CSCanada
Higher Education of Social Science
Volume 25, Number 1, 2023, pp. 27-43
DOI:10.3968/13164

ISSN 1927-0232 [Print]
ISSN 1927-0240 [Online]
www.cscanada.net
www.cscanada.org

Application of Gideon Toury's Translation Norms Theory in Translation Teaching With Special Reference to the Post-Editing of the English Version of *High-Quality Development of Meteorology Roadmap (2022-2035)*

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Received 21 May 2023; accepted 15 August 2023
Published online 26 September 2023

Abstract

The current research aims to investigate the practical application of Gideon Toury's Translation Norms Theory in the post-editing of meteorological texts between Chinese and English. Using an empirical approach, the analysis examines the norms, regularities as well as conventions that guide the translation process and how they influence the translation of meteorological texts. The study analyzes a real proofreading task commissioned by the government to determine how translators should apply Toury's norms theory in the post-editing process. The present empirical study shall provide valuable insights into the translation of meteorological texts and highlight the importance of linguistic norms in achieving accurate and effective translations, which could also provide some practical implications for translation teaching and translator training.

Key words: Norms; Translation teaching; Post-editing; Meteorological texts

Wang, W., & Zhou, W. H. (2023). Application of Gideon Toury's Translation Norms Theory in Translation Teaching With Special Reference to the Post-Editing of the English Version of *High-Quality Development of Meteorology Roadmap (2022-2035)*. *Higher Education of Social Science*, *25*(1), 27-43. Available from: URL: http://www.cscanada.net/index.php/hess/article/view/13164
DOI: http://dx.doi.org/10.3968/13164

INTRODUCTION TO THE CURRENT RESEARCH

Gideon Toury's Translation Norms Theory, also known as Descriptive Translation Studies (DTS), is a prominent framework in translation studies that focuses on the descriptive analysis of translated texts and the norms that shape the translation process. Developed by Israeli translation scholar Gideon Toury (1974, 1976, 1979) in the 1970s, this theory offers a comprehensive approach to understanding translation as a social and cultural phenomenon. In the paper "Translated Literature: System, Norm, Performance: Toward a TT-Oriented Approach to Literary Translation" presented at *Synopsis 1*: "Translation Theory and Intercultural Relations" held at Tel Aviv University, Toury (1981) formally presented and elaborated the notion and function of "translation norms" in a "TT-oriented approach." Following a descriptive approach, Toury (1995) argues that intersubjective factors embedded in the culture of target texts could be regarded as a set of norms, which is a fundamental concept in Toury's translation theory system. In Toury's (Ibid) opinion, the significance of a norm relies on the system in which it is rooted. The identification and analysis of translation norms largely depend on actual patterns in some sort of target culture. Thus it somehow implicates that the concept of norm is a set of dynamic regularities instead of a fixed and obligatory law. Translation Norm Theory challenges the traditional approach to translation, which often upholds an idealistic and prescriptive notion of translating texts. Instead, Toury argues that translators are influenced by a set of norms that are shaped by various factors, such as social, cultural, historical, and ideological contexts. These norms act as guidelines or conventions that determine the choices made by translators during the translation process. Constraints can be described using a scale with two extremes: rules and idiosyncrasies. Norms are positioned between the two extreme requirements. Thus, norms form a graded continuum: some are stronger and closer to norms, while the weaker norms are close to idiosyncrasies. Toury (1995) classifies two larger groups of norms of translation: preliminary norms and operational norms; similarly, norms could also be divided into basic (primary) norms and secondary norms (or tendencies). According to Toury, the art of translation involves a set of norms, upon which translators often adjust their choices in specific contexts. Thus norms are not fixed or universal; they are context-dependent and subject to change over time. Translators are not passive agents but active participants who adhere to, negotiate, and potentially challenge these norms in their translation practice. Norms can be observed at different levels, such as the decision-making process, the linguistic choices made, the target text's structural organization, and the interaction between translators and the target audience. One key aspect of Toury's theory is the concept of "initial norms" (general decision-making considerations/strategy) and "operational norms" (real techniques in translating). Initial norms represent the translator's pre-existing knowledge, assumptions, and expectations about translating a given text. These norms are influenced by the translator's training, education, and exposure to certain translating practices. On the other hand, operational norms are the norms that emerge during the translation process itself, taking into account the specific constraints and possibilities faced by the translator. Norms in Translation Theory are not limited to linguistic aspects but also encompass cultural issues, power dynamics, and ideological considerations. Translators may consciously or unconsciously conform to these norms due to the expectations of the target audience, publisher requirements, or the desire to achieve equivalence between the source and target texts. Toury's Translation Norm Theory has significantly influenced the field of translation studies. It emphasizes the importance of understanding translation as a product of social and cultural influences rather than a mere linguistic transfer. By studying translation norms, researchers and practitioners gain insight into the complexities of translation and the multiple factors that shape the translator's choices. This approach has opened up avenues for the analysis of translated texts from diverse perspectives and has contributed to a more nuanced understanding of translation as a dynamic and multifaceted practice. However, other scholars keep challenging Toury on the practical application of Norms Theory – "… we might usefully learn that our descriptions of norms – be they those of Descriptive Translation Studies or of some kind of more critical theory – are far from neutral. When we describe, we immediately participate" (Pym 1998). Pym and Toury may have different approaches to translation studies, with Pym advocating for a particular methodology or theoretical framework that differs from Toury's. Pym may challenge Toury's ideas in order to promote his own approach or to highlight what he sees as limitations or flaws in Toury's methodology. While the current study still holds that at least "operational norms" (Toury 1995) could provide some real implications for post-editing of Chinese-English translation.

With the advancement of machine translation (MT) technologies, post-editing has emerged as a crucial step in the translation workflow. Post-editing (cf. O'Brien 2005, 2010, 2014; Huang et al. 2014; Vieira 2014) refers to the process of reviewing and editing machine-translated content to ensure its accuracy, fluency, and adherence to the target language's linguistic and cultural norms. Previous research in the field of post-editing has focused on various aspects, including the quality of machine translation output, the role of post-editors, and the impact of post-editing on translation productivity and efficiency. These studies have provided valuable insights into the benefits and challenges of post-editing, leading to the development of best practices and guidelines for post-editors. One area of research has been the evaluation of machine translation quality and its impact on post-editing. Studies have examined different evaluation metrics, such as BLEU (Bilingual Evaluation Understudy), to assess the accuracy and fluency of machine-translated content. These evaluations help identify the strengths and weaknesses of MT systems, enabling post-editors to focus on specific areas that require improvement. Another area of research has explored the role of post-editors and their expertise in the post-editing process. Post-editors play a critical role in ensuring the final translation meets the desired quality standards. Their linguistic and cultural knowledge, along with their ability to understand the source text and its context, enables them to make informed decisions during the editing process. Research has highlighted the importance of training and continuous professional development for post-editors to enhance their skills and expertise. Practical applications of post-editing can be found in various domains, including technical, legal, medical, and marketing translations. In technical translations, post-editing ensures that complex technical terms and concepts are accurately conveyed in the target language. Legal translations require post-editors to ensure the translated content adheres to legal terminology and maintains the intended legal meaning. Medical translations demand precision and accuracy to ensure patient safety and effective communication between healthcare professionals. In marketing translations, post-editing ensures that the translated content effectively conveys the intended message and resonates with the target audience. Post-editing offers several benefits, including increased translation productivity, reduced costs, and improved translation quality. By leveraging the strengths of machine translation and combining it with human expertise, post-editing allows for faster turnaround times while maintaining high-quality translations. It also enables translators to focus on more creative and challenging aspects of their work, such as adapting the content to the target audience and ensuring cultural appropriateness. Post-editing is a crucial process in Chinese-English translation that involves revising and refining machine-translated content to ensure accuracy, fluency, and overall quality. As advancements in machine translation technology continue to evolve, post-editing has become an essential step in the translation process, enabling human translators to optimize the output generated by automated translation systems. Chinese-English translation poses unique challenges due to the significant linguistic and cultural differences between the two languages. Machine translation systems, although constantly improving, often struggle with accurately capturing the nuances, idiomatic expressions, and context-specific meanings that are characteristic of both Chinese and English. This is where post-editing comes into play, serving as a bridge between the limitations of machine translation and the high standards of human translation. The application of post-editing in Chinese-English translation involves several key aspects. Firstly, the post-editor must possess expert knowledge of both Chinese and English languages, as well as a deep understanding of the cultural, social, and technical contexts of the content being translated. This ensures that the final output reads naturally and accurately, without compromising the intended meaning of the source text. During the post-editing process, the translator carefully examines the machine-generated translation, comparing it to the original text, and making necessary revisions to improve the overall quality. This includes correcting grammatical errors, improving sentence structure, adjusting vocabulary choices, and eliminating inconsistencies. Post-editing also involves adapting the translated content to suit the target audience and ensuring that it conforms to specific style guidelines or industry-specific terminologies. Post-editing is a process where a human translator reviews and edits machine-translated content to improve its quality and accuracy. It has become an essential tool in translation teaching and translator training due to the increasing use of machine translation (MT) systems in the translation industry. Practical applications of post-editing in translation teaching and translator training are presented as follows. Firstly, post-editing provides an opportunity for translation students and trainee translators to refine their translation skills. By working with machine-translated content, they can analyze and compare the output with their own translations, identifying errors, inconsistencies, and areas for improvement. This process helps them develop a critical eye and improve their translation abilities. Second, post-editing could bridge the gap between theory and practice: Translation theory and practice often differ, and post-editing helps bridge this gap. Students and trainee translators can apply the theoretical knowledge they have acquired in their translation courses to real-world scenarios. By post-editing machine-translated content, they gain practical experience and understand the challenges and complexities of working with MT systems. Thridly, post-editing exposes translation students and trainee translators to different MT systems and their functionalities. They learn how to use various translation tools and software, understand the strengths and limitations of different MT engines, and become familiar with the specific requirements of post-editing. This knowledge is valuable in the translation industry, where MT is increasingly used. Post-editing requires translators to adapt their translation strategies and approaches to the machine-translated content. They need to understand the context, intended meaning, and style of the source text, and make appropriate edits to ensure the final translation is accurate and natural. This process helps students and trainee translators develop adaptability and flexibility in their translation work. It also involves reviewing and revising machine-translated content to ensure its quality. Translation students and trainee translators learn how to identify and correct errors, improve fluency, and maintain consistency in terminology and style. These skills are crucial for producing high-quality translations and meeting client expectations. Post-editing teaches translation students and trainee translators how to collaborate effectively with MT systems. They learn how to leverage the strengths of MT, such as speed and efficiency, while mitigating its weaknesses. This collaboration helps them understand the role of MT in the translation process and how to optimize its use to enhance productivity. What's more, post-editing is an essential skill in the translation industry, and training in this area enhances the employability of translation students and trainee translators. By gaining expertise in post-editing, they become more competitive in the job market and can offer specialized services to clients who require post-editing of machine-translated content. To sum up, post-editing plays a crucial role in translation teaching and translator training. It enhances translation skills, bridges the gap between theory and practice, familiarizes students with MT technology, develops adaptability and flexibility, improves quality control and revision skills, promotes collaboration with MT systems, and contributes to professional development. By incorporating post-editing into translation curricula and training programs, educators can prepare students and trainee translators for the evolving demands of the translation industry.

As the demand for translation continues to grow, post-editing will remain a crucial component in ensuring the highest quality translations in the Chinese-English language pair. The authors of the present research received the special task of proofreading and post-editing of *Qi xiang gao zhi liang fa zhan gang yao (2022-2035)* from Publicity Department of the Communist Party of China in December 2022, and it took the authors 20 days to finish the project of post-editing. Thus the post-editing task and the second draft have been used as real teaching material in the spring semester 2023 at BISU. Students were taught the practical application of norms theory as well as necessary operation methods of the software AntConc.

METHODOLOGY AND TRAINING DATA COLLECTION

The current study chooses qualitative as well as quantitative approaches as methodology. We choose *NOOA SATELLITE METEROLOGY AND CLIMATE DIVISION ROADMAP* as the reference text and use AntConc software to extract its word frequency and other data. AntConc is a powerful and versatile software tool widely used in linguistics and text analysis. It can also be beneficial in the field of translation post-editing, which involves reviewing and improving machine-generated translations. The main goal of proofreading of translation is to check the accuracy of translation; make sure that the message in SL (source language) has been accurately conveyed in TL (target language). If it is a machine translation which often is the case, then the goal of proofreading of this kind of translation is also make the final translation grammatically correct and readable. AntConc can assist translators and post-editors in various ways, including identifying patterns, analyzing terminology, and improving text coherence. This discussion will explore the practical application of AntConc in translation post-editing, including its origin, case analysis, and feasibility. AntConc, short for "Ant Concordance," is a software program developed by Laurence Anthony, a linguist and professor at Waseda University in Japan. It was created to facilitate the analysis of large textual corpora by providing tools for concordancing, word frequency analysis, and text processing. Originally designed for linguistic research, AntConc has found applications in various fields, including translation and language processing. The current study lists some practical ways in which AntConc might be applied in the translation post-editing process: 1) Concordancing for terminology consistency: Translators can use AntConc to search for specific terms or phrases in the source text and the machine-generated translation. This helps in identifying instances where the machine translation system may have used inconsistent terminology. Translators can then make necessary corrections for terminological consistency; 2) Collocation analysis: AntConc can identify word collocations (words that frequently appear together) in both the source text and the machine translation. This helps post-editors ensure that collocations in the target language align with natural language usage, improving text fluency; 3) Frequency analysis: Translators can analyze word frequency lists to identify overused or underused terms in the translated text. This analysis can help maintain the appropriate balance of vocabulary in the target language; 4) Stylistic consistency: AntConc can be used to analyze the style of the source text and ensure that the machine-generated translation aligns with the intended style and tone. This is particularly important in fields like marketing or literature, where style plays a significant role; 5) Parallel text comparison: AntConc allows users to compare the translated text with a reference translation or a parallel text in the same domain. This helps in verifying the quality and consistency of the translation and ensures that the post-edited version is accurate and contextually appropriate. We also use AntConc to extract the first draft's corresponding data and compare it with NOOA's *Roadmap*. Thus the data differences provide us detailed "operational norms" in the post-editing process.

STATISTICAL DATA ANALYSIS

The general distribution of word classes in contemporary English texts can vary depending on the specific text and its genre. However, we can provide a rough estimate based on the typical distribution in English language corpora -- nouns are the most common word class in English texts as they represent people, places, things, and ideas. They generally account for around 25-30% of the words in a text; Verbs represent actions, states, or occurrences. They usually make up around 15-20% of the words in English texts; Adjectives describe or modify nouns. They typically constitute around 5-10% of the words in a text; Adverbs modify verbs, adjectives, or other adverbs. They generally make up around 5-10% of the words in English texts; Pronouns are used to replace nouns. They usually account for around 5-10% of the words in a text; Prepositions show relationships between words. They typically constitute around 5-10% of the words in English texts; Conjunctions connect words, phrases, or clauses. They generally make up around 5-10% of the words in a text; Determiners introduce or specify nouns. They usually account for around 5-10% of the words in English texts; Interjections express strong emotions or reactions. They typically constitute a small percentage (less than 5%) of the words in a text. A corpus of meteorological texts translated from Chinese into English is analyzed to identify the norms and conventions that guide the translation process. The first English version are analyzed using several criteria, including the accuracy of technical terminology, the use of idiomatic expressions, and the overall readability of the translation. By comparing the word class distribution differences (as illustrated in Table 1 and Table 2) in NOOA's *Roadmap* and the first English version, we obtain the preliminary norms for the post-editing.

Table 1
Word class distribution in *NOOA SATELLITE METEROLOGY AND CLIMATE DIVISION ROADMAP*

Content word	Noun	61%	78%
	Verb	7%	
	Adjective	9%	
	Adverb	1%	
Function word	Auxiliary Verb	3%	22%
	Preposition	10%	
	Article	3%	
	Conjunction	4%	
	Pronoun	1%	
	Possessive 's	1%	

Table 2
Word class distribution in *1st draft*

Content Word	Noun	45%	83%
	Verb	14%	
	Adjective	24%	
	Adverb	0%	
Function Word	Auxiliary Verb	2%	17%
	Preposition	9%	
	Article	3%	
	Conjunction	3%	
	Pronoun	0%	
	Possessive ’s	0%	

Thus in our post-editing process, we take the differences in mind and try to make the second version’s data close to NOOA’s *Roadmap*. The nouns used by NOOA’s *Roadmap* also provide direct references for the second English version. The frequent distributionf noun phrases (NPs) in NOOA’s Roadmap implicates that the meteorology-realted texts are rather static than dynamic, which is an obvious operational norm in our post-editing process. We replaced the original verb phrases (VPs) with NPs in the second draft. The data in Table 3 is closer to NOOA’s *Roadmap*. Furthermore, the nouns used in our edited version are more adequtely selected compared with the 1st draft, which are shown in Table 4.

Table 3
Word class distribution in *2nd draft*

Content Word	Noun	50%	82%
	Verb	8%	
	Adjective	24%	
	Adverb	0%	
Function Word	Auxiliary verb	2%	18%
	Preposition	10%	
	Article	3%	
	Conjunction	2%	
	Pronoun	1%	
	Possessive ’s	0%	

Table 4
Distribution of nouns in NOOA’s *Roadmap*, the first draft, and the second draft

Ranking	Nooa Roadmap	1ST Draft	2Nd Draft
1	satellite	services	services
2	data	system	system
3	smcd	climate	climate
4	products	weather	development
5	noaa	development	support
6	climate	monitoring	disaster
7	weather	disaster	monitoring
8	ozone	disasters	science
9	quality	meteorology	weather
10	research	science	meteorology
11	observations	forecasting	service
12	roadmap	mechanism	mechanism
13	npoess	service	China
14	system	capacity	quality
15	air	warning	technology
16	instruments	key	security
17	models	innovation	areas
18	surface	quality	data
19	aerosol	technology	disasters
20	algorithms	areas	key
21	development	China	resources
22	water	data	warning
23	snow	modification	forecasting
24	microwave	observation	innovation
25	instrument	developed	meteorologists
26	monitoring	research	modification
27	assimilation	security	operation
28	program	information	change
29	sounder	resources	information
30	vegetation	risk	production
31	satellites	meteorologists	protection
32	temperature	operation	supply
33	precipitation	projects	management
34	airs	supply	power
35	information	production	risk
36	forecast	protection	talent
37	cloud	transport	technologies
38	earth	application	transport
39	goal	construction	belt
40	nwp	forecasts	capacity
41	product	management	community
42	radiation	platform	construction
43	calibration	power	observation
44	forecasts	prediction	projects
45	applications	talent	regions
46	carbon		research
47	infrared		river
48	measurements		water
49	science		wind
50	scientists		application
51	branch		
52	hazards		
53	jcsda		
54	systems		
55	goals		
56	project		
57	wind		
58	division		
59	metop		
60	model		
61	prediction		

DISCUSSION

The benefits of referring to parallel texts in target-language as opertaional norms in post-editing are numerous. Firstly, it significantly reduces the time and effort required to translate large volumes of content. By using machine translation (e.g. GPT, DeepL, Google Translate, etc.) as a starting point, translators can focus on refining and polishing the translation, rather than starting from scratch. This ultimately leads to increased productivity and faster turnaround times. Additionally, post-editing allows for consistent and high-quality translations across various projects. By developing a glossary and style guide specific to each client or subject area, post-editors can ensure consistency in terminology and writing style, resulting in a cohesive and professional translation output. Moreover, post-editing helps improve the accuracy and reliability of machine translation systems. By analyzing and correcting errors made by the machine, translators provide valuable feedback that can be used to refine and enhance the performance of automated translation tools. This iterative process facilitates continuous improvement and better alignment between machine translation and human translation. Therefore, post-editing plays a vital role in Chinese-English translation by bridging the gap between machine-generated translations and human expectations. It combines the efficiency of machine translation with the linguistic expertise and cultural understanding of human translators to produce accurate, fluent, and contextually appropriate translations. The feasibility of using AntConc in translation post-editing depends on several factors: 1)Text size: AntConc is most effective when dealing with larger texts or corpora. For shorter texts or individual sentences, its utility may be limited; 2) Technical proficiency: Translators and post-editors need to be familiar with the software and its features to use it effectively. Training may be necessary for those who are new to AntConc; 3)Availability of source materials: The quality and availability of the source materials, including the machine-generated translation and any reference texts, are crucial for meaningful analysis; 4)Time constraints: While AntConc can enhance the quality of post-editing, it may also add time to the process. Post-editors need to balance the benefits of using the tool with project deadlines.To sum up, AntConc can be a valuable tool in the translation post-editing process, aiding in terminology consistency, collocation analysis, stylistic alignment, and quality assurance. Its feasibility depends on factors such as text size, user proficiency, source materials, and project timelines. Data analysis by AntConc reveals that NOOA's *Roadmap* has applied a huge amount of nouns in describing meteorological technology and phenomena. Thus we could consider that this kind of genre is quite static instead of dynamic compared with liteary genres. Passive voice is also widely applied in NOOA's *Roadmap*, which provides applicable operational norms in our post-editing process. The translators simply copied the word "roadmap" and replaced the word "guidelines" in the first draft. All these operations show that Toury's argumentation of "operational norms" could offer some necessary tips in post-editing process.

IMPLICATIONS FOR TRANSLATION TEACHING AND TRANSLATOR TRAINING

Translation norms theory provides a useful framework for understanding and addressing the challenges of meteorological text translation between Chinese and English. The application of this theory facilitates the identification of translation norms and the development of strategies that ensure accurate and effective translation. The case study presented in this essay highlights the importance of the pragmatic norm, the textual norm and the communicative norm in meteorological text translation, and provides practical insights into this field. Further research can examine the application of other translation theories and explore the impact of recent technological advancements on meteorological text translation. Toury's translation norms theory suggests that translation is not a purely linguistic activity but is influenced by various norms, both external and internal. External norms refer to the expectations and requirements of the target culture, while internal norms are the translator's own preferences and strategies. Translation norms theory has several implications for translation teaching and translator training: first, teaching translation based on Toury's theory helps students understand that translation is not a mechanical process but involves making choices based on norms. Students learn to identify and analyze the norms that govern translation in different contexts, which enhances their understanding of the target culture and improves their translation skills. Secondly, Toury's theory emphasizes the importance of considering the target culture's norms. Translation teaching should focus on providing students with the necessary knowledge and skills to adapt the source text to the target culture's expectations. This involves understanding cultural references, idiomatic expressions, and other aspects specific to the target language. Translation norms theory encourages translators to critically evaluate the norms they encounter and make conscious decisions about adhering to or deviating from them. Translation teaching should foster critical thinking skills, enabling students to question and challenge norms when necessary. This helps them develop their own translation strategies and style. Post-editing refers to the process of revising machine-translated texts. Translation norms theory suggests that post-editing should not be seen as a simple correction task but as an opportunity to apply translation norms and improve the quality of the final product. Translator training should include post-editing techniques and strategies to ensure that translators can effectively revise machine-generated translations. Norms theory highlights the ethical dimension of translation, as translators must navigate between external norms and their own preferences. Translation teaching should emphasize the importance of ethical decision-making, including issues such as fidelity to the source text, cultural sensitivity, and respect for the target audience. The application of norms theory in post-editing could promote a more nuanced understanding of translation as a complex and context-dependent activity, enabling students to develop the necessary skills and knowledge to produce high-quality translations.

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Appendix Comparison between the 1st and 2nd English versions

1st Draft

The Guidelines on High-quality Development of Meteorology (2022-2035)

Based on science and technology, meteorology serves the fundamental interest of the public. Since the 18th National Congress of the Communist Party of China (CPC) in 2012, under the strong leadership of the CPC Central Committee with Comrade Xi Jinping at its core, relevant authorities in every region of China have launched unremitting efforts to promote the development of meteorology, resulting in remarkable success. In the context of global warming, weather and climate extremes have increased in frequency and intensity in China. Seeking to balance development and security imperatives at the same time generates increasing demands for preparedness against meteorological disaster risks, and the people's needs for meteorological services to support improved lifestyles have become increasingly diverse. The Guideline was formulated to accelerate the high-quality development of meteorological services to meet the needs of new circumstances and deliver on the decisions of the CPC Central Committee and the State Council of China.

I. General Requirements

(1) Guiding principle

Guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, we will foster a new development paradigm by applying a new vision of development. The focus is on meeting major national needs, safeguarding people's life and production, and exploring international scientific frontiers. To provide high-quality and modern meteorological services, we will follow the innovation-driven and demand-driven trajectory with the synergy of various sectors. We will aim for a modern meteorological system that features forerunning science and technology, sophisticated monitoring, precision forecasting, tailored services, and public satisfaction by highlighting the role of meteorology at the frontline of disaster prevention and mitigation. It supports safe life, robust production, affluent living, and sound ecology on all fronts, meeting people's ever-growing needs for a better life and providing strong support for ecological conservation, building China into a great modern socialist country in all respects, and realizing the Chinese Dream of national rejuvenation.

(2) Development goals

By 2025, the key and core meteorological technologies will be mastered, accompanied by a more robust system of modern meteorology encompassing technological innovation, service delivery, operation, and management. Besides, capabilities will be enhanced to deliver sophisticated monitoring, precision forecasting, and tailored services. All these efforts will lead to improved supply and equal access to meteorological services, lifting modern meteorology to a new level.

By 2035, major breakthroughs will be made in key meteorological science and technology fields to enable China to lead the world in meteorological monitoring, forecasting, and service delivery, improve its international competitiveness and influence, and realize meteorological modernization featuring smart operation. Meteorology will be deeply integrated with various sectors of the national economy thanks to a more coordinated mechanism for meteorological development. We will put in place a more sophisticated monitoring system with optimized structure and advanced functionality, deliver a more precision and seamless forecasting system for all, and increase coverage and benefits of meteorological services to the public satisfaction.

II. Enhancing Innovation Capacity in Meteorological Science and Technology

(3) Accelerating research on key and core technologies

The medium and long-term development plan on meteorological science and technology will be implemented by incorporating major meteorological core technologies into the national science and technology programs (projects and funds) to ensure focused research support. Basic research will be stepped up on weather mechanisms, climate patterns, climate change, occurrence of meteorological disasters, and interaction between multiple spheres of the Earth system. To seek technological breakthroughs, stronger scientific research will be performed in fields of numerical prediction of the Earth system, severe weather prediction, climate change, weather modification, and meteorological equipment. Atmospheric scientific experiments on rainstorms, severe convective weather, monsoons, typhoons, the Qinghai-Tibet Plateau, and oceans will be carried out while fostering deep integration and application of artificial intelligence (AI), big data, and quantum computing to meteorology. China will contribute to in-depth international cooperation in meteorological science and technology through heading up international mega-science programs and projects in fields related to the Earth system and climate change.

(4) Building meteorological science and technology innovation platforms

Regional capacity to perform meteorological research on oceans, the Qinghai-Tibet Plateau, deserts, and other areas will be increased by enhancing the strength and excellence of key national severe weather laboratories and seeking to develop a meteorological science and technology innovation platform and the capacity to produce major meteorological equipment and meteorological satellites to study rainstorms and typhoons. Steady steps will be taken for national meteorological field scientific observation and research stations, with an array of meteorological field scientific experiment bases to be set up in key regions. The scientific and technological innovation capacity of meteorological research institutions will be enhanced and new technological innovation alliances that bring together research institutions and the meteorological industry will be explored as part of a doubling plan for meteorological science and technology.

(5) Improving the system and mechanism for innovation in meteorological science and technology

A mechanism of joint efforts to tackle key technological problems like numerical prediction will be set up to facilitate integrated allocation of projects, talent, and funds in key meteorological fields. The organization and management of meteorological science and technology projects will be improved, including the practice of "an open competition mechanism to select the best candidates to lead research projects". The reform of meteorological research institutes will be facilitated by giving more autonomy to researchers. We will adopt differentiated methods to assess meteorological scientific and technological achievements, while giving incentives to technology commercialization and innovation, and putting in place a research integrity system.

III. Strengthening the Basic Meteorological Capacity Building

(6) Developing a sophisticated meteorological monitoring system

In accordance with the relevant plan for a coherent layout, joint efforts will be made to deploy a national weather, climate and climate change, specialized and space meteorological observation network to serve as a sophisticated and efficient meteorological monitoring system based on integration and coordination of land, sea, air and space. Meteorological satellite and radar systems will continue to be improved to strengthen the comprehensive application of remote sensing and make a robust analysis of frequency use demand and its related verification. Global meteorological monitoring will be strengthened to better obtain and share global meteorological data. The development of high-precision and intelligent meteorological observation equipment will feature localization and iterative upgrading to improve measurement, calibration, testing, and the verification system. Various meteorological observation facilities will be built in a sound and intensive way, and the quality management system of meteorological observation will be improved. Social meteorological observation activities will be encouraged and regulated.

(7) Developing a precision meteorological forecasting system

The capacity of the CMA Earth System Modeling and Prediction Center (CEMC) will be expanded over time to develop its own controllable Earth System Numerical Prediction Model that features precision prediction capability to produce warning of local severe weather with a lead time of one hour, generate weather forecasts with a lead time of one day, make notice of severe weather forecasts with a lead time of one week, provide major weather process forecasts with a lead time of one month, and predict global climate anomalies with a lead time of one year. Specialized weather forecasting models for typhoons, oceans, and the terrestrial environment will be improved while the operational system utilizing intelligent and digital forecasting will be enhanced to deliver better weather forecasts for major cities around the world, advance notice of severe weather forecasts, and predictions of major climate events by developing a cooperative, intelligent, and efficient platform for comprehensive meteorological forecasting, prediction, and analysis.

(8) Developing a tailored meteorological service system

The digital and intelligent transformation of meteorological services will be promoted by developing scenario and impact-based meteorological service technologies, devising a platform for big data, intelligent product generation, and release of meteorological services based on media convergence, and developing smart meteorological services that are intelligently analyzed and accurately delivered. Furthermore, an interactive mechanism will be set up to bridge meteorologists and various service recipients to set up meteorological service enabling platforms and crowd innovation platforms for all of society and facilitate efficient application of meteorological information in all fields.

(9) Building a meteorological information support system

To ensure the security of meteorological data, a big data platform for the Earth system will be developed to facilitate information openness and shared growth through collaboration. Improving the regulatory system for acquisition, storage, collection and usage of cross-sectoral and cross-regional meteorological data will lead to the development of high-quality meteorological data sets to ensure improved application and service of meteorological data. The iterative meteorological supercomputer system will be upgraded moderately while a high-speed ubiquitous meteorological telecommunication network is devised with fixed-mobile integration. A digital twin of the atmosphere will be built to improve atmospheric simulation and analysis. Policies for the property protection of meteorological data will be formulated to strengthen the security of meteorological data resources, information networks, and application systems.

IV. Reinforcing the Role of Meteorology at the Frontline of Disaster Prevention and Mitigation

(10) Improving the monitoring, forecasting and early warning of meteorological disasters

With the principle of people first and life first in mind, the hazard and sector-based monitoring, forecasting, and early warning systems for meteorological disasters will be improved to better forecast and warn of extreme weather and climate events and meteorological risks such as floods in small and medium-sized rivers, mountain torrents, geological disasters, marine disasters, inundations in basin areas, and forest and grassland fires by improving the national emergency alert system. A meteorological disaster risk assessment and decision information support system will be developed including a meteorological disaster identification and assessment component. Monitoring, forecasting, and warning of space weather disasters such as solar storms and geospace storms will be developed to build the capacity of the National Space Weather Monitoring and Warning Center.

(11) Improving the readiness of all of society against meteorological disasters

A comprehensive risk zoning for meteorological disasters will be carried out on a regular basis, while the formulation of meteorological disaster plans and construction of facilities will be strengthened, with infrastructure standards revised and protection measures optimized according to the potential impact of meteorological disasters. This will improve the readiness and resilience of infrastructure in key regions and sensitive sectors. Procedures governing issuance of meteorological disaster warnings will be formulated in a coordinated manner, and the “green channel” practice to facilitate rapid release of alert about major meteorological disasters will be introduced. Fifth generation mobile communication (5G), community broadcasting, and other technologies will be applied to this end. The “Grid + Meteorology” action will be implemented to manage meteorological disaster risk reduction (DRR) in a grid fashion at community levels of townships, villages, and streets. Public science education on meteorology will be strengthened together with meteorological disaster preparedness drills.

(12) Improving weather modification

The national weather modification development plan will be drafted and implemented to push forward the national, regional and provincial weather modification centers and the national weather modification experiment bases. Besides, safe and efficient weather modification technologies and new operational equipment like high-performance rain enhancement aircraft will be developed to improve weather modification operations such as disaster prevention, mitigation, and relief, eco-environment protection and restoration, support for major national events, and fast responses to major emergencies. The weather modification mechanism and the unified and coordinated weather modification command and operation system will be improved to strengthen the safety management of weather modification operations.

(13) Strengthening the meteorological disaster risk reduction mechanism

Under the principle of hierarchical responsibility and jurisdiction-based management, the meteorological disaster prevention and mitigation system and mechanism will be improved including practices related to the preparation and release of emergency programs and alerts on meteorological disasters. The meteorological disaster warning-led coordination mechanism will be improved to build meteorological support and service capacity for emergency rescue as part of an extreme weather disaster prevention and risk avoidance system. Meteorological disaster readiness will be assessed on a regular basis to ensure implementation of meteorological disaster measures. Management of meteorological disaster risk will be strengthened, and the risk transfer system for meteorological disasters will be improved. The climate feasibility of major programs and key projects will be verified in accordance with law to strengthen meteorological services in support of major national projects.

V. Improving Meteorological Services for High-quality Economic Development

(14) Providing more effective and efficient meteorological services for agriculture

Meteorological services related to agricultural production will be strengthened including application of advanced technologies such as hyperspectral remote sensing and related equipment used in crop condition monitoring to better tailor the prediction of meteorological disasters and grain yield throughout the production process. To support functional grain producing areas, important agricultural production protection areas, and advantageous areas for specialty agricultural products, the capacity to monitor, forecast, and warn about agrometeorological disasters will be expanded while meteorological services for disease and pest control and seed production will be provided. A meteorological risk monitoring and warning system for global food security will be developed while a smart agrometeorological service base will strengthen meteorological services for specialty agriculture production, empowering new agricultural business entities to be covered fully and directly. Climate conditions will be utilized to guide agricultural production and restructuring to strengthen utilization of agricultural climate resources.

(15) Supporting maritime development

Marine meteorological observation capacity will be built by implementing a program to place meteorological observation equipment on platforms like ocean-going ships and large wind farms to promote the sharing of marine and meteorological data. The monitoring, forecasting, and warning of marine meteorological disasters will be strengthened to protect marine ecology, ensure maritime transport safety, develop the marine economy, and safeguard marine rights and interests. Meteorological services for global ocean navigation will be strengthened to provide meteorological information services for important routes and pivots of maritime transport.

(16) Supporting transport development

A modern comprehensive transport meteorological service platform will be developed and deployed to further build capacity for transport-oriented meteorological monitoring, forecasting, and warnings. Transport meteorological services will be specific in terms of hazard, road section, navigation channel, water area, and railway line and strengthened for major projects such as the Sichuan-Tibet Railway, the new land-sea corridor in western China, and the South to North Water Diversion Project, as well as select key water areas. Meanwhile, advisory services on hazardous weather will be strengthened. A multi-modal meteorological logistics service system will be developed to support global commercial trade logistics with meteorological services.

(17) Implementing "meteorology+" enabling action

Meteorological services will be deeply integrated into production, circulation, consumption, and other processes, and improvements will be made in energy exploitation, planning, layout, construction, operation, allocation, storage, and transportation. The forecasting and warning of meteorological disasters that may affect electric power will be strengthened to tailor meteorological services to foster safe operation of power grids and scheduling. Meteorological services will be actively developed to serve finance, insurance, and agricultural futures. Relevant systems and policies will be adopted to promote and regulate the meteorological industry in an effort to unleash vitality of market players.

(18) Serving coordinated regional development

Stronger and better meteorological services will be delivered to support implementation of major regional strategies such as the coordinated development of Beijing, Tianjin, and Hebei, development of the Yangtze River Economic Belt, construction of the Guangdong-Hong Kong-Macao Greater Bay Area, integrated development of the Yangtze River Delta, and ecological protection and high-quality growth of the Yellow River basin. Eastern China will be encouraged to take the lead in achieving high-quality meteorological development, northeastern China will seek breakthroughs, and central and western China will speed up progress in this sector. Essentially, a meteorological service and support system will be in place that aligns with the coordinated regional development strategy.

VI. Refining Meteorological Services for Better Living

(19) Strengthening the supply of public meteorological services (PMSs)

Innovation in supply of PMSs is necessary in terms of delivery. A PMS list will be formed to ensure the long-term effective operation of PMS system. Equal PMSs will be facilitated by building more dissemination channels, providing various media outlets full access to meteorological information and making it more accessible to rural, mountainous, island, and remote areas and groups like the elderly and the disabled, thanks to a wider coverage of meteorological services.

(20) Strengthening meteorological services for high quality of life

Meteorological services will be personalized and customized to be upgraded in quality and diversity. Meteorology will be integrated into digital life to accelerate inclusive application of digital meteorological services. Tourism resources will be developed with an increased supply of meteorological services for travel safety. Meteorological services will better support competitive sports like winter and water sports and national fitness events.

(21) Developing a meteorological service system covering urban and rural areas

Monitoring and warning for urban meteorological disasters will be strengthened based on forecasts by region, period, and intensity by increasing the number of urban meteorological observation stations as planned. In urban planning, construction and operation, meteorological risks and climate resilience will be analyzed to enhance urban climate adaptability and defend against major meteorological disasters. Meteorological services will be processed by an urban data brain that in turn deploys a meteorological service system in support of intelligent management of the urban water supply, power supply, gas supply, heating, flood control and waterlogging drainage, transport, and energy conservation. Meanwhile, rural meteorological disaster prevention and mitigation will be incorporated into the rural construction initiative by introducing a meteorological warning information release and response system covering all administrative villages to further build the capacity of monitoring and warning service delivery in rural areas with high meteorological disaster risk.

VII. Strengthening Meteorological Support for Ecological Conservation

(22) Reinforcing scientific and technological support for climate change response

The monitoring of the impact of global warming on climate-vulnerable areas such as the Qinghai-Tibet Plateau will be improved while the impact of climate change on food security, water security, ecological security, transport security, energy security, and defense security will be assessed and countermeasures reviewed. The assessment of climate resilience will be strengthened by developing an early warning system for climate security, and capacity in climate change risk warning and intelligent decision-making in key regions will be expanded. Monitoring and dynamic tracking and study of greenhouse gas concentration will be promoted to develop a release system for monitored climate change. Meanwhile, scientific assessment of the international climate change response will be stepped up to enhance scientific and technological support for participation in global climate governance.

(23) Promoting rational exploitation of climate resources

The survey, planning, and utilization of climate resources will be pushed forward by devising a system to perform surveying, zoning, monitoring, and unified information release of wind, solar and other climate resources, while reviewing the accelerated construction of relevant monitoring networks. Assessment of resources for wind and photovoltaic power development will be made as part of comprehensive investigation and evaluation of available wind and photovoltaic power generation resources in China. A climate resource monitoring and forecasting system will be devised to improve the accuracy of forecasting related to wind and photovoltaic power generation. We will also build meteorological service bases to support the planning, construction, operation, and scheduling of wind farms and solar power plants.

(24) Supporting ecosystem protection and restoration

The ecological meteorological support project will be implemented to reinforce meteorological services for, among others, major projects protecting and restoring important ecosystems, the red line-based management and control of ecological protection, and evaluation and assessment of ecological conservation targets. The mechanism for eco-meteorological services in key regions such as the "three zones and four belts" (ecological barrier zone of the Qinghai-Tibet Plateau, key ecological zone of the Yellow River, key ecological zone of the Yangtze River, and the northeastern forest belt, northern sand belt, southern hill and mountain belt, coastal belt) and nature reserves. Meteorological services for the coordinated control of multiple pollutants and regional coordinated treatment will be stepped up to better respond to severe pollution and sudden environmental events. The mechanism to realize the value of ecological products will be developed to build climate-smart brands such as meteorological parks, natural oxygen parks, summer resorts, and climate livable places.

VIII. Building a High-caliber Talent Pool for Meteorology

(25) Building teams of high-caliber meteorologists

More support will go to meteorology through national talent programs and awards. Special talent programs will be implemented in the meteorological field to cultivate strategic scientists, scientific and technological leaders, and innovation teams, build a team of young scientific and technical professionals with international competitiveness, and foster high-caliber age diverse meteorologist teams. The system and mechanism to manage talented meteorologists in Beijing-Tianjin-Hebei (BTH), the Yangtze River Delta (YRD), and the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) as well as in major cities with large pools of top-notch human resources should be further reformed to better attract high-caliber meteorologists.

(26) Facilitating talent training for meteorology

Disciplines construction and talent training will be boosted in the field of atmospheric science by encouraging and guiding colleges and universities to set up meteorological disciplines, expand enrollment, optimize the discipline structure, promote interdisciplinary cultivation of meteorologists, and promote integration of basic and applied meteorological disciplines to form a complete training system for high-caliber meteorologists. Talented meteorologists will be supported by the National Program for Basic Researchers, and international cooperation on meteorologist training will be strengthened. Meanwhile, the meteorological education and training system will be reinforced for capacity building of meteorologist teams.

(27) Optimizing the environment for talent cultivation

A meteorologist evaluation system highlighting innovation, values, competence, and contributions will be developed to manage the close link between responsibility, performance, and actual contributions. It will include a distribution incentive mechanism that fully reflects talent value and encourages innovation and creation. Relevant provisions would be followed to distribute benefits arising from research commercialization. In the context of human development coordinated at different levels, in different regions, and in different fields, meteorologists will be supported by local talent programs. College and university graduates will be incentivized to provide meteorological services in central and western regions and in harsh remote areas. We will also reset community posts and deliver on the policy of "targeted evaluation and employment" for technical professionals at local stations to bolster the staffing of meteorologists at community levels. The spirit of scientists and craftsmen will be promoted by increasing the publicity of role models in the field. Organizations and individuals that have made outstanding contributions to high-quality meteorological development shall be commended and rewarded in accordance with relevant provisions of the State.

IX. Facilitating Organization and Implementation

(28) Improving organization

The CPC will play a leading role in facilitating the meteorological development. The working mechanism of inter-agency coordination and engagement between central and local governments will be improved to ensure high-quality meteorological services and guarantee funding and land usage by incorporating meteorological progress into relevant plans. CMA should coordinate, supervise, and inspect the delivery of the Guideline by launching pilot projects and exploring practices that can be replicated and scaled up elsewhere.

(29) Making overall plans

The planned layout and construction of meteorological facilities will be formulated and implemented to facilitate rational allocation, efficient use, and open sharing of meteorological resources. The supply side of meteorological services will be restructured to facilitate an ideal match of supply and demand of meteorological services and diversification of participants therein. An institutional mechanism to serve the overall development of meteorology in relevant sectors will be devised to bring meteorological observation facilities owned and operated by and in various ministries and sectors into the national meteorological observation network to be planned, supervised, and coordinated by the meteorological authority in a unified way.

(30) Strengthening the rule of law

Efforts will be made to improve the framework of meteorological laws and regulations under which meteorological facilities and the environment for meteorological observation will be protected. A unified system for issuing public meteorological forecasts, severe weather alerts, and meteorological disaster warning signals will be implemented, and activities related to weather modification, meteorological disaster defense, climate resource protection and exploitation, and meteorological information services will be regulated. Furthermore, safety supervision of lightning protection and weather modification operations and the framework defining meteorological standards will be improved.

(31) Promoting openness and cooperation

Integrated development of collaboration among enterprises, universities, research institutes and end-users of meteorological science will be deepened, and global services provided by Fengyun meteorological satellites will be strengthened to support countries involved with Belt and Road meteorological services. An open cooperative platform supporting meteorology will be in place to facilitate active participation in formulation and revision of international meteorological rules and standards aligning with the framework of the World Meteorological Organization (WMO) and other authorities.

(32) Ensuring investment

Policy and financial support for high-quality meteorological development will be improved, while meteorological research will be supported by national science and technology programs. The mechanism for upgrading, iteration, operation, and maintenance will be improved to support basic meteorological capacity building at the community level and in underdeveloped regions. We will improve payment for community meteorological professionals that work in harsh and remote areas, while facilitating public engagement in high-quality meteorological development.

2nd Draft

High-quality Development of Meteorology Roadmap (2022-2035)

Based on science and technology, meteorology serves the fundamental interest of the public. Since the 18th National Congress of the Communist Party of China (CPC) in 2012, under the strong leadership of the CPC Central Committee with Comrade Xi Jinping at its core, relevant authorities in every region of China have launched unremitting efforts to promote the development of meteorology, resulting in remarkable success. In the context of global warming, weather and climate extremes have increased in frequency and intensity in China. Seeking to balance development and security imperatives at the same time generates increasing demands for preparedness against meteorological disaster risks, and the people's needs for meteorological services to support improved lifestyles have become increasingly diverse. The Guideline was formulated to accelerate the high-quality development of meteorological services to meet the needs of new circumstances and deliver on the decisions of the CPC Central Committee and the State Council of China.

I. General Requirements

(1) Guiding principle

Guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, we will foster a new development paradigm by applying a new vision of development. The focus is on meeting major national needs, safeguarding people's life and production, and exploring international scientific frontiers. To provide high-quality and modern meteorological services, we will follow the innovation-driven and demand-driven trajectory with the synergy of various sectors. We will aim for a modern meteorological system that features forerunning science and technology, sophisticated monitoring, precision forecasting, tailored services, and public satisfaction by highlighting the role of meteorology at the frontline of disaster prevention and mitigation. It supports safe life, robust production, affluent living, and sound ecology on all fronts, meeting people's ever-growing needs for a better life and providing strong support for ecological conservation, building China into a great modern socialist country in all respects, and realizing the Chinese Dream of national rejuvenation.

(2) Development goals

By 2025, the key and core meteorological technologies will be mastered, accompanied by a more robust system of modern meteorology encompassing technological innovation, service delivery, operation, and management. Besides, capabilities will be enhanced to deliver sophisticated monitoring, precision forecasting, and tailored services. All these efforts will lead to improved supply and equal access to meteorological services, lifting modern meteorology to a new level.

By 2035, major breakthroughs will be made in key meteorological science and technology fields to enable China to lead the world in meteorological monitoring, forecasting, and service delivery, improve its international competitiveness and influence, and realize meteorological modernization featuring smart operation. Meteorology will be deeply integrated with various sectors of the national economy thanks to a more coordinated mechanism for meteorological development. We will put in place a more sophisticated monitoring system with optimized structure and advanced functionality, deliver a more precision and seamless forecasting system for all, and increase coverage and benefits of meteorological services to the public satisfaction.

II. Innovations in Meteorological Science and Technology

(3) Major breakthroughs on core technologies. The medium and long-term goal on meteorological science and technology will be implemented by incorporating major meteorological core technologies into the national science and technology programs (projects and funds) to ensure special support. Basic research will be stepped up on weather mechanisms, climate patterns, climate change, occurrence of meteorological disasters, and interaction between multiple spheres of the Earth system. To seek technological breakthroughs, stronger scientific research will be performed in fields of numerical prediction of the Earth system, severe weather projections, climate change, weather modification, and meteorological equipments. Atmospheric scientific experiments on rainstorms, severe convective weather, monsoons, typhoons, the Qinghai-Tibet Plateau, and oceans will be carried out while fostering integration and application of artificial intelligence (AI), Big Data, and quantum computing to meteorology. China will contribute to wider international cooperation in meteorological science and technology through heading up international mega-science programs and projects in fields related to the Earth system and climate change.

(4) Consructing meteorological science and technology innovation platforms. We will improve research capabilities on oceans, the Qinghai-Tibet Plateau, deserts, and other regions, shore up and develop national key laboratories of severe storms, explore and integrate innovation platforms of crucial meteorological equipments, meteorological satellites, rainstorms as well as typhoons. We will push forward the construction of national meteorological field scientific observation and research stations and meteorological field scientific experiment bases in several key regions. The scientific and technological innovation capacity of meteorological research institutions will be boosted and new technological innovation leagues incorporating research institutions and the meteorological industry will be encouraged as part of the Boosting Plan for meteorological science and technology.

(5) Improving the system and mechanism for meteorological science and technology innovation . A mechanism of joint efforts to tackle key technological problems like numerical prediction will be set up to facilitate integrated allocation of projects, talents, and funds in key meteorological fields. The organization and management of meteorological science and technology projects will be improved, including the practice of "Open Competition Mechanism to Select Best Candidates for Key Research Projects". The reform of meteorological research institutes will be facilitated by providing more autonomy to researchers. We will adopt differentiated methods to assess meteorological achievements, while promoting incentives to technology commercialization and innovation, and establishing a research integrity system.

III. Consolidate the foundation for Meteorological Capacity

(6) Develop a sophisticated meteorological monitoring system

We will follow suit a coordinated plan and make joint efforts to deploy a meteorological observation network targeting nationwide weather, climate, climate change, on-demand meteorological services and space weather, serving as a precise, sophisticated and efficient meteorological monitoring system incorporating the meteorological observation towards land, sea, upper-air and space. We will continue to improve meteorological satellite and radar systems, boost the overall application of remote sensing, analyze the frequency of on-demand use, and make corresponding evaluation. We will continue to develop capabilities for global meteorological monitoring to acquire and share meteorological data with international community. We will develop and upgrade high precision intelligent meteorological observation equipments made in China, and optimize the verification system of the meteorological detection equipment measurement and experiment. We will construct different types of meteorological detection facilities in a scientific and encrypted manner, encourage and regulate meteorological observation activities conducted by civil organizations.

(7) Construct a precision weather forecasting network

Center for Earth System Modeling and Prediction (CEMC) will boost its capacity to develop its own controllable Earth System Numerical Prediction Model which can issue alerts of local severe weather before one hour, provide weather forecasts before 24 hours, make notice of severe weather forecasts before 7 days, provide major weather process forecasts before 30 days, and predict global climate anomalies before 365 days. We will promote on-demand meteorological services, pinpointing forecasts of conditions such as typhoons, oceans and environment. We will improve algorithmic forecasting system, and increase prediction accuracy of weather forecasts for major international cities, severe weather warnings and significant climate events. We will develop a coordinated, intelligent and efficient platform offering weather forecasting, predictions and analysis.

(8) Develop on-demand meteorological service system

The digital and intelligent transformation of meteorological services will be promoted by developing scenario and impact-based meteorological service technologies, devising a platform incorporating big data, production of intelligent products, and release of meteorological services based on media convergence, and developing smart meteorological services featuring intelligent analysis and targeted messaging. Furthermore, an interactive mechanism will be set up to provide an effective communication channel for meteorologists and various service providers. We will explore and construct a new meteorological service platform for the public and small businesses, which will enable the entire society to have access to the meteorological information.

(9) Construct a meteorological information support system

To ensure the security of meteorological data, a big data platform for the Earth system will be developed to facilitate information transparency and shared growth through collaboration. Improving the regulatory system for acquisition, storage, collection and usage of cross-sectoral and cross-regional meteorological data will boost the development of high-quality meteorological data sets to ensure improved application and service of meteorological data. The iterative meteorological supercomputer system will be upgraded moderately while a high-speed ubiquitous meteorological telecommunication network is devised with fixed-mobile integration.

A digital twin of the atmosphere will be built to improve atmospheric simulation and analysis. Policies for the property protection of meteorological data will be formulated to increase the security of meteorological data resources, information networks, and application systems.

IV. Fulfill Meteorology's Responsibilities in Disaster Prevention and Mitigation

(10) Enhance the capabilities of monitoring and predicting meteorological disasters, as well as issuing early warning

We will stick to "the Principle of People First and Life First"and improve the risk-based monitoring, forecasting, and early warning systems targeting meteorological disasters, and increase the prediction accuracy of extreme weather and climate events and meteorological risks such as floods in small and medium-sized rivers, mountain torrents, geological disasters, marine disasters, inundations in basin areas, and forest and grassland fires realized by the upgraded national emergency warning information alert system.. We will construct a meteorological disaster risk assessment and decision information support system including a meteorological disaster identification and assessment standard. We will also develop monitoring, forecasting, and warning systems for space weather disasters such as solar storms and geospace storms. We will enhance the capabilities of the National Space Weather Monitoring and Warning Center.

(11) Enhance social capabilities against meteorological disasters

We will periodically survey and screen the overall risks of meteorological disasters based on geographic differences. We will make and revise meteorological disaster preparedness plans and construct corresponding facilities. We will revise and optimize infrastructure standards and protection measures according to the impact differences of potential meteorological disasters.This will improve the readiness and resilience of infrastructure in key regions and sensitive sectors. Procedures governing issuance of meteorological disaster warnings will be formulated in a coordinated manner, and the "green channel" practice to facilitate rapid release of alert about major meteorological disasters will be introduced. Fifth generation mobile communication (5G), community broadcasting, and other technologies will be applied to this end. The "Grid + Meteorology" action will be implemented to manage meteorological disaster risk reduction (DRR) in a grid mode at community levels of townships, villages, and neighborhoods. Public science education on meteorology will be strengthened together with meteorological disaster preparedness drills.

(12) Improve artificial weathering capabilities

The national weather modification development plan will be drafted and implemented to push forward the national, regional and provincial weather modification centers and the national weather modification experiment bases. Besides, safe and efficient weather modification technologies and new operational equipment like high-performance rain enhancement aircraft will be developed to improve artificial weathering capabilities such as disaster prevention, mitigation, and relief, eco-environment protection and restoration, support for major national events, and fast responses to major emergencies. The weather modification mechanism and the unified and coordinated weather modification command and operation system will be improved to strengthen the safety management of artificial weathering operations.

(13) Accelerate the construction of meteorological disaster reduction and relief mechanism

Under the principle of hierarchical responsibility and jurisdiction-based management, the meteorological disaster prevention and mitigation system and mechanism will be improved including practices related to the preparation and release of emergency programs and alerts on meteorological disasters. The meteorological disaster warning-led coordination mechanism will be improved to build meteorological support and service capabilities for emergency rescue as part of an extreme weather disaster prevention and risk avoidance system. Meteorological disaster readiness will be assessed on a regular basis to ensure implementation of meteorological disaster measures. Management of meteorological disaster risk will be strengthened, and the risk transfer system for meteorological disasters will be improved. We will push forward the verification of major programs and key projects in accordance with law and provide accurate meteorological services for major national projects.V. Provide More Accurate Meteorological Services for Economic Development

(14) Provide more accurate meteorological services for agriculture

Meteorological services targeting agricultural production will be improved, which will include application of advanced technologies such as hyperspectral remote sensing and related equipment used in crop condition monitoring to better tailor the prediction of meteorological disasters and grain yield throughout the production process. To support functional grain producing areas, important agricultural production protection areas, and advantageous areas for specialty agricultural products, the monitoring, forecasting, and warning capabilities against agrometeorological disasters will be enhanced while meteorological services for disease and pest control and seed production will be improved. A meteorological risk monitoring and warning system for global food security will be developed while a smart agrometeorological service base will upgrade meteorological services for specialty agriculture production, empowering new agricultural business entities to be covered fully and directly. Climate conditions will be utilized to guide agricultural production and restructuring to strengthen utilization of agricultural climate resources.

(15) Provide more accurate meteorological services for maritime industry

Maritime meteorological observation capabilities will be increased by implementing a program to place meteorological observation equipment on platforms like ocean-going ships and large wind farms to promote the sharing of marine and meteorological data. The monitoring, forecasting, and warning of marine meteorological disasters will be strengthened to protect marine ecology, ensure maritime transport safety, develop the marine economy, and safeguard marine rights and interests. Meteorological services for global ocean navigation will be strengthened to provide meteorological information services for important routes and harbors of maritime transport.

(16) Provide more accurate meteorological services for transport

A modern comprehensive transport meteorological service platform will be developed and deployed to further build capacity for transport-oriented meteorological monitoring, forecasting, and warnings. Transport meteorological services will be classified according to hazard, road section, navigation channel, water area, and railway line and strengthened for major projects such as the Sichuan-Tibet Railway, the new land-sea corridor in western China, and the South to North Water Diversion Project, as well as select key water areas. Meanwhile, advisory services on hazardous weather will be improved. A multi-modal meteorological logistics service system will be developed to support global commercial trade logistics.

(17) Conduct "Meteorology+" support task

Meteorological services will be deeply integrated into production, circulation, consumption, and other processes, and improvements will be made in energy exploitation, planning, layout, construction, operation, allocation, storage, and transportation. The forecasting and warning of meteorological disasters that may affect electric power will be strengthened to tailor meteorological services to foster safe operation of power grids and scheduling. Meteorological services will be actively developed to serve finance, insurance, and agricultural futures. Relevant systems and policies will be adopted to promote and regulate the meteorological industry to stimulate the meteorological businesses.

(18) Provide more accurate meteorological services for coordinated development in key regions

Stronger and better meteorological services will be delivered to support implementation of major regional strategies such as the coordinated development of Beijing, Tianjin, and Hebei, the Yangtze River Economic Belt, the Guangdong-Hong Kong-Macao Greater Bay Area, integrated development of the Yangtze River Delta, and ecological protection and high-quality growth of the Yellow River basin. Eastern China will be encouraged to take the lead in achieving high-quality meteorological development, northeastern China will seek breakthroughs, and central and western China will speed up progress in this sector. Essentially, a meteorological service and support system will be in place that aligns with the strategy of coordinated regional development.

VI. Provide First-class Meteorological Services to Ensure a Better Life for Chinese People

(19) Increase supply of public meteorological services (PMSs)

We will create a new supply mode of public meteorological services. A PMS list will be formed to ensure the long-term effective operation of PMS system. Equal PMSs will be facilitated by building more dissemination channels, providing various media outlets full access to meteorological information and making it more accessible to rural, mountainous, island, and remote areas and groups like the elderly and the disabled, thanks to a wider coverage of meteorological services.

(20) Strengthening meteorological services for high quality of life

Meteorological services will be personalized and customized to be upgraded in quality and diversity. Meteorology will be integrated into digital life to accelerate inclusive application of digital meteorological services. Tourism resources will be developed with an increased supply of meteorological services for travel safety. Meteorological services will better support competitive sports like winter and water sports and national fitness events.

(21) Developing a meteorological service system covering urban and rural areas

Monitoring and warning for urban meteorological disasters will be strengthened based on forecasts by region, period, and intensity by increasing the number of urban meteorological observation stations as planned. In urban planning, construction and operation, meteorological risks and climate resilience will be analyzed to enhance urban climate adaptability and defend against major meteorological disasters. Meteorological services will be processed by an urban data brain that in turn deploys a meteorological service system in support of intelligent management of the urban water supply, power supply, gas supply, heating, flood control and waterlogging drainage, transport, and energy conservation. Meanwhile, rural meteorological disaster prevention and mitigation will be incorporated into the rural construction initiative by introducing a meteorological warning information release and response system covering all administrative villages to further build the capacity of monitoring and warning service delivery in rural areas with high meteorological disaster risk.

VII. Strengthening Meteorological Support for Ecological Conservation

(22) Reinforcing scientific and technological support for climate change response

The monitoring of the impact of global warming on climate-vulnerable areas such as the Qinghai-Tibet Plateau will be improved while the impact of climate change on food security, water security, ecological security, transport security, energy security, and defense security will be assessed and countermeasures reviewed. The assessment of climate resilience will be strengthened by developing an early warning system for climate security, and capacity in climate change risk warning and intelligent decision-making in key regions will be expanded. Monitoring and dynamic tracking and study of greenhouse gas concentration will be promoted to develop a release system for monitored climate change. Meanwhile, scientific assessment of the international climate change response will be stepped up to enhance scientific and technological support for participation in global climate governance.

(23) Promoting rational exploitation of climate resources

The survey, planning, and utilization of climate resources will be pushed forward by devising a system to perform surveying, zoning, monitoring, and unified information release of wind, solar and other climate resources, while reviewing the accelerated construction of relevant monitoring networks. Assessment of resources for wind and photovoltaic power development will be made as part of comprehensive investigation and evaluation of available wind and photovoltaic power generation resources in China. A climate resource monitoring and forecasting system will be devised to improve the accuracy of forecasting related to wind and photovoltaic power generation. We will also build meteorological service bases to support the planning, construction, operation, and scheduling of wind farms and solar power plants.

(24) Supporting ecosystem protection and restoration

The ecological meteorological support project will be implemented to reinforce meteorological services for, among others, major projects protecting and restoring important ecosystems, the red line-based management and control of ecological protection, and evaluation and assessment of ecological conservation targets. The mechanism for eco-meteorological services in key regions such as the "three zones and four belts" (ecological barrier zone of the Qinghai-Tibet Plateau, key ecological zone of the Yellow River, key ecological zone of the Yangtze River, and the northeastern forest belt, northern sand belt, southern hill and mountain belt, coastal belt) and nature reserves. Meteorological services for the coordinated control of multiple pollutants and regional coordinated treatment will be stepped up to better respond to severe pollution and sudden environmental events. The mechanism to realize the value of ecological products will be developed to build climate-smart brands such as meteorological parks, natural oxygen parks, summer resorts, and climate livable places.

VIII. Building a High-caliber Talent Pool for Meteorology

(25) Building teams of high-caliber meteorologists

More support will go to meteorology through national talent programs and awards. Special talent programs will be implemented in the meteorological field to cultivate strategic scientists, scientific and technological leaders, and innovation teams, build a team of young scientific and technical professionals with international competitiveness, and foster high-caliber age diverse meteorologist teams. The system and mechanism to manage talented meteorologists in Beijing-Tianjin-Hebei (BTH), the Yangtze River Delta (YRD), and the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) as well as in major cities with large pools of top-notch human resources should be further reformed to better attract high-caliber meteorologists.

(26) Facilitating talent training for meteorology

Disciplines construction and talent training will be boosted in the field of atmospheric science by encouraging and guiding colleges and universities to set up meteorological disciplines, expand enrollment, optimize the discipline structure, promote interdisciplinary cultivation of meteorologists, and promote integration of basic and applied meteorological disciplines to form a complete training system for high-caliber meteorologists. Talented meteorologists will be supported by the National Program for Basic Researchers, and international cooperation on meteorologist training will be strengthened. Meanwhile, the meteorological education and training system will be reinforced for capacity building of meteorologist teams.

(27) Optimizing the environment for talent cultivation

A meteorologist evaluation system highlighting innovation, values, competence, and contributions will be developed to manage the close link between responsibility, performance, and actual contributions. It will include a distribution incentive mechanism that fully reflects talent value and encourages innovation and creation. Relevant provisions would be followed to distribute benefits arising from research commercialization. In the context of human development coordinated at different levels, in different regions, and in different fields, meteorologists will be supported by local talent programs. College and university graduates will be incentivized to provide meteorological services in central and western regions and in harsh remote areas. We will also reset community posts and deliver on the policy of "targeted evaluation and employment" for technical professionals at local stations to bolster the staffing of meteorologists at community levels. The spirit of scientists and craftsmen will be promoted by increasing the publicity of role models in the field. Organizations and individuals that have made outstanding contributions to high-quality meteorological development shall be commended and rewarded in accordance with relevant provisions of the State.

IX. Facilitating Organization and Implementation

(28) Improving organization

The CPC will play a leading role in facilitating the meteorological development. The working mechanism of inter-agency coordination and engagement between central and local governments will be improved to ensure high-quality meteorological services and guarantee funding and land usage by incorporating meteorological progress into relevant plans. CMA should coordinate, supervise, and inspect the delivery of the Guideline by launching pilot projects and exploring practices that can be replicated and scaled up elsewhere.

(29) Making overall plans

The planned layout and construction of meteorological facilities will be formulated and implemented to facilitate rational allocation, efficient use, and open sharing of meteorological resources. The supply side of meteorological services will be restructured to facilitate an ideal match of supply and demand of meteorological services and diversification of participants therein. An institutional mechanism to serve the overall development of meteorology in relevant sectors will be devised to bring meteorological observation facilities owned and operated by and in various ministries and sectors into the national meteorological observation network to be planned, supervised, and coordinated by the meteorological authority in a unified way.

(30) Strengthening the rule of law

Efforts will be made to improve the framework of meteorological laws and regulations under which meteorological facilities and the environment for meteorological observation will be protected. A unified system for issuing public meteorological forecasts, severe weather alerts, and meteorological disaster warning signals will be implemented, and activities related to weather modification, meteorological disaster defense, climate resource protection and exploitation, and meteorological information services will be regulated. Furthermore, safety supervision of lightning protection and weather modification operations and the framework defining meteorological standards will be improved.

(31) Promoting openness and cooperation

Integrated development of collaboration among enterprises, universities, research institutes and end-users of meteorological science will be deepened, and global services provided by Fengyun meteorological satellites will be strengthened to support countries involved with Belt and Road meteorological services. An open cooperative platform supporting meteorology will be in place to facilitate active participation in formulation and revision of international meteorological rules and standards aligning with the framework of the World Meteorological Organization (WMO) and other authorities.

(32) Ensuring investment

Policy and financial support for high-quality meteorological development will be improved, while meteorological research will be supported by national science and technology programs. The mechanism for upgrading, iteration, operation, and maintenance will be improved to support basic meteorological capacity building at the community level and in underdeveloped regions. We will improve payment for community meteorological professionals that work in harsh and remote areas, while facilitating public engagement in high-quality meteorological development.