Spatiotemporal trends in flood hazards in the Pearl River Basin using MODIS time-series images, China

Jiulang Qiu 1, Xiankun Yang 1,2,*, Paolo Tarolli 3

1School of Geographical Sciences, Guangzhou University, Guangzhou 510006, China; qjiuliang@gzhu.edu.cn (J.Q); xkyang@gzhu.edu.cn (X.Y)
2Department of Land, Environment, Agriculture and Forestry, University of Padova, Vicenza, Viale delle Scienze 1, 35121, Italy; paolo.tarolli@unipd.it (P.T.)

Abstract

The Pearl River Basin (PRB), as one of the most prosperous and densely populated areas in China, is a flood-prone area in which huge casualties and big economic losses constantly happen. Therefore, it is of great importance for the study on the characteristics of flood hazards and spatiotemporal trends in the PRB. Based on Google Earth Engine, this study combined 873-phase Mods 8-Day composite MOD09Q1.006 images with 30-meters SRTM DEM to monitor flood dynamics in the PRB from 2000 to 2018 using an integrated threshold method. The approach synthesized several key factors, including spectrum characters of water body cloud and the slope (slope-1) information derived from SRTM DEM. Moreover, Sentinel-2 images were used to validate the accuracy of flood inundation maps. The results indicated that, from 2001 to 2019, the flood area in PRB showed expanding trends, especially in the Pearl River Delta region; frequencies of most inundation/flooded pixels are 1 and 2; Low-frequency flooding events showed expanding trends in PRB from 2001 to 2019, while high-frequency flooding events showed shrinking trends in PRB from 2001 to 2019.

Introduction

The Pearl River basin (PRB) is controlled by subtropical monsoon climate zone and has good water vapor transport conditions (Wu et al., 2007), which are prone to large or severe rainstorms, easily causing flood. The Pearl River Delta region, including Guangzhou, Shenzen, Foshan and other mega cities, is a densely populated region, constantly undergoing huge casualties and big economic losses due to flood hazards (Wei et al., 2017). Therefore, it is of great importance to investigate the characteristics of flood hazards and spatiotemporal trends in the Pearl River Basin.

Research Objectives

The aim of this research is to analyze the spatiotemporal trends in flood hazards in the PRB from 2001 to 2019. Based on the Mods image, we will calculate the frequency of flooding of each pixel in each image to characterize the area and frequency of flooding in PRB.

Methods

Methods for water body monitoring using Mods

We selected Mods 8-Day composite MOD09Q1.006 product to monitor water body because it has the potential for temporal and spatial continuity. It can distinguish between water body and other terrestrial object (Huang et al., 2012). Figure 2 is the Flowchart of water body monitoring.

Results & Analysis

Validation for water body monitoring

According to figure 7, the validation of the accuracy of water body monitoring based on Mods image was shown to be effective. Because the resolution of the Mods image is about 250 meters, the Mods image cannot detect water bodies smaller than 250*250 meters. In the Pearl River Basin, the width of the main river can reach about 400 meters, and the width of some lakes and rivers is about 250 meters. Therefore, the Mods image can not monitor the river and large lakes. However, we used Sentinel-2 image (250 meters resolution) to validate the accuracy of water body monitoring based on Mods image. According to figure 4, Sentinel-2 showed a higher accuracy in water body monitoring due to its higher resolution. Even in river trunk and relatively bigger lakes, there are some water pixels. Because water body where the width size less than 250 meters. Therefore, Mods couldn’t monitor the water body in water trunk and relatively bigger lakes, causing offset to water body monitoring.

Preliminary Results

According to figure 4, we found that inundation pixel densely distributed in Pearl River Delta (PRD). Therefore, for better understanding of the pattern of inundation frequency in PRD, as a case in PRB, we mapped the distribution of inundation frequency from 2001 to 2019 in PRD. Here, if inundation frequency is larger than 8, we consider the corresponding pixel is permanent water body. According to figure 6, overall, inundation pixel showed slightly expanding trends in PRD from 2001 to 2019. From 2001 to 2019, in submerged flood pixels, most of the frequencies are 1 and 2.

Final Remarks

According to figure 7, overall, in whole Pearl River Basin, the total number of inundation pixels with frequencies from 1 to 8 showed slightly increasing trend from 2001 to 2019, which meant that flood area showed expanding trends in PRB from 2001 to 2019. Similarly, number of inundation pixels with frequency 1 and frequency 2 showed slightly increasing trends from 2001 to 2019, which meant that low-frequency flooding events showed expanding trends in PRB from 2001 to 2019. On the contrary, number of inundation pixels with frequency 1, 4, 5, 6, 7 and 8 showed shrinking trends from 2001 to 2019, which meant that high-frequency flooding events showed shrinking trends from 2001 to 2019 in PRB. Further statistical analysis are on processing.

References

