Digitization of the Kobe Collection

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Introduction

The Japan Meteorological Agency (JMA) carried out two projects to digitize a set of historical marine meteorological observations known as the Kobe Collection with the US Weather Bureau (USWB) in 1960-1962 and with the Japan Weather Association (JWA) in 1995-2003.
Under these projects, 7 tons of marine meteorological log sheets were copied onto 621 rolls of microfilms and 364 rolls out of the 621 rolls, which contained observations made by merchant ships, fishing boats and research vessels, were digitized.
The digitized Kobe Collection contains total amount of 5.8 million marine meteorological observations over the period 1889-1961. The 2.7 million observations over the period 1933-1961 digitized by JMA-USWB were already included in the Comprehensive Ocean-Atmosphere Data Set (COADS) Release 1. The final CD-ROM of the JMA-JWA project that contains the 3.1million observations over the period 1889-1940 has been distributed. It is expected that they will be widely used.

This paper provides information about the two projects with emphasis on the latter.

The Kobe Collection

The Kobe Collection is a set of historical surface marine meteorological observations collected and stored by the Kobe Marine Observatory (formerly the Imperial Marine Observatory).

In 1889, the Central Meteorological Observatory, the predecessor of the JMA, started collecting marine meteorological log sheets from Japanese ships. In 1890, the observatory received log sheets from 36 ships.

When the Imperial Marine Observatory, which undertook marine meteorological services, was established in Kobe, one of the oldest international trade ports in Japan, in 1920, it took over the collection and management of the log sheets from the Central Meteorological Observatory. Since then, marine meteorological log sheets had accumulated until internationally standardized digitization of marine meteorological data started under the Marine Climatological Summary Scheme of the World Meteorological Organization (WMO) in the early 1960's.

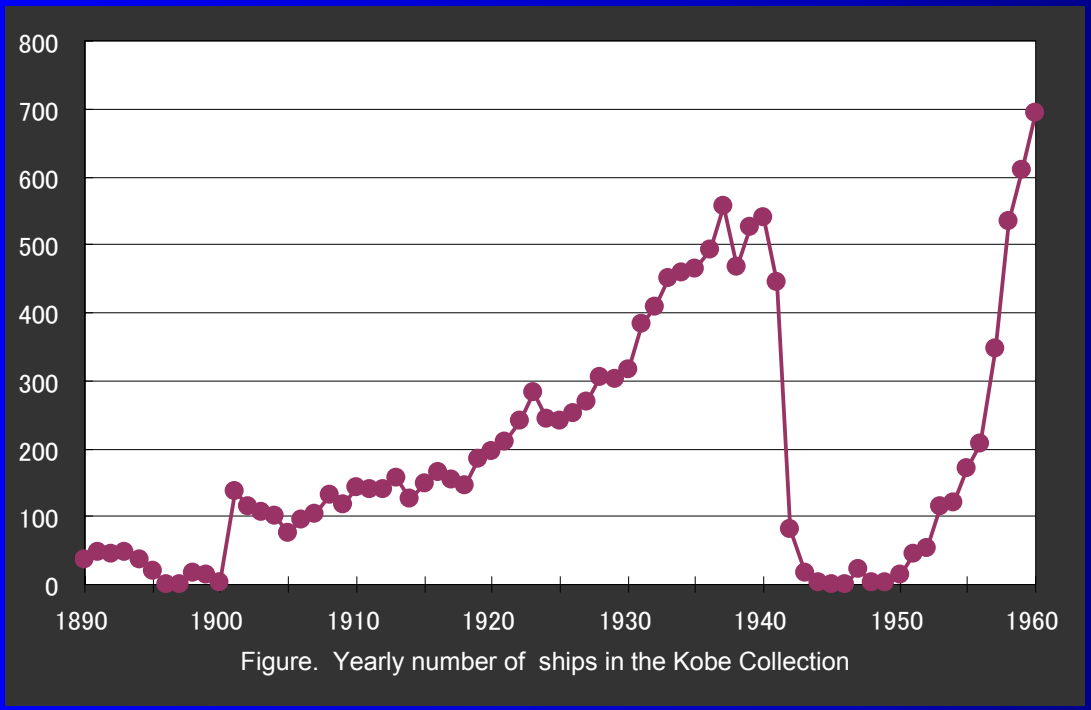


Figure. Yearly number of ships in the Kobe Collection

The number of ships that sent log sheets increased gradually in the early 20th century. While Japanese merchant ship fleet was devastated during World War II, the number of ships that sent log sheets recovered to more that 500 in 1958.

By the time when the JMA-USWB project started, seven tons of log sheets, which contained 6.8 million observations in the period 1889-1961, had accumulated at the Kobe Marine Observatory as the Kobe Collection.

Log sheet at early times

Observational elements in the log sheet at early times were date and time, ship's location, wind direction and Beaufort force, air pressure, temperature indicated by thermometer attached to barometer, dry-bulb and wet-bulb temperature, cloud, weather, direction and height of waves, temperature and specific gravity of sea surface water, and direction and velocity of sea surface current.

Most ships before 1923 made observations six times a day at 0200, 0600, 1000, 1400, 1800 and 2200 Japan Standard Time (JST). The observation times were printed on log sheets beforehand.

A guide to meteorological observation on board was printed on the back of the sheet. It included the Beaufort scale couched in terms of the ship's characteristics under sail and the Beaufort weather notation code.

Addresses of the coastal meteorological observatories that provided the barometer and thermometer calibration services were also printed.

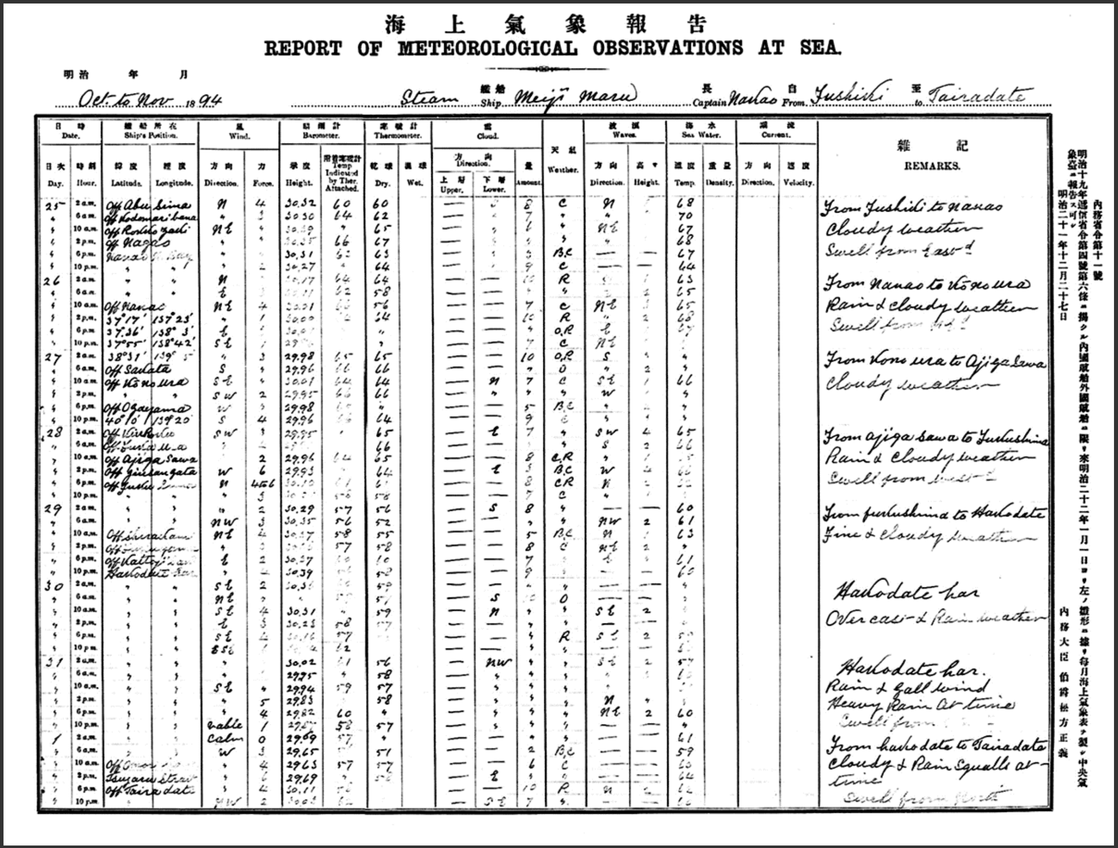


Figure. Example of one of the oldest log sheets in the Kobe collection. The *Meiji Maru* cruised from the Japan Sea to the Tsugaru Straits in October 1894. Observational times (2 a.m., 6 a.m., 10 a.m., 2 p.m., 6 p.m., and 10 p.m.) were printed on the sheet beforehand.

Change of log sheet format in 1923

The format of a log sheet was changed several times. The biggest change was made in 1923.

After 1923, most ships made observations four times a day at 0000, 0600, 1200 and 1800 JST.

In this change, columns for the observations of swell (direction and height) and visibility were added, while columns for wet-bulb temperatures disappeared. Columns for metadata on barometer, such as the type of barometer, instrumental errors, indication of the instrumental error correction, date and place of calibration, and the height correction were also added.

The Beaufort scale with velocity equivalents was printed on the back of the sheet.

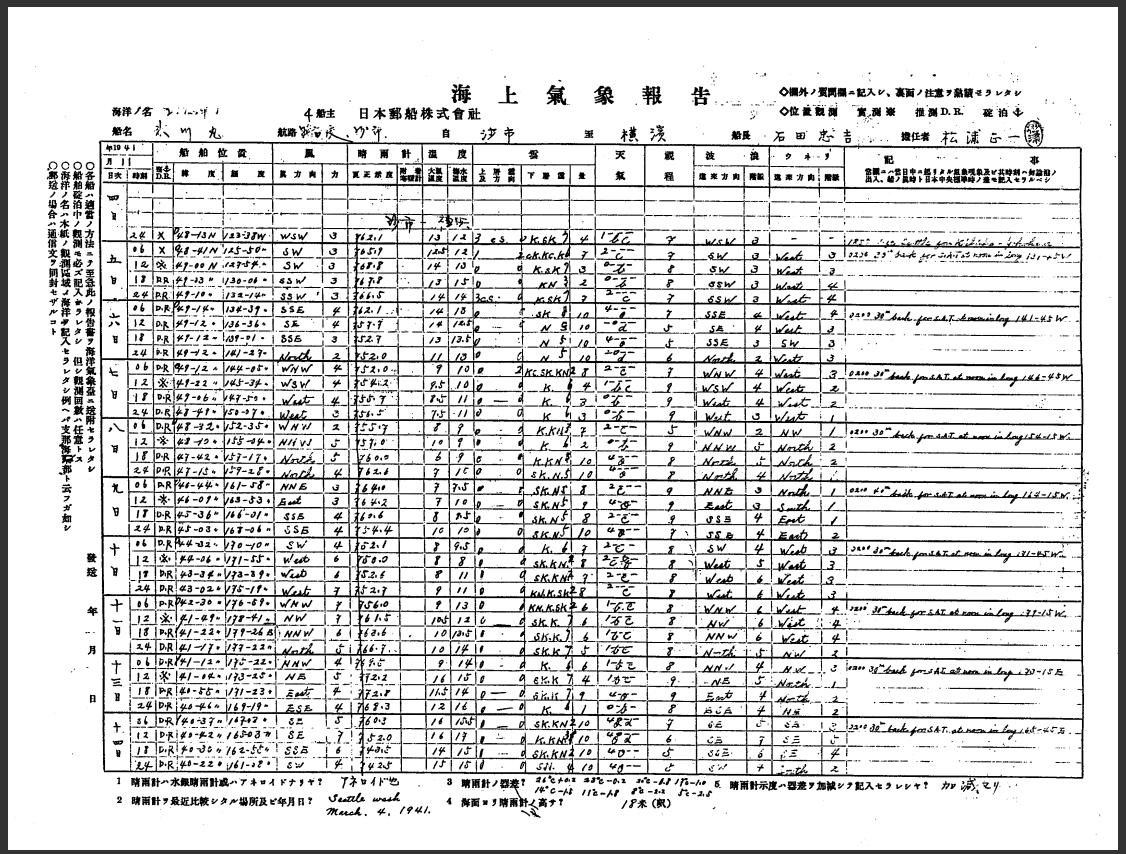


Figure. Example of one of the log sheets used after 1923 in the Kobe collection.
The *Hikawa Maru* left Seattle on 4 November 1941 bound for Yokohama.
Observations were made four time a day (at 6 a.m., noon, 6 p.m., and midnight).
There was no column for wet-bulb temperature on this sheet.

JMA-USWB digitization project in 1960-1962

JMA had an interest in punching the Kobe Collection in 1950's. It was planned once but suspended because of financial difficulties. In 1959, the United States Weather Bureau (USWB) proposed a JMA-USWB joint project to preserve the whole collection on microfilm and digitize a subset of the collection on punch cards for the purpose of preparing an ocean atlas with maximum available data for the computation of ocean climatology.

In 1960, an agreement was reached between JMA and USWB, and the project started. They agreed that JMA produced a set of punch cards which included one million marine meteorological observations and a set of microfilms of Japanese historical meteorological log sheets and sent them to the US National Weather Records Center in Asheville, and USWB paid the cost and gave JMA a permission to copy the cards and microfilms for its own use. Under the project, 7 tons of marine meteorological log sheets had been copied onto 621 rolls of microfilms and 2.7 million observations had been digitized on punch cards by March 1962. The 621 rolls of microfilms consisted of 364 rolls which contained Japanese VOS observations made by merchant ships, fishing boats and research vessels over the period 1889-1961 and 257 rolls which contained observations obtained by the Japanese Imperial Navy in 1903-1944. The 2.7 million punch cards were Japanese VOS observations obtained after 1933.

All microfilms and punch cards produced under the project were sent to the US National Weather Records Center in Asheville and the full set of the copies was kept by JMA. The 2.7 million punch cards account for 40 % of the Kobe Collection (VOS observations). They were already included in the Comprehensive Ocean-Atmosphere Data Set (COADS) Release 1 and widely used.

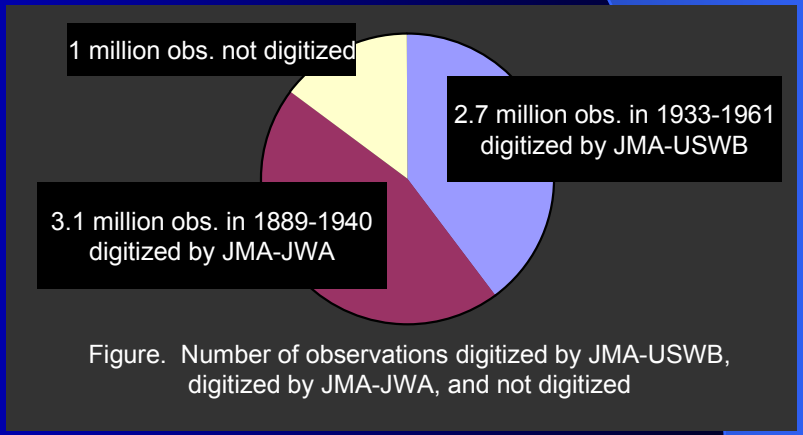


Figure. Number of observations digitized by JMA-USWB, digitized by JMA-JWA, and not digitized

JMA-JWA digitization project in 1995-2003

Considering a great interest in the scientific community in historical observations and the importance of making more complete and longer time series of climate system variables, JMA started another project to digitize the Kobe Collection in cooperation with the Japan Weather association (JWA). The project was carried out in 1995-2003 with financial support of the Nippon Foundation.

A set of 179 rolls of VOS observation microfilms, which had been filmed under the JMA-USWB project and had not been digitized then, was the source of the project. It contained more than 4 million observations over the period 1889-1932. Other log sheets, which contained about 55,000 VOS observations, were found in the Kobe Marine Observatory during the project. They were the other source of the project.

The project resulted in 3.1 million digitized observations over the period 1889-1940. About one million observations were not digitized because of the following reasons.

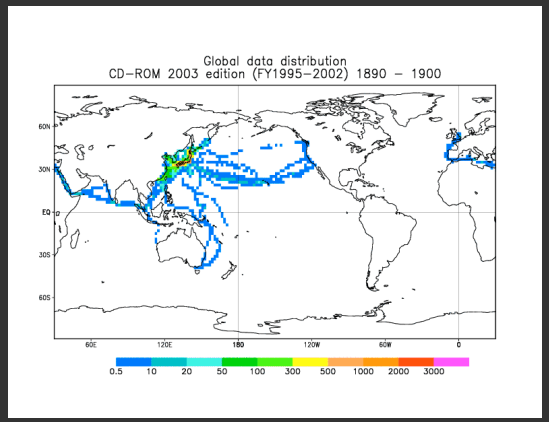
- unreadable handwriting
- no location or few locations (once a day or less)
- stationary observations mostly at port

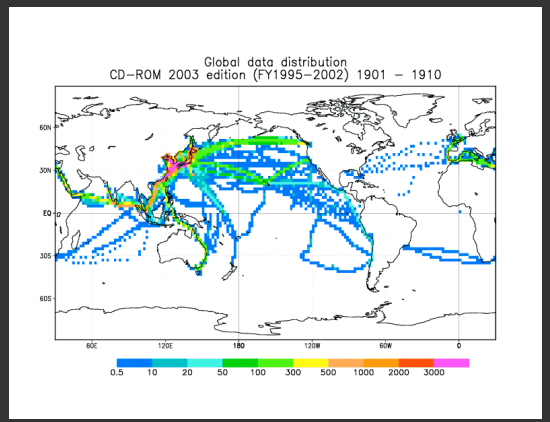
The Minimum Quality Control Standards (MQCS) of WMO were applied to all digitized observations. Possible manual corrections were made in the cases of doubtful date, time and location before applying MQCS. Majority of digitized observations are indicated with flag 1 (element appears to be correct). A few percent of wind speed, air temperature, wet-bulb temperature and sea surface temperature are indicated with flags 2 or 3 (inconsistent with other elements or doubtful, respectively). More than half observations do not have wet-bulb temperature because some types of log sheets do not have the column for the value.

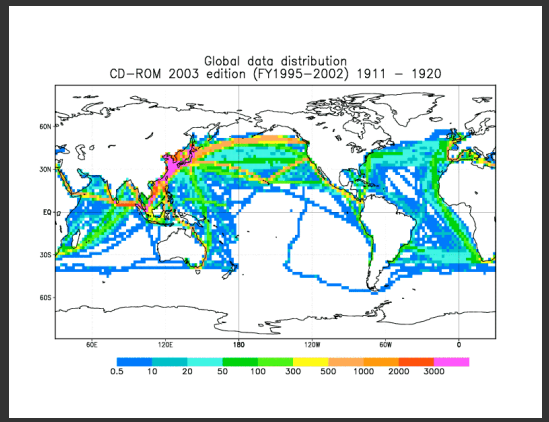
Observations were recorded using the International Marine Meteorological Tape format (IMMT-1). A 5-digit identifier, which consists of lower two digits of observation year and serial number, is used to identify each ship instead of ship's radio call sign. A ship name corresponding to each ship identifier is recorded in a metadata file. The file contains metadata such as ship identifier, ship name, number of data obtained by the ship in the year, log sheet type, barometer height, barometer correction, and unit of pressure and temperature in the log sheet.

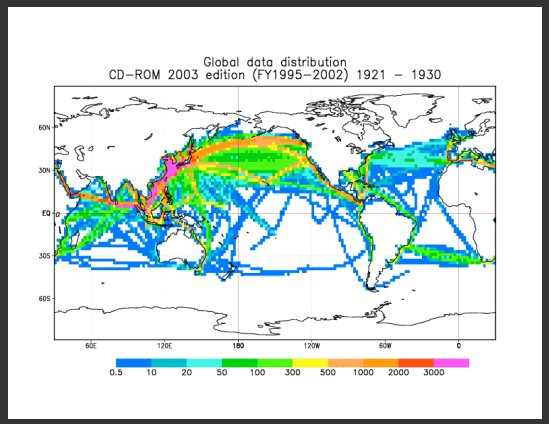
Geographical distribution of data

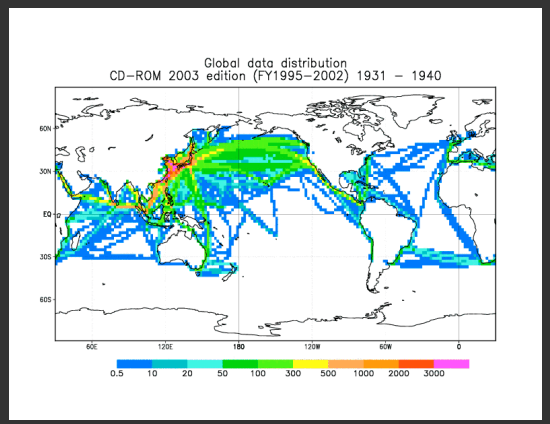
The data are mainly distributed in the North Pacific and east Asian seas, especially along the major shipping routes such as Japan-North America, Japan-Hawaii-California. More than 80% are in the regions. The period 1911-1920 is different from the other decades because there are many data over the Atlantic as well as the Pacific.











Figures. Geographical distribution of data by decades from decade of 1890-1900 to decade of 1931-1940. Each two degree square is colored according to the number of observations.

Significance of the digitized Kobe Collection
-- Increase of available data in the Pacific --

Available data in the Pacific in the early 20th century significantly increased by both the JMA-USWB and JMA-JWA digitization projects. The latter greatly contributes to the global coverage in the second half of 1910's including the World War I period.

Figures. Yearly number of observations in the Kobe Collection and COADS Release 1 (the Kobe Collection data digitized in 1960-1962 are excluded) in the Pacific and in the global ocean.