

## Mapping NOAA's Marine Research in the Arctic

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### *Abstract*

The Arctic holds a special allure for researchers and in the mind of the general public. The United States has a long history of research in the Arctic. For a project to document the history of NOAA's work in the region, we are conducting oral history interviews and gathering archival materials and historical resources that will extend baselines for studying ecological and environmental changes in the Arctic back in time. As with all research, NOAA's work in the Arctic has both spatial and temporal components. The results of these interviews will be used to create a geodatabase of the spatial and temporal aspects of the research. From the materials gathered, we hope to be able to discern spatiotemporal patterns in areas where work was conducted. To make our results available for educating the public, we will be creating Web pages and visualizations of the spatial aspects of the research.

### *Introduction*

Seen as cold, remote and forbidding, the Arctic occupies a special niche in the public imagination. Strategically important, resource-rich and physically fragile, it also holds a special place in the history of scientific research. While the results of the research are clearly described in journal articles and other publications, the background of where research was conducted, when it was conducted and why it was conducted may be less apparent. For a project to document the history of NOAA's work in the region, we are conducting oral history interviews and gathering archival materials and historical resources that will extend baselines for studying ecological and environmental changes in the Arctic back in time. These interviews are intended to explore the background of the research projects that were conducted. We aim to gather information on where projects were conducted, when and why they were conducted, who funded the research and the interconnections between research projects. As with all research, the conduct of NOAA's work in the Arctic has both spatial and temporal components. We are using a variety of geovisualization techniques to explore some of these patterns.

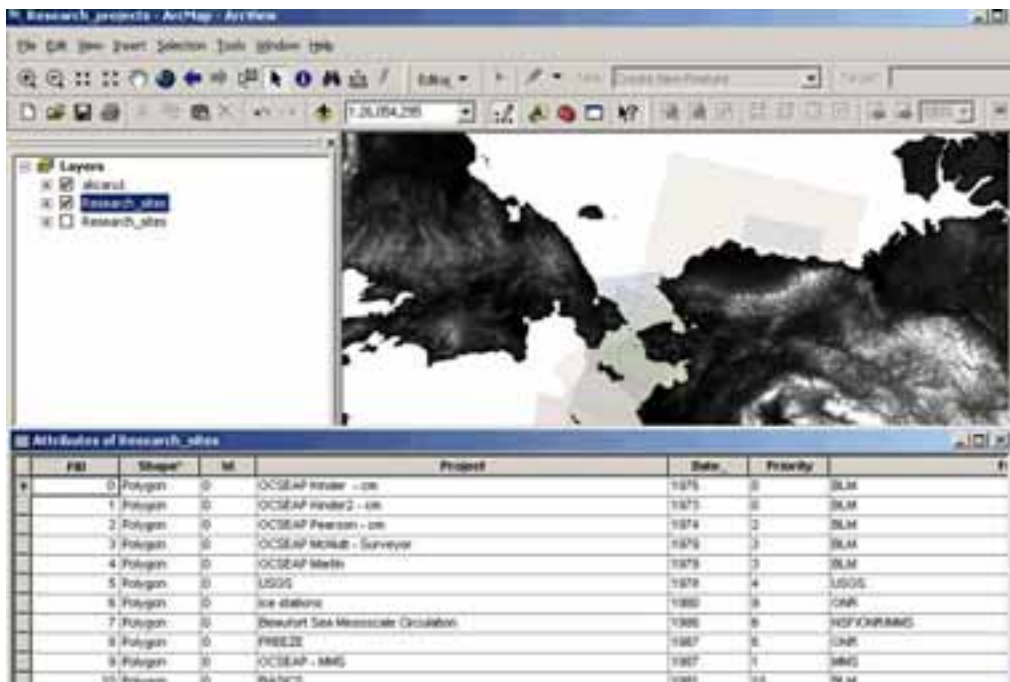
Creating visualizations of the historical patterns of research has a number of technical and sociological challenges. Traditionally, history of science has been text-based, both for sources and for the presentation of ideas. Historians tend to be more comfortable with the linear format of an article or oral presentation. Geographers who create visualizations and web presentations may use similarly textual sources, but the results are visual and may well be non-linear. This linear/textual versus non-linear/graphical dichotomy can be challenging in this kind of project. However, there is also an increasing desire, especially within the history and historical geography communities, to explore the possibilities of using GIS to represent and analyze historical data.

We are using the traditional historiographic techniques of oral histories and archival research to gather the materials for the project. The results will be presented both in more traditional textual formats and as maps, visualizations and web pages. The project includes

historians and geographers, and the results are being presented at both geographical and historical professional meetings.

### Data

For the project we are seeking information on NOAA and non-NOAA research projects in the Arctic and the Bering Sea in the 20<sup>th</sup> century, primarily during the later Cold War era. We are interested in temporal extent, spatial extent, funding (both stated and hidden sources), research area (biology, geology, geophysics, physical oceanography and meteorology), scientists involved and links to other projects. The latter will be used for building a research web of how the projects fit together. The basic data for the visualizations are the locations, durations, funding sources and participants in research projects. Ancillary information includes the type of research conducted, links to published results, relationships between projects and participants in the projects. Data sources include annual reports of the NOAA laboratories involved, journal articles on projects, summaries of US Arctic research and on-line metadata projects such as the North Pacific Ecosystem Metadatabase (<http://www.pmel.noaa.gov/np/mdb/index.html>).



**Figure 1** - Database of attributes for research projects

These sources have allowed us to create a general framework of the NOAA projects conducted from the 1970's to the 1990's. We will be using information gathered in the oral history interviews to fill in this framework and to extend our data into the past. The interviews should also allow us to better understand the relationships between projects and also the funding sources in cases where the true funding agency is not clear from the official report. We are also aware that there are many contemporary and earlier efforts in the area. These include activities

related to the International Geophysical Year (1957-58), military activities both classified and unclassified, university research and research conducted by other government agencies. We hope to include similar data about these projects as they become available.

### Methods

The data are collected in a database and used to specify attributes for a shapefile outlining the research area. The shapefile is created by digitizing maps of cruise tracklines, data points or station locations. Where a cruise report is not available, details such as the bounding box given in a metadata record are used. Temporal duration is taken to be the time during which samples were collected or instruments were deployed. The other ancillary information is added from sources such as final reports and journal articles. One challenge is determining how to characterize the nature and aims of programs when they may, at times, have mixed or conflicting goals. This will also be the case for programs that had classified and unclassified components. We are creating a hierarchy of attributes about funding and goals to allow for complex searches.

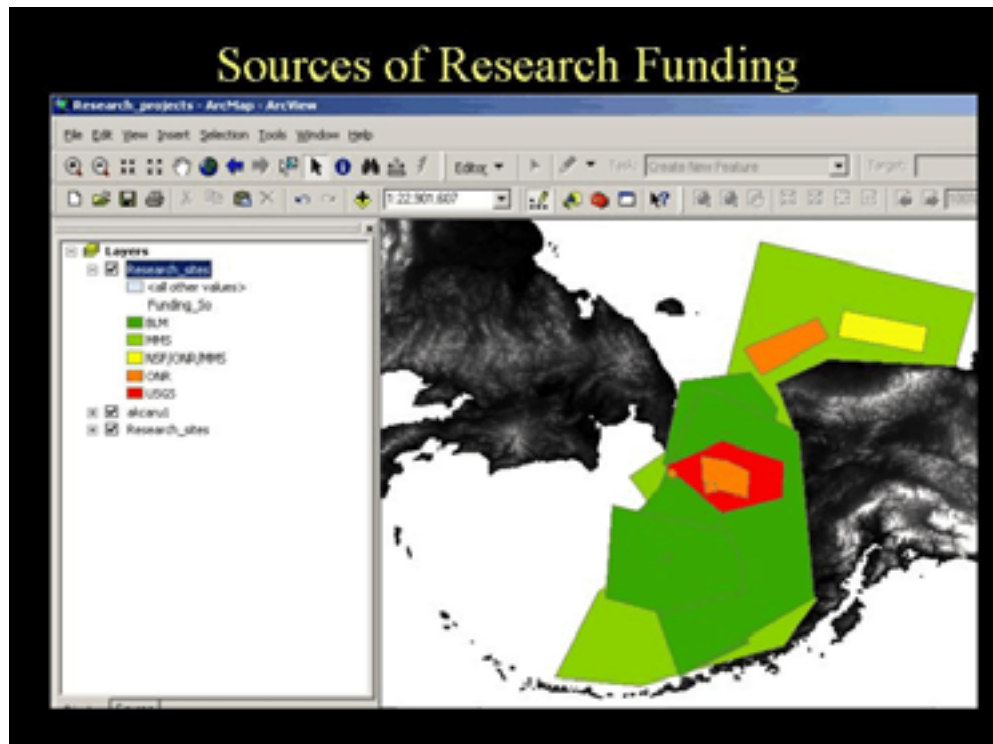
The shapefiles are used to create a project in ArcGIS and supporting information, such as bathymetry and topography, are added. Static maps are created to show overall patterns for scientific research. Tracking Analyst is used to create animation files (.avi) based upon the duration given for each project. The AVI file is annotated as needed.



Figure 2 - Locations of research projects

## Results

The database has been used to create preliminary maps of research projects and also of the funding agencies for the projects. The maps of the projects show the wide range of sizes and locations of projects while the maps of the funding sources show the predominance of Minerals Management Service funding as a result of research supporting exploration for oil and gas in the Bering and Chukchi Seas. Expanding our database to research prior to the start of this exploration should show how research is tied to the exploitation of a variety of resources. Gaining more information on the unpublicized aspects of research funding may show how strategic concerns helped or hindered which projects were funded.



**Figure 3** - Funding sources for projects

Animations were created using Tracking Analyst. The animations show some patterns in the location of projects over time - but again, a more complete database will show more temporal patterns. To see the animations go to [http://www.oregonstate.edu/~vancet/PAIG-Cold\\_History/Mapping.html](http://www.oregonstate.edu/~vancet/PAIG-Cold_History/Mapping.html). These preliminary visualizations have been used as a part of a series of web pages we have created for the project [[http://www.oregonstate.edu/~vancet/PAIG-Cold\\_History/Cold\\_History.html](http://www.oregonstate.edu/~vancet/PAIG-Cold_History/Cold_History.html)].

Eventually, the web pages will contain a history of research, extracts from the oral history interviews, an enhanced timeline of research in the Arctic, links to supporting materials and enhanced visualizations. We will also be exploring ways to represent the intellectual web of the research - the interconnections between projects and between researchers on the projects.



Figure 4 - Web page presenting results of the project

### Further plans

We plan to continue gathering data on NOAA projects. In the beginning we have concentrated on oceanographic cruises and projects, we will be expanding our scope to include fisheries programs and activities of the Weather Service. We will also be adding activities of the various precursor agencies to NOAA, including the Weather Bureau and the Bureau of Fisheries. We will be enhancing the animations and may investigate tools such as *TimeMap* (<http://www.timemap.net/>) which is a visualization and animation tool developed especially for historical datasets. With the increased interest in the history of the International Polar Years (IPY), we will also expand our datasets to include non-NOAA research in the Arctic. We will further explore ways to spatialize the patterns of scientific research and ways to represent intellectual webs. We will continue to present our ideas and results to both historians and geographers to gain their differing insights on the problems being studied.

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### *References*

Knowles, Anne Kelly. in development. *Placing History: How Maps, Spatial Data, and GIS are Changing Historical Scholarship* (with Amy Hillier, ESRI Press).

Cold History- NOAA in the Arctic web page,  
[http://oregonstate.edu/~vancet/PAIG-Cold\\_History/Cold\\_History.html](http://oregonstate.edu/~vancet/PAIG-Cold_History/Cold_History.html) , accessed 6/22/06.

North Pacific Ecosystem Metadatabase, <http://www.pmel.noaa.gov/np/mdb/index.html> , accessed 6/21/06.

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