Research on Smart Immigration System Using Computer Dynamic Forecast Model and Big Data Technology

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Abstract. Sea-level rise caused by global warming puts island countries at lower elevations at risk of inundation, resulting in an increase in the number of environmental displaced persons (EDP). How to choose a suitable country for EDP to emigrate and protect its unique culture has become an urgent problem to be solved. Therefore, this paper uses the global sea level average height data provided by AVISO+ from 1993 to 2019 to predict the global sea level height in 2050 and compare it with the elevations of the island countries in the world to find out which are "high risk island countries". Secondly, when EDP have to migrate to a new country to survive, they will inevitably face the problem of cultural assimilation, that is, cultural loss. In order to predict the risk of cultural loss in high-risk countries, this paper constructs a risk assessment model of cultural loss in high-risk countries on the basis of ISO/IEC general standards and some commercial standards. A comprehensive evaluation model is used to determine which country EDP should migrate to, while ensuring that the risk of cultural loss is minimized. This paper uses data on greenhouse gas emissions, per capita GDP, virtual variables consistent with the official language of high-risk island countries, and the geographical distance of each country. The study found that the global sea level is rising at a rate of 3.397 millimeters a year. By 2050, Maldives, Tuvalu, Kiribati and the Marshall Islands will not have the conditions for normal human life.

Keywords: environmentally displaced person, cultural protection, big data forecast.

1. Introduction

1.1. Background
Environmental problems caused by excessive emissions of greenhouse gases have emerged one after another, which has attracted widespread attention from people all over the world. According to Wei Gray of the National Center for Atmospheric Research, by 2400, the greenhouse gas components in the atmosphere will increase the global average temperature by at least 1°C, and the continuous emission of greenhouse gases will increase the global average temperature 2 -6°C, these two factors together will cause the global sea level to rise by 35 cm every century. The accelerated rise of sea level will seriously affect people's normal life, make coastal areas uninhabitable, and put some island countries in danger of being submerged.
At present, scholars have identified several "high-risk island countries", such as the Maldives, Tuvalu, Kiribati and the Marshall Islands, which will be at risk of disappearing completely \[1\]. Once these island countries are submerged, the people on the island will become environmentally displaced persons (EDPs) and face the resettlement problem.

1.2. Research ideas

The research ideas of this paper can be divided into three parts: Firstly, analyze which countries will face the risk of being submerged and become "high-risk countries" in the context of global warming and rising sea levels. Secondly, environmental refugees who relocate to a new country will face the problem of "cultural assimilation"\[2\], so this article establishes a model to analyze the risk of losing their native culture.

2. Research hypothesis

People will not take special measures to interfere with changes in sea level.

Assuming that when the difference between the height of the island country and the global average sea level is less than 1 meter, it does not meet the conditions for normal human life, and island residents are at risk of becoming EDPs.

Take the forecast results in 2050 as the analysis scope of this article.

3. Model Construction

3.1. Symbols and meanings

| Table 1. symbols |
|------------------|
| Notation | Meaning |
| i | High-risk island countries, i=1, 2, …n |
| \( \hat{h}_i \) | Global sea level height after t year (cm) |
| j | Threats of cultural loss, j=1, 2, …m |

3.2. Model Construction Steps

First, we need to determine which countries will become "high-risk island countries" that are no longer suitable for human habitation as sea levels continue to rise, and then analyze the risk of loss of the unique culture of these "high-risk island countries" separately. The specific modeling is as follows:

3.2.1. Island country prediction model. Using the data of the average height of the global sea level from 1993 to 2019 provided by AVISO+, the least square method is used for fitting to construct the prediction function of the average height of the global sea level:

\[
\hat{h}_i = a_1 + a_2 t
\]  

Then the sea level height value after t years is \( \hat{h}_i \), and the island country with an altitude of less than \( \hat{h}_i +100 \) (cm) at this time is a high-risk island country, which is recorded as i.

3.2.2. Assessment model. When the EDPs of high-risk island countries migrate as a "minority group" to a region with a different culture from the original, their language, religious beliefs, and living habits will gradually become assimilated. The assimilation theory represented by Milton Gordon defines this phenomenon as "cultural assimilation"\[3\].

The process of cultural assimilation is also the process of gradual loss of culture in high-risk countries. In order to assess the magnitude of this risk, we learn from the ideas of Pei Erming and Liu...
Baoxu [4] and refer to ISO/IEC general standards and some commercial standards to build the risk assessment model for cultural loss in high-risk countries, details are as follows:

1. Define the combination of threat and cultural fragility as the possible degree of assimilation, namely \( C = f(T, V) \)

2. The impact on the culture of high-risk countries depends not only on threats and cultural fragility, but also on the importance of the culture itself. so \( I = f_2(C, A) \), or \( I = f_3(T, V, A) \).

3. Once a threatening behavior occurs, the function of the impact caused by the value of culture and the probability of threat occurrence is the size of the risk, namely \( R = f(P, I) = I \times P \iff R = f'(T, V, A, P) \).

The risk composition diagram is as follows:

4. Refer to ISO/IEC 13335 and define \( C = (T + V) - 1 \), then when the \( i \)-th country faces \( m \) threat \( j \), the risk assessment model for cultural loss is:

\[
R_i = \sum_{j=1}^{m} (C_j P_j) A_i = \sum_{j=1}^{m} \left\{ \left[ (T_j + V_j - 1) \right] A_j P_j \right\}, i = 1, 2, ..., n
\]  

3.3. Results

3.3.1. Island countries prediction model results. The least squares method is used to fit and obtain, from this we can see that the annual growth rate of the global sea level is 3.397mm/yr, and the prediction function is: \( h_t = -677.6850 + 0.3397t \)
Figure 2. GMSL fitting

Using the sea level height model to predict 30 years later, that is, $t=2050$, the global average sea level height is $\hat{h}_{2050} = 18.727\, cm$. Comparing the average altitude of the island countries in the world, it is found that the Maldives, Tuvalu, Kiribati and the Marshall Islands are no longer capable of meeting human normal living conditions, the residents of these island countries are facing the risk of becoming EDPs. Besides, as time goes by, the sea level will continue to rise, and countries such as the Bahamas, Bahrain, and Nauru will face the same problem in the near future.

3.3.2. Assessment model results. This article uses a combination of qualitative and quantitative methods to establish the risk assessment model.

First of all, through qualitative analysis, the cultural value of high-risk countries namely cultural importance $A$, vulnerability $V$, and possible threats $T$ in the migration process are determined, including:

1. Using the method of decentralized migration, the residents of the same island country are relocated to different countries;
2. the degree of cultural difference with the destination country is large, such as the local language, religious belief and lifestyle, etc.;
3. the destination country of migration has certain requirements for EDP, such as restricting the use of the language and religious beliefs of the destination country. These commands will speed up the process of assimilation of EDP's culture as a minority group.

Then determine the probability $P$ of various threats based on empirical analysis.

Secondly, use a quantitative method to classify the quaternary elements ($T$, $V$, $A$, $P$), and assign different values to different levels for analysis and calculation. The three elements of $T$, $V$, and $A$ are set to 3 levels and assigned values: High (3), Middle (2), Low (1), then the possible cultural assimilation degree $C$ and influence $I$ are listed as follows:
Table 2. cultural assimilation degree C

|      | V  |
|------|----|
|      | 1  | 2  | 3  |
| 1    | 1  | 2  | 3  |
| 2    | 2  | 3  | 4  |
| 3    | 3  | 4  | 5  |

Table 3. influence I

|      | C  |
|------|----|
|      | 1  | 2  | 3  | 4  | 5  |
| 1    | 1  |
| 2    |    |
| 3    |    |

Since there may be multiple threats T related to the value of I, there are multiple values of cultural assimilation degree C brought by each threat, so the value of I should be the sum of the impacts of all threats T, and the results in Table 3 need to be determined based on specific issues.

Finally, the risk R=I*P, and the specific expansion is: R=(T+V-1) *A*P

For a single threat factor, if the risk value exceeds the highest assigned value of 3, it can be judged as high risk. Now we need to assess the overall risk of the three threats, so we set two critical risk values R1=4 and R2=9. When R≤R1, it is low risk; when R1≤R≤R2, it is medium risk and when R≥R2, it is high risk. The risk distribution diagram is as follows. Dark areas are high-risk areas, gray areas are medium-risk areas, and white areas are low-risk areas. The distribution density of various risk values in different intervals indicates the level of overall risk.
Based on the comprehensive analysis of the population, religion, culture, history, current state of the country, and economic capabilities of the four island countries of the Maldives, Tuvalu, Kiribati and the Marshall Islands, as well as an assessment based on the existing immigration situation, such as the whole country of Tuvalu migrated to New Zealand, the available scores for T, P, V, A should be as follows:

|    | T_j | P_j | V_i | A_i |
|----|-----|-----|-----|-----|
| 2  | 0.4 | 1   | 2   |
| 3  | 0.6 | 3   | 2   |
| 3  | 0.3 | 2   | 2   |

Substituting the values into the formula \( R_i = \sum_{j=1}^{m} \left\{ \left[ (T_j + V_j) - 1 \right]\right\} \) respectively, the risks of cultural loss in the four countries are as follows:

- Maldives: \( R_1 = 7 \)
- Tuvalu: \( R_2 = 12.2 \)
- Kiribati: \( R_3 = 9.6 \)
- Marshall Islands: \( R_4 = 12.2 \)

Comparing the risk scores of these four countries with the risk distribution diagram, we can find that the Maldives is in the medium-risk zone, while Tuvalu, Kiribati and the Marshall Islands are all in the high-risk zone of cultural loss. It can be seen that the forced relocation of EDPs will put these island countries' unique culture at greater risk.

The pixel of a country map extracted in this paper is 567*683ppi, and the cellular space is defined as 1*1ppi. The cellular status corresponds to four states of the place: indigenous people (local people waiting to accept the foreign culture), successful people (refugees who have been assimilated through cultural transmission), intermediate people (indirect transmission of the foreign culture), and persistent people (determined not to accept other cultures).

The transition rule of a cell refers to the law of the evolution process of the state of a cell. The state of the current central cell and its neighbor cell determines the dynamic function of the central state at the next moment, namely a state transfer function:
At the moment $t+1$, $f$ is the mapping function, that is, is the local motion rule of the cell. The simulation results of the model obtained by cellular transformation are as follows:

$$f : s_i^{t+1} = f \left(s_i', s_i''^{t+1}\right)$$

(3)

Figure 4. The medium and long term evolution of cellular automata

4. Conclusion
First of all, the prediction function of the average height of the global sea level obtained by the fitting shows that the height of the global sea level is rising at a rate of 3.397mm per year. By 2050, the height will reach 18.727cm, which will make the Maldives, Tuvalu, Kiribati and the Marshall Islands not have the conditions to satisfy the normal life of human beings. In addition, these island countries have a higher risk of losing their unique culture. Finally, taking into account the GHG emissions and economic strength of various countries, countries with the highest scores such as the United States, China, Luxembourg, Switzerland, and Japan are obliged to accept more refugees. When choosing the best country for migration, “high-risk island countries” should choose countries with similar cultural characteristics, which can slow down the process of “cultural assimilation”. For example, the top three countries most suitable for Marshall Islands migration are Australia, Singapore and Canada.

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