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Applications of the Digital Mapping System (DMS) and the Influence on Climate Change

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Abstract: Recent years have seen a rapid change in climate, which has led to an increase in the number of severe weather-related disasters. The management, on the other hand, has not provided a solution that is adequate to the question of how to avert similar calamities. Because planners, designers, and those in charge of making decisions lack essential meteorological expertise and data, there is currently insufficient consideration given to the influence that DMS will have on the climate. As a direct result of increasing urbanisation, the rate at which climate change is occurring is accelerating, which means that the significance of this problem is growing. The city virtual map system has the potential to serve as a convergence point for virtual and climate systems, which will make it easier to find solutions to problems. The significance of DMS is analysed, and data-driven recommendations are offered based on the obtained meteorological data and after taking into consideration the effects of climate, population, and greening. This article starts with a brief overview of how the city's climate has changed recently. Next, the purpose of the urban climate map is explained, followed by a list of relevant pros and cons based on the relevant characteristics and a discussion of how DMS could be used in real-world situations.

Keywords: climate, digital mapping system, city

1. Introduction

Due to a lack of knowledge and research between meteorological statistics departments and DMS, designers lack significant meteorological knowledge and information, resulting in managers' disregard for meteorological elements, which affect the lives and living surroundings of people. Therefore, it is imperative to devise a solution to the aforementioned issues. Through DMS, the city's electronic map can not only detect the climate but also intuitively notice climate change, which impacts all elements of the production, life, and health of its inhabitants and also has a significant impact on the quality of the living environment.

International research on the relationship between climate environment and DMS can be traced back to Luke Howard's "London Climate" in the early nineteenth century, which observed urban-specific physical environment issues such as the heat island phenomenon for ten years (1807-1816), thereby initiating a systematic study of the urban physical environment [1]. It may be broken down into five distinct categories: data measurement and observation, satellite telemetry, experimental simulation, computer numerical simulation, and urban ecological management. Price assessed the

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extent and severity of the heat island effect in the Northern United States using remote sensing data (Price) [2].

Byrne discovered a linear correlation between temperatures in climate-similar locations and remotely observed nighttime surface temperatures [3]. Balling and Brazel employed thermal infrared data to examine the surface radiation temperature in the Phoenix metropolitan region of the United States. They discovered that the surface temperature was connected to the kind of land cover [4].

Using thermal infrared measurements, Carnahan and Larson determined that Indianapolis had a lower surface temperature than the surrounding countryside [5]. They measured the summer surface radiation temperature in the Seattle region of the United States using satellite data. The Weather Research & Forecasting Model (WRF) was created in 2000 by the American Center for Environmental Prediction (NCEP), the National Center for Atmospheric Research (NCAR), and other research institutions for both real-world simulations and theoretical discussions of basic physical processes [6]. Based on the results of the studies that came before, this study will look at and recommend data and expert analysis based on an in-depth study of how to use a Digital Mapping System to notice climate change. In turn, recommendations are made to assist future researchers in investigating Digital Mapping System's significance to climate change.

2. Research Development International

ClimateEx used forecasting models to illustrate the greatest and smallest regions of global climate change over the next fifty years. The climate changes the most in white and brown areas and changes the least in green areas.

In 2018, scientists from the University of Cincinnati in the United States released a report in the Bulletin of the American Meteorological Society describing the creation of a virtual electronic map that allows students and academics to compare climates anywhere in the world. The image uses public meteorological data collected from 50,000 worldwide weather stations over the course of five decades. Researchers can observe variations in temperature and precipitation between the two poles using the interactive map. The tropical regions surrounding the equator have seen significant changes. "It is not because of changes in temperature; it is because of variations in monthly precipitation." The map demonstrates that climate and climatic variety fluctuate throughout time. One of the authors of the study, Thomas Stephansky, stated. Using monthly climate data from the WorldClim public database, researchers have devised an accessible visualisation tool for analysing climate trends and climatic variability throughout the globe over time. In addition, researchers may use the map to determine which regions of the planet, including the Arctic, have undergone the most extreme climatic change throughout time. People often think about temperature and precipitation, but our mathematical model includes both. "This map is especially useful when comparing places that are not related or geographically distant, as the weather can vary greatly from month to month depending on the seasons," Stephensky explained. On the other hand, when seen on a multidecade timescale, the magnitude of this issue becomes clear. Stephansky stated. This map can assist in predicting future temperatures and preparing for potential disaster risks. Also, the map is easy to use and understand, so anyone can use it to plan trips and moves.

Also, in June 2017, President Donald Trump of the United States announced the United States' withdrawal from the Paris Climate Agreement, prompting global outrage [7]. The Paris Climate Pact is a worldwide agreement made by 195 nations to progressively reduce greenhouse gas emissions, therefore averting a large rise in global temperatures. Analysts fear that the US decision may deter developing nations from taking more steps to control emissions, which may impede overall emission reduction efforts, resulting in dangerously high temperatures. There is a consensus that global climate change is no longer a single scientific issue but involves a range of economic and policy issues. Lin Hun stated that in order to combat the threat of climate change, on the one hand, it is necessary to adopt international agreements and policies to limit greenhouse gas emissions, and on the other hand, a large, integrated policy model that can simulate and feedback the ozone layer is required [8]. Each country's economic growth model and land use condition is unique. Hence the model's outcome is also unique. In order to achieve this objective, the research group constructed the GCAM-China model on the basis of the Global Change Assessment Model (GCAM) and combined it with China's actual high-energy-consuming industrial structure and energy consumption structure, subdivided China's regional industrial sectors, and divided China's industries into seven categories: cement, steel, chemical, non-ferrous metals, papermaking, and equipment manufacturing. Using China's base-year land data, fuel kinds and energy consumption technologies in each sector were recreated with real-time updates and calibrations [8]. Lin Hun stated, "Some believe China's urbanisation is the most significant symbol of the 21st century, and more than 60 percent of the world's steel and cement are put on China's land, which creates a large amount of energy consumption; if such occurrences can be defined and estimated, it will be more appropriate for China's national circumstances" [8]. By simulating the development path of global radiation forcing, greenhouse gas concentration, temperature rise, carbon tax, emission reduction cost, energy consumption, and land use conversion under different temperature rise targets in 2100, researchers found that by controlling the global temperature rise to within 1.5 degrees Celsius, the cost of emission reduction will increase significantly, which is more than double the target of controlling the temperature rise to within o degrees Celsius. China's target of near-zero emissions will be accelerated from 2070 to 2050, and the energy sector will undergo a fundamental low-carbon transformation.

3. Condition of the Surroundings

In 2013, a team led by Professor Wu Enrong and his Doctoral student Professor Ren Chao produced the urban climate map theory on a solid theoretical research foundation and performed urban planning case studies. Use the Fengtai District in southwest Beijing to show the application of urban climate maps. The influence of the urban heat island effect in Beijing has intensified annually with urbanisation and human activities. As seen, the surface temperature of the city centre of Beijing is much greater than that of the surrounding suburbs [9]. According to meteorological statistics, the average air temperature in Beijing grew by 0.39 °C each decade between 1951 and 2007, which was much higher than the national average (0.26 °C/10 years) and the average for northern China (0.33 °C/10 years). Annual precipitation ranges from 242 to 1,406 millimetres, and the rate of change is 58%. This indicates that the annual rainfall in Beijing is very variable, which might result in floods and droughts occurring at unexpected periods. In addition, the predominant winds in Beijing are predominantly from the north throughout the year, with the exception of July and August, when the western mountains cause them to shift to the southwest. The yearly average wind speed in Beijing is roughly 2.6 meters per second [9].

3.1. Case Study

The Fengtai neighbourhood is located in the southwest portion of Beijing's downtown. The west is bounded by mountains and has a flat topography, which facilitates the arrival of summer breezes [10]. Nevertheless, based on the current state of the building, this portion of the region consists mostly of commercial and residential property, the greening rate is low, and the urban heat island effect is severe. Greening changes around existing structures and future urban design can increase ventilation. The primary practice consists of introducing breezes from the southwest highlands, constructing three major ventilation ducts, and attempting to improve the microclimate of the numerous roadways and outdoor places. In addition, the inadequate ventilation condition in the southwest is improved, and the southwest breeze is introduced into the city during the summer to lessen the urban heat island

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effect in Beijing. Specifically, the wind speed and direction are modified by altering the building's breadth and orientation in the area where the wind is desired. Similarly, some low-rise buildings and open urban areas, such as urban public buildings, city squares, urban parks, and more., are also conducive to the introduction of wind, and this type of space should be considered in the design in order to provide channels for the introduction of wind and alter the existing wind environment [10]. Moreover, little green spaces cannot have an effective cooling impact. Under the assumption of not growing the green space, the greening should be designed to the greatest extent feasible so that the surrounding area may be cooled more effectively. The comprehensive design should also include considerations for the entrance of wind, such as the installation of tiny vents and more, which can improve the microenvironment's ventilation status [10]. Briefly, for planning and design, the appropriate procedures should be selected based on the current state of various plots.

With the fast expansion of cities, many urban planners are confronted with several issues, such as the environment and pollution caused by rapid urbanisation. Scholars from many fields are likewise attempting to resolve this issue. As an interdisciplinary field of climate science and architectural design, urban climate maps provide novel solutions to this issue.

3.2. Strengths and Drawbacks of the Digital Mapping System

This study examined the effects of DMS and climate change on cities by investigating the process of urbanisation under the influence of DMS and the advantages and drawbacks of climate warning under the influence of DMS. A substantial amount of pertinent literature and examples were consulted as research objects. DMS ground observation meteorological data were used, along with comparative methodology, to assess the features and changes of the contemporary urban climate. The following are the main conclusions:

3.3. The Role of the Sensor

"Big data in climate first means we have sensors everywhere: in space, looking down via remote sensing satellites, and on the ground," said George Mason University professor and data scientist Kirk Borne [11]. He stated that these sensors continuously collect data on weather, land usage, vegetation, seas, ice cover, precipitation, drought, and the quality of water. They are also keeping an eye on the links between different sets of data, such as changes in biodiversity, invasive species, and endangered species.

NEON (National Ecological Observatory Network) and OOI (Ocean Observatories Initiative) are two large-scale monitoring programs of this type.

"All of these sensors also provide a substantial rise in the pace and number of climate-related metrics that we now measure, monitor, and track," Borne explained [11]. These data give us a deeper and broader understanding of climate change over time and space. Borne stated that climate change is one of the most prominent examples of scientific modelling and simulation. The focus is not on the weather of tomorrow but on decades and millennia into the future.

"Large-scale climate simulations are being performed daily, if not more frequently." [11].In comparison to earlier models, these simulations feature a higher horizontal spatial resolution (hundreds of kilometres as opposed to tens of kilometres), a higher vertical resolution (the number of atmospheric layers that can be represented), and a higher temporal precision (focused on minutes or hours as opposed to days or weeks).The output of each daily simulation is petabytes of data and requires a variety of tools for storing, processing, analysing, visualising, and mining. Interpreting climate change data may be the most difficult task. "When working with big data, it is simple to create a model that explains the correlations that we find in our data," Borne said [11]. "However, we must

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remember that a correlation does not prove a cause-and-effect relationship. Because of this, we must use strict scientific methods" [11].

It Is also vital to remember the statistician George Box's adage, "All models are flawed, but some are useful" "This is especially important for computer models with numbers because there are so many assumptions and "parameters of the model of our ignorance." "exist" "We combine the most recent and best observational data into the existing model of a real system in order to correct, adapt, and validate" Borne explained, referring to the method by which "we combine the most recent and best observational data into the existing model of a real system in order to correct, adapt, and validate. Big data play a critical and fundamental part in the science of climate prediction by offering corrective measures through continuous data assimilation" [11].

3.4. Inform People about the Local Climate

Richard Wiles, vice president of strategic communications and director of research at the Climate Center, stated, "Our objective is to inform people about the local climate in a manner they can comprehend, and big data analytics is the only way to accomplish this. "Big data helps you to communicate clearly and concisely" [12]. The first is data that has just recently been obtained but is frequently so huge and complicated that it has been impossible to analyse it successfully in the past, such as NASA's thermal imaging of major cities. Wiles claims that this type of data "was basically impossible to process" because it was too large until the second type of big data is some relatively old but probably less reliable data," such as historical temperature trends in the United States [12]. This data is generally less complex, but there may be many gaps and errors. Wiles claims that the existing data has "as much capability as there is, as tough as it is to tackle these problems. We have been distributing this information in an effort to keep residents informed about climate change patterns.

3.5. Enhancement of the DMS for Addressing the Issue of Climate Change

Improve the Emergency Response function; solve the problem of how to arrange the best rescue and evacuation routes for personnel and equip the corresponding transportation and support facilities when major natural disasters such as floods, droughts, cold waves, tornadoes, typhoons, and other major natural disasters are caused by sudden climate changes. It may also be used for the allocation of resources such as material distribution, energy security on a large scale, and food supply in different disaster relief and mitigation initiatives.

3.6. Environmental Management and Modeling

These two disciplines perform mostly regional ecological planning, environmental status evaluation, and planning. Which can fully use climate factors such as national land use remote sensing maps, river flow, and pollution mapping maps to maximise the change of climate factors such as temperature, precipitation, wind direction, and more, and provide robust support for land consolidation and environmental protection.

3.7. Visualisation Application

Visualisation Application Based on digital terrain models, a three-dimensional visualisation model is developed to enable multi-angle browsing. This model is extensively used in advertising, urban and regional planning, large-scale project management and simulation, tourism, and other industries. To combat climate change, this function can be implemented, and a database of dynamic changes in precipitation, temperature, and more can be established in various locations and displayed visually,

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such as a three-dimensional model of river runoff, reservoir capacity change, and a change map of the "snow line" of significant mountain peaks (the dynamic situation of the melting of alpine snow caused by "global warming" is displayed in real-time with a three-dimensional animation, which will be more intuitive than boring text).

3.8. Agriculture Resource Management

Agriculture (resource management) is mainly used in agriculture and forestry to tackle the distribution, grading, statistics, mapping, and other problems associated with diverse resources (such as land and precipitation) in agriculture and forestry. It primarily addresses the two categories of "positioning" and "mode" problems. People believe that climate change's most immediate and far-reaching effect is its interference with agriculture (cropping). Using GIS, one believes it is feasible to construct a dynamic change model of precipitation and runoff in diverse locations, which may serve as a valuable resource for water resource distribution decisions. Similar to the severe drought in the southwest, it can be useful.

However, its advantages are also substantial. It is also feasible to model big traffic and urban engineering structures with the Digital Mapping System. Predict meteorological processes such as convective weather and thunderstorms. Observing small crustal shifts can also aid in disaster mitigation. Observations of the climate give accurate and enduring data. In contemporary digital city systems, virtual map information systems may observe stereoscopic details and can jump to other areas to explore the possibilities of opening up new observations.

4. Conclusions

Overall, the topic of global climate change and global change has garnered widespread attention from the international community and is transforming into a multidisciplinary convergence field, demonstrating its great social, economic, and political significance. Under the guidance of the concept of a unified climate agenda, with the strong organisation and coordination of the United Nations institutions and other international organisations, the implementation of large-scale international plans with strict designs, such as the WCP, IGBP, HDP, and GCOs, as well as the joint efforts of scientists from around the world and close multidisciplinary cooperation, it is anticipated that with the rapid development of new observation techniques, an increased understanding of climate change will be achieved. The creation of climate models includes the study of regional climate models, the physical processes of climate, and the chemistry of the biosphere and external variables. The impact of human activities on global climate change and the impact of global climate change on humans will become clearer; research areas on the impact of climate change and research on climate as a service for sustainable development will attract more attention from relevant disciplines and become scientific experimental fields characterised by multidisciplinary cooperation and mutual penetration. On the basis of the aforementioned advancements, by the end of this century and the beginning of the next, the initial steps will be incorporated into a comprehensive climate model that incorporates the five circles of various climatic subsystems, as well as a regional climate and influence model that accounts for the physical characteristics of the region. On this basis, we will be able to improve our ability to simulate and predict climate, enable people to gain a deeper understanding of the formation and evolution of climate and the influence of natural and anthropogenic factors, and make advances and breakthroughs in climate prediction and climate services.

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