to support their ice forecasts to operational centers such as U.S. Coast Guard's District 1, 9 and 17. Additionally, ADAC seeks HIOMAS to be accessible to ship captains via the NOAA's Arctic Environmental Response Management Application (ERMA), in order to promote safer maritime transportation.

In addition to the above direct operator application, HIOMAS data is also leveraged to provide forcing inputs to drive other models such as wave and oil spill models (including ADAC's Arctic Oil Spill Model project).

Research Methodology: The research method involves expert mathematical modeling of satellite provided data of the Arctic Ocean basin to obtain sea ice thickness and sea ice and ocean current movement. The research project seek to advance HIOMAS application to benefit operational community needs, factoring appropriate Arctic meteorological conditions. Currently Dr Zhang is investigating the following science questions:

ADAC: Research for the Arctic Operator…for today and the future

1

POAM…

Intended to help better invest the customer!

Research to Capability Process…Current Internal ADAC actions

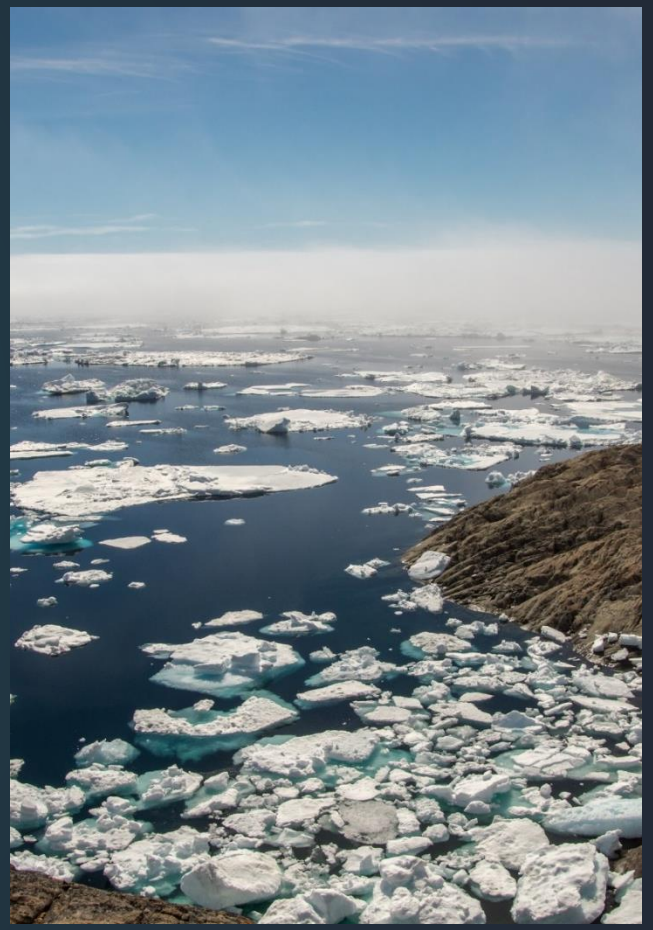
ADAC's DHS S&T OUP Annual workplan: Identifies specific research activity overall and for a given period of performance (normally a year at a time).

- Approved Management, Individual Project, Education and Financial Accounting.
- Management section details how accomplishes overall program and project research.
- Key component for leading research progress: Center Quarterly Reviews.

Each project assessed against approved workplan schedule, milestones metrics. As research accomplishes established transition readiness level.

Center leadership along with research team seek to transition capability to end user in accordance with end-user's stated transition requirements.

- Includes training, documenting, validating, and supporting transition in accordance with destination user requirements.



ADAC's Summary Strategy on Transition

- Collaborate and gain consensus for research destination.
- Engage destination team (in coordination w/USCG Project Champion) for acceptance requirements.
- Equipped with destination requirements…establish overall "Plan of Action and Milestones (POAM)…and gain concurrence of the destination leadership team.
- Identifying and accounting for Intellectual Property is critical.
- Plan remaining research agenda to incorporate acceptance requirements and sequence of actions needed to achieve transition.
  - This includes items such as validation testing/accreditation, research documentation, operator training and onward tech support as desired by destination leaders and operators.
  - Milestones include research review to ensure conformance of current research approved plan.
  - Longer term transition allows for a partnership between the research and receiving teams.

ADAC Leadership and Project Investigators are committed to deliver!

Arctic Incidents of National Significance (Arctic IoNS)…Oil Spill Workshop

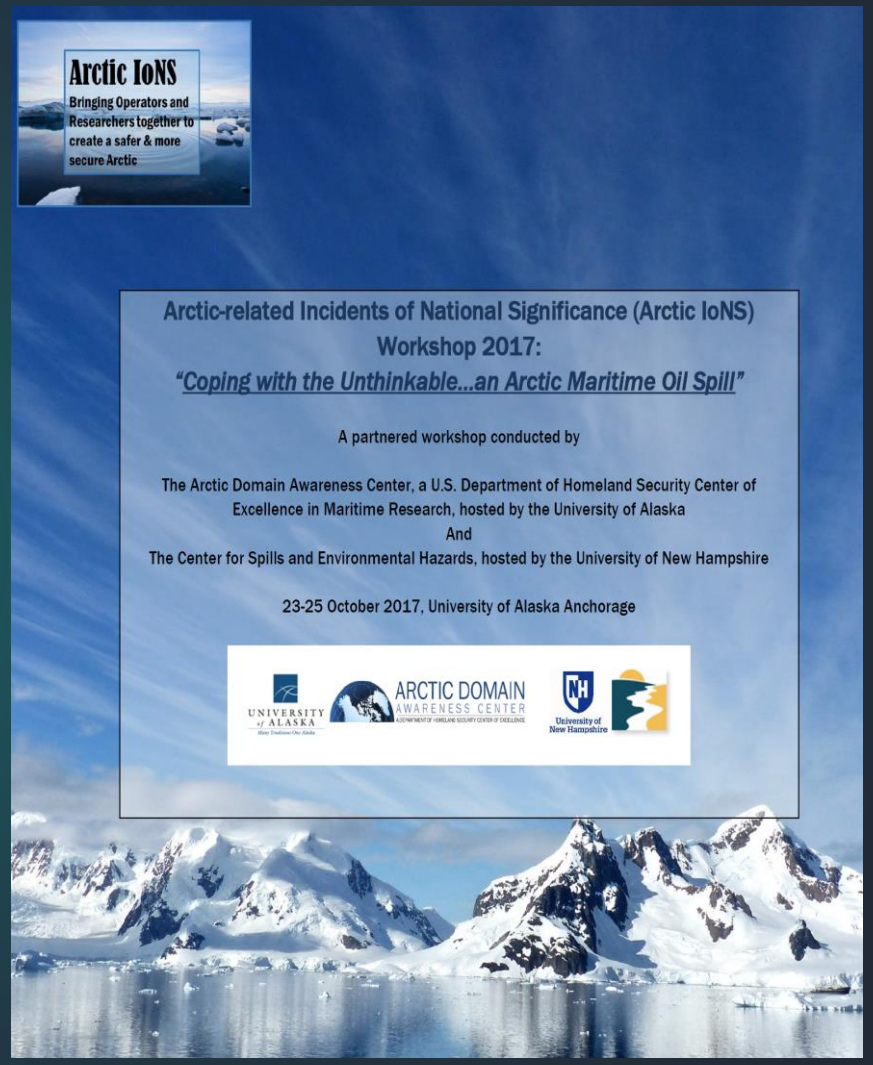
"Coping with the Unthinkable…an Arctic Maritime Oil Spill" Workshop on 23-25 Oct 2017. ADAC's second Arctic IoNS venue

A total of 87 participants across Federal Govt, State of Alaska, Canada, Academics, Industry and Tribal organizations.

Superb participation by D17 and D17 Sector Anchorage!
Report completed, Research Questions developed
RFP readied and released.
Next steps…Processing responses on 7 May 2018:

- A parallel review for science and customer relevancy.
  - Science Review Panel planned 19 Jun 2018.
- Projects starting late Summer 2018.

Planning a new Arctic IoNS workshop…Winter 2019



Arctic Futures Workshop, Nome, 26-27 Mar 2018

ADAC's follow-on to the May 2017 "Arctic 2030…Needs of the North" conference at UAF.

Workshop: "*Arctic in the Distant future…gaining Alaskan Native insight to challenges anticipated across Maritime and Coastal Regions*" 26-27 March 2018.

Event preceded the Western Alaska Interdisciplinary Science Conference.

Goal achieved: Listen, learn, and compile a workshop knowledge product useful for DHS, USCG and other Federal agencies working Arctic strategy and policy.

60 + participants facilitated by a multi-disciplined planning team
Remarkable support from City of Nome

ADAC's "Arctic Environmental Security" Course (BIOL 490/690)

Experimental course co-instructed by ADAC Principal Investigator and Executive Director at UAA Spring Semester 2018.

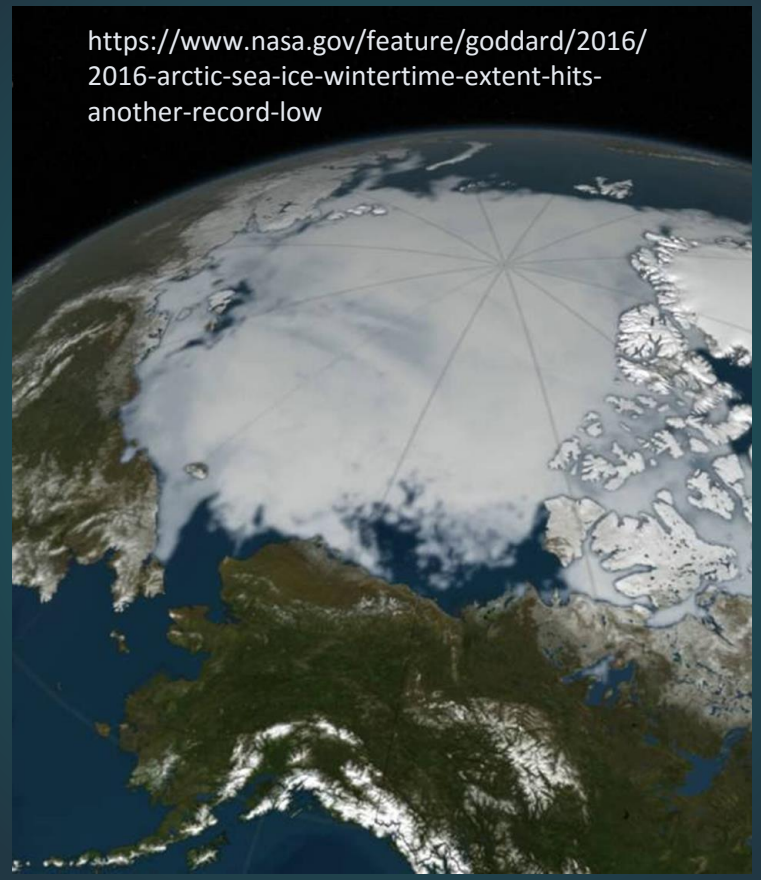
Topics include:

- Ecological Dynamics.
- Social Resilience.
- Subsistence and Food Security.
- Environmental Conservation.
- Regional and National Security.

- 25 Students.
- Seminar style.
- On-line participation, including guest lectures.

ADAC's understanding of Operator Concerns in the Arctic

- Communications.
- Multi-dimension information fusion.
- Arctic bathymetry.
- Understanding sea-ice dynamics.
- Oil spill response.
- Precision weather (including sea-ice formation and accurate sea-states).
- Vessel Safety.
- Waterways management



- Understanding Marine mammal and fish dynamics.
- Understanding changes in the water column.
- Discerning dark targets.
- Arctic mariner compliance with new IMO Polar Code.
- Ability to respond proactively across the range of missions.

The following is a snap-shot of ADAC activities addressing these concerns…

ADAC Activities Update
Maritime Domain Awareness *RFP*

U.S. Coast Guard approved Maritime Domain Awareness Request for Proposal (RFP).

Released 19 Sep 2017.

Received 17 responses on 31 Oct 2017.

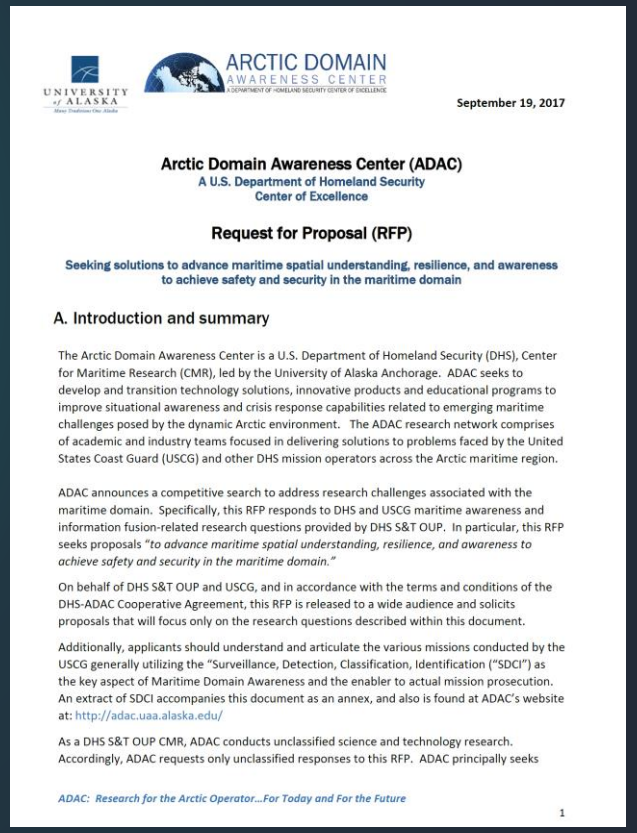
Science Review: Jointly conducted by ADAC and Borders Trade and Immigration (BTI) University of Houston.

Customer Relevancy: Conducted by CG-926.

So far: Two new Projects Selected:

1. The Arctic All Hazards GIS Platform, led by University of Maryland.
2. Arctic Vessel Monitoring Geofencing/Alert Awareness, led by the Alaska Maritime Prevention and Response Network.

Next steps: Constructing projects for approval.



UNIVERSITY of ALASKA

ARCTIC DOMAIN AWARENESS CENTER
A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

September 19, 2017

Arctic Domain Awareness Center (ADAC)
A U.S. Department of Homeland Security Center of Excellence

Request for Proposal (RFP)

Seeking solutions to advance maritime spatial understanding, resilience, and awareness to achieve safety and security in the maritime domain

A. Introduction and summary

The Arctic Domain Awareness Center is a U.S. Department of Homeland Security (DHS), Center for Maritime Research (CMR), led by the University of Alaska Anchorage. ADAC seeks to develop and transition technology solutions, innovative products and educational programs to improve situational awareness and crisis response capabilities related to emerging maritime challenges posed by the dynamic Arctic environment. The ADAC research network comprises of academic and industry teams focused in delivering solutions to problems faced by the United States Coast Guard (USCG) and other DHS mission operators across the Arctic maritime region.

ADAC announces a competitive search to address research challenges associated with the maritime domain. Specifically, this RFP responds to DHS and USCG maritime awareness and information fusion-related research questions provided by DHS S&T OUP. In particular, this RFP seeks proposals *"to advance maritime spatial understanding, resilience, and awareness to achieve safety and security in the maritime domain."*

On behalf of DHS S&T OUP and USCG, and in accordance with the terms and conditions of the DHS-ADAC Cooperative Agreement, this RFP is released to a wide audience and solicits proposals that will focus only on the research questions described within this document.

Additionally, applicants should understand and articulate the various missions conducted by the USCG generally utilizing the "Surveillance, Detection, Classification, Identification ("SDCI") as the key aspect of Maritime Domain Awareness and the enabler to actual mission prosecution. An extract of SDCI accompanies this document as an annex, and also is found at ADAC's website at: http://adac.uaa.alaska.edu/

As a DHS S&T OUP CMR, ADAC conducts unclassified science and technology research. Accordingly, ADAC requests only unclassified responses to this RFP. ADAC principally seeks

ADAC: Research for the Arctic Operator…For Today and For the Future

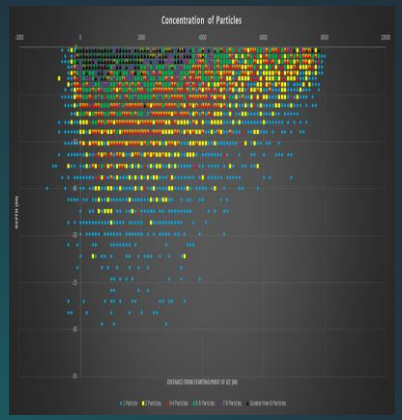
1

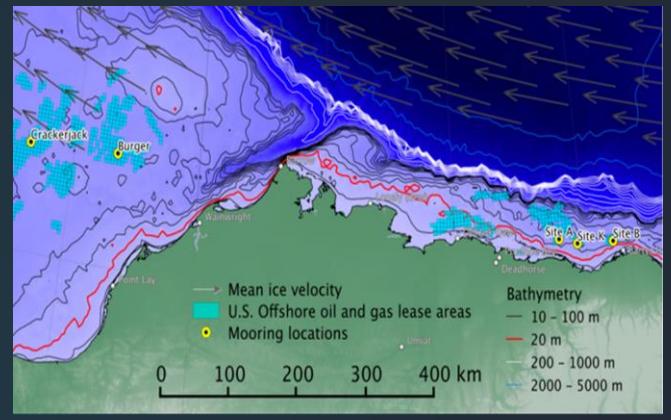
Arctic Oil Spill Modeling (AOSM)

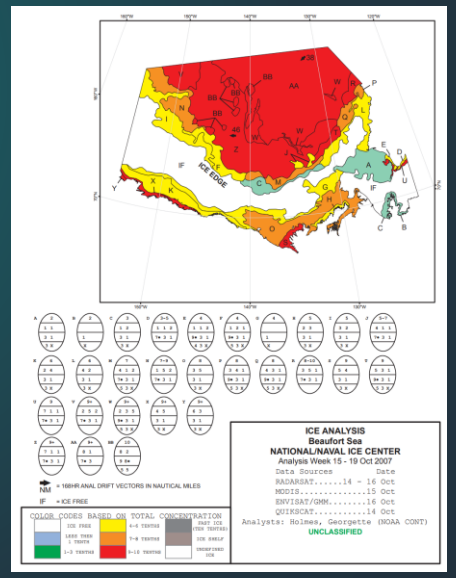
Project assists U.S. Coast Guard and the NOAA Office of Response and Restoration with the development of an Arctic-capable oil spill model that can be leveraged via NOAA's General NOAA Operational Model Environment (GNOME).

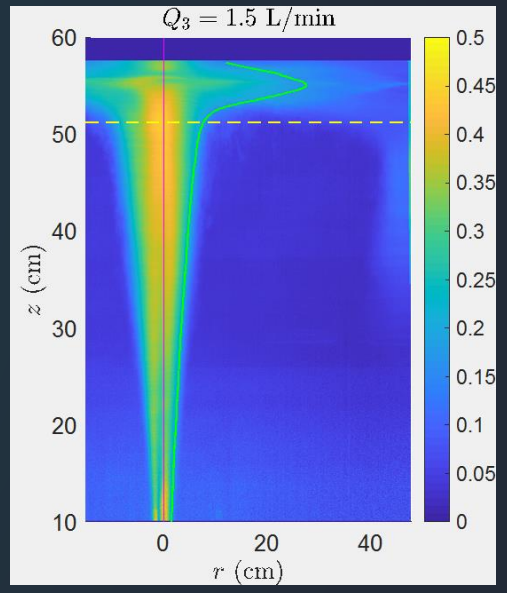
- Working with NOAA to develop a new variable within GNOME: under-ice storage capacity.
- Ice storage capacity has been estimated at several locations in the Chukchi and Beaufort Seas, based on ice draft data.
- 3 D model support for LRAUV.
- Improving integration of TAMOC with GNOME to include all oil fate processes.
- Training NOAA staff to use TAMOC and AOSC algorithms within GNOME.
- Capable of "On-demand" support (such as Cook Inlet Methane Leak).

Transition: NOAA's GNOME.









Propeller Driven Long Range Autonomous Underwater Vehicle

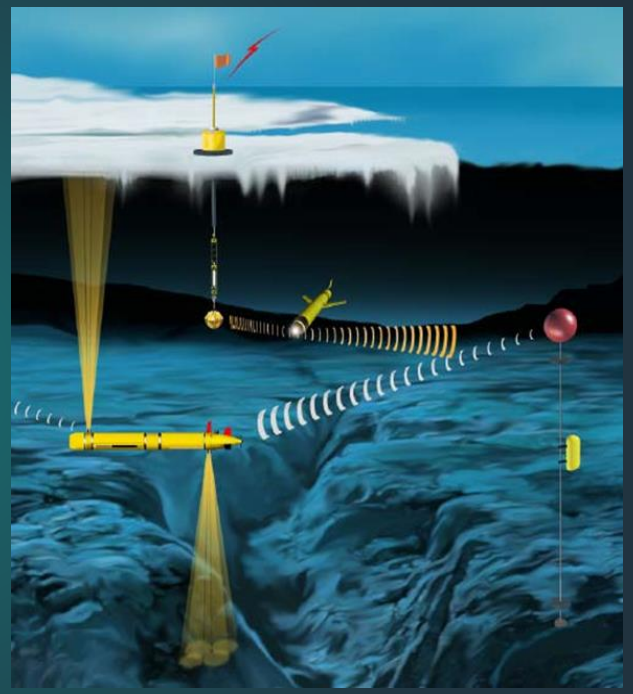
LRAUV is helicopter portable, carrying an environmental mapping payload, allowing rapid response to provide situational awareness and damage mitigation for first responders/USCG.

Initial Capabilities (expandable):

- Ability to map in 3D.
- Extended unattended deployment (days to weeks).
- 600 KM range…under ice.
- Detection and quantification of dissolved particles and fluorescent material (with current sensor package).
- Environmental characterization.

Transition: CG-926, USCG RDC & or Commercialization.

Tethys testing deployment January 2018 being operated from a cell phone in Monterey Bay California



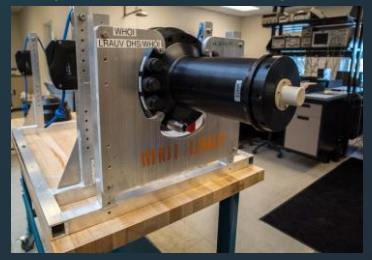
Plume mapping auto detection and 2 D mapping proof of concept mission Buzzard Bay MA, November 2016)

Photos of LRAUV, which is currently in fabrication at MBARI, California…completion date" Mid April 2018

Vehicle cart and Nbell/chassis

Thruster assembly

Variable Ballast Assembly



High resolution Modeling of Arctic Sea Ice and Currents

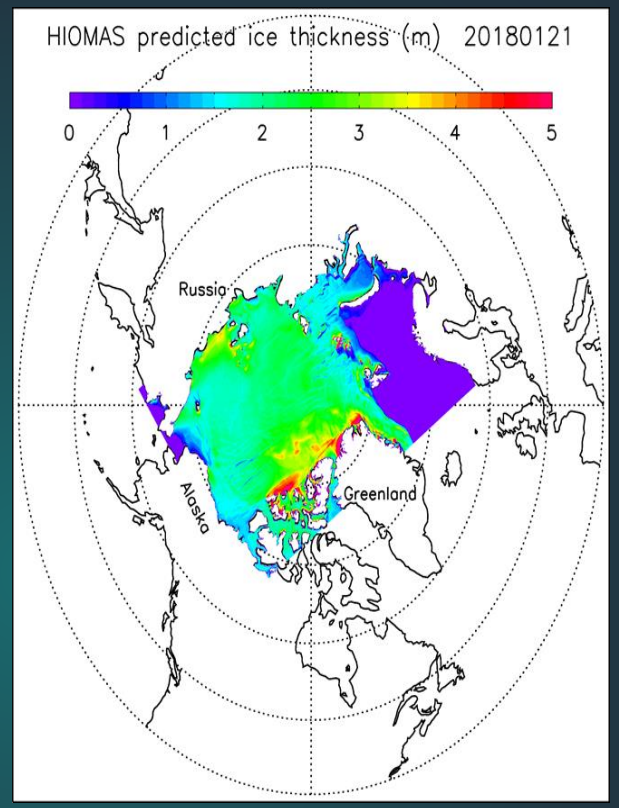
HIOMAS (High-resolution Ice-Ocean Modeling and Assimilation System)

- A forecast system that can distribute the forecast data to the Coast Guard and other Arctic stakeholders.

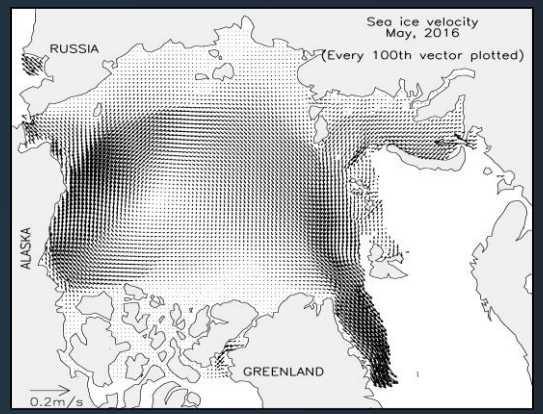
- Developed 3 versions of HIOMAS with 6, 4 and 2 km horizontal resolutions.
- Assimilate satellite sea ice concentration in HIOMAS hindcast to improve initial conditions for forecast.
- Calibrated and validated HIOMAS hindcast using sea ice observations; no excessive ice thickness buildup in areas such as the Beaufort Sea.
- Conducted (near) real-time hindcast and daily to seasonal forecast of Arctic sea ice and currents.

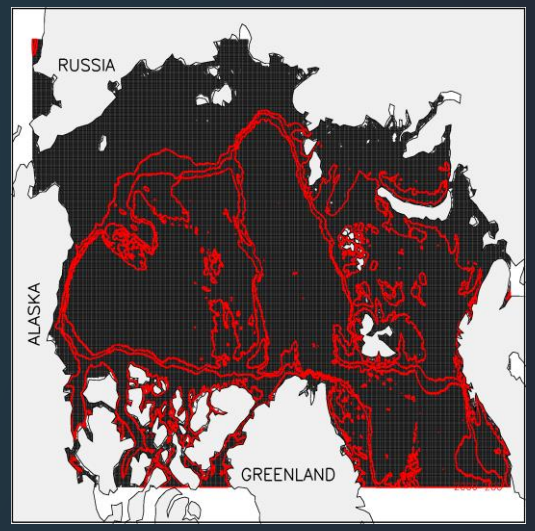
Transition: In development with NOAA.

- Note: Still publishing to Arctic ERMA.

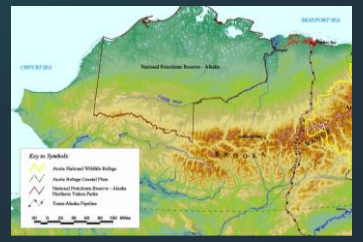


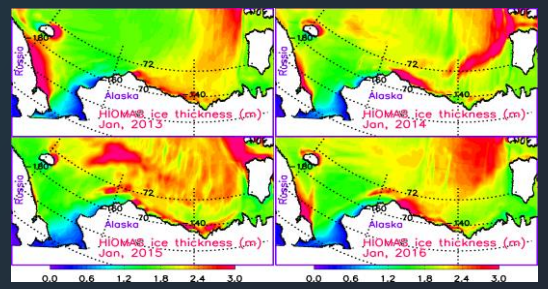
4 km resolution HIOMAS





Just created a 1 KM resolution version for the US. EEZ for Bering, Chukchi and Beaufort Seas



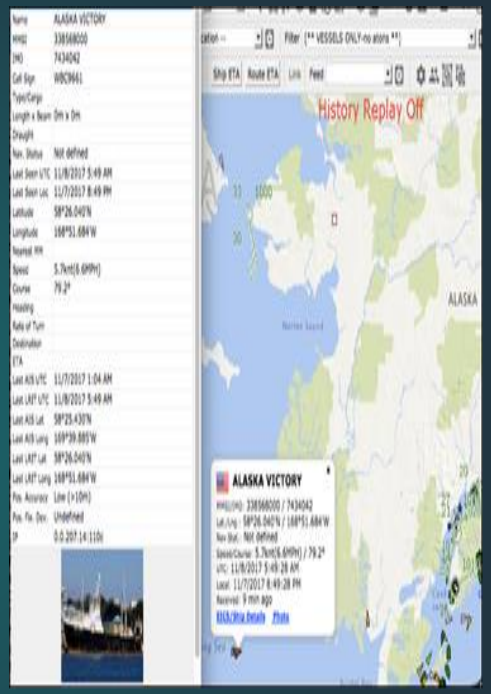


Using Vessel Tracking Data to Prioritize Bathymetric Surveying

Project creates products that inform decision-making about vessel traffic and vessel safety in a rapidly changing Arctic environment.

- The research effort is develop the capability to reduce execution time for handling and analyzing exceptionally large collections of Automated Information System (AIS) vessel tracking data.
- A large data analytics effort.
- Gridded files provide the extracted AIS information needed for decision makers and stakeholders in the U.S. Arctic area.

Transition: A set of knowledge products useful for USCG and NOAA to apply to survey/mapping efforts for Alaska (including Arctic Alaska).



Crisis Response Sea-Ice and Weather Forecasting tools

Research project strives to improve USCG and other DHS Arctic maritime operator situational awareness and crisis response by enhancing support for planning and emergency response to meteorological and environmental marine hazards in the Arctic.

- Literature Reviews and interviews with a host of marine operators.
- Identification of hazardous ice events using coastal radars:
  - Ice Convergence, Landfast ice breakout and Anomalous ice motion.

Transition: Researchers will develop a decision support tool, grounded in stakeholder interactions, to support weather and sea ice-sensitive decision making. Destinations include GNOME, future ADAC decision support research or as determined by USCG Project Champion.

Phase 1: Preliminary tool development

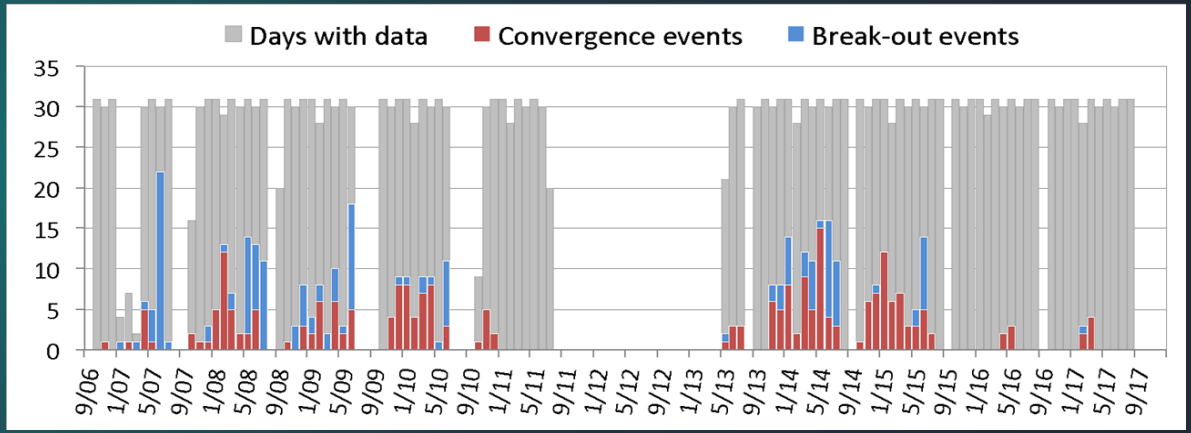
1a: Assess decision context

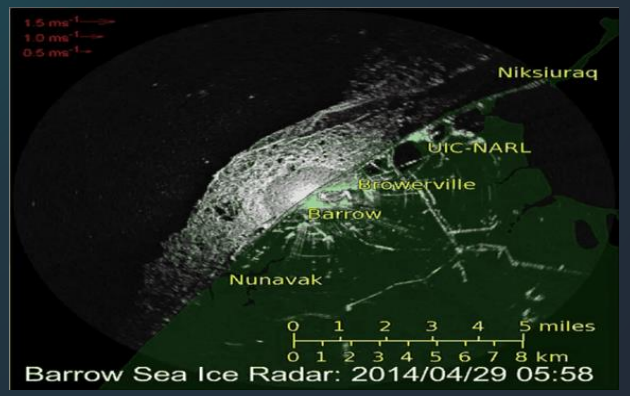
1b: Develop early warning systems for coastal ice hazards

1c: Define hazard notification formats and procedures

→ **Phase 2:** Stakeholder feedback and Tool optimization

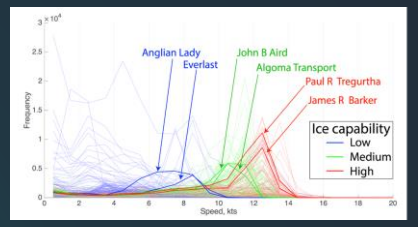
→ **Phase 3:** Outreach Data dissemination and Evaluation

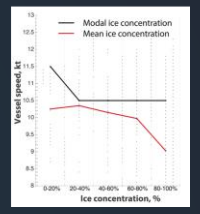




Creating an Ice Conditions Decision Index for the Great Lakes region maritime operations

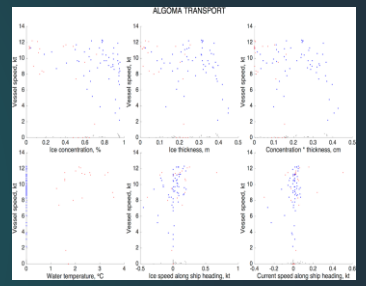
Developing an ice condition index (ICECON) for the Great Lakes for USCG operators and lake mariners that can use available data to forecast ICECON up to 3 days into the future. Creates important ship safety, potentially reducing number of ship rescues for vessel ice entrapment.

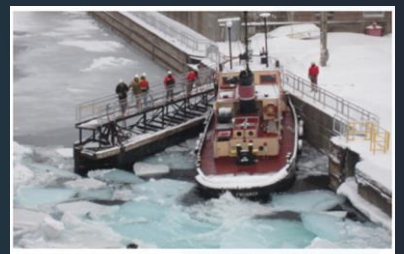




With ice parameters collected by USCG and Canadian Coast Guard crews operating in the Great Lakes in the 2016-2017 time frame, team conducting Monte Carlo simulations to determine the most predictive relationship between the ice parameters and ICECON.

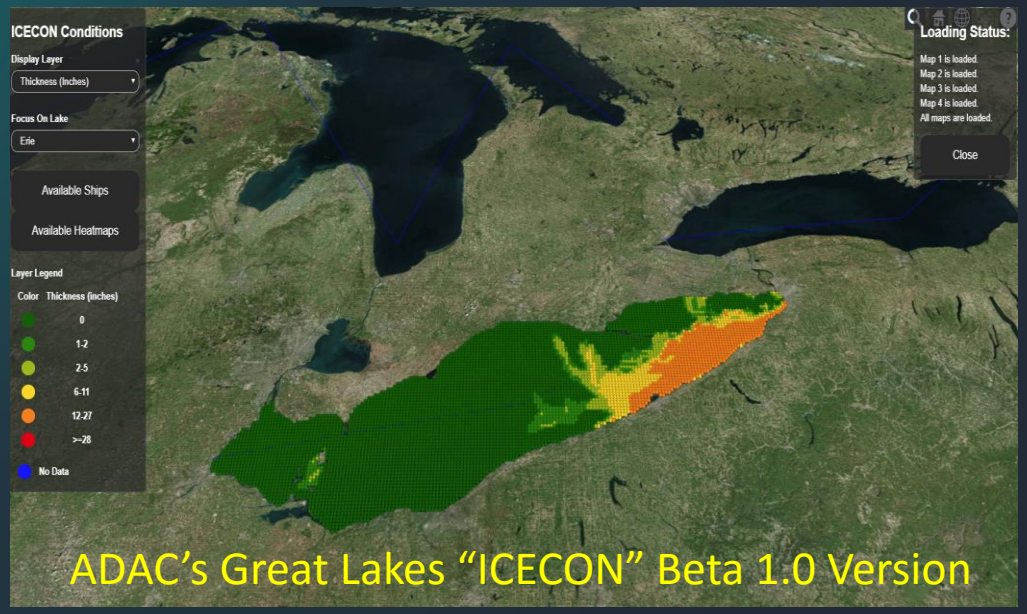
- Using ice-data from the 2013-2017 period in conjunction with AIS data to determine which parameters affect vessel speed and are important to ICECON.
- Pulling nowcast and forecast data in real-time (every 6 hours), compute the ICECON nowcast and forecast, and display it on a project website.





Tug stuck in the ice at the Soo Locks. March 20, 2014. Credit: NOAA

Transition: USNIC to project ICECON and create an Arctic version if approved.



ADAC's Great Lakes "ICECON" Beta 1.0 Version

Exploring Enhancements to Arctic Communications and Domain Awareness using the ASF CubeSat Antenna Farm Experiment (CAFE)

Project is direct USCG award, that partners ADAC and University of Alaska Fairbanks' Alaska Satellite Facility to conduct cube satellite research in support of USCG Arctic Communications shortfall research via a Mobile CubeSat Command and Control (MC3) antenna system and radome at the Alaska Satellite Facility. Research will increase USCG knowledge on Arctic communications and viability of Cube satellites to improve maritime communication in Bering, Chukchi and Beaufort Seas.

https://www.nasa.gov/feature/goddard/2016/mini-nasa-satellite-begins-environmental-testing

Transition: Depends on success of experiment.

Completed Research: Mariner Ice Navigation Courseware for IMO Polar Code

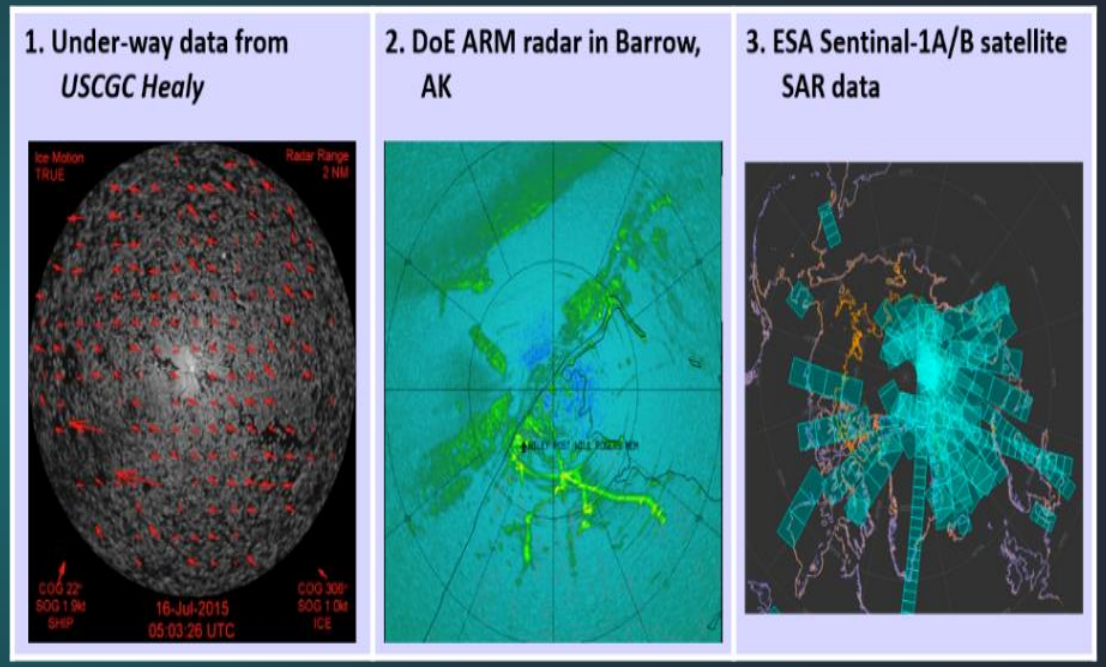
With the implementation of the new International Maritime Organization (IMO) Polar Code in Jan 2017, there is a requirement for training in ice navigation and operation of ships in Polar environments.

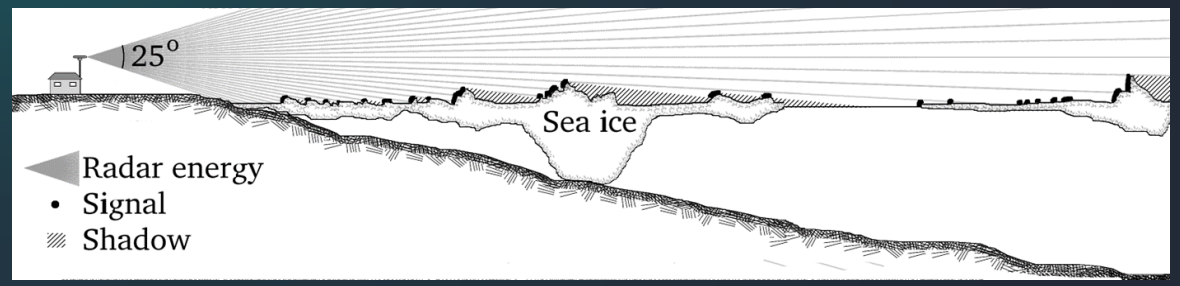
- ADAC's partner, Maine Maritime Academy (MMA) has developed a basic ice navigation class and has just completed an advanced ice navigation class to meet this knowledge gap.
- Following USCG Office of Navigation certification, ADAC and MMA seek to provide courseware for commercial application to shipping industry, mariner academies and mariner technical training locations.
- Now in work for Private Sector application with Merchant Marine Academies.
- ADAC awaiting words on Advanced course SCTW Certification…due shortly.
- Transition: Courseware currently being instructed at MMA. Seeking other mariner academies and USCG icebreaker crew member training.

Prior Research: Integrated Ice Hazards and Sensors

Develop framework for identifying, tracking and communicating sea ice-related hazards utilizing existing Arctic observing assets. Project enhances capability of surface-based radar (either coastal or ship-borne for monitoring sea ice hazards). Now Investigating commercial application with vessel radar industry.

Transition: Now seeking a commercial application…for Shipborne radars.



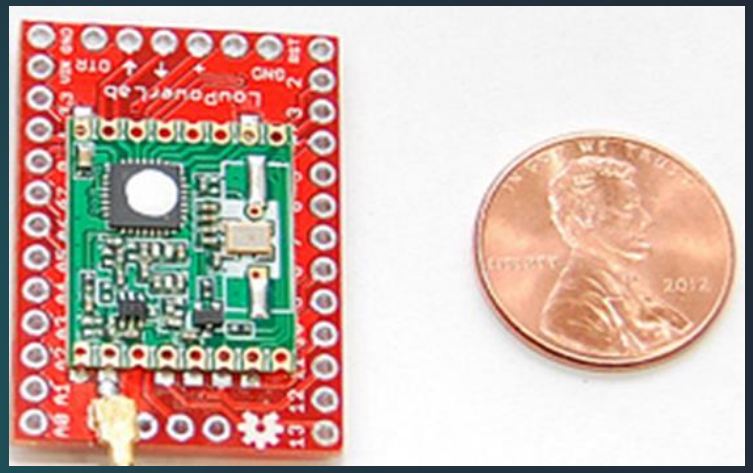


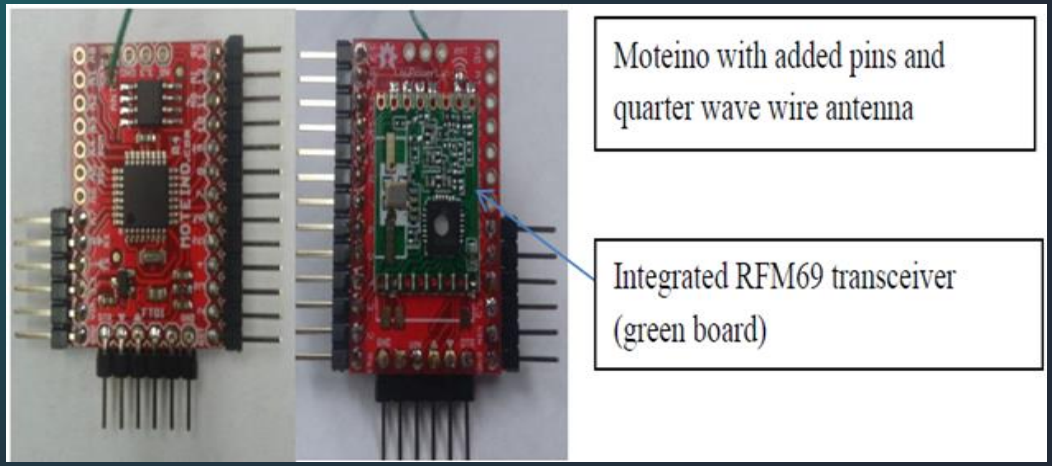
Prior Research: Low Cost Sensors

Develop low-cost wireless sensors for use in remote monitoring, asset management, surveillance, and security, particularly in Arctic and marine environments.

Robust network design with rapid deployment capability for situational tactical awareness.

Transition: Now preparing a journal article and planning new research sponsorship, seeking to support U.S. Navy ICE-EX 2020.



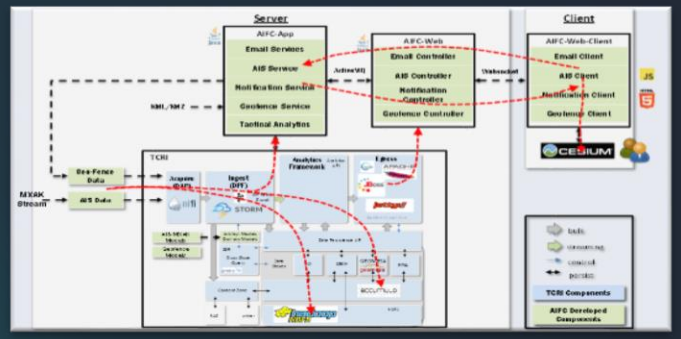


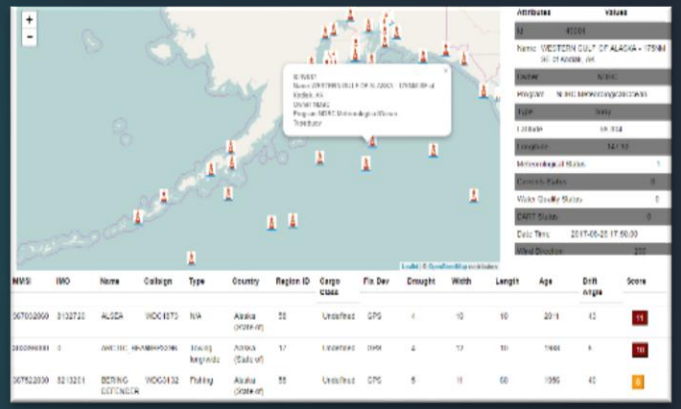
Prior Research: AIFC

Arctic Information Fusion Capability (AIFC). Project seeks to support operational decision makers in the maritime domain ranging from operational commanders to tactical operators to community-based observers. AIFC advanced research for two-dimensional geographic orientation of precision mapping data, near-real-time and high-resolution satellite imagery incorporated with available modeling, sensors, web-based communications and appropriate social networking feeds to gain domain awareness in support of operational decision making and interface with humans and responders in the field.

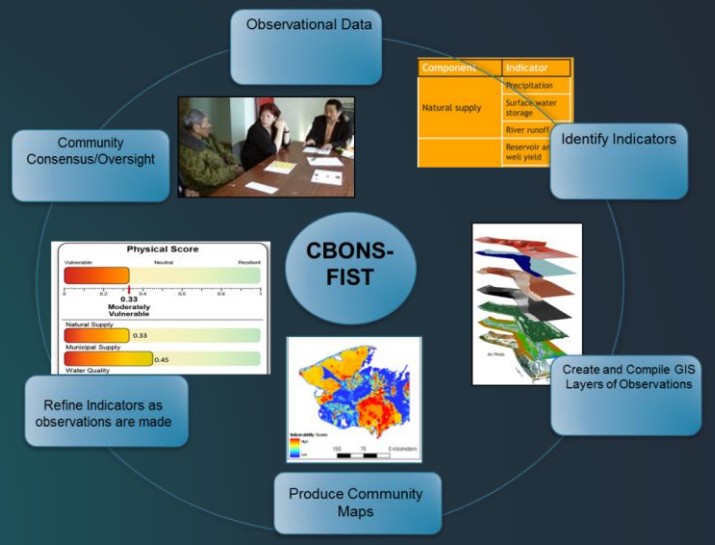
Following the Biennial Review, this project was discontinued. USCG subsequently provided a series of Maritime Domain Awareness Questions, which were released in an RFP in early Sep 2017 and resulted in 17 submissions which are being evaluated by ADAC or BTI at University of Houston for Science merit and DHS S&T OUP and USCG for Customer relevancy.

Transition: AIFC is being evaluated for commercial application by ASRC Federal Mission Solutions.





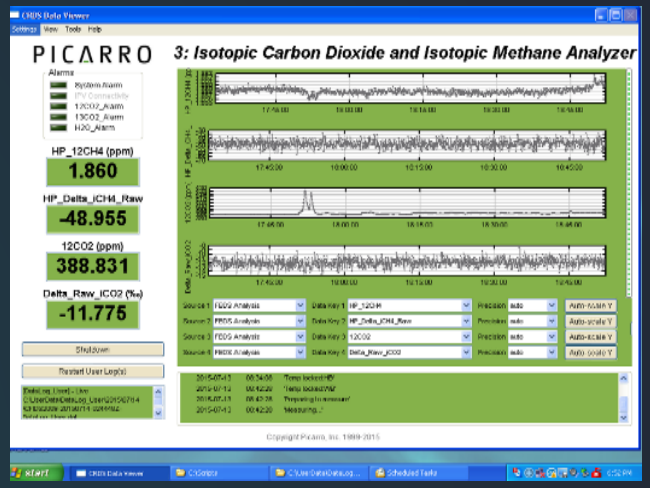
Prior Research: CBON-SA/CBONS-FIST

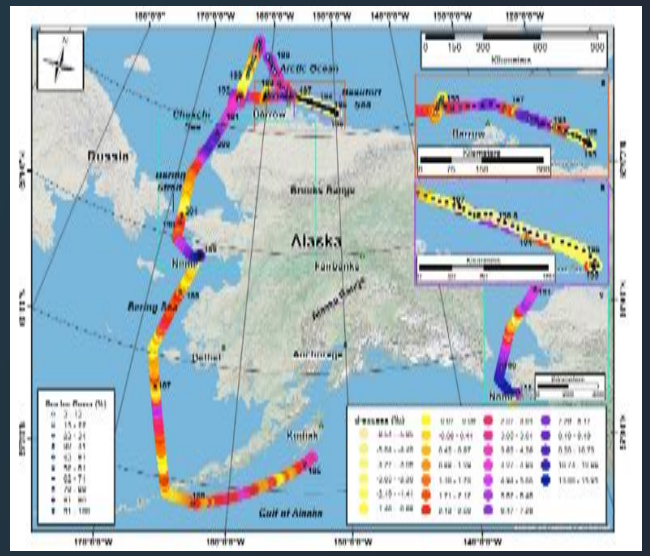


Researching the construct that High fidelity observers (HFOs) who submit quality assured and coordinated observations on biophysical variables that can be integrated with data from other observing systems. Connected to USCG Command via Austere environment comms, CBONS data adds to Arctic Information…from the tactical edge.

Transition: Following the conclusion of Year 3 of the CBON-SA project the community-based observing effort has been evolved and refined into TAOS-S6 (Technology Amplified Observing System – See Something, Say Something, Send Something). Prior research now being leveraged in this new initiative to serve maritime domain awareness needs for a range of stakeholders across Federal, State, Local, Tribal and Territorial (FSLTT) Partners as part of broader federal security efforts.

Prior Research: Monitoring Intentional and Unintentional Catastrophic Events: Detecting sea ice and oil spills through measurement of the H2O and C isotope geochemistry in winds





Primary aim is to provide ship or vessel captains real-time data of sea ice conditions (open water, light sea ice, heavy sea ice and total sea ice coverage) and presence of oil chemicals in a marine environment that will be displayed at the helm of vessels that are fitted with the detection systems as well as making sea ice conditions estimates available from shore/platform-based systems.

Transition: TBD. ADAC believes there is merit to the research…what is needed is further investigation into the application.

Prior Research: Smart-Camera research

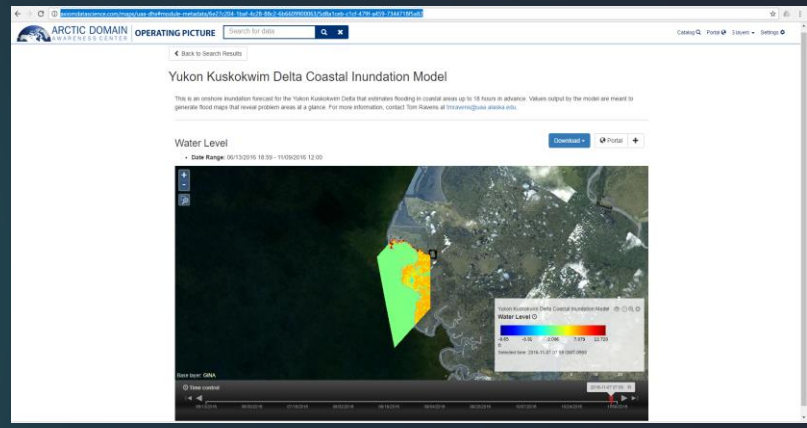
Project designed a power efficient (less than 10 Watt peak) three channel (visible + long wave infrared) camera system. The SmartCam integrates all off-the-shelf optics, computing and detectors, so it is defined by software and the system design.

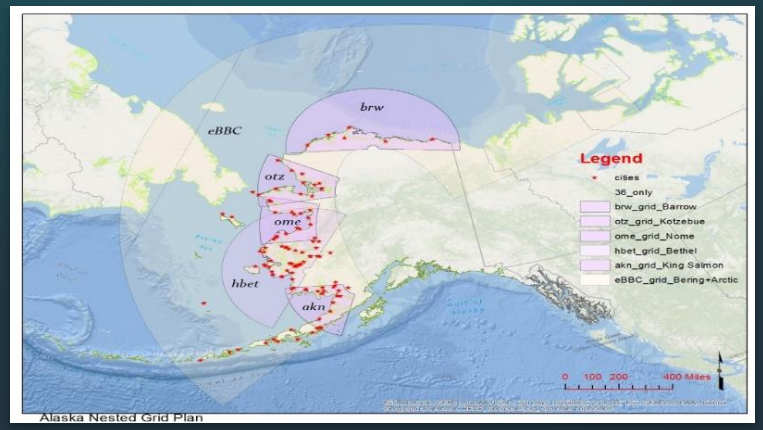
Transition: Research PI at Embry Riddle University has continued investigation via other academic oriented sponsorship.

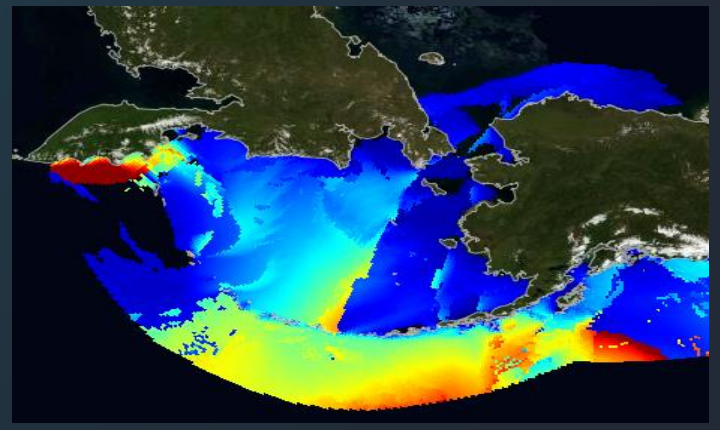
Prior Research: Real-Time Storm Surge and Coastal Flood Forecasting for Western Alaska.

ADAC developed high resolution, nearshore forecasts of storm surge, coastal flooding, and wave conditions at two sites on the West Coast of Alaska – the Yukon Kuskokwim river delta and Norton Sound. The Delft3D and SWAN models were used for the storm surge and wave modeling, respectively. The ocean boundary of the SWAN wave model came from nowcasts and forecasts from NOAA's Wavewatch III wave model.

Transition: UAA College of Engineering has continued investigation in this topic…and leveraged a portion of the prior work for Coastal Erosion Forecasting in support of U.S. Army Corps of Engineers project on North Slope.



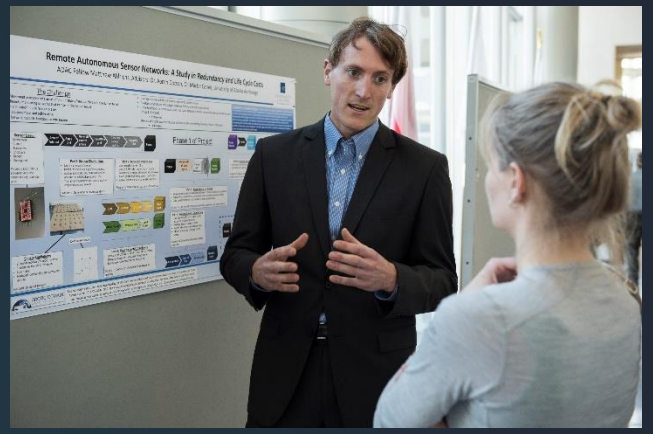


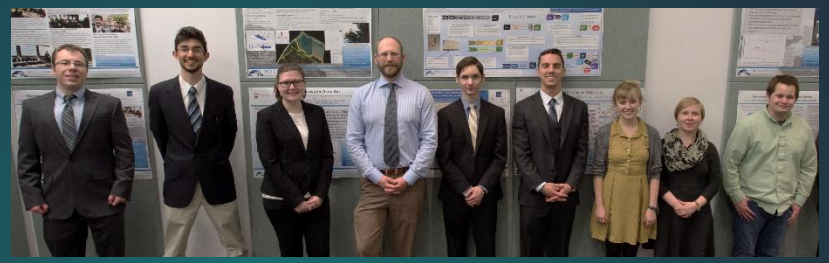


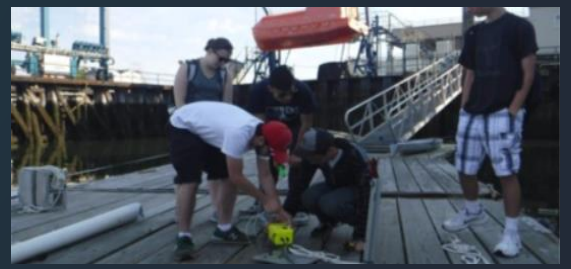
Preparing the next generation for HSE..ADAC Fellows

ADAC Student Fellows Program. ADAC's Fellows are undergraduate and graduate students across the ADAC Research Network that supports Operator Driven research for the Center. This includes:

- Approved project research support.
- Center activity research (such as workshop reports and literature reviews).
- Individual research activity (with assigned ADAC mentor)
- Minority Serving Institute participation.
- Summer Internships.







ADAC…steadily advancing to provide operator driven S&T research

- ADAC's efforts…can help to reduce risk, improve safety, increase awareness, increase decision precision.
- ADAC will continue to seek research that addresses shortfalls and gaps as the priority.
- ADAC will seek to leverage prior investments to find suitable futures as practically as possible
- ADAC will prosecute approved investigation to develop, and transition …in order to field capability.

- We believe in our mission…and sincerely strive to deliver.

Ready for Questions & Discussion

...Thank you for your attention!

ARCTIC DOMAIN
AWARENESS CENTER
A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

ARCTIC DOMAIN AWARENESS CENTER

A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

Research for the Arctic Operator…

For Today and For the Future

http://adac.uaa.alaska.edu/

Concluded/Discontinued research…ADAC's perspective

#1: Always strive to be the best steward of each and every provided research dollar

- If there is a way to leverage conducted research…we should practically strive to so leverage.

#2: Conducted research may have an application not considered or planned in the initial investigation.

- The inventors of sticky pages had thought they had failed!

#3: Different research sponsors…have different needs.

- If the original sponsors felt the research was not useful to meet their requirements, should not preclude an opportunity for different research sponsorship.
- Perhaps modifying the investigation to a new plan and objective…can meet or exceed what was originally planned.

#4: If the project was worthy to fund in the first place…analysis is needed to determine if a different path, process or method would have made a difference in meeting the original objective.

- Following the analysis…then see #1!