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ICOADS Marine Data Rescue: Status and Future CDMP Priorities

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1. Introduction

Completion of another full International Comprehensive Ocean-Atmosphere Data Set (ICOADS) update following Release 2.5 (R2.5; spanning ~1662-2007; Woodruff et al. 2009) would be highly desirable by October 2010 to support the following reanalysis efforts: (a) NOAA-CIRES Surface Input Reanalysis for Climate Applications (SIRCA; 1840s-present), (b) ECMWF's ERA-CLIM (~1935-present), and (c) NCEP/CPC's for the "radiosonde era" (~1950-present).

Additionally, efforts to improve sea surface temperature (SST) analyses—including by the UK Met Office of a HadISST2 product (~1850-present) and by NCDC of a revised ERSST product—would greatly benefit from improvements in the ICOADS data and metadata within approximately that same timeframe. However, while very helpful continuing international contributions are anticipated (e.g. UK), making these desired improvements within the proposed update schedule appears highly dependent on adequate resources from CDMP (subject to year-to-year uncertainty owing to the special funding basis), as well as on adequate NOAA funding for the ICOADS project (also uncertain).

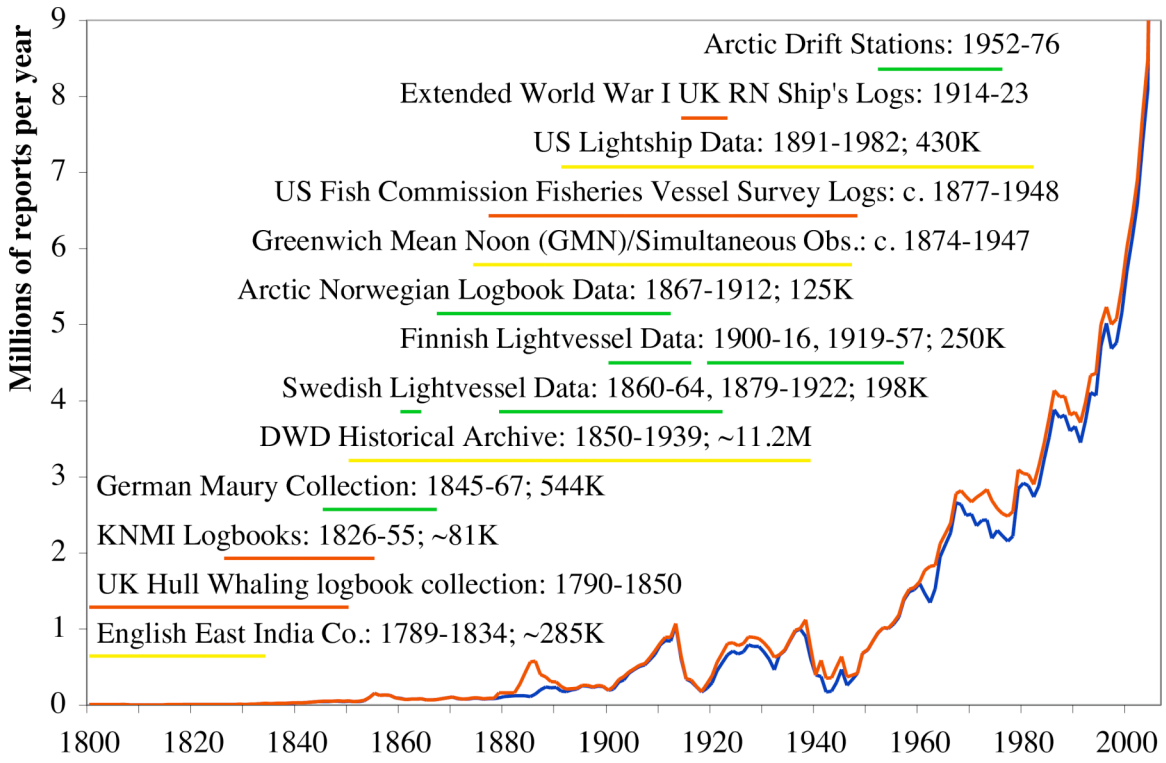

Figure 1. The time periods of selected candidate historical data sources (discussed in more detail in Wilkinson et al. 2009) to be blended into ICOADS, are spanned by horizontal colored lines: green candidates are fully digitized but require format translation, yellow are partially digitized, and red are in the planning stages for digitization. Each dataset name is appended with the date range and approximate number of reports (if known). 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). We hope that datasets available by 31 March 2010 can be included in the next major ICOADS ("R2.6") required by the start of FY2011 to meet reanalysis requirements.

This document brings together background and status information for a number of historical marine datasets already in digital form, or planned for imaging and/or digitization by the NOAA Climate Database Modernization Program (CDMP) or related international initiatives, and targeted for blending into ICOADS, either as part of the proposed update before 2010 to support reanalyses, 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 2007)—are estimated. 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 CDMP's Environmental Document Access and Display System (EDADS).

Significant additional time and resources (not yet estimated in detail, but at least six months April-September 2010) will also be needed to: (a) adequately assess in advance the quality of new data sources before they are blended into ICOADS; (b) implement the blend (i.e. additional QC including data preconditioning, duplicate elimination, and further steps required to make the observations and products ready for users; we note however that only the individual observations are likely needed for reanalyses/SST analyses).

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., 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 are becoming available via the RECovery of Logbooks And International Marine data (RECLAIM) Project (http://icoads.noaa.gov/reclaim/; Wilkinson et al. 2009).

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 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.

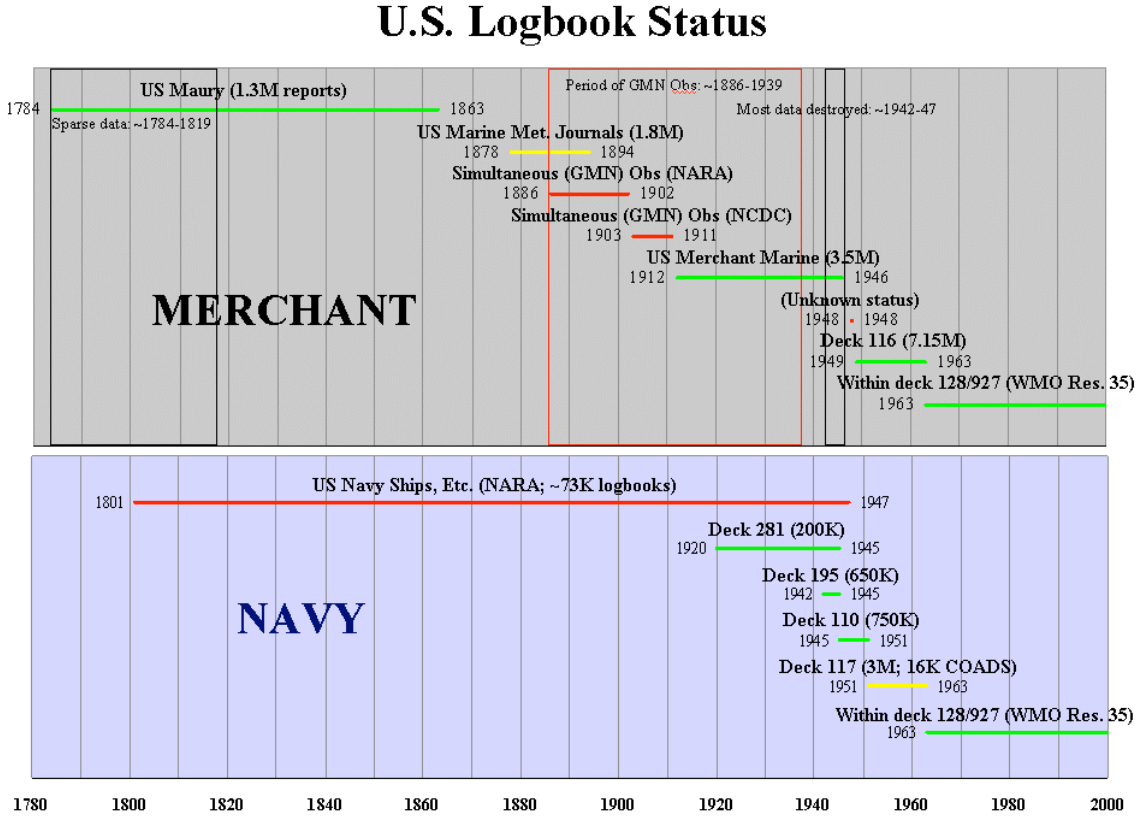

Figure 2. The US National Archives and Records Administration (NARA) and NCDC both have responsibility for wide ranges of merchant and military logbooks (or later meteorological forms), with lines on the above figure indicating their temporal ranges: red=undigitized, yellow=digitized but not yet blended, green=blended into ICOADS [note: as of Release 2.4; the Marine Met. Journals were blended into R2.5, thus the figure is not current]. See also Annex D for further detailed information used to develop this figure. Notes regarding two potential future CDMP remedial data-improvement projects:

(i) At least some US logbook data for a period starting around 1995 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). [Note: figure also needs to be adjusted to accurately reflect this issue.]

(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 CDMP data improvement project at some point, in view of the key role of SST data in climate research.

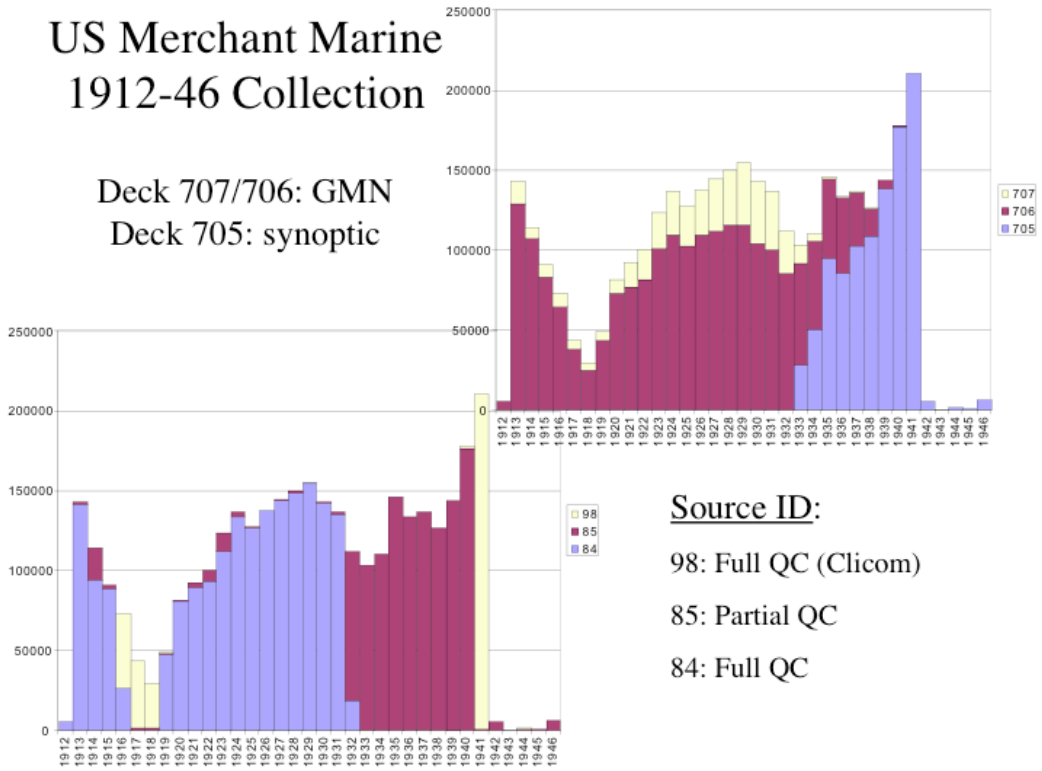

Figure 3. Temporal distribution of the US Merchant Marine 1912-46 Collection by deck (705-707) and source ID (SID; 84-85, 98), consisting of 3.5M reports blended into ICOADS Release 2.0. These data were digitized through a lengthy NCDC project initiated in 1989 (Elms et al. 1993), which ending up transitioning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

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. 2009, as noted. Goals are indicated as applicable for imaging, digitization, and translation into the IMMA format (Woodruff 2007).

2.1 English East India Co.: 1789-1834; 285K (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) have been imaged by the British Library, and will be digitized by CDMP (probably limited to the instrumental observations, and neglecting most of the subdaily wind and weather observations due to budgetary considerations).

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

2.2 Hull Archives Whaling Logbooks: 1790-1850

Three rolls of microfilm of early logbooks received by CDMP from Dennis Wheeler (University of Sunderland, UK) in 2006, containing non-instrumental data and covering the period from the late C18th to the mid-C19th. The lack of instrumental data is compensated for by the value of daily wind force, wind direction and ice cover data for the very far northern latitudes. These images were recorded on voyages from Hull to the high polar latitudes. In addition images from five logbooks of merchants were secured from the same archive. These cover voyages from Hull, across the North Sea to the Baltic, with one exceptional voyage from London, UK to Lisbon, Portugal. Latitudes were rarely recorded and longitudes never recorded. Includes multiple voyages of the vessels *Bridget*, *John and Sarah*, *Resource*, *Retrieve*, and *Samuel Spyvee* from 1798-1805 and 1834-35. Other whaling logbooks exist in UK archives (see Annex A) and this exercise relates only to those held in Hull City Library (the UK's largest single whaling collection).

Imaging: received by NCDC as digital images (jpg format)
Digitization goal: (to be decided)
Translation goal: (to be decided)

2.3 KNMI Logbooks: 1826-55

A collection of Dutch logbooks (~170; 9K logbook pages) from the 19th century, planned for digitization by the CDMP, as resources permit (see also Annex B).

Imaging: completed in 2006 (by KNMI)
Digitization goal: (to be decided)
Translation goal: (to be decided)

2.4 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 will likely require attention to some issues of data homogeneity with the US Maury Collection (WEA05), and characteristics of (at least) the US Maury data (e.g. biased pressure observations) still being studied by KNMI (Wallbrink, 2008).

Imaging: completed in 2005
Digitization: completed in 2006
Translation goal: 2010

2.5 DWD Historical Archive: 1850-1939; 11.2M

Background: (See Annex C.)

2.6 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 digitised 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: (to be decided)

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

Background (from WEA05): Digital records supplied in 1999 by the Norwegian Polar Institute (http://dss.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)

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

Background (adapted from WEA5): 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 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:

2.8.1 Published: Weather Bureau *Bulletin of International Simultaneous Observations 1875-89 (*ref. MWR, 1914, which 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.

Imaging goal: completed in 2009
Digitization goal: 2010
Translation goal: 2010

2.8.2 Records of Simultaneous Meteorological Observations on Ships 1886-1902

Imaging goal: completed in 2009
Digitization goal: 2011
Translation goal: 2012

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

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

2.8.4 GMN Monthly and Daily Marine Forms (1910-47)

Imaging goal: completed in 2009
Digitization goal: 2010
Translation goal: 2010

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

Background: Original logbooks of US Fish Commission fisheries vessels are archived at the Smithsonian (siarchives.si.edu/findingaids/faru7184.htm), and at the NARA facility in College Park (Record Group 22). 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).

Imaging: completed in 2009
Digitization goal: 2012
Translation goal: 2012

2.10 US Lightship Data: 1891-1982; 430K

Background (from WEA5): 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 data exist for the UK and Ireland, which should be digitized at some point).

Imaging: completed
Digitization goal: 2010
Translation goal: 2010

2.11 Extended WWI UK Royal Navy (RN) Ship's Logs: 1914-23

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).

Imaging: being completed by the UK National Archives
Digitization: proposed for consideration as a CDMP task
Translation goal: (to be decided)

2.12 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://dss.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 *Maud* and *Fram*. Only some of the data, including from the *Maud* and *Fram*, were blended into R2.0.

Imaging: (not applicable)
Digitization: completed c. 2000
Translation goal: (to be decided)

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 a format other than the original card deck 117 format (possibly TDF-11). Note that these 16K reports may provide valuable validation information for a new conversion from the original card deck format into IMMA. Also some deck 117 records were tapped to fill gaps in Arctic Drift Stations (sec. 2.12; ref. Table 1 in Elms et al. 1993).

Imaging: (not applicable)
Digitization: completed c. 1957 (original card deck reference manuals available here: http://icoads.noaa.gov/reclaim/us.html).
Translation goal: (to be decided)

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://dss.ucar.edu/datasets/ds541.4/) from NCDC on CD-ROM.

Imaging: (not applicable)
Digitization: (not applicable; data published/available on CD-ROM)
Translation goal: (to be decided)

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.
  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 R2.2 (completed in 2005, data extending through 2004; http://dss.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 (http://dss.ucar.edu/datasets/ds256.1/).
- Canadian moored buoy data (1970-November 1998, obtained from Val Swail Feb. 1999; http://dss.ucar.edu/datasets/ds256.3/).

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

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

Imaging: (not applicable)
Digitization goal: (not applicable)
Translation goal: (to be decided)

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://dss.ucar.edu/datasets/ds257.0/).

Imaging: (not applicable)
Digitization goal: (not applicable)
Translation goal: (to be decided)

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]. Imaging and digitization began in 2008 and will be completed in 2010. Data are being keyed in csv format.

Imaging goal: 2010
Digitization goal: 2010
Translation goal: 2010

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://dss.ucar.edu/datasets/ds530.0/).

Imaging goal: (not applicable)
Digitization goal: (not applicable)
Translation goal: (to be decided)

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: (to be decided)
Digitization goal: (to be decided)
Translation goal: (to be decided)

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."

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

Imaging goal: (to be decided)
Digitization goal: (to be decided)
Translation goal: (to be decided)

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."

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(Note: references marked † are available in electronic form at http://icoads.noaa.gov/publications.html and publications marked †† at http://icoads.noaa.gov/reclaim/selected.html)

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Annex A: Additional RECLAIM and ACRE-Related Activities

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

2009 Accomplishments

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

A sum of GB£111K (US$200K) from Defra/MoD was allocated for imaging, and this commenced in October 2008. Under RECLAIM a shortlist of logbooks with relevant statistics and a detailed set of movement records was provided. As a result of sufficient lead-in time, this listing is superior in quality and detail to the corresponding WWII initiative (Brohan et al. 2009) and will hopefully yield far less in-port met data. Initial funding was expected to produce about 294K images. Due to subsequent budget restraints, there are likely to be no more that c. 150k images. There are presently no funds available beyond imaging, and therefore digitization of the images will require additional resources (possibly from CDMP; ref. main sec. 3).

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 August 2008. Work on the CORRAL Project "COLonial Registers and Royal navy Logbooks" (http://www.corral.org.uk) began in October 2008 and will be complete by September 2009, with monies covering both imaging and 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; these probably began c. 1830s and span both the 18thC and 19thC. There are 194 logbooks, six of which are met 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/)

The "Colonial Met Registers", kept at lighthouses, and at St Helena (South Atlantic) and Malden (Pacific) islands, are a collection of meteorological registers kept in the National Meteorological Archive, and housed at the Devon Record Office in Exeter, and have been imaged as part of the CORRAL Project.

Plans for 2009/10 and Beyond

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 has been 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 deck logbooks. However before the 1850s the RN logs may not all contain instrumental met data. Certainly after 1860/70 they will. The chief advantage to imaging the remarks books is 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 remarks books are compared to ensure consistency and accuracy of recording between the two, as part of a pre-imaging QC exercise. Unless funds appear suddenly (as with JISC) it is unlikely that any imaging will start before 2011.

There is an additional modest project feasible at the UKHO involving the digitization of subsurface sea temperatures. These are 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 USNO has an extensive series of books for chronometers aboard US ships (see Annex D) and (with further inquiries being 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 of elsewhere in journals, you might find you have further series of oceanic observations."

Exeter University Project

Exeter University Maritime Studies are presently writing a bid for substantial funds, GB£1-1.5M (US$1.8-2.7M), to study the operations of the RN from 1815-99 in conjunction with providing met data for scientific research. Funds are intended to support two research officers and two PhD students; nevertheless there will be considerable sums for the imaging of logbooks. One of the research officers is intended to study the quality and purpose of the observations, and through this, it should be possible to collect and assess much useful instrument metadata. Based on materials prepared for RECLAIM, an estimate of the number of logbooks readily available has been submitted to Mike Duffy who is leading the project. The project is multi-disciplinary and if immediately successful may begin sometime in 2010. Otherwise the bid will need to be revised and re-submitted for commencement at some point beyond 2010. At present (Aug 2009) no news concerning this proposal has been received but it is assumed that efforts will continue to secure funding.

Whaling Logbook Project

The Universities of Hull and Sunderland together with the British Arctic Whaling Group (http://www.hull.ac.uk/baw/overview/overview.htm) have been attempting to secure funds with which to explore the collection of UK whaling ship logbooks, some of which date back to the late 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 valuable particularly for this period. Bids are pending but no decision has yet been made on support. At the time of writing the applicants have received favourable reviews at the first stage of project assessment. They have been asked to respond to the points raised at stage-one review, and a final decision is anticipated during September '09.

[Note from sec. 3c of the main text that three rolls of microfilmed whaling logbooks from the Hull Archive arranged by Dennis Wheeler in 2006 have been archived by NCDC/CDMP, but further digitization work or possible availability of the images on EDADS awaits CDMP or external funding.]

Printed Met Data from Online Scans, Books, and Journals

This activity (ACRE funded) is ongoing and 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 digitised, translated and blended into Release 2.5 of ICOADS, as have observations from the US Exploring and *Challenger* expeditions in the late 1830s-early 1840s and 1870s respectively. Three more expeditions (William Parry's first, second and third North West Passage voyages) have been digitised and translated as a contribution to the CORRAL project. Records from several other expeditions have been digitised, but not yet translated. These include notable English and French explorations and circumnavigations in the 19th Century. RECLAIM has provided a list (presently [Aug 2009] 960 items of which 750 are of marine met or oceanographic interest) of printed journals and other publications many of these containing tabulated met data. In this area ACRE and RECLAIM are pooling resources and expertise. This is very much an on-going exercise with great potential.

Other Items

UK Met Office Ships' Met Logs

There is an urgent need to make some sort of comparison between some of the WWII logs already digitized and the corresponding Met Log at the UK Met Office. However the Met Logs as a collection stretch back to the mid-1850s and are superior in every respect to the corresponding RN deck log 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 Ship's Logs [see

metadata below]). Again both the deck and Met Logs of selected vessels should be compared as part of an initial QC exercise. An inventory has been started (RN complete to 1890) but there are up to 4K separate items most of them from merchant vessels. A few weeks work would see this complete and it is an essential first step to further progress.

Australian Joint Copying Project

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 to 1993, materials in British archives concerning the history of Australia and the surrounding region were copied on 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.

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 probably will need to be contacted separately to find out the status of these holdings, and any planned digitization efforts.

ACRE Chile

In April/May 2009, a delegation representing ACRE, RECLAIM and the Scott Polar 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. Inquiries are also underway with the Chilean Hydrographic Service (SHOA) to ascertain the existence of "Remark Books" or something similar in their archive. Efforts to support a project to image and digitize Chilean marine data are presently (Aug 2009) ongoing. The potential data from such a project would cover the SE Pacific, which is presently data sparse.

Royal Navy Eastern Pacific Logbooks 1790-1913.

In anticipation of a Chilean marine data digitization project, 904 corresponding Royal Navy logbooks for the eastern Pacific have been identified, their movements documented and the relevant ship platform metadata assembled. Provision has also been made to gather instrument metadata, which is expected to be present for vessels from c. 1875 onwards. An initial estimate of images and costs indicates 305K images costing about £155K ($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.

Royal Navy Indo-Pacific Logbooks 1800-1913

A similar exercise is presently (Aug 2009) underway to identify corresponding Royal Navy logbooks covering the western Pacific, [China and Australian stations], Indonesia and the Indian Ocean. This will be complete by late 2009 and will provide the basis of a further digitization project. At the present stage, no estimates of images and costs can be provided.

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 of sea temperature. An example of a whale fisher catch book (a duplicate of one archived at St. Andrews) is also held at the Climatic Research Unit, University of East Anglia. The collection has been noted for future investigation.

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 Bay Company (HBC) and N. American Royal Navy logbooks (V. Swail, Canada), plus historical Arctic efforts (R. Przybylak, Poland)
• Australian ships' logbooks (~1,300; 1855-1982) (Bill Wright, Australia; R. Allan, UK)
• New Zealand logbooks (e.g. 3K covering 1936-94) (C. Wilkinson, UK)
• South African (Capetown) 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 UK 20thC Ship's Logs do not contain instrument or platform metadata and the search for the data is a task that needs to be undertaken. It may for instance be noted in the very first logbook in a sequence for any one commission. (So the first thing to check is EDADS.) The corresponding Met Office 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 (for instance for the Exeter project, the JISC exploration project, or the proposed eastern Pacific Project) 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 met 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 will produce a report on instruments and observing methods/instructions, noting in particular historic changes in instrumentation and observing methodology.

At least for international merchant ships, 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).

[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..... pr Petras	1	425	1	8	iron	I.		'62	London	New York Engs 2 dir cyl 28 in SP 28 in	W. Whann	170 22' 13	S	Sc rig 4 bkhds 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 bkhds	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 H'dyan&Hollinsw'th	Phila Ver dir 250 HP	R. F. Loper 1 of 30 in SP 28 in	150 23' 17'	M	Sc rig 8 bkhds 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 salns	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 3 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 28 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 30 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 SF 4 ft	A. Leary & Co	211 30' 19'	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 Ric	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 '65	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	Egn 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 spensions	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	Egn rig L reps '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 bkhds F C	N Y 4, '66

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

Information from Wilkinson et al. (2009):

In 2006, Royal Netherlands Meteorological Institute (KNMI) produced approximately 15K digital images of a collection of Dutch logbooks from the 19th century that resides in the archives of the Institute. These images are planned for digitisation by CDMP, as resources permit. Support in the form of interpretation of the images is given by KNMI.

Under the umbrella of the KNMI project HIStorical CLIMate (HISKLIM) more inventories of national archives and museums will be completed and more historic marine data will be made available (http://www.knmi.nl/onderzk/hisklim/index-en.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.

Annex C: Deutscher Wetterdienst (DWD) Marine Meteorological Archive

(1) Selected DWD data were obtained by NCDC in 1999 from Volker Wagner, and used in cooperation with NSIDC to create a 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.

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

(3) Letter (e-mail only) sent 13 February 2007 to Reinhard Zöllner (Volker Wagner's replacement) from the GCOS AOPC/OOPC Working Group on Surface Pressure (WG-SP) requested urgent consideration by DWD for providing as much as possible of the DWD archive for blending with ICOADS, and indicated 1880-1948 as the main period of interest.

(4) At ETMC-II, Mr Zöllner described historical marine digitization activities at DWD, which began in the 1940s and are continuing in the framework of DWD's "HISTOR" project. ETMC-II endorsed investigations of the feasibility of making the DWD historical marine archive available for merger with ICOADS, in accordance with the above recommendation from WG-SP (action Mr Zöllner by mid 2007; ref.: JCOMM, 2007).

(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 report):

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

(6) More details about the "HISTOR" project were presented by Mr Zöllner at CLIMAR-III (Gdynia, Poland, May 2008; however the poster presentation was not made available for the workshop proceedings, possibly due to DWD policies). Following up on the ACRE Workshop (Zurich, July 2008) Woodruff wrote to Mr Zöllner (3 July 2008 requesting consideration of DWD supplying more of their archived data (no response as of August 2009, although this issue was discussed informally by them in conjunction with a JCOMM meeting (SOT-V) in May 2009).

Annex D: Undigitized US Logbook/Marine Collections

This describes the known archival location and status of US merchant (Tables D1-D2) and US Navy marine meteorological logbooks ("deck logs") or forms (Table D3). Older data are primarily held by NARA in the National Archives II facility at College Park, MD. More recent data are held in their East Point, GA facility or at NCDC (noting that generally many merchant and Navy weather records for 1903-forward all are the responsibility of NCDC, even those physically archived at East Point [note: to be confirmed]). Some of these records listed in Tables D1-D3 have been imaged by CDMP and are becoming available via EDADS.

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) and 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).

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…."

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 B4), 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 D4 might refer to some of these volumes. From discussion (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
1945-63*	Merchant Marine	Unknown (archived at East Point/NCDC?)
1964-date**	Merchant Marine	Unknown (archived at East Point/NCDC?)

* 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. Navy logbooks: most original records up to about 1947 appear to 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].

Period	*Title/Description*	*Status of original records/comments*
1804-1947	US Navy logbooks	NARS (1978) gives a ship inventory [apparently not available in digital form from NARA—possible future candidate for imaging/digitization?]
1926-45	US Navy Monthly Aerological Record (MAR)	Unknown (ref. TDF-11 deck 281)
1945-51	US Navy Marine	Unknown (ref. TDF-11 deck 110)
1952-64*	US Navy Hourlies	Unknown (ref. TDF-11 deck 117)
1965-date**	(Unknown?)	Unknown (archived at East Point/NCDC?)

* Thus far only a very small amount (16K reports) out of the total deck 117 (3M) reports have been blended into ICOADS.

** From about 1965 until the early 1980s (to be confirmed), 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 call sign/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. 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, including in conjunction with the German Maury digitization project.]

(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. 2.8.1 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. 2.8.2)

- Forms have been imaged and will be loaded to EDADS.

3. Records of International Simultaneous Ship and Land Observations, 1874-92 (NC Entry #69; 16 Oversize volumes and possibly 47 additional boxes) (ref. sec. 2.8.3)

- 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. 2.8.4)

- 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: Lightship Observational Forms 1937-82 From Woods Hole Oceanographic Institute (WHOI)

(Information about earlier holdings at NARA to be added)

- WHOI forms have been imaged and loaded to EDADS.
- 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 that were keyed, 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	1947-79
Delaware	1961-70
Diamond Shoals	1947-74
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, EDADS 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., EDADS Libraries, and ICOADS information. The pathway to the EDADS 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 G2 for international projects e.g. ACRE-related data rescue tasks that aren'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.*	*EDADS 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)	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./ Maury Journals (U.S.)	701 [69]
KNMI Logbooks	??	??	1826-55	(TBD)	S. Daily O.F./ Dutch Logbooks	(TBD)
German Maury Collection	DWD	??	1845-67	05-07	S. Daily O.F./ Maury Journals (German)	(TBD)

US Marine Met. Journals	NARA	RG 27 Entry 127 (1,955 vols.--135 ft.)		(N/A, digitization by China)	S. Daily O.F./ U.S. Marine Meteorological Journals	704 [125]
World War II RN Ship's Logs	UK National Archives (TNA)	??	1938-1947	L-23	S. Daily O.F./ Royal Navy WWII Logbooks	245 [126]
US Lightship Data	NARA	RG ? Entry ?	??	??	S. Daily O.F./ Lightship Observations/ NARA Lightship Daily Obs. *and* NARA Monthly Obs.	(TBD)
US Lightship Data	WHOI	??	(see Table F1)	04-35	S. Daily O.F./ Lightship Observations/ Lightship Daily Obs. *and* Lightship Monthly Obs.	(TBD)
English East India Co.	British Library	India Office Records	1789-1834	L-23	S. Daily O.F./ East India Company Logbooks	(TBD)
UK Hull Whaling Logbook Collection	Hull City Library	microfilm??	1790-1850	??	(TBD??)	(TBD)
US Fish Commission	Smithsonian Institution	??	1877-1948	L-49	(TBD??)	(TBD)
US Fish Commission	NARA	RG 22	??	(TBD)		
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./ Pre-1947 Greenwich Mean Noon Marine Obs.	(TBD)