

# The Collection of Historical Ships' Data in Kobe Marine Observatory

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## Abstract

Japan started in 1889 to collect the marine meteorological data observed systematically by merchant ships. The Imperial Marine Observatory (the former name of the Kobe Marine Observatory) calculated various kinds of means and published them using the data in the period from 1911 to 1941. All the data in the period from 1890 to 1961 were microfilmed and sent to the U.S. National Weather Records Center (NWRC) in Jan. 1961 and Jan. 1962. Among them, the data in the period from 1933 to 1961 had been digitized on punch cards and sent to NWRC. These data are available through the Japan Meteorological Agency (JMA) and through NOAA. But pre-1933 data have not been digitized, at least by JMA, and there are no plans to do so, as yet.

Since the early years, manuals have instructed observers that the measurements of air and sea surface temperature need great care so as not to be interfered with by the sunlight or any discharge from the ship. Most of the thermometers used for the observations had been tested by the authorized observatories. However, we have not yet been able to find the early instruments or their photographs used for the observations; e.g., thermometers, screens, canvas buckets and others.

## 1. Introduction

A systematic collection of ship data observed by merchant ships was started in 1889 in Japan. The ship data of those days were sent to the Central Meteorological Observatory of Japan (CMO) or to the Hydrographic Department (HD) of the old Japanese Navy.

In 1920, the Imperial Marine Observatory (IMO) was established as a governmental organization independent of CMO and took over the marine data collection from CMO and HD. In the next year, IMO published an instruction manual for marine meteorological observation “Kaiyo kisho kansokuho” in order to instruct how to make accurate marine meteorological observations, and how to report the data by the reporting form “Meteorological Log Kept on Board”.

In 1942, the name of IMO was changed to Kobe Marine Observatory (KMO) and in 1949 KMO was made into a regional marine meteorological and oceanographical center under CMO. In 1951, CMO published “Handbook on the marine meteorological observations for ships” and changed the form of “Meteorological Log Kept on Board” into the form of “Marine Meteorological Logbook”. At the same time, CMO resumed the collection of ship data instead of KMO. In 1956, CMO was consolidated into the Japan Meteorological Agency (JMA). The collection of ship data has been continued by the Maritime Meteorological Division, Marine Department of JMA up to now.

In this report, we report on the management of historical ship data collected before 1961, and on the method of observation and the instruments used in those days.

## 2. The Archives in the Kobe Marine Observatory

The Kobe Marine Observatory keeps the original data in the form of the meteorological log reported by merchant ships for 54 years from 1889 to 1942. The elements of those observations were wind (direction and force in Beaufort scale), atmospheric pressure, air temperature (dry and wet), cloud amount, waves, sea surface temperature, current, etc. Those observations had been made six times a day at 2, 6, 10, 14, 18, 22 in the local time till 1923 and were made four times a day at 6, 12, 18, 24 in the local time from 1924. The data observed aboard a ship were sent to CMO via shore radio station for weather forecast, and put in the Meteorological Log sheet in sequence and mailed to KMO in port. On the reverse side of the Meteorological Log sheets, notes for observation and entry were printed in order to keep accuracy. These historical data in the form of log sheets were filed in yearly volumes. Though we did not recount them at this time, the total number of these data is estimated to be around 6 million according to some past investigations (Kanda, 1962) (Table 1).

The Imperial Marine Observatory calculated various kinds of mean values and published many annual reports and 5-, 20- and 25-year reports on the marine meteorology. Figure 1 shows the covers of the reports. In the introduction of each report, the methods of observation and the condition of measurement were explained as shown in Fig. 2. For the period from 1911 to 1926, the means on three elements (atmospheric pressure, cloud amount and sea surface temperature) had been calculated. For the period from 1927 to 1941, the element of air temperature had been added. From 1936, the element of atmospheric pressure had been excepted. The mean values were calculated for every five-degree square in the North Pacific Ocean and for every one-degree square in the South China Sea, the East China Sea, the Yellow Sea, the Japan Sea and the neighbouring seas of the Pacific coast of Japan as shown in Figs. 3 and 4.

For the period from 1911 to 1930, the data were published as 4 volumes of five-year reports. These five-year reports contain monthly, annual means and five-year means of each month. For the period from 1926 to 1941, annual reports were published. A twenty-year report (1911-1930) was published in 1935 and a twenty-five-year report (1911-1935) was also published in 1937.

## 3. The exchange of the historical ships' data with meteorological organizations of U.S.A.

All ships' data collected by JMA for the period from 1890 to June 1961 were microfilmed under the agreement of cooperation among JMA and the United States Department of Commerce, Weather Bureau. Among them, the data for the period from 1933 to June 1961 were also digitized and punched then. The archives of the Kobe Marine Observatory are included in those data. JMA prepared two sets of microfilms and punched cards. One set is in the possession of JMA. The other set was transported to the U.S. National Climatic Data Center at Asheville by dividing it into two shipments, one in January 1961 and the other in January 1962. However, the historical data before 1932 which are in the Kobe Marine Observatory have not digitized. There is no plan to do so, as yet.

The punched cards have two kinds of card-form (Format 1 and 2), as a result of the change of the reporting form by the regulation revision in 1953. The details of the Format 1 were given in the work sheet made by the 1st Weather Wing, General Headquarters (GHQ) in June 1956. Figure 5 shows the card-form of Format 1. Format 2 follows the FM21.A Code (WMO, 1964). The data for the period from 1933 to 1952 (except for the period from 1939 to 1943) and some part of 1953 were punched in Format 1. The data for the period of the remaining part of 1953 and from 1954 to June 1961 were punched in Format 2.

Almost all data in JMA's possession were microfilmed at that time. But the data observed on board of Japanese antarctic whaling ships and of the Japanese antarctic research ship "Soya" were not microfilmed because those data had already been punched by the Office of Antarctic Observation, JMA. The data for Ocean Weather Station (OWS) "X" and "T" for the period from 1947 to 1953 were not microfilmed either. However, the data of OWS "T" for the period from 1954 to 1959 were microfilmed. The number of the reporting sheets which have been microfilmed is estimated to be around 700,000. Though most data for the period from 1933 to June 1961 were digitized in the form of punch cards in 1960 and 1961, the data for the period from 1939 to 1943 were not punched then because those had already been punched by the 1st Weather Wing, United States Air Force, GHQ in June 1956, as mentioned above. Old Japanese Navy Data were not punched either.

All data collected after 1960 in Japan have been digitized and recorded on magnetic tapes. Using these data, JMA has published a series of reports (see Appendix). The Maritime Meteorological Division, JMA exchanges all Japanese ship data with international and foreign organizations at present.

#### 4. The method of observation and the accuracy

Recently, there has been much interest about climatic changes. Many scientists have begun to use long-term records of worldwide sea surface temperature, marine air temperature and other marine data. Some of them point out that some of the sea surface temperatures observed by Japanese merchant ships around the 1930's show colder temperatures by several tenths of degrees Celsius relative to other nations' ships nearby (private message from David Parker). So, questions have been raised about whether they were observed accurately. However, some scientists indicate that the sea surface temperature in those days was in fact colder (Iida et al., 1979).

So we looked into the observation methods and instruments used in those days. We could not find any guidebooks for observation used around 1890 when systematic marine meteorological observations started. But we found some notes for observation and entry printed on the reverse side of the reporting sheets named "Meteorological Log Kept on Board". The notes on sea surface temperature measurements were as follows:

As sea surface temperature is essential for navigation and marine studies, it must be observed as regularly as possible. Thermometer should be immersed directly in drawing water from the bow. About 15 minutes after, take the thermometer out of the water and read it immediately. Sufficient time should be allowed for the temperature to become

steady. Hot bucket in the sunlight and little volume of water may change the temperature. It is most important to consider such conditions.

The measurements by inaccurate barometers and thermometers are not only useless, but also misleading.

These instruments need to be compared with those of a meteorological observatory at times.

The instrumental errors for the barometers and the thermometers must be attached to this report in the following form.

The observations must have been based on these notes until the Imperial Marine Observatory published the Instruction in 1921. So we conclude that the observers devoted great care to record those data accurately.

Since 1921, the observations must have been based on the published Instruction. The methods of sea surface temperature measurement are instructed as follows:

- A mercury thermometer having the temperature scale marked on the tube is most suitable.
- The temperature scale must be marked at 0.50 C or 1° F intervals or finer.
- The instrumental error should be determined by an authorized observatory, periodically.
- Once, fill a bucket with the water and empty it. Then, draw the water again and measure the temperature, or the difference of the temperature between them may cause a wrong measurement.
- Draw the water at the bow so as not to be interfered with by any discharge from the ship.
- Read the thermometer right in front of the face to avoid the parallax error.

These contents are essentially the same as the marine observation methods in other countries. For the period under discussion around the 1930's, almost all data were taken based on this instruction. Though only the old Japanese Navy data were based on another instruction issued by the Hydrographic Department of the old Japanese Navy in 1922, there is no practical difference between the two.

- Then, we inquired of several retired captains, officers and sailors about the conditions of the observation in those days. They replied similarly as follows:
- The observations were based on the instruction issued by the Imperial Marine Observatory.
- The buckets for drawing water were made of thick canvas and were painted thickly.
- The bucket was about 20 cm to 30 cm in diameter and about 40 cm in height.

- The mercury thermometers were used mainly in temperature measurement and they were graduated by the Celsius scale.

The conditions mentioned in this section continued until 1951 when the Central Meteorological Observatory published “Handbook on the marine meteorological observations for ships”. So, it is not reasonable that the data are doubtful only for around the 1930’s. We conclude that the data in those days are as highly reliable as well as for the other period.

## References

- Kanda, T., 1962: The production of microfilms and punched cards on the marine meteorological data (part 1) (in Japanese), *Weather Service Bulletin*, **29**, 71-76.
- Kanda, T., 1962: The production of microfilms and punched cards on the marine meteorological data (part 2) (in Japanese), *Weather Service Bulletin*, **29**, 109-116.
- WMO, 1964: Weather reports, stations, codes and transmissions; Vol B, Codes. WMO No. 9 TP-4.
- Iida, H., Fujiwara, L., Bessho, S., Ishikawa, K. and Naito, N. (1979): Variations of the Kuroshio and the oceanographic and atmospheric conditions, *Proceeding of VI CSK symposium*, 155.

Note: A different version of this paper appeared in the March 1992, Bulletin of the Kobe Marine Observatory, No. 211, 19-29.

## Appendix

Related publications are as follows:

publications before 1961

Instructions

The Imperial Marine Observatory, 1921: Kaiyo kisho kansokuho.

The Imperial Marine Observatory, 1936: Kaiyo kansokuho.

The Central Meteorological Observatory, 1951: Handbook on the marine meteorological observations for ships.

20-year report

The Imperial Marine Observatory, 1935: The mean atmospheric pressure, cloudiness, air temperature and sea surface temperature of the North Pacific Ocean and the neighbouring seas during the years, 1911 to 1930.

5-year reports

The Imperial Marine Observatory, 1928: The mean atmospheric pressure, cloudiness and sea surface temperature of the North Pacific Ocean and the neighbouring seas for the lustrum, 1911 to 1915. (continued for the lustrum 1916-1920 and 1921- 1925)

The Imperial Marine Observatory, 1932: The mean atmospheric pressure, cloudiness, air and sea surface temperature of the North Pacific Ocean and the neighbouring seas for the lustrum, 1926 to 1930.

annual reports

The Imperial Marine Observatory, 1927: The mean atmospheric pressure, cloudiness and sea surface temperature of the North Pacific Ocean and the neighbouring seas for the year, 1926.

The Imperial Marine Observatory, 1928: The mean atmospheric pressure, cloudiness, air temperature and sea surface temperature of the North Pacific Ocean and the neighbouring seas for the year, 1927. (continued for the year from 1928 to 1935)

The Imperial Marine Observatory, 1938: The mean air temperature, cloudiness and sea surface temperature of the North Pacific Ocean and the neighbouring seas for the year, 1936. (continued for the year from 1937 to 1941)

publications after 1961

JMA, 1962: Technical report of the Japan Meteorological Agency No.17, Marine climatological tables of the North Pacific Ocean, 1942-1960 part I.

JMA, 1963: Technical report of the Japan Meteorological Agency No.23, Marine climatological tables of the North Pacific Ocean, 1942-1960 part 2.

JMA, 1966: Technical report of the Japan Meteorological Agency No.51, Marine climatological tables of the North Pacific Ocean, 1961.

JMA, 1967: Marine climatological tables of the North Pacific Ocean for 1962. (continued for from 1963 to 1983)

JMA, 1991: Marine climatological charts of the North Pacific Ocean for 1984, 1985, 1986.

JMA,1977:Marine climatological summary, area 00°-46°N,120°-170°W, 1961 No. 1 (continues up to now every year).

Table 1. The numbers of reporting ships and of collected data from 1890 to 1960 (after Kanda, 1962).

| Year | Ship | Data   | Year | Ship | Data   | Year | Ship | Data   | Year | Ship | Data   |
|------|------|--------|------|------|--------|------|------|--------|------|------|--------|
| 1890 | 36   |        | 1910 | 144  | 98732  | 1930 | 316  | 147377 | 1950 | 14   | 1768   |
| 1891 | 48   |        | 1911 | 141  | 129622 | 1931 | 383  | 168943 | 1951 | 44   | 10238  |
| 1892 | 46   |        | 1912 | 140  | 105756 | 1932 | 407  | 202972 | 1952 | 54   | 14963  |
| 1893 | 47   |        | 1913 | 157  | 133310 | 1933 | 449  | 200548 | 1953 | 116  | 24588  |
| 1894 | 36   |        | 1914 | 127  | 97643  | 1934 | 458  | 215035 | 1954 | 120  | 31604  |
| 1895 | 20   | 134601 | 1915 | 147  | 121047 | 1935 | 464  | 214441 | 1955 | 171  | 52164  |
| 1896 | -    |        | 1916 | 164  | 136994 | 1936 | 491  | 218562 | 1956 | 208  | 69108  |
| 1897 | -    |        | 1917 | 155  | 116899 | 1937 | 558  | 212553 | 1957 | 346  | 108316 |
| 1898 | 16   |        | 1918 | 146  | 100526 | 1938 | 467  | 158498 | 1958 | 533  | 163738 |
| 1899 | 15   |        | 1919 | 186  | 126384 | 1939 | 527  |        | 1959 | 611  | 194400 |
| 1900 | 2    |        | 1920 | 196  | 126870 | 1940 | 539  |        | 1960 | 694  | 218722 |
| 1901 | 138  | 91670  | 1921 | 209  | 136377 | 1941 | 446  | 513056 |      |      |        |
| 1902 | 115  | 105984 | 1922 | 241  | 174560 | 1942 | 80   |        |      |      |        |
| 1903 | 107  | 122503 | 1923 | 282  | 180403 | 1943 | 18   |        |      |      |        |
| 1904 | 100  | 85908  | 1924 | 244  | 160249 | 1944 | 2    | 76     |      |      |        |
| 1905 | 76   | 68315  | 1925 | 241  | 128118 | 1945 | 1    | 155    |      |      |        |
| 1906 | 94   | 88066  | 1926 | 252  | 129973 | 1946 | 1    | 149    |      |      |        |
| 1907 | 103  | 84493  | 1927 | 269  | 116777 | 1947 | 23   | 1803   |      |      |        |
| 1908 | 132  | 102055 | 1928 | 304  | 128920 | 1948 | 4    | 243    |      |      |        |
| 1909 | 117  | 104783 | 1929 | 302  | 127943 | 1949 | 3    | 169    |      |      |        |

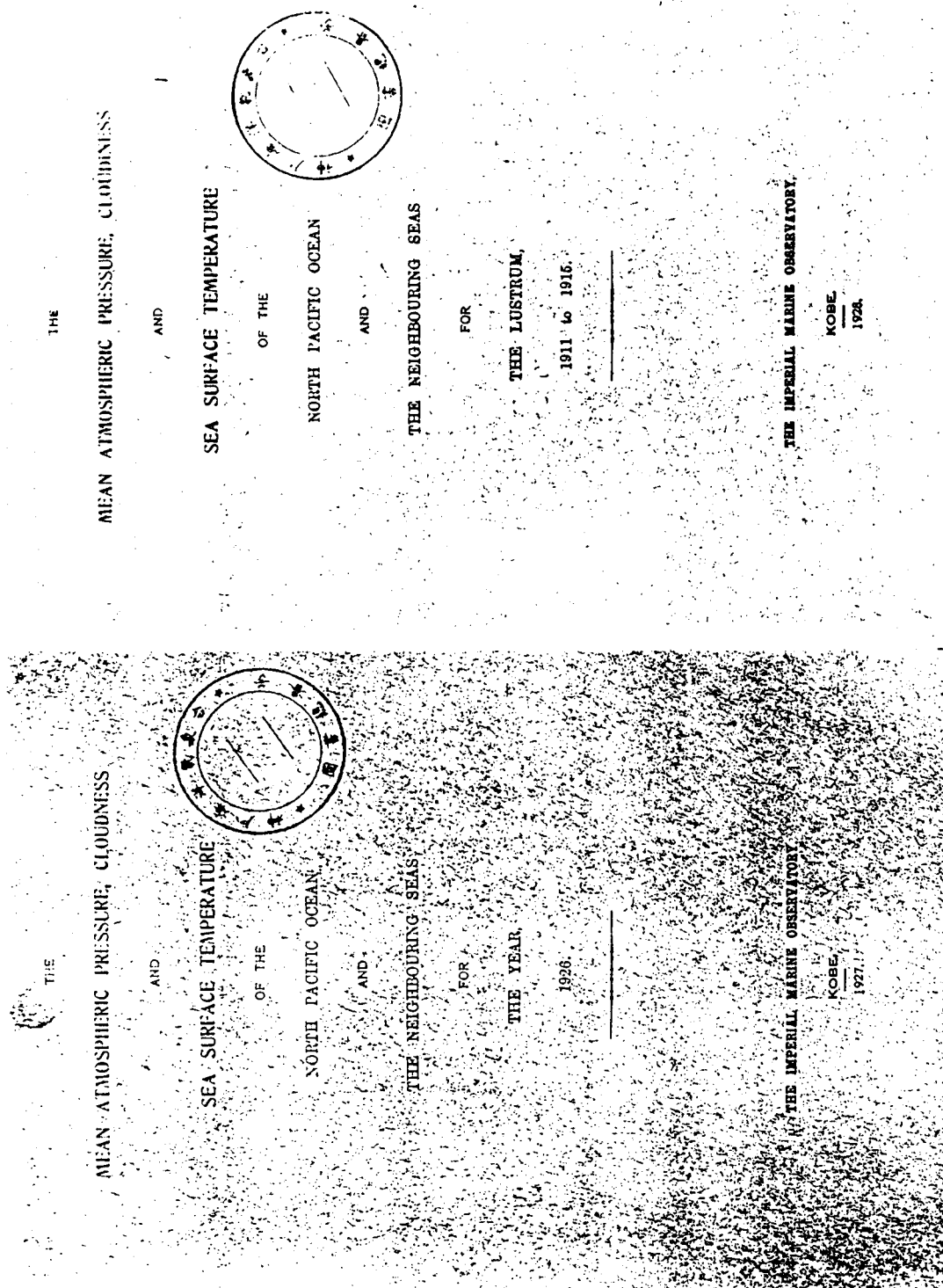


Figure 1. The covers of annual report and five year report.







SOUTH CHINA SEA.  
(NORTHERN PART.)

ANNUAL MEAN PRESSURE. (700 mm+)

1935.

昭和十年

| Longt | 107° | 108° | 109° | 110° | 111° | 113° | 114° | 115° | 116° | 117° | 118° | 119° | 120° | 121° | 122° | 123° |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Lat.N | 26°  | 24°  | 23°  | 22°  | 21°  | 20°  | 19°  | 18°  | 17°  | 16°  | 15°  | 14°  | 13°  | 12°  | 11°  | 10°  |
|       | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 | 89.0 |

(SOUTHERN PART.)

| Longt | 101° | 102° | 103° | 104° | 105° | 106° | 107° | 108° | 109° | 110° | 111° | 112° | 113° | 114° |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Lat.N | 13°  | 12°  | 11°  | 10°  | 9°   | 8°   | 7°   | 6°   | 5°   | 4°   | 3°   | 2°   | 1°   |      |
|       | 56.9 | 56.3 | 56.4 | 56.0 | 56.5 | 56.3 | 56.7 | 56.9 | 56.9 | 56.9 | 56.9 | 56.9 | 56.9 | 56.8 |

(EASTERN ARCHIPELAGO.)

| Longt | 115° | 116° | 117° | 118° | 119° | 120° | 121° | 122° | 123° | 124° | 125° | 126° | 127° | 128° |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Lat.N | 13°  | 12°  | 11°  | 10°  | 9°   | 8°   | 7°   | 6°   | 5°   | 4°   | 3°   | 2°   | 1°   |      |
|       | 56.7 | 56.7 | 56.7 | 56.7 | 56.7 | 56.7 | 56.7 | 56.7 | 56.7 | 56.7 | 56.7 | 56.7 | 56.7 | 56.7 |

NEIGHBOURING WATER ON OUR PACIFIC SIDE.

Part I.

(700 mm+)

ANNUAL MEAN PRESSURE. (mm)

1935.

昭和十年

| Longt | 140°    | 141°    | 142°    | 143°    | 144°    | 145°    | 146°    | 147°    | 148°    | 149°    | 150°    |
|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Lat.N | 46°-47° | 46°-46° | 44°-46° | 43°-44° | 41°-43° | 40°-41° | 39°-40° | 38°-39° | 37°-38° | 35°-36° | 34°-35° |
|       | 58.3    | 58.3    | 58.1    | 58.9    | 59.0    | 59.2    | 59.6    | 59.5    | 59.3    | 58.4    | 58.4    |

NEIGHBOURING WATER ON OUR PACIFIC SIDE.

Part II.

(700 mm+)

ANNUAL MEAN PRESSURE. (mm)

1935.

昭和十年

| Longt | 130°    | 131°    | 132°    | 133°    | 134°    | 135°    | 136°    | 137°    | 138°    | 139°    | 140°    | 141°    | 142°    | 143°    |
|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Lat.N | 35°-36° | 34°-36° | 33°-34° | 32°-33° | 30°-31° | 29°-30° | 28°-29° | 27°-28° | 26°-27° | 25°-26° | 24°-25° | 23°-24° | 22°-23° | 21°-22° |
|       | 60.3    | 60.4    | 60.4    | 60.4    | 60.4    | 60.4    | 60.4    | 60.4    | 60.4    | 60.4    | 60.4    | 60.4    | 60.4    | 60.4    |

Figure 4. Examples of mean values tables (continued from Figure 3).

