Regional Climate Monitoring and Assessment in the Belt and Road

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Abstract. The Belt and Road is the abbreviation of the Silk Road Economic Belt and the 21st Century Maritime Silk Road. The countries along the Belt and Road routes are generally highly sensitive and vulnerable to climate change, so it is urgent to design a service platform for climate change prediction and monitoring. In this paper, based on the various demands of climate change prediction and monitoring, we analyzed the importance of the establishment of a climate service platform and the main measures to improve the capabilities of climate service platform. According to the principle of "refinement, systematization and specialization", a meteorological service platform was designed, which are based on space remote sensing, supplemented by airborne remote sensing, and verified by the ground observation network to verify that the real-time monitoring and prediction of sky and ground integration. The platform can provide scientific basis for the countries along the routes, and improve the infrastructure construction progress and personnel safety along the Belt and Road.

1. Introduction

In March 2015, the Chinese government listed the Belt and Road as a significant development strategy in the 21st century. The "Belt and Road" strategy transforms Asia, Europe, and Africa, connecting the active East Asian economic circle with the developed European economic circle, and the vast hinterland countries in the middle have huge economic development potential. The Silk Road Economic Belt mainly includes three routes: one is China via Central Asia, Russia to the Baltic Sea in Europe; the other is China via Central Asia, West Asia to the Persian Gulf, and the Mediterranean; the third is China to Southeast Asia, South Asia, and the Indian Ocean.[1]

The Belt and Road is intended to promote economic cooperation, to establish a win-win regional economy. The routes run across the continent of Asia, Europe and Africa, passing through more than 60 countries, among which more than 60 percent of the world's population lives in.[2] However, according to the Global Competitiveness Report, more than half of the national infrastructure indexes are below the global average along the routes, so the governments of the countries along the routes have shown a positive attitude towards infrastructure construction projects for improving the economy. At present, the developing countries are speeding up investment in infrastructure construction, while developed countries are also speeding up infrastructure upgrading and inter-regional infrastructure connectivity.

However, there are some difficulties. The global climate has been changeable in recent decades. Since 1950, many extreme weather events have been occurred, such as high temperature stress, storms, extreme precipitation, landslides, sea-level rise and storm surges.[3] Countries along the Belt
and Road routes are located in two natural disaster zones, the Pacific rim and the mid-latitudes of the northern hemisphere, with diverse climate and fragile environments.[4] Natural disasters have caused a risk to infrastructure construction and personnel safety. Therefore, we need to know and predict the climate change in time. The traditional method is to use ground meteorological stations for observation, but the terrain along the routes is more complex, mountainous, plateau, desert, ocean and other no man's land, meteorological ground observation blind spots.[4] Therefore, countries along the Belt and Road are in urgent need of meteorological satellites to conduct three-dimensional observation of meteorological environment and forecast climate change, so as to make up for the shortage of ground observation. In the future, the Belt and Road infrastructure construction, meteorological satellites will provide scientific basis for climate monitoring and prediction along the routes, so as to fully guarantee the construction quality and personnel safety.

2. The Belt and Road climate security service capacity needs

From 1995 to 2019, among the top ten countries affected by climate disasters in the world, 7 countries seriously threatened the safety of life and property in the countries along the Belt and Road,[5] and restricted the local economic development and the construction of the Belt and Road. The Chinese government attaches great importance to the climate change on construction along the routes, organized by the China Meteorological Administration(CMA) and World Meteorological Organization(WMO). The CMA and WMO signed the letter of intent on promoting regional meteorological co-operation and co-building the Belt and Road, improved the intergovernmental cooperation mechanism, and strengthened safeguards against climate change; enhanced the capacity of climate prediction and assessment for countries along the Belt and Road.[6]

2.1 Demand for remote sensing monitoring of natural environment

Multi-source satellites data are used to monitor the land use and land cover, ecological environment and topography factors which are closely related to the climate in the countries along the Belt and Road, so as to monitor environment by satellites in the countries along the routes. We should make full use of meteorological satellites and Gaofen(GF) satellites to conduct monitoring of human activities and ecological damage caused by human activities in vulnerable areas of the ecological environment in countries along the routes. According to the data, the land use and land cover, development intensity, pollution degree and other information of the damaged environment can be identified, and the problems causing significant ecological environment changes can be identified.

2.2 Requirements of meteorological environmental quality assessment

Based on the data of meteorological and other multi-source satellites data, the environmental assessment for atmospheric quality, soil quality and vegetation quality are carried out. The climate and environmental quality data in the countries along the Belt and Road are analyzed, and the meteorological quality assessment reports are generated to provide data support for the infrastructure construction along the routes. According to report, the meteorological contribution rate of the country is calculated. Meteorological elements are added to the environmental assessment and audit of countries along the routes to scientifically and objectively measure their achievements in ecological protection, to promote China and the countries along the Belt and Road to complete the green construction of national independent contributions.

2.3 Climate forecast requirements

Infrastructure constructors need to make construction plans, so predicting climate change is essential. The phenomenon of abrupt climate change is an emerging research field in modern climatology. Regarding the prediction problem, we need historical data and choose a good prediction model. Based on the data of high temperature heat wave, low temperature freezing, fire, drought, rainstorm, typhoon and other natural disasters in the countries along the Belt and Road, this paper establishes a long series of historical datasets, analyzes the datasets, and evaluates the impact degree and development trend of
natural disasters used deep learning theory. According to the satellite and radar data, short-term monitoring and prediction of near climate disaster and sudden environmental pollution events are conducted to provide decision support for disaster prevention.

3. Measures to enhance the meteorological service capacity of the Belt and Road

The general idea of this paper is to use satellite, cloud computing, big data, geographic information system and other technical means to improve the ability of meteorological services, and to carry out all-weather and full coverage monitoring and assessment of meteorological in countries along the Belt and Road. Through the multi-source satellite remote sensing monitoring data, the dynamic climate change situation in the countries along the route can be monitored in the real time, the possibility and risk of natural disasters can be assessed timely, and meteorological services can be provided by comprehensive and objective information, so as to promote the healthy and orderly development of national ecological and environmental protection. The meteorological support service capacity will be improved from the following four aspects.

3.1 Construction of integrated sky and ground monitoring system

The advantages of satellite, such as wide coverage, large amount of data and long-term dynamic monitoring, are one of the important means to realize the integration of sky and ground system. However, the disadvantages of satellite, such as low resolution and long return period will affect climate assessment, while airborne remote sensing can make up for these disadvantages.[7] It can also play an important role in environment monitoring and early warning, environmental emergency and other fields. To realize the sky-ground integrated monitoring system, the support of the ground monitoring data is indispensable. The ground monitoring data can greatly improve the effectiveness of meteorological satellite and ensure the accuracy of observation and analysis results. It is necessary to build a monitoring system based on space remote sensing, supplemented by airborne remote sensing and verified by the ground observation network.

At present, China has the ground systems of eight Fengyun(FY) [8] meteorological satellites, including four FY-2(E/F/G/H) [8] stationary meteorological satellites, one FY-4A[8] stationary meteorological satellite and three FY-3(B/C/D) [8] polar meteorological satellites. China has also set up agricultural meteorological experimental stations, solar radiation observation stations and a large number of conventional meteorological elements observation stations.[9] These resources, especially the ground monitoring network, are huge advantage. We should make full use of these resources, expand satellite data, increase airborne monitoring capabilities, improve the ground monitoring station network, and build an integrated sky and ground monitoring network to improve the capacity of climate monitoring.

3.2 Meteorological forecast for countries along the Belt and Road

Countries along the Belt and Road are generally highly sensitive and vulnerable to climate change. However, it is undeniable that the construction of the "Belt and Road" involves a wide range of regions and fields, and the amount of investment is huge. Moreover, most countries and regions along the "Belt and Road" are in the process of rapid economic and social development, so lack of real-time monitoring[10] and forecasting[11] research on climate change. China is one of the few countries with climate prediction system[12], month dynamic prediction and seasonal climate prediction model system. It plays an important role in the global climate prediction information exchange, and provides the main reference for the east Asian regional climate predictions. In order to cooperate with countries along the routes to tackle climate change, it is most important to know the reality of climate change in countries along the Belt and Road. The Institute of Atmospheric Physics of University of Chinese Academy of Sciences has carried out systematic research on the forecasting of climate change. The main characteristics of future climate change at local, sub-regional and regional scales have been clarified. These data are integrated and analyzed, combined with relevant model, forecast the climate change on the regional scale.
3.3 Meteorological service platform

Based on multi-source satellites data and in close cooperation with local meteorological departments, a meteorological service platform has been established to provide basis for local scientific decision-making. In recent years, the National Climate Center of China has focused on the characteristics of climate disasters in different countries along the Belt and Road. The Belt and Road International Earth Environment Research Center, University of Chinese Academy of Sciences has been cooperating with countries along the routes to carry out research on climate and environmental changes.[6] Preliminary research results have been obtained on the characteristics, rules and impacts of climate and environmental changes in different time scales of countries along the Belt and Road. According to the principle of "refinement, systematization and specialization", a meteorological service platform was formed, which was piloted in China, and evaluated whether the functions of platform is perfect, and then popularized used in countries along the Belt and Road.

4. Summary and prospects

Building a monitoring system based on space remote sensing, supplemented by airborne remote sensing and verified by the ground observation network, can realize the real-time monitoring of sky and ground, to ensure the construction quality and personnel safety. Combined with the climate data over years and inputting appropriate models, climate change can be predicted by providing technical support for the cooperation of countries along the Belt and Road routes to deal with climate change. The meteorological satellite will play a significant role in ensuring the construction quality.[13]

In a word, cooperation with countries along the Belt and Road to address climate change fully embodies the purposes of the UN 2030 agenda for sustainable development and the Paris Agreement on climate change. All Countries should seize the opportunities brought about by joint cooperation to achieve mutual benefit and win-win results. In the current complex international situation of anti-globalization, we should cooperate with the countries along the Belt and Road in addressing climate change. It not only provides opportunities for the common development and prosperity of the countries along the Belt and Road, but also has important strategic and practical significance in promoting the construction of a community with a shared future for mankind.

At present, tackling climate change is a global governance issue that the international community pays close attention to. Success or failure directly affects the future and destiny of all countries in the world, and is related to the survival and continuity of all mankind. China must take more practical and effective measures to promote the coordination and integration of the Belt and Road construction and global climate governance goals. Only by truly implementing the relevant actions and goals of the Belt and Road and turning the routes into a low-carbon road and a climate-friendly road can we jointly seek a global ecological civilization and realize China's active promotion of the Belt and Road initiative the original intention and vision to contribute Chinese wisdom and power to global climate governance.

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