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Current Situation and Development of Meteorological Metrological Verification

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Abstract

Meteorological Metrology began in the 1950s and has made important contributions to the accuracy and comparability of observational network data. Meteorological Metrological verification is an important link to ensure the quality of meteorological observation equipment and the transmission of meteorological elements metrological standards, and to carry out scientific, normative and high standard metrological verification of meteorological observation instruments, is our country each meteorological station observation data comparability, the accuracy and the consistency important guarantee. With the continuous development of meteorological metrology verification business, especially the need of the construction of modern meteorological technology support work. With the development of science and technology, meteorological observation data are more and more dependent on the acquisition of instruments. However, the baseline drift of the instrument itself causes the reliability of the measured or detected data to decrease with the time. Therefore, the verification of meteorological metrology is of great significance in meteorological operations.

Keywords

Meteorology, metrological verification, present situation

Introduction

Meteorological Service is based on meteorological observation data. Only by obtaining effective and reliable observation data, it is possible to carry out data analysis and provide high-quality meteorological service [1]. At present, the observation of air pressure, temperature, humidity, wind direction, wind speed and precipitation are all completely dependent on instruments and equipment. Therefore, whether the observation data are reliable and accurate depends mainly on the performance of the instrument and equipment.

1. The significance of meteorological metrological verification

Baseline Drift is a common phenomenon in meteorological instruments, that is, the performance of instruments changes with time, and most of the drift is permanent. At this time, the instrument and equipment will not reflect the real weather conditions, which will directly affect the flight safety. At the same time, the deviation of meteorological data will result in the statistical error of long-term trend of meteorological changes, and the unreliable data accumulation will destroy the basis of meteorological data analysis [2]. In order to provide reliable meteorological information and data, meteorological observation instruments and equipment are required to ensure the accuracy and reliability of the measured data. All of these should be based on the national standard, standard and transmission system of meteorological measurement in the whole industry, to ensure the reliability of the standard of meteorological elements and the unity of the measurement system.

Measurement means to achieve unity of units and accurate and reliable measurement value. The use of scientific methods and general means of monitoring is the important means of effective measurement and accurate calculation. The measurement

reliability of an instrument can be effectively evaluated by measurement. The metrological verification gives the correction value or correction curve to the drift of the instrument and equipment, and calibrates the instrument and equipment. When the drift can not be corrected, the instrument can no longer be used.

2. The current situation of meteorological metrology verification business

Meteorological Metrology shall be carried out in accordance with the "Law of the People's Republic of China on metrology" and the principles and requirements for its implementation. It plays an important role in the error identification of meteorological observation data, the quality management of meteorological observation data and the accuracy control of meteorological observation data. With the development of meteorology, the number of meteorological observation instruments and equipment has increased, and in the measurement accuracy requirements, it has reached an unprecedented height.

At present, a nationwide meteorological measurement service network with the National Meteorological Measurement Station as the technical core and 32 provincial meteorological measurement institutions as the main body has been formed. The National Meteorological Measurement Station, as the only national meteorological professional measurement institution in our country, maintains the highest measurement standards of all the established standard projects, and undertakes to transmit standard values to provincial-level meteorological measurement institutions, of the project [3]. The provincial and provincial-level meteorological province-level division agencies are the intermediate links of the national meteorological measurement and the transmission of the standard values of the stations to the observation instruments at the stations, through the provincial meteorological measurement standards maintained by the province to undertake independent meteorological observation instruments within the province's metrological support tasks. The transmission of measurement values by national and provincial meteorological agencies is mainly carried out by means of measurement verification, and the unified national or departmental verification procedures are adopted. The China Meteorological Administration Division manages the national operations. Under the unified planning of the Department of integrated observation of the China Meteorological Administration, the operational capacities established by the provincial-level meteorological measurement agencies throughout the country are basically the same.

The National Meteorological Metrology Station has established the industry highest metrology standards for 5 items of temperature, humidity, pressure, wind and solar radiation, as well as precipitation metrology standards equivalent to the level of provincial meteorological metrology institutions. Provincial-level meteorological metrological institutions have generally established metrological standards for five items, namely temperature, humidity, pressure, wind and precipitation, and seven provinces have established metrological standards for solar radiation, some provinces and cities have established acid rain, soil moisture measurement standards. In order to cope with the growing scale of the Chinese observation network and improve the efficiency of meteorological measurement support, since 2000, China has been actively exploring on-site measurement support models for regional Automatic weather station, most city-level meteorological bureaus are equipped with vehicle-borne metering equipment to carry out on-site verification of regional Automatic weather station [4]. Some provinces, such as Zhejiang, have set up their own meteorological measurement institutions at the prefecture and city levels.

Since 2008, nearly US $6 million has been invested in four-parameter environmental simulation studies of temperature, humidity, pressure and solar radiation, it is expected that the joint test of the multi-parameter measurement performance of the observation instrument will be realized on the accuracy of the measurement grade. In 2013, provincial meteorological measurement stations deployed provincial-level meteorological measurement management systems, automating the verification of Automatic weather station sensors and standardizing measurement management, it can complete the verification work well under the current value transfer method and management system, and improve the work efficiency. At the same time in Shanghai and Anhui visibility simulation device research, completed in June 2016, for the development of visibility meter calibration provides a basic condition. Since 2013, the China Meteorological Administration has invested in the development of automated systems for the calibration of meteorological measurements. The system was deployed in national meteorological metrology laboratories in 2015, more than doubling the work efficiency.

With the cooperation of the national and provincial meteorological measurement organizations, the annual verification capacity can reach more than 3000 automatic weather stations, it can meet the measurement support needs of more than 2,400 national-level Automatic weather station, but compared with the overall measurement support needs of the 60,000-plus Automatic weather station already installed in China's ground-based meteorological observation system, there is a certain inadequacy in ability. So, for the managers of meteorological metrology verification, we can draw lessons from some of the current experience models of the management of technicians' licenses, and start from two aspects of training and assessment, build a professional knowledge, familiar with the business management team. The goal of stable and hierarchical management of personnel can be basically realized by adopting the technical support forms from national meteorological stations to provincial meteorological stations and then to city and county levels, thus the work of meteorological metrology verification will be pro-

moted to a new level. At the same time to achieve electronic management of the measurement verification files. Archives are not only the necessary supporting evidence in metrological verification, but also play an important role in the dynamic management of instrument and equipment. The efficient and scientific management of archives is the basis of metrological verification management. Therefore, the realization of electronic management is the only way [5]. When the conditions are ripe, we can set up a unified metrological verification archives in the meteorological metrology verification industry, and further realize the linkage management with the fixed assets management system and the spare parts management system.

3. Development trend of meteorological metrology

In the future, measuring instruments and equipment will be more intelligent, micro-scale, integrated, chip-based, systems engineering. Multi-instrument networking has been applied, and virtual instruments, three-dimensional multimedia and other new technologies began to be applied. The test equipment used will not be purely mechanical, but a highly integrated high-tech collection of light, electricity, computers, mechanics of materials, physics, chemistry, biological sciences and advanced technologies, electronic and computer technology become important parts of test equipment, which can realize automatic data acquisition, data processing and automatic calibration by computer control. Traditional measurement methods have also undergone epoch-making changes due to the continuous improvement of modern automatic instruments and computer technology. Digital measurement is replacing analog measurement, measurement will no longer be analog measurement and pure instrument management, but a high degree of digital measurement and high reliability of measurement results combined.

The change of metrological management mode, the diversification of calibration and verification relations, and the metrological assurance scheme will be dominant in the meteorological and other fields, the verification relations will also tend to be diversified, and the metrological management mode will mainly be the metrological assurance scheme. In our country, although the traditional transmission mode of the value of the quantity can make the instrument in a controlled state, the necessary conditions are provided to ensure the accuracy and consistency of the measurement results. But there is no further investigation and quality control on the reliability and accuracy of the instrument after the measurement results. Measurement Assurance Program (MAP) is a new type of quality Assurance Program, which has been widely used in foreign countries. It is a kind of measure process to affect the Measurement accuracy of various factors, including calibration, measurement methods, environmental conditions, the use of measuring instruments, and the level of operation technology to carry out a comprehensive, controlled mode of work. Taking the National Institute of Standards and technology (NIST) as an example, the NIST will pass the “Transmission standard” to the participating MAP laboratory for the determination of unknown samples, and the laboratory will return the results to NIST, according to the measured data and related parameters, NIST makes a comprehensive evaluation on the measuring process, experimental conditions and experimental techniques of MAP laboratory, so as to control the measuring process of this laboratory, the aim of accurate, unified and reliable measurement is achieved.

On the other hand, the development trend of meteorological measurement is reflected in the remote network measurement. Remote measurement is not only reflected in data collection, analysis, it also embodies in the sharing of measurement equipment, test data, the separation of measurement environment and measured parameter environment, and the realization of optimal control and prediction. Remote measurement through various forms of network to achieve, it needs to establish a network measurement environment. In this way, instruments can be operated over the Internet and distributed Measurement and Control Networks can be formed in homes, offices and work sites, and standards on MCN (Measurement and Control Networks) are being actively developed, some progress has been made, which makes the measurement and control process further networked. The network has maximized the scope of measurement and control, and now people can effectively control instrumentation, testing and control anywhere. In the near future, it will be possible to monitor and even control the condition of meteorology and other instruments through the network.

In addition, surface and sub-surface metrology will have a greater development, and its applications will be more extensive. The measurement and evaluation of surface topography is the hotspot of nanometrology research at present. Scanning tunneling microscopy (STM) is the first method to measure the three-dimensional surface topography at the nanometer scale, which has greatly promoted the development of surface metrology, then atomic force microscopy (AFM), laser force microscopy (LFM), Magnetic force microscope microscopy (MFM), ballistic electron emission microscopy (Beem), scanning ion electron microscopy (SICM), scanning near-field optical microscopy (Snom), photon scanning tunneling microscopy (PSTM), etc. The application of these instruments will not only have a great impact on biology, life, science, chemistry, materials science, vacuum physics and so on, but also become a new blood in the field of meteorological measurement, we will continue to modernize meteorological metrology. Now, the researchers' field of vision has expanded from surface micro-topography measurement to surface micro-defect measurement, from small-scale surface measurement to large-scale surface measurement, and from plane measurement to curved surface, spherical surface and aspheric surface measurement, surface measurement extends to sub-surface measurement, geometry measurement extends to other mechanical, physical and other micro-quantity measurement.

4. Summary

In order to ensure the overall validity of the observation data of the meteorological observation network, the development goal of covering the whole meteorological measurement network in China is put forward. In order to achieve this goal, the China Meteorological Administration has given long-term and continuous support to the study of meteorological measurement techniques to contribute to the further improvement of the quality of meteorological sounding data. At present, the high technology in the field of meteorology is developing vigorously, its development speed, breadth and depth are often beyond the normal, and some are even moving forward faster than expected, at the same time, because of the obvious trend of internationalization, integration and integration, we should make the high-tech situation, the meteorological measurement in our country can develop in step with it, we must establish a set of perfect system and adapt to the mechanism, in order to more effectively promote the rapid development of our country's meteorological metrology. Stand the tide.

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