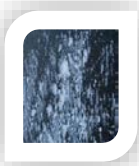




Autonomous Remote Sensor Networks

- Graduate Student: Matt Ahlrichs
- Project Leads: Dr. Martin Cenek and Dr. Aaron Dotson
- Hosting University: University of Alaska Anchorage
- Student Participation: Undergraduate assistance in sensor construction
- Faculty Mentor: Dr. Aaron Dotson
- Project Support: Dr. Aaron Dotson, Dr. Martin Cenek, and Dr. Robert Lang
- Project Advocate: Arctic Domain Awareness Center





Remote Autonomous Sensors: Description and Baseline

- **The remote nature and extreme climates along the US/Canadian Border makes monitoring these large areas cost prohibitive**
- **Currently, the United States has large gaps in its ability to detect movement on an as-needed-basis in remote areas**
- **This proposed network aims to meet that need by developing a framework for an autonomous sensor network that is low cost, able to function for a defined period of time, robust, and easily deployable**
- **This platform can function as a stand-alone monitoring network or provide additional spatial and temporal resolution to existing monitoring networks**





Project Description

- **Determine feasibility of a hypothetical sensor network in northern Montana**
- **My project role is divided into three tasks**
 - **Estimate time-to-failure of a network**
 - **Develop a redundancy model for sensor communication in ArcGIS**
 - **Complete a Life Cycle Assessment (LCA)**
- **For the purposes of this study the model will estimate sensor loss over a three-month period, ensuring that the remaining network does not have significant gaps in coverage which preclude being able to receive and transmit data**



Remote Autonomous Sensors: Relevance and Method

- **Currently, the United States has large gaps in its ability to detect movement on an as-needed-basis in remote areas**
- **This study aims to create the framework for a model that will determine if a sensor's design and distribution is appropriate for the target environment.**
- **Reduce the number of sensors that will need to be deployed and subsequently collected**
- **Each task has its own unique methodology**

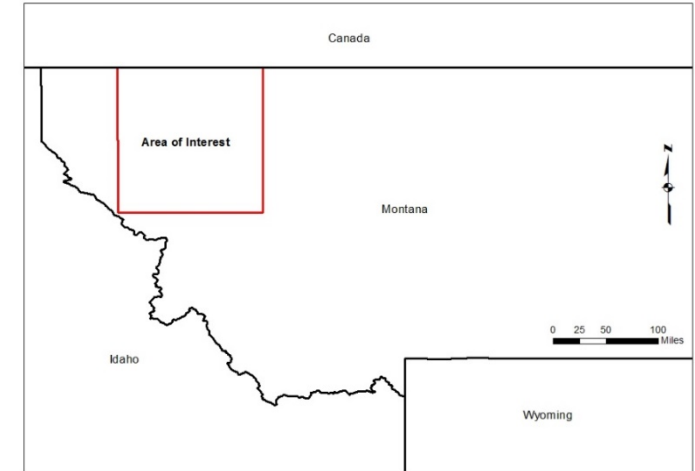




Methodology

- Time to failure of device
 - Battery type
 - Seasonal changes
 - ArcGIS model to estimate where sensors will fail due to environmental conditions resulting from topologic, meteorologic, and land cover

- Communication redundancy model
 - Use ArcGIS to estimate the impact of topologic, meteorologic, and land cover to acoustic receiving distance and radio frequency transmission distance

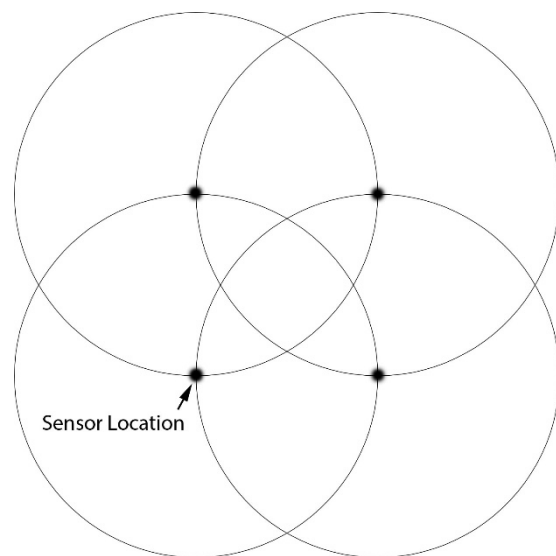


<http://main.panasonic-eneloop.eu/en/eneloop-self-discharge>



Methodology

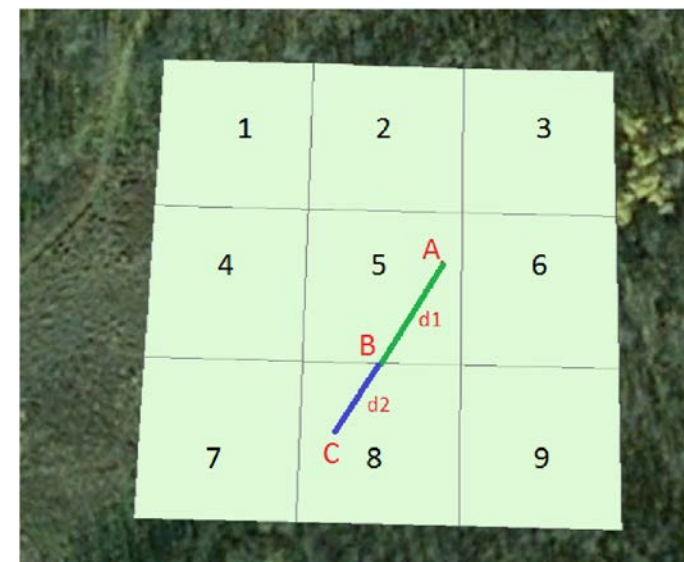
Sensor Spacing:



Acoustic Transmission Distance:



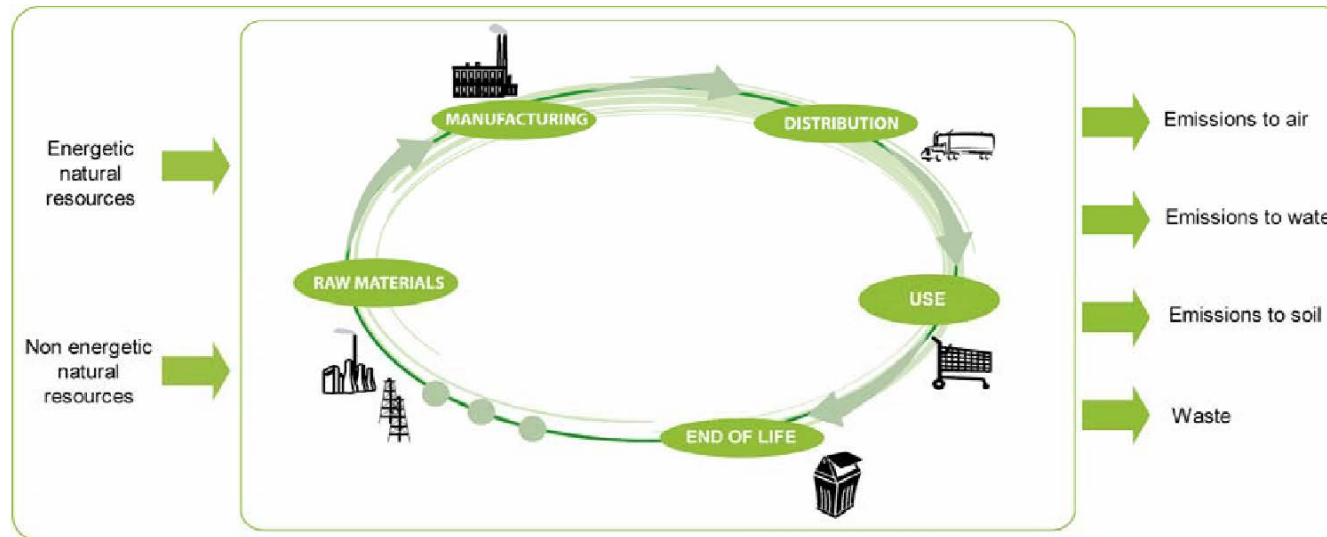
Radio Frequency Propagation Loss:





Methodology

- Life Cycle Assessment
 - Use existing LCAs to guide emission and toxicity calculation
 - Identify which components have the highest life cycle costs
 - Find alternative materials to reduce environmental impact and ensure ability to acquire components in the long-term





Remote Autonomous Sensors: Schedule and Metrics

- **Currently in year two of the project.**
- **Milestones:**
 - **Gathered necessary datasets for GIS analysis**
 - **Completed review of existing LCA literature on components of sensor network**
 - **Began figure generation of GIS analysis**
 - **Began LCA figure generation of existing research**
- **Current year metrics:**
 - **Complete GIS figure generation**
 - **Complete LCA figure generation**
 - **Complete first chapter of thesis**



Remote Autonomous Sensors: Planned Research Outcomes

- **Feasibility of current design in Montana – will our network succeed**
- **Analysis framework for future networks**
- **Design change recommendations**
- **This framework should be used to ensure design feasibility for future government monitoring networks**



Remote Autonomous Sensors: Transition Plans

- **In order to achieve the desired outcomes of the research, investigation team plans the following transition pathways:**
 - **This framework will be published in Environmental Monitoring and Assessment**
 - **Coordinate the use of this framework with Coast Guard and other DHS entities**



Experience as an ADAC Fellow

- Participated and presented research at nationwide conferences
- Completed summer internship with the Maritime Security Center at Stevens Institute of Technology
- Understand STEM job opportunities in the government
- ADAC has opened their resources to aid in helping lining up future career possibilities
 - Ideally involving disaster response





Ready for questions

Feedback...

- What are we missing?
- What can we improve?
- Who should we contact to improve the integration of this research?

