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A BRIEF HISTORY OF METEOROLOGICAL OBSERVATIONS IN FRENCH INDOCHINA

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Abstract In this study, we attempt to describe a brief history of meteorological observation and data in French Indochina based on materials found in libraries belonging to the national hydro-meteorological services of Japan, Vietnam, and France, and on the websites of the National Oceanic and Atmospheric Administration, USA and the National Library of France. In our search, we found very important publications relating to historical meteorological information in French Indochina for the period from the 1860's to 1954. Before the establishment of the meteorological service of French Indochina, medical officers in the French Navy conducted meteorological observations. After the establishment of the meteorological service, its observation activities were strongly affected by French Indochina government policies. An image collection of historical meteorological information in French Indochina could potentially contribute to historical meteorological data recovery.

Keywords: French Indochina, meteorological service, historical meteorological data

1. Introduction

Globally, climate change is currently one of the most significant environmental problems. The Vietnamese government is aware of increasing hazards in the future, in particular, in coastal regions, agricultural sectors, and water resources, based on recent global climate model outputs. However, how well such climate models replicate past climate data from Vietnam is unclear due to the poor availability of historical meteorological records, especially before Vietnam achieved independence in 1954, with the exception of the meteorological records that have already been included in the World Weather Records, which includes monthly pressure, temperature, and precipitation. Although the historical meteorological data in Vietnam were included in the World Monthly Surface Station Climatology of the National Center for Atmospheric Research, the Global Historical Climatology Network of the National Oceanic and Atmospheric Administration (NOAA) and others, those were come from the World Weather Records. To evaluate the quality of the climate model outputs and to describe climate variations in Vietnam over the course of the late 19th and 20th century, historical meteorological records before 1954 need to be found and brought to the fore.

From the late 19th century to 1954, the eastern part of the Indochinese Peninsula was a French colony, so-called French Indochina (*Indochine Française*). Cochichina, the southernmost part of Vietnam, became a French colony in 1864. French rule was later expanded to Cambodia, Annam,

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Tonkin, and Laos. In 1887, the Indochinese Union (*Union Indochine*) was established, and French rule continued until 1954 (Brocheux and Hémary 2011).

Pyenson (1993) described the transmission of science to French colonies by French missionaries and scientists, and noted why geophysics, including meteorology and climatology, were not well developed in French Indochina. However, there do exist a small amount of information about meteorological observations in French Indochina.

We visited libraries of meteorological services, and the website of the NOAA central library and the National Library of France, and searched for historical meteorological information related to French Indochina. In this paper, we describe the history of meteorological observation in French Indochina based on those sources. It is noted that the situation of meteorological service in French Indochina was mainly described based on official documents of the French Indochina Government and publications of the meteorological service. Further we summarize a digital image collection of historical meteorological information that could contribute to the recovery of meteorological data for Vietnam, Cambodia, Laos, and China before 1954.

2. Observations by Medical Officers of the French Navy

In the 19th Century, French physicians commonly shared “Hippocratic thinking,” such as the relationship between human health and the surrounding environment, i.e., air, water, and soil. In the French Navy, the health conditions of the crew had a strong relationship with the overall hygiene of the ship and that of the port (Osborne 2014). For example, if the cabin temperature was always too high, the crew’s physical condition would worsen. Therefore, French Navy physicians measured the temperature and humidity either on a ship or at a port to examine the relationship between the crew’s health conditions and their environment.

The French Navy was frequently dispatched to a region that could be conquered. Navy medical officers were obligated to submit a report after each campaign. The report would include a summary of the military operation, meteorological information, and statistics of damages, which consisted of the number of death, injured, and infected by disease. The French Navy constructed hospitals in each colony and meteorological observations were carried out there. Instructions for meteorological observations at hospitals in the colonies were published in 1852 and revised in 1874 (Ministère de La Marine et des Colonies. 1874). Thus, meteorological observations were made by naval medical officers in French Indochina and there is a possibility that the meteorological data were archived in France.

A navy doctor Andre Richaud reported on the meteorological conditions of Saigon in 1862 (Richaud 1864). Dr. Gueirard published a monograph of *medical topography* of lower Cochichina. He described seasonal changes of temperature, rainfall, and wind based on observations made at Saigon, and summarized meteorological observations at Cap Saint Jacques from 1866 to 1868 (Gueirard 1872). Dr. Delteil (1885) also described the climate in Cochinchina and conducted water quality observations of the Mekong River at several points from Cambodia to Cochichina. He also tabulated a seven-year (1874–1880) mean monthly meteorological summary at a hospital in Saigon.

Dr. Foiret (1878) mentioned meteorological observations at Hai-phong, Tonkin from September 1875 to February 1877; unfortunately the exact observation period is unclear. Dr. Magget (1881) reported a monthly summary of observations at Hai-phong from September 1877 to September 1880 and described the climate in Tonkin. Dr. Alfred E. Borius (1883) reported a

monthly summary of temperature observations at Hanoi from September 1877 to May 1879 based on observations by Mr. Hamon. MacKeown (2011: 20) wrote that “[Borius] was charged with setting up a meteorological service in 1884 for Indochina based on Hai-phong.” However, a decision made on December 20, 1884 by the Governor General of Indochina included an order for Dr. Borius to establish a meteorological station at Hai-phong, not a meteorological service in Indochina (Ganter, 1895: 403).

Dr. Schillemans (1885) described a monthly summary of meteorological observations at Hue, Annam, from August 1882 to March 1883, and from February 1884 to September 1885. Furthermore, Dr. Simon (1886) extended the description of the climate at Hue based on meteorological observations from 1881 to 1886 and discussed temporal variations of the surface pressure during typhoon passages around Qui-Nhon, about 250 km south of Hue, on October 17, 1886.

Although the observations at Saigon, Hai-phong, Hanoi, and Hue are fragmentally documented above, the climates of those cities are well described from the viewpoint of our current knowledge on the climate of Vietnam. There may exist original observers’ logs in those cities at the *Service historique de la Marine*, France.

3. Meteorological Service in French Indochina

Establishment of *Service Météorologique*

A meteorological service (*Service Météorologique*) was created in 1897 at the suggestion of Elenthère Mascart, who was the Director of the Central Meteorological Bureau of France. Important aims of the service were contributions to agriculture and providing storm warning to maritime transport. Therefore, the service fell under the Department of Agriculture and Commerce (*Direction de l’Agriculture et du Commerce de l’Indo-Chine*).

In 1898, Claude-Jean-Baptiste Ferra became the first director of the meteorological service. He studied mathematical sciences and had worked in observatories in Paris and Montsouris (Pyenson 1993). However, he joined the French Indochina Government in November 1888, and worked as a civil servant. Thus, he was simply an administrator without experience and knowledge of meteorology.

It is noted that meteorological stations were not created by the meteorological service and did not belong to the service. The meteorological service provided observational equipment to another government body or the armed forces, known as “meteorological stations.” The meteorological service paid the operating expenses of the stations and received observational results from the stations. The principal stations were at Saigon, Nhatrang, Langsa, and Hanoi, and the secondary stations were located at Ong-yem, Qui-nhone, Hue, Quang-yen, Mon-cay, Cao-bang, and Lao-kay in 1898. Twice daily observation readings at the lighthouses located at Cap Saint Jacques, Cap Padaran, and Tourane were reported to the meteorological service, the commercial ports of Saigon and Haiphong, the French Navy in Cochichina, and the Saigon Chamber of Commerce. The same information was transmitted to observatories at Hong Kong, Manila, and Zi-Ka-Wei in Shanghai. The meteorological service collected the observed data and checked the quality of the data. Finally, daily summaries were published every month as tables in the *Bulletin Économique de L’Indochine*. The number of staff employed by the service was very limited. There were only three European staff members, including the director, and indigenous staff numbered less than twenty.

The provision of meteorological information had been started, but no scientific work was

conducted in this period. To promote geophysical research in Indochina, the Central Meteorological Observatory was planned in 1899. The Governor General requested Father Pere Froc of the director of the Zi-Ka-Wei Observatory to select the appropriate position for the observatory. Froc surveyed along the coast of French Indochina and finally selected a hill near Hai-phong. The selected position was Phu-lien, situated about nine kilometers from Hai-phong. From a meteorological point of view, the position of Phu-lien does not look good because the observatory is located at the top of a hill. The meteorological conditions there were not representative of that region. However, the observatory seems to be better suited to astronomical observation in the Red River Delta. A road to the hill top was constructed from 1899, and the budget for the construction of the observatory was decided in 1900. During 1900, Ferra visited the Zi-Ka-Wei Observatory, as well as the Central Meteorological Observatory in Tokyo along with Froc (Froc 1902a; 1902b). They observed the meteorological observation facilities of the Tokyo observatory, and interviewed staff to find out how to operate a meteorological station network and how to gather meteorological information from the network.

Phu-Lien Observatory

Dr. Le Cadet joined the meteorological service in April 1906. He worked at the Observatory Lyon and obtained a Doctor of Science degree. He was interested in atmospheric electricity and had experience working with atmospheric electricity observation using a balloon. Pyenson (1993: 79) wrote that “Ferra believed that Le Cadet had the moral authority in the world of research [and] was [going] to bring Phu-lien to [the] world[’s] attention.”

Meteorological observation at the Phu-lien Observatory was started in June 1904, and the observatory completed in 1906. The scientific mission of the observatory was to study atmospheric phenomena, geomagnetism, and other matters. The official work of the observatory was 1) the provision of weather information and the issuing of storm warnings, 2) the collection of meteorological observation data, 3) the provision of technical services, and 4) time information service.

Provision of weather information and issuing storm warnings

Observations made at the meteorological station were used for weather information services, including drawing isobaric charts and the accumulation of climatic information. Observations made at 8 AM, 10 AM, and 4 PM were sent to the observatory. It is noted that local time was seven hours ahead of Greenwich Mean Time. Isobaric charts and weather reports were prepared every morning based on the 8 AM reports. In the evening, information was prepared relating to the weather status along the coast, and it was transmitted to governmental services and shipping companies before 6 PM. Observations made at Phu-lien, Tourane, and Cap Saint Jacques at 8 AM and 4 PM were transmitted to Hong Kong, Manila, and Zi-Ka-Wei. In fact, this information was tabulated in the Monthly Meteorological Bulletin of the Hong Kong Observatory from 1913 to 1925.

When a depression or Typhoon appeared in the South China Sea, the observatory issued a storm warning. The warning was coded and transmitted via semaphore (signal post) at the lighthouse, and the Haiphong Post was responsible for sending it to interested parties.

Collection of meteorological observation data

At meteorological and climatological stations, meteorological readings were taken every two hours from 6 AM to 8 PM. The data were sent to the observatory every day. The observatory calculated bi-hourly, daily, and monthly averages.

Technical services

Observation equipment was ordered from France and installed by the observatory's technical staff. When problems occurred, the equipment was repaired at the observatory.

Observation network

In 1906, there were 16 meteorological stations and 28 climatological stations. The meteorological station reported observed records to the observatory by telegram for provision of storm warning, while the climatological stations did not. In addition, other stations where meteorological observations were made under the Department of Agriculture also provided observed data to the meteorological service. The number of stations changed from year to year depending on the government budget.

Stagnation of activity

Dr. Le Cadet became the Director of the observatory in 1911. During his directorship, the number of European staff varied from two to four including the Director, and the number of indigenous staff was very limited. This was due to budgetary limitations and the effects of World War I.

Due to the limited number of stations, meteorological and climatological studies were very difficult in 1911. Therefore, Le Cadet tried to expand the observation network. The French Indochina government allowed him to prepare 350 rain gauges for new rainfall monitoring posts in 1914. The expansion plan of the rainfall monitoring network had unfortunately dissipated by World War I. Nevertheless, the rainfall monitoring network gradually expanded due to the Agricultural Service, planters and various colonial companies recognized the importance of the impact of the climate on the economy. The observatory provided equipment to companies that wanted to contribute to the rainfall monitoring network.

The meteorological service essentially used the same observation equipments as the Central Meteorological Bureau of France. In 1911, Le Cadet proposed a change from a French-type shelter to a new shelter that would be more appropriate for tropical conditions. This proposal was quickly accepted. However, due to this change, there might exist inhomogeneity in the temperature records since the establishment of the new shelter.

In 1918, Le Cadet faced problems with observation data quality. The observatory received data from the station network. However, they received many erroneous reports and tried to correct them. At that time, the local station could not provide original logbooks to the observatory because the local station kept it in their own archives. Although Le Cadet thought of starting a training course for observers in 1919, such a course was never carried out under his directorship.

Le Cadet wrote that he made sacrificed to establish scientific work because of limitation of equipments and staffs, and the meteorological service aimed at studying the atmosphere and its disturbances for the improvement of our knowledge for the establishment weather forecasts (Gouvernement Général de l'Indochine, 1914). As he noted, the number of staff was limited, while their duties were significant and included preparing weather information, collecting data, and compiling statistics of the data. There was no space to conduct scientific research at the time. Le Cadet left for France on March 20, 1926.

More contributions to the economy

The French Indochina government largely reorganized the meteorological service in 1926, and the Bureau of Climatology and Agricultural Meteorology was created. The intention of the government was to open up climate-related information of Indochina not only to governmental

services, but also to private companies and planters in French Indochina. The government needed to enhance the agricultural economy. The head of the Bureau came from the General Inspector of Agriculture, and the Bureau targeted 1) the systematic study of the climatology of all Indochina; and 2) the study of agricultural ecology, which is finding relationships between the development of plants and the climate. To find proper farming methods in local conditions with the highest yields was important issue.

Another new task was assigned to the meteorological service in 1927. Since the quality of aircraft was rapidly improved during World War I, military aviation was deployed to French Indochina. The meteorological service contributed to the safety of air navigation in French Indochina. To provide weather information to aircrafts, new meteorological stations were established in Cambodia and Laos.

The reporting procedures from the meteorological stations to the observatory were also changed. Six semaphoric stations transmitted the observed records at 6 AM, 10 AM, 2 PM, and 4 PM, and twenty meteorological stations sent data to the observatory at 10 AM and 4 PM. At the observatory, two radio transmission systems were introduced. One was for long wave and the other for short wave. The meteorological service began a weather information exchange with French Indochina ships that traveled between Hai-phong and Hong Kong, and other ships that shuttled between Hai-phong and Saigon. The meteorological information exchange between Hong Kong and Zi-Ka-Wei also changed to radio transmission.

The following observation equipments were used at the meteorological and climatological stations: a rain gauge, an anemometer, maximum/minimum thermometers, a self-recording thermometer, a self-recording hygrometer, and a psychrometer. These equipments were installed in a modified Eiffel-type shelter. In addition to this equipment, a heliograph, the Piche evaporimeter, and thermometers for soil temperature were installed at climatological stations.

Étienne Bruzon, a retired Lieutenant in the French Navy, joined the meteorological service in 1924 and became the Chief of the meteorological service in 1928. Under his leadership, the meteorological service struggled to accomplish a large portion of their duties. Another important member of the meteorological service was Dr. Paul Carton, an agronomist who graduated from the National Institute of Colonial Agriculture in France. He joined the French Indochina government in 1920, and transferred to the meteorological service in 1927. In the meteorological service, he was the Chief of the Bureau of Climatology and Agricultural Meteorology. The meteorological observation network expanded and the frequency of reports also increased. The increase of the received information was very difficult to handle at the observatory because there were so many errors in the received data.

The expansion of the duties of the meteorological service introduced another problem, which was the recruitment of more indigene staff. According to a government regulation, indigene persons who wanted to join the service had to have a Franco-Annamese Graduate Certificate. Since the number of Certificate holders was very limited, the meteorological service permitted non-graduate candidates to join as trainees. The meteorological service would have performed at a much lower level without these trainees. In 1929, the meteorological service decided that trained indigene staff would be allocated to major meteorological stations to ensure that correct observations were made. The meteorological service used the radio transmission system to exchange observations and forecast information between the Central Observatory and meteorological stations near the airport. It is also noted that there was an increase in the information exchanged between the meteorological service and ships belonging to French Indochina-based shipping companies and the French Navy via radio transmission.

Pilot balloon observations were introduced at eight principal meteorological stations in 1933 and were expected to provide wind information at a constant altitude over French Indochina. Since the amount of air navigation safety-related jobs had increased, the meteorological service decided to split the meteorological stations into two regional groups. The meteorological stations in the northern (southern) part of French Indochina transmitted their observed records to the Central Observatory (the Saigon Meteorological Station). The observed and forecast-related information was then exchanged between the Central Observatory and the Saigon Meteorological Station.

Related to agricultural meteorology, the meteorological service provided information to institutions and services under the French Indochina government and to private companies, for example, Michelin and Planter. From 1927 to 1941, the number of stations, especially rain gauge posts, rapidly increased to relay more complete climate information in French Indochina. Figure 1 shows the spatial distribution of rain gauge posts in 1940 and the time series of the number of rain gauges in each region corresponding to the present countries. In present-day Vietnam, the number of rain gauges exceeded 400 around 1933, and reached its maximum, 450 rain gauges, in 1940.

In 1938, main functions of the Phu-Lien Observatory transferred to Hanoi, and the Phu-Lien Observatory became a meteorological station with some research functions. Bruzon left for France in 1939, and Romer became the fourth director.

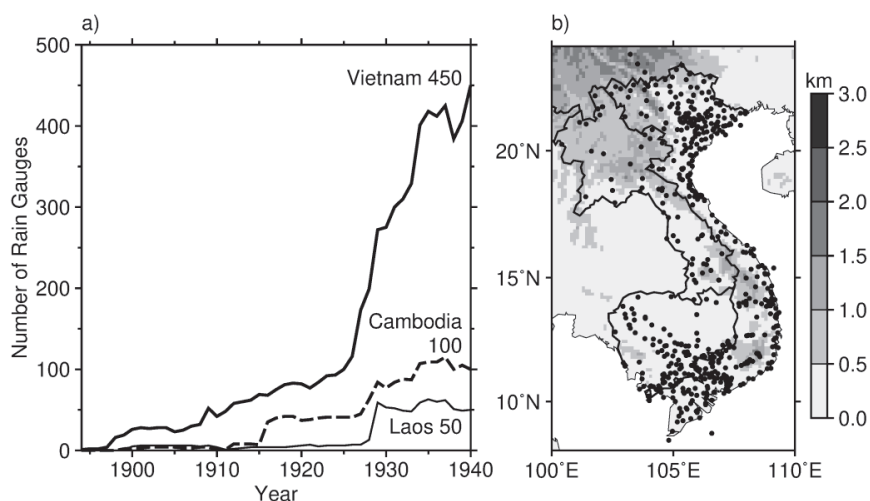


Fig. 1 a) The time series of number of rain gauges in each region from 1894 to 1940. The numerals indicate the number of rain gauges in each present country in 1940. b) Rain gauge distribution shown by dots in French Indochina in 1940.

From the Japanese occupation to French withdrawal

The Japanese Imperial Army occupied French Indochina in 1941. During the Japanese occupation, the meteorological service continued their observations. Although observations continued, the Japanese Army classified the data. Therefore, there were no publications during the occupation period, and no meteorological and climatological data are currently available from 1942 to 1948. The meteorological service once more published monthly summary reports from 1949, which continued until 1954. However, the number of rain gauges decreased from 600 in

1940 to 91 in 1952.

4. Digital Image Collections of Historical Meteorological Information

We visited the libraries of the Japan Meteorological Agency (JMA) and Météo France (MF), and made digital images of meteorological publications in 2013. We also visited the library of the Vietnamese National Hydro-Meteorological Service in 2014 (In 2018, its name was changed to the Viet Nam Meteorological and Hydrological Administration; VNMHA), and asked to take photograph of historical observer's logbooks. We also visited the websites of the Central Library of NOAA¹, USA and that of the National Library of France (Gallica)². Furthermore, we asked the library of the National Museum of Ethnology, Japan for photocopies of "*Revue Indochinois*." List of digital image collections is shown in Table 1.

Table 1 List of digital image collections on historical meteorological information in French Indochina for the period from 1890 to 1954 collected by the authors

Title	Years
Observer's Logbook (18 stations in Cochinchina, Annam, Tonkin)	Late 1890s to 1909
Annales du Bureau Central Météorologique de France	1890–1914
Bulletin Économique de l'Indochine	1898–1905
Bulletin Pluviométrique	1906–1930
Annales du Service Météorologique de l'Indochine	1928–1937
Bulletin Mensuel des Observations	1925–1941
Résumé Mensuel du Temps en Indochine	1949–1954
Annales des Services Météorologiques de la France d'Outre-Mer	1951–1954
Revue Indochinoise	1899–1901

The observer's logbooks were handwritten and include sub daily observations. The logbooks before 1920 were archived in the library of the VNMHA. Unfortunately, observer logbooks from 1921 to 1954 were not found in the libraries of the VNMHA and MF.

"*Annales du Bureau Central Météorologique de France*" was found in the libraries of JMA, MF, and NOAA. This publication only includes monthly summarized values.

"*Bulletin Économique de L'Indochine*" could be accessed at Gallica web site. Daily values were summarized until May 1904. After that, monthly summaries appeared. The bulletins published from 1933 to 1937 included monthly summery tables of observations.

Four publications of the meteorological service, namely, "*Bulletin Pluviométrique*," "*Annales du Service Météorologique de l'Indochine*," "*Bulletin Mensuel des Observation*," and "*Résumé Mensuel du Temps en Indochine*," were found in the libraries of the JMA, MF, and NOAA. Daily rainfall data were tabulated in "*Bulletin Pluviométrique*" from 1910 to 1930. Other three

¹ <https://library.noaa.gov/Collections/Digital-Documents/Foreign-Climate-Data-Home>

² <https://gallica.bnf.fr/accueil/fr/content/accueil-fr?mode=desktop>

publications contained monthly summaries of observations.

“*Annales des Services Météorologiques de la France d’Outre-Mer*” can be accessed from the websites of the libraries of the MF and NOAA, and only contain monthly summaries of the observations.

“*Revue Indochinois*” is a journal published in Hanoi. The journal posted the meteorological data of the meteorological service and their own daily observations.

5. Discussion and Conclusion

We visited libraries belonging to national hydro-meteorological services in Japan, Vietnam, and France. In addition, we visited the websites of NOAA and the National Library of France. We found very important publications related to historical meteorological information in French Indochina.

In this paper, we have tried to provide a brief history of meteorological observations in French Indochina. Before the establishment of the meteorological service of French Indochina, medical officers in the French Navy conducted meteorological observations. These observations were needed for their activities, since information on meteorological and climatological conditions were required to illuminate the hygiene of navy crews and disease epidemics. We found several published reports of observations at Saigon, Hanoi, Haiphong, and Hue, and expected that observational logs made by doctors may exist in the archives of the French Navy.

The activities of the meteorological service in French Indochina before 1941 can be divided into three epochs: the establishment stage (1897–1906), stagnation stage (1906–1926), and economy-oriented stage (1926–1941). These stages came about due to the changes of the policies of the French Indochina government. In the establishment stage, the government needed meteorological information for maritime safety and wanted to enhance scientific activity in French Indochina. However, the meteorological service’s difficult budgetary situation during the stagnation stage induced the abandonment of scientific research. After the late 1920s, the French government policy changed to something that was more economy-oriented. The policy forced the meteorological service to commit to creating “usable climate information for the agricultural sector” and information for air and marine navigation. To meet these requests, the meteorological observation network in French Indochina was expanded in a very short period of time. Unfortunately, French Indochina was ravaged by war after 1941, and the observed data were largely not used in climate research.

The historical meteorological data published in French Indochina have the potential to be used for climate change and climate model evaluation researches. Therefore, we partially digitized and analyzed the daily rainfall amounts and monthly rainfall statistics from about twenty stations. The results will be submitted in the near future.

Finally, historical meteorological data may have several pitfalls. Delteil (1885) wrote that “he and his colleagues made observation everywhere the marine went. However, thermometer did not calibrate after depart from France.” This suggests that there is a possibility of drift in the observed temperature data in the early period of the French conquest of Indochina. Thus, we should take drifting and other errors into account in the data during the course of the quality control processes of the digitized data for French Indochina. Another note is related to observational practices and statistical methods. Chauveau (1907) compared meteorological statistics from different places in Hanoi from the late 1890s to 1905. He found that differences emerged based on different

observation times and places. These results are very suggestive and connect temperature time series between different observation practices and different observation sites in a city.

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