

# The Evolving Arctic Domain: Meeting the Challenge on Behalf of the DoD & Nation

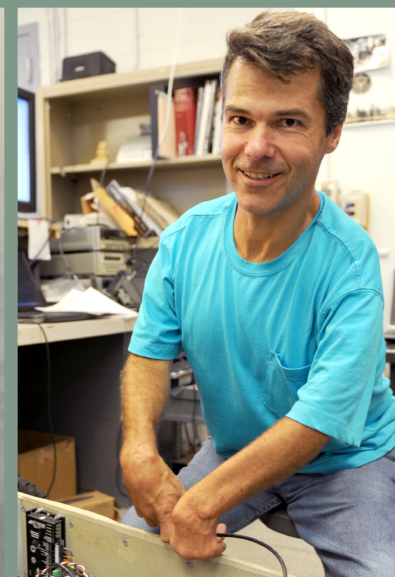
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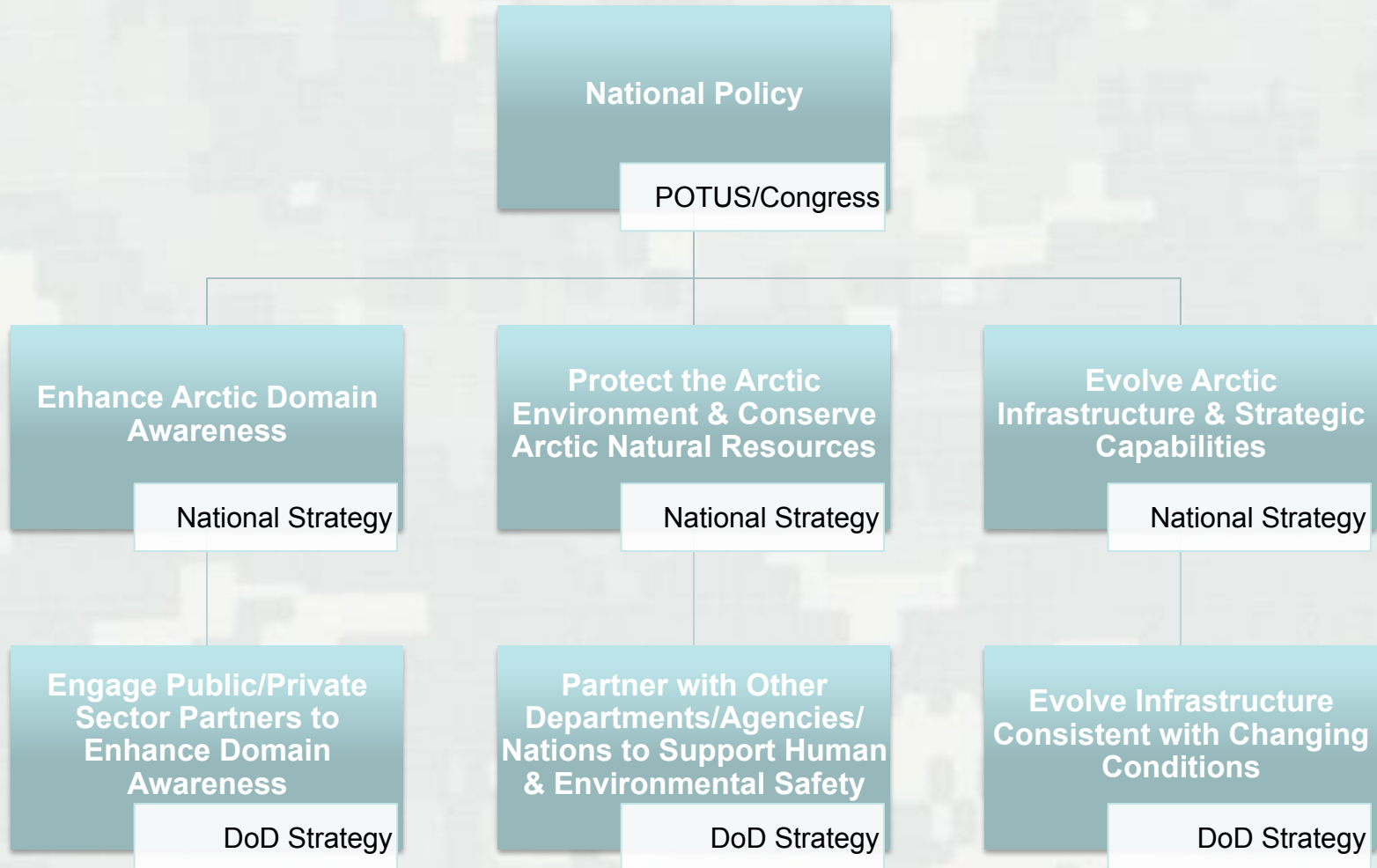


US Army Corps  
of Engineers.

**ERDC**

Engineer Research and  
Development Center

# Strategic Posture



# Capability Thrusts



# Reset CRREL Strategic Objectives

## ■ The Arctic “Vision”

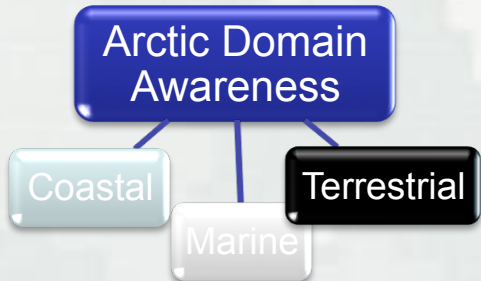
*Enable the DoD and the Nation to make truly effective decisions that mitigate risks to national security, operations, and the environment (marine and terrestrial)*

## ■ Set Strategic Goals (evolving)

- *Science and engineering solutions to support military and civil operations*
- *Integrated technologies for terrain characterization*
- *Infrastructure planning and mitigation of adverse effects due to climate change*
- *Systems and materials evaluation and development for use under harsh Arctic conditions*
- *Holistic understanding of Arctic/subarctic ecosystem processes*



# Major Objective 1: Domain



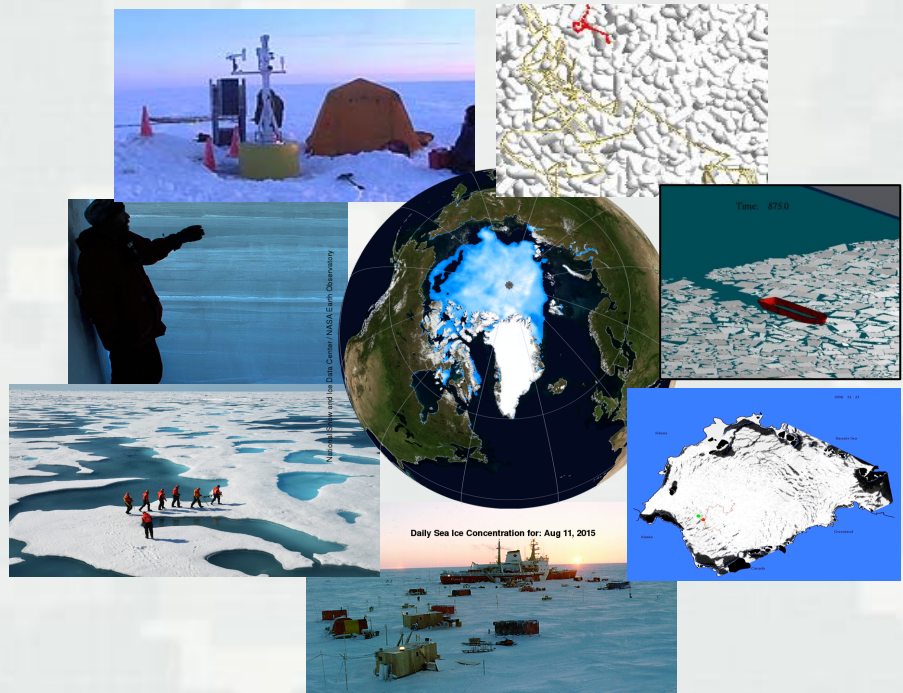
**In Situ Observations**  
(Field Campaigns)  
(Autonomous Sensors/Platforms)

**Signal Propagation**  
(Environmental Effects)

**Dynamic Geospatial Characterization**  
(Remote Sensing)

**Fully-coupled Systems Models**  
(current and future operational awareness)

**Holistic Understanding of the Arctic Domain**



*Build a basic understanding of Arctic climate processes; Incorporate knowledge into predictive models; Provide current and future operational awareness*



# Major Objective 2: Ops & Infrastructure

Arctic Operations & Infrastructure

Natural

Built

Terrain Characterization  
(Integrated Technologies)

Snow & Ice  
(Technologies to Define Engineering Properties)

Infrastructure & Material Systems  
(Design, Develop, Evaluate and Implement)

Ecosystem Assessment  
(Contaminant effects, fate and transport)

Evolve Operations with Changing Conditions



Mitigate operational risks via a holistic understanding of ecosystem processes; Predict adverse effects on natural and built infrastructure; Provide science and engineering solutions to ensure a sustainable presence



# RD&E Topic Areas at CRREL

1. **Infrastructure** – Structure systems, material evolution, energy production, utilities....
2. **Logistics, Mobility and Operations** – Human / vehicle / terrain interactions. Austere entry and maneuvers.
3. **Permafrost** – Rapid ground ice assessment, stand off characterization techniques, refined engineering parameters.
4. **Snow Characterization** – New technologies to define engineering properties, processing technologies and using snow as a construction/concealment material
5. **Arctic Climate** – Warming trend and implications, observation sensors and networks (domain awareness: RS/GIS), changing weather systems.
6. **Durable Adaptation** – mitigating climate change impacts, innovation and improvements. Sustained and sustainable solutions.
7. **Sea Ice** – Operations impact, monitoring, avoidance, properties.
8. **Environmental Engineering** – Prevention, assessment, mitigation.



# Example 1: Topic Area *Permafrost*

- **Existing RD&E Programs**

- Permafrost characterization methods
- Development of low altitude aerial EM methods
- Mitigation of thaw destabilized infrastructure
- Contaminants and Arctic installations
- Permafrost terrain climate warming analysis
- Arctic installations permafrost and hydrology
- Alaska Permafrost Research Station
- Permafrost Tunnel and Farmers Loop

- **Capability Enhancements Linked to Topic Area**

- Vegetation and near surface soil behavior
- Cold regions building envelope performance
- Cold regions thermal modeling
- Replacement of heavily used geophysics and drilling equipment





# Example 2: Topic Area *Snow Characterization*

## ▪ **Existing RD&E Programs**

- Snow roads, runways, tunnels, trenches, foundations and built infrastructure
- Snow drifting, deposition and mitigation
- Snow contaminants and pollution
- Snow friction
- Snow strength
- Snow densification and processes
- Snow microbiology
- Water resource from snow basins (hydrology/hydraulics)
- Snow remote sensing

## ▪ **Capability Enhancements Linked to Topic Area**

- Snow process numerical modeling
- Snow remote sensing
- Instrument suite development/integration of current unique capabilities
- Augment heavily used micro-CT, high res IR video, etc.



# Example 3: Topic Area *Sea Ice*

- **Existing RD&E Programs**

- Sea ice monitoring, buoys, RS/GIS, domain awareness
- Sea ice processes and properties (in-situ, remote and modeling)
- Oil in sea ice
- Oil spill clean-up in ice rich seas
- Sea ice strength and forces (ships, fixed infrastructure)

- **Capability Enhancements Linked to Topic Area**

- Sea ice mechanics
- Sea ice properties
- Develop unique instrumentation for measuring thermal properties
- Ship hull modeling/ice interaction/ice forces
- Facilities upgrades



# Objectives Driven by Overarching Needs

Increased Maritime  
Traffic, Militarization  
and Resource  
Extraction



Energy Security,  
Optimized Delivery,  
Reliable Systems

Innovation to  
Optimize  
Resources,  
Minimize Logistics



Human Presence  
Drives Increased  
Arctic Development  
= Infrastructure/Ops/  
Material  
Requirements



# The Biggest Challenge

- **There are no earmarked “direct” funds**
- **This is an organic, bottom-up effort**
- **We will develop and leverage technology and customers**
- **Build on our existing “arctic” customer base**
  - Army, Navy, Air Force
  - Coast Guard
  - NASA, NSF, NOAA, Smithsonian
  - National Academy of Sciences
  - Academic institutions
  - oil consortiums
  - Many international partners (e.g. Australia, Chile, BAS, etc.)



# New Starts & New Technologies

- **Renewed partnership with Natick Labs for material development and arctic terrain classification (Domain Awareness/Infrastructure)**
- **UAS developments to marry EMI, GPR and other technology to small, efficient aerial delivery systems (Domain Awareness)**
- **New RS/GIS programs focused on high latitude water resources including sensor packages (Protect Environment)**
- **New Army effort on smart building technology and resilient infrastructure (Infrastructure)**
- **NORAD/NORTHCOM program for enhanced arctic energy security (Domain Awareness/Infrastructure)**



# Thank You & Questions



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