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ICOADS Marine Data Rescue: Status and Future Priorities

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1. Introduction

The International Comprehensive Ocean-Atmosphere Data Set (ICOADS; http://icoads.noaa.gov) is an invaluable international resource, providing secure and traceable access to a comprehensive archive of surface marine climate data. The observational archive and products underpin a wide range of activities including regional and international climate monitoring and assessments; atmospheric, ocean and coupled reanalyses; and calibration and validation of measurements from satellites.

Release 2.5 (R2.5; 1662-2007), the last major historical update, was completed in 2009. While R2.5 (Woodruff et al. 2011) was accompanied by

preliminary updates, based exclusively on Global Telecommunication System (GTS) data, that successfully extend ICOADS monthly in near-real-time—another update for the full historical period—Release 3.0 (R3.0)—is long overdue.

While major international contributions—chiefly from Germany and UK—in support of R3.0 are now being established, major NOAA resource constraints emerged in the last few years slowing progress towards R3.0. Firstly, in 2010, NOAA's successful public-private partnership Climate Data Modernization Program (CDMP) was dramatically scaled back and then in FY2012 discontinued[1]. Secondly, starting in late 2011, NOAA funding for ICOADS became uncertain and caused much concern for the user community. Fortunately the outlook now appears less bleak, and steps are being taken—including through establishment of the international partnership—to ensure a secure future for ICOADS.

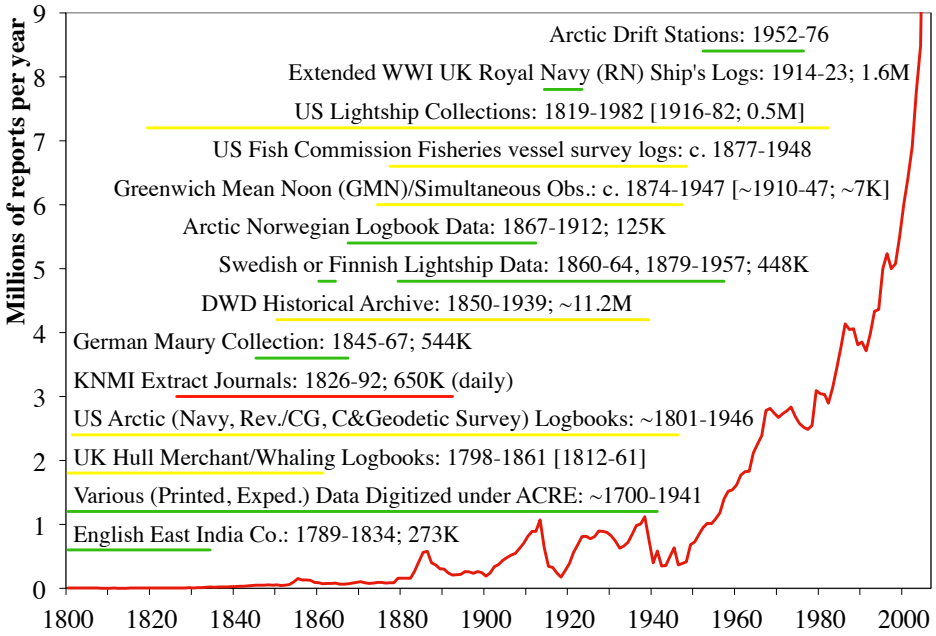

Figure 1. The time periods of selected candidate historical data sources (some discussed in more detail in Wilkinson et al. 2011) to be eventually blended into ICOADS (or offered separately in advance of formal Releases as "Auxiliary" datasets), are spanned by horizontal colored lines: green candidates are fully digitized but require format translation, yellow are partially digitized, and red are in the planning stages for digitization. Each dataset name is appended with the date range and approximate total number of reports (if known). In addition, anticipated near-term data availability for R3.0 is listed in [square brackets], if applicable. The solid blue curve is the number of reports in ICOADS Release 2.4; the solid red curve is the number in Release 2.5 (R2.5).

This document brings together background and status information for a number of historical marine datasets already in digital form, or planned for

[1] CDMP ended as a result of congressional decisions to remove earmarks from the 2011 budget.

imaging and/or digitization through national or international data rescue initiatives, and targeted for blending into ICOADS, either as part of R3.0 or later updates. Fig. 1 compares the temporal coverage and size of selected major candidates, with existing ICOADS temporal data density.

Brief summaries are provided in sec. 2 for each of the selected historical collections shown in Fig. 1, and in sec. 3 for a number of important additional collections. As part of the collection summaries, timing goals for three major steps—imaging, digitization, and translation into the International Maritime Meteorological Archive (IMMA) format (Woodruff 2010)—are estimated (or "TBD" indicates to be decided). Annexes A-F provide detailed additional information in a number of areas including Dutch, German, UK, and US initiatives and collections; and Annex G summarizes the archival location and characteristics of a number of prominent collections, including (if applicable) the location of the imaged forms within the former CDMP's Environmental Document Access and Display System (EDADS) Version 2 (EV2)[2]. Annex H provides a preliminary Automated Research Vessel (R/V) Observations Catalog.

Significant additional time and resources (not yet estimated in detail) will also be needed to: (a) adequately assess in advance the quality of new data sources before they are offered as Auxiliary datasets or blended into ICOADS; (b) implement the blend, e.g. additional QC including data preconditioning, duplicate elimination, and further steps required to make the observations and products ready for users.

As further US background, Fig. 2 focuses on the status of merchant and Navy logbook data, highlighting major undigitized collections, including areas for possible remedial work (with additional details provided in Annexes D-F). Fig. 3 illustrates some of the temporal characteristics of the US Merchant Marine 1912-46 Collection (already within ICOADS), which could be important to consider because the corresponding original records form part of the Greenwich Mean Noon (GMN)/Simultaneous Obs. (see sec. 2.10), as shown in Figs. 1-2.

For several additional UK-related or other international collections (Annex A), joint funding and extensive additional cooperation have been obtained for example through the UK Met Office and the Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative (http://www.met-acre.org/); and many metadata, inventory results, and historical documents associated with these efforts have become available via the RECovery of Logbooks And International Marine data (RECLAIM) Project (http://icoads.noaa.gov/reclaim/; Wilkinson et al. 2011).

It is important to draw a distinction between the instrumental data discussed in much of this document, and the existence of many years of even earlier non-instrumental data in, for example, early US Navy (Fig. 1) or UK Royal Navy (RN) logbooks. Generally that transition occurs after the Brussels Maritime Conference of 1853 (Maury 1854), which recommended a set of international observing and reporting practices for keeping "Abstract Logs" of ship meteorological

[2] Access to EV2 is limited, as indicated on this webpage: http://www.ncdc.noaa.gov/climate-information/research-programs/climate-database-modernization-program

observations, including a variety of instrumental data. However, the English East India Co. collection (Fig. 1) contains some of the earliest known instrumental marine data.

Another important stratification develops historically in the available record types between logbooks (or “deck logs”), and more specialized meteorological (or oceanographic) records (of which the Abstract Logs and GMN observations discussed above can be considered early examples). NHC (2007) describes US Navy deck logs, for example, as “…a daily chronology of certain events for administrative and legal purposes,” but also including “meteorological phenomena.” Contemporary marine meteorological observations in contrast generally are managed internationally under the Voluntary Observing Ship (VOS) scheme of the World Meteorological Organization (WMO)—and its Joint (with the Intergovernmental Oceanographic Commission) Technical Commission for Oceanography and Marine Meteorology (JCOMM)—and are reported for example in specialized nationally-designed meteorological forms (or increasingly via electronic logbooks and other digital mechanisms).

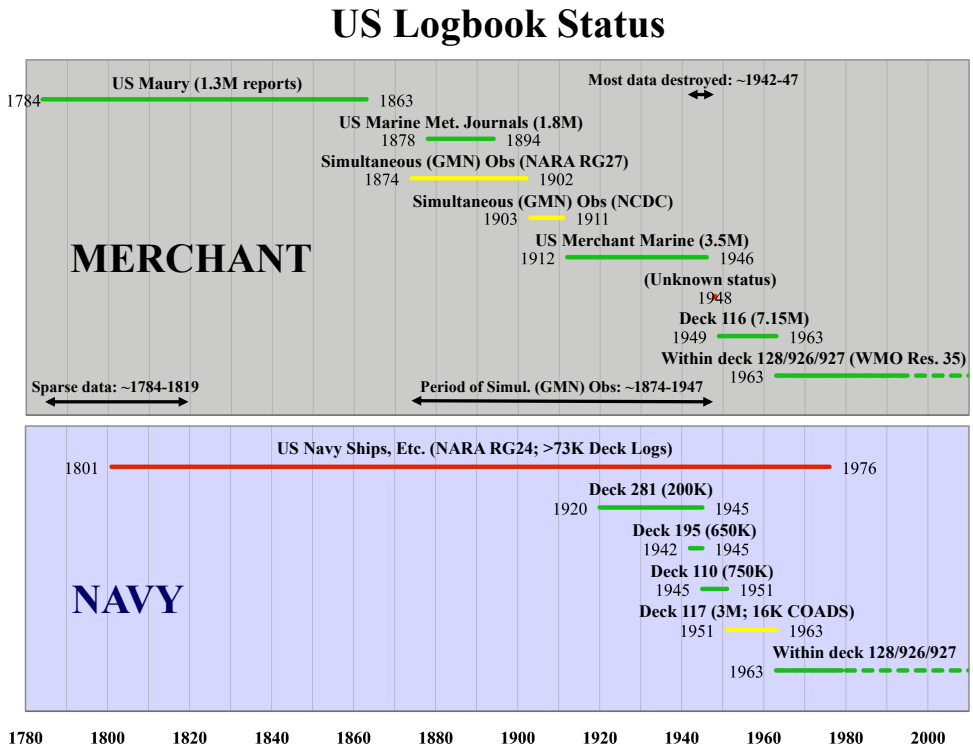

Figure 2. The US National Archives and Records Administration (NARA) and NCDC both have responsibility for wide ranges of merchant and military logbooks (or later meteorological forms), with lines on the above figure indicating their

temporal ranges: red=undigitized, yellow=in digital form (partly or fully) but not yet blended, green=blended into ICOADS. See also Annex D for further detailed information used to develop this figure. Notes regarding two potential future remedial data-improvement projects:

(i) The two lines starting in 1963 in the figure become dashed later on. In the merchant case, this signifies that starting around 1995 at least some data are undigitized (or incompletely digitized). A new marine processing system (MOPS, earlier called MOPUP) introduced at NCDC around then had a goal to save money by minimizing keying (relying more on GTS receipts), but that system introduced some data problems. The cessation of keying of US Navy data apparently extended over a longer period (see Annex D).

(ii) As discussed in Slutz et al., 1985 (p. 23, Cautions regarding "Bucket Indicators") the SST measurement method indicators for US-recruited data from 1968 through approximately May 1973 are believed to be unusable due to long-past processing errors, resolution of which (e.g. by sample re-keying to diagnose problems, or probably best by full re-keying using modern techniques) could form a very useful data rescue project at some point, in view of the key role of SST data in climate research.

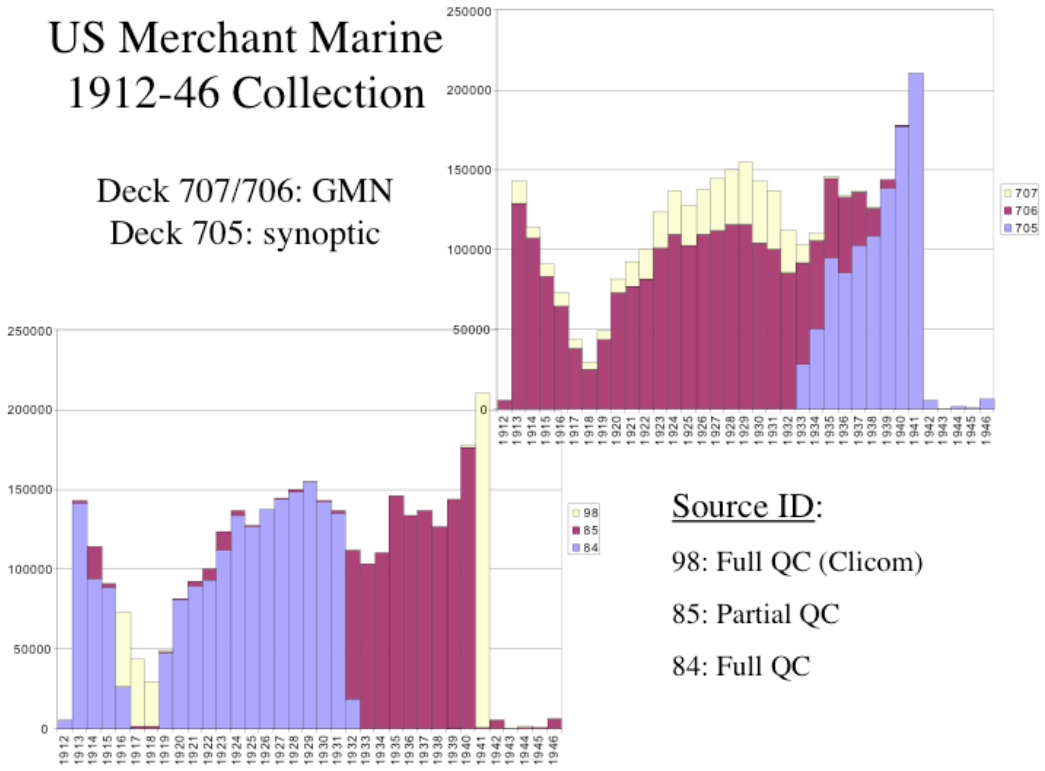

Figure 3. Temporal distribution of the US Merchant Marine 1912-46 Collection by deck (705-707) and source ID (*SID*; 84-85, 98), consisting of 3.5M reports blended into ICOADS Release 2.0. These data were digitized through a lengthy NCDC project initiated in 1989 (Elms et al. 1993), which ending up transitioning through three different QC schemes (as reflected by *SID*). Note that GMN records (sec. 2.10) were used for two of the decks.

2. Status of Future Blend Candidates (Fig. 1)

Portions of the following background information are taken from Woodruff et al. 2005 (henceforth WEA05) and from Wilkinson et al. 2011, as noted. Goals are indicated as applicable for imaging, digitization, and translation into the IMMA format (Woodruff 2010).

2.1 English East India Co.: 1789-1834; 273K (daily) to <6.8M (subdaily)
Background: Through a cooperative project with the international ACRE initiative, linked to the UK Met Office Hadley Centre, a selection of approximately 1K logbooks containing early daily instrumental data (i.e. air temperature, SST, and sea level pressure) were imaged by the British Library, and digitized by CDMP (limited to forms containing instrumental observations, and neglecting most of the sub-daily wind and weather observations due to budgetary considerations).

Imaging: completed in 2009
Digitization: completed in 2011
Translation goal: completed in 2011

2.2 Various (Printed, Exped.) Data Digitized under ACRE: ~1700-1941 (marine data portion)
See Annex A for more background about ACRE activities. As the first part of this data group, in July 2010 Rob Allan provided data files (Excel spreadsheets) digitized from Google Books and similar resources, containing a mixture of historical terrestrial and marine weather observations, but with the longer/major Antarctic voyages of discovery having been translated into IMMA format by Philip Brohan and included in R2.5 (this large HISTORICAL DIGITISED folder was also sent to NCDC for extraction of the land-based observations). The second part of this data group consists of Antarctic region marine observations for ~1895-1940 as listed here: http://brohan.org/~philip/job/digitisation/antarctic/docs/, which already have been translated into IMMA format.

Imaging goal: (not applicable)
Digitization goal: completed in 2010 or later
Translation goal: by 2014 (for R3.0)

2.3 Hull City Library Merchant and Whaling Logbooks: 1798-1861
Logbooks from the Hull City Library Archives hold numerous logbooks of voyages from Hull to the high polar latitudes. The observations consist of non-instrumental observations, but are compensated for by the value of daily wind force, wind direction and ice cover data for the very far northern latitudes. Latitudes were rarely recorded and longitudes never recorded. The overall collection is subdivided as follows:

2.3.1 Hull Archives Merchant Logbooks: 1798-1835
Fourteen logbooks of merchants were secured from the Hull City Library Archive and were supplied to CDMP by Dennis Wheeler. These cover voyages from Hull,

across the North Sea to the Baltic, with one exceptional voyage from London, UK to Lisbon, Portugal. Includes multiple voyages of the vessels *Bridget*, *John and Sarah*, *Resource*, *Retrieve*, and *Samuel Spyvee* from 1798-1805 and 1834-35.

Imaging: received by NCDC as digital images (jpg format)
Digitization goal: TBD
Translation goal: TBD

2.3.2 Hull Archives Whaling Logbooks: 1812-61

Similar to the Hull Merchant logs (ref 2.2.1), the original whaling logbooks are located at the Hull City Library Archive in the UK. Three rolls of microfilm of early logbooks received by CDMP from Dennis Wheeler (University of Sunderland, UK) in 2006 covering the period from the early to mid-C19th. There are over forty-two whaling logs from voyages aboard ships such as *Andrew Marvell, Brunswick, Cumbrian* (?)*, Eagle, Exmouth, Laurel, Margaret, Favourite Nancy, Neptune, Orion, Progress, William, Swan, Royal George, Duncombe, Volunteer, Dordon, Truelove,* and *Ariel*. The microfilm has been converted to digital images, but quality of the microfilm was often times very poor and some images were not recoverable. Dr Wheeler will investigate other alternatives for imaging these logs. Other whaling logbooks exist in UK archives (see Annex A) and this exercise relates only to those held in Hull City Library. The Hull collection is the largest such gathering of whaling logbooks in the UK, over 90% of the UK stock of such logbooks. These data were digitized by the Arctic Climate Change 1750-1850 (ARCdoc) project (http://arcdoc.wordpress.com/2011/11/21/hull-history-centre/; see also Annex A).

Imaging: Received by NCDC as microfilm; microfilm converted to digital images in 2009, but will need to be revisited (still??) due to poor quality
Digitization goal: completed in 2011?
Translation goal: by 2014 (for R3.0)

2.4 US Arctic (Navy, Rev./CG, Coast&Geodetic Survey) Logbooks; ~1801-1946

The US logbooks on Old Weather were photographed as part of a NOAA/NARA joint imaging project from Record Groups 23, 24, and 26; i.e. specifically from US Ships and Stations 1801-1946, US Revenue Cutter and US Coast Guard Vessels 1820-1941, as well as US Coast and Geodetic Survey logs from the late 19thC. Preservation and conservation work for materials being imaged is by NARA staff with a focus on preserving the records in their original format. Project supported by the North Pacific Research Board (NPRB), the NOAA Arctic Research Program, and by in-kind and volunteer contributions from many others. Selected vessels already available on microfilm were digitized by CDMP through a grant to the Office of National Marine Sanctuaries (adapted from: http://www.oldweather.org/sources).

Imaging: TBD
Digitization goal: TBD
Translation goal: limited data may be available by 2014 (for R3.0)

2.5 KNMI Extract Journals: 1826-92

A collection of Dutch logbooks (~193; 17.6K logbook pages) from the 19th century, planned for digitization in the future as resources permit (see also Annex B).

Imaging: completed in 2009 (by KNMI)
Digitization goal: TBD
Translation goal: TBD

2.6 German Maury Collection: 1845-67; 544K

Background: Loaned to the US by the Deutscher Wetterdienst (DWD) for imaging (Braun 2000), and digitized by CDMP. The translation into IMMA format (http://icoads.noaa.gov/maury_german.html) considered to a limited extent some issues of data homogeneity with the US Maury Collection (WEA05), e.g. biased pressure observations) as also studied by KNMI (Wallbrink et al. 2009).

Imaging: completed in 2005
Digitization: completed in 2006
Translation goal: completed in 2012

2.7 DWD Historical Archive: 1850-1939; 11.2M

Background: (See Annex C.)

2.8 Swedish (1860-64, 1879-1922) and Finnish (1900-16, 1919-57) Lightvessel Data

Logbooks were imaged from the US National Oceanographic Data Center (NODC), Swedish Meteorological and Hydrographic Institute (SMHI), and Finland Institute of Marine Research (FIMR). A combination of oceanographic (e.g. temperature, salinity, and current speed and direction) and meteorological (e.g. air temperature, wind, and barometric pressure) data was digitized from the collections. The Swedish data were collected in the Skagerrak, Kattegat, Baltic Sea and Gulf of Bothnia by 14 Swedish lightvessels, and the Finnish data in the Baltic Sea, Gulf of Finland and Gulf of Bothnia by 32 lightvessels.

Imaging goal: completed
Digitization goal: completed (data are available on CD-ROMs)
Translation goal: TBD

2.9 Arctic Norwegian Logbook Data: 1867-1912; 125K

Background (from WEA05): Digital records supplied in 1999 by the Norwegian Polar Institute (http://rda.ucar.edu/datasets/ds539.1/). This collection extends past the period (1867-99) of the 600 logbooks from which the Norwegian Logbook Collection (deck 702; 1867-89; 201K reports) included in Release 2.0 was extracted (see Woodruff et al. 1999). However, only SST and air temperature data were keyed. Unfortunately, no active contacts currently exist with Norway to explore the possibility of imaging/digitizing additional data, but this should be pursued if possible in the future. It is also important to note that the

earlier project digitizing deck 702 only succeeded in keying about 1/3 (200 logbooks) of that collection.

Imaging: it is not known if any of the 600 19th century logbooks, or additional logbooks e.g. extending through 1912, were ever imaged by Norway (ref. also Table A1)

Digitization: completed by 1999 (highly abbreviated records, however)

Translation goal: (not yet established, assuming these abbreviated records are worth including in ICOADS)

2.10 Greenwich Mean Noon (GMN)/Simultaneous Obs.: ~1874-1947

Background (adapted from WEA05): Around 1888, the US started switching from the systematic observations made throughout the day in its Marine Meteorological Journals, to "simultaneous" observations taken once daily worldwide at Greenwich Mean Noon (GMN, i.e. 12:00 UTC). These GMN observations make up many of the records in the US Merchant Marine 1912-46 collection until the 1930s (Fig. 3). The change was made to construct daily synoptic weather charts, and in hopes that "the number of observers would increase in the same ratio as the services required of them would diminish" (Page, 1901). However, modern climate analyses may need to carefully weigh the method of including these data (which prior to 1912 are largely undigitized), so as to avoid introducing false variations, due to observations made at different times in the diurnal cycle (e.g. some locations were only observed during the day—others only at night). The overall collection is subdivided as follows, with additional background provided in Annex E:

2.10.1 Published: Weather Bureau Bulletin of International Simultaneous Observations, 1875-89 (Marine portion: 1877-84, 205K)

MWR (1914) also notes a "valued supplement in the *Tägliche synoptische Wetterkarte des Nordatlantischen Ozeans*, issued jointly by the Deutsche Seewarte and the Danske Meteorologiske Institut beginning with 1884"). Daily observations concluded on 30 June 1884 and thereafter continued on a monthly or semi-annual basis through the remainder of the period of record. Semi-annual publications for 1888-89 have yet to be located. Imaged publications available at: http://docs.lib.noaa.gov/rescue/bulletin_international_meterological_obs/. When CDMP lost funding (~March 2011), this project was put on hold indefinitely. A digitization test pilot was under development and sample files for the years 1876-1880 were produced but never properly QC'd.

Imaging goal: completed in 2009

Digitization goal: TBD

Translation goal: TBD

2.10.2 Records of Simultaneous Meteorological Observations on Ships 1886-1902

Imaging goal: completed in 2009

Digitization goal: TBD

Translation goal: TBD

2.10.3 Records of International Simultaneous Ship and Land Observations 1874-92

Imaging goal: (TBD)
Digitization goal: (TBD)
Translation goal: (TBD)

2.10.4 GMN Monthly and Daily Marine Forms (1910-47); ~7K

As noted above some of these records (i.e. covering 1912-46 for the US Merchant Marine) were already digitized and included in ICOADS (see Fig. 3). "Daily Journal," "Fog," and "Gale" reports contained on separate pages within the daily observations were imaged, but are not being digitized, and should be considered for later digitization. When CDMP lost funding, this project (similarly to 2.10.1) was placed on hold indefinitely. Four batches (AA25788, AA25817, AA95663, and AA95666) were fully digitized, but most of the collection remains to be keyed. Over 7K reports are included in the aforementioned batches, and are available for translation into the IMMA format; while additional files were also digitized, they were never adequately QC'd or approved for quality by CDMP. Due to the large number of reports contained in this collection, these forms should be considered for future crowdsourcing or other means of digitization.

Imaging goal: completed in 2009
Digitization goal: TBD
Translation goal: at least the four batches of data by 2014 (for R3.0)

2.11 US Fish Commission Fisheries vessel survey logs: c. 1877-1948

Background: Original logbooks of the US Commission of Fish and Fisheries vessels (and its successor agencies) are archived at the Smithsonian (siarchives.si.edu/findingaids/faru7184.htm), and at the NARA facility in College Park, MD (Record Group 22; http://www.archives.gov/research/guide-fed-records/groups/022.html). Among the environmental variables recorded are depth, character of the bottom, weather, air and ocean temperature, barometric pressure, winds, salinity, currents, and species brought back from the trawls or dredges at specific time, for specific locations. An initial FY2008 CDMP imaging project established the groundwork to a follow-up project where the geo-referenced biological, oceanographic, and marine meteorological data from these logs are being digitized for inclusion in ICOADS and the World Ocean Database Project (http://www.nodc.noaa.gov/General/NODC-dataexch/NODC-godar.html). Approximately 100 additional logbooks from fisheries survey vessels were identified in 2009 that are recommended for imaging and digitization. These logs are archived at NARA RG22 (Archives II) and RG24 (Archives I) (see also Annex D). These include primarily deck logs of survey vessels that document temperature, pressure, and weather conditions in a standardized format.

Imaging: completed in 2009 (only for the survey logs)
Digitization goal: TBD
Translation goal: TBD

2.12 US Lightship Collections: 1819-1982

Background (from WEA05, Flint 1994): Observations from ships anchored around the US coastline, most recently operated by the Coast Guard, as an aid to navigation (Annex F provides additional background). Similar historical data exist for the UK and Ireland, which should also be digitized as circumstances permit. The UK still operates a few lightships from which digital data should exist (http://research.metoffice.gov.uk/research/ocean/goos/maws_pic.html). These US records are all archived at NARA, but described separately in the following two subsections because Woods Hole Oceanographic Institution (WHOI) initiated work, including through a CDMP proposal, to image and digitize a selection of East Coast records:

2.12.1 US Lightship Collection (work initiated by WHOI): 1916-1982; 0.5M

These records are limited to the East Coast and a limited period. See Annex F for additional details (also http://www.whoi.edu/science/GG/woos/index.html).

Imaging: completed
Digitization goal: 2011
Translation goal: by 2014 (for R3.0)

2.12.2 US Lightship Collection (remaining records from NARA): ~1819-1972

See Annex F for additional details. Some of the lightship records have already been imaged, but many more remain to complete the set. A thorough inventory will need to be completed to determine the full scope of lightship holdings at NARA (and of other Coast Guard records) and to avoid duplication of imaging already completed by CDMP under 2.10.1.

Imaging: partially completed
Digitization goal: TBD
Translation goal: TBD

2.13 Extended WWI UK Royal Navy (RN) Ship's Logs: 1914-23; 1.6M

An extended period during and following World War I (1914-23), 7-8K Royal Navy Ship's Logs held in the UK National Archives (following on from previous joint US-UK work on data for the World War II period, Brohan et al. 2009). See Annex A for further information.

Imaging: being completed by the UK National Archives
Digitization: Began in late 2010 as a pilot project for the volunteer digitization group GalaxyZoo (http://www.galaxyzoo.org/)
Translation goal: completed in initial form, but to be revised by 2014 (for R3.0)

2.14 Arctic Drift Stations: 1952-76

Background: These data (many different formats) were collected and organized by NCDC and NSIDC leading to the production of the Arctic Climatology Project (2000) CD-ROM. The complete collection (1893-1976) is archived at NCAR (http://rda.ucar.edu/datasets/ds258.2/) and includes data from Western Arctic ice

drifting stations AIDJEX, ARLIS I, ARLIS II, Ice Station *Alpha*, Ice Station *Charlie*, and T-3 (called Ice Station *Bravo* during IGY), and from the North Polar expeditionary ships *Fram* and *Maud*. Only some of the data, including from the *Fram* and *Maud*, were blended into R2.0.

Imaging: (not applicable)
Digitization: completed c. 2000
Translation goal: TBD

3. Status of Additional (to Fig. 1) Blend Candidates

3.1 US Navy Hourlies: 1952-64; ~3M (deck 117)

Background: Only 16K reports from deck 117 were included in COADS Release 1, which were blended in from TDF-11 format (i.e. not from the original card deck 117 format). Also previously some deck 117 records were tapped to fill gaps in Arctic Drift Stations (sec. 2.14 ref. Table 1 in Elms et al. 1993). A webpage ((http://icoads.noaa.gov/deck117.html) discusses comparisons between three different sources of deck 117 data that were subsequently located at NCDC, and their conversion into IMMA format.

Imaging: (apparently not applicable, but the status of the original records is not presently known)
Digitization: completed c. 1957 (original card deck reference manuals available here: http://icoads.noaa.gov/reclaim/us.html).
Translation goal: completed in 2010 (http://icoads.noaa.gov/deck117.html)

3.2 Chinese/GODAR Ships: 1968-93; 424K

Background: As part of Global Ocean Data Archeology and Rescue (GODAR) project, surface marine ship data were digitized in China. The data were received at NCAR (http://rda.ucar.edu/datasets/ds541.4/) from NCDC on CD-ROM, and have now been translated into IMMA format (http://icoads.noaa.gov/godar.html).

Imaging: (not applicable)
Digitization: (not applicable; data published/available on CD-ROM)
Translation goal: completed in 2010 (http://icoads.noaa.gov/godar.html)

3.3 DM buoy/ODAS data (e.g. Canadian): early 1970s-date

Background: A variety of delayed-mode (DM) buoy or other automated Ocean Data Acquisition System (ODAS) data fall into this category and should be considered for addition to or updating in ICOADS as resources permit, including:

- An update of the NDBC moored buoy and Coastal-Marine Automated Network (C-MAN) archive (format F291; NCDC DSI-1138) was translated into IMMA format (based on NODC's archive, followed by an intermediate translation into NCDC's abbreviated DSI-1171 format) for partial blending into R2.5 (completed in 2009, data extending through 2007).

  Imaging: (not applicable)
  Digitization: (not applicable)
  Translation goal: completed c. October 2008

- Worldwide drifting buoy data from Canada/ISDM (formerly MEDS) were last updated as part of R2.5 (http://rda.ucar.edu/datasets/ds256.0/).
- Tropical Pacific/Atlantic moored buoy data for the TAO/TRITON and PIRATA arrays were obtained from PMEL and JAMSTEC, and also last updated as part of R2.2 (completed in 2005, data extending through 2004; http://rda.ucar.edu/datasets/ds256.1/).
- Canadian moored buoy data (1970-November 1998, obtained from Val Swail Feb. 1999; http://rda.ucar.edu/datasets/ds256.3/).

3.4 Baltic Sea Marine Surface Observations: 1961-90; 360K

Baltic Sea ship data (http://rda.ucar.edu/datasets/ds258.3/), resulting from a project described in WMO (1998).

Imaging: (not applicable)
Digitization goal: (not applicable)
Translation goal: TBD

3.5 Canada/MEDS Daily Seawater: 1914-85

Daily time series of water temperature and salinity (plus some surface wind data) collected at various points on the Western and Eastern Canadian coasts (http://rda.ucar.edu/datasets/ds257.0/).

Imaging: (not applicable)
Digitization goal: (not applicable)
Translation goal: TBD

3.6 Bering Sea Crab Data (Pilot House Log and R/V Records): 1966-74

Historic eastern Bering Sea crab data includes survey results and fishing data on crab abundance that contain embedded environmental data, including surface weather observations, as well as bottom temperatures. Among the logs, the environmental variables recorded are time and location of observations, ship's heading, Loran readings, barometer, wind direction and speed, sea and swell heights, and clouds (amount). Other forms contain sub-surface observations as well [note: more info needed here]. Under a project initiated by Bob Foy at the Kodiac NOAA Fisheries Lab (http://www.afsc.noaa.gov/Kodiak/), imaging and digitization began in 2008. Data are being keyed in a "csv" (comma separated value) format.

Imaging goal: TBD
Digitization goal: TBD
Translation goal: TBD

3.7 Ukrainian Marine Data: 1958-85

During 1999-2001, Alex Polonsky from the Ukraine provided for ICOADS digitized marine surface observations (approximately 52 cruises totaling over 4K reports; generally containing wind, AT, and SLP data, with lower frequencies of clouds, waves, etc.; being archived within: http://rda.ucar.edu/datasets/ds530.0/).

Imaging goal: (not applicable)
Digitization goal: (not applicable)

Translation goal: TBD

3.8 US Tide Gauge Meteorological Observations: ~1854-forward

Steve Lyles (NOAA/NOS, now retired) indicated 2 January 2009 that earlier meteorological (e.g. SST) observations, such as from the station established 30 June 1854 in San Francisco, have not been digitized (note: however some data have been digitized for research, e.g. Maul et al. 2001), and older records have been transferred to NARA from NOS. Some original records may be described at http://www.archives.gov/research/guide-fed-records/groups/023.html under item 23.4.2 (Scientific records) as 'Meteorological observations and water temperature and density readings ("TW" Series), 1845-1911.'

Imaging goal: TBD
Digitization goal: TBD
Translation goal: TBD

3.9 Mariner's Museum (Newport News, VA) Private Logbook Collection (C17th-)

Via Lin Chambers (Lin.H.Chambers@nasa.gov) we learned (March 2009) about a private collection of ~400 ships' logbooks or journals:

> "A few from 1690s (probably copies). Lots from 1800s. Some from 1700s. Ends late 1960s/early 70s. Some are account books or journals rather than logbooks. Logbooks include lat/long, temp, weather conditions. […] Mostly North Atlantic, Coastal, Chesapeake Bay. Not exclusively; some worldwide. Nothing has been mined yet. Would require researcher or intern. A datasheet may exist on each logbook. Done by volunteers. Handwritten. There is an Access Database with at least some info about each item."

It was proposed to contact Bill Barker (bbarker@marinersmuseum.org) about the possibility of obtaining example images and for additional information.

Imaging goal: TBD
Digitization goal: TBD
Translation goal: TBD

3.10 US Weather Bureau North Atlantic Thermograph Program (pre-WW2)

From Kevin Wood (7 May 2009; ref. Church 1937; see also Brooks 1930, Brooks and Fitton 1930):

> "It looks like a significant number of ships on scheduled (e.g. weekly) liner service were equipped with recording thermographs beginning in the 1920s with the intent of investigating the western Atlantic - Gulf Stream system. Such that in a 1937 paper by P.E. Church we find that by 1933 some 100 synoptic charts based on ~1200 thermograph records had been constructed. I would think this material—if it could be found again—would be rather interesting in light of current interest in low-frequency variability and potential climate implications related to WBCs. Certainly our work on the early 20th c. warming points in this direction. I don't know what the benefit might be over the current ICOADS-based products if the charts/and or thermographs were relocated, but it seems that some features like the position of the cold wall, eddies and so forth could be resolved a bit better. I've attached a map showing the steamship routes across the GS and a chart of annual average from the Church paper."

3.11 Islas Orcadas: 1962-73

Data for the *Islas Orcadas* (formerly the oceanographic research vessel *Eltanin*; http://en.wikipedia.org/wiki/USNS_Eltanin_(T-AK-270)) were obtained around the time of COADS *Release 1* (Slutz et al. 1985), but never translated (from supp.

K): “The ship *Eltanin* was operated by the National Science Foundation in the Antarctic region from 1962 to 1973. It was given to the Argentine Navy in 1974. The Argentines operated the ship through 1979 and renamed it *Islas Orcadas*.”

Imaging goal: TBD
Digitization goal: TBD
Translation goal: TBD

3.12 Fram data digitized by Environment Canada: 1898-1902

Additional data (see sec. 2.14) digitized from the *Report of the Second Norwegian Arctic Expedition in the “Fram” 1898-1902* (Mohn 1907) were received from Environment Canada in 2010 (and archived within: http://rda.ucar.edu/datasets/ds530.0/), including:

(1) 2-hourly observations of sea level pressure, air temperature, humidity, wind velocity and direction, cloud and days with precipitation at the following locations have been digitized for the indicated periods:

Place	Latitude	Longitude	Period
Rice Strait	78°45.7' N	74°56.5' W	1898 Sept. 19 to 1899 July 24
Havnefjord	76°29.4' N	84°3.7' W	1899 Oct. 23 to 1900 Aug. 9
Gaasefjord I	76°48.9' N	88°39.5' W	1900 Sept. 18 to 1901 Aug. 12
Gaasefjord II	76°39.8' N	88°38.3' W	1901 Sept. 6 to 1902 July. 21

(2) Sea-observations (3-6 times per day) of wind, sea-level pressure, air temperature, humidity, clouds, weather and sea surface temperature, taken from July 1898-Sept. 1902 at different locations (with lat./long. recorded).

Imaging goal: (not applicable)
Digitization goal: completed ~2010 by Environment Canada
Translation goal: completed in 2014 (for R3.0)

3.13 *Online Archive of California (OAC) Logbook Collections: 1799-2010(?)*

Online inventory access to multiple institutions within the OAC, mostly at the San Francisco Maritime National Historical Park. More logbooks are showing up online as digital access to collections grows. All institutions within this system should be checked on occasion as many may house old logbooks that have never been digitized until recently.

http://www.oac.cdlib.org/

Imaging goal: TBD
Digitization goal: TBD
Translation goal: TBD

3.14 *Norwegian Factory Ships: 1905-60*

The Whaling Museum in Sandefjord, Norway, holds 171 logbooks of which 108 are for factory ships, whale catchers, oil tankers and cargo ships in Antarctic waters c. 1905-42. Ninety-three of these logbooks have been examined and all contain 4-hourly observations of exceptional quantity and quality. There are 74 engine room logs, some with SSTs and at least 6 catch books containing noon pressure data and ice observations. A detailed inventory, funded by the UK Met Office was produced in 2013 and a report is also available. In addition to the Museum, the regional Vestfold Archive, also in Sandefjord, holds 83 logbooks.

Most of the logbooks are for factory ships and whale catchers operating in Antarctic waters, but a significant number of logs cover whaling activities in the South Atlantic, off the coast of the former French Congo, and at least one vessel hunting on the Peruvian whaling grounds An exhaustive search is still required to determine what other relevant material may be found in this archive.

Imaging goal: TBD
Digitization goal: TBD
Translation goal: TBD

3.15 Hudson's Bay Company (HBC) Ships' Logbooks

A selection of these logs have been transcribed by the the Arctic Climate Change 1750-1850 (ARCdoc) project (http://arcdoc.wordpress.com/2011/09/06/the-hudsons-bay-company-and-its-ships-logbooks/; see also Annex A).

Temporal and geographical extent: The HBC's logbook record extends from 1751-1870 with a gap from 1839-41. The HBC ships sailed annually between London and the HBC trading posts in the bay, leaving the Thames estuary around the 31 May. Once out of the Thames, they sailed northwards along the east coast of the British Isles to Stromness in the Orkney Islands. From there, the ships headed west at around 60°N, sailing around Cape Farewell in Greenland and into Hudson Strait, south of Resolution Island. Once in the bay, the routes diverged, either south to Moose Factory or more westerly to Churchill or York Factory. On the return voyage, the majority of ships travelled back to London again via the Orkney Islands, but occasionally some took a more southerly route towards the English Channel and Thames Estuary; arriving late September or early October.

Sources: The original logbooks are held at the HBC archives in Manitoba, Canada. Microfilm copies of these logs are held at the National Archives in Kew, London but they are generally of poor quality and difficult to read. Digital copies of the microfilms were kindly made available by Xiaolan Wang at Environment Canada and it is from these digital copies that the transcriptions were made.

*Transcribed dataset***:** For each annual voyage the following variables were transcribed: lat./long., meridian, noon wind direction, noon wind force, daily maximum wind, noon weather, rain, snow, fog, sea state, presence of ice and magnetic variation. Instrumental observations are few in number. Metadata such as name of the recording officer, and ports of call have also been included. All of the original transcription, and analytical, spreadsheets are to be made freely available in 2014 via a dedicated website hosted by Hull University.

Imaging: N/A
Transcription: Complete
Translation goal: by 2014 (for R3.0)

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Annex A: Additional RECLAIM and ACRE-Related Activities

(C. Wilkinson, D. Wheeler, R. Allan, P. Brohan)

Work in Progress or Completed 2009-2013

UK Met Office Sea-Ice Project

During 2012-13, funding was provided to inventory, image and digitize sources of sea ice observations in the southern hemisphere. These included land-based observations from Antarctic stations and observations from ships. A inventory was compiled of sources internationally, including observations archived in the UK, USA, Norway, Chile and Australia, The inventory additionally included a comprehensive list of vessels operating in or near the Southern Ocean whose documentation is yet to be sourced for additional observations. The inventory contains nearly 3K separate entries. From this inventory, in early 2013, 130 sets of logbooks were imaged (6K images) from Royal Navy vessels (1906-1969) operating in Antarctic waters, and held at the National Archives, Kew. At the Scott Polar Research Institute, Cambridge, 78 sets of logbooks were imaged (6.5K images) including the meteorological logbooks of the *Terra Nova* (1910-1913) and of the *Erebus* and *Terror* (1839-1843). The *Erebus* and *Terro*r logbooks contain hourly meteorological data over the entire 3-year span of the Ross Expedition. At the British Antarctic Survey, Cambridge, 134 logbooks were imaged along with 52 station reports (15K images). The logbooks are from research vessels and supply ships operated or chartered by the Falkland Islands Dependencies Survey and from 1962, the British Antarctic Survey. Station reports are mostly from Signy and Deception Islands off the Antarctic Peninsula. Observations are from the late 1940s to 1979. As well as sea-ice observations almost all the records contain pressure, temperature and SST data. A catalogue of the images is available. Presently (2014) none of the imaged documents have been keyed.

In the autumn of 2013 the archive of the Christian Salvesen Shipping Company, held at Edinburgh University, was examined for scientific data. Christian Salvesen operated whale factory ships in the Southern Ocean and close to the ice edge mostly during 1920-39 and 1945-62. Twenty-three different vessels have been identified, operating in Antarctic waters, some of them over many decades. A variety of documents were discovered including 20 Chief Officers' Whaling Logbooks, 11 for the *Southern Harvester* 1950-1960 and 9 for the *Southern Venturer* 1951-1959, six day reports, all of them for the factory ship *Sourabaya,* during the years 1932-1936, with air temperature and barometric pressure observations taken at 8am, 7 catch logs for the vessels *Sourabaya* 1932-35, *Salvestria* 1932-33, and *New Sevilla* 1932-34, with noon weather conditions and observations of barometric pressure and air temperature.

There are ten sets of H1-9 Current Reports for the vessels *Sourabaya* 1932-1934, *Salvestria* 1933-1936 and *New Sevilla* 1932-1935. Three of the reports associated with the *New Sevilla* have an additional report on weather and ice conditions. The H1-9 is a pre-printed form issued by the US Hydrographic Office. Some of the reports have parallel observations of SST at the surface and at the injector with a stated depth of the injector. The Archive also holds eight ice charts for the vessels (whaling seasons): *New Sevilla* (1933/4, 1934-5, 1935/6), *Salvestria* (1934/5, 1935/6) and *Sourabaya* (1933/4, 1934/5). In addition there are a small number of catch books and whale oil books all containing weather and ice observations, An inventory and report is available. Also in 2013, the archives of the Whaling Museum (Hvalfangstmuseet) and the regional Vestfold Archive, in Sandefjord, Norway were examined (see 3.14 above) A report and inventory is also available.

Extended WWI Royal Navy (RN) Logbooks: 1914-23

A sum of GB£111K (US$180K) from the Department for Environment, Food and Rural Affairs (Defra) of the Ministry of Defence (MoD) was allocated for imaging, which commenced in Oct. 2008. Under RECLAIM, a shortlist of Ship's (Deck) Logs with relevant statistics and a detailed set of movement records were provided. As a result of sufficient lead-in time, this listing was superior in detail to the corresponding WWII initiative (Brohan et al. 2009) and will yield far less in-port met data. Initial funding was expected to produce about 294K images. Due to subsequent budget restraints however, there are likely to be no more than c. 150K images. The images were

digitized, through a UK JISC funded project, by Oldweather (http://www.oldweather.org/) a "citizen science" project (see also http://zooniverse.org/home). Digitization has been completed.

Ships of Exploration/Survey Vessels/Colonial Met Registers

Funding for a project encompassing "Expeditions, travels, circumnavigations and ships of exploration" and colonial met registers was secured from the Joint Information Systems Committee (JISC), and success confirmed in Aug. 2008. Work on the COLonial Registers and Royal navy Logbooks (CORRAL; http://www.corral.org.uk) Project began in Oct. 2008 and was completed Dec. 2009, with monies covering both imaging and selected digitization. Catharine Ward identified vessels of exploration (ADM 55), and the logbooks of ships attached to the Hydrographic Survey of the RN that contain instrumental data; the latter began c. 1830s whereas ADM 55 spans both the 18thC and 19thC. There are 194 logbooks, six of which are meteorological journals. A significant proportion of ADM 55 has instrumental data, prior to about 1820. These items are presently on microfilm and all have been imaged at high quality and made freely available through the British Atmospheric Data Centre (http://badc.nerc.ac.uk/data/corral/)

In addition, CORRAL imaged the logbooks (ADM 53) of the eight vessels of the "Flying Squadron," a training squadron that performed an extended circumnavigation 1869-1870. The "Colonial Met Registers," kept at lighthouses, and at St Helena (South Atlantic) and Malden (Pacific) islands, are a collection of meteorological registers in the National Meteorological Archive, and housed at the Devon Record Office in Exeter, which have also been imaged under CORRAL.

UK Hydrographic Office Remark Books

The inventory of Remark Books was completed in 2008 and funded through ACRE by the UK Met Office Hadley Centre's Integrated Climate Project [Note from Annex D that US NARA includes in RG37 "('Daily Remark Books'), 1866-75"]. A report with input from the two research assistants was produced and includes estimates of numbers of observations of pressure, air temperature and SST. It is now possible to give a good estimate of images and therefore probable costs to process all or part of the collection as a first step to bidding for funds. There is duplication between the Remark Books and the (ADM 53) RN Ship's (or Deck) Logs. While before the 1850s the RN Logs may not all contain instrumental meteorological data, certainly after 1860/70 they will. The chief advantage to imaging the Remark Books appears to be cost. In the Deck Log each image will cover one day. In the Remark Books there will be multiple days, anything from 10 days up to an entire month in one view. Some of the Remark Books will also contain more sub-daily data and there is a modest amount of sub-surface sea temperature data. It is essential however that corresponding Deck Logs and Remark Books are compared to ensure consistency and accuracy of recording between the two, as part of a pre-imaging QC exercise. Presently there are no plans in hand to image the Remark Books. There is an additional modest project feasible at the UKHO involving the digitization of subsurface sea temperatures to be found in printed books. There may be more material in manuscript and printed form but these have not yet come to light. Furthermore, "draft sailing directions" housed at the Hydrographic Office may provide additional material and should be investigated.

Andrew Cook (UK) pointed out that the US Naval Observatory (USNO) has an extensive series of books for chronometers aboard US ships (see Annex D) and (with further inquiries planned to be initiated in the UK) that: "The UK index to chronometer records is in NMM, I think, or in RGO records. It was necessary, in assessing the going of chronometers, to establish the ambient temperature and relative humidity, for the effect on the coiled spring. If these are preserved for chronometers on voyage, and if the daily geocoordinates of the voyage are also available, in the chronometer or elsewhere in journals, you might find you have further series of oceanic observations."

Arctic Climate Change 1750-1850: ARCdoc Project

The Universities of Hull and Sunderland together with the British Arctic Whaling Group (http://www.hull.ac.uk/baw/overview/overview.htm) and the Scott Polar Research Institute, Cambridge University, secured funds with which to explore the collection of UK whaling ship logbooks, some of which date back to the mid-18thC and which number over 200. The data are

exclusively non-instrumental but references to wind force and direction and to ice cover will be particularly valuable, for this period. Funding of GB£246K (US$397K) was secured from the Leverhulme Trust and work commenced in March 2011. The project encompasses logs of whalers (including microfilmed logs from the Hull Archive; see sec. 2.3.2 of the main text), the Hudson's Bay Company (HBC). This project was scheduled to end 30 April 2014 (see also http://arcdoc.wordpress.com).

Printed Met Data from Online Scans, Books, and Journals

This ACRE-funded activity is presently limited to a single person (Gail Willetts) digitizing data from a variety of sources ranging from the 18thC to 20thC. Observations from a dozen expeditions from the heroic age of Antarctic exploration (1896-1940) have been digitized, as have observations from the US Exploring and *Challenger* expeditions in the late 1830s-early 1840s and 1870s respectively. Some of these collections were translated and blended into R2.5. Three more expeditions (William Parry's first, second and third Northwest Passage voyages) have been digitised as a contribution to CORRAL (see above). Records from several other expeditions have been digitised, but not yet translated. These include notable 19thC English and French explorations and circumnavigations. As discussed in sec. 2.2, a collection of these data (both terrestrial and marine) was provided by Rob Allan in 2010, however these types of materials still hold great potential as an on-going exercise.

RECLAIM has assembled a list of books and journals of which 800 are of marine met or oceanographic interest. Many of these printed journals and other publications contain tabulated meteorological data.

ACRE Chile

In April 2009, a delegation representing ACRE, RECLAIM and the Scott Polar Research Institute, made a visit to Chile to investigate the possibilities of joint terrestrial and marine digitization projects. A visit to the Chilean naval museum in Valparaiso identified over 6K Chilean naval logbooks dating from 1870, but mostly 20thC. A regional report of meteorological and oceanographic data sources for Chile and the southern Pacific has been produced (Nov 2010). The report combines all known sources of marine data from Chilean and British archives, covering the southeast Pacific back to the early 19thC, where presently data are sparse. With a grant from the European Union of 300K euros, the ERA-Clim Project commenced imaging and digitization of the Chilean marine and terrestrial data in 2012. Terrestrial data and 19thC marine data has been imaged and part digitized (2013). Further funding for work in Chile has been secured under ERA-Clim2. Imaging and digitization of terrestrial data will continue, along with the 20thC Chilean Navy logbooks. Priority will be given to those logbooks of vessels operating in Antarctic waters from the mid 1940s onwards.

Potential Projects and Sources for Future Imaging and Digitization

UK Met Office Ships' Met Logs

There remains a need to make additional comparisons between WWII RN Ship's Logs already digitized and the corresponding Met Logs at the UK Met Office (building on the results of limited comparisons, including with UK Marine Data Bank data versions digitized many years ago, available from http://icoads.noaa.gov/ukrn_ww2_mdb.html)–e.g. Met Logs of HMS *Exeter* and HMS *Newcastle* have been scanned and would permit a detailed comparison, if the necessary resources could be located. The Met Logs as a collection (mostly merchant shipping) stretch back to the mid-1850s and both merchant shipping and Royal Navy met logs appear superior in many respects to the corresponding RN Ship's (or Deck) Logs, e.g. in terms of cost (more data per image) and probably the quality of the observations (and include instrumental and platform metadata frequently not present in the deck logs [see metadata below]). Again both the Deck and Met Logs of selected vessels should be compared as part of an initial QC exercise (note: in contrast to the WWII situation, and for unknown reasons, significant numbers of WWI RN Met Logs, corresponding to RN Ship's Logs, do not appear to exist). Several inventories have been started (RN complete to 1890 and merchant shipping, eastern Pacific 1880s complete) but there are up to 10K separate items most of them from merchant vessels. A detailed inventory and

movement record is now possible produced from scans of the original UK Met Office Entry Books (6 volumes 1854-1904).

Australian Joint Copying Project (AJCP)

Extensive literature on this project has been passed to ACRE/RECLAIM, through Sara Joynes from the National Library of Australia, Australia House in London. From 1948-93, materials in British archives concerning the history of Australia and the surrounding region were copied to microfilm. These included extensive numbers of UK ships' logbooks. Future logbook digitization projects may be able to take advantage of the fact that a significant quantity of imaging has already been achieved. A new ACRE initiative (ACRE-Pacific), with RECLAIM support, was slated to form plans to exploit this material.

Logbooks kept in the National Archives of Australia and New Zealand etc. (Table A1)

The Australian and New Zealand holdings are on-line and have been viewed to some extent when working on WWII and WWI material, as several RN ships were transferred or lent and their logbooks are therefore in those countries rather than the UK. Australia in particular has archive material back into the 19thC including some RN Logs for that period. Australian and New Zealand archives will need to be contacted separately to find out the status of these holdings, and any planned digitization efforts. This may be done through ACRE-Pacific

2010 – ACRE Pacific

A proposal to the Asian-Pacific Network (APN) "Improving Pacific Island Meteorological Data rescue and Data Visualisation Capabilities through Involvement in Emerging Climate Research Programs" funded a meeting held at NIWA in Auckland, New Zealand in Sept. 2010 at which an ACRE Pacific focus was formed. This group, combined with ACRE Chile and RECLAIM, can form the basis to improving data coverage for the wider Pacific region, in particular the southern Pacific.

UK Royal Navy Eastern Pacific Logs, 1790-1913

In anticipation of a Chilean marine data and other Pacific digitization projects, 904 corresponding RN Ship's Logs for the eastern Pacific were identified, ship movements documented and the relevant platform metadata assembled. Provision has also been made to gather instrumental metadata, which is expected to be present for vessels from c. 1875 onwards. An initial estimate of imaging costs indicates 305K images costing about GB£155K (US$250K). The minimum output from this project would produce 185K days of sub-daily pressure data and 100K days of sub-daily SST. Sub-daily observations number six per day in most instances. The area covered is the NE and SE Pacific from the Bering Strait to Cape Horn, and extending westward to the longitudes of Hawaii and Easter Island. All circumnavigations have also been included. Recovering, imaging and digitizing of this material will occur as part of the ACRE Chile and ACRE Pacific regional foci, but as yet (2014) no funds have been identified to carry out this work

2010 – ACRE India

This regional focus aims to recover, image and digitise historical weather observations for the Indian region, surrounding countries and across the wider Indian Ocean domain. It involves collaboration with the British Library-India initiative, which is funded by the Arts and Humanities Research Council (AHRC) in the UK and the HE Cell in Bangalore (funded by the Tata Trust), the Indian Meteorological Department and other relevant archives and libraries across India. The first contribution (noted below) will be the digitising of both terrestrial and marine weather observations for the period 1893-1908 from the Daily Weather Report and Charts of the Indian Monsoon Area.

UK Royal Navy Indo-Pacific Logbooks 1800-1913

A similar exercise has identified the corresponding RN Ship's Logs covering the western Pacific, Australian waters, Indonesia and the Indian Ocean. This inventory is complete and will provide the basis of a further digitization project. At the present stage, no estimates of images

and costs can be provided. Recovering, imaging and digitizing of this material will occur as part of the ACRE India and ACRE Pacific regional foci.

19thC Century Indian Navy Logbooks

The India Office of the British Library holds 49 logbooks of the early Indian Navy. These vessels were commanded by officers of the British Royal Navy and the collection is part of the same series as the East India Company journals. Geographic coverage is mostly confined to the Bay of Bengal and Arabian Sea, with some vessels operating further afield in the East Indies and Chinese waters. A few of the logbooks cover voyages from the UK to India. The logbooks date from the 1830s through to the 1850s. It is likely that some of the logbooks will have instrumental meteorological observations, although this must be confirmed. An inventory of the collection has been made.

19thC-20thC Century Indian Weather Reports

The *Daily Weather Reports and Charts of the Indian Monsoon Area* were published from January 1893 until at least 1908. Copies of these volumes are archived at the UK Met Office and at the NOAA Library. Each daily report consisted of a synoptic chart and a page of tabulated data. The second section of the tabulated data consisted of "8am observations recorded on board ships in the Indian seas." Daily observations were taken from about 60 vessels recording the name of the vessel, the position (degrees/minutes), with ship's course and distance made in the previous 24 hours, barometric pressure, wind force and direction and sea state. Obtaining daily tabulated meteorological data for over sixty vessels in a single view is very efficient, and easier than extracting these data from over sixty-plus individual logbooks, which have probably not survived anyway. The marine data were collected by clerks from the Bombay and Calcutta Meteorological Offices. The clerks visited the ships that entered the ports of Bombay and Calcutta and copied the meteorological observations directly from the ships' logbooks where permitted to do so. Apparently the Indian Meteorological Office did not obtain, archive or retain any copies of logbooks for the compilation of these reports. When permitted the clerks also made comparisons of the ships' barometers "with portable secondary standards."

Records of the Sea Mammal Research Unit (SMRU)

This collection is held at St. Andrews University, Scotland, and includes British Antarctic Whaling Records, 1924-1966. Whale fishery catch books, and inspectors' logs, record daily barometric pressure and sometimes sea temperatures. SMRU also has separate records (field notes) of sea temperature. An example of a whale fisher catch book (a duplicate of one archived at St. Andrews) is held at the Climatic Research Unit (CRU), University of East Anglia. The collection, originally held at the British Antarctic Survey (BAS), Cambridge, was catalogued by BAS before transfer to St. Andrews. An inventory of the holdings has been made, including sample images from the catch book held by CRU. The collection consists of items from 15 different factory ships operating in Antarctic waters (1924-1966), with 96 catch books, 35 sets of field notes and 32 inspectors' diaries.

French National Archives and the French Pacific Fund

A collection has been identified in Series JJ Hydrographic Service. This includes scientific observations (3JJ) and *journaux de bord* or logbooks (5JJ) as well as other papers related to early surveys and explorations by the French Navy. The collection requires documentation and assessment and at present no further detail is available. A grant proposal was due to be drawn up in 2011, to image marine and terrestrial data from the French Pacific Islands. No further details are available presently [note: update needed].

In December 2010, JCOMM wrote a letter of support to Météo-France regarding their proposed project "…to recover and digitize the French mainland, overseas territories and colonial meteorological records currently held in its archives under an asbestos rich environment."

Table A1. Additional miscellaneous international projects or proposed projects (adapted from: http://icoads.noaa.gov/etmc/etmc2/etmc2-docs/ETMC2-Doc-4.4-Logbook.pdf).

• French historical logbook microfilm records and documentation (R. García-Herrera, Spain)
• Canadian Hudson's Bay Company (HBC) [see sec. 3.15 of main text) and N. American Royal Navy logbooks (V. Swail, Canada), plus historical Arctic efforts (R. Przybylak, Poland)
• Australian ships' logbooks (~1,300; 1855-1982) (W. Wright, Australia; R. Allan, UK)
• New Zealand logbooks (e.g. 3K covering 1936-94) (C. Wilkinson, UK)
• South African (Cape Town) logs and harbor master records (1820-60s) (C. Wilkinson, UK; et al.)
• Norwegian (1785-1870) logbooks (A. Mjaland, Norway; C. Wilkinson, UK)
• Chinese Maritime Customs Project meteorological data (R. Bickers, UK; R. Allan, UK)

Metadata

Much of the early 20thC UK RN Ship's Logs do not contain instrument or platform metadata and the search for those metadata is a task that needs to be undertaken. It may for instance be noted in the very first Log in a sequence for any one commission. The corresponding Met Office RN Met Logs have some metadata (see above). However for the WWII period, these Met Logs (with some exceptions) are confined to vessels serving as fleet or squadron flagships.

We recommend that in any examination of a logbook, that the relevant instrument metadata be noted or imaged so that some sort of comprehensive ship metadata inventory can be initiated. Likewise, Clive Wilkinson plans to continue abstracting metadata for SST and meteorological observations from printed sources as they come to light. Once a critical mass of information has been assembled from printed sources and from logbooks, C. Wilkinson plans to produce a report on instruments and observing methods/instructions, noting in particular historical changes in instrumentation and observing methodology.

At least for international Voluntary Observing Ships (VOS), availability of WMO Pub. 47 metadata starting in 1955 (as well as other sources such as the proprietary *Lloyd's List*) should be noted (Kent et al. 2007; http://www.wmo.int/pages/prog/www/ois/pub47/pub47-home.htm).

[Note: Mystic Seaport Museum has imaged editions for 1859-83 of *American Lloyd's Register of American and Foreign Shipping*, plus other similar historical ship (and yacht) lists through about 1900, available here: http://library.mysticseaport.org/initiative/ShipRegisterList.cfm, e.g. the following example page is from the 1867 *Register*, illustrating that most such information is likely to be confined to platform (e.g. ship size and construction) as opposed to instrumental metadata.]

NAME AND CAPTAIN.	Class A.	Tons.	Decks	Draft.	Material.	Fast.	When Metaled.	When Built.	Where and by Whom Built.	Port Belonging to.	Owners or Consignees	Dimensions.	Model	Remarks.	Place and Date of Survey.
G															
⊙ **G. H. Stout**..... pr Borden		228	1	7	o	I.		'59	N Brunswick	Phila	W. P. Clyde	123 22 S	M	x Wm. P. Clyde Riv nav	N Y 3, '66
G. T. Watson..... Petrea	1	425	1	8	iron	I.		'62	London	New York Engs 2 dir cyl 28 in S P 28 in	W. Whann	170 22' 13	S	Sc rig 4 blkhds x The Kate	N Y 7, '64
Galatia..... pr	1½	1200	2	14		C. I.		'62	New York	P't au Prince Ver 2 of 24 in S P 36 in	R. Murray, Jr	218 35 12	M	Sc rig 4 comp F S good	N Y 10, '65
★ **Galatea**..... pr J. M. Jones	1–	1400	1	13	o h	C. I.		'64	New York	New York Double ver cyl 2 of 44 in SP 36 in	Prov.& N.Y.S.S.Co	245 40 15	F	4 blkhds	N Y 2, '67
⊙ **Gen. Banks**..... s w		750	2	11	iron	I.		'47	England	New York Ver 4 of 40 in	Whitn'y&Hath'w'y	101 28 13	M	Sc rig F S good D C	N Y 2, '63
Gen. Burnside..... pr	1½	387	1	8	iron	I.		'62	Wilmington, D It'alian&Hollinw'th	Phila Ver dir 250 HP	R. F. Loper 1 of 30 in SP 28 in	150 23' 17'	M	Sc rig S blkhds Enclsd M dk F S good	Phil 5, '62
★ **Gen. J. K. Barnes**.. s w Morton	1*	n1365	2	14	o×h	C. I.		'64	New York	New York Bm eng cyl 60 in SP 10 ft	H. Livingston	223 35' 21'	S	Sc rig Dk salus	N Y 1, '67
Gen. Dulce..... pr Ariege	1½–	272	1	7	o	C. I.		'63	New York	St. Jago Eng ver dir cyl 36 in SP 2 ft 2 in	Ducurare	122' 25 9'	M	Sc rig	N Y 10, '65
★ **Gen. Custer**..... pr O. P. Rector	2	459	2	14	o	C. I.		'53	Phila	Georgetown Eng dir act cyl 26 in SP 2 ft 4 in	Morgan&Rhin'hart	156 24 18	M	3 m sc rig C blw Hg ks Sideports F S good x Memphis	N Y 12, '66
⊙ **Gen. Grant**..... pr E. W. Holmes		1210	3	18	o h	C. I.	'63	'63	New York	New York Eng dir act cyl 50 in SP 54 in	Wm. F. Weld	216 34 24	M		N Y 1, '67
⊙ **Gen. Hooker**..... s w		270	1	6	o	C. I.		'64	Boston	Boston	McKay & Aldus		F	Enclsd M dk Riv nav	Bos 2, '64
⊙ **Gen. McCallum**.... s w		n511	1	7	iron	I.		'64	Glasgow	New York Eng incl'd cyl 2 of 32 in SP 4 ft	A. Leary & Co		M	Sc rig	N Y 4, '65
★ **Gen. Meade**..... pr Sampson	1	893	3	16	iron			'61	Stockton	Boston Eng ver dir cyl 44 in SP 30 in	Wm. F. Weld & Co	211 30' 19'	S	Bg rig 5 comp F S good	N Y 1, '67
Gen. Shepley..... s w	2½	219	1	3	o	I.		'64	Portland	Portland	Ross Sturdevant		M	Stern wheel Riv nav	Ptd '65
★ **Gen. Sedgwick**..... pr Sawyer	1*	811	2	12	o×c	C. I.		'64	Mystic, Ct	Mystic Eng dir cyl 3 of 6 in SP 26 in	C. H. Mallory	179 31	S	Sc rig	N Y 4, '66
Gen. Sherman..... pr J. Pendleton	1½	400	2	10	o c	C. I.		'64	New Haven	New York Eng tk cyl 20 in SP 20 in	N.L. & G. Griswold	136 23 15'	M	Sc rig F S good Sold at Rio	N Y 1, '67
Geo. Appold..... pr Howes	2	n1370	3	14	o h	C. I.		'64	Phila	Phila Eng dir act cyl 1 of 56 in SP 3 ft 5 in	Mer.&Min.Tran.Co	223 35 24	M		N Y 2, '65
Geo. G. Collins..... pr Wm. Thrasher	2	236	1	7	o c	C. I.	S '63	'62	G'd'peed L'd'g	Hartford Dir 30 in S P 36 in	D. A. Smith	150 28 6'	M	Enclsd clk fore and aft N bot '63	N Y 4, '64
★ **Geo. Cromwell**..... pr E. E. Vail	1*	n1000	2	14	o	C. I.		'62	New York	New York Dir 45 in SP 54 in	H.B. Cromwell&Co	187' 30 15	M	Bgn rig N P dk F S good	N Y 2, '67
⊙ **Geo. Leary**..... s w		n1271	1	6½	o c	C. I.		'64	New York	New York	Leary Bro	231 37' 12'	S	Prom clk Watr whl guards fore and aft a spensons	N Y 4, '64
★ **Geo. S. Wright**..... pr Malster	2	341	1	10	pine	I.		'63	Fort Ludlow	New York Eng dir cyl 30 in SP 30 in	West. Union Tel. Co	116' 25' 10'	M	Sc rig Solid floor	S F 7, '65
★ **Geo. Washington**... pr E. V. Gager	1*	1000	2	14	o	C. I.		'62	New York	New York	H.B. Cromwell&Co	187 30 15	M	Bgn rig L regs '65	N Y 1, '67
Georgia..... pr Dewars	1–	671	2	12½	iron			'63	Dumbarton Denny	New York Steeple eng cyl 2 of 50 in SP 3 ft 6 in	Williams & Guion	206 27 14		Bg rig 4 blkhds P C	N Y 4, '66

Annex B: Royal Netherlands Meteorological Institute (KNMI) Marine Data Rescue Activities

Information partially from Wilkinson et al. (2011):

In 2009, Royal Netherlands Meteorological Institute (KNMI) provided (on 12 DVDs) 17,565 digital images of a collection of 193 Dutch logbooks from the 19th century that resides in the archives of the Institute. (These images were planned for digitization starting in 2011, but then CDMP was terminated.) A detailed ship inventory is available, including indications that some of these data were already digitized and included in the CLIWOC project. Support in the form of interpretation of the images would be available from KNMI.

Under the umbrella of KNMI's HIStorical CLIMate (HISKLIM) project inventories of national archives and museums will be completed and more historical marine data will be made available (http://www.knmi.nl/research/climate_services/hisklim.html). Surveys will be conducted to find original logbooks or observations that were used to produce several Dutch atlases and publications in the 19th Century (e.g. Van der Stok 1897). These surveys are in addition to the inventory of the Dutch part of CLIWOC that only concentrated on the period 1750-1850. As resources permit, an investigation into the availability of early Dutch East India Company logbooks (pre-1750) will be carried out.

Other important work related to marine data rescue already completed under the HISKLIM project includes a chronological review of Dutch historical marine meteorological codes and logbook instructions as presented for worldwide ships' observations since 1854 in Wallbrink and Koek (2010).

Annex C: Deutscher Wetterdienst (DWD) Marine Meteorological Archive

(1) The digitization of the meteorological journals collected by Deutsche Seewarte since 1876 started in the early 1940s with extraction especially of the data from the North and South Atlantic. At the end of WWII a copy of these (and another set of land-oriented) punch cards existing in the archive was taken by UK and USA (see WEA05 for further information). In ICOADS these data, plus some data punched by Deutsche Seewarte subsequent to WWII, can be identified as (R2.5 output period; numbers of reports):

- Deck 192 / 215 Deutsche Seewarte Marine 1855–1839 5.944K
- Deck 196 Deutsche Seewarte Marine (192 extension) 1949–1954 143K

(2) After WWII digitization continued depending on financial and personnel resources, and the German marine meteorological archive was utilized for several international projects, e.g.:

- McDonald (1938) Atlas Project: during 1956-58, all observations from local noon were extracted for the Pacific, Southern Indian Ocean, and Southern Atlantic as a contribution; a total of 556K observations beginning 1869 were keyed
- Deck 1989 Atlantic (German Responsibility) HSST 1852–1961 5.564M
- Deck 850 German FGGE 1978–1979 146K

(3) Selected DWD data were obtained by NCDC in 1999 from Volker Wagner, and used in cooperation with the US National Snow and Ice Data Center (NSIDC) to create an improved dataset for the North Polar expedition of the *Fram* (ref.: Arctic Climatology Project, 2000). The resulting data (1893-96, North of 76°N; 8K reports) are presently available within ICOADS as part of deck 734.

(4) Additional selected DWD data (1884-1914; 833K reports) were obtained by Gil Compo in 2002 from Volker Wagner as two files covering (a) the N. Hemisphere ≥60°N and (b) the Pacific (excepting any data ≥60°N).

(5) In early 2008, selected archive subsets (assigned to deck 720) were provided by Mr Zöllner and blended (together with previously available subset data; total coverage: 1876-1915 (1.2M)) into ICOADS, separated by Source ID (SID) (R2.5 output period; numbers of reports):

- SID 135: DWD Marine Meteorological Archive: Newly Digitized Data (1876-1902; 395K)
- SID 136: DWD Marine Meteorological Archive: HISTOR Data (1882-1899; <1K)

(6) The aim of the HISTOR project (presented by Mr Zöllner at CLIMAR-III (Gdynia, Poland, May 2008, ACRE Workshop (Zurich, July 2008), JCOMM meeting (SOT-V) in May 2009), Gudrun Rosenhagen ETMC-III (JCOMM 2010) and at ETMC-IV (JCOMM 2012) is to:

- make available all data from German historical meteorological ship journals, which are not yet digitized
- define metadata (name, size, type, instruments, corrections) for each ship
- identify the different parts already available and join them to voyages
- exchange these data and metadata for inclusion in ICOADS

(7) Most recently, DWD agreed to become an international partner (together with UK and US) on ICOADS. With this it is planned to contribute the newly digitized data from merchant sailing ships (~250K reports), together with highly QC'd data (~1000K reports) from 16 German light vessels in the North and Baltic Sea for the period 1930 to 2010, for inclusion in R3.0.

(8) In addition, a longer-range proposal is continuing to be developed for eventual formal recognition of ICOADS under JCOMM's emerging new Marine Climate Data System (MCDS) as a WMO-IOC Centre for Marine-Meteorological and Oceanographic Climate Data (CMOC), together potentially with other centers holding global marine climatological datasets. The proposed formalization would be beneficial in a number of respects, including in facilitating more open exchange of historical marine data and metadata, with the assurance that those data and metadata (in some cases rescued at considerable expense to nations) would become part of a formal and permanent international archive.

Annex D: Undigitized US Logbook/Marine Collections

This describes the known archival location and status of US merchant (Tables D1-D2) and US Navy (Table D3) logbooks ("deck logs") or of specialized meteorological forms.

Older data are primarily held by NARA in the National Archives I facility at Washington, DC. Post-WWII US Navy deck logs are archived at NARA II in College Park, MD. The format of US Navy deck logs was standardized by the Bureau of Navigation in 1866 and is described in the Bureau's publication *Directions for Keeping the Ship's Log* (1866) (summary available in Appendix II of NARS 1978). This format was largely retained throughout the 20th century.

Generally, NCDC appears to have archival oversight over meteorological forms for approximately 1903-forward [note: to be confirmed], although some of these records are still held by NARA in their East Point, GA facility (Table D4). Some of the records listed in Tables D1-D3 were imaged by CDMP and are available in EV2.

Other logbooks or meteorological records reside in other NARA Record Groups (RG) such as of the Coast Guard (RG26; 1785-1988; http://www.archives.gov/research/guide-fed-records/groups/026.html; see also Annex F), of the Hydrographic Office (RG 37; 1754-1971; http://www.archives.gov/research/guide-fed-records/groups/037.html; see also Johnson and Heynen, 1971), and Naval Records Collection of the Office of Naval Records and Library [ONRL] (RG45; 1691-1945; http://www.archives.gov/research/guide-fed-records/groups/045.html).

For example, RG37 includes (within 37.4.1 Records of the Division of Sailing Directions): "Logs and journals of the U.S. Exploring Expedition (Wilkes Expedition), 1838-42. Records of observations made by navigators on cruises ('Daily Remark Books'), 1866-75." US Navy Dept. (1865) for example documented requirements for navigators (paragraph 455) to submit a "remark-book" including "…a description of the instruments he may employ….".

RG45 similarly contains some expedition logs and journals (1829-41), and includes on microfilm (NARA 2006; ~1897-1918): "…34 logbooks and other bound volumes of original German Navy and merchant marine records."

Records of the Bureau of Ships (RG19; 1794-1972; http://www.archives.gov/research/guide-fed-records/groups/019.html) may contain some useful ship metadata (e.g. design specifications and photographs).

Records of the US Naval Observatory (RG78; http://www.archives.gov/research/guide-fed-records/groups/078.html) includes "Index to 'abstract logs' (meteorological data collected by ships), 1853-61."

Three large log books for chronometers aboard US ships back to the 1850s are held among the rare books at the US Naval Observatory (USNO) library (http://www.usno.navy.mil/), but unfortunately probably do not contain any associated meteorological observations (to be investigated; Maury's *Wind and Current Charts* available at NARA also were suggested as possibly containing meteorological and other data of interest).

Many US and possibly international whaling logbooks (Sherman et al. 1986) are held at private museums and libraries such as in the US at the Mystic Seaport Museum (Stein, 1983) and New Bedford Museum (http://www.whalingmuseum.org/).

Table D1. US merchant marine logbooks and related records held at NARA in RG 27, Records of the Weather Bureau (http://www.archives.gov/research/guide-fed-records/groups/027.html), 27.5.5 Records of the Marine Division. Periods listed in parentheses, and much of the other details listed here, were taken from a paper copy of an earlier RG27 "Location Register" obtained from NARA (Woodruff 1989). Additional records of interest may reside elsewhere within RG27 (e.g. Records of Polar Expeditions, 1881-1923; see also Finneran 1965).

Period	*Title/Description*	*Status of original records/comments*
1796-1861 (1842-93)	US Maury Collection	Microfilm publication M1160 (88 rolls; NARA 1986). Original records (Entry 119) occupied 526 vols.—40 ft. Data digitized by China (except as noted in Table C4) and blended into ICOADS R2.0.
1862-78 (1842-93)	Abstracts of Ships' Logs	According to Woodruff (1989) referred to the original US Maury abstract log records (entry 119), but the dates have now changed on the NARA webpage! Those

		original paper records were also believed to contain about 171 additional volumes concentrated after the Civil War.* Indexes (in card and book form: Entry 120—4 ft. and entry 121, 6 vols.—1 ft.) were also available.
1886-1902	Simult. Marine Obs.	Entry 123—104 ft.
1896-1910	Abstract Storm Logs	Entry 124—10 ft.
1895-1910	Gale/Storm Reports	Entry 125—7 ft.
1896-1910	Fog Reports	Entry 126.
1879-93	Marine Meteorological Journals	Entry 128, 1,955 vols.—135 ft. An Index (entry 128—4 ft.) was also available. The collection was microfilmed by NARA (except as noted in Table D5), digitized by China, and the data have been blended into R2.5.
1887-1902	Unusual Phenomena	Entry 129—1 in.
~1873-1930	(additional records)	These appear less relevant to ICOADS (e.g. obs. summarized by ocean square) and are not itemized (additional information available on the RG27 webpage).

* Table D5 might refer to some of these volumes. From discussion (with Woodruff in 1997) with Sharon Thibodeau, NARA, who wrote the Maury microfilm (M1160) introductory text:

> *After Maury's departure due to the Civil War, Entry 119 does contain some logbooks gathered later by the Hydrographic Office (the Weather Bureau was responsible for establishing the group of logbooks that make up Entry 119, including those not directly associated with Maury). The Civil War likely constitutes a large or complete gap in the data, and the later logbooks are probably less systematic and well-organized than those gathered personally by Maury. As detailed in an index (among the holdings of the Hydrographic Office in a RG37), there were 533 original Maury volumes, of which only 355 were "transferred to the archives." But this discrepancy may be partly due to re-binding of multiple Maury volumes of similar size together at a later date, e.g. by the Weather Bureau.*

(See also WEA05 for further discussion of the US Maury Collection original and digitized records.)

Table D2. US merchant marine logbooks (and later meteorological forms), which are believed to be the responsibility of NCDC (possibly stored at NARA facilities).

Period	*Title/Description*	*Status of original records/comments*
1903-11	(Unknown?)	Unknown (archived at East Point/NCDC?)
1912-4?	Merchant Marine	Archived at East Point?
194?-46	World War II	Believed destroyed in 1974 by Maritime Administration, ref. Elms et al. (1997), NHC (2007)*
1945-63**	Merchant Marine	Unknown (archived at East Point/NCDC?)
1964-date†	Merchant Marine	Unknown (archived at East Point/NCDC?)

* From NHC (2007): "There is no central repository for deck logs from merchant ships. Deck logs were traditionally considered to be the property of the ship owners to be held or disposed of according to their own recordkeeping practices. After World War II, the deck and engineering logbooks of vessels operated by the War Shipping Administration were turned over to that agency by the ship owners, and were later destroyed, by the Maritime Administration, in the 1970s on the grounds that they were voluminous, costly to house and service, and very seldom used for research."

** Digitized as part of the original TDF-11 in deck 116.

† Digitized since WMO Resolution 35 (1963) in deck 128, 926, or 927. However, keying of US-recruited logbook data was virtually halted (except for a small percentage of verification records) around 1994 as part of NCDC's Marine Observations Processing System (MOPS) as a cost-savings measure to instead utilize Global Telecommunications System (GTS) data to the maximum extent.

Table D3. US Navy logbooks and specialized meteorological/aerological forms: deck logs currently through 1976 reside in RG24, Records of the Bureau of Naval Personnel (http://www.archives.gov/research/guide-fed-records/groups/024.html). Possibly records after 1903 are the responsibility of NCDC (similarly to the merchant records) [note: to be confirmed]. Some of the original records probably reside at the NARA East Point facility (Table D4).

Period	*Title/Description*	*Status of original records/comments*
1804-1976*	US Navy logbooks	NARS (1978) gives a ship inventory through 1946; also RG24 entries can be searched in "ARC," the NARA online catalog.
~1946-81	Military Sea Transportation Service (MSTS) and Military Sealift Command (MSC) Deck Logs	A short document is available (Mark Mollan, personal correspondence, 2011) describing these records.
	Meteorological/aerological forms	
1926-45	US Navy Monthly Aerological Record (MAR) (deck 281)	Unknown
1945-51	US Navy Marine (deck 110)	Unknown
1952-64**	US Navy Hourlies (deck 117)	East Point (Table D4) or unknown
1965-date†	(Unknown?)	Unknown

* Deck logs are transferred to NARA after a 30-year delay (NHC 2007), thus this is a sliding date.
** Thus far only a very small amount (16K reports) out of the total deck 117 (3M) reports have been blended into ICOADS, ref. http://icoads.noaa.gov/deck117.html.
† From about 1965 until the early 1980s [note: to be confirmed], meteorological records (or possibly logbooks) from US Navy ships were keyed at NCDC and ended up in decks 128, 926, and 927 (mixed with merchant data; hopefully identifiable by callsign/ID). At that time, due to cutbacks in Navy funding and since an assessment determined that the GTS provided adequate Navy data, NCDC halted keying Navy logbooks (approximately 300 ships per month).

Table D4. NCDC marine data accessions archived at the NARA Southeast Region (East Point, Georgia) archive facility (as of 13 September 2005; adapted from a document circulated in 2005 by Henry J. Ray, Records Officer, NCDC).

Accession #	*Series description*	*Period of record*
370-66-1075	Navy Marine Atlas Tabulations	1966
370-66-1371	Ships Weather Observations	1910-55*
370-66-B1371	Ships Weather Observations	1940-55
370-66-C1371	Ships Weather Observations	1940-55
370-66-D1371	Ships Weather Observations	1940-55
370-69-1840	Ships Weather Observations	1956-65
370-84-0001	Ships Weather Observations	1966-82
370-85-0004	Ocean Station Vessels Observations	1940-77
370-85-0005	Great Lakes Ships Weather Obs.	1941-82
370-88-0005	Navy Ships Weather Obs. (WBAN 11)	1974
370-88-0006	Navy Ships Weather OBs. (WBAN 11)	1975
370-88-0007	Navy Ships Weather Obs. (WBAN 11)	1976
370-88-0008	Navy Ships Weather Obs. (WBAN 11)	1977
370-88-0009	Navy Ships Weather Obs. (WBAN 11)	1978
370-88-0010	Navy Ships Weather Obs. (WBAN 11)	1979
370-88-0011	Navy Ships Weather Obs. (WBAN 11)	1980
370-88-0012	Navy Ships Weather Obs. (WBAN 11)	1981
370-88-0013	Navy Ships Weather Obs. (WBAN 11)	1982
370-88-0014	Navy Ships Weather Obs. (WBAN 11)	1983
370-88-0015	Navy Ships Weather Obs. (Form 3144)	1977
370-88-0016	Navy Ships Weather Obs. (Form 3144)	1978
370-88-0017	Navy Ships Weather Obs. (Form 3144)	1979
370-88-0018	Navy Ships Weather Obs. (Form 3144)	1980
370-88-0019	Navy Ships Weather Obs. (Form 3144)	1981

370-88-0020	Navy Ships Weather Obs. (Form 3144)	1982
370-88-0021	Navy Ships Weather Obs. (Form 3144)	1983

* 1910-40 data permanently withdrawn to NCDC in September 2004.

Table D5. Unresolved problems and undigitized portions of the US Maury (ML) and US Marine Meteorological Journals (MMJ) Collections. [To be confirmed by NCDC that none of these issues have been resolved.]

(a) Overview of ML and MMJ Additional Proposed Work

Two small supplementary data collections should be digitized as resources permit to improve the ML and MMJ: (i) two microfilm reels (40-60K records) from the past ML digitizing effort, and (ii) 31 voyages (approximately 28K records) of newly discovered data from the MMJ (see (b)). Further background on (i) follows (excerpted from:

http://icoads.noaa.gov/e-doc/other/transpec/maury/maury_transpec):

'[1] Reels keyed in the Collection

Reels 1-2 and 45 were missing from the digital data obtained from the CD-ROM. This was explained by CD-ROM documentation "about.txt" (excerpted as follows) except that it erroneously refers to reel44 (references should be to reel45):

"There were eighty-eight reels of microfilmed records in the collection. Reels One, Two, and Forty-four do not appear on the CD-ROM. Reel One is simply an inventory, and we were unable to produce clear paper copies from Reel Two. Reel Forty-four, keyed in a different format, was used in the pilot digitization project to help finalize the formats that were adopted for the remainder of the collection. Reel Forty-four will later be converted to a common format."

At this writing, NCDC has been unable to locate the details of the "pilot" format used for reel45. Moreover, notes indicated that only about half the data from the reel were keyed, owing to some paper copies being lost enroute to China. These data will need to be re-digitized under a future project.'

(b) MMJ Records Not Microfilmed (information received by Joe Elms from NARA c. 2003)

Several Marine Meteorological Journals were inadvertently filed with the "Maury Logs" (i.e. the US Maury Collection). The following Journals have not been microfilmed, and are filed in boxes 58 to 64 in the "Maury Logs" series:

Volume Number	*"Maury Logs" Number*	*Name of Ship*	*Dates*
181	319	*William Frederick*	1888-1889
322	339	*Sarmatian*	1879
337	329	*Conqueror*	1879
1023	308	*David Brown*	1883-1884
1274	311	*W.C. Sibley*	1884
1388	313	*San Pablo*	1885
1834	337	*Portland Lloyds*	1886
2077	317	*Hudson*	1885
2078	327	*Hudson*	1885
2081	334	*Red Cross*	1885
2083	332	*Coryphene*	1885
2084	315	*Coryphene*	1885
2085	344	*Coryphene*	1886
2086	333	*John D. Brewer*	1885
2087	343	*John D. Brewer*	1885
2088	322	*Ada Peard*	1885
2141	326	*C.F. Sargent*	1885
2595	309	*Thessalus*	1885-1886
2586	341	*Duchess of Albany*	1886
2626	330	*Imperial*	1885
2642	310	*Peterborough*	1886
2697	323	*Vincenze Accame*	1886-1887

3088	338	*Atlantic*	1886
3235	325	*Glide*	1887-1888
3719	342	*Oceanic*	1887
3793	320	*Savanna*	1888
3802	324	*L. Schipp*	1889
3805	312	*Robert Dixon*	1889-1890
3828	331	*George V. Jordan*	1887-1888
3832	335	*Jose Olaverri*	1888
3834	336	*Freeman*	1888

Annex E: International Simultaneous Ship Observations (~1874-1947; Published and Original Forms)

1. Bulletin of International Simultaneous Observations 1875-89 (ref. sec. 2.10.1 in the main text)
Forty-five volumes published by the Weather Bureau covering 1875-87 have been located at NCDC and at the NOAA Central Library; however, semi-annual publications for 1888-89 (Moore 1894, NOAA 1978) have not yet been located. Note on possible duplicate observations between volumes: Sometimes bound volumes contain previously printed months (e.g. volumes 1875 April-June and 1875 May-June), which contain the same observations. Reprinted months will have to be investigated further as to why the same month would have been bound and published twice. Upon preliminary review it appears that observations located in duplicate months are duplicates, but all will have to be verified as duplicate or unique.

Table E1. Timeline listing noteworthy changes in marine data characteristics, of the Weather Bureau *Bulletin of International Simultaneous Observations.*

Date	*Change in marine data characteristics*
01/01/1875	· Bulletin started, but NO marine data – only terrestrial
04/24/1875	· Marine Series begins
05/31/1876	· First Naval Series (no data) – data is now split between US merchant and US Navy ships
01/01/1877	· First column of “Stations and Vessels” in the Naval Series, but no data
01/04/1877	· Naval Series with data
01/13/1877	· Variety of Marine Series with data – merchant ships now categorized by shipping lines.
05/01/1879	· Stopped recording “Attached Thermometer” data
03/12/1880	· Ceased having an “Attached Thermometer” column
07/01/1880	· International merchant and naval ships included, divided by nationality, with merchant ships sub-divided by shipping lines · Only shows 7:35am Washington Mean Time on the cover · No more ‘Notes’ · All ‘Corrections’ are now noted in the Monthly Summary (00/dd/yyyy) volumes: “The following symbols and abbreviations are common to all the series, viz: †, aneroid; *, instrumental error and the reduction to sea-level whenever they could be ascertained by means of reliable comparisons made when the vessel was at or near land-stations”· “The following symbols and abbreviations are common to all the series, viz: †, aneroid; *, instrumental error and the reduction to sea-level whenever they could be ascertained by means of reliable comparisons made when the vessel was at or near land-stations”
01/01/1880	· The time for International Meteorological Observations is now 7am, Washington Time. Unless otherwise noted. “On and after January 1st, 1881, the times for Simultaneous International Meteorological Observations will be 35 minutes earlier than the above (7:35am WMT); meanwhile any such early observations will be published with a §.”
02/01/1883	· Use of 'Districts' to categorize vessel locations

06/30/1884 · Last Daily Marine Observation

2. Records of Simultaneous Meteorological Observations on Ships 1886-1902 (NC 3 Entry #123; 200 boxes) 1886-1902 (ref. sec. 2.10.2)

- Forms have been imaged and need to be loaded to EV2.

3. Records of International Simultaneous Ship and Land Observations, 1874-92 (NC Entry #69; 16 Oversize volumes and possibly 47 additional boxes) (ref. sec. 2.10.3)

- This one is not very clear and needs more investigation. Books are rumored to be in very bad shape and have not been set for imaging/digitization. A check for unique records not included in #1 or #2 will have to be investigated.

4. GMN Monthly and Daily Marine Forms (1910-47) (ref. sec. 2.10.4)

- Total of 956 boxes containing approximately 500K pages.
- Form types are as follows: Form No. 1201-M, Form No. 1210A-Marine, W.B. Form No. 42, N.H.O. 407, N.H.O. 123, Form 121, Form 121A, Form Model No. 10, Form 911, Form 138, N. Nav.43, N. Aer. 443 (a, b, c and d), N. Aer. 473 (a, b, d and pp), FormNAVAER-443A2, Form N. Aer 472, Form D-201, Form 50, Form 43 and miscellaneous. There are 14 form types for the 8½" x 3¼" booklets: Form No. 1201-Marine-15 days, No. 1201-Marine-31 days, No. 1201 O.M.-15 days, No. 1201 O.M.-31 days, No. 1 O.M.-15 days, No. 1 O.M.-31 days, 105-15 days, 105-31 days, 105-12-'94, 105-11-'95, 105-5-'95, 105-6-'96, 105-33, 105-77.
- Meteorological elements vary per form type and are as follows: vessel name, type of ship (steam or motor), voyage from, destination, location (port name or lat/lon if out to sea), octant of globe, nationality observational time (GMT/LST), barometer type, ship's course, ships speed, average ship's speed during last 3 hours (knots), wind direction, wind force (Beaufort scale), barometer (corrected or uncorrected) (inches, millibars, millimeters), attached thermometer, dry bulb, wet bulb and sea water temperatures (Fahrenheit, Centigrade, Kelvin, Reaumur), present weather, past weather, visibility (miles or code), total cloud amount (tenths or code), low cloud type, low cloud amount, middle cloud type, upper cloud type, percentage of clouds, barometric tendency, barometer too high or too low, sea direction, sea state (Douglas scale), swell direction, swell (Douglas scale).

Annex F: US Lightship and Other US Coast Guard Records from NARA (~1819-1974); US Lightship Collection Observational Forms (1916-82) (work initiated by Woods Hole Oceanographic Institution; WHOI)

Records of the United States Coast Guard (RG26; http://www.archives.gov/research/guide-fed-records/groups/026.html) at NARA include meteorological reports from lightships and other vessels (or shore locations), extending at least from 1819 through 1974. Entries 79 and 159 in RG26 also contain a large collection of logbooks (e.g. deck logs) and journals for lightships, light vessels, revenue cutters and tenders, as well as light stations/houses and depots. The dates for the record entries are as follows: Entry 79 (1890-1939), Entry 159 (1819-1947), and Entry 330 (1948-1972). The earliest records contain primarily only wind directions, but similar to naval deck logs, post-1860 logs adhere to the Bureau of Navigation's format standard.

The following bullets and Table F1 describe the status of a WHOI project (http://www.whoi.edu/science/GG/woos/index.html) to image and digitize an East Coast (and limited temporal) selection of the US lightship records archived at NARA:

- WHOI forms have been imaged and loaded to EV2.

- Forms types are as follows: WB Form 1210F, WB Form 615-5, ESSA Form 72-1, NOAA Form 72-1, NOAA Form 72-1A, WB Form 1083, WB Form 1082, Form 1083, WB Form 610-7, WB Form 610.6-1, WB Form 1034, WB Form 630-8, Form No. 1130-AER, SC Form 444, NOAA Form 72-5A, ESSA Form 72-5, DATAC-ER 1
- Meteorological elements vary per station and are as follows: station/lightship name, octant/quadrant, latitude/longitude, observational time (GMT/LST), wind direction, wind velocity (mph, knots, beaufort scale), wind gusts, estimated wind speed and gusts, sea-level pressure (millibars and inches), station pressure (millibars and inches), altimeter, 3 hour pressure characteristic, 3 hour pressure change, 3 hour pressure tendency exceeding 9.9 millibars, dry bulb, wet bulb and dew point temperatures (Fahrenheit and Centigrade), relative humidity, sea-water temperature (Fahrenheit and Centigrade), wave direction (1st and 2nd wave group), wave period (1st and 2nd wave group, wave height (1st and 2nd wave group), state of sea (plain language remarks), swell direction, swell (low, moderate, heavy etc..) visibility (statute miles, nautical miles, yards, feet, kilometers), present weather, past weather, max and min thermometer at observation, time of precipitation or thunderstorm, total precipitation past 6 hours, total cloud amount, low/middle/high cloud type, height of lowest cloud, amount of lowest cloud, ceiling.

Table F1. The names of the 14 lightships keyed for the WHOI project, and their approximate period(s) of record (note: which may include missing periods, in the event no data were available).

Lightship Name	*Period(s) of record*
Ambrose	1937-74
Barnegat	1947-70
Boston	1958-75
Buzzards Bay	1958-80
Chesapeake	1947-65
Delaware	1961-70
Diamond Shoals	1947-67
Five Fathoms	1957-72
Frying Pan Shoals	1936-79
Georges Shoal AFS	1956-60
Nantucket	1916-18 and 1947-82
Pollock Rip	1947-69
Portland	1956-66
Savannah	1954-64

Annex G: CDMP Task, EV2 Library, and ICOADS Cross References

Table G1. Correspondence between original archive information (NARA RG 27 Entry information from Woodruff 1989), CDMP task dataset names, Task Nos., EV2 Libraries, and ICOADS information. The pathway to the EV2 location of each imaged collection is given starting from one (or two) of the three top-level libraries: Surface Daily Observational Forms (S. Daily O.F.), Surface Monthly Observational Forms (S. Monthly O.F.), and Documentation. For Period of Record, "resultant" refers to the processed data made available to the public in ICOADS. [Note: Later perhaps there might be another table for international projects e.g. ACRE-related data rescue tasks that weren't directly related to CDMP, providing similar information including the ICOADS assignment numbers.]

Dataset name	*Original archive*	*Original archive location information*	*Period of record*	*CDMP Task Nos.*	*EV2 Pathway*	*ICOADS deck [SID]*
Japanese Whaling Ships	Japan?	Photocopies provided by M.I.T.	1946-84 (resultant)	#45 (old system?)	(N/A)	761 (see also 187) [115; see also 116]
WMO Pub. 47 metadata	WMO	Publication (international libraries etc.)	1955-98	L-19 L-10?	Documentation/ Reference Manuals/ Materials	(N/A)
US Maury Collection	NARA	RG 27; Microfilm publication M1160; Entry 119 (526 vols.–40 ft.) contained the original paper records	1784-1863 (resultant)	(N/A, digitization by China)	S. Daily O.F.	701 [69]
KNMI Logbooks	KNMI	Original logbooks?	1826-92	(TBD)	S. Daily O.F.	(TBD)
German Maury Collection	DWD, Hamburg	Original logbooks	1845-67	05-07	S. Daily O.F.	721 [152]
US Marine Met. Journals	NARA	RG 27 Entry 127 (1,955 vols.–135 ft.)		(N/A, digitization by China)	S. Daily O.F.	704 [125]
World War II RN Ship's Logs	UK National Archives (TNA)	??	1938-1947	L-23	S. Daily O.F.	245 [126]
US Lightship Collection (plus light vessels, station, and depot data)	NARA	RG 26 Entries: 79, 159, 330	1819-1972(?)	??	S. Daily O.F.	703 [145]
US Lightship Collection (WHOI initiated project described in 2.11.1)	NARA	RG 26	1916-1982 (see Table F1)	04-35; S-7 (Current)	S. Daily O.F.	703 [144]
English East India Co.	British Library	India Office Records	1789-1834	L-23	S. Daily O.F.	(TBD)
UK Hull Merchant	Hull City Library	Received as digital images	1798-1835	??	(TBD?)	(TBD)

Dataset name	*Original archive*	*Original archive location information*	*Period of record*	*CDMP Task Nos.*	*EV2 Pathway*	*ICOADS deck [SID]*
Logbook Collection						
UK Hull Whaling Logbook Collection	Hull City Library	3 rolls of microfilm	1812-1861	??	(TBD?)	(TBD)
US Fish Commission	Smithsonian Institution	RU7184	1877-1948	L-49 (Imaging) / S-14 (Digitiz.)	S. Daily O.F.	(TBD)
US Fish Commission	NARA	RG 22	??	L49 (Imaging)		
Bulletin of International Simultaneous Observations	NOAA Central Library and NCDC	NOAA Central Library and NCDC (bound volumes)	1875-89	L-54	Daily/ Bulletin of Intl. Simultaneous Obs.	(TBD)
Records of Simultaneous Met. Obs. on Ships	NARA	RG 27 Entry 123 (104 ft.)	1886-1902	(TBD)	(TBD)	(TBD)
Record of International Simultaneous Ship and Land Obs.	NARA	RG 27? Entry 69?	1874-92	(TBD)	(TBD)	(TBD)
Greenwich Mean Noon Obs.	NCDC	Original paper forms	1910-47	L-17	S. Daily O.F/ *and* S. Monthly O.F.	(TBD)

Annex H: Automated Research Vessel (R/V) Observations Catalog

In support of the JCOMM Expert Team on Marine Climatology (ETMC), the Shipboard Automated Meteorological and Oceanographic System (SAMOS) data center at the Florida State University (USA) has developed a partial catalog of digital observations made by R/Vs that may not be readily available in delayed-mode climate archives. The catalog includes information for 30 R/Vs with readily available digital archives, which was provided by the operators and data centers in Japan, Australia, Canada, UK, and USA. Temporal coverage varies but begins as early as 1985 covering up to the present. Further provision of available digital research vessel records is requested from all international vessel operators. Additional information regarding R/V data available in the US Rolling Deck to Repository (R2R) archive can be found in Table H2.

Table H1. Preliminary catalog of research vessel marine meteorological observations. These data are all available in digital formats and may be candidates to augment the marine climate data record for the late 20thC and early 21stC. Some providers noted that their data are likely already in ICOADS as circulated over the GTS, or possibly provided in delayed-mode to the JCOMM Global Collecting Centers (GCCs). Many more research vessels could be added to this list as time and resources allow.

Vessel(s)	Source	Start year	End year	Catalog source
Maurice Ewing	LDEO	1999	2005	Cruise list provided by R. Arko at LDEO
Marcus Langseth	LDEO	2008	2009	Cruise list provided by R. Arko at LDEO
Revelle, Melville	Scripps	1994	2007	Catalog available on line - http://siox.sdsc.edu/search.php?xml=xqdl_0_1.xml
Southern Surveyor	CSIRO	1990	Present	http://www.marine.csiro.au/nationalfacility/voyages/datasets.htm
Franklin	CSIRO	1985	2002	http://www.marine.csiro.au/nationalfacility/voyages/datasets.htm
Aurora Australis	Australian Antarctic Data Centre	1987	Present	Access available via new geoserver - http://services.aad.gov.au/geoserver/web/?wicket:bookmarkablePage=:org.geoserver.web.demo.MapPreviewPage 1-min snapshots from higher frequency data (available on request)
Natsushima	JAMSTEC	1987	2010	http://www.godac.jamstec.go.jp/cruisedata/e/ (note: 1 min data samples under navigation tab)
Kaiyo	JAMSTEC	1991	2010	http://www.godac.jamstec.go.jp/cruisedata/e/ (note: 1 min data samples under navigation tab)
Yokosuka	JAMSTEC	2001	2010	http://www.godac.jamstec.go.jp/cruisedata/e/ (note: 1 min data samples under navigation tab)
Marai	JAMSTEC	1998	2010	http://www.godac.jamstec.go.jp/cruisedata/e/ (note: 1 min data samples under navigation tab, also separate met files with radiation)
Kairei	JAMSTEC	2001	2010	http://www.godac.jamstec.go.jp/cruisedata/e/ (note: 1 min data samples under navigation tab)
Ryofu-Maru, Keifu-Maru, Kofu-Maru, Seifu Maru, Chofu Maru	JMA	1997	2010	Cruise and data catalog available at: http://www.data.kishou.go.jp/kaiyou/db/vessel_obs/data-report/html/ship/ship_e.php Note: Not all cruises have MET data files listed on line and the format looks to be IMMT-1, so most of these data should be in marine climate archives through the

				GCCs. Received confirmation from Mizuho at JMA that their vessels do not collect higher frequency data than what is in IMMT-1 and transmitted to the GCCs. These data should be in ICOADS via that pathway.s
CCGS Shammok, CCGS Wilfred Templeman, CCGS Alfred Needler, CCGS Teleost, CCGS Pareizeau, CCGS Hudosn, CSS Dawson, MV Gadus Atlantica, and others	NW Atlantic Fisheries Centre, Canada	1985	Present	AWS data provided (hourly?) to Environment Canada – likely in ICOADS through GCCs. Also have digital copies of station logs (~2500 per year) with note that these may be of variable quality. Prior to 1985 data may exist on paper. Contact: Dave Senciall
RRS Discovery; RRS James Cook; RRS Charles Darwin (retired); RV Prince Madog; RRS James Clark Ross	British Oceanographic Data Center	~2006	Present	Digital data available, but not currently on line. Independent of bridge weather reports. Cruise inventory available at: https://www.bodc.ac.uk/data/information_and_inventories/cruise_inventory/search/

Table H2: Catalog of research vessel underway data held by the US Rolling Deck to Repository (http://www.rvdata.us) project. The vast majority of these data should include SAMOS-type meteorological and flow water systems data. All data are in digital formats, but format type will vary greatly from vessel to vessel. A subset of these data may have been circulated over the GTS, or possibly provided in delayed-mode to the JCOMM GCCs. In addition to callsigns as circulated over GTS, ship codes defined by the International Council for the Exploration of the Sea (ICES) in connection with the SeaDataNet project have been listed (http://ocean.ices.dk/Codes/ShipCodes.aspx).

Vessel	Callsign	ICES Code	Start Date	End Date
Alpha Helix	WSD7078	31HX	1998-03-08	2004-12-09
Atlantic Explorer[2]	WDC9417	33H4	2008-01-14	2011-12-30
Atlantis[2]	KAQP	33AT	2000-01-12	2012-08-09
Blue Heron	WCX7521	33B1	2010-05-14	2011-11-09
Cape Hatteras	WRZ8934	32KZ	2009-01-08	2011-11-16
Clifford A. Barnes	WRN5495	33CB	2008-04-05	2012-05-04
Endeavor[2]	WCE5063	32EV	2010-02-17	2012-07-13
F.G. Walton Smith	WCZ6292	33WA	2008-01-28	2011-10-21
Healy[2]	NEPP	33HQ	2000-01-26	2012-10-25
Hugh R. Sharp	WDC6908	33H5	2006-02-10	2012-10-27
Kaimikai-o-Kanaloa	WBN4310	33KI	2000-02-01	2010-05-21
Kilo Moana[2]	WDA7827	33KB	2002-07-25	2012-06-29
Knorr[2]	KCEJ	316N	2000-01-12	2012-07-27
Marcus G. Langseth	WDC6698	33H3	2007-03-04	2012-07-23
Maurice Ewing	WLDZ	3230	1990-06-13	2005-02-13
Melville[2]	WECB	318M	2005-01-28	2011-11-26
New Horizon[1]	WKWB	32NM	2009-01-07	2012-10-15
Oceanus[2]	WXAQ	32OC	2000-05-15	2012-10-22
Pelican	WSK3051	32PE	2007-10-05	2012-08-04
Point Sur	WSC2276	32P0	2009-01-29	2011-12-05
Robert Gordon Sproul[1]	WSQ2674	32QU	2009-01-03	2012-10-08
Roger Revelle[2]	KAOU	33RR	2005-01-09	2012-01-05
Savannah	WDA5407	33H6	2009-01-14	2012-07-05
Thomas G. Thompson[2]	KTDQ	3250	2006-02-14	2012-07-24
Wecoma	WSD7079	32WC	2005-01-10	2011-11-30

[1] Missing years 2010 and 2011

[2] Some data after 2005 included in SAMOS holdings