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**It All Adds Up: Contributing Climate Data to the Community.**

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### **Background and Premise:**

Prior to 1880, there is insufficient weather data available for climate scientists to use in order to formulate global temperature averages for the study of the world's climate. The data sets at NASA's Goddard Institute, NOAA's National Climatic Data Center and the United Kingdom's Meteorological Office's Hadley Center all begin in 1880. So, how do scientists begin to supplement the data sets to aid in climate related research? Well they're going to get creative.

In order to supplement the historical record, scientists at a number of different institutions throughout the world have sought out other means in which to locate weather data for study and use. One creative way that scientists have located such data is through marine logbooks, which over the past 20 years, has resulted in the creation of a multitude of databases containing digitized climate records.

Starting in 2000, the National Oceanographic Atmospheric Administration's (NOAA) Climate Database Modernization Program (CDMP) digitized climate related records through individual projects which resulted in the creation of 56 million climate-related images. One such project even occurred on an international scale as the CDMP partnered with the British Archives and the Meteorological Service of Canada to digitize marine logbook resources.

Similarly, the European Union funded the Climatological Database for the World's Oceans (CLIWOC) project from 2001-2003 in an effort to make historical climate data available. This project digitized and transcribed British, Dutch, French, Spanish, and Argentinean ships' logbooks created between 1750-1850.

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Upon the conclusion of the CLIWOC project, NOAA began the Recovery of Logbooks and International Marine data (RECLAIM) project, which sought to build upon and add to the existing data set previously compiled by the CLIWOC project.

Recent and ongoing projects include the Old Weather project, which uses crowdsourced transcription to collect and collate sea ice and weather data from 19th and 20th century military vessels that sailed through the Arctic regions.

The Joint Institute for the Study of the Atmosphere and Ocean (JISAO) at the University of Washington in conjunction with the National Archives and Records Administration (NARA), NOAA, and the Archives Foundation created *Seas of Knowledge: Digitization and Retrospective Analysis of the Historical Logbooks of the United States Navy*. This project aims to digitize and make available historical data from United States Naval ships for inclusion within the Old Weather Project.

### **Why Logbooks?**

Logbooks were created and maintained by a number of ships' crew to record events, transactions, and remarks about navigation during a vessel's voyage. Depending on the type of ship and the creator of the logbook, there could be a number of different types of entries or focus of the logbooks' content. For instance, logbooks can contain entries regarding day-to-day shipboard operations, lists of provisions and their replenishment, engineering reports, ship sightings, biological sightings, crew lists, or a combination of the above. In addition, marine logbooks also consistently recorded location and the weather.

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Weather data derived from logbooks can be broken down into two parts: observational and instrumental. Observational data consists of fog, precipitation, and the state of the sea, i.e., “heavy,” or “calm.” In some cases, depending on the direction of the voyage, logbooks recorded the location where the vessel first saw and encountered ice. Instrumental weather data that is quite specific is also present in some logbooks with entries annotating the wind speed and direction, as well as air temperature. Much of this data is being recorded systematically, in some instances data is recorded every hour. Couple that with the total duration of the ships’ voyage and there could be a significant amount of individual data points contained within each logbook.

I first became familiar with these projects while working on transcribing fisheries logbooks at my last institution and was fascinated by the creative use of these collections items and have since been able to renew my interest at the University of Notre Dame.

The Department of Rare Books and Special Collections (RBSC) at the University of Notre Dame is well known for holdings that are particularly strong in Catholic studies, Irish studies, Italian literature, Latin American studies, American Studies, and, of course, being Notre Dame - sports. During a collections assessment I discovered that RBSC does maintain a handful of 18th and 19th century logbooks.

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\*\*\*\*\*LOGBOOK EXAMPLES\*\*\*\*\*

#### **Bonaventure:**

Recounts the 1739-1740 voyage of the Bonaventure from New England to the Leeward Islands (Antigua, Nevis, etc.) The format of the logbook provides space to record data every two hours

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(wind speed, direction, and course) with observational data and latitude longitude recorded in the right column. Entry on the first part of the 20th day out at sea “Weather Sabath Day squally and rainy.” The latter part of the day “fairwether” and then records the latitude. Entries such as this - wherein the observational data is recorded three times a day is quite common.

#### **Meridian Logbook:**

Recounts the 1839-1840 voyage of the Meridian to the Canaries, South to Brazil, through the Caribbean and the Gulf of Mexico. This format is more narrative than the Bonaventure. But still maintains the three times a day observational data reporting structure. The entry from Sunday May 17, 1840 reads: “Begins with strong fles from the eastward to. Heading to the Southeast. Middle part South - Southeast squally. Later part set the foresail” Closes out the entry for the day by recording “Ends”

#### **Corvo/Enterprise Logbook:**

Recounts the voyage of the ship Corvo and the Brig Enterprise in waters off the coast of Chili and the Falkalnd Islands between October 6 1840 and 17 may 1841. Similar structure to the Meridian logbook. And since its a whaling vessel - it also includes some really neat drawings of whales. The entry for March 29, 1841 reads “Comes in with a strong breeze from the southwest and light squalls of rain. At 4pm went out and saw nothing (no whales) the later part string gales from the southwest and squally”

### **USS Bonita Logbook:**

This example is unique among the other logbooks in that it was written from the perspective of the ships' purser. As such, there is no format to the logbook at all - rather its more in the style of a journal. Nevertheless, the logbook does still contain weather data as evidenced by the entry on September 3, 1846. The entry states: "The morning quite rainy and very warm - the thermometer reading at 86 degrees.

### **Raven Logbook:**

Logbook of a voyage of the Raven with daily entries from 28 August 1855 to 13 June 1856. Sailed from Virginia to Australia, to Padang in Sumatra and then westward to New York. The format of this logbook allows space for recording the ships speed and wind direction every hour. November 25, 1855 notes "strong breezes and thick foggy weather throughout the day." Apparently they also killed a pig.

Just to sum up the locations and data points represented in the logbook examples. We have the Bonaventure data starting from New England to the Leeward Islands (Antigua, Nevis, etc.) represented with two-hour entries. The Meridian with entries from Massachusetts to the Canaries, then south to Brazil, and home by way of the Carribean and the Gulf of Mexico recorded in three hour increments. The Corvo/Enterprise data includes points at the southern coast of South America, again with observations recorded three times a day. The USS Bonita with logbook entries starting in New York and mentioning points along the Gulf coast of Mexico in a more narrative format. Finally the Raven voyage which contains entries from Richmond,

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Virginia to Sydney, Australia, Padang in Sumatra then on to New York with hourly entries.

Combined, this data truly does add up.

This discovery led me to three questions: First, if Notre Dame has marine logbooks, what other repositories that are not traditionally associated with the maritime industry have them? Second, how do repositories describe their materials to aid in their discovery? Last, in the absence of a mechanism to contribute our data to large-scale projects, how do we leverage and describe the data contained within the logbooks to ensure their discoverability?

#### **The Scope and Method:**

Knowing that projects like this have happened in the past, and that some projects are still ongoing, I needed to set the scope of my initial research with that in mind.

First, I decided to only search for logbooks contained in the United States that were most likely not utilized in one of the large-scale projects. Second, I only searched for logbooks using Archivegrid - knowing full well that this was not an exhaustive list of all logbooks available in repositories across the United States.

Third, I purposefully did not include items from institutions that have a collecting focus on the maritime or sailing industry. Repositories such as the Peabody Essex Museum, New Bedford Whaling Museum, etc., which ultimately led me to exclude the entire state of Massachusetts. The rationale behind this decision was based on the overall ArchiveGrid search yield. The results from an ArchiveGrid search for “logbook” yielded 6,769 logbooks, of those, 2,846 were

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contained in repositories within the state of Massachusetts. Excluding these items not only limited the scope, it also limited the results to logbooks that were less likely to be included in another large scale project in the future.

Last, the scope was limited to only include logbooks created prior to 1880. Again, the date that is most widely believed to be the beginning of officially recorded weather.

### **The Results:**

Using the parameters above, the search yield contained 325 records from twenty-seven different states. Of those 325, only 106 specifically mentioned weather in their description (Scope and Content note in a finding aid or 520 MARC field in the catalog record). Further, of the 325, only four utilized a Library of Congress Subject Heading (Meteorology, Weather, and Climatology) as access points to aid in discoverability.

### **Conclusion:**

Weather data prior to 1880 was insufficient to calculate global temperature averages. Logbook data is being used by scientists to supplement the historical record of weather-related data as evidenced by the number of large-scale projects that have existed over the past 20 years. These efforts have been international – the CDMP Project, as well as iterative – CLIWOC - >RECLAIM, and Seas of Knowledge bolstering the Old Weather Project. We also know that these projects are substantive – the CDMP project alone was responsible for creating 56 million digitized images.



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Logbooks do exist disparately and in repositories that are not traditionally associated with the maritime industry. Further, the research shows that description and access points are lacking in regards to the logbooks' weather-related content. The absence of descriptive metadata not only limits the use of these rich items, it also hinders their discoverability.

Compared to the data discovered with the large-scale projects mentioned previously, RBSC does not contain even a fraction of the logbooks that other repositories have. Nevertheless, we do have data. Take the Raven Logbook for instance – the voyage of the Raven lasted 210 days and data was recorded using multiple times a day. At a minimum – using only the observational data present, that adds up to 630 additional observational data points. Even though we only have but a handful of logbooks the data does truly add up and as an information professional I feel obligated to share our data to the climate research community. For this reason, we have created standard weather-related access terms and have reviewed all logbooks within our holdings to ensure there discoverability through this research lens. While the holdings at Notre Dame may be small - their data is not and when coupled with other repositories' holdings, the data set becomes exponentially larger and it starts to really add up.