Analysis of Vulnerability to Flood Hazard
Based on Land Use and Population Distribution in the Huaihe River Basin, China

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1. Introduction

Large scale flooding due to heavy rainfall and drainage congestion are being regularly experienced in the floodplain area of the Huaihe River basin, China. There is danger of loss of life and severe damage to the economies. The actual amount of flood damage of a specific flood event depends on the vulnerability of the affected socio-economic and ecological systems. In this regard, vulnerability has emerged as the most critical concept in disaster studies. As part of the mitigation planning process, vulnerability analysis of flood hazard is highly significant. Although vulnerability is a multidimensional and multivariate concept associated with high uncertainty in measurement and classification, land use and population are the key components of exposure for flood hazard vulnerability analysis.

Satellite remote sensing provides powerful techniques for objectively detecting flooded areas and classifying land use and land cover, and many studies have been undertaken in these research fields with the application of a range of suitable satellite data sources for different purposes, such as Landsat, IKONOS, SPOT, NOAA-AVHRR and RADARSAT SAR data. For a severe flood occurring in a large area, Moderate Resolution Imaging Spectroradiometer (MODIS) data products offer a great opportunity to acquire the expected information by a low-cost and expeditious dynamic analysis. Based on land use classification and identification of flooded area, the population affected by flooding can be generated. With the application of spatial analysis method and auxiliary data, the flood hazard vulnerability is analyzed.

The objectives of this study are: (1) To characterize the dynamic change of flooded area captured by MODIS NDVI composite imagery; (2) To estimate the distribution of people at flood risk based on flood event analysis; and (3) To identify and analyze the flood hazard vulnerability.

2. Methodology

Instead of following the conventional approach of flooded area delineation and overall damage estimation, this paper proposes a method to identify the people at risk that is vulnerable to flood according to the extraction of flooded area after land use classification and change detection. And integrated analysis of vulnerability to flood hazard is discussed according to causal factors.

To study the extent of flood inundation, the analysis of multi-temporal MODIS composite imagery has been performed and the smoothed time profiles of NDVI, EVI and some other derived data are obtained from MOD13 16-day composite time-series data with 250-m spatial resolution. Additionally, the multi-temporal images are classified using the Decision Tree classifier, which is defined as a classification procedure that recursively partitions a data set into more uniform subdivisions based on tests defined at each node in the tree.

3. Results and discussions

The proposed algorithm is applied to produce time-series inundation maps for the analysis of flood event of the year 2003 in the Huaihe River. Meanwhile the methodology to analyze flood vulnerability at a regional scale is introduced. Combining with demographic data, spatial modeling of vulnerability to flood hazard is achieved. The method to estimate the flooded area is applicable to large area flood with long duration. This research is significant to assess vulnerability for the further study.