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History of Meteorological Observations in the East of Russia and a Number of Eastern Countries

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Abstract. *Introduction.* The article reviews the history of the origin and development of meteorological observations in the East of Russia and some Eastern countries of Eurasia. *Goals.* The paper seeks not just to describe the sequence of events from the history of the development of meteorology as a science in the East, but rather to find patterns that lead to the chain of research on the nature of the region, identify the main stages or periods thereof, consider and clarify the development of meteorology in the East of Russia and Eastern Eurasia. *Materials.* The work employs a set of complementary research methods, such as theoretical analysis of geographical and historical literature on the problem under consideration; provides insights into archival materials and published sources; conducts comparative analysis of events from the history of the origin and development of meteorological science on the Eastern borders of our country. *Conclusions.* The study of archival materials and published sources made it possible to determine trends in the development of meteorological research in the region. The article primarily focuses on the influence of the Beijing Magnetic Meteorological and Main Physical Observatories on the emergence and development of the meteorological network of the East.
Keywords: meteorology, observatory, Main Physical Observatory, East, meteorological observations, meteorological instruments, meteorological network
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История становления метеорологических наблюдений на востоке России и в ряде восточных странах

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Аннотация. *Цель* статьи — рассмотреть историю возникновения и развития метеорологических наблюдений на востоке России и в восточных странах Евразии. Задачи данной статьи — не просто описать череду событий из истории становления метеорологии как науки на Востоке, а найти закономерности, обуславливающие ход, цепочки исследований природы этого региона, выделить основные этапы или периоды, по которым шло развитие; рассмотреть и уточнить вопросы становления метеорологии на востоке России и восточных странах Евразии. *Материалы и методы*. Для решения поставленных задач использовался комплекс дополняющих друг друга методов исследования: теоретический анализ географической, исторической литературы по исследуемой проблеме; изучение архивных материалов и опубликованных источников; сравнительный анализ событий из истории возникновения и развития метеорологической науки на восточных рубежах нашей страны. *Результаты*. Изучение архивных материалов и опубликованных источников позволило определить тенденции развития метеорологических исследований региона. Основной акцент в статье сделан на влияние Пекинской магнитно-метеорологической и Главной физической обсерваторий на возникновение и развитие метеорологической сети Востока.

Ключевые слова: метеорология, обсерватория, Главная физическая обсерватория, Восток, метеорологические наблюдения, метеорологические инструменты, метеорологическая сеть

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Introduction

In recent decades, the science has been interested in researches and analysis of the history of how geography was studying various components of nature in certain regions within physical, geographical, political, administrative, and ethnical frameworks. The history of meteorological observations in a certain territory is worth attention due to both scientific interest and the interest of people towards the history of meteorology in their countries and localities. It is crucial to study how meteorology occurred and developed and what peculiarities it had, as the world increasingly tends to apply a retrospective search of information to predict the environmental conditions and monitor the environment [Zaripova 2015: 44].

The first network of meteorological stations in Russia was established during the Great Northern Expedition (1732–1743). The expedition was led by Vitus J. Bering. The network stretched from the Volga River and to the Lena River, and further to the Argun River. The meteorological issues of the expedition were managed by Johann F. Gmelin, a natural scientist, and Louis de l'Isle, an astronomer. The expedition established meteorological stations in Kazan, Sverdlovsk (present-day Yekaterinburg), Tobolsk, Yamyshev, Yeniseysk, Tomsk, Turukhansk, Irkutsk, Yakutsk, Selenginsk, Nerchinsk, and in Argun silver mines (currently the area of Nerchinsky Zavod). All these 12 stations followed the instructions of the expedition for subsequent observations [Arkhangelsky 1986: 11].

Meteorological observations in the 18th and 19th centuries in the territory of Siberia and the Far East

The Northern Expedition ceased in 1743. That resulted in the shutdown of the meteorological station network. However, the observations collected in the 18th century allowed to understand what the climate was in the previously unexplored areas. Let us examine the main historical events related to the accumulation of meteorological data in the East of our country.

Table 1. History of meteorological data collection through observations in Siberia, 18th–19th centuries [compiled by authors]

Years	Description of research
1787–1795	First meteorological observations in Okhotsk
1820–1823	First meteorological observations in Ust-Yansk and Nizhnekolymsk
1828–1830	First meteorological observations in Petropavlovsk-on-Kamchatka, Chita, Petrovsky Zavod. Observations resumed in Irkutsk and Yakutsk
1838–1839	Regular meteorological observations launched in Barnaul and Nerchinsky Zavod
1842–1843	Observations resumed in Petropavlovsk-on-Kamchatka and Okhotsk
1844	Observations launched in Ayan
1854–1856	Observations carried out in Nikolaevsk-on-Amur
1858–1859	Observations carried out in Olga Bay
1860–1861	First observations carried out in the newly founded Vladivostok
1872	Arrangement of regular observations in Vladivostok

In the 1860s–1870s, Eastern Siberia and the Far East had approximately 30 regularly operating meteorological stations. Between the beginning of the Great Northern Expedition and the last quarter of 19th century, Eastern Siberia and the Far East managed to collect the ultimate amount of actual data. The meteorological observation data collected across Eastern Siberia and the Far East and materials of observations accumulated in other areas allowed A. I. Voyekov to create *Climates of the Globe, Especially That of Russia* in 1884. A. I. Voeykov used the materials of accumulated meteorological observations to perform a study of the climate of the East Asian monsoon. Prior to writing his work, he made many trips across Russia, traveled to North and South Americas, Europe, South and East Asia, visited the foothills of the Himalayas, Java, Japan, and participated in ocean expeditions [Dzerdzeevsky 1962: 492].

Before A. I. Voeikov it was assumed that the seasonal change of monsoons extends only to parts of India, Indochina and South China, but the researcher proved that such seasonal wind changes actually extend up to 60° N, including the entire Amur Region, i. e., our Primorye [Oldfield 2016: 684].

The materials of meteorological observations collected in Eastern Siberia and the Far East, together with the accumulated results of observations in other regions, were sufficient for the publication of the series of scientific papers presented in Table 2.

Table 2. Eastern regions of Russia in the 19th–20th centuries. Fundamental climatological and meteorological studies [compiled by authors]

Author	Contribution of scientist, researcher
A. I. Voyekov	Climates of the Globe, Especially That of Russia (1884)
G. V. Yakhontov	Thesis on Storms of the Baikal Lake (1906)
A. V. Voznesensky	Thesis on Climatic Peculiarities of the Baikal (1907)
A. V. Voznesensky, V. B. Shostakovich	Basic Data for Studying Climate of Eastern Siberia, with Atlas (1913)
N. V. Kirillov	Climate of Primorskaya Oblast. Investigation Goals (1911), Studying Climate of Primorsky Area. Meteorological Chrestomathy for the Far East (1914)
M. I. Sumgin, P. I. Koloskov	Studies of climate and microclimate in Amur Oblast, first climatic zoning of the Far East, a unified review of studies dealing with permafrost in our country
B. V. Davydov and N. N. Vladimirsky	Studies aimed at determining weather and climate parameters of the Far Eastern seas
M. M. Partansky	Climate of Vladivostok (1923)
A. A. Kamensky, E. S. Rubinstein	Climate Reference Book of the USSR (1931–1967)

Features of meteorological research in the 20th century

In the 1900s, the eastern part of the Trans-Siberian Railway was being constructed. This resulted in significant changes in the economic and cultural development of Eastern Siberia and the Far East. Those times witnessed a significant growth of the meteorological station network. The meteorological researches in Eastern Siberia and the Far East at that period were important for two agencies, viz. the Ministry of Railways and Directorate for Resettlement [Polyanskaya 2011: 6].

The Ministry of Railways tended to arrange meteorological stations at large railway stations. The Directorate for Resettlement established them in new settlements suitable for agriculture. For example, between 1895 and 1910 Chita Oblast extended its meteorological network from 4 to 33 stations. The Far East had had 94 reporting meteorological stations by the opening of Vladivostok Meteorological Observatory [Polyanskaya 2011: 6].

The national economy and defense capacity were expanding in the country. It resulted in the new requirements to meteorological services. The country needed weather forecasts. That is why they needed weather offices in all crucial centers of Eastern Siberia and the Far East. So, they arranged weather offices in Irkutsk (1929), Vladivostok (1930), Chita and Khabarovsk (1932), Magadan and Petropavlovsk-on-Kamchatka (1934) [Bedritsky, Borisenkov, Korovchenko, Pasetskiy 1997: 113].

Weather services in the Far East occurred thanks to the Marine Service that sought to arrange storm warnings in Vladivostok (1911). That is when Eastern Russia began intensively developing the Weather Service [Bedritsky, Borisenkov, Korovchenko, Pasetskiy 1997: 115].

During the Great Patriotic War, the meteorological station network in the Far East only kept growing. In the early 1940s, the meteorological station network kept expanding along with upper-air synoptic stations, special and high altitude stations. In 1957, Primorsky Krai had 59 meteorological stations, 4 of them were high and medium altitude ones. There were 9 pilot balloon observatories and 3 radiosonde observation stations [Bedritsky, Borisenkov, Korovchenko, Pasetskiy 1997: 174].

Later in the 1950s, the observatories and weather offices were transformed into local hydrometeorological research institutes in Vladivostok, Almaty, Kyiv and Tashkent. It facilitated further improvement of researches in local synoptic meteorology [Guidebook 1988: 27].

Significance of the Russian Ecclesiastical Mission (located in Beijing) in the meteorological research of the East of our country

In the 18th century, Beijing hosted the Russian Spiritual Mission. The Mission was exercising patronage over Russians residing in China. This organization also was a trading office of Russia and a consulate to China [St. PBA RAS. Coll. 337. Cat. 1. File 30. F. 11]. Moreover, its members were exploring China. The Mission got instructions from the Academy of Science, the main research institution of Russia. The Academy trained the former's personnel and sent its own associate scientists to China. Such cooperation turned the Mission into a unique basis for investigating the shut-in Chinese Empire. The mission's main goals, objectives and rights were described in detail by Russian-Chinese agreements such as the Treaty of Kyakhta, Treaty of Aigun, and Treaty of Beijing [St. PBA RAS. Coll. 337. Cat. 1. File 30. F. 12]. The 1848 establishment of the Northern Branch of the Magnetic Meteorological Observatory only encouraged researches and strengthened the mission. Initially, the observatory had been operated by the Department for Mining and Salt Business affiliated to the Ministry of Finance. In 1862, it was re-attached to the Imperial Academy of Sciences. It was joined to the stations and observatories of St. Petersburg Main Physical Observatory (hereinafter referred to as MPO). This network included a line of stations from Helsinki in Finland to Taiwan in China. The observatory in Beijing when run by its last director G. A. Fritsche became the center of meteorology for the entire Eastern Russia [St. PBA RAS. Coll. 337. Cat. 1. File 30. F. 12].

The board of the station was led by its director to establish new ones. They inspected tools the stations had and purchased new equipment for various expeditions. Meteorological researches in the East attracted K. A. Skachkov. He took interest in Chinese astronomy, studied the Chinese language and wrote related theses [Rykachov 1899: 214]. However, K. A. Skachkov had a poor health and could not stay in Beijing for a long time. In 1857, he had to quit. Over the next six years (1856–1862) the institution was being led by D. A. Peshchurov [Skachkov 1874: 38].

On October 27, 1856, the Emperor Nicolas I of Russia appointed D. A. Peshchurov Director of the Beijing Observatory. The latter was the first one to determine astronomic coordinates of a number of North Chinese towns. In 1861, Russia opened a consulate to Beijing. Peshchurov was sent there as a translator [Feklova 2020: 191].

The Department for Mining and Salt Business then asked the Academy of Sciences to train a successor to head the Beijing Observatory. On March 21, 1862, the Director A. Ya. Kupffer recommended K. K. Neiman for this position. By that time, he had been trained at MPO, and thus was appointed with no trouble. Before leaving to China he got an assignment from the Academy of Science to inspect the major meteorological stations. Yet all of a sudden K. K. Neiman refuses to go to China. In 1866, he was dismissed. At the meeting of the Academy of Sciences L. M. Kämtz introduces the new candidate to lead the Beijing Magnetic Meteorological Observatory — G. A. Fritsche, a calculationalist at MPO [RSHA. Coll. 733. Cat. 142. File 336. F. 1].

The Academy of Sciences approved G. A. Fritsche. On March 24, 1867, L. M. Kämtz was reporting to the Minister of Enlightenment D. A. Tolstoi and recommended to appoint G. A. Fritsche the new Director. When in the observatory, G. A. Fritsche managed to make a substantial contribution to the development of meteorology and magnetic researches in China and the Far East. On January 14, 1868, he entered his office in China supported by P. Xiang and I. Dong [St. PBA RAS. Coll. 4. Cat. 4. File 622. F. 11].

In 1873, G. A. Fritsche went for a business trip to St. Petersburg. He was going to purchase new equipment and tools for the observatory. On June 3, 1874, the Director of MPO H. I. Wild was reporting to the Minister of People's Enlightenment A. P. Shirinsky-Shikhmatov. Wild suggested inspecting the existing magnetic meteorological stations and creating new ones. Involvement of brand new equipment would allow to conduct both short and long term observations and make forecasts [St. PBA RAS. Coll. 4. Cat. 4. File 622. F. 157].

Beijing Observatory was supposed to send tools to towns that were to house new stations. The tools were to be installed and set up by G. A. Fritsche who was also to train local meteorologists to work with up-to-date devices and research methods, thus transforming amateurs into professional researches [St. PBA RAS. Coll. 4. Cat. 4. File 622. F. 157].

The project of enhancement of Siberia's meteorological station network was fully approved on June 5, 1874. MPO budget allocated 800 rubles thereto. The allocation basis said 'for scientific travels and trips to inspect meteorological stations' [St. PBA RAS. Coll. 4. Cat. 4. File 622. F. 157].

It is important to point out that on January 18, 1868, the Emperor Alexander II of Russia signed a decree to include all the meteorological stations into the Imperial Academy of Sciences, which resulted in a unification of all meteorological observations nationwide. Annually, the national budget allocated 4000 rubles. The Academy of Sciences allowed the Physical Observatory to appoint special awards for observers to have gained success in meteorology [Rykachev 1899: 256].

In 1869, MPO issued a detailed *Guideline for Meteorological Stations* authored by MPO's director H. I. Wild [Wild 1869]. This Guideline became a standard for all researches of modern meteorological stations. The Guideline by H. I. Wild made meteorological observations cyclical: all the data were registered strictly at 7 a.m., 1 p.m. and 9 p.m. The Guideline unified the tools and methods of observation. It was H. I. Wild who introduced regulations for records. It is crucial to mention that it was he who initiated Centigrade temperature measurement [Maklakov, Efremychev, Khomenko 1976: 92].

For better performance devices were relocated. The Guideline by H. I. Wild stresses that devices should stay apart from one another for more precise readings [Maklakov, Efremychev, Khomenko 1976: 94]. Thermometers and barometers were placed in special wooden booths. The booths were located 2 meters above the ground and equipped with lattice walls that let the air pass through. These conditions ensured good and precise measurement. Such conditions were created for other devices at meteorological stations. Even nowadays this Guideline's provisions remain in force. The Guideline also paid a special attention to time. So, H. I. Wild advised to set the clocks at meteorological stations by the most accurate clocks in town. That allowed to coordinate researches conducted nationwide. Usually such clocks were located at telegraph stations [Maklakov, Efremychev, Khomenko 1976: 95].

To sum up, it should be said that the expedition of G. A. Fritsche aimed at making measurements and observations comply with common standards both at the old and newly-designed stations. The new points of observation were Krasnoyarsk, Ishim, Tomsk, Kainsk, Omsk and Kyakhta.

All the cities that had had or were supposed to have a meteorological station needed their tools upgraded. The tools were to arrive from the Main Physical Observatory in St. Petersburg and included as follows: an iron weather vane with a wind-intensity indicator; two rain gauges with a metric glass; two Geissler-type mercury barometers, an alcohol minimum-thermometer and a hair hygrometer (a humidity metering device); tin cages for the thee thermometers; a latest non-filled mercury barometer and 5 pounds of pure mercury; an aneroid (a pressure metering device not driven by a liquid unlike the barometer); a sun dial [Fritsche 1876: 126].

To check the tools, G. A. Fritsche brought instruments prepared by MPO. The kit included a pocket aneroid made by the renown German craftsman G. Goldschmidt, a metal-and-glass latest siphon barometer, barometer tube filler, about ten pounds of pure mercury, spare barometric tubes, alcohol, sulphuric acid, distilled water, various mechanical tools, three Piel-type chronometers and two Arnold pocket chronometers, a device for determining the earth magnetism (multiply used during the trip) [Fritsche 1876: 125].

The first destination of the trip was Ishim. G. A. Fritsche arrived there on July 29, 1874. But his tools were still en route, and he had to wait for them for 18 days. Not to waste his time the scientist decided to establish a new station in Omsk which is halfway from Ishim to Kainsk. Upon his arrival G. A. Fritsche met a man who had been dealing with meteorological observations in town. The man was an adjutant of the district headquarters named I. F. Sokolov. Being sure in I. F. Sokolov's expertise, G. A. Fritsche started building an observation site that was placed in a small square near the new state-provided accomodation of Sokolov. The latter was renting an apartment in a fortress in the northwest of the city, on the right bank of the Ob and Irtysh. A decision was made to install all the devices in the garden next to the fortress. The devices were set by the clock at the telegraph station believed to be the most accurate one [Fritsche 1876: 125].

Psychrometric observations were based on the thermometers with whole Centigrade scales. Yet, barometric observations were based on scales divided into halves of a unit. The Director of MPO H. I. Wild was asked by G. A. Fritsche to equip the station with new tools they lacked, such as a rain gauge, a thermometer, a weather vane [Fritsche 1876: 126]. The visit to the station resulted in the observations became regular and recorded precipitations, temperature and wind parameters every day [Schwer 1980: 8].

On July 26, the director of Beijing Observatory left Omsk for Tomsk. En route G. A. Fritsche decided to visit Salair (present-day Kemerovo Oblast) where he wanted to check instruments at the meteorological station founded by an enthusiastic amateur F. E. Zass. The town was located in the north of the Altai Mountains and received meteorological tools from St. Petersburg according to the plan developed by MPO that wanted to arrange a continuously operating network of meteorological stations. The tools were installed by G. A. Fritsche. In accordance with the new guidelines, the thermometer was placed into a special booth equipped with a weather vane (with a wind-intensity indicator) and a rain gauge. MPO also delivered a mercury thermometer and a hair hygrometer to the station [Fritsche 1876: 130].

The director of Beijing Observatory concluded that the observations made in Salair by F. E. Zass fully complied with the meteorology principles [Fritsche 1876: 130]. In 1830, Tomsk launched regular meteorological observations through efforts undertaken by employees of educational institutions. Between 1830 and 1843, observations were made by I. G. Novotroitsky (Headmaster of Tomsk Governorate's vocational schools); between November 1846 and June 1873 with little pauses those were performed by S. Elsner (a gymnasium teacher) [Kryukova, Pinaeva 2013: 192]. Further observations were the responsibility of P. A. Butkeev who was an inspector of public schools in Tomsk. Later he had a meteorological station and a sun dial built next to his house. It was arranged by G. A. Fritsche at the order of the director H. I. Wild [Dmitrienko 2003: 137]. Just like the case with other stations, this station also received a wooden booth protecting the thermometer from external impacts. The booth also had a weather vane and a rain gauge. G. A. Fritsche delivered a siphon barometer to the meteorological station [Fritsche 1876: 131].

G. A. Fritsche's trip across Siberia in 1874 gave rise to a number of new meteorological stations. The existing stations had all their tools replaced or set up. Besides, Fritsche arranged trainings for employees of both the new and existing stations. He would explain how modern appliances worked, how to handle them and conduct observations. It is then that a special wooden booth that protected the metering appliances from external impacts was introduced for the first time. The towns were located close to the telegraph line, which allowed a quick transfer of collected data to MPO in St. Petersburg. This made it possible to pass from observing weather to forecasting it [Pogosyan, Taborovskiy 1947: 3]. Thanks to G. A. Fritsche, meteorological observations became regular, and the timing of observations was exact (7 a. m., 1 p. m. and 9 p. m.). That allowed to define daily temperature and humidity fluctuations, changes in wind strength and direction. Further on, Beijing observatory was an intermediate for exchanging tools, guidelines, books and data between regional meteorological stations and MPO in St. Petersburg. Up-to-date appliances installed in a certain way to protect them from external impacts, personnel training, quick data transmission to the central observatory to form weather reviews made it possible to include the new stations founded by G. A. Fritsche in Siberia into the operating network of meteorological station across the entire Russia [Feklova 2020: 192].

In conclusion, let us consider the contributions of individual Chinese scientists. Shěn Kuò (11th century AD) was very interested in the problem of weather forecasting and compiling meteorological bulletins. It is believed he was the first one to explain the rainbow with-out the knowledge of light refraction. In 12th century, Zhu Xi was trying to determine what caused clouds and rains. Finally, he assumed that clouds and rains arise from vapors [Feklova 2020: 191].

Already in the Song period (late 10th – second half of the 13th centuries AD), schemes to calculate volumes of rain gauges appeared in China, and in 1424 the former were sent to all provinces along with an order to report to Beijing about actual amounts of precipitation. In 1442, a rain gauge was constructed to accurately determine amounts of precipitation. Rain gauges had the appearance of a copper cylinder mounted in a stone base. Later, rain gauges were made of iron or baked clay, and measurement tools were made of bamboo [Feklova 2020: 191]. They were sent to provinces, districts, towns and villages. Local authorities had to regularly perform observations and report about the results. For the first time ever the state started establishing meteorological stations nationwide. Unfortunately, the majority of observation data were lost forever.

Studies of Russian scientists in the territory of Mongolia

Russian scientists pioneered in observations at hydrometeorological stations and offices established in Mongolia. The first station was launched there in 1924.

The main figure in terms of Mongolia's meteorological stations was V. B. Shostakovich, a famous Russian scientists and the director of Irkutsk Magnetic Meteorological Observatory. In 1926, in one of his theses he wrote as follows: 'Meteorological network in Mongolia now includes 8 operating stations. The most noteworthy ones are those in Ulaanbaatar and Sangiyn Khuree that can actually be considered observatories equipped with a number of self-recording machines' [Shostakovich 1926: 3].

Ulaanbaatar was distinguished by an air-station which launched balloons to investigate upper atmospheric layers. These researches connected the Mongolian network with the global one.

An important endeavor for a team of enthusiasts (including V. B. Shostakovich) was the attempt of establishing a station near the Baikal in 1897–1898. In 1900, V. B. Shostakovich joined Irkutsk Observatory where he changed his scientific approaches focused on hydrology, meteorology and geophysics of the area. V. B. Shostakovich summarized the data on waters freezing in the Asian part of our country, which proved instrumental in determining the tendencies that helped him define the thermal water discharge to the Arctic seas and classify rivers in the permafrost area with due regard of their hydrological regimes. V. B. Shostakovich was granted the Golden Medal of the Russian Geographical Society for his studies in geophysics [Furman 2000: 265].

Mongolian meteorologists still refer to V. B. Shostakovich's *Necessity and Immediate Tasks of Climate Research in Mongolia* written in 1926. The monograph describes physical and geographical conditions of Mongolia as a country with the semi-natural economy. The work also gives a detailed description that before entering Mongolia air masses get to high marginal ridges where they lose a part of their moisture and arrive in the territory in a dryer condition. The researcher points out that in winter Mongolia experiences high pressures typical for this area only. The study explores and describes the climate of the territory to conclude the country has sunny winters with little precipitation, while summers are cloudy and rainy. A temperature profile is articulated too. The climate is severely continental characterized by dramatic differences between daytime glare and night chill [Shostakovich 1926: 8].

History of meteorological observations in Central Asian Region

It is important to mention the history of meteorological observations in Soviet Central Asia. That area had hydrometeorological institutions that initiated studies in meteorology and climatology. First of all, the initiative belonged to the Soviet Central Asia Meteorological Service. Its employees worked there part time, remaining full-time employees at universities, i. e. their studies were owned by the latter [Bulletin 1927: 9].

The first summarizing researches and materials are shown in works by A. I. Voeykov describing the climatic conditions of Soviet Central Asia. Similar works were published by D. D. Gedeonov and S. Tikhonov [Selikhanovich 1959: 23].

A. I. Voeykov's works for the first time ever give a detailed description of the climate and climate-forming factors of the territory [Voeykov 1913].

D. D. Gedeonov in his paper describes climatic circumstances of the Samarkand Basin and Fergana Valley. His monograph suggests that the South of the Gissar Mountains is characterized by a subtropical climate. The main peculiarity of his work is that D. D. Gedeonov analyzes the precipitation behavior and reveals an important component of Soviet Central Asia's climate, i. e. the uneven spread of precipitation throughout the year across the southern part of the territory [Selikhanovich 1959: 27]. Before the Revolution of 1917, all these data were theoretical and unconfirmed by actual evidence or researches. The works lacked climate genesis description and insight into local peculiarities. All the climate studies published by that time were not related to economy or business [Selikhanovich 1959: 28].

R. R. Zimmerman and L. A. Molchanov investigated the general characteristics of the climate of Central Asia and its zonal-belt differentiation. Together they summarized all the data of the territory and issued monographs about large areas. In 1922–1924, I. Baidikov joined the project aimed at territory zoning [Molchanov, Zimmerman 1926: 1]. Two years later their zoning experience was published by R. R. Zimmerman and L. A. Molchanov [Molchanov, Zimmerman 1926: 2] to become a most significant scientific event because despite the lack of data the authors managed to show major parameters of the climate both in latitude and altitude directions, outlining climate peculiarities and providing their detailed descriptions.

They decided to carry out zoning of the territory according to the method of V. Köppen proposed in 1901 [Bluthgen 1972]:

– desert climate;
– steppe climate;
– foothill climate;
– mountain climate;
– high mountain climate;
– mountain climate;
– high-mountain desert climate.

Identifying territories as 'regions' [Molchanov, Zimmerman 1926: 5], the authors apparently meant climatic belts, which is confirmed by the text: 'The region of deserts covers the entire middle and west plain parts'.

However, it does not belittle the authors' contribution to the climatic zoning. Years later their ideas were fully confirmed and developed by studies of other researchers, such as D. N. Kashkarov, A. N. Rozanov and E. P. Korovin that conducted their researches in Betpak-Dal and the Karakum [Kashkarov, Korovin 1936].

Unfortunately, even showing differences in hydrothermal behaviors, the scientists did not take into account that Soviet Central Asia includes a collision of two climatic belts – temperate and subtropical ones. This fact for the first time was considered by university bibliographers D. N. Kashkarov, R. I. Abolin and E. P. Korovin [Kashkarov, Korovin 1936].

They fully confirmed the researches of L. A. Molchanov and R. R. Zimmerman about hydrothermal behaviors, and made amendments regarding the fact that all the climatic differences outlined in the monograph make it possible to distinguish a crucial physical and geographic boundary, since differences in behaviors in the south and the north of Soviet Central Asia affect all components of nature, i. e. result in inhomogeneous physical and geographic conditions [Molchanov, Zimmerman 1926: 9].

It was important for this hypothesis that other Soviet scientists (A. A. Grigoryev, I. P Gerasimov, V. M. Chetyrkin) tackled it too. However, the most outstanding studies were performed by A. N. Rozanov and E. P. Korovin. They assumed that the boundaries do not close only in plain and piedmont areas, but last in mountain areas too. The boundary in the mountain area stretches from the Karatau Range to Badakhshan. The southern part of the boundary lying across Soviet Central Asia is referred to as Soviet Central Asia Climatic Province.

The researchers outline two hydrothermal and biologically different phases of the vegetation period. The first phase was named mesothermal, i. e. characterized by a warm humid spring. The other one was named xerothermic, i. e. distinguished by a hot droughty summer. Later this idea was scrutinized by other scientists (V. M. Chetyrkin, L. N. Babushkin) who made their own contributions.

The above mentioned signifies that the climatic zoning of R. R. Zimmerman and L. A. Molchanov was majorly accepted by scientists and researchers. It proved useful in further development and studies of the region. Nevertheless, these scientists published other works dedicated to Soviet Central Asia. R. R. Zimmerman, in particular, had his article ('Climatology') published in B. Kh. Schlegel's *Water Economy of Central Asia* [Schlegel 1926]. L. A. Molchanov's notable works are *Climate of Turkmenistan* [Molchanov 1929], *General Problems of Climatology in Central Asia* [Molchanov 1928], *Program of Route Meteorological Observations in Central Asia* [Molchanov 1926].

Approaches to studies of regional peculiarities of Soviet Central Asia in R. I. Abolin's works are essentially different and focus on climatic parameters as crucial criteria of natural historical zoning. Therefore, his studies emphasize the climate changes, such as temperature behaviors and precipitation amounts in relation to altitude and latitude parameters of a territory [Abolin 1929: 30].

The above mentioned works analyze statistical data obtained by meteorological stations. But none of them investigated the factors that influence the climate in Soviet Central Asia, especially in relation to atmosphere circulation, i. e. synoptic researches started developing much later that climatic ones. An important role in such studies was played by I. I. Kramley, Director of Turkmenia Meteorological Agency who was in charge of the Synoptics Department.

The synoptical meteorology was rapidly developing thanks to the national economy that needed weather forecasts for purposes of agriculture, water and air transport. V. A. Giorgio launched synoptical researches at universities [Giorgio 1949]. After V. A. Giorgio such studies were encouraged by V. A. Bugaev [Bugaev 1946].

Dynamic climatology made a great leap forward due to works of V. A. Giorgio and V. A. Bugaev. They studied genetic aspects of Soviet Central Asia's climate and discovered the connection between the former and the atmospheric circulation. Their works were instrumental in drawing the scheme that classified weather types for Soviet Central Asia. The scheme was dynamic and referred to space and time. They outlined main components of the atmospheric circulation, studied frontogenesis and advection typical for the region. The mathematical statistics method for the study of synoptic processes and phenomena was developed by the mathematician T. A. Sarymsakov.

Original researches on microclimate were conducted by A. A. and Yu. A. Skvortsovs [Skvortsov, Skvortsov 1964]. They were investigating irrigation-caused salinization processes in Mirzacho'l ('Hungry Steppe'). Their studies focused on air temperature and humidity observations made at different heights on fields and over the ground cultivated for agricultural purposes. All these studies made the Skvortsovs conclude that irrigation influenced the atmospheric layers located right above the ground, and that this behavior was getting independent, therefore, the Skvortsovs introduced a new term – 'agroclimate'. The main goal of their researches was to reveal main trends and peculiarities of the microclimate. In that work, they had to deal with the underlying terrain thermal balance, the latter being a crucial component of microclimatic surveys [Skvortsov, Skvortsov 1928: 8].

A. A. Skvortsov managed to define components of the thermal balance. He studied certain aspects that influence the microclimate. All these findings were made when he worked at Soviet Central Asia Meteorological Agency [Skvortsov, Skvortsov 1928: 10]. Later, when he was working at the university (after the Great Patriotic War) his observations were proved by experiments. He was articulating complicated questions related to convective processes in the atmosphere, which resulted in a theory that was called convective conversion strata law. That proved a discovery for the scientific community [Skvortsov, Skvortsov 1964: 174].

Kazakhstan launched first meteorological observations in the mid-19th century. The first station was founded in Kazalinsk in 1848. In 1854, another station was created in Semipalatinsk. In 1856, stations were established in Irgiz and Kyzylorda. In 1859, they opened a station in Uralsk. By the early 20th century, Kazakhstan had established 28 operating stations [Bugaev 1946: 21]. All the observations were made with simple equipment that recorded only air temperature, wind intensity and precipitation amount. The most interesting thing is that the observations were carried out by untrained personnel or volunteers from MPO. Doctors, students and teachers conducted observations at different stations. For example, the researcher in Semipalatinsk was a drug store chemist whose name was A .G. Anikeev. The researcher in Irgiz was Mr. Vitkevich, a chief medical officer. All these data are still kept by MPO [Bugaev 1946: 20].

Conclusion

The analysis of theoretical materials dealing with meteorological observations in the East of Russia and a number of Oriental countries concludes as follows:

1. The late 19th century witnessed an industry development, the Trans-Siberian Railway's construction, migration of peasants from European Russia to the Far East. These event significantly affected the economic and cultural development of the region. The Ministry of Transportation and the Directorate for Resettlement had to focus on studies of climate in the Far East. Climatic data started being collected more actively.

2. The history of meteorology and its development in general and in Siberia in particular have attracted attention of numerous scientists and researchers. The monograph by V. A. Voeykov became the first research examining climate and describing multiple aspects and parameters of climatic factors [Voeykov 1884].

History of Meteorology by V. I. Slutsky [Slutskiy 1998] pays a special attention to the prehistory, occurrence and development of meteorology in Tomsk. First scientific information dedicated to this topic can be obtained from the records of e Beijing Magnetic Meteorological Observatory [Feklova 2020: 193].

3. Data of the 19th-century meteorological observations were being accumulated continuously majorly by large meteorological stations. A special role in meteorological researches in the East was played by China. A great contribution in the development of the hydrometeorological service in Mongolia was made by Soviet and Russian researches.

4. Fundamental research on climatology and meteorology of the Eastern regions of the country in the 19th-20th centuries occupy a special place. Meteorological observation materials in this region and the data accumulated in other regions allowed A. I. Voeykov to create *Climates of the Globe, Especially That of Russia* in 1884.

Sources

St. PBA RAS — Archives of the Russian Academy of Sciences, St. Petersburg Branch (In Russ.)

RSHA — Russian State Historical Archive (In Russ.)

References

Abolin 1929 — Abolin R. I. Fundamentals of Natural-Historical Zoning in Central Asia. Transactions of Central Asian State University. Ser. XII a: Geography. Vol. 2. Tashkent, 1929. 37 p. (In Russ.)

Arkhangelsky 1986 — Arkhangelsky V. L. Reduction of Air Pressure to Sea Level across Siberia in Winter. Saratov: Saratov State University, 1986. 23 p. (In Russ.)

Bedritsky, Borisenkov, Korovchenko, Pasetskiy 1997 — Bedritsky A. I., Borisenkov E. P., Korovchenko A. S., Pasetskiy V. M. Hydrometeorological Service of Russia: Historical Essays. St. Petersburg: Gidrometeoizdat, 1997. 363 p. (In Russ.)

Bluthgen 1972 — Bluthgen I. Geography of Climates. Moscow: Progress, 1972. 428 p. (In Russ.)

Bugaev 1946 — Bugaev V. A. Climate of Central Asia and Kazakhstan. Tashkent: Uzbek SSR Academy of Sciences, 1946. 24 p. (In Russ.)

Bulletin 1927 — Bulletin of the Central Asian Hydrometeorological Institute. 1927–1931. Tashkent. (In Russ.)

Dmitrienko 2003 — Dmitrienko N. M. Day by Day, Year by Year: Chronicles of Tomsk, 17th–20th Centuries. Tomsk: Tomsk State University, 2003. 347 p. (In Russ.)

Dzerdzeevsky 1962 — Dzerdzeevsky B. L. Alexander I. Voeykov. In: People of Russian Science. Essays on Outstanding Figures of Natural Science and Technology. Geology and Geography. Moscow: Physics and Mathematics Literature, 1962. Pp. 488–496. (In Russ.)

Feklova 2020 — Feklova T. Yu. The name's return. G. A. Fritsche — the founder of meteorological stations in Siberia. *Tomsk State University Journal of History*. 2020. No. 65. Pp. 190–194. (In Russ.)

Fritsche 1876 — Fritsche G. A. Report on the Establishment of New Meteorological Stations in Siberia in 1874 and on the State of Existing Ones. *Zapiski Imperatorskoy Akademii nauk*. 1876. Vol. 28. No. 1. Pp. 125–138. (In Russ.)

Furman 2000 — Furman M. Sh. V. B. Shostakovich — researcher of the East Siberian Region. In: Shostakovich B. S., Kozhova O. M. (eds.) Benedykt T. Dybowski. Novosibirsk: Nauka, 2000. Pp. 263–274. (In Russ.)

Giorgio 1949 — Giorgio V. A. On borders of the natural synoptic region for Central Asia. *Byulleten' Sredneaziatskogo gosudarstvennogo universiteta*. 1949. No. 29. Pp. 33–35. (In Russ.)

Guidebook 1988 — Guidebook to Short-Term Weather Forecasts. Part II. Is. 3. Far East. Leningrad: Gidrometeoizdat, 1988. Pp. 4–67. (In Russ.)

Kashkarov, Korovin 1936 — Kashkarov D. N., Korovin E. P. Life of the Desert. Leningrad: Biomedgiz, 1936. 252 p. (In Russ.)

Kryukova, Pinaeva 2013 — Kryukova K. A., Pinaeva N. V. History of phenological observations in Tomsk and Tomsk province. *Tomsk State University Journal of Biology*. 2013. No. 1 (21). Pp. 191–197.

Maklakov, Efremychev, Khomenko 1976 — Maklakov A. F., Efremychev V. I., Khomenko Ya. N. Essays on the Development of National Hydrometeorological Instrumentation. Leningrad: Gidrometeoizdat, 1976. 240 p. (In Russ.)

Molchanov 1929 — Molchanov L. A. Climate of Turkmenistan. Leningrad, 1929. 38 p. (In Russ.)

Molchanov 1928 — Molchanov L. A. General Problems of Climatology in Central Asia. Tashkent, 1928. 9 p. (In Russ.)

Molchanov 1926 — Molchanov L. A. Program of Route Meteorological Observations in Central Asia. Tashkent, 1926. 24 p. (In Russ.)

Molchanov, Zimmerman 1926 — Molchanov L. A., Zimmerman R. R. Climate Zoning of Central Asia. Ser.: Bulletin of the Zoning Committee. Vol. 3. Tashkent, 1926. 12 p. (In Russ.)

Oldfield 2016 — Oldfield J. D. Mikhail Budyko's (1920–2001) contributions to Global Climate Science: from heat balances to climate change and global ecology. *WIREs Climate Change*. 2016, September/October. Vol. 7. Pp. 682–692. (In Eng.)

Pogosyan, Taborovsky 1947 — Pogosyan Kh. P., Taborovsky N. L. 75th anniversary of the Soviet weather service. *Meteorologiya i gidrologiya*. 1947. No. 1. Pp. 3–10. (In Russ.)

Polyanskaya 2011 — Polyanskaya E. A. Synoptic Processes of Eastern Siberia and the Far East. Saratov: Saratov State University, 2011. 48 p. (In Russ.)

Rykachev 1899 — Rykachev M. A. Historical Essay on the Main Physical Observatory: Over the 50 Years. 1849–1899. St. Petersburg: Imperial Academy of Sciences, 1899. 415 p. (In Russ.)

Schlegel 1926 — Schlegel B. Kh. Water Economy of Central Asia. Moscow, 1926. 69 p. (In Russ.)

Schwer 1980 — Schwer Ts. A. (ed.) The Climate of Omsk. Leningrad: Gidrometeoizdat, 1980. 246 p. (In Russ.)

Selikhanovich 1959 — Selikhanovich V. G. Dmitry D. Gedeonov: Military Geodesist and Astronomer. An Essay on Life and Scientific Activities. Moscow: Geodezizdat, 1959. 64 p. (In Russ.)

Shostakovich 1926 — Shostakovich V. B. Necessity and Immediate Tasks of Climate Research in Mongolia. Irkutsk, 1926. 9 p. (In Russ.)

Skachkov 1874 — Skachkov K. A. The fate of astronomy in China. *Zhurnal Ministerstva narodnogo prosveshcheniya*. 1874. Vol. CLXXIII. No. 5. Pp. 23–58. (In Russ.)

Skvortsov, Skvortsov 1928 — Skvortsov A. A., Skvortsov Yu. A. Agroclimate and Thermal Balance of Irrigation Fields. Tashkent: Institute of Water Economy, 1928. 14 p. (In Russ.)

Skvortsov, Skvortsov 1964 — Skvortsov A. A., Skvortsov Yu. A. Irrigation of Agricultural Fields and Microclimate: Methodology and Research Results. Leningrad: Gidrometeoizdat, 1964. 275 p. (In Russ.)

Slutsky 1998 — Slutsky V. I. History of Meteorology at Tomsk University. Tomsk: Tomsk Center for Scientific and Technical Information, 1998. 112 p. (In Russ.)

Voeykov 1884 — Voeykov V. A. Climates of the Globe, Especially That of Russia. St. Petersburg: A. Ilyin, 1884. 640 p. (In Russ.)

Voeykov 1913 — Voeykov V. A. Essays on Turkestan. St. Petersburg: Selsky Vestnik, 1913. 56 p. (In Russ.)

Wild 1869 — Wild H. I. Guideline for Meteorological Stations. St. Petersburg: Imperial Academy of Sciences, 1869. 23 p. (In Russ.)

Zaripova 2015 — Zaripova L. A. On the history of meteorological researches in Russia by the example of the Southern Urals. *Izvestia of Samara Scientific Center of the Russian Academy of Sciences*. 2015. Vol. 17. No. 3. Pp. 44–48. (In Russ.)