Air dust pollution and online music teaching effect based on heterogeneous wireless network

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Abstract
This article first introduces management technology and handover technology in heterogeneous wireless networks and summarizes common network access selection strategies and algorithms. Aiming at the shortcomings of long switching delay in existing fuzzy logic network selection algorithms, a low-complexity fuzzy logic-based heterogeneous wireless network access selection algorithm is proposed. Therefore, this paper uses the WRF-Chem model of the Urban Forest Consortium to carry out a numerical simulation study on the air and dust pollution of mountain city L. Combining the single-layer urban forest model with the WRF-Chem model, this model has an improved simulation function after testing, which can simulate the air pollution process in the L city center and analyze the factors of the urban canopy on the distribution of atmospheric dust pollutants and influences. Finally, we have conducted a comprehensive research on the educational effects of online music education. With the rapid development of Internet communication technology, online education has gradually become popular with the public. As a part of it, online music teaching has also been rapidly developed and promoted. It breaks the time and space limitations of traditional music education and is changing the way and concept of music learners. This article summarizes the background and development of online music teaching, analyzes the advantages and limitations of online music teaching, and briefly introduces future development trends. This paper applies the research results of air dust pollution based on different wireless networks to the research on the effect of online music education, which has successfully promoted the development of online music education.

Keywords Heterogeneous wireless network · Air dust pollution · Music teaching · Online courses

Introduction

Future communication systems will coexist with multiple wireless access technologies, and different access networks have different technical characteristics (Barma et al. 2018). There is no wireless access technology that can meet all user needs in terms of bandwidth, delay, mobility support functions, and range. For the multi-user and multi-network selection scheme, this paper proposes a heterogeneous wireless network, which is based on a matching game (Catcheside and Ralph 2002). We define the utility function and matching window of the user and the network respectively, and based on this, we propose a heterogeneous wireless network based on the matching game (Chang et al. 2020). Constructing a wireless network: This kind of network selection method can consider the utility of the user and the network (Chen et al. 2003). The simulation results show that based on the matching game, the low blocking rate network selection efficiency of the heterogeneous wireless network is higher (Chen et al. 2017). Therefore, this paper conducts a numerical simulation study on the air dust pollution in L city (Chen et al. 2019). Before the numerical simulation of urban air pollution, this article first tested the model’s ability to simulate meteorological elements (Ghosh et al. 2014). The WRF model combined with the canopy of another city was used to simulate two meteorological processes in L urban area. The simulation results of various urban forests are analyzed by comparing observation points. The following simulation is combined with the effective single-layer urban forest model WRF-Chem to numerically simulate the air dust pollution process.
in L city (Gupta and Gupta 2014). Finally, we combined the WRF-Chem model and the single-layer urban canopy model to analyze the impact of the urban forest model on atmospheric dust pollution according to the development trend. In L city, a sensitivity test was conducted on the height changes of regional buildings and urban buildings, and the impact of urbanization was analyzed (Haider et al. 2013). Finally, in this article, we conduct a systematic investigation on the effect of music online course education (Hamidi et al. 2017). Music online courses are also an important part of quality education. Thanks to preferential policies, technical support, and changes in social concepts, music education in China has been developing rapidly and exhibiting explosive growth in recent years (Hamidi et al. 2021). In terms of Internet and technology, the Internet has gradually participated in the 5G network, and the network communication speed is getting faster and faster. This means that the delay and stuttering problems in online real-time training have been alleviated to a certain extent. Speeding up the communication speed means that it can be more smoothly use higher quality picture quality and clearer sound quality (Haq et al. 2018). VR technology will greatly help online music teaching. It effectively solves the deficiencies of online education, such as lack of immersion or being easily disturbed by others. Although the development of music online course education is in full swing, the traditional music education form still maintains a dominant position in terms of educational experience and effects, because it relies heavily on the teaching characteristics of musical instruments and singing teachers (Huang et al. 2013). This article believes that the mainstream trend of music in the future will become a complementary model of online and offline (Jian et al. 2019). No one can change the relationship between the two. The combination of the two will further promote the more comprehensive development of music education (Jones et al. 2010).

### Materials and methods

#### Research data

Land cover data is an important basis for understanding the complex interaction between human activities and changes in weather factors. This data classifies land into different categories based on different surface features (Klein et al. 1997). The United States Geological Survey divides the world’s land types into 24 categories, namely the land use types of USGS-24. See Table 1 for specific classification categories.

| Numbering | Land type                                      |
|-----------|-----------------------------------------------|
| 1         | Urban and Built_Up Land.                      |
| 2         | Dryland Cropland and Pasture.                |
| 3         | Irrigated Cropland and Pasture.              |
| 4         | Mixed Dryland and Irrigated Cropland and Pasture. |
| 5         | Cropland/Grassland Mosaic.                   |
| 6         | Cropland/Woodland Mosaic.                    |
| 7         | Grassland.                                   |
| 8         | Shrubland.                                   |
| 9         | Mixed Shrubland/Grassland.                   |
| 10        | Savanna.                                     |
| 11        | Deciduous Broadleaf Forest.                  |
| 12        | Deciduous Needleleaf Forest.                 |
| 13        | Evergreen Broadleaf Forest.                  |
| 14        | Evergreen Needleleaf Forest.                 |
| 15        | Mixed Forest.                                |
| 16        | Water Bodies.                                |
| 17        | Herbaceous Wetland.                          |
| 18        | Wooded Wetland.                              |
| 19        | Barren or Sparsely Vegetated.                |
| 20        | Herbaceous Tundra.                           |
| 21        | Wooded Tundra.                               |
| 22        | Mixed Tundra.                                |
| 23        | Bare Ground Tundra.                          |
| 24        | Snow or Ice.                                 |

The WRF model provides global land cover data of USGS-24 type and MODIS type, but it does not accurately describe the actual distribution of the two main indicators in China, especially in urban areas where the technology changes greatly (Li et al. 2019). In this article, we use the high-resolution basic surface data FROM-GLC-agg instead of the basic surface data of L city. The overall accuracy of land classification data is 65.5%, and the applicability is good.

This is an important criterion for testing the simulation effect of weather observation data models. In this article, we use the observation data of four weather stations in L cities, namely Y, G, L, and Z stations. The site parameters are shown in Table 2.

The observational data of air pollutants is an important reference result for verifying the WRF-Chem model simulation. This paper adopts the measurement data of 5 air quality monitoring stations in L city. L Hotel, Education Bureau, Biological Product Laboratory, Railway Design Laboratory, and L University (Table 3) showed us the basic information of surveillance sites. Observational data of air pollutants can be obtained from the National Real-time Air Quality Emission Platform of the China Environmental Monitoring Station, which can provide pollutant concentration monitoring data at five monitoring points in L every hour.

The grid design of the model is triple overlap, the number of grid points in the first grid is $145 \times 100$, the center latitude and longitude are $37.04^\circ$ N, $94.44^\circ$ E, and the grid resolution is 25 km; in the second grid, the number of grids in the grid is...
Table 2: Basic information table of meteorological observation station

| Observation site | Station No. | Geographical location | Altitude (m) | Underlying surface type |
|------------------|-------------|-----------------------|--------------|-------------------------|
| Y                | 52884       | 36°43′N,103°14′E      | 2118.6       | Rural                   |
| G                | 52883       | 36°20′N,103°54′E      | 1669.5       | Rural                   |
| L                | 52888       | 36°01′N,103°52′E      | 1518.1       | City                    |
| Z                | 52982       | 35°54′N,104°07′E      | 1875.2       | Rural                   |

141 × 141 with a resolution of 5 km; and the number of grid points in the third back grid is 161 × 181 with a resolution of 1 km.

Physical parameter options include the following: Ferrier is used for microscopic physical parameters, GF is used for cumulus convection parameter schemes, rrtm is used for long-wave radiation, Dudhia is used for short-wave radiation, and BouLac TKE is used for boundary layer schemes. Set up 4 sets of experiments, namely the uncoupled urban canopy WRF mode (WRF will be used below) and a combined single-layer urban canopy WRF mode (we will use UCM below), and the combination is not considered; energy is carried out inside and outside the city. The design of urban parameters is shown in Table 4.

Research methods

Heterogeneous wireless network

Based on the cost function, the network selection algorithm evaluates the cost of accessing each candidate network through the weighted sum of each parameter. The general form of the cost function is:

\[ f^n = \sum_s \sum_i w_ip_{sj} \sum_j w_j = 1 \]  

(1)

The available networks for mobile terminal access are:

\[ A = \arg \min_n (f^n) \]  

(2)

Simple weighting method (SAW) The literature is using the SAW method to evaluate candidate networks. The total score of each candidate network can be obtained by the weighted sum of all network features. The mobile terminal switches to the network with the highest score, that is

\[ A_{\text{SAW}} = \arg \max_i \sum_j w_j r_{ij} \]  

(3)

If the parameter \( j \) is a profit indicator, there are:

\[ r_{ij} = \frac{x_{ij}}{\max_i x_{ij}} \]  

(4)

If parameter \( j \) is a cost indicator, then it will be:

\[ r_{ij} = \frac{\min_i x_{ij}}{x_{ij}} \]  

(5)

TOPSIS selects the network that is closest to the best solution or the network that is the furthest from the worst solution. This method is called approximating the ideal solution. The most ideal solution is a network with various parameters reaching ideal values. The selected network is:

\[ A_{\text{TOPSIS}} = -\arg \max_i C_i \]  

(6)

(GRA): Press P to decompose each factor that affects the network selection problem into several levels and assign corresponding weights. This analysis method is called an analytic hierarchy process. It is used to rank candidate networks. Users can select the best network according to the ranking. This method is called a gray relational analysis. The specific selection process is:

\[ A_{\text{GRA}} = -\arg \max_i \text{GRC}_i \]  

(7)

Table 3: Basic information of air quality monitoring stations in L city

| Site name                        | Site number | Longitude (°E) | Latitude (°N) | Types of          |
|----------------------------------|-------------|----------------|---------------|-------------------|
| Staff hospital                   | 1475A       | 103.6          | 36.2          | Urban area        |
| L. Guesthouse                    | 1476A       | 103.5          | 36.2          | Urban area        |
| L. University                    | 1477A       | 104.0          | 35.8          | Suburbs           |
| Biological Products Laboratory   | 1478A       | 103.7          | 36.2          | Urban area        |
| Railway Design Laboratory        | 1479A       | 103.7          | 36.1          | Urban area        |
Sand and dust pollution observation model

**Average deviation** The formula is:

\[
\text{bias} = \frac{1}{n} \sum_{i=1}^{n} (d_{\text{sim}} - d_{\text{obs}})
\]

In the formula, \(d_{\text{sim}}\) is the simulated value, and \(d_{\text{obs}}\) is the observed value. This mainly refers to the degree of height between the simulated value and the observed value.

**Root mean square error** The formula is:

\[
\text{RMSE} = \left( \frac{1}{n} \sum_{i=1}^{n} (d_{\text{sim}} - d_{\text{obs}})^2 \right)^{\frac{1}{2}}
\]

The deviation between the simulated value and the measured value determines its value.

**Correlation coefficient** The correlation coefficient between the simulated value and the observed value is calculated, and the correlation between the model simulation result and the observed value is described in the significant difference test. The higher the absolute value of the correlation coefficient, the stronger the correlation. The closer the value is to 1 or \(-1\), the stronger the correlation. The closer the value is to 0, the weaker the correlation.

**Experimental setup**

The simulation example chosen in this chapter is the sand and dust air pollution process in L city in winter. On November 10, 2020, a sandstorm occurred in L city, and the Air Quality Index (AQI) reached 500, causing serious pollution. The main pollutant is the inhalable particulate matter PM10, the daily average concentration has reached 199 \(\mu\text{g/m}^3\), and the daily average concentration of particulate matter PM2.5 is 222 \(\mu\text{g/m}^3\). The air pollution on No. 11 in L city is still very serious, and the main pollutant is PM10. The air quality has improved since the 12th, and the AQI is lower than 200. On the 13th, air quality turned to moderate pollution, and the dust pollution process ended. During the period of sand and dust pollution, the north wind dominates the urban area of L. In the urban area, the relative humidity with low visibility and poor visibility is less than 70%, and there is a reversal layer in the urban area. Figure 1 shows the changes in the concentration of the main pollutant (PM10) at five air quality monitoring stations in the city.

The selection of grid design and parameter scheme in this chapter is consistent with the design in Chapter 3. The simulation area is triple overlap. In order to obtain high-resolution simulation results, the innermost resolution is set to 1 km \(\times\) 1 km. The main physical parameter schemes are as follows: the boundary layer scheme is BouLacTKE scheme, Noah is used for the selection of surface process parameterization scheme, Monin-Obuhohu is used for the selection of near-surface layer scheme, and Fast-J is used for photolysis process. RACM-KPP is used for chemical use, GOCART is used for aerosol process, Shao04 is used for sand removal plan, and the emission source data is selected as the global emission source. We designed two sets of experiments in the combination of a single-story urban forest, namely WRF-Chem and WRF-Chem-UCM.

**Results**

**Simulation results of air dust pollution**

Comparing the simulation results with the observed results can well illustrate the model’s ability to simulate the pollution process. During the pollution process, the simulation results of 2 m air temperature, 10 m wind speed, and PM10 concentration in the urban area of L city and y district are compared in Fig. 2.

The simulation of meteorological elements has been tested in the previous chapter. Combined with the simulation results and a brief introduction to each problem, we can see that the weather elements simulated by the WRF-Chem model basically match the description of the actual process. After combining with the single-layer urban canopy model, the meteorological factors in area y have not changed much. The temperature in the urban area of L city dropped slightly, and the wind speed only appeared at 8 o’clock every day; otherwise, the wind speed would not change much during this period. In combination with the single-layer urban canopy model, it can be seen that the model has a specific function and can simulate the meteorological elements in the process of sand and dust pollution.

The trends of PM10 concentration simulated in WRF-Chem model and WRF-Chem-UCM model are consistent with the observation results. Both PM10 concentrations on
the 10th day started to increase at dawn, but the simulated PM10 concentration value of the model was lower, and the observed PM10 concentration and the simulated PM10 concentration both decreased at 8 o’clock on the 10th day. In the PM10 concentration model, it increased sharply from around 8 o’clock in the evening on the 10th to about 700 μg/m³, and the PM10 concentration observed from 8 o’clock in the evening on the 10th remained around 700 μg/m³. At this time, the PM10 concentration simulated by the model is close to the observed PM10 concentration value. This relatively high PM10 concentration remained until the next day and began to decline, which was reflected in the process model. In the high-concentration maintenance phase, the simulated PM10 concentration in the WRF-Chem-UCM model is close to the observed maintenance time, and the simulation result of the WRF-Chem-UCM model is better. Compared with the change trend of PM10 concentration in y area, the PM10 concentration simulated by WRF-Chem-UCM model is closer to the observed value, which is consistent with the observed trend.

**Time change of air dust pollution**

The location of the 1478A surveillance site in L city is selected to represent the changes in urban elements. Figure 3 shows the changes of each element in the monitoring site.
In the WRF-Chem model and WRF-Chem-UCM model, there are certain differences in the simulation of various elements in cities, but the simulation differences of various elements in rural areas are relatively small. In the time change graph of each urban element in L city (Fig. 3), the trends of these two models are the same as the simulation trends of the city’s 2 m temperature. The simulation results of the WRF-Chem-UCM model are usually slightly higher than the results of the WRF-Chem model. Combined with the urban forest model, the simulated value of wind speed of 10 m in the city will increase every moment, but the basic trend is the same. In the early days of dust pollution, the wind speed increased significantly by 10 m. During the maintenance phase when the PM10 concentration is high, the wind speed decreases and the dust pollution ends. The wind speed of 10 m rises slightly, and the results obtained by the two models are similar to the higher vertical speed of 700 hPa, indicating that the initial vertical velocity of sand dust or air pollution fluctuates greatly, and the convection movement is obvious, and the stratification is unstable at this time. During the maintenance phase when the PM10 concentration is high, the vertical velocity gradually decreases. The value becomes 0, which means that the convective motion is weakened and the stratification is stable.

When the air pollution process is terminated, the vertical velocity will increase slightly. After merging the single-layer urban canopy model, the vertical velocity increases at the end of the post-pollution process, and the 2 m relative humidity simulated in the two models tends to be the same. Combining the WRF-Chem model and the defective urban canopy, the relative humidity in the early morning is relatively high. The elevation of the boundary layer simulated in the two models shows whether the height of the dust and air pollution decreases after the occurrence of dust and air pollution, and the height of the boundary layer at night in the WRF-Chem-UCM model is low. These differences in meteorological factors affect PM10 distribution which has a big impact. In the WRF-Chem-UCM model, the PM10 concentration is simulated as higher. In WRF-Chem-UCM model, the duration of high PM10 concentration is longer.

In summary, before the occurrence of dust and air pollution, the wind speed near the ground increases and the convection movement is obvious, and the boundary layer height is higher. When the wind speed decreases, the convection weakens and the stratification is stable, the height of the boundary layer decreases, and the concentration of pollutants increases and remains relatively large. Compared with the
WRF-Chem model, combined with the single-layer urban canopy model, the wind speed of 10 m is slightly increased, the duration of stable stratification is longer, the height of the boundary layer at night is significantly reduced, and the high concentration of PM10 continues to take longer.

The vertical profile can reflect the distribution of each element in the vertical direction. By analyzing the vertical distribution of the temperature, PM10 concentration, relative humidity, and wind position at each point in the dust and air pollution process, we can understand the vertical and horizontal distribution of pollutants during the pollution process. The relationship between the locations deepens the understanding of the pollution process. The vertical distribution of temperature, PM10 concentration, relative humidity, and wind position at different time points is shown in Fig. 4.

**Spatial distribution of air dust pollution**

The pollution degree of each location is represented by the level distribution of pollutants. The distribution at different stages of the pollutant process has different characteristics. The distribution of PM10 concentration in the initial stage of dust and air pollution (07:00 on the 10th) and the distribution of simulated differences between the two modes are shown in Fig. 5. PM10 is transmitted from the northeast to the urban area of L city. In the WRF-Chem-UCM model, the PM10 concentration range in the northern part of L city is 400 μg/m³ or larger than the WRF-Chem model. Combined with the 10-m wind field, the north wind is dominant in the position of the wind near the surface of the northern part of L city. The north air current simulated by the WRF-Chem-UCM model is the WRF-Chem model. At the same time, through the urban canopy model, a stronger easterly wind in the northwest of L city was simulated, which resulted in a stronger penetration of PM10 in the west of L city and an increase in the range of higher pollutant concentrations. Through the combined urban canopy model in the differential graph, it can be clearly seen that the concentration of PM10 in PM cities has increased significantly, while the concentration of PM10 in eastern cities has decreased. In the WRF-Chem-UCM model, the distribution of PM10 from the northeast to the east of L city is weak.

The distribution of air pollutants in the vertical direction can be analyzed through the vertical profile. Figure 6 is a cross-sectional view along the 103.83° E meridian at the beginning of the pollution process (07:00 on the 10th). The figure shows the PM10 concentration distribution boundary layer height and wind field. The northern part of the city is dominated by the northerly wind near the surface, while the air current blows southward into the air. In the WRF-Chem-UCM model, the concentration of PM10 in the northern part of the city is increasing. In the northern part of the city, the PM10 concentration gradient of the WRF-Chem-UCM model is large, while the concentration gradient of WRF-Chem is small, and the PM10 concentration is simulated by the WRF-Chem-UCM model. The location of the city is slightly lower. In the WRF-Chem-UCM model, the transmission of PM10 to the city with the north wind is disturbed by the city. PM10 accumulates in the northern part of the city, making the concentration of PM10 in the urban area lower. Taking into account the canopy effect of the city, it can be seen that the city has a certain obstacle to the spread of pollutants from the surface to the city center, which will lead to a slow increase in the concentration of urban pollutants. In the WRF-Chem-UCM model, the northern airflow in the northern part of the simulated urban area is weaker than the result of the WRF-Chem model, which has a certain impact on the transportation of pollutants in the city, and the pollutants migrate to the northern part of the city and stay in this area, where PM10 concentration is very high. After combining the urban forest model, in the WRF-Chem-UCM model, the local circulation of the city has been greatly strengthened, and it can be clearly seen in the number of cities simulated in WRF-Chem-UCM. This model is more eye-catching than the WRF-Chem model, and the obvious local circulation also leads to a decrease in PM10 concentration near the urban surface. The results of the boundary layer height simulated by the two models are not much different.

The above analysis shows that in the early stages of dust and air pollution, combined with the urban forest model, air pollutants caused extensive pollution in the city and surrounding areas and the city prevented the spread of pollutants. The result is that the concentration of pollutants in the city is low, and air pollutants accumulate along the wind direction of the city. The combined urban canopy model has a certain influence on the position of the wind. As the wind speed of the wind direction weakens, the phenomenon of “circulation” appears on the side toward the city. At the same time, it promotes the increase of local circulation in the city and reduces the concentration of urban pollutants.

During the pollution process at 02:00 on the 11th, the concentration of PM10 was close to its limit, and L city was heavily polluted. Figure 7 shows the PM10 concentration distribution and 10 m wind direction. At this time, the wind speed near the northern surface of L city was relatively fast, and a large amount of PM10 was transmitted to the urban area. The PM10 concentration in the WRF-Chem-UCM model is higher than the PM10 concentration in the WRF-Chem model. This is related to the accumulation of PM10 in the northern area of L city in the early stage of pollution. In the WRF-Chem-UCM model, there is still eastern airflow in the northwest of the urban area. PM10 is transmitted to the western area of the urban area, the high concentration of PM10 area increases, and the pollution range is wider. At present, pollution in L cities in the east is more serious than in cities in the west. This is due to the large amount of PM10 being transported to urban areas. Combined with the urban forest model, it can
be seen that as pollutants increase, the degree of pollution also increases, which is directly related to the distribution of initial pollutants.

As shown in Fig. 8, in the mid-stage of the pollution process, it can be seen that the concentration of PM10 in the canyon (city) is much higher than that in the early stage of the pollution, indicating that PM10 was transmitted to the city center of L city. The WRF-Chem model shows that PM10 is evenly distributed in urban areas, while the pollution level caused by PM10 in urban areas is basically the same. In the WRF-Chem-UCM model, because the PM10 concentration is high and evenly distributed at the bottom of the river valley, PM10 is completely diffused in the urban area, but it can be seen that PM10 is the higher concentration in the city. In the difference analysis, the WRF-Chem-UCM model shows the local circulation of the entire city, and the convection

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**Fig. 4** The vertical distribution of air temperature, PM10 concentration, relative humidity and wind field at different moments of the pollution process at the 1478A monitoring site
movement occurs in the north of the city. PM10 gathers in the south due to the subsidence airflow on the northern slope, which causes the high concentration of PM10 in the southern part of the city. However, local circulation has little effect on the distribution of PM10 concentration near the urban surface. Combined with the urban forest model, a relatively definite local circulation was simulated, but the effect was not obvious. The distribution of PM10 concentration near the urban surface has a constant height in the city, and the influence of PM10 concentration distribution is more obvious. As a result of the simulation of the elevation of the boundary layer, the WRF-Chem-UCM model simulates the elevation of the lower boundary layer of the city, which is also the reason for the high concentration of PM10 in the city.

At 08:00 on the 12th, the pollution process basically ended. The PM10 concentration at the 1478A monitoring point fell below 400 μg/m³. The inverted structure in the urban area of L city disappeared. The distribution of PM10 is shown in Fig. 9. The concentration of PM10 in L city is greatly decreasing, and the concentration of PM10 in the city is higher than that in the suburbs. The PM10 concentration in the WRF-Chem-UCM model is higher than that in the WRF-Chem model. Its value center is located in the center of L city, the northeast of L city, the high concentration center in the west of the city, and the “circulation” phenomenon that occurred in the northwest of the city before and after mid-term pollution. In a related manner, more PM10 in the urban canopy model is located in the west of the city. In the city center and the northeastern part of L city, local PM10 concentrations will accumulate during the pollution process and lead to higher peaks. In the WRF-Chem model, the PM10 concentration distribution in urban areas is relatively uniform. Combining the urban canopy model will increase the PM10 concentration gradient from the city center to the city edge. Combined with the urban canopy model, the diffusion capacity of PM10 in the city center is reduced. PM10 in the city center is difficult to diffuse, and the pollution time is longer. In terms of wind distribution, northerly winds still prevail in the northern part of the city, and the wind speed in the upwind direction is still weakening.

Figure 10 shows the wind field distribution and PM10 concentration at the later stage of the pollution process and their differences in L city. The profile diagram shows that the PM10 concentration in the cities simulated by the two models is far lower than the mid-term pollution concentration. However, the PM10 concentration in the cities simulated by the WRF-Chem-UCM model is still higher than that in the WRF-Chem model, and the air quality in the WRF-Chem-UCM model cities is still lower and the pollution time is longer. The results show that the simulated boundary layer height of the WRF-Chem-UCM model in urban areas is slightly higher than that of the WRF-Chem model, and the atmospheric diffusion conditions in the WRF-Chem-UCM model urban
areas are better. In the northern part of the city, the northerly wind near the city surface is weak, and the results of the two models are not much different, but the WRF-Chem-UCM model simulates the local circulation in the city.

Discussion

Analysis of air dust pollution

In this chapter, the WRF-Chem model is used in conjunction with a single-layer urban canopy to simulate the air pollution process of L city sand and dust. By comparing the differences between the two models, we analyzed the impact of the urban canopy model on air pollution. The result shows the following: Before being contaminated by sand and dust, the wind speed near the ground increased, the convection movement was clear, and the humidity decreased, resulting in an increase in the height of the boundary layer. The increase in pollutant concentration corresponds to the decrease of wind speed near the earth’s surface, the stable stratification and the decrease of boundary layer height, and the weakening of convection (Li et al. 2021). Combined with the single-layer urban canopy model, the wind speed of 10 m is slightly increased, and the duration of stable stratification is longer.

Therefore, the height of the boundary layer at night is lower, resulting in higher pollutant concentration and the pollutant concentration is higher, and the high concentration continues for a long time (Liu et al. 2016). The temperature inversion layer has a great impact on dust and air pollution. Combined with the urban canopy model, the concentration of urban ground pollutants increases significantly, the intensity of the inversion layer increases, the duration is longer, and the wind speed under the inversion layer decreases. When the temperature reversal structure is destroyed, the concentration of air pollutants decreases and the air quality improves (Lupton et al. 2020).

In the early stages of pollution, by combining the WRF-Chem model (WRF-Chem-UCM) with the defective urban canopy, the wind speed in urban areas is lower than that of the WRF-Chem model, and the pollutants are located in the accumulation of pollutants. Spread to a wider area. The distribution of pollutants in the pollution process is mainly near the city, and the distribution of ground pollutants has little effect (Machnikowska et al. 2002). However, in the later stage of the pollution process, the removal rate of pollutants in the central area of the city is affected by the urban canopy pattern, resulting in urban pollution the increase in time. In the model, the simulated urban local circulation is more obvious than the uncoupled case (Mullakaev et al. 2017).
Analysis of the necessity of online music teaching

Online education is a way of teaching through the Internet. This kind of online education is not limited by time and space and is benefiting more and more people, especially the latest development of online education shows a rapid development trend. According to online statistics, online education is still in a gradually developing market, with many target customers (Nguyen et al. 2019). It is expected that it will exceed 300 billion yuan in 2020, and the industry is still in an expansion period.

Online music education is also part of an important development and part of quality education. Thanks to preferential policies, technical support, and changes in social concepts, music education in China has been developing rapidly and exhibiting explosive growth in recent years.

Policy level

We value the development of students’ comprehensive quality and encourage the development of high-quality educational institutions. The admission mode of school examinations is according to the usual preferential policies, high-quality comprehensive education courses are becoming more and more popular, especially the music category is the most popular, and the music education market has a lot of room for development. Online music education according to the Ministry of Education and the “Guiding Opinions on Promoting the Healthy Development of Online Education” jointly issued with 11 other departments the latest information technologies such as the Internet and artificial intelligence are between education and learning to promote the development of online music. Education: a new interactive teaching method. Secondly, one of the reasons why music education is so popular among consumers is the performance test system and the socially trustworthy scoring system.

Technical level

In the twenty-first century, with the rapid development of the Internet, the enhancement of mobile communication technology, and the popularization of mobile devices such as mobile phones and tablets, the world has entered an era of information explosion. Audio, video capture, transmission technology, artificial intelligence, and big data technology for online music education are also successful in the transition to the advanced intelligent era.

Social concepts

On the one hand, with the increase of the disposable income of each resident, the improvement of the quality of life, the
increase of education consumption expenditure, the popularization of the Internet, and the continuous maturity of online education technology prepare to provide children with high-quality education and training, while paying attention to artistic emotions. At the same time, more and more adults value their hobbies and are willing to learn musical instruments or songs. Adults of this type are also likely to receive online music education. With the basic completion of the online education industry chain, users are becoming more and more conscious of payment.

**Status quo of online music teaching**

With relatively new teaching methods, online music education is still in an exploratory period. Therefore, on the first resource website, you can see that online education and other types of online music education channels are different.

**One-way resource class**

Such online music education has been established for a long time and enjoys a high reputation, but it is mainly based on resource sharing, many of which are free, and there are some paid resources. It includes lectures by famous lecturers, performance videos, and musical scores and theoretical knowledge and is indispensable for high-quality education in cooperation with universities. Currently, the more popular websites are the following:

**China University MOOC** MOOC is a high-quality Chinese learning platform in China, with more than 1000 excellent courses including 985 universities. Among them, music lectures cover the history of Chinese and foreign music in instrument performance, music appreciation, and music practice and are taught by experienced teachers from various universities with high quality.

**Alto online** Zhongyin online is one of the first online music education platforms to provide online education for musicians, music exams, and college entrance examinations. Zhongyin online collected intensive video lectures by hundreds of well-known teachers from experts such as the Central Conservatory of Music, the Chinese Conservatory of Music, and the Chinese People’s Liberation Army Art Academy, and synchronized with hundreds of the latest textbooks. The training content is detailed and clear.

**China guzheng net** China Guzheng.com is one of the most successful portals on the folk song platform, with a large amount of text content and more than 3000 customized online songs. The playing time of the video exceeds 1000 hours, most of which are completely self-recorded programs. Music courses cover everything from elementary education to popular song creation, and some professional courses require payment. Users cover almost all senior netizens and provide a wide range of learning and communication platforms for most guzheng enthusiasts, ancient zheng education, and training centers and senior enterprises. There are many one-way resource websites, but this platform is mainly one-way output learning, and most of the rest of the time students need to practice and imitate, which requires a high degree of learner autonomy.

**Two-way interaction**

The salient feature of music education and English K12 education is the guidance of main courses and the “28 attributes” of after-school education. Students spend most of their time and energy in get out of class after class. Therefore, compared with the early resource-based online music learning, online one-to-many, or one-to-one music courses are becoming a trend.

**Douyin live broadcast, Taobao live broadcast, and other software** This platform attracts a good customer base through specific marketing techniques and provides training services in the form of free real-time streaming or group buying courses. This live broadcast platform has a powerful online real-time questioning or commenting ability, and because the teacher not only completes the class, but also further explains and answers the questions according to the needs of the students, the level of dialogue has been greatly improved. On the other hand, courses that rely on the platform rely on the team or background work to assign students’ homework and check the learning results after work, which is usually done by full-time personnel.

**Tencent QQ, WeChat, and other audio-visual software** This kind of application is social software that people often use every day, and the embedded audio, video, and communication functions are very helpful for teachers to teach themselves. Offline training can be directly carried out online without the need to build and promote a platform. For special periods, there are no face-to-face courses. It provides a more convenient and cheaper option for most music teachers and learners. However, unlike cultural education, music education has high requirements for sound and video, and because of the compression and loss processing performed in the communication protocol, this kind of social software is difficult to achieve offline education to a certain extent. For this reason, it is necessary to maintain communication with students after class and supplement guidance by submitting homework, commenting, and teaching videos in a timely manner.
Analysis of the effect of online music teaching

The emergence of new things must have both pros and cons. It is very important to objectively look at the advantages and limitations of online music education.

Advantages of online music education

Convenient and fast Traditional music education is restricted by regions, and music education resources are unequally distributed, making it difficult to find excellent teachers. At the same time, online music education only requires a computer or mobile phone to connect to the Internet to break through space constraints and achieve learning. The online music education model also breaks the time limit. In addition to the one-to-one real-time training that needs to be scheduled with the teacher, other recorded courses provide powerful functions. The convenience of watching and learning anytime, anywhere is the biggest advantage of online music education.

Resource disclosure With the development of the Internet, various music teaching resources including music scores, audio, and video-based courses can be easily obtained on search engines, and the transparency and popularity of music learning are also increasing. At the same time, whether it is an ordinary music teacher course or a famous musician course, with the help of an online music teaching platform, the official account is selected for independent learning, and educational resources are fully allocated.

Popularity The user position in online music education is mainly for beginners and music lovers and is committed to developing many free or low-cost personal experience courses. These courses have greatly increased people’s enthusiasm for learning music to attract major platforms and corporate customers. At the same time, you can freely choose the advantages of online music education, study time, and subject teachers, which can increase students’ interest and learning tendency.

Limitations of online music education

At the technical level The first is the strict requirements of the Internet. The premise of online music education is that knowledge must be spread through the Internet as a medium. In other words, a more complete online music training course requires a stable network. If there is no network or there is a delay in online teaching, the quality of online education will rapidly decline or be difficult to implement. In addition, during audio and video calls, online courses may need to be delayed. The teacher cannot synchronize the accompaniment, nor can it let the students follow it like an offline course. It is believed that with the advent of the 5G era, this limitation will get better and better.

The second is music transmission technology. The difference between music education and other cultural subjects is that it has high requirements for the degree of sound recovery and the clarity of the performance picture. So far, in addition to high-quality recording and broadcast program resources can ensure the use of professional pickup equipment and high-resolution shooting equipment, it is difficult to achieve most online real-time training. This also means that students cannot clearly hear the teacher’s voice and the colorful parts like offline, nor can they perceive what they have learned from three dimensions.

Weak classroom immersion Traditional music teaching is a classroom setting, and there are many ways of interaction between teachers and students. Under the leadership of the teacher, students can be more focused and immersed in the classroom. On the other hand, online music education only communicates through electronic screens, and the learning process is easily disturbed by the outside world and unexpected situations. This requires students to have a higher degree of autonomy to ensure the effect of learning.

Lack of a standardized industrial supervision system The online music education industry is considered to be an emerging industry. Its business model and content are still under study. It lacks a standardized operation model and management mechanism. The quality of platform institutions and the level of teachers are not uniform. The laws and policies are gradually being improved, which takes time. And experience slowly accumulates.

Conclusion

This article firstly analyzes the continuous development of urbanization in L city, combining the WRF-Chem model with the single-story urban canopy model to conduct a sensitivity test and analyze the urbanization impact and growth of L city, and the increase in the height of urban buildings in L city affects many aspects of the local area. Different urban canopy models have a problem in the simulation of 2 m temperature, that is, the simulation of high temperature during the day and low temperature at night is insufficient. The urban canopy model is different from the WRF model at 2 m temperature. The simulation effect of the WRF model (UCM) of the single-layer urban canopy is the best in the two processes. The deviation of the simulation results and the root mean square error are related to the phase. The coefficients are all very good. Finally, this article conducts a systematic research on the teaching effect of online music education. As the economy continues to grow actively and the market demand is very
large, various platforms and companies are striving to further develop more systematic and comprehensive online music learning software and develop complete online education functions. Among them, online music sparring services are part of the earlier maturity and widespread use of online music education by forming a clear goal, easy-to-implement, and reproducible business model. This article believes that online education and offline education complement each other to obtain the best educational effect, which can promote the development of music teaching.

Declarations

Conflict of interest The author declares no competing interests.

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