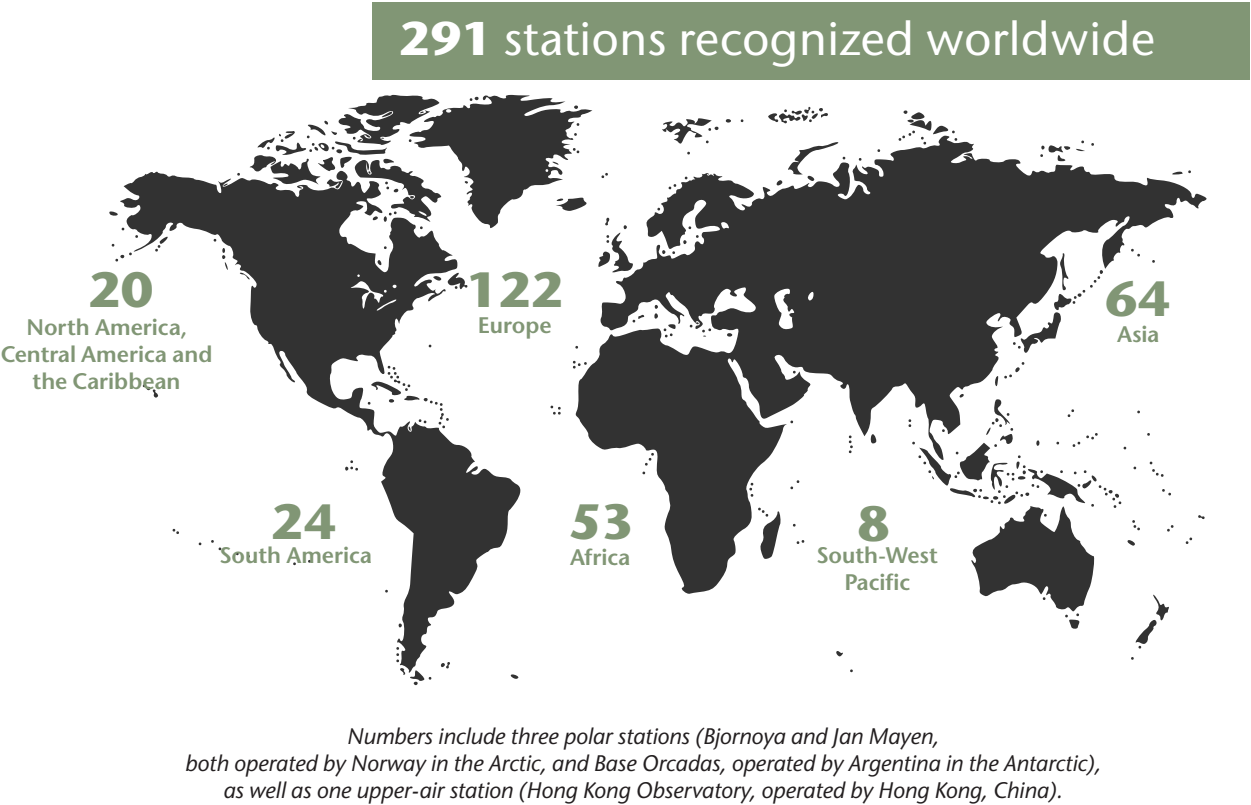


Centennial Observing Stations

State of Recognition Report – 2021



Key messages



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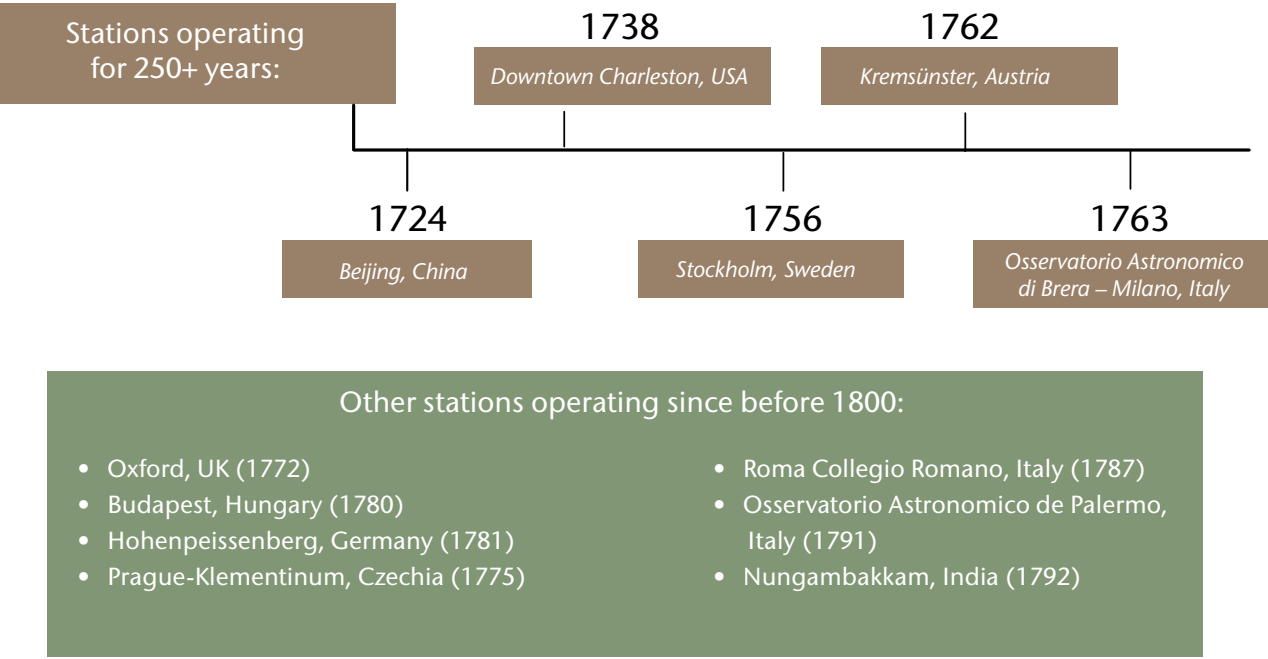
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FOREWORD

The past decade (2011–2020) was the warmest decade on record. Confirming such significant warming over the past century would not be possible without long-term observations from weather stations around the world. Unfortunately, too many old weather stations are being closed because of budget constraints or urban development. WMO has therefore created the Centennial Observing Stations initiative to raise awareness of this issue and to encourage governments everywhere to protect and maintain the vital scientific records generated at these stations.

Centennial Observing Stations (which are stations that have marked their 100th anniversary of operation) maintain the world's longest weather observation records, thereby making an essential contribution to scientists' growing understanding of the climate system, its variability and its change. Long-term weather observations aid adaption and mitigation efforts and inform international mechanisms such as the United Nations Framework Convention on Climate Change (UNFCCC) to evaluate risks of and find solutions to climate change impacts. Results from the UNFCCC are then assessed by the Intergovernmental Panel on Climate Change (IPCC), established by WMO and the United Nations Environment Programme (UNEP). The IPCC provides authoritative reports summarizing what scientists around the world have learned about how the climate is changing and how it will likely change in the decades ahead. These reports guide international action under the UNFCCC and the Paris Agreement.

Beyond providing consistent data over decades, many Centennial Observing Stations also contribute to the WMO World Weather Watch system, ensuring that weather data are shared around the world every day. Additionally, some Centennial Observing Stations are part of the surface network of the Global Climate Observing System, which regularly assesses the status of global climate observations and produces guidance for its improvement. Sustaining and strengthening this system is a key priority for WMO and for climate science.

WMO is committed to promoting long-term weather observations all around the world. Maintaining an observing station, day in and day out, for more than 100 years is a major challenge. It requires skilled staff, financial resources, a stable location for the equipment and – perhaps most importantly – dedication and commitment. By recognizing Centennial Observing Stations, WMO congratulates the station operator on such an achievement. This report highlights nearly 300 stations, officially recognized as of 2021, in order to promote their sustainable observational standards and best practices that facilitate the generation of high-quality time series data.



Jan Mayen Station, Norway

IMPORTANCE OF LONG-TERM OBSERVATIONS

Observation data are the foundation of science. Standardized meteorological observations, made and gathered in a coordinated manner, allow for identifying weather conditions over different spatial and geographical scales, from local to global. Collected and stored over long timescales, these observations reflect the memory of past weather conditions, which form the basis of our understanding of the Earth's climate. High-quality time series data of meteorological observations, spanning over decades or even centuries, allow scientists to study and understand the Earth's climate, including its variations and trends. Such data also enable scientists to identify and analyse climate processes, including its physics. This kind of physical understanding underpins climate modelling to generate climate predictions and climate scenarios.

Weather data has been collected on an unsystematic basis for many centuries, often attached to weather and climate events with considerable impact on communities. However, systematic observations started only a few centuries ago. The history of coordinated weather observations by an observational network dates back to more than 200 years ago when, in 1781, the Societas Meteorologica Palatina in Europe began systematic and coordinated weather observations. Many observations have been taken since then, but only few meteorological observing stations have been operated from the same place over decades or centuries without disruption. Such long-term observing stations represent a real heritage, and their time series observational data represent unique sources of knowledge. **There is no other source of systematic historic data for analysing and understanding the status, physical characteristics and spatiotemporal variability of the atmospheric elements of the climate system.**

Observations from long-term observing stations are therefore vital inputs to climate models that scientists use to understand the climate. Together, observations and modelling allow scientists to create credible scenarios of future climate change. For example, the widespread flooding that caused massive destruction in western parts of Germany in summer 2021 was caused by extreme precipitation. This is something that climate models indicate will occur more frequently as climate change continues. Long-term observations from weather stations and other observing platforms (including satellites, buoys, vessels, airplanes and so forth) not only accurately measure how these most destructive extreme rainfall events are changing in terms of occurrence, but they also inform climate services.

Knowing how the climate has been changing over the past 100 or 200 years makes it possible to evaluate risks and find solutions to climate impacts like extreme precipitation and flooding. Other impacts might include mudslides and rockslides due to melting permafrost, or reduced hydropower supply due to changes in water flows, or damaged crops due to drier and hotter summers, all of which have the potential to have devastating effects on a country's long-term socioeconomic development.

Additionally, and most prominently, long-term observations greatly contribute to WMO flagship products, such as the annual global and regional *State of the Climate* reports, which provide scientifically sound, reliable information for policymakers and decision makers. WMO has produced the annual *State of the Global Climate* report since 1993 (see, for example, the [2021 report](#)), which is now complemented by regional reports. The reports use key climate indicators such as temperature and precipitation to highlight global trends and anomalies (see, for example, Figure 1). Global estimates and analyses require both in situ data and historical observations provided by WMO Members.

The *State of the Climate* reports serve as an authoritative source not only on weather patterns, climate trends and extreme events, but also on their impact on people, ecosystems and sustainable development around the world. These reports serve the interested public, policymakers and, perhaps most importantly, climate negotiators and delegates at forums such as the Conference of the Parties (COP) to the UNFCCC. The importance of these reports for providing the scientific basis for action was highlighted most recently in the *Glasgow Climate Pact*, reached at COP26 (31 October to 13 November 2021, Glasgow), which welcomed “the recent global and regional reports on the state of the climate from the World Meteorological Organization”. Informing such high-level mechanisms and climate agreements would not be possible without the long-term observations of Centennial Observing Stations.

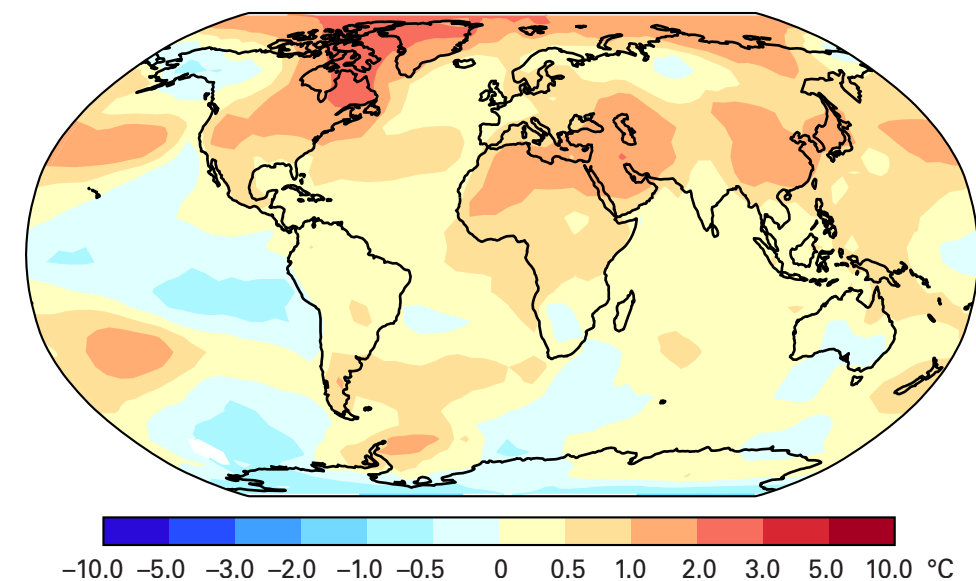


Figure 1. Temperature difference between 2021 and 1981–2010.

Source: WMO *State of the Global Climate 2021* (WMO-No. 1290).

WMO RECOGNITION CRITERIA AND MECHANISM

Background

In 2013, a formal WMO process was initiated to set up an appropriate mechanism for recognizing Centennial Observing Stations based on a minimum set of objective assessment criteria. This process was concluded in June 2016 with endorsement of the mechanism by the Executive Council at its sixty-eighth session. For more details on the background to the recognition mechanism please refer to the [WMO website](#).

Recognition criteria (as of June 2021)

1. The observing station was founded at least 100 years ago, observing at least one meteorological element since then, and is in operation as an observing station at the date of nomination.
2. Periods of inactivity of the observing station shall not exceed 10%.
3. The minimum historic station metadata for the full duration of station operation shall contain actual or derived geographical coordinates including elevation, known changes of station name and/or station identifier, identified meteorological element(s) and its unit(s) as well as the observing schedule(s).
4. Any known observing station relocation or change in the measurement technique have not significantly affected the climatological time series data. *Note: Documented data homogenization for the observing station is considered compliant with criterion 4.*
5. All historic observational data and metadata have been digitally archived or will be rescued. Members shall share their plans for data rescue, if applicable.
6. The observing station shall be operated according to WMO observing standards according to the [Manual on the WMO Integrated Global Observing System](#) (WMO-No. 1160) and the [Guide to Instruments and Methods of Observation](#) (WMO-No. 8). *Note: Explanatory information shall be provided for those stations that do not meet current WMO observing standards.*
7. The current environment of the observing station has been classified or will be classified according to the siting classification defined in the [Guide to Instruments and Methods of Observation](#) (WMO-No. 8). Members shall share (i) the metadata attached to the siting classification in the appropriate WMO metadata repository (currently OSCAR) or (ii) their plans to classify the observing station, if applicable.

- 8. The observed and measured data shall be subject to routine quality control procedures according to current WMO guidelines and practices. The quality control processes as well as their results shall be well documented. *Note: A brief description of the routine quality procedures at the observing station shall be included in the References/Remarks column.*
- 9. Members shall do their utmost to maintain nominated stations according to the above recognition criteria.
- 10. Historic observation data and metadata have been made available for scientific research, consistent with [Resolution 40 \(Cg-XII\)](#) – WMO Policy and Practice for the Exchange of Meteorological and Related Data and Products Including Guidelines on Relationships in Commercial Meteorological Activities, and [Resolution 60 \(Cg-17\)](#) – WMO Policy for the International Exchange of Climate Data and Products to Support the Implementation of the Global Framework for Climate Services, or will be made available.¹ Members shall share their plans for data availability, if applicable.

Recognition mechanism (as of June 2021)

- a. WMO Secretary-General sends out to Members, on a regular basis (e.g., every second year), an invitation to apply for WMO recognition of long-term observing stations as per endorsed criteria. *Note: The invitation will include the list of recognition criteria to be ticked off and commented on by Members for each nominated observing station. Further, it will include information on the review process, and it will request nomination of a national focal point including information of his/her official position in their respective organization. Members will be encouraged to include in their application, nominations from observing station operators outside the National Meteorological and Hydrological Services (NMHS).*
- b. Review of nominations received for the recognition of long-term observing stations by an Advisory Board consisting of experts from Infrastructure and Services Commissions² (climate, hydrology and marine domains; climate observing networks; measurement, instruments and traceability), GCOS, Research Board and regional associations, as appropriate.
- c. Recommendations for formal recognition of long-term observing stations to be tabled at Executive Council sessions for endorsement, after a review by the Technical Coordination Committee.
- d. Recognized stations to be listed in the Observing Systems Capability Analysis and Review tool (OSCAR).
- e. WMO Secretariat to run, and to keep up to date, a website and a brochure on long-term observing stations indicating their importance, with reference to the above-mentioned station list.
- f. Recognized stations to be re-assessed every 10 years.
- g. Any substantive change to the recognition mechanism and its criteria shall be tabled at a session of a WMO Technical Commission for Members’ approval and channelled through the Technical Coordination Committee for Executive Council endorsement.

¹ The World Meteorological Congress, at its extraordinary session in 2021, endorsed [Resolution 1 \(Cg-Ext\(2021\)\)](#) – WMO Unified Policy for the International Exchange of Earth System Data, replacing these resolutions.

² Infrastructure Commission: Commission for Observation, Infrastructure and Information Systems; Services Commission: Commission for Weather, Climate, Water and Related Environmental Services and Applications

RECOGNIZED CENTENNIAL OBSERVING STATIONS 2021

As of December 2021, [291 stations have been recognised by WMO](#) (see Figure 2). The stations are located in all six WMO regions and Antarctica, providing critically necessary long-term observations from around the world.

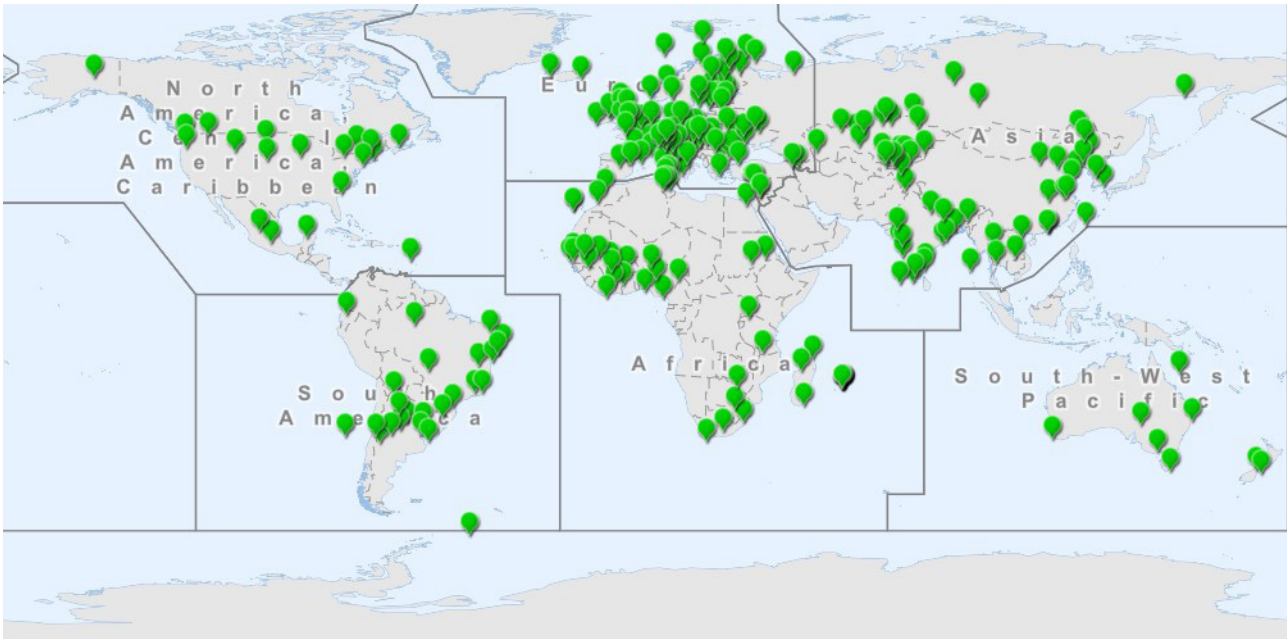


Figure 2. Recognized WMO Centennial Observing Stations, December 2021

Region I: Africa



Izana Station, Canary Islands, 1916



Izana Station, Canary Islands, 2021

Centennial Observing Stations in Africa

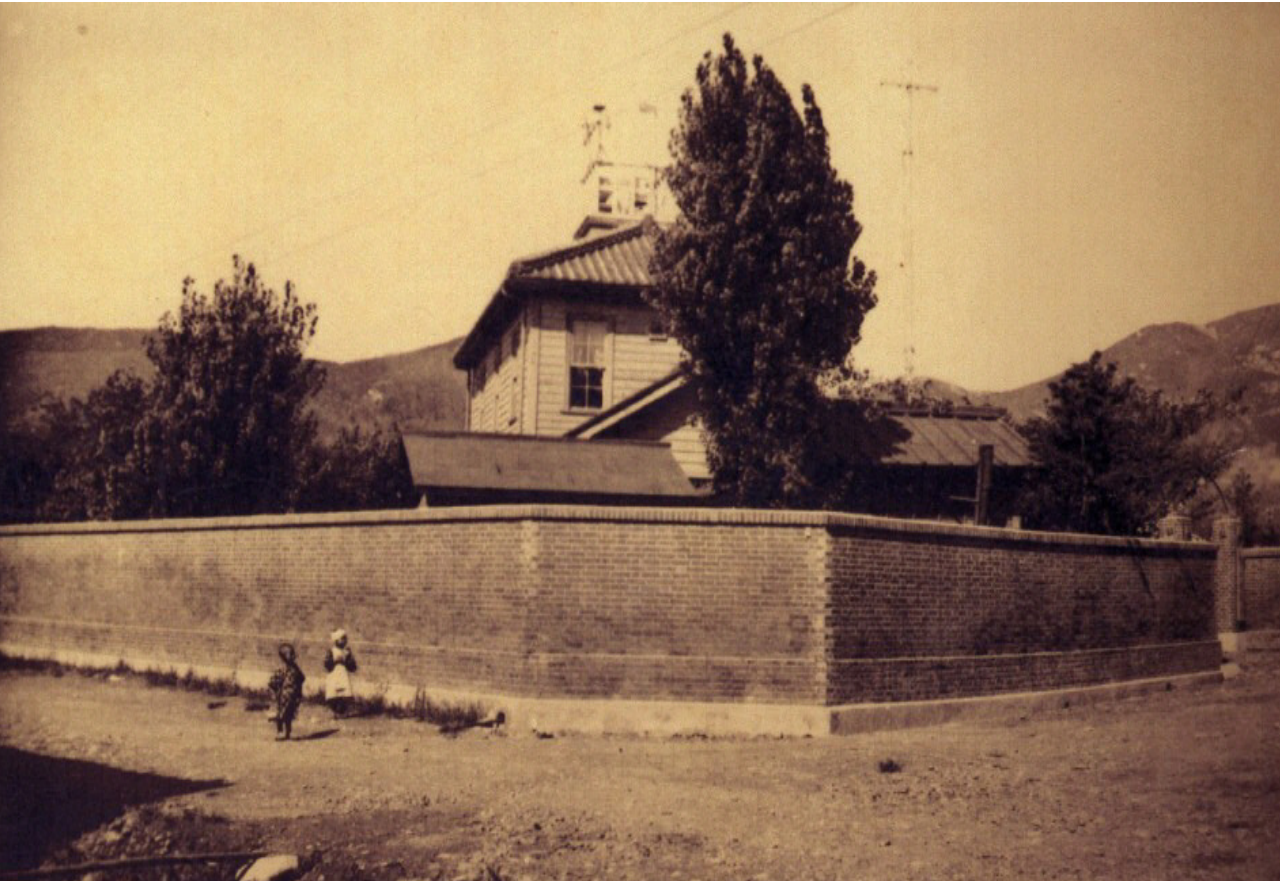
Total stations – 53

Oldest station – Cape Agulhas, South Africa (1855)

Stations more than 200 years old – N/A

Country	Station name	Start of operation	Country	Station name	Start of operation
Burkina Faso	Bobo-Dioulasso	1907	Nigeria	Calabar	1899
	Ouagadougou Airport	1902		Lagos Roof	1892
Côte d'Ivoire	Bondoukou	1919		Minna	1916
	Bouaké	1904		Sokoto	1916
	Tabou	1919		Yola	1914
Egypt	Helwan	1912	Senegal	Saint Louis	1897
Madagascar	Antsiranana	1901		Dakar	1904
	Amborovy Mahajanga	1897		Diourbel	1912
	Taolagnaro	1903		Kédougou	1918
Mali	Kayes	1895		Matam	1918
	Ségou	1907	South Africa	Cape Agulhas	1855
	Sikasso	1907		Cedara	1904
	Nioro du Sahel	1899		Roodebloem	1882
Mauritius	Pamplemousses	1862		Zuurbekom	1899
	Labourdonnais	1862	Spain	Izana	1916
	Beau Vallon Cour	1865		Santa Cruz de Tenerife	1865
	Constance	1865	Sudan	Kassala	1900
	Britannia	1869		El-Dueim	1902
	Vacoas	1901	Tanzania	Bukoba	1893
	St. Antoine	1874		Songea	1908
	Medine	1904	Tunisia	Tunis Cartage	1886
	Fuel	1881		Bizerte	1920
	Bel Ombre	1886		Jendouba	1901
Morocco	Alma	1873		Gabes	1901
	Casablanca	1911		Gafsa	1900
	Agadir Inezgane	1921		Tozeur	1898
			Zimbabwe	Bulawayo Goetz	1897

Region II: Asia



Busan Station, Republic of Korea, 1905



Busan Station, Republic of Korea, present

Centennial Observing Stations in Asia

Total stations – 64

Oldest station –
Beijing, China (1724)

Stations more than
200 years old – 2

Country	Station name	Start of operation
China	Dalian	1904
	Changchun	1908
	Hohhot	1915
	Shenyang	1905
	Wuhan	1869
	Yingkou	1904
	Beijing	1724
	Wuhu	1880
	Qingdao	1898
	Nanjing	1904
Hong Kong, China	Qiqihar	1901
	Hong Kong Observatory	1884
India	Hong Kong Upper Air Observation Station	1921
	Mumbai (Colaba)	1841
	Nungambakkam	1792
	Panjim	1860
	Pune	1856
	Thiruvananthapuram	1853
	Srinagar	1891
	Port Blair	1866
	Alipore	1877
	Ahmedabad	1893
	Gopalpur	1881
	Puri	1888
	Cuddalore	1889
	Kodaikanal	1899
	Minicoy	1891
	Bahraich	1892
	Shillong	1902
	Patna	1867
Japan	Ishigakijima	1896

Country	Station name	Start of operation
Kazakhstan	Akkol	1909
	Aral Tenizi	1884
	Mikhailovka	1907
	Atbasar	1886
	Irgiz	1856
	Kazaly	1848
	Turkestan	1882
	Fort-Shevchenko	1848
	Merke	1910
	Kokshetau	1895
	Aktobe	1898
	Torgay	1874
Korea, Republic of	Semiyarka	1893
	Zharkent	1890
Korea, Republic of	Busan	1904
	Seoul	1907
Kyrgyzstan	Baytik	1912
	Naryn	1885
Macao, China	Taipa Grande	1901
Russian Federation	Ola	1914
	Polyarnoe	1889
	Mezen	1883
	Werkhnejmbatsk	1911
Tajikistan	Taseewo	1901
	Khujand	1866
Thailand	Murgab	1894
	Chiang Mai	1911
Uzbekistan	Kanchana Buri	1911
	Ubon Ratchathani	1911
	Fergana	1880
Viet Nam	Namangan	1878
	Tashkent Observatory	1867
Viet Nam	Phu Lien	1906

Region III: South America



Base Orcadas Station, Argentina, 1933

Centennial Observing Stations in South America

Total stations – 24			Oldest station – Quinta Normal, Chile (1857)			Stations more than 200 years old – N/A		
Country	Station name	Start of operation	Country	Station name	Start of operation			
Argentina	Base Orcadas (Antarctica)	1904	Brazil (Cont'd.)	Maceió	1909			
	Ceres Aero	1896		Manaus	1910			
	La Quiaca Observatorio	1902		Quixeramobim	1896			
	Malargüe Aero	1914		Salvador (Ondina)	1903			
	Pilar Observatorio	1907		Aracaju	1910			
	Monte Caseros Aero	1904		Campos dos Goytacazes	1912			
	San Luis Aero	1874		Passo Fundo	1912			
	Santiago del Estero Aero	1873		Chile	Juan Fernandez	1901		
			Quinta Normal		1857			
Brazil	Caetité	1907	Ecuador	Quito OAQ/EPN	1891			
	Cuiabá	1911	Uruguay	Mercedes	1908			
	Curitiba	1911		Prado	1901			
	Juiz De Fora	1910						

Region IV: North America, Central America and the Caribbean



Blue Hill Observatory Station, USA, 1894



Blue Hill Observatory Station, USA, 2004

Centennial Observing Stations in North America, Central America and the Caribbean

Total stations – 20			Oldest station – Downtown Charleston, USA (1738)			Stations more than 200 years old – 1		
Country	Station name	Start of operation	Country	Station name	Start of operation			
Canada	Ottawa CDA RCS	1889	United States of America	Blue Hill Observatory, Milton	1885			
	Victoria Gonzales CS	1919		Buffalo Bill Dam	1905			
	Nappan Auto	1890		Mandan Experiment Station	1913			
	Welland-Pelham	1872		Olga	1890			
	Creston Campbell Scientific	1912		Purdum	1902			
France	Fond-Saint-Denis-Cardet	1905		Saint Johnsbury	1894			
Mexico	Central Tacubaya	1877		University Experiment Station	1911			
	Merida Aeropuerto Internacional	1898		Vancouver 4 NNE	1895			
	Zakatecas (La Bufa)	1877		New York City Central Park	1869			
				Prairie du Chien	1893			
				Downtown Charleston	1738			

Region V: South-West Pacific



Lincoln Station, New Zealand, 1959



Lincoln Station, New Zealand, 2018

Centennial Observing Stations in South-West Pacific

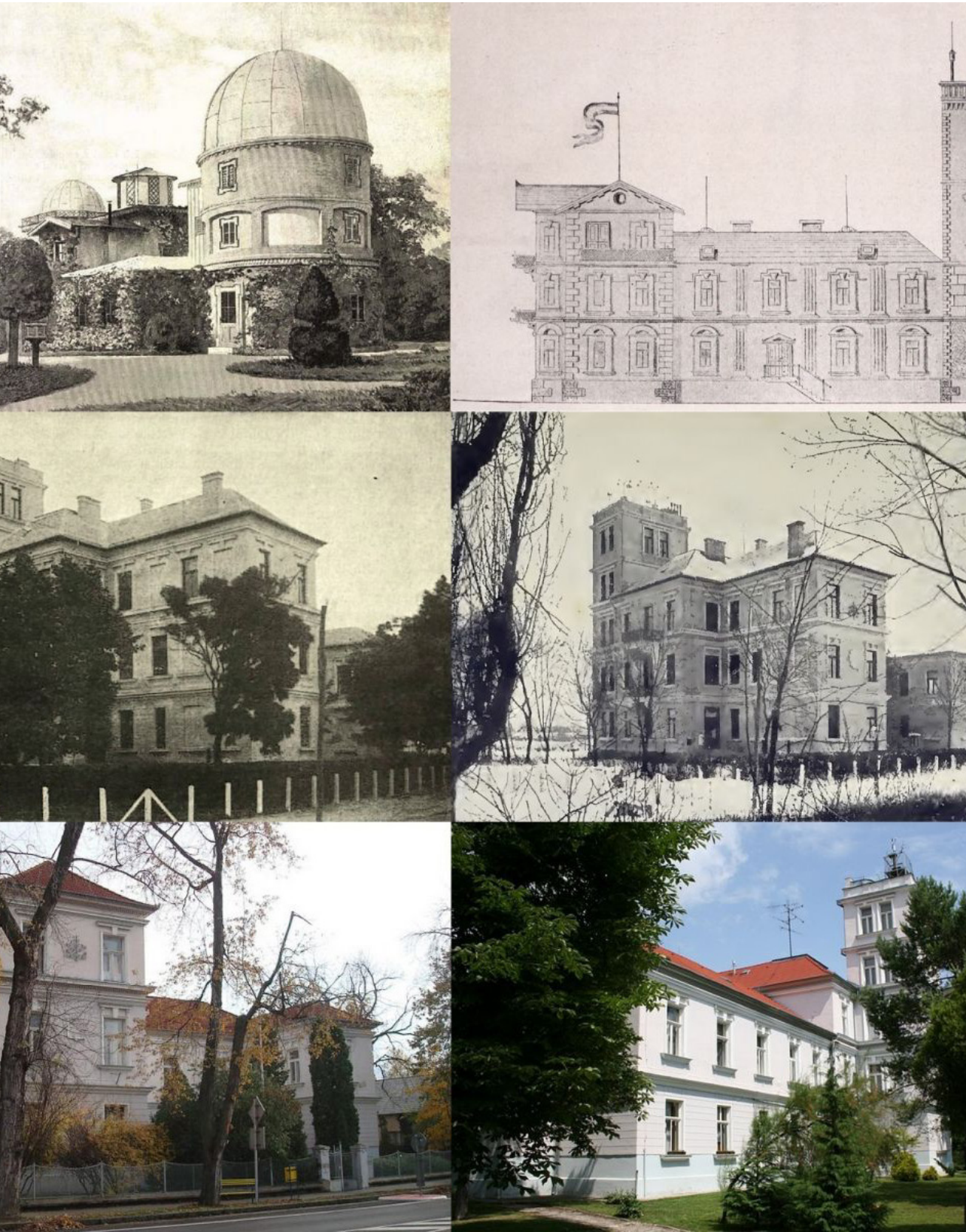
Total stations – 8

Oldest station – Mt Boninyong, Australia (1856)

Stations more than 200 years old – N/A

Country	Station name	Start of operation
Australia	Hobart	1882
	Wooltana	1877
	Cape Leeuwin	1897
	Willis Island	1921
	Mt Boninyong	1856
	Yamba Pilot Station	1877
New Zealand	Hokitika	1865
	Lincoln Broadfield	1881

Region VI: Europe



Centennial Observing Stations in Europe

Total stations – 122

Oldest station – Stockholm, Sweden (1756)

Stations more than 200 years old – 12

Country	Station name	Start of operation	Country	Station name	Start of operation
Armenia	Gavar	1890	France	Paris-Montsouris	1872
	Gyumri	1895		Saint-Genis-Laval	1881
	Armavir	1904		Besançon	1884
Austria	Kremsmünster	1762		Sauternes	1888
	Stift Zwettl	1833		Mont Aigoual	1895
	Wien-Hohe Warte	1872		Dunkerque	1917
	Innsbruck University	1877		Istres	1920
	Sonnblick	1886	Germany	Hohenpeissenberg	1781
Belgium	Graz University	1894		Potsdam	1893
	Uccle	1886		Brocken	1895
Bulgaria	Sliven	1889	Greece	National Observatory of Athens	(1891 on current location)
	Obrazcov Chiflik	1890			
	Knezha	1910	Hungary	Budapest	1780
Croatia	Hvar	1858		Debrecen	1853
	Zagreb-Gric	1861		Szombathely	1864
	Gospic	1872		Pecs/Pogany	1871
Cyprus	Lefkosia	1899		Szeged	1871
	Polis Chrysochous	1908	Iceland	Stykkishólmur	1846
	Stavros Psokas	1916		Teigarhorn	1881
	Pano Panagia	1916	Ireland	Phoenix Park	1829
	Saittas	1916		Valentia Observatory	(1892 on current location)
	Troodos Square	1916	Israel	Miqwe Israel	1897
	Platania	1916		Beit Jimal	1919
	Kornos	1916	Italy	Osservatorio Astronomico di Brera, Milano	1763
Czechia	Panagia Bridge	1916		Roma Collegio Romano	1787
	Prague-Klementinum	1775		Osservatorio Astronomico di Palermo	1791
	Sumperk	1865		Piacenza-Collegio Alberoni	1802
	Prerov	1874		Osservatorio Ximeniano	1813
	Klatovy	1876		Osservatorio Modena	1830
	Opava	1887		Genoa University	1833
Estonia	Milesovka	1905		Osservatorio Cavanis	1835
	Vilsandi	1865		Urbino-Osservatorio Meteorologico Alessandro Serpieri	1850
Finland	Tooma	1911		Moncalieri-Collegio Carlo Alberto	1859
	Helsinki Kaisaniemi	1844			
	Parainen Utö	1881			
	Siikajoki Ruukki	1904			
	Sodankylä Tähtelä	1908			
	Kuusamo Airport	1909			

Country	Station name	Start of operation
Italy (<i>Cont'd.</i>)	Osservatorio Valerio, Pesaro	1871
	Domodossola-Collegio Rosmini	1871
	Rovereto	1882
	Montevergine	1884
	Carloforte Osservatorio	1901
	Vigna de Valle	1910
	Chieti	1918
	Aggius	1919
	Campotosto	1919
	Sulmona	1919
Latvia	Liepaja	1870
	Mersrags	1895
	Ventspils	1901
	Priekuli	1912
Lithuania	Panevezys	1894
Moldova, Republic of	Chisinau	1886
	Soroca	1891
Netherlands	De Bilt	1897
Norway	Vardo	1829
	Dombaas	1864
	Utsira LH	1867
	Karasjok	1877
	Ferder LH	1885
	Bjornoya (Arctic)	1920
	Jan Mayen (Arctic)	1921
Romania	Drobeta Turnu Severin	1896
	Calarasi	1898

Country	Station name	Start of operation
Slovakia	Hurbanovo	1872
Spain	Madrid Retiro	1893
	Daroca	1909
	Barcelona (Observatorio Fabra)	1913
	Tortosa	1880
Sweden	Stockholm	1756
	Bjuröklubb	1879
	Hoburg	1879
	Abisko	1913
Switzerland	Grand-Saint-Bernard	1817
	Säntis	1882
Türkiye	Kandilli Observatory	1911
Ukraine	Odesa	1866
	Dubno	1885
	Romny	1885
	Poltava	1886
	Uman	1886
United Kingdom	Oxford	1772
	Armagh	1836
	Rothamsted	1872
	Balmoral	1882
	Llys dinam	1882
	Maison St. Louis Observatory, Jersey	1894
	Morpeth, Cockle Park	1897
	Eskdalemuir	1908

Featured station

Jan Mayen, Norway

Start of operation: 1921

The Norwegian Meteorological Institute has been observing the weather on Jan Mayen since 1921. Parts of the island were annexed by the Norwegian Meteorological Institute on behalf of Norway in 1922, and the whole island in 1926. There are no permanent residents on the island, however four employees of the Norwegian Meteorological Institute are deployed there for six months at a time, and fourteen employees of the Norwegian Armed Forces operate the airfield and other infrastructure.

The first observing station was burnt down and evacuated during the war in 1940, however observers had already returned the next year to resume the measurements. They built up a new station a few kilometres north-west of the first station. During the Second World War, the German forces attempted to destroy the station and to establish their own, however they were unsuccessful. The Allies started secret radiosonde measurements in 1944, which became

important for the Arctic convoy route to the then Soviet Union and for the weather forecast on D-Day, when the Allies landed in Normandy.



The station was moved in 1962 to its current location on the south side of the island. The station measures temperature, pressure, relative humidity, wind speed and direction, precipitation, visibility, radiation, sea temperature, weather and clouds. There are still some manual observations on Jan Mayen, but they have begun to be automated in order to secure the station's observations for the future.



Jan Mayen in 1954

Jan Mayen in 2018

Long-term observing stations are, of course, very important for studying climate change, and stations in the Arctic, like Jan Mayen, are especially important because the Arctic is warming much faster than any other region on Earth.

Jan Mayen is also a remote island far from other weather stations and is therefore important for both weather forecasting and observing climate and climate change. Jan Mayen is and has always been an important station for weather forecasting as it is placed in a zone where cold polar air meets warmer air over the Atlantic Ocean. This has a major impact on the weather conditions to the east and



Jan Mayen in 1938

south. Even though the station has been relocated a few times, it has not been affected by urbanization or other changes in the environment that might have affected the temperature series.

Many people today choose to work on Jan Mayen for six months at a time to experience nature and a different everyday life. However, in the 1920s there was something else that lured people to come to this remote island far away from civilization: fox hunting. Hunting provided them with a supplementary income and an extra activity aside from weather observation.

More recently, the station celebrated its 100th anniversary. The Director General of the Norwegian Meteorological Institute, Roar Skålin, and representatives from the Norwegian Ministry of Climate and Environment visited the island to celebrate the anniversary and the Centennial Observing Station recognition.

Input provided by Hildegunn D. Nygård, Norwegian Meteorological Institute



Jan Mayen in 1939

OUTLOOK

The recognition of long-term surface observing stations has generated significant interest among WMO Members. The marine and hydrological communities have expressed interest in the application of the recognition mechanism for their observing stations and platforms. Draft recognition criteria have been developed to reflect the specific characteristics of marine and hydrological observing stations and a test phase has been initiated to trial these draft criteria with real nominations of centennial marine and hydrological observing stations. The test phase will be carried out in 2022 in close collaboration with the respective communities. The successful conclusion of the test phase will enable the full implementation of the recognition mechanism for marine and hydrological long-term observing stations.

Furthermore, at the request of Members and in order to protect long-term observing stations not yet eligible for recognition as WMO Centennial Observing Stations, guidelines for a mechanism for **national** recognition of observing stations with a history of more than 75 years (but less than 100 years) will be published in due course. The WMO recognition mechanism for long-term observing stations will also be incorporated in the *Technical Regulations* (WMO-No. 49).

The present *State of Recognition Report* is intended to be updated every third year to inform policy makers, scientists and the public, thereby promoting long-term observations.



Zugspitze Station, Germany. Photo by Claudia Hinz.

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