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### Spatial-temporal changes of tidal flats in the Huanghe River Delta using Landsat TM/ETM+ images

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Integrating remote sensing, geographic information system (GIS) and fractal theory, change characteristics of tidal flats and tidal creeks in the Huanghe (Yellow) River Delta over the period of 1986-2001 were discussed. The results show that evolutions of tidal flats throughout the Huanghe River Delta are influenced by various factors, and that progressive succession and regression of tidal flats concur in different coastal segments of the delta. Human activities have played an increasingly important role in the succession process of tidal flats. Due to land reclamation in coastal zones of the delta in the last 15 years, lots of tidal flats were occupied, the artificial coastline migrated seaward (the maximum change rate was 0.8 kmyr<sup>-1</sup>) and tidal creeks became sparser (the highest decreasing rate of length of tidal creeks was 14.9 kmyr<sup>-1</sup>). Except for two coastal segments from the Tiaohe Estuary to the 106 Station and from the south of the Huanghe River mouth to the north of the Xiaodao River Estuary, fractal dimension values of tidal creeks in the remaining coastal segments of the delta decreased. In addition, the time dimension, sediment fluxes into the sea, waves and tidal-currents have profound influences on the evolution process of tidal flats. Four types of tidal flats-river-dominated tidal flats, tide-dominated tidal flats, wave-dominated tidal flats and man-dominated tidal flats can be identified. Owing to the intensification of human activities in coastal zones of the delta, man-dominated tidal flats have become the main kind of tidal flats.

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**关键词:** Huanghe River Delta; tidal flats; tidal creeks; spatial-temporal change; fractal dimension; remote sensing  
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