Computer-Aided Modeling of Urban Heat Island Effect Evolution in East China in Recent Ten Years Based on Doppler Radar

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Abstract:Using "radial rectangle mapping" to convert radially distributed radar data into grid point data; complete the mapping of window mapping and isosceles triangle detection template at the same time, so as to obtain the description of the convergence intensity and position of the convergence point on the basis of quickly locating the convergence point The parameter vector of. Analyze the characteristics of urban thermal environment changes in East China. The results show that the urban heat island area in East China expanded from 2012 to 2022, especially in Changle District, Fuqing City, and Shangjie Town in Minhou County. The characteristics of urban thermal environment changes in East China were analyzed. The results show that the urban heat island area in East China expanded from 2012 to 2022, especially in Changle District, Fuqing City, and Shangjie Town in Minhou County.

Keywords: Computer-Aided Modeling, Urban Heat Island Effect, East China, Doppler Radar

1. INTRODUCTION

Fuzhou is the capital city of Fujian Province, as well as the center of finance, technology, commerce and trade and an important transportation hub in southern Fujian. In recent years, the urbanization of Fuzhou has been accelerating steadily, and the scale of the city and population has expanded significantly [1]. Among them, the urban heat island effect is a very serious urban environmental problem. With the acceleration of urbanization, the urban heat island problem has become more and more prominent, which has a serious impact on the normal life and health of urban residents, and is also widely recognized by scholars at home and abroad. Pay attention to [2-3].

In short, MARC refers to the strong radial convergence zone concentrated in the middle layer of convective storms (usually 3-9, km). Once the convergence intensity (radial convergence velocity difference) reaches more than 25,m/s, the probability of severe linear ground wind increases greatly. Hou Yiling et al. [4] conducted research using the daily average data of 11 meteorological observation stations in Shanghai and found that The urban heat island effect in Shanghai is very significant [5], and the scope is constantly expanding, and high temperature and heat wave events occur frequently in central cities. However, due to the depth of research on the formation mechanism of debris flows, the current debris flow prediction models are mostly precipitation statistical models based on the critical rainfall that triggers debris flows. The model is local and difficult to generalize [6].

The critical rainfall is based on the historical disaster events and landforms in the region. The extensive application of Doppler weather radar data can greatly enhance the detection and early warning capabilities of small and medium-scale weather systems, and is useful for monitoring short-term severe weather systems and flood disasters. It has laid a solid foundation for early warning, weather modification, and mesoscale numerical forecasting. In order to meet the requirements of frequency stability and easily detect the small frequency change of the echo signal, that is, the frequency change of the radar echo signal caused by the radial motion of

the target relative to the radar, the researchers developed the research based on the Doppler effect of electromagnetic waves. Doppler radar [7].

In the 19th century, British meteorologist Lake Howard observed that the temperature difference between urban and suburban areas was 1.1°C during the day, and the largest temperature difference at night was 2.1°C, and recorded this phenomenon [8]. People first recognized this phenomenon. The population of China is also increasing (. The city has brought great convenience to human production and life, and promoted social and economic development. At the same time, it has also produced a series of urban ecological and environmental problems. When drones work, no one The micro-Doppler effect is produced by the rapid rotation of the rotor blades of the aircraft [9]. Through the Doppler characteristic information produced by the micro-Doppler effect, the structure and motion state of the UAV can be estimated. Remote sensing research on urban heat islands requires thermal infrared data. At present, the most commonly used and typical ones are the thermal infrared band and MODIS surface temperature products of Landsat remote sensing image data, which provide new ideas and methods for better research on urban heat island problems [10]. The landscape pattern is based on the methods and principles of ecology, so it is more scientific. The convergence intensity in the convective storm often has a strong predictor for the disastrous gale [11].

In 1992, Lemon et al. [12] found that there is a deep convergence zone (DCZ) with a vertical extension of 10 km at the junction of the ascending and descending airflows of the supercell. Deng Liantang et al. [13] used 30-min data from two suburban stations, The analysis found that the diurnal variation of the intensity of the heat island is obvious, with a main cycle of 24h and a sub-cycle of 12h. Generally, the heat island is stronger at night than in the daytime [14]. If the area is too small, the various indicators evaluated in the cell cannot reflect the real conditions of the development of debris flow, and make the forecast The results are overly fragmented. According to the distribution of the size of debris flow ditch

in Liangshan Prefecture, the statistical cell is set as 3km×3km, that is, the area of each cell is 9km2 [15].

In view of the current problems of scattered Doppler weather radar data management in Tibet, no unified data management system, and low data usage efficiency, we designed a reasonable Doppler radar data management strategy to effectively store and manage data for the needs of business scientific research. The process of using Doppler radar to achieve target tracking [16] has been studied by many scholars. In practical scenarios, the relationship between the signal detected by the radar and the moving target is not linear, and usually contains complex nonlinear patterns.

2. THE PROPOSED METHODOLOGY

2.1 The Doppler Radar

In a convective system, there are both updraft and downdraft airflow, and the two converge to form a convergent field, and the radial velocity component at each point of the convergent field is reflected in the radial velocity map, which is limited to the area of the convective cell. Doppler weather radar data mainly include basic data (that is, radar volume scan files, which contain radar reflection factor Z, radial wind speed V, spectral width W and other information, in binary file format), and data based on basic data through various It is impossible to directly compare and analyze the products generated by meteorological algorithms and digital image processing, and the temperature needs to be normalized and graded.

At present, there are two methods of temperature classification: one is to directly divide the study area at equal intervals according to the highest and lowest temperatures in the study area, and this method of dividing the heat island interval is contingent; During the tracking process, the influence of the strong nonlinear change of the measured signal on the target tracking accuracy, this paper proposes a sequential high-order unscented transform Kalman filter algorithm. The algorithm introduces various information of the Doppler radar to observe the target, and uses the azimuth angle in the observation equation. Since the basic data is in binary data format, professional software is required to read the useful information. For the sharing and use of data, the system develops a background data processing system to extract the most important radar reflection factor Z in the basic data in real time. In recent years, the number of grids of heat islands with relative brightness temperatures between, strong heat islands with relative brightness temperatures between, and extremely strong heat islands with relative brightness temperatures have all shown a decreasing trend, indicating that the distribution range of heat islands with higher intensity is reduce. Due to the large amount of basic data, in order to facilitate storage, the system adopts compression technology, develops an automatic data compression processing module, and effectively compresses the basic data and stores it; there are various state components in radar observations, and the conventional method is to compress these state components together. deal with. In Doppler radar, sequential thinking can be used.

2.2 The Urban Heat Island Effect in East China In The Past Decade

Remote sensing research on urban heat islands requires thermal infrared data. At present, the most commonly used and most typical ones are thermal infrared bands and MODIS surface temperature products of Landsat remote sensing image data. The dominant heat island landscape types (types 4, 5 and 6) have an extremely important impact on the

development and evolution of the urban heat island effect in Tianjin. The change process and development trend in the past 10 years are shown in Figure 2) describes the type area of the heat island landscape. Looking at the convergence zone in the convective cell from the perspective of the image, it is actually the junction of the adjacent parts of two velocity areas with a specific azimuth relationship. The matching calculation of the value can know whether there is a strong convergence. According to the characteristics of Doppler radar data, the system is developed by the combination of B/S (browser/server mode) and C/S (client/server mode). The shared application system is developed in B/S mode, and the data management system is developed in C/S mode.

There are two methods for urban heat island zoning. The first is to directly classify the surface temperature after inversion; the second is to normalize the surface temperature and then classify it according to the temperature. Since the acquisition time of the three remote sensing images used in this paper is 1995, 2007 and 2017, the time span is relatively large. The images are supervised and classified to extract the spatial distribution range of urban green space. The results are shown in the figure. After extracting the range of green space, calculate its area, and quantitatively analyze the development and change laws of urban green space in the study area in recent years.

The micro-Doppler frequency of the multi-rotor is a curve transformed by a sine function, and the frequency of the sine function □ is the same as the angular frequency of the blade rotation. When the UAV rotor rotates, the speed at the tip of the blade is the largest, so the corresponding Doppler frequency is also the largest. At present, the commonly used atmospheric correction methods include the radiative transfer model method, the dark pixel method, and the statistical model method. In this study, the FLASH atmospheric correction method was used to perform atmospheric correction on the images. This method is based on the MODTRAN4+ radiative transfer model and can effectively remove the scattering effects of water vapor and aerosol in the atmosphere.

2.3 The Computer Aided Modeling of Heat Island Effect Evolution

In this section, the effectiveness of the proposed method is verified by simulation, and the proposed improved algorithm (SHUKF) is compared with higher-order unscented Kalman filter (HUKF) and statically fused transformed Kalman filter (SMCMKF). Using remote sensing information to extract water bodies generally adopts a multi-band combination method, and calculates the ratio of the water body's reflection and absorption of sunlight. From the wavelength range, it can be known that the water body has the weakest reflectivity in the mid-infrared band, the highest absorption rate, blue and green The light band has the strongest reflectivity. The distance of the cooling effect of the green space is closely related to the factors of the green space itself and the layout of the construction land around the green space. Here, the relationship between the green space area and the cooling effect distance of the green space is discussed first.

In this paper, the green space action distance adopts the interval expression form, which is a qualitative expression. In order to study the specific cooling action distance, the cooling distance expression form is quantified. The distance from the radar to the UAV is 200m, the radar azimuth □ is 0□, the pitch angle is 20□, the UAV translation speed is 0, and the number of rotors is 4, among which the rotors 1 and 2 rotate

counterclockwise, 3 , 4 is clockwise rotation, the frequency of rotor rotation is 40r/s, the initial rotation angle of each rotor blade is 0, and the length of each blade is 12cm.

3. CONCLUSIONS

A "radial rectangle map" is constructed to map the volume scan data of the Doppler radar in the ray distribution into grid point data, which is convenient for the design and implementation of the image processing algorithm. The urban heat island effect is also increasing. In the past ten years, the area of the urban heat island has expanded by 372.71 km2. Although the high-order unscented Kalman filter (HUKF) has a fast convergence speed at the initial position, due to the large amount of nonlinearities in the processed information, the performance of the high-order unscented Kalman filter (HUKF) in the processing process is high. Not stable. The temporal distribution characteristics of the heat island effect were studied, and the mean-standard deviation method was used to divide the surface temperature in the four seasons of spring, summer, autumn and winter in the study area. 17.80% .

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