EFFECT OF SPATIAL AND SPECTRAL RESOLUTION OF IMAGES ON INTERPRETING INTERTIDAL ESTUARINE SEDIMENT GRAIN SIZE DISTRIBUTIONS

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1. INTRODUCTION

Sediment grain-size distribution is closely relevant to the research of coast evolution, estuarine ecosystem and pathways of nutrients and pollutants. It also is an indicator of hydrodynamics and morphological change [1]. So the distribution of intertidal sediment is of significant interest to scientists who work in the field of morphodynamics and morphology of coastal environments. However, intertidal areas are difficult to access, which makes the measurement of surface parameters a difficult and time-consuming task. Thus, remote sensing technique was applied for examining the tidal flats sediment distributions and yielding substantial results in airborne remote sensing [2], multi-spectral and hyperspectral remote sensing. Hyperspectral remote sensing has a great application potential in this field. Meanwhile multi-spectral remote sensing, such as LandsatTM, is cost-effective and possible to acquire historical data. So the assessing impact of both multi- and hyper-spectral remote sensing on the research of sediment distribution is very indispensable. This paper evaluates quantitatively the effect of spatial and spectral resolution on sediment distribution in the southwestern tidal flats of Laizhou Bay.

2. DATA AND METHODS

The intertidal area between Xiaoqinghe estuary and Weihe estuary, situated on the southwestern longshore part of the Laizhou Bay in China, is selected as the study area (Fig.1). The intertidal flat extends 6-9km seaward with an average slope of 0.45‰. The area is covered mainly by silt and very fine sand sediments with 0.125~0.016mm of grain size range, whose distribution strongly depends on the local hydrodynamic forces. The tidal flats experience an irregular semi-diurnal tide, the mean tidal range increases from 1.25m near the mouth of the Xiaoqinghe to 1.35m near the Weihe estuary. Spectral reflectance of tidal flats sediment has beenmeasured two times; meanwhile sediment samples were collected respectively. In May 1990, a 4-channel spectronradiometer of FieldSpec Dual made by ASD Company in USA was selected to match 4 spectral bands of Landsat MSS [2], and a 10-channel spectronradiometer was selected to cover 7 bands of Landsat TM in March 2007. HJ-1A satellite hyperspectral image was obtained from an ultra-spectral imager of HJ-1 satellites that was launched in 2008 by China. It provides images in about 135 spectral bands between 0.45 and 0.95μm, with spatial resolution of 100 meters. This study will establish regression relevant models between the spectral reflectance of sediment and the sediment grain size parameters of mean diameter, medium diameter, skewness and sorting coefficient to get the spatial distribution characteristics of grain size parameters of tidal flats.

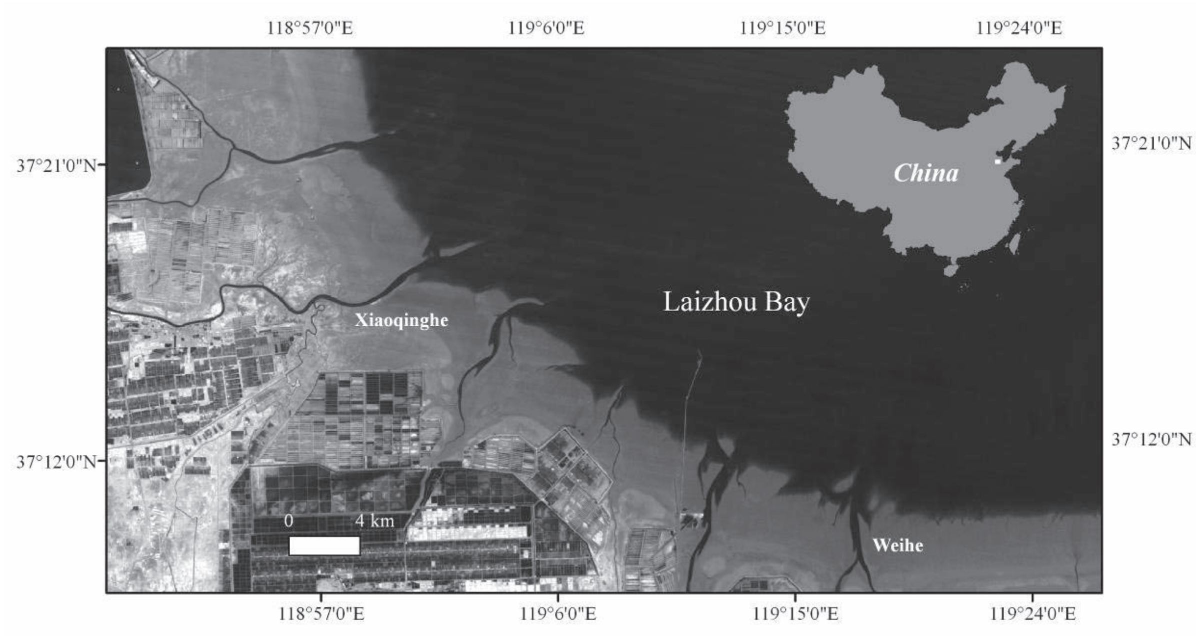

Fig.1 The location of study area between the Xiaoqinghe estuary and Weihe estuary

(Landsat TM image on 9 Oct. 1997)

The steps of processing data and empirical models building are summarized as follows: (1) Quasi-synchronous data of the Landsat MSS, Landsat TM and HJ-1A hyperspectral image with in *situ* measurement were corrected geometrically. The invalid bands of low signal-to-noise ratio were eliminated, bad pixels were fixed, and dark vertical strips were removed for hyperspectral image. (2) The atmospheric corrections were carried out by applying the FLAASH module using ENVI software. The intertidal areas were extracted by building the mask of tidal flats using fixed threshold method. (3) After the samples were removed any carbonate and organic materials, the grain size was measured using a Cilas 940L Mastersizer within the particle size range 0.3-2000μm. Furthermore, the sediment grain size parameters of mean diameter, medium diameter, skewness and sorting coefficient were calculated by using the formula of Folk and Ward. (4) The grain size parameters that have strong relativity with spectral bands were identified by analyzing the relationship between the grain size parameters of sediment and single band or band combination. (5) The sediment samples were random classified into two groups. One group was used to establish linear, exponential, logarithmic, and quadratic linear regression model between the spectral reflectance and grain size parameters.

The other group was used to assess the precision of model. The model of high precision and strong relativity was selected to retrieval sediment grain size parameters.

3. RESULTS

The grain size distributions of sediment samples that were collected during the image acquisition were used to be compared with extracted intertidal sediment grain size parameters from Landsat MSS, Landsat TM and HJ-1A hyperspectral images. A careful analysis of the errors and uncertainties that were involved in the interpretation approach was carried out. Considering the vegetation distribution patterns, the hydrodynamic conditions and the sources of sediments in this area, the effect of diverse spatial resolution when the spectral resolution is the same, or diverse spectral resolution when the spatial resolution is the same on the results of surface sediment distributions was estimated, respectively and quantitatively.

4. REFERENCES

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