Presentation to the Team at the First Annual Partner Review 2015

By
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Breaking News about ADAC:

- I received a call from the White House!
  - They are impressed with ADAC – and requested a white paper this week.
    1) Overview of ADAC.
    2) Next directions.

- I will be interviewed by Al Jazeera TV this week about ADAC.

Other presentation items:
- Provided briefing to IARPC about ADAC June 2015.
- Provided briefing at USC in November on *High Latitude Chokepoints and Vulnerabilities* included overview of ADAC.
Healy Excursions:
• I arranged with USCG for 7 ADAC team members to participate on different excursions.
  o **Perform Experiments** - Prof. Welker & students; Prof Mahoney& students.
  o **Observe USCG operations** - Dr. Wisniewski; Dr. Spalinger; and Dr. Kamberov

ADAC Workshops
• **September 3 and 4 – Climate Change Analytic Requirements** – Sponsored by ADAC and DHS.
• **USCG Arctic Zephyr - Table top demonstrations** - October 20,21, 2015 – hosted by ADAC/UAA.

• **ADAC Ribbon Cutting Ceremony** – October 2015
  • Under Secretary of DHS; Officials from Arctic Council; Additional Federal and State Officials and USCG.
**Mission:** Develop and transition technology solutions, innovative products, and educational programs to improve situational awareness and crisis response capabilities related to emerging maritime challenges in the dynamic Arctic environment.

**ADAC develops systems** to observe, assess, predict, and alert incident commanders with actionable information and decision support to respond and prepare for Arctic challenges.

**Research Areas**
Maritime Domain Awareness
Maritime Situational Awareness and Response Support
Maritime Technology Research
Integrated Education

**Consortium of Partners:**
**UAA Center Lead**

**University Partners**
- University of Idaho
- University of Washington
- University of Alaska Fairbanks
- Maine Maritime Academy

**Institutional Partners**
- Woods Hole Oceanographic Institute

**Industry Partners**
- MDA Systems
- GeoNorth (Native Alaskan Company)
- Lockheed Martin
- AeroVironment
- Dynamic Spectrum
- Liquid Robotics
- Robotic Technology
- Port of Anchorage

**Remote Alaskan Communities**
participate in Community Based Observer Networks (CBONS).
ADAC already has communities in the Bering Strait participating in CBONS and has provided them with means to interface with ADAC’s intelligent integrated system of systems (IIOS).

**Town of Gambell – Bering Strait**
Hunters come to the shore to check on the condition of the ice and possible leads. Once the ice has cleared enough to allow for decent passage, hunters will bring their gear to the shore and launch.

**Goal:** Have local community members observe and document changes in and around the Bering Sea. These changes include unusual sea ice, oil spills, sick animals, storm surges, tracking ship/vessels, and natural and/or man-made disasters such as ship grounding.
Purpose: Provide observations within a cultural context, increasing community members’ capacity to enhance security and safety and to become first responders to disasters. To increase understanding of resource security for multiple end users.

Outcomes:
- Observations are transmitted to the ADAC real time IISoS so that the Coast Guard can use to help in Search and Rescue (SAR) efforts.
- Observations will be linked to a whole observing system including data from satellite, radar, and buoys.
- Community Observers can provide nowcast weather conditions in the event of an emergency that no satellite or model can detect – important for SAR.

Outcomes, cont.
- CBONs - increase the observational capacity of residents of Gambell allowing them to capture real-time events that are connected to a host of resources through the ADAC IISoS. This network can lead to increased awareness and facilitate swifter response.
  - Townspeople equipped and trained to help respond to natural and manmade disasters.
  - Maintain real time communication with USCG database.
  - Improve spill response infrastructure
  - Spot and report non-AIS (Automatic Identification System) vessels.
Methods:

- Observers communicate real-time observations, including spatial data to IISoS in Anchorage via Iridium satellite phone.
- Observers maintain a log of observations made and will photograph unusual observations to be shared with Anchorage base.
- Observations made while observers are partaking in marine hunting or boating activities.

View of Gambell taken from the west beach. The three wind turbines can be seen as well as the Sivuqaq Mountain.
Purpose: IISoS will improve situational awareness for maritime responders by:

Integrating and analyzing data from:
- ADAC developed remote sensors
- Event modeling
- Community based observer networks
- Databases
- Unmanned autonomous vehicles
- Communication devices

Providing:
- Incident commanders with actionable information to respond to intentional and unintentional catastrophic events.
- Predictive models and analysis for preparing and planning for these events.
  - Example: Enhance the Coast Guard’s ability to prepare for and respond to oil spills in the Arctic Ocean, to conduct search and rescue missions, and support efforts to prepare for disasters caused by large coastal storms.
- Big data – predictive analytics - of Arctic activities with automated report generation for rapid decision making.
**E2E Theme**

**Maritime Domain Awareness Theme**

**Maritime Technology Theme**

**Integrated Education Theme**

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**OBSERVE**
- CBONS
- Unmanned Ground/Ice Sensors (UGS)
- Unmanned Vehicle borne sensors (UVV)
- DHS Fusion Center and other products

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**ACT**
- Push Situational Awareness and Response data to stakeholders
- Unmanned assets Command & Control
- Sensor tasking

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**ORIENT**
- Regional Ocean, Ice Conditions
- Ship distribution maps
- Crisis Situational Awareness synopses

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**DECIDE**
- Event prediction, Threat Level assessment
- Region Specific Crisis Response Course of Action (COA) planning
- Infrastructure Planning Assessment

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Stakeholders
Methodology:

- Modify Architecture developed by NIST - 4D/RCS (Real time Control System) - includes modules for autonomous intelligent control to process inputs from multiple heterogeneous sources, understand the data, and provide a format for rapid decision making.

- Combine in-situ and remote sensors, models, CBON’s local knowledge.

- Incorporate Big Data software from DHS – Steven Dennis - “Narrative Science” software that automatically generates reports for decision making.

- Use improved assessment and prediction models and data fusion methods.

- Employ automatic methods to integrate Arctic environmental models with observational validation and verification and to plan sensor deployments and observations.

Accomplishments:

- Began initial development of IISoS – Integrating data from external sensors (isotope data), CBON observations, modeling.
**Purpose:** Develop new High-resolution Ice-Ocean Modeling and Assimilation System (HIOMAS) for now-casting and forecasting of Arctic sea ice and currents to assist in navigation for search and rescue.

**Provides:**
- State of the art ocean/sea ice models have a resolution of about 4 km, and ADAC’s goal is to increase the resolution to 2 km.
- Sea ice thickness, concentration, extent, floe size, growth/melt, motion, and deformation, snow depth, surface heat fluxes, salt and freshwater fluxes, stress on the surface of sea ice and ocean, 3-D ocean temperature, salinity, and velocity.

**Methods:**
- Based on ROMS (Regional Ocean Modeling System) and builds on the Hybrid Coordinate Ocean Model developed by the U.S. Naval Research Laboratory, and the University of Washington’s Marginal Ice Zone Modeling and Assimilation System.
- Investigate and select appropriate data from HYCOM Consortium for Data-Assimilative Ocean Modeling and the NAVY Global Environmental Model (NAVGEM) or the NCEP Coupled Forecast System (CFS) to drive the model.
**Purpose:**
Provide a framework at the local scale to identify, track and communicate key environmental hazards in ice-covered extreme maritime environments to enhance and inform MDA emergency response.

**Methodology:**
- Develop and implement a geolocation and conversion algorithm for generation of ice velocity vector data in near-real time, in USCG/ERMA compatible format.
- Generate data for model ingestion/inter-comparison through averaging and potentially resampling to match the model grid.
- Deployment and calibration of dedicated ADAC and COTS sensors to derive sea-level benchmarks to support ingestion of data from in/sub-ice sensors.
Purpose: Support oil spill response planning and risk assessment of the ecosystem impacts of potential oil spills in the Arctic.

Methodology:

- Work with NOAA (Glen Watabayashi) on how to integrate high resolution sea ice and currents data from the ADAC ocean/sea ice model into the GNOME modeling framework to:
  - Improve oil spill modeling and planning in the arctic by providing higher resolution ocean current and sea ice data than is currently available.
  - Incorporate sea ice data within the GNOME modeling framework.
  - Eliminate the over-estimation of oil spreading by the current models in Arctic cold waters, in pack ice, under ice, and on ice.
  - Account for sea ice conditions in the drift computations.
  - Modify the evaporation computations in drift ice, on ice, and in snow.
**Purpose:** Provide quantitative measure of the vulnerability of communities and support the development of tactics and strategies for best response by the communities. This will support DHS efforts to prepare and plan for disasters caused by large coastal storms.

**Model outputs include:** water level and velocity.

**Methodology:**
- Obtain forcing data (surge level) on the ocean boundary from a course-grid NWS model.
- Integrate high resolution sea ice and currents model data.

**Accomplishments:**
- Developed operational code for a real-time storm surge forecasting model for Cook Inlet. Achieved high resolution of 200 yards in contrast to current models whose estimates are obtained at a few distant points for example 40 points in Alaska and 5 in the Cook Inlet.
- Engaged with the coastal community and providing recommendations for water level monitoring stations throughout the modeling domain. The data from these stations will be used for model validation.
**ZENSOR Sensors** – wireless sensors yielding an order of magnitude improvement for remote monitoring, asset management, surveillance and security. The sensors collect, transmit and store data for long periods of time without external power. Successfully tested in Alaska.

**ADAC Implementation**

- Developing protocols for low power transmission to vessels of opportunity and UASs.
- Deploy from UAVs, or other vehicles to pepper a remote landscape - include water and sea ice to monitor ice flow, changes in ice level, movement of oil spills, surges in water surface levels.
- Integrate with Arctic Sea Ice and Storm Surge Prediction model validation.

**Capabilities:**

- No batteries.
- Long lasting – 50 years.
- Distributed wireless networked.
- Each sensor can store information from every device in the network.
- Maintenance free.
- Current data suite: humidity, light intensity, temperature, color, sound, thermal images, vibrations.
- Added data suite: GPS locations, greenhouse gases.
New class of propeller-driven Long-Range AUV – *(MBARI & Woods Hole)*

- **Purpose:** Develop new class of propeller-driven long-range AUV for under ice mapping of oil spills and environmental hazard.

- **Methodology:**
  - Long Range AUV based on the Tethys system.
  - Tethys has been created to carry ‘intermediate power’ sensors for long duration expeditions.
  - The long range AUV will have range up to 600 km with area coverage of up to 1000km².
  - Variable buoyancy enable efficient operations at low speed, and also permits the surfacing and submerging at zero speed, as in open water between ice floes, for satellite communications and navigation fixes.
  - Incorporates ultrashort baseline (USBL) acoustic systems for recovery via homing.
  - Uses augmented AUV simulator and test scenarios addressing high-risk elements, including navigation and sensing systems.

- **Deliverable:**
  In 2016 a long range AUC with high-latitude navigation and oil sensors.
Description: Systems located in remote areas perform continuous measurement of non radioactive stable isotopes, using three meter tower mounted Picarro laser spectrometers.

These systems provide continuous monitoring of:

- Ice retreat over a vast region by detecting open arctic water vapor sources.
  - Example of Benefit when other Data is old or not available: A ship coming to an area, no new data available and no satellite transmission to update its data, can use the isotope data to estimate ice conditions and reduce risk

- Isotopes related to oil spill vapors –
  - Carbon (C) isotopes in carbon dioxide (CO2) and CH4.

- To improve the predictive power—combine with near ground level measurements collected by the CBONS and canopy level measurements using UAV mounted miniaturized systems.

Accomplishments:

- Integrated data into the IISoS.
- Discovered that Arctic Ocean sea ice conditions can be monitored effectively from land-based stations by real-time, continuous water vapor isotope monitoring of winds—*Nature paper 2015*.
- Initial water vapor isotope data from the Port of Anchorage indicates that Cook Inlet sea ice variation seasonally and daily with the tides can be resolved.
- Experiments and testing will be performed on Healey expedition July 2015.
ADAC’s primary stakeholder is USCG. ADAC is working with USCG: Headquarters, R&D Center, District 17, Anchorage Command to ensure customer satisfaction.

E2E provides incident commander single interface to IISoS that is comprised of individual products and systems, which can be also transition individually.

The E2E team will begin the transitioning to DHS stakeholders of the following ADAC products by June 2016:

- Sea ice and Ocean currents models to provide now casting and forecasting data to the Environmental Data Server for the USCG SAROPS. The E2E team will work on the transition with Mr. Arthur Allen, Oceanographer for USCG SAR mission, USCG Office of Search and Rescue. The transition will include testing and verification of the models.
- Complete modular Arctic-specific Ice Navigation course plus modules plus simulator-based practical assessments. The E2E team will work with Ms. Mayte Medina, Chief of USCG Marine Personnel and Qualifications Division to assess and certify the Navigation course using the TRANSAS simulator.
- Develop and test a prototype of the IISoS with RADM Abel and LCMDR McGoey from USCG District 17.
- SmartCam installation at the Port of Anchorage to enhance the existing port surveillance system that was funded by a DHS FEMA Port Security grant, as requested by the port Director.
- Long Range Autonomous underwater vehicle for testing.
To ensure effective training and develop a future work force that will address DHS needs through:

- Curriculum Development
- Experiential Learning
- Training
- Minority Serving Institutions (MSI) outreach
  - Organizing an ADAC “Diversity Day” at UAA
- Internships
- Scholarships for students in STEM, and interest in DHS related careers

**Arctic Education: Implementing the arctic strategy in training**

- Develop ice navigation course with ice navigation software and simulator for training.
- Incorporate research results from Maritime Domain Awareness research, in particular “Arctic Sea Ice and Storm Surge Predictions” into the training software.
7 ADAC team members including students will be participating on two different excursions.

- To gain an understanding of US Coast Guard operations.
- To Perform Experiments:
  - Using isotope sensing systems for determining changes in ocean productivity and contaminants, including fuel/oil leaks and discharges.
  - Ice Floe research - To collect imagery from the ship’s radar system to test and develop algorithms for deriving motion and deformation fields of ice around the vessel.
University of Alaska Anchorage
Center Lead

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- **Theme Leads**
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- **Comp Enterprise Solutions**
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- **Maine Maritime Academy**
  Victoria Blackwood
  Capt. Ralph Pundt
  Capt. Timothy Nease

- **Alaska Community**
  Grace Beaujean
  Aleut International Association
o ADAC was formed at a critical time.

o The Arctic is receiving more focus as a key region of the US with critical global influence.

o The US heads the Arctic Council.

o Through its mission ADAC will improve maritime situational awareness and crisis response to emerging maritime challenges in the dynamic Arctic environment.