Seasonal variation of coastal circulation based on parameter grey estimation and evaluation of residents' physical exercise behavior

Chen Jin¹ · Zhu Jie² · Wang Bin¹

Received: 4 June 2021 / Accepted: 15 July 2021 / Published online: 27 July 2021
© Saudi Society for Geosciences 2021

Abstract
In the past decades, global climate change has greatly changed the natural environment. Due to the lack of measurement data and technical means, there is no consensus on the structure and dynamic mechanism of the b-sea cycle. In this paper, based on ROMs model and grey estimation of parameters, a three-dimensional baroclinic model of thermodynamic coupling in b-ocean region under new background field is established by using high-quality data recently obtained. According to the simulation results and comparative experiments, the seasonal distribution characteristics of b-sea circulation and the water exchange form between b-sea and high seas are analyzed and explained. And many scientific problems of coastal circulation, such as education and mutation mechanism. However, good physical exercise is an important way to improve the physical quality of residents. As the basic requirement of residents’ physical exercise, the community sports environment affects and limits the residents’ physical exercise behavior. Environmental behavior studies show that the relationship between environment and behavior is not directly related to the individual’s response to environmental stimuli. The principle of “applicability” should be emphasized in the construction of sports environment in society. Therefore, the residents' behavior evaluation of the school sports environment should become an important feedback information in the construction of community sports environment. The purpose of this paper is to analyze the correlation between residents’ sports environment evaluation and sports exercise behavior orientation, and to provide a theoretical basis for improving residents' sports exercise behavior and optimizing and perfecting the sports environment of the community.

Keywords Grey estimation of parameters · Coastal circulation · Residents’ physical exercise · Behavior evaluation

Introduction
In this work, we first analyzed the seasonal variation characteristics of ocean circulation in the b sea, and discussed the possible ways of water exchange between the B sea and other sea areas from the perspective of circulation model (Kritikos and Davies 2015). Then the maximum seawater temperature and salinity structure, and the spatial distribution of a-seawater and m-bay water are analyzed (Suzen and Doyuran 2004). Finally, we choose the 6-channel of M Bay estuary ° Part n. The coastal circulation in the B sea is studied by using grey estimation of parameters. The velocity of ocean circulation in sea B is very small, and the annual velocity in most areas is less than 5 cm/s, which is much smaller than the tidal current in this area. In the horizontal distribution, the current near the meandering coast of B sea is strong all year round, while the current in the middle of B Bay and I state Bay is weak. In the vertical direction, the surface velocity is always greater than the ground velocity. In the four seasons, the residual flow is larger in summer and spring, but smaller in autumn and winter. In recent years, all aspects of society are focused on the health of residents, because it is not only related to the overall coordinated development of residents, but also determines the sustainable development of Chinese society and the quality of talents necessary for social development (Lee and Pradhan 2007). China must build a harmonious society, the
development of residents’ physical exercise habits just determines the residents’ physical condition. Therefore, the health level of residents is steadily improving, and promoting their physical exercise habits becomes the top priority of current Chinese education, which is of great strategic significance (Nguyen et al. 2019; Riclki and Graf 2009). It can be said that although all sectors of the society attach great importance to this problem, in fact, citizens’ awareness of spontaneous exercise is weak, but it is difficult to develop exercise habits, and their physical condition is deteriorating year by year (Santini et al. 2009). The purpose of this paper is to investigate and statistically analyze the situation of residents participating in sports activities in specific cities, so as to combine the residents’ own characteristics, learn from the residents’ previous physical education experience, and consider the following factors, such as family and society, and then check again (Sangchini et al. 2015). The current task is to improve the residents’ awareness of lifelong sports, and put forward some suggestions to support the development of residents’ physical exercise habits in theory, and promote the harmonious and unified development of residents’ quality. This article mainly uses the literature data method, the investigation method, the mathematical statistics method, the logical analysis method, and the comprehensive research method, the behavior appraisal and so on the research method to carry on the research, has drawn the conclusion, namely affects the resident physical exercise behavior habit the formation factor (Lee et al. 2001; Pham et al. 2016).

Materials and methods

Overview of the study area

P sea is a closed shallow sea in the deep part of China, located at 37° 07′ ~ 4100 N and 117° 35′ ~ 121° 10′ E. It is surrounded by three sides of land, and only passing through the P channel and the H sea wall to communicate eastward. It is 480 km long from north to south and 350 km wide from east to west, covering an area of 70,000 square kilometers. It can be divided into five parts: LD Bay, P Bay, I state Bay, Z basin, and B channel. Despite its small size, b-meer’s pool area is wide (Ma et al. 2013). There are three main river systems: H, I, and P. There are more than 40 annual outflow of water in the coastal ocean, which is related to the overall ecological pattern of P sea.

B the average depth of sea water is 18 meters, while the shallow water below 20 meters is more than half. The largest depth is near the old fellow iron road in the north of the Strait, about 86 meters (Valencia Ortiz and Martinez-Grañá 2018). The topography of the seabed is usually inclined from three bays to the middle of the sea area and the North Sea, and there is a shallow depression in the center, narrow

in the north and wide in the south, with a depth of 20–25 m, which is called intermediate stage B.

Research methods

Parameter grey estimation model

The calculation of mediation variables is based on the mechanism of mediation variables. Through the above analysis, we can know that the mechanism of the intermediate variables is as follows:

1. There is a causal relationship between independent variable x and dependent variable y.
2. The independent variable x has an effect on the variable m, and then M affects y, so M plays a mediating role.
3. If there is no intermediate variable m, the influence of X on y will be greatly reduced or even disappeared.

There are the following relationships between the effects:

\[ w = c + a \cdot b \]  \hspace{1cm} (1)

PLS is executed by SmartPls software, and the result is used to initialize the population of DCQGA. The parameter error and indirect effect error of SmartPls estimation are calculated by the following Eqs. 2 and 3, respectively.

\[ \text{error} = \sum_{i=1}^{p} \left( w_i - \tilde{w}_i \right)^2 \]  \hspace{1cm} (2)

In the complete mediator model, the direct effect is 0, and the indirect effect is the total effect:

\[ \text{error} = \frac{1}{n} \sum_{i=1}^{p} \left( w_i - \tilde{w}_i \right)^2 \]  \hspace{1cm} (3)

\[ E_{\text{error}} = \left( E_{\text{pl}} - E_{\text{ideal}} \right)^2 \]  \hspace{1cm} (4)

The new DCQGA program runs for 20 times, and the average value of the parameters of the feasible solution in the 20 times running results is taken as the final parameter result of the new DCQGA. The parameter estimation error of new DCQGA is defined as:

\[ E_{\text{error}} = \left( E_{\text{DCQGA}} - E_{\text{ideal}} \right)^2 \]  \hspace{1cm} (5)
Coastal circulation research model configuration

The space area of the model specified in this paper is: 37.00° N, 117.40° ~ 122.50° E. The in the case of using rectangular grid, it covers the whole B sea area and the adjacent part of the North Sea area, and the open boundary only covers the eastern boundary (i.e. 122.50 °) The boundary of EE meridian. The horizontal resolution is about 4 km, and the vertical resolution is divided into 10 s layers. In calm water, detailed experiments and discussions on the structure and conversion of residual cycles are carried out with this spatial accuracy. The top data is based on the 2 fine terrain of the China Sea, although the stability of the calculation model needs to be improved. Referring to the maximum height of area B in the ocean, the minimum water level is set at 5 m. combined with CFL status, the time of external model is 20, and the step size of internal model is 600 (Yalcin et al. 2011). Because only a single M2 tidal component is considered, it cannot effectively reflect the actual circulation of ocean B. In the open boundary, four main astronomical components m2, K1, S2, and O1 and their tides are introduced, and the harmonic constants are obtained from the United States. The results from the global tide model TPXO7 Alta of Oregon State University (OSU) refer to the atlas of the oceans to correct the limit values accordingly. Tpxo Altas model is based on Laplace tide equation, which can obtain various altitude measurement data (such as TOPEX/Poseidon) and integrate fine terrain and measurement data (such as coastal water station and ship ADCP) nearby. In order to ensure the stability of the model calculation, the limit water level gradually increases from zero (Mousavi et al. 2011).

According to the purpose of this paper, we should choose the forced atmosphere field and open boundary flow field as far as possible from the average climate data in recent years. Unless otherwise stated, the following data can only be obtained after several years of average processing: the average period of annual change fields is about 2013–2019. This is selected according to the length of the available data set, and different variables may have small differences (Makealou et al. 2015).

The upper limit of the model is determined by the relevant parameters of atmosphere, precipitation rate, and radiation value. The wind data are from the reanalysis results of MM5 model in the East China Sea. The separation time is 3 h and the separation width is 0.1 °. The other is based on CFSR analysis data prepared by the National Center for Environmental Prediction (NCEP). The time interval was 6 h, and the resolution of the residue was 0.3 ° to 0.5 °. These records are based on global connections. The results of ocean atmosphere Land Ocean ice system and the absorption of historical observation data improve the quality of the previous generation NCEP products. Due to the small area of simulated sea area and the special geographical location of sea B, there may still be a certain gap between the specified atmospheric constraint data and the actual situation. The model also refers to the actual sea surface temperature, the heat flow between the salt field and the upper interface and the fresh water flow. Sea surface temperature data were selected from NOAA data products (oisst) based on satellite observations, and used with 0.25 °. The best interpolation method of spatial resolution and monthly average time processing (Martha et al. 2019).

Results

Experimental results of parameter grey estimation algorithm

Table 1 shows that for the 15 parameter values, the new DCQGA estimates are closer to this value than the SmartPLS estimates. For the first six values, the smartpls estimate is usually higher. For example, for our exception, the estimated value of ESield14 is 0.62, while the estimated value of new DCQGA is 0.86, which is close to the optimal value of 0.9. The last estimates for the last nine are usually outside the size range. For example, for parameter 10, the estimated SmartPLS value is 1, and the estimated new DCQGA value is 1.2, which is close to the optimal value of 0.5. In general, the nominal error of new DCQGA is 0.830 less than that of smartpls, and the operation error of new DCQGA is 0.0112 less than that of smartpls. In other words, the accuracy of measurement and the ability to estimate the accuracy of new DCQGA are also very high.

The results of effect estimation of new DCQGA’s complete mediation model are shown in Table 2:

It can be seen from Table 3 that after adding the negative scenario, the estimation error of smartpls is large, while new DCQGA is very close to the optimal value. In general, the nominal error of new DCQGA is 0.813 less than that of smartpls, and the operation error of new DCQGA is 0.0129 less than that of smartpls. In other words, new DCQGA’s parameter estimation and effect estimation are more accurate with negative scenarios.

The parameter estimation results of new DCQGA’s complete mediation model are shown in Table 3.

The effect estimation results of new DCQGA’s complete mediation model are shown in Table 4.

Analysis of the characteristics of the current velocity in the Sea circulation

In Table 5, the velocity characteristic values of b-sea ring flow field in four seasons are briefly counted.

From this table, we can get a preliminary understanding of cycle B system.
The residual flow of B is very small, and the average value of the whole area is less than 5 cm/s, which is far less than the tidal current in this area; At the same level, the maximum value of residual flow is about 20 to 30 cm/s, and the minimum value is only 0.01 cm/s; From the average point of view, the vertical surface velocity is always greater than the ground velocity; In the whole four seasons, the residual flow is larger in summer and spring, but smaller in autumn and winter. The above points 1 to 3 have been confirmed in the actual measurement and simulation results of previous products. As for the fourth point, it is seldom mentioned because the B ocean circulation of four seasons is seldom studied at the same time.

Among the factors that affect the ocean B circulation, the coastal runoff, temperature, and salinity structure show obvious seasonal variations. These three factors were also considered in the subsequent control experiments. Therefore, when describing the circulation system of each season, we will briefly introduce these background environmental areas for comparative analysis. Figure 1 shows the distribution of 10 m wind field over the sea surface in four seasons of the simulation area.

Figure 2 shows the simulated temperature and salinity structure of sea B in winter and summer. Seasonal variation results of coastal circulation

In February, the wind in b-sea is very strong, and the wind speed has a certain spatial variation. The wind speed of LD Bay and B sea is the highest, and gradually decreases to B Bay and I state. The wind direction is usually northerly, while it is relatively small in the north. The runoff into the ocean should be at least 1% of the annual runoff, and the monthly runoff slope shall not exceed 5% of the annual runoff. The temperature and salinity of the ocean area basically have no change in the vertical direction. In the horizontal direction: the temperature amplitude changes little, and decreases from the mouth of H Canyon and B sea to the top of the three. The temperature difference is about 4 °C. The highest temperature is in the north of the Strait, the lowest temperature is in the west of the Strait, above LD Bay. The cold water area near B middle school group is also weak. Except LD Bay, and Izhou Bay, a clear salt area was formed due to runoff and salt distribution. In addition, the area of other sea areas is relatively uniform. The west coast of B Bay and LD Bay is slightly higher, while the north of the Strait is slightly lower. At this time, the effects of temperature and density distribution on density cancel each other, and the density of ocean area is almost constant.

As shown in Fig. 3, in winter, the B circulation is generally weak from the perspective of deep average flow, and the velocity in most areas is less than 5 cm/s, while the residual current is in the middle. In addition, there are some scattered strong currents in the coastal areas, such as Xizhong island in the east of B. LD Bay and CX Island along the coast, dike construction in the south of B Bay and near the Yellow River Estuary in Izhou Bay, etc. Most of these areas have winding coastlines. Combined with Fang Guohong’s explanation of the residual current generated by the sea tide in the mantle, its formation should be related to the interaction between the coastline and the tidal wave, which will be discussed in detail in the later control experiments. The horizontal structure of the b-sea circulation is not very clear due to the weak velocity and chaotic current in the coastal area: there is a large flow ring and clock in the middle of the b-sea near the Liaodong Bay mouth; There is no obvious stratum on the coast of LD Bay. In some areas, the structure is clear. On the east side of the estuary, there is a small anticlockwise ring at a shallow depth of 10 m at the top. In the vicinity of CX Island, a small headland formed northward clockwise, and Fuzhou Bay distributed along the southern coast. To the north of the Bay there is a southern river leading to bay B, while to the south there is regular coastal runoff. The circulation in the bay is mainly

| Table 1 | Parameter estimation results of new DCQGA’s complete mediation model |
|---------|------------------------------------------------|
| Method  | 15 parameter values | Error |
| Ideal value | (0.6,0.7,0.8,0.8,0.8,0.8,0.9,0.8,0.4,0.5,0.8,0.7,0.3,0.8) | 0 |
| SmartPLS | (0.61,0.52,0.62,0.47,0.61,0.70,1,1,1,1,1,1,1,0.44,0.90) | 0.86 |
| DCQGA average | (0.71,0.8,0.86,0.65,0.82,0.85,0.75,0.86,0.94,0.52,0.7,0.85,0.69,0.39,0.74) | 0.032 |

| Table 2 | Effect estimation results of new DCQGA’s complete mediation model |
|---------|------------------------------------------------|
| Ideal value | SmartPLS | DCQGA | Error(DCQGA)- Error(SmartPLS) |
| Indirect effect | 0.32 | 0.437 | 0.271 | −0.0112 |
| Total effect | 0.32 | 0.437 | 0.271 | −0.0112 |
controlled by the counterclockwise circulation along the coast, but from the north of the Haihe estuary to the Nanpu coast. It is a kind of low power ring structure with clock; The inner part of zhouwan Bay is roughly counterclockwise, and there is an obvious coastal runoff on the east coast of zhouwan Bay, which finally flows out of the B sea through the south of the B sea.

Figure 4 also shows the three-dimensional structure of the winter cycle of the B sea. It can be seen that the velocity of the surface layer is obviously higher than that of the lower layer. Compared with the deep average flow, the surface layer shows an improved flow in the middle of LD Bay, and basically shows a southerly trend corresponding to the north wind field. However, due to the influence of the winter monsoon, the flow in the East increases, while that in the West decreases, and the center of the flow ring moves westward. In the estuary of l-zhou Bay, there is a large amount of flood eastward, which finally merges into the southern exit of the Strait, and the lower flow is similar to the deep average flow. It can be seen that the influence of wind on the circulation is mainly reflected in the upper surface, which corresponds to the conclusion drawn from the measured data. The only area with great difference is at the estuary of Zhouzhou Bay, while the current faces west at the estuary of H. The outer part also points to the estuarine coast, which extends in the opposite direction to the surface water flow and is in the form of equilibrium flow.

As shown in Fig. 5, from the perspective of the middle and lower reaches, the cycle in spring is stronger than that in winter. Further flow between the Gulf and the north is also the lowest. The current is very strong in winter, and there is no change in the coastal area. The inflow to the north of the Strait rose a short distance along the east coast of LD Bay. It merges in this circulation and finally enters the large circulation clockwise in the West. In the coastal area of LD Bay, there is still no obvious large circulation, and the small circulation structure near the tip of CX island has almost no change, but it is affected by the east coast mentioned above. The effect of countercurrent circuit is that the residual flow in the bracket F may still become chaotic, and the flow at the bracket mouth will deflect clockwise. In the middle of LD field, although the residual flow is very small, it is at 40 °. A weak counterclockwise flux loop is shown near the large anticlockwise flow ring along the Gulf Coast has disappeared, and the flow trend in the southern coast of the coastal bay is not obvious, but it shows the flow pattern from coast to North in the Haihe estuary and a certain range. Then the coastal flow in the Bay moves clockwise, and the flow in l state Bay weakens. Except for the strong coastal runoff on the east coast of the Bay, the circulation structure of other areas is unclear.

The three-dimensional structure of the circulation system in spring is shown in Fig. 6.

As shown in Fig. 7, from the perspective of deep average flow, the summer circulation has been further improved. Except for the middle part of LD Bay, the original flow area does not change much, so it is not repeated. The middle area near LD bay mouth is more significant, and the velocity is basically more than 5 cm/s. It has also become a strong current area. At present, in the middle part of LD Bay, the velocity of B bay mouth and the open sea has increased.

As shown in Fig. 8, from the perspective of depth average flow, the circulation of B sea in autumn is similar to that in February in both magnitude and flow pattern.

The three-dimensional structure of the autumn circulation system is shown in Fig. 9.

As shown in Fig. 10, from the perspective of depth average flow, the circulation of B sea in autumn is similar to that in February in both magnitude and flow pattern.

The three-dimensional structure of the autumn circulation system is shown in Fig. 9.

### Table 3 Parameter estimation results of new DCQGA’s complete mediation model

| Method          | 15 parameter values | Error |
|-----------------|---------------------|-------|
| Ideal value     | (0.5, 0.7, 0.5, 0.9, 0.6, 0.8, 0.5, 0.8, 0.9, 0.5, 0.7, 0.8, 0.8, 0.4, −0.7) | 0     |
| SmartPLS        | (0.57, 0.57, 0.61, 0.47, 0.61, 0.70, 1, 1, 1, 1, 1, 1, 0.44, 0.89) | 0.845 |
| DCQGA average   | (0.81, 0.86, 0.93, 0.67, 0.74, 0.83, 0.71, 0.76, 0.87, 0.53, 0.66, 0.88, 0.81, 0.38, −0.69) | 0.032 |

### Table 4 Effect estimation results of new DCQGA’s complete mediation model

|                  | Ideal value | SmartPLS | DCQGA  | Error(DCQGA)− Error(SmartPLS) |
|------------------|-------------|----------|--------|-------------------------------|
| Indirect effect  | 0.32        | 0.435    | 0.304  | −0.0129                       |
| Total effect     | 0.32        | 0.435    | 0.304  | −0.0129                       |


Discussion

Analysis of seasonal variation of coastal circulation

According to the above description, the characteristics and variation rules of the b-cycle system in four seasons can be summarized:

1. Circulation flow value: the seawater flow value of B in most areas of the year is relatively small, and the flow rate is less than 5 cm/s from the average point of view, the surface flow is stronger than that of B. The flow of bottom flow, spring, and summer is faster than that in autumn and winter. In marine areas, some strong currents do not usually change over time (Althuwaynee et al. 2014). They are distributed in the relatively curved seawater near sea B and the coastline. The lower part of B Bay, L-state Bay, and middle LD Bay are weak water flow area all year round.

2. Circulation structure: in the sea B region, because of the separation of strong and weak current regions, the traditional view is that the continuous large circulation mode is not very obvious, but the local small-scale vortex ring structure is relatively clear. That is what it is when it

Fig. 1. The distribution of 10 m mean wind field over sea B in four seasons

|         | Depth average flow rate (cm/s) | Near surface velocity (cm/s) | Velocity near the bottom layer (cm/s) |
|---------|--------------------------------|------------------------------|--------------------------------------|
|         | Max    | Minimum | Average value | Max    | Minimum | Average value | Max    | Minimum | Average value |
| Winter  | 21.54  | 0.01    | 1.37         | 24.27  | 0.05    | 1.8          | 17.13  | 0.01    | 1.24        |
| Spring  | 23.29  | 0.02    | 1.77         | 29.15  | 0.06    | 3.26         | 14.92  | 0.01    | 1.35        |
| Summer  | 26.86  | 0.02    | 2.33         | 35.89  | 0.02    | 4           | 14.13  | 0.01    | 1.48        |
| Autumn  | 21.79  | 0.02    | 1.57         | 26.74  | 0.02    | 2.24         | 16.83  | 0.01    | 1.33        |
comes to very deep average flow. In the middle of Lake B near Liaodong Bay mouth, there is a large clock cycle throughout the year. This is also the most obvious circular structure of Central Sea B. The strength of the flow ring varies with the seasons. Autumn and winter season is weak, spring and summer season is strong, and small eddy appears in the east edge of the flow ring in spring and summer season, and the flow is large (Baeza and Corominas 2001). There is no continuous large circulation structure in the four seasons of the middle of LD Bay coast, but there are some obvious small-scale water flows in some areas: anticlockwise, small flow circulation on the east side of upper l-mouth, located at the foot of the mountain, is now along the mouth of Fuzhou bay to the south (Arora et al. 2004). These small vortices are almost present in the four seasons of the coastal area, and the influence of the surrounding ocean circulation is not changed, the seasons are not changing much. In spring and summer, it consists of small anti-clockwise flow in the northeast and a large flow ring on the south coast. At present, the trend of the south coast is unclear. The circulation of the bay is mainly anticlockwise. In spring and summer, the flow rate is very weak. In autumn and winter, the east coast of the bay is present all year round due to the strengthening of coastal water flow. Unique coastal water flows from sea level B through the south of the channel. In summer, outside the entrance of the Yellow River, a northeast north-east water flow converges in the middle of ocean B. The three-dimensional structure of b-meer cycle is obvious, and the distribution of residual flow on the surface and bottom layer is different. The main flow is not changed with seasons,
mainly due to the strong current of the channel and the coast, the strong current on the west side of Laizhou Bay mouth and the clockwise flow in the center of the sea area. The difference is significant, which shows that the influence of wind on circulation is mainly limited to the upper ocean. In spring and summer, it will be less affected by wind field, similar to the deep average flow pattern. Combined with the distribution of temperature field in these two seasons, the most important control factors should be temperature and salt structure, which will be discussed further later (Chae et al. 2017).

Analysis of residents’ physical exercise behavior elements

Habit is defined to consciously carry out certain activities under specific circumstances, which can also be called fixed habit. Through repeated physical exercise, gradually form exercise habits. This is a regular and regular sports activity, which can meet the needs of the subjects. It’s a way of life that doesn’t need special memory, and it’s also a way of nurturing and expressing in a pleasant way. The formation of sports habit refers to a relatively stable behavior and phrase, which can promote the coordinated development of body and mind through continuous physical exercise (Chang and Chiang 2009). The structural elements of forming common sports habits include: the full understanding of physical exercise, the understanding of the rules of physical exercise, the understanding of the meaning and characteristics of physical exercise, and the ability to understand the methods and principles of physical exercise.

In order to judge whether the residents’ physical exercise habit is formed, we must establish a more systematic index system to define the residents’ physical activity habit. We think we can judge it through the behavior habit elements of the training attitude scale (Kaur et al. 2018).

Analysis on influencing factors of residents’ physical exercise behavior

Through the analysis and comparison of the survey results and the scale used by residents to check the behavior habits in physical exercise, we can find that the number of residents in the age group with normal exercise habits is the number to be checked (Chau and Y. F. T. 2004). Among the
respondents, men and women; Among the respondents of this age group, the number of residents who have physical exercise habits, and constitute the respondents of this age group, including boys and girls. This means that in primary schools, the proportion of residents with normal exercise habits is relatively low, and the difference between men and women is not great. In senior high school, the proportion of residents engaged in sports activities is relatively high, and the height of boys is twice that of girls (Fell et al. 2008). The reason for the above situation may be that the concept of physical exercise of small residents is still unclear, which means that fewer people with normal physical exercise habits and more and more people continue with physical exercise after graduating from middle school. Due to the physiological reasons of girls, their interest in physical exercise is declining. As a result, the number of girls who are used to middle school sports is much less than that of boys (Kanungo and Sharma 2014).

There are many different ways of skill expression between people. As a person in the community, everyone hopes to be recognized by the community in all aspects. Sports activities are based on their own characteristics, which can give full play to people’s sports ability among the elderly, especially among the young people. Residents have begun to pay more attention to their image in front of others, especially their behavior, appearance, and various skills (Dapples et al. 2002). They often respond to outside comments and seem very sensitive. The sports ability of residents is very important to actively participate in sports activities, and the basis of residents’ sports ability is their inherent body shape (Kayastha et al. 2013).

**Development strategy of residents’ physical exercise behavior**

The author thinks that the basic concept of family, school, and community is “three in one”, so as to promote residents to participate in sports activities: through cooperation with family, school, and community, following the basic principle of people-oriented, developing student sports, and establishing appropriate organizations. The coordination of several parties promotes the physical and mental health of residents, and improves their ability to participate in sports and the process of sustainable
development (Cogan and Gratchev 2019). Its connotation includes the following contents: first, we should give full play to its driving force through a variety of factors, and finally form the development process of common forces. “Trinity” mechanism must play a full role in encouraging residents to participate in sports activities, and then the three subsystems form a strong synergy. The ultimate goal is not only to enable citizens to consciously participate in sports activities of their families, schools, and communities, but also to create a situation in which families and communities can appreciate the value of sports. Secondly, the Trinity is constantly developing the residents’ ability to participate in sports activities, and changing the phenomenon of training only on campus in the past and isolating from sports activities after leaving school. Third, “Trinity” requires a specific organization to encourage citizens to participate in sports activities, and take necessary safeguard measures by making appropriate coordination plans (Guzzetti et al. 2005). The purpose of establishing similar organizations at all levels is to organize and guide the development of sports activities in each system on the one hand, and to coordinate and guide the meetings of the three systems on the other. From the perspective of level, it occurs orderly in a certain order of time and space through the three teaching channels of family, school, and society (Harilal et al. 2019). In this process, we need to deal with some problems, such as: B. in the case of families and communities outside the school, how to use the sports skills that residents learn in the school sports classroom, and how to provide conditions for families and residents in the community to continue to contact and participate in sports activities. However, at present, the overall situation of sports development of local residents in China is common. Most places where children and young people participate in sports learning and training are limited to learning places. When they return to their families and communities, they stop exercising, and many do (Hemasinghe et al. 2018). The reason for this is that traditional school physical education is separated from family physical education and social physical education. In terms of time, the process of “Trinity mechanism” can be divided into main stage and secondary stage.

Fig. 8. Distribution of surface and bottom Euler residual currents in summer over sea B (basic simulation results)

Fig. 9. Distribution of depth averaged Eulerian residual current in sea B in autumn (basic simulation results)
Conclusion

Based on the current international advanced ROMs model, this paper uses the recently obtained measurement data and analysis data products to establish the annual cycle model for the thermodynamic dynamic B sea under the new climate with higher quality and higher resolution. According to the simulation results, the system describes the latest structure and annual variation process of b-sea circulation system, and further studies the formation mechanism and seasonal variation mechanism of b-sea circulation through the design of control experiment. Through the behavior evaluation, this paper further analyzes the residents’ physical exercise, and draws the following conclusions: age, gender, interest in sports, understanding of the importance of sports and personal physical quality, and other personal factors will affect the health of the elderly. However, the personal factors of residents are often ignored, which cannot reflect their dominant position in participating in sports activities. They only carry out passive sports activities, and failed to achieve the set goals.

Declarations

Competing interests The authors declare no competing interests.

Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution, and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article’s Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit http://creativecommons.org/licenses/by/4.0/.

References

Althuwaynee OF, Pradhan B, Park H-J, Lee JH (2014) A novel ensemble decision tree-based CHi-squared Automatic Interaction Detection (CHAID) and multivariate logistic regression models in landslide susceptibility mapping. Landslides 11(6):1063–1078. https://doi.org/10.1007/s10346-014-0466-0

Arora MK, Das Gupta AS, Gupta RP (2004) An artificial neural network approach for landslide hazard zonation in the Bhagirathi (Ganga) Valley, Himalayas. Int J Remote Sens 25(3):559–572. https://doi.org/10.1080/0143116031000156819

Baeza C, Corominas J (2001) Assessment of shallow landslide susceptibility by means of multivariate statistical techniques. Earth Surf Process Landf 26(12):1251–1263. https://doi.org/10.1002/esp.263

Chae BG, Park HJ, Catani F, Simoni A, Berti M (2017) Landslide prediction, monitoring and early warning: a concise review of state-of-the-art. Geosci J 21(6):1033–1070. https://doi.org/10.1007/s12303-017-0034-4

Chang K-T, Chiang S-H (2009) An integrated model for predicting rainfall-induced landslides. Geomorphology 105(3–4):366–373. https://doi.org/10.1016/j.geomorph.2008.10.012

Chau KT, Y. F. T. (2004) GIS based rockfall hazard map for Hong Kong. Int J Rock Mech Min Sci 41(3):1–6

Cogun J, Gratchev I (2019) A study on the effect of rainfall and slope characteristics on landslide initiation by means of flume tests. Landslides 16(12):2369–2379. https://doi.org/10.1007/s10346-019-01261-0

Dapples F, Lotter AF, Van Leeuwen JFN, Van Der Knaap WO, Dimitriadis S, Oswald D (2002) Paleolimnological evidence for increased landslide activity due to forest clearing and land-use since 3600 cal bp in the western swiss alps. J Paleolimnol 27(2):239–248. https://doi.org/10.1023/A:1014215501407

Fell R, Corominas J, Bonnard C, Cascini L, Leroi E, Savage WZ (2008) Guidelines for landslide susceptibility, hazard and risk zoning for land use planning. Eng Geol 102(3–4):85–98. https://doi.org/10.1016/j.enggeo.2008.03.022

Guzzetti F, Reichenbach P, Cardinali M, Galli M, Ardizzone F (2005) Probabilistic landslide hazard assessment at the basin scale.
Kritikos T, Davies T (2015) Assessment of rainfall-generated shallow landslides around Chamoli-Joshimath region, Garhwal Himalayas, India. Landslides 11(4):629–638. https://doi.org/10.1007/s10346-014-0438-9

Kaur H, Gupta S, Parkash S, Thapa R (2018) Knowledge-driven method: a tool for landslide susceptibility zonation (LSZ). Geology, Ecology, and Landscapes 00(00):1–15. https://doi.org/10.1080/24749508.2018.1558024

Kayastha P, Dhital MR, De Smedt F (2013) Application of the analytical hierarchy process (AHP) for landslide susceptibility mapping: a case study in Badulla District, Sri Lanka. Procedia Eng 212:1046–1053. https://doi.org/10.1016/j.proeng.2018.01.135

Kanungo DP, Sharma S (2014) Rainfall thresholds for prediction of shallow landslides using frequency ratio and logistic regression models. Environ Geol 45(5):665–679. https://doi.org/10.1007/s00254-003-0848-9

Kaur H, Gupta S, Parkash S, Thapa R (2018) Knowledge-driven method: a tool for landslide susceptibility zonation (LSZ). Geology, Ecology, and Landscapes 00(00):1–15. https://doi.org/10.1080/24749508.2018.1558024

Kayastha P, Dhital MR, De Smedt F (2013) Application of the analytical hierarchy process (AHP) for landslide susceptibility mapping: a case study from the Tinau watershed, west Nepal. Comput Geosci 52:398–408. https://doi.org/10.1016/j.cageo.2012.11.003

Kritikos T, Davies T (2015) Assessment of rainfall-generated shallow landslide/debris-flow susceptibility and runout using a GIS-based approach: application to western Southern Alps of New Zealand. Landslides 12(6):1051–1057. https://doi.org/10.1007/s10346-014-0533-6

Lee S, Pradhan B (2007) Landslide hazard mapping at Selangor, Malaysia using frequency ratio and logistic regression models. Landslides 4(1):33–41. https://doi.org/10.1007/s10346-006-0047-y

Lee CF, Li J, Xu ZW, Dai FC (2001) Assessment of landslide susceptibility on the natural terrain of Lantau Island, Hong Kong. Environ Geol 40(3):381–391. https://doi.org/10.1007/s002540000163

Ma F, Wang J, Yuan R, Zhao H, Guo J (2013) Application of analytical hierarchy process and least-squares method for landslide susceptibility assessment along the Zhong-Wu natural gas pipeline, China. Landslides 10(4):481–492. https://doi.org/10.1007/s10346-014-0402-8

Makealoun S, Eka Putra DP, Wilopo W (2015) Landslide susceptibility assessment of Kokap area using multiple logistic regression. Appl Geology 6(2):53–61. https://doi.org/10.22276/jag.721

Martha TR, Roy P, Khanna K, Mrinalini K, Padal Kumar K (2019) Landslides mapped using satellite data in the Western Ghats of India after excess rainfall during August 2018. Curr Sci 117(5):804. https://doi.org/10.18520/cs/v117i5/804-812

Mousavi SZ, Kavian A, Soleimani K, Mousavi SR, Shirzadi A (2011) GIS-based spatial prediction of landslide susceptibility using logistic regression model. Geomatics, Natural Hazards and Risk 2(1):33–50. https://doi.org/10.1080/19475705.2010.532975

Nguyen V, Pham B, Vu B, Prakash I, Jha S, Shahabi H, Shirzadi A, Ba D, Kumar R, Chatterjee J, Tien Bui D (2019) Hybrid machine learning approaches for landslide susceptibility modeling. Forests 10(2):157. https://doi.org/10.3390/f10020157

Pham BT, Pradhan B, Tien Bui D, Prakash I, Dholakia MB (2016) A comparative study of different machine learning methods for landslide susceptibility assessment: a case study of Uttar Pradesh (India). Environ Model Softw 84:240–253. https://doi.org/10.1016/j.envsoft.2016.07.005

Rickli C, Graf F (2009) Effects of forests on shallow landslides—case studies in Switzerland. Forest Snow and Landscape Research 82(1):33–44

Sangchini EK, Nowjavan MR, Arab A (2015) Landslide susceptibility mapping using logistic statistical regression in Babahyderd Watershed, Chaharmahal Va Bakhtiari Province. Iran Iran’ in Çaharmahal ve Bahar İyani’nde yer alan Baba Haydar Havzası’ nda lojistik regresyon kullanılarak he 65(1):30–40. https://doi.org/10.1080/19475705.2018.1513083

Santini M, Grifoni S, Savelli F, Petroselli A, Rulli MC (2009) Pre-processing algorithms and landslide modelling on remotely sensed DEMs. Geomorphology 113(1–2):110–125. https://doi.org/10.1016/j.geomorph.2009.03.023

Suzen ML, Doyuran V (2004) A comparison of the GIS based landslide susceptibility assessment methods: multivariate versus bivariate. Geomorphology 50:665–679. https://doi.org/10.1016/j.geomorph.2003.07.017-8

Valencia Ortiz JA, Martínez-Graña AM (2018) A neural network model applied to landslide susceptibility analysis (Capitanejo, Colombia). Geomat Nat Haz Risk 9(1):1106–1128. https://doi.org/10.1080/19475705.2018.1513083

Yalcin A, Reis S, Aydinoglu AC, Yomralioglu T (2011) A GIS-based comparative study of frequency ratio, analytical hierarchy process, bivariate statistics and logistics regression methods for landslide susceptibility mapping in Trabzon, NE Turkey. CATENA 85(3):274–287. https://doi.org/10.1016/j.catena.2011.01.014