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

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**Strategic Posture**

- **National Policy**
  - POTUS/Congress

- **Enhance Arctic Domain Awareness**
  - National Strategy
  - Engage Public/Private Sector Partners to Enhance Domain Awareness
    - DoD Strategy

- **Protect the Arctic Environment & Conserve Arctic Natural Resources**
  - National Strategy
  - Partner with Other Departments/Agencies/Nations to Support Human & Environmental Safety
    - DoD Strategy

- **Evolve Arctic Infrastructure & Strategic Capabilities**
  - National Strategy
  - Evolve Infrastructure Consistent with Changing Conditions
    - DoD Strategy

Innovative solutions for a safer, better world
Capability Thrusts

- Engage Public/Private Sector Partners to Enhance Domain Awareness
  - DoD Strategy
  - ERDC Strategic Thrust: Modeling, Mechanics, Waterways
  - ERDC Strategic Thrust: Autonomous Sensors, Climate Dynamics
- Protect the Arctic Environment & Conserve Arctic Natural Resources
  - DoD Strategy
  - ERDC Strategic Thrust: Holistic Understanding
  - ERDC Strategic Thrust: Detection & Mitigation
- Evolve Infrastructure Consistent with Changing Conditions
  - DoD Strategy
  - ERDC Strategic Thrust: Integrated Technologies
  - ERDC Strategic Thrust: Material Performance

Innovative solutions for a safer, better world

BUILDING STRONG®
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

Arctic Domain Awareness

Coastal  Terrestrial  Marine

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
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.


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

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

Innovation to Optimize Resources, Minimize Logistics
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