Mapping Sediment Types of Muddy Intertidal flat using Remote Sensing

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ABSTRACT
Sediment type of muddy intertidal flats was an important surface parameter and understanding of its distribution is capable of benefitting environmental protection as well as engineering management. Remote sensing has been widely used for mapping intertidal surfaces. However, the spectral signal of sediment is easily concealed by water. In order to weaken its impact, a linear spectral mixture model was employed to retrieve moisture content. Then, moisture was introduced into a regression equation to map sediment types. It is shown that this method has a good potential to map sediment types.

KEY WORDS: Sediment classification; muddy intertidal flat; remote sensing.

INTRODUCTION
Understanding the spatial distribution of intertidal sediments can not only help to analyze topographic changes in coastal zones, but also benefit coastal environmental monitoring and project planning (Sorensen, 2006). The traditional method is easy to map accurate sediment types of intertidal flats through sampling collection and particle size measurement. However, it is time-consuming and costs expensively as a plenty of field work is required. If sampling collection is insufficient, the collected samples will not represent the characteristics spatially that is easily resulting in inaccurate investigation results (Tyler and Sanderson, 1996). As the tidal flat exposure time is limited as the result of the ebb and flow, the remote sensing integrated with the field work has been widely used to map ground surfaces of intertidal flats. Often used methods include supervised classification (Yates and Jones, 1993; Ryu and Na, 2004), unsupervised classification (Tyler and Sanderson, 1996), component retrieval method (Zhang, 2008), principal component analysis method (Rainey and Tyler, 2000), and spectral unmixing method (Rainey and Tyler, 2003) etc. The remote sensing data source normally involved a variety of sensors, such as TM (Yates and Jones, 1993; Bartholdy and Folving, 1986), Hyperion (Zhang, 2008), CASI (Rainey and Tyler, 2000), SAR (Van-der-Wal and Herman, 2005), and IKONOS (Choi and Ryu, 2010) etc. At present, the main difficulties in identifying the sediment types of tidal flat are that the water conceal the spectral signal of the sediment itself, resulting in low accuracy for sediments mapping. So Rainey (2000) and Lobell (2002) have proposed that the water in the spectrum should be removed to improve the classification accuracy of sediments. Now, there are mainly two methods to reduce the impact of water in sediments: (1) to avoid the usage of waveband which is sensitive to the water, and take advantage of the microwave band, which is insensitive to water to identify the sediment types. For example, Van der Wal (2005) et al. built a regression model for the logarithms of scattering coefficient and mud (silt & clay) content by using the waveband C of SAR to measure the sediments obtained, so as to identify the sediment; (2) to use the linear spectral mixture model (LSMM) to eliminate effects of moisture from the spectrum and simultaneously extract the abundance of sediment component (Rainey and Tyler, 2003). However, this method is only effective when the tidal flat exposes a long time with a low content of moisture. Therefore, the purpose of this study is to improve the classification accuracy of sediment types by weakening the impact of moisture on the spectra.

MATERIALS AND METHODS
Taking Jiangsu Dafeng tidal flat as the study area (Fig. 1), we predicted moisture by a linear spectral mixture model (LSMM) and then introduced the moisture into the component retrieval model to weaken the impact of moisture, so as to map three basic components of sediment in tidal flat. Finally, retrieved components were input to Shepard classification system to identify sediment types of each pixel (Shepard, 1954). Relevant data were collected or measured under below.

Preprocessing of Hyperion Image
An EO-1 Hyperion acquired on December the 3th 2007 at 02:10 AM GMT was selected in this study. This remotely sensed image is cloud-free and recorded at low tide (Fig. 1). Image processing include (Zhang, 2009): (1) bad lines fixing; (2) vertical stripes removing; (3) atmospheric correction; (4) geometric correction and (5) intertidal area subsetting.

Collection of Samples