Historical precipitation data in Sumatra and Kalimantan from 1879 to 1900, by using Dutch colonial materials

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Abstract. Indonesia suffers from serious fire and haze problems occurring in the peatland areas of Sumatra and Kalimantan. Haze has become an international issue in Southeast Asia, and Indonesia must now implement better prevention management for this severe crisis. To understand the meteorological conditions in Indonesia, it is important to analyze the historical precipitation ranging back to the colonial days. This study focuses on historical precipitation data observed during the Dutch colonial era. The observation records from 1879-1900 were recorded in historical materials called “Regenwaarnemingen in Nederlandsch-Indie”. The records not only include Batavia, but also other observation stations in Indonesia. In this study, the historical precipitation data in Sumatra (Medan, Jambi, Bengkalis) and Kalimantan (Pontianak, Banjarmasin, Amuntai) were reconstructed. By using these reconstructed precipitation data, I analyzed the annual precipitation fluctuation and mean monthly precipitation at six stations. The colonial materials have not yet been examined enough in the meteorological research field, and their historical data contribute to Indonesia’s historical research and climatic problems.

1. Introduction

1.1. Background
In September 2015, large fires occurred in Sumatra and Kalimantan, Indonesia. The peat fire caused serious haze problems not only in Indonesia, but also in surrounding Southeast Asian countries, such as Singapore, Malaysia, Brunei, and Thailand [1]. The haze poses health hazards to humans and emerges as a serious international problem due to its transboundary nature. Indonesia has been criticized internationally for its fire management, and is now trying to reduce the risk of fire and haze by developing better prevention management practices. After the 1980s, peatland in Indonesia faced a major threat from human activities, such as the transmigration program, reclamation by local people, the drainage of water for agricultural regions, and large-scale deforestation [2]. Continuous water drainage in peatland areas and increasing human activities caused this peatland to become fire-prone in dry seasons. The frequency of fire is affected by precipitation throughout the year. It is important to search and collect colonial precipitation data to understand the historical rain conditions of those characteristic sites in Sumatra and Kalimantan.

1.2. Previous studies related to Indonesian rainfall
Studies on precipitation in Indonesia have mainly been conducted in the modern era, especially after the 1950s and the post-colonial era. Yasunari [3] analyzed the long-term fluctuations in monthly
precipitation (1951-1973) using data from the BMG (Institute of Meteorology and Geophysics, Indonesia). Eguchi [4] clarified the relationship between rainfall distribution and air streams in Indonesia using a climatic dataset (1978-1979) from the Geostationary Meteorological Satellite. However, historical precipitation data from the Dutch colonial era do not usually receive enough focus when collecting data from historical materials. Konnen’s group [5] reconstructed air pressure and rain-day count data in Indonesia and Haiti. Their study targeted two countries, only focused on Jakarta and Bogor in Indonesia (formerly Batavia and Buitenzorg). They used climatic reports by Braak [6] and Berlage [7], which were published in the Dutch colonial era, to reconstruct related meteorological data. As their research target cities were Batavia and Buitenzorg, it is necessary to use other colonial data or materials to reconstruct meteorological data for the other regions in Indonesia, such as Sumatra and Kalimantan. The SACA&D Project (Southeast Asian Climate Assessment & Dataset Project [8]) was completed by a collaboration between the BMKG (Institute of Meteorology, Climatology and Geophysics, Indonesia) and KNMI (Royal Netherlands Meteorological Institute, Netherlands). This project focused on the digitization of historical meteorological data since 1901 in Southeast Asian countries and they created a database called the SACA Dataset. Indonesia is also included in this dataset, but the available data period is mainly after the independence of Indonesia (only Batavia has the data from 1866). Batavia’s dataset was collected from colonial materials called the “Observations made at the Royal Magnetical and Meteorological Observatory at Batavia”. This series of materials was originally published in Dutch and English, and it contains historical meteorological data, such as the air pressure, humidity, temperature, rain-day counts, and precipitation in Batavia. It was the center of the colonial government, so detailed meteorological observation was conducted by the Batavia Central Observatory. The SACA Dataset is an important meteorological database for Southeast Asia and Indonesia, but historical meteorological records in Indonesia must be reconstructed from various historical materials, and not only from the “Observations made at the Royal Magnetical and Meteorological Observatory at Batavia”. In this study, material series called “Regenwaarnemingen in Nederlandsch-Indie” (Rainfall in the East Indian Archipelago [9]) includes historical precipitation records from the 19-20th Centuries. The purpose of this study is to focus on collecting the precipitation records of Sumatra and Kalimantan from Dutch colonial materials. A reconstruction of the historical precipitation data from the late 19th Century will create a new dataset for Indonesia’s meteorological research.

2. Historical materials and colonial rainfall observation structure

2.1. General outline of “Regenwaarnemingen in Nederlandsch-Indie”

The “Regenwaarnemingen in Nederlandsch-Indie” series was first published by Batavia Landsdrukkerij (Batavia Government Printing Office) in 1880. This study used 22 volumes (volume 1-22) and the precipitation records of 1879-1900. Photo 1 shows the sample pages from volume 21 of “Regenwaarnemingen in Nederlandsch-Indie”. The left photo describes the monthly precipitation records by each observation station located in Indonesia in 1899. The right photo refers to the location of each observation station with an explanation of each station’s regent (administrative district in the Dutch colonial era) and its distance from the coastline.
2.2. Method of rainfall observation and equipment in the late 19th Century

In the late 19th Century, observers were under the control of rigid rules for conducting precise rainfall observations. Those involved in rainfall observation were not only official staff, but also non-official people. The official observers were surgeons and medical officers from the army or civil services, and other observers were categorized as non-official. They used the same observation equipment distributed by the observatory. The rain gauge used for measurement was originally made by H. Olland from Utrecht, Netherlands. A detailed explanation of this “rain-gauge” is described in the preface section of “Regenwaarnemingen in Nederlandsch-Indie”, as cited below.

The receiving surface is circular and has a diameter of 12 centimetres (about 5 inches). The receiving funnel is tightly screwed on to a rectangular iron box, in which is placed a movable copper vessel acting as a reservoir; two reservoirs are added to each rain-gauge. At the observation hour the reservoirs are changed and the water collected is gauged by means of a measuring glass; this can be done within doors which is very convenient in this country, especially during heavy rains. The iron box that contains the reservoir and protects it from the direct influence of the rays of the sun, is fixed by means of three screws on to an iron stand; the base of this stand is a rectangular frame which by means of a few iron pins, about half a foot long, is fixed to the ground, in order to prevent the stand from being shifted by accident. The height of the receiving surface above the ground is 1.2 metres (about 3 1/2 feet).

All observers followed strict rules for rainfall observation using the above equipment. They must have conducted an observation once per day by selecting a time from 6, 7, 8, or 9 in the morning. If there are any rotational changes or troubles, the observer in charge should have noted the reason for this problem. They compiled daily records to generate a monthly report for the central government, and this copy of the monthly report was also sent to the Official Gazette (Javasche Courant) and Batavia Central Observatory.

2.3. The Number of observation station in the late 19th century

According to “Regenwaarnemingen in Nederlandsch-Indie”, the observation began at 124 stations in 1879. This number gradually increased to 225 stations in 1900. Figure 1 shows the number of observation stations in 1879 and 1900, categorizing the locations into six groups, as shown below. (1) Java and the surrounding islands (including Kangean, Madura, and Bawean), (2) Sumatra and the
surrounding islands (including Nias, Weh, Belitung, Bangka, and the Riau Archipelagos), (3) Kalimantan, (4) Sulawesi and the surrounding islands (including Sangihe, Salebabu, and Selayar), (5) Maluku (including the Banda Islands and New Guinea), and (6) the Lesser Sunda Islands. The first rainfall observation was taken in Batavia in 1866, as discussed by a previous study. Since 1879, observation stations expanded into wide areas and simultaneously begun observation.

This study mainly focuses on peatland and its surrounding areas in Sumatra and Kalimantan by selecting the following six observation stations: Medan, Bengkalis, Jambi, Pontianak, Amuntai, and Banjarmasin (see Figure 2 for a location map). These six stations recorded all 22 years of precipitation without a large blank period between 1879 and 1900.

Figure 1. Number of observation stations in Colonial Indonesia 1879 and 1900. Java possessed the most observation stations, and Batavia Observatory was a central observatory in the colonial era.

Figure 2. Location map for the six observation stations in Sumatra and Kalimantan.
3. Annual precipitation at the six observation stations from Sumatra and Kalimantan

Indonesia has two seasons in a year, a dry season and a rainy season. Table 1 shows the annual precipitation at the six stations from 1879 to 1900. In Table 1, years labeled with “*” include unknown monthly precipitation data. For more detailed information regarding the unavailable monthly precipitation data, see Appendix Table A.

Table 1. Annual precipitation records from 1879-1900. Each observation station has reported monthly precipitation data in volumes 1-22 of "Regenwaarnemingen in Nederlandsch-Indie". The annual precipitation was calculated by summing the monthly precipitation from January to December. The seven years labeled with “*” in this table include missing precipitation data for one of the months in that year. Monthly precipitation is described in detail in Appendix Table A. The column headings describe the names of the stations and their province (N.Sum = North Sumatra, S.Kali = South Kalimantan, W.Kali = West Kalimantan).

| year | Bengkalis, Riau | Medan, N.Sum | Jambi, Jambi | Amuntai, S.Kali | Pontianak, W.Kali | Banjarmasin, S.Kali |
|------|-----------------|--------------|--------------|-----------------|-----------------|-------------------|
| 1879 | 3005*           | 2028*        | 2460         | 2651*           | 3326            | 2643              |
| 1880 | 2679            | 3510         | 2661         | 2469            | 2753            | 2214              |
| 1881 | 2671            | 2327         | 2662         | 2485            | 3186            | 2606              |
| 1882 | 2164            | 1840         | 2154         | 2673            | 3186            | 2609              |
| 1883 | 2515            | 1972         | 2393         | 2411            | 2662            | 1656              |
| 1884 | 2178            | 2130         | 2557         | 2205            | 3279            | 2501              |
| 1885 | 2173            | 1920         | 1553         | 2401            | 3768            | 1591*             |
| 1886 | 2624            | 1821         | 2841         | 3229            | 3620            | 2768              |
| 1887 | 2886            | 2556         | 3258         | 2402            | 3820            | 2419              |
| 1888 | 2754            | 2196         | 1990         | 2276*           | 3473            | 1777              |
| 1889 | 2808            | 2137         | 2280         | 2864            | 3398            | 3578              |
| 1890 | 2817            | 1641         | 2339         | 2986            | 3372            | 2885              |
| 1891 | 2848            | 1683         | 2603         | 1630            | 2617            | 1885*             |
| 1892 | 3391            | 2029         | 2754         | 2982            | 3355            | 3060              |
| 1893 | 2495            | 1794         | 2684         | 2401            | 3187            | 2582              |
| 1894 | 2768            | 1749         | 2345         | 2127            | 2890            | 2848              |
| 1895 | 2633            | 2242         | 3246         | 2517            | 3119            | 2732              |
| 1896 | 2142            | 2125         | 2251         | 2108            | 2719            | 2035              |
| 1897 | 2909            | 2457         | 2664         | 2279            | 3972            | 2293              |
| 1898 | 2742            | 1985*        | 2440         | 2397            | 4331            | 2557              |
| 1899 | 2534            | 1671         | 2890         | 2182            | 2521            | 2011              |
| 1900 | 2297            | 1728         | 3100         | 2534            | 3253            | 2246              |

Figure 3 shows the annual fluctuation in precipitation at the Sumatra observation stations in 1879-1900. Rainfall increased annually at Bengkalis (Riau) and Jambi (Jambi), while that at Medan (North Sumatra) decreased annually. The highest annual precipitation at each station is as follows: Bengkalis-1892 (3391 mm), Medan-1880 (3510 mm), Jambi-1887 (3258 mm). The lowest annual precipitation is as follows: Bengkalis-1896 (2142 mm), Medan-1890 (1641 mm), Jambi-1885 (1553 mm). Three horizontal lines indicate normal year precipitation in 2005 (2208 mm), El Nino year precipitation in 1997 (1893 mm), La Nina year precipitation in 1999 (2972 mm), respectively at Medan, N.Sumatra. These precipitation data referred from BMKG Online Database, Iklim data.[10]
Figure 4 shows the annual precipitation fluctuations at the observation stations in Kalimantan during 1879-1900. Precipitation increased annually at Pontianak and Banjarmasin, but decreased annually at Amuntai. The highest annual precipitation at each station is as follows: Pontianak-1898 (4331 mm), Banjarmasin-1889 (3578 mm), Amuntai-1886 (3229 mm). The lowest annual precipitation at each station is as follows: Pontianak-1899 (2521 mm), Banjarmasin-1885 (1591 mm), Amuntai-1891 (1630 mm). Three Horizontal lines indicate normal year precipitation in 2018 (2791 mm), El Nino year precipitation in 1997 (1689 mm), La Nina year precipitation in 1999 (3122 mm), respectively at Banjarmasin, S.Kalimantan. These precipitation data referred from BMKG Iklim data, same as Figure 3. Both Figures 3 and 4 are available to understand the precipitation conditions in the areas surrounding the peatland during the late 19th Century.
4. Monthly precipitation records at six stations in Sumatra and Kalimantan

4.1. Reconstruction of historical precipitation data from monthly records
Appendix Table A shows the monthly precipitation records from the six observation stations. There are some abbreviations, “n.w.” and “w.o.”, written in the table, which stand for “niet waargenomen” (“no observation has been made”) and “waarnemingen onvolledig” (“insufficient to give suitable record”), respectively. The other two labels, “-” and “?” mean that the corresponding month has no numerical data. These unavailable monthly records were from the Bengkalis (January and February of 1879), Medan (January 1879 and April 1898), Amuntai (January 1879 and July 1888), and Banjarmasin stations (September 1885 and August 1891). In this period, the observers were simply ordered to conduct daily observations by their supervisor, but most of them had no interest in meteorology nor certain methods. Konnen [5] noted that the observers were frightened about receiving a penalty for their poor job, so they carefully checked the daily routine work and recorded data. At these six stations, eight months were unavailable from the precipitation records during 1879-1900. In 1879, not all observation stations began operation at the same time.

4.2. Mean monthly precipitation for 22 years historical data
Figure 5 shows the mean monthly precipitation during 1879-1900. This graph indicates that the dry season began in May at the six locations, but the specific trend differs between each location. At first, the three stations in Sumatra presented similar characteristics for the fluctuations in precipitation. Bengkalis recorded lower amounts for mean monthly precipitation in January (157.5 mm), February (146.9 mm), June (143.7 mm), and July (143.8 mm). August is usually the onset of the rainy season, and it lasts until December in this area. Jambi experienced higher precipitation (over 200 mm) from October to April, but precipitation declined during May to September (less than 200 mm). In Medan’s case, the mean recorded monthly precipitation from January to July was below 200 mm, but it increased from August to December (more than 200 mm).

The mean monthly precipitation at the three stations in Kalimantan indicates that Amuntai and Banjarmasin exhibited similar fluctuations in the 22 years of data. Amuntai is located in the approximately 123 km north-east of Banjarmasin, and these two locations experienced over 200 mm of precipitation from November to April. However, both Amuntai and Banjarmasin experienced low precipitation from May to October, especially during August and September, with extremely low precipitation of below 100 mm. For these reasons, the conditions in the southern part of Kalimantan were quite severe in the dry season. In Pontianak, the western coastal city of Kalimantan, experienced over 200 mm of precipitation in every month excluding July (160.5 mm). Notably, in October and November, high levels of precipitation exceeding 400 mm were recorded. According to the fire history map from Global Forest Watch Fire [11], recent fire and haze (2001-2015) largely occurred in the western and southern parts of Kalimantan. However, unlike the present day, Figure 5 indicates that Pontianak did not experience severe dry seasons during 1879-1900, therefore, it can be presumed that serious fire and haze did not occur during that colonial period. Figure 5 also includes dashed line and dotted line, which show current mean monthly precipitation in Sumatra and Kalimantan, respectively. Adding to this, long dashed line shows the El Nino year precipitation in Banjarmasin 1997.
Discussions and Conclusions

This study aimed to reconstruct historical precipitation records in Indonesia from Dutch colonial materials. Table 1 and Appendix Table A present the important historical Indonesian precipitation data reconstructed from materials that have not been used by previous research. This study focused on six observation stations in Sumatra and Kalimantan to determine the precipitation in the late 19th century by using "Regenwaarnemingen in Nederlandsch-Indie", which is a vital material for understanding Indonesian precipitation in areas other than Batavia, including Sumatra and Kalimantan. Data reconstruction and digitization need to continue for the other observation stations. This study also advocates the importance of using written Dutch colonial materials to reconstruct meteorological data.

To understand climate change in Indonesia from the long perspective, it is the reason why we need to work on colonial data reconstruction. In the future, more detailed investigation for historical meteorological conditions in colonial times is required. Due to climate change and serious global warming in recent years, our assignment is to build sustainable society for human beings. Scientists need to work on this matter by working on sustainability science and multiple disciplines. This paper is contributing to this concept of sustainability science, from interdisciplinary research of history and meteorology of Indonesia. The sustainable society needs to be built framework and discuss the feasibility of concept from a longer scale time. Reconstruction of precise historical precipitation data would be helpful to meteorological research, which is directly associated with discussion of climate change. Nineteenth century is one of the essential periods for history of Indonesia and climate conditions, it is my future assignments to continue the reconstruction of meteorological data from Dutch colonial materials.

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Figure 5. Mean monthly precipitation at six stations from 1879-1900 records. Dashed line and dotted line show current mean monthly precipitation in Sumatra and Kalimantan, respectively. Long dashed line indicates monthly precipitation in El Nino Year 1997 at Banjarmasin. The dry season was concentrated in June and July.
Appendix

Table A. Monthly precipitation records from January 1879 to December 1900. There are three different abbreviations used for the unavailable month records. In this table, (1) “n.w.” stands for “niet waargenomen”, which means no observation has been made, (2) “w.o.” stands for “waarnemingen onvolledig”, which means that the observations were insufficient to give a record, and (3) “-” and “?” mean that this month is without any numerical data for any reason.

| year/month | Bengkalis Riau | Medan, N.Sum | Jambi, Jambi | Amuntai, S.Kali | Pontianak, W.Kali | Banjarmasin S.Kali |
|------------|----------------|-------------|--------------|----------------|-------------------|-------------------|
| 1879-Jan   | n.w.           | n.w.        | 203          | n.w.           | 356               | 329               |
| 1879-Feb   | w.o.           | 110         | 234          | 187            | 94                | 281               |
| 1879-Mar   | 349            | 129         | 269          | 377            | 132               | 357               |
| 1879-Apr   | 386            | 146         | 174          | 225            | 83                | 112               |
| 1879-May   | 359            | 158         | 242          | 218            | 321               | 101               |
| 1879-Jun   | 173            | 76          | 58           | 204            | 300               | 301               |
| 1879-Jul   | 152            | 90          | 292          | 124            | 329               | 168               |
| 1879-Aug   | 467            | 338         | 185          | 194            | 324               | 273               |
| 1879-Sep   | 252            | 196         | 139          | 170            | 269               | 122               |
| 1879-Oct   | 400            | 273         | 294          | 207            | 619               | 129               |
| 1879-Nov   | 226            | 386         | 184          | 418            | 301               | 231               |
| 1879-Dec   | 241            | 126         | 186          | 327            | 198               | 239               |
| 1880-Jan   | 109            | 154         | 168          | 257            | 203               | 212               |
| 1880-Feb   | 249            | 13          | 381          | 219            | 288               | 237               |
| 1880-Mar   | 107            | 155         | 357          | 331            | 57                | 300               |
| 1880-Apr   | 279            | 202         | 391          | 231            | 306               | 252               |
| 1880-May   | 190            | 390         | 195          | 206            | 252               | 109               |
| 1880-Jun   | 219            | 72          | 138          | 266            | 267               | 185               |
| 1880-Jul   | 46             | 124         | 125          | 150            | 94                | 170               |
| 1880-Aug   | 148            | 377         | 115          | 15             | 129               | 130               |
| 1880-Sep   | 165            | 243         | 165          | 70             | 128               | 33                |
| 1880-Oct   | 293            | 1198        | 130          | 59             | 289               | 143               |
| 1880-Nov   | 508            | 305         | 261          | 253            | 460               | 84                |
| 1880-Dec   | 366            | 277         | 235          | 412            | 280               | 359               |
| 1881-Jan   | 86             | 196         | 261          | 383            | 340               | 323               |
| 1881-Feb   | 12             | 4           | 100          | 290            | 130               | 252               |
| 1881-Mar   | 145            | 122         | 276          | 546            | 311               | 416               |
| 1881-Apr   | 175            | 68          | 257          | 139            | 293               | 276               |
| 1881-May   | 431            | 382         | 339          | 240            | 205               | 210               |
| 1881-Jun   | 254            | 30          | 211          | 220            | 143               | 159               |
| 1881-Jul   | 72             | 155         | 121          | 49             | 188               | 46                |
| 1881-Aug   | 89             | 148         | 78           | 60             | 170               | 120               |
| 1881-Sep   | 248            | 251         | 85           | 9              | 146               | 32                |
| 1881-Oct   | 368            | 297         | 191          | 36             | 510               | 46                |
| 1881-Nov   | 472            | 366         | 311          | 175            | 475               | 313               |
| 1881-Dec   | 319            | 308         | 432          | 338            | 275               | 413               |
| 1882-Jan   | 102            | 85          | 142          | 228            | 241               | 252               |
| 1882-Feb   | 388            | 134         | 236          | 266            | 394               | 382               |
| 1882-Mar   | 136            | 78          | 110          | 211            | 358               | 314               |
| 1882-Apr   | 221            | 142         | 201          | 261            | 393               | 340               |
| 1882-May   | 135            | 80          | 92           | 245            | 211               | 297               |
| 1882-Jun   | 20             | 171         | 122          | 219            | 155               | 113               |
| 1882-Jul   | 83             | 70          | 85           | 99             | 52                | 143               |
| 1882-Aug   | 95             | 152         | 112          | 69             | 123               | 74                |
| 1882-Sep   | 329            | 218         | 221          | 145            | 262               | 31                |
| 1882-Oct   | 154            | 203         | 232          | 189            | 200               | 168               |
| 1882-Nov   | 191            | 273         | 268          | 392            | 506               | 233               |
| Year  | Month | Day | Rainfall | Day | Rainfall | Day | Rainfall | Day | Rainfall |
|-------|-------|-----|----------|-----|----------|-----|----------|-----|----------|
| 1887  | Nov   | 269 | 354      | 505 | 340      | 452 | 212      |
| 1887- Dec | 604 | 303 | 515    | 415 | 779    | 385 |
| 1888  | Jan   | 53  | 198      | 211 | 209      | 117 | 199      |
| 1888  | Feb   | 49  | 94       | 139 | 501      | 269 | 255      |
| 1888  | Mar   | 325 | 56       | 224 | 276      | 401 | 186      |
| 1888  | Apr   | 302 | 185      | 216 | 353      | 169 | 279      |
| 1888  | May   | 183 | 255      | 225 | 386      | 330 | 303      |
| 1888  | Jun   | 70  | 76       | 37  | 54       | 220 | 139      |
| 1888  | Jul   | 107 | 115      | 68  | -        | 40  | 25       |
| 1888  | Aug   | 249 | 216      | 114 | 19       | 129 | 8        |
| 1888  | Sep   | 335 | 207      | 195 | 34       | 143 | 59       |
| 1888  | Oct   | 176 | 208      | 92  | 45       | 752 | 71       |
| 1888  | Nov   | 441 | 197      | 231 | 66       | 474 | 87       |
| 1888- Dec | 464 | 389 | 238    | 336 | 429    | 166 |
| 1889  | Jan   | 255 | 146      | 139 | 318      | 171 | 326      |
| 1889  | Feb   | 287 | 121      | 137 | 318      | 410 | 459      |
| 1889  | Mar   | 153 | 66       | 431 | 374      | 193 | 519      |
| 1889  | Apr   | 313 | 67       | 223 | 173      | 260 | 321      |
| 1889  | May   | 86  | 141      | 105 | 184      | 238 | 271      |
| 1889  | Jun   | 111 | 108      | 114 | 186      | 187 | 309      |
| 1889  | Jul   | 99  | 212      | 225 | 149      | 261 | 323      |
| 1889  | Aug   | 145 | 270      | 89  | 157      | 301 | 86       |
| 1889  | Sep   | 377 | 328      | 233 | 175      | 379 | 287      |
| 1889  | Oct   | 308 | 217      | 292 | 171      | 333 | 183      |
| 1889  | Nov   | 339 | 273      | 192 | 364      | 391 | 303      |
| 1889- Dec | 335 | 188 | 100    | 295 | 174    | 191 |
| 1890  | Jan   | 262 | 89       | 320 | 453      | 192 | 271      |
| 1890  | Feb   | 366 | 195      | 199 | 337      | 126 | 442      |
| 1890  | Mar   | 173 | 25       | 205 | 473      | 141 | 210      |
| 1890  | Apr   | 338 | 106      | 266 | 242      | 311 | 166      |
| 1890  | May   | 189 | 183      | 201 | 149      | 219 | 113      |
| 1890  | Jun   | 166 | 113      | 31  | 111      | 363 | 235      |
| 1890  | Jul   | 177 | 66       | 96  | 159      | 293 | 211      |
| 1890  | Aug   | 249 | 136      | 94  | 162      | 313 | 173      |
| 1890  | Sep   | 218 | 191      | 236 | 78       | 205 | 94       |
| 1890  | Oct   | 217 | 299      | 192 | 136      | 423 | 285      |
| 1890  | Nov   | 266 | 149      | 314 | 323      | 478 | 374      |
| 1890- Dec | 266 | 189 | 195    | 308 | 386    | 311 |
| 1891  | Jan   | 319 | 158      | 374 | 263      | 139 | 335      |
| 1891  | Feb   | 49  | 138      | 343 | 202      | 47  | 277      |
| 1891  | Mar   | 194 | 40       | 212 | 240      | 386 | 359      |
| 1891  | Apr   | 179 | 19       | 348 | 149      | 221 | 117      |
| 1891  | May   | 238 | 58       | 130 | 164      | 318 | 171      |
| 1891  | Jun   | 103 | 105      | 55  | 23       | 82  | 50       |
| 1891  | Jul   | 130 | 71       | 146 | 66       | 129 | 2        |
| 1891  | Aug   | 272 | 147      | 17  | 33       | 135 | 5        |
| 1891  | Sep   | 403 | 334      | 149 | 46       | 137 | 31       |
| 1891  | Oct   | 249 | 222      | 246 | 69       | 274 | 124      |
| 1891  | Nov   | 389 | 187      | 317 | 147      | 385 | 200      |
| 1891- Dec | 323 | 204 | 266    | 228 | 364    | 219 |
| 1892  | Jan   | 209 | 124      | 326 | 394      | 375 | 398      |
| 1892  | Feb   | 89  | 256      | 183 | 398      | 166 | 404      |
| 1892  | Mar   | 164 | 128      | 242 | 263      | 230 | 341      |
| 1892  | Apr   | 299 | 293      | 427 | 520      | 270 | 294      |
| 1892  | May   | 368 | 160      | 181 | 193      | 350 | 234      |
| 1892  | Jun   | 127 | 68       | 206 | 140      | 308 | 333      |
| 1892  | Jul   | 298 | 96       | 101 | 56       | 148 | 28       |
| 1892  | Aug   | 155 | 121      | 187 | 192      | 337 | 246      |
| 1892  | Sep   | 332 | 252      | 245 | 96       | 223 | 96       |
| Year | Month | Value |
|------|-------|-------|
| 1892 | Oct   | 501   |
| 1892 | Nov   | 367   |
| 1892 | Dec   | 482   |
| 1893 | Jan   | 95    |
| 1893 | Feb   | 7     |
| 1893 | Mar   | 181   |
| 1893 | Apr   | 239   |
| 1893 | May   | 304   |
| 1893 | Jun   | 178   |
| 1893 | Jul   | 243   |
| 1893 | Aug   | 96    |
| 1893 | Sep   | 218   |
| 1893 | Oct   | 283   |
| 1893 | Nov   | 403   |
| 1893 | Dec   | 248   |
| 1894 | Jan   | 191   |
| 1894 | Feb   | 77    |
| 1894 | Mar   | 517   |
| 1894 | Apr   | 320   |
| 1894 | May   | 117   |
| 1894 | Jun   | 117   |
| 1894 | Jul   | 134   |
| 1894 | Aug   | 163   |
| 1894 | Sep   | 338   |
| 1894 | Oct   | 330   |
| 1894 | Nov   | 253   |
| 1894 | Dec   | 211   |
| 1895 | Jan   | 162   |
| 1895 | Feb   | 112   |
| 1895 | Mar   | 262   |
| 1895 | Apr   | 258   |
| 1895 | May   | 305   |
| 1895 | Jun   | 115   |
| 1895 | Jul   | 109   |
| 1895 | Aug   | 268   |
| 1895 | Sep   | 215   |
| 1895 | Oct   | 375   |
| 1895 | Nov   | 213   |
| 1895 | Dec   | 239   |
| 1896 | Jan   | 60    |
| 1896 | Feb   | 116   |
| 1896 | Mar   | 144   |
| 1896 | Apr   | 284   |
| 1896 | May   | 116   |
| 1896 | Jun   | 191   |
| 1896 | Jul   | 64    |
| 1896 | Aug   | 144   |
| 1896 | Sep   | 284   |
| 1896 | Oct   | 284   |
| 1896 | Nov   | 116   |
| 1896 | Dec   | 106   |
| 1897 | Jan   | 33    |
| 1897 | Feb   | 333   |
| 1897 | Mar   | 277   |
| 1897 | Apr   | 115   |
| 1897 | May   | 128   |
| 1897 | Jun   | 112   |
| 1897 | Jul   | 81    |
| 1897 | Aug   | 257   |

**Note:** The data represents some form of periodic measurements or counts for each month from 1892 to 1897.
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