

The Impact of Sea-Level Rise on Tourism Small Islands a Case Study of Wenzhou Island during the Pre-COVID-19 Pandemic Period

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Abstract

During the COVID-19 pandemic period, island tourism experienced a severe impact. Island tourism is a thriving tourism model, but it is greatly affected by the SLR (sea level rise) due to climate change. Small island tourism must face flooding problems that cause sea-level rise. GIS can be used to plan and monitor land use. This case study uses GIS (Geography information system) pre-COVID-19 pandemic period to predict flooding at different scales. After three different scales of digitization processing, it is found that: Overall, the flood area is located in the northern part of the island. The relationship is consistent, that is, the flood season is directly proportional to the peak tourist season. Sea level rise will cause changes in tourist attractions on the island; residents' daily lives will face major changes. This study provides a small amount of inundation scale predictions at different scales; hopes to be helpful for the island's tourism resource planning and residents' adaptation. To avoid add climate change refugees and rational use of tourism resources on lack nature resource small islands.

Keywords: COVID-19 pandemic period, Sea level rises SLR, tourism small islands, flood.

1. Introduction

Studies have shown that the warm water island tourism has always been an attractive way to travel. Although warm water islands account for a very small percentage of the world's land area, sea level rise will cause island flooding, and at the same time, affect the underground drinking water quality and the ecological environment around the island [1,2]. Most small islands suffer from water shortages and low groundwater levels. Due to the increase in daily life needs (for example, population growth and tourism development) and the decreased supply of natural resources (for example, changes in pollution and precipitation patterns), freshwater resources are increasingly limited. For instance, the Southern Pacific Fiji island [3] often suffers from business spillover effect (slow FIji mineral water) of competition as well as conflict between residents' water usage and tourists' water usage. The threatened ecosystem and the limited economic resources on the island further affect the island ability to adapt to climate change and lead to ecological fragility, so prevention in advance favors sustainable development [4,5]. Weizhou Island is an island located in Beibu Gulf waters in Southern Beihai City, Guangxi Zhuang Autonomous Region of southern China, with an area of 24.74 square kilometers and a highest altitude of only 79 meters, which is a small volcanic island with tourist attraction. The number of tourists on Weizhou Island broke through 1.6 million person-times in 2019, making it face great tourism pressure. Fortunately, related studies have pointed out that the island suffers from small impact from typhoon surges, as the waves are distributed outside the bay to the east of Hainan. The meso-scale expansion caused by the typhoon is difficult to spread to the northern bay because it cannot pass through the narrow Qiongzhou Strait [6,7]. However, according to attribution theory, the impact of storm surges cannot be ruled out, because typhoon surges and sea-level rise will incur unpredictable damage and crisis to the island sometimes pre-COVID-19 pandemic period. Island tourism experienced a severe impact during the COVID-19 pandemic period.



Fig 1: Weizhou Island source: Xu, Zhang, , & Zhou, J (2019).

II. Methodology

The first is to select the Digital Grid processing base map required for the research. The base map of this research is mainly the satellite Digital base map generated by the Japan ASTER sensor ASTER (Advanced Space borne Thermal Emission and Reflection Radiometer) using the same-orbit stereo observation method. [8] This Digital ASTER has a flight altitude ratio of 0.6 stereo image, which is mounted on the Terra satellite of the United States for flight, and the orbital altitude of the satellite is 705km. Period: 99 minutes (14 complete orbits per day). Pixel product A GDEM Global Digital Elevation Model.[9], file with elevation information and a quality assessment (QA) NUM file. Both files have a dimension of 3601 samples by 3601 lines, which correspond to 1 degree by 1 degree data area. The names of individual data tiles refer to the latitude and longitude at the geometric center of the lower-left (southwest) corner pixel. After that, the software based on geographic information system (GIS) was used for research and analysis. [10]. For the geographic information system (GIS), the first part is to process the base map (using google map), including image correction, edge correction, cutting, splicing, resampling, format conversion, coordinate conversion. The second part is Grid-based Program for Estimating Terrain Attributes (GETA), including the necessary file format conversion, basic processing modules, terrain feature extraction module for terrain analysis. This study combines these two programs to analyze different scales of 2m / 5m / 10m sea level rise, and overlaps respectively. It selects 2m related research such as. [11], and then adds scale, using sea level rise/5m/10m as different scale for comparisons to study flood area of Weizhou Island under sea level rise.

III. Results and Discussion

After three different scales of digitization processing frame and construct, the research it found that: Overall, the flood area is located in the northern part of the island. And it is in line with the correlation, that is, certain correlation between the flooded area and the flooded height. The reason for choosing 2m as the research starting point or check point of the scale is that the wave height generated by the Fresh wind level follow in the Beaufort wind scale is 2m.The Strong class wind as 5m scale; The Storm wind as 10m scale.

The 2m scale of sea level rise (fig2), flood area is not obvious; the area of the flooded area is not obvious, and the flooded area is the northern part of the island. Usually a storm cause tide or current can easily reach a state where the water surface raises 2m and cause coast huge disasters. Global sea level has been rising over the past century, and the rate has increased in recent decades. NOAA (National Oceanic and Atmospheric Administration US): In

2014, global sea level was 2.6 inches above the 1993 average—the highest annual average in the satellite record (1993-present). This statement is on the NOAA website. Sea level continues to rise at a rate of about one-eighth of an inch per year is clearly. Therefore, the storm and sea level rise will have a serious impact on island tourism.



Fig 2 2M flood area

Under the scale of 5m flooding (fig3), a larger area of flooding is found. As shown in Figure 3. It is speculated that it is related to the terrain and may cause the phenomenon of standing water. The flooded location move inward slightly with small area. The flooded area is still in the northern part of this small island and did not expand to other regions. Checking the topographical map of this island found that there are more sandy beaches in the northern part of the island, which may be related to this condition. It is possible that the flooded area falls in the northern area; however, there is also a large area of sandy beaches in the southwest area of the island. The results of GIS rendering fall in the north part of the island or a question to be solved.

In the research about flood 10m scale condition, the flood area gradually expanded, and it can be connected with the original water (small pond or small lake, small wetland) area on the island, causing long-term water accumulation and change landscape temporarily or permanently. The flood location is still in the northern part of the small island. With fig4 DEM using 10m scale perform analysis, it can be seen that about 1/3 of the islands may be flooded at the 10m flooding scale. This Probability of occurrences not high, but it is worthy of reference for planning. The next planned can be design flooded buffer zone or protected area. Examining the 10m scale area again, we can see that the flooded area blocks or interrupt the main cycle road in the northern part of the Weizhou island. In fact, the roundabouts of some small islands are often damaged by large waves or storms, causing traffic interruptions. In terms of water resources, large-scale seawater intrusion may cause salinization of groundwater, which cannot be used as domestic water.

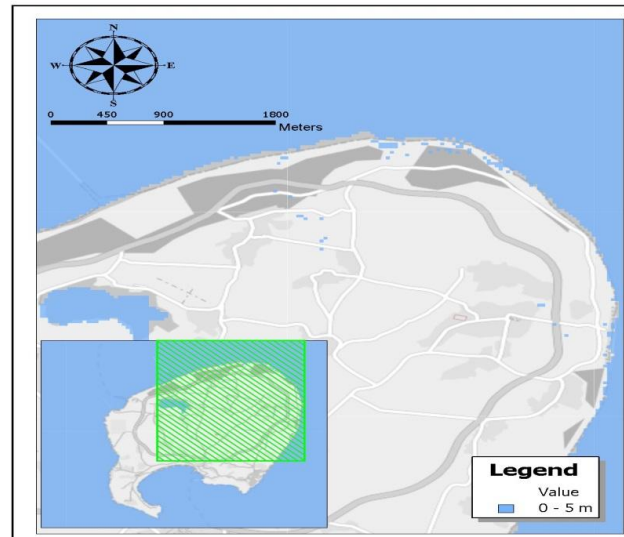


Fig 3 5M flood area



Fig 4 10M flood area

IV. Conclusion

During the COVID-19 pandemic period, island tourism is a severe impact. Island tourism is a thriving tourism model, but it is greatly affected by the SLR (sea level rise) due to climate change. Small island tourism must face flooding problems that cause sea-level rise. GIS can be used to plan and monitor land use. This case study uses GIS (Geography information system) to predict flooding at different scales in pre-COVID-19 pandemic period. After three different scales of digitization processing, it is found that: Overall, the flood area is located in the northern part of the island. The relationship is consistent, that is, the flood season is directly proportional to the peak tourist season. Sea level rise will cause changes in tourist attractions on the island; residents' daily lives will face major changes. This study provides a small amount of inundation scale predictions at different scales; hopes to be helpful for the island's tourism resource planning and residents' adaptation. To avoid add climate change

refugees and rational use of tourism resources on lack nature resource small islands. The data and evidence based on this research can clearly indicate that the north part in the island have a potential flooding risk three discussion directions are proposed as follows:

4.1 Operation and management of flooded scenic spots

Proposed mitigation system is capable of protecting this crucial area from flood risks and increases the national income from tourism [12]. Prove that flooding has an impact on the tourism economy. In particular, the island's residents have a high degree of dependence on the tourism industry including accommodation and food supply even water sports. Approximately 20 % residents are engaged in tourism-related businesses in the island. Another point of view is that the peak tourist season coincides with the peak period of natural disasters [13]. At this point, the resource small island that this research focuses on is basic option the peak tourist season in summer and summer is also the peak period of typhoons or storm. Low-level development or the establishment of parks and other facilities are more suitable for the operation of flooded areas.

4.2 Develops a methodology for the assessment

At least approximately 10% of tourism beaches are at high risk to flooding, [14]. According to this research statement, it is inevitable that the residents of this small island will be threatened by flooding. Thus the local tourism management authority should develop an evaluation method including social dimension include social net and community relationship; economic, and nature resource as wild animal and wild plant habitat evaluation synthesize models. This research shows that the flooded areas are all in the north part of this island. According this information, a comprehensive survey of the north part in the island should be done, especially the tourism industry and tourist attractions. After reviewing and analysis of local tourism resources, the important resources in the northern part of the island are classified beaches and wetland parks, these two types have different corresponding ways to face floods. Another point to be considered is the status of residents and their property in the flooded area. The ecological status of wetlands is particularly important. For ecosystems, wetlands ecosystems are the boundary between water field and land field also Complex system. Ecological species are particularly rich of Wetland, but it is transitional condition and hard keeps equilibrium. In particular, wetlands in tropical areas have some problems with mosquitoes and the environment. Tropical wetland is not necessarily a good place for outdoor recreation.

4.3 Flood projections land subsidence

Flood projections land subsidence has been used for many years, and there are many types of methods, [15,16]. It is closely related to the type of local economic sources. The type of subsidy and the amount of subsidy need to be incorporated into the opinions of local residents and seek consensus. Especially the system must establishment in compensation and measurement standards for different levels of flooding. The land blocks in the flooded areas mentioned above are beaches and wetlands, and it seems feasible to designate low-density tourist areas. However, how to implement subsidy policies is a difficult management problem.

Climate refugees are those who are forced to relocate for survival from unpleasant residence due to natural disasters caused by climate change, such as floods, wind disasters, desertification, rising seawater, or wars caused by lack of food and water resources due to natural disasters. The latest report issued by the Global Commission on Adaptation points out that climate crisis is inevitable, but poverty, lack of water resources and massive immigration due to seriously insufficient global response will lead to inestimable impact on human life. Most of the immigration waves due to climate change occur within the country, and those who cross the border are mostly limited to movement between neighboring countries [17,18]. The reason for the increase in subsidies is the emergence and increase of climate victims especially the residents of small islands who often become climate

refugees.

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