**NASA DEVELOP National Program**

**Fall 2015 Project Proposal**

University of Georgia

**Antarctica Climate**

Applying NASA Earth Observations to Assess the Impact of Climate on Sea Ice Dynamics and Ecological Disturbance and Productivity in McMurdo Sound, Ross Sea, Antarctica

**Objective:**

To assess the impact of climate on ecological productivity and benthic disturbance by measuring changes in the temperature and areal extent of sea ice deposits encumbered with the ecosystem engineer, the Antarctic scallop, *Adamussium colbecki*.

**Community Concern:**

Waters surrounding Antarctica are rich in economically-important species, yet little is known about ecosystem interactions in relation to climate change. In particular, sea ice is integral to the health of Antarctic ecosystems. Decreased sea ice can lead to a decrease in nutrient supply, directly affecting productivity and population densities. Anchor ice forms around scallops living on the seafloor. Over time, due to a density contrast, this anchor ice floats from the sea floor to the sea ice and, through ablation, is exposed on the surface, thereby serving as a proxy for anchor ice disturbance and scallop populations. By measuring the areal extent of sea ice, in association with temperature, we can indirectly measure benthic disturbance from anchor ice in the Ross Sea and document changes in relation to climate change.

**Partner Organizations:**

The Wadsworth Center: New York's State Public Health Laboratory (End-User, POC: Samuel Bowser, Ph.D., Research Scientist)

National Science Foundation (Boundary Organization, POC: Charles D. Amsler, Ph.D., Program director, Antarctic Organisms & Ecosystems)

University of Georgia (Collaborator, POC: Sally Walker, Ph.D., Professor of Geology and Marine Sciences)

Contact has been made with Charles D. Amsler at the National Science Foundation Office of Polar Programs, who provided a letter of support. Dr. Sam Bowser has active NSF Polar Programs support for field research in Antarctica and would benefit from the addition of remote sensing data, noted in his letter. Additionally, Dr. Sally Walker is in strong support of this project because of its potential impact on decision-making processes related to the Antarctic Treaty.

**Letters of Support:** 1)National Science Foundation, Charles D. Amsler, Ph.D., Program Director, Antarctic Organisms & Ecosystems; 2) The Wadsworth Center: New York's State Public Health Laboratory, Samuel Bowser, Ph.D., Research Scientist; 3) University of Georgia, Sally Walker, Ph.D., Professor of Geology and Marine Sciences.

**Decision Making Process:**

In 2041, the Antarctic Treaty will be modified, and the environmental protection of the continent may be at risk. Due to the difficulty and high cost of conducting survey work in Antarctica, alternative methods are both necessary and of great value. Currently, field collection is the only method our partners have for surveying ecological populations in association with sea ice melting. Remote sensing data provided to the National Science Foundation (NSF) Polar Programs and scientists, like Dr. Samuel Bowser, will supply baseline data to model benthic ecosystems and aid in assessing ecological risk in response to climate change. To date, NASA products have not been tied to benthic ecological impacts by directly measuring sea ice disturbance. However, such deliverables can be used for long-term monitoring of Antarctic benthos and resource management decisions, essential data to support Antarctica’s environmental conservation. These data are crucial as we near the end of the current Antarctic Treaty.

**Earth Observations:**

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| --- | --- | --- |
| **Platform** | **Sensor** | **Geophysical Parameter** |
| Terra | AIRS | Historical atmospheric temperature  |
| Aqua  | MODIS | Historical land surface temperature |
| Terra | MODIS | Historical land surface temperature and snow cover and sea ice extent data |
| Landsat 5 | TM | Land cover  |
| Landsat 7 | ETM+ | Land cover |
| Landsat 8 | OLI | Land cover |
| NASA ICESat | GLAS | Ice-sheet topography and extent |
| P-3 Aircraft | IceBridge | Polar ice extent, Antarctica 2013 campaign |

**NASA Earth Observations to be Highlighted:**

Terra and Aqua collect data on Earth’s land, atmosphere, and oceans that provide information useful for assessing climate change. Their orbital differences result in different data collection times for a given location. Their high temporal resolution will also allow for robust datasets concerning temperature and sea-ice fluctuations. The MODIS sensor will provide land surface temperature and snow and ice extent at moderate resolutions, while AIRS will provide atmospheric temperature data. The historical Landsat imagery can be used to map change in sea ice extent.

**Ancillary Datasets:**

To ensure robust spatial maps for this project, scallop collections, sea-ice field transects and underwater ecosystem video data from 2008 and 2010 will be made available for the proposed project; these data are provided by Dr. Sally Walker and Dr. Samuel Bowser and were collected under the auspices of NSF Polar Programs. Additionally, DigitalGlobe imagery specialized in sea ice extent coverage will be used providing valuable information for sea-ice dynamic analysis.

**Decision Support Tools & Analyses:**

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| --- | --- | --- |
| **Proposed End Products** | **Decision to be Impacted** | **Current Partner Tool/Method** |
| Sea Ice Differential Melting Map | Climate mitigation efforts and the Antarctic Treaty | None |

*Sea Ice Differential Melting Map –* Analysis of MODIS derived atmospheric and land surface temperature data to measure changes in sea ice surface temperature through time. Analysis of Landsat data to determine melting rate of sea surface ice. Assess correlation between the two. Examine distribution of sea ice as temperatures change.

* Create a time series of sea ice surface temperature maps
* Create a time series of sea ice extent maps
* Correlation/statistics
* Overlay assemblage data and examine relationships

**Project Details:**

**National Application Areas Addressed:** Climate, Ecological Forecasting

**Source of Project Idea:** The motivation for this project coincides with the intentions behind NASA Earth Sciences to develop understanding of Earth’s climatic processes. Antarctica is a remote region where little is known about underwater ecosystem dynamics, which current methods rely on short 30-minute dives into the coldest waters on Earth. Using anchor ice deposits archived in Antarctic sea ice provides not only a novel and relatively quick method for assessing ecosystem disturbance, but also provides a proxy for population estimates concerning the ecosystem engineer, *Adamussium colbecki*.

**Study Location:** McMurdo Sound, Ross Sea, Antarctica (sites: Explorers Cove, Cape Chocolate, Ferrar Glacier region, Bay of Sails, Terra Nova Bay)

**Period being Studied:**  October 1980-October 2014

**Advisors:** Dr. Sally Walker (Professor, Department of Geology, University of Georgia), Dr. Adam Milewski (Assistant Professor, Department of Geology, University of Georgia)

**Participants Requested:** 4

**Project Timeline:** 1 Term: Fall 2015

**Software & Scripting Utilized:**

* ArcGIS - Raster manipulation/analysis, image enhancement & map creation of Landsat TM and ETM+, Aqua/Terra MODIS
* ENVI – Geospatial analysis and spectral image processing of Landsat TM and ETM+ and Aqua/Terra MODIS data