

REMOTE SENSING ASSESSMENT OF COASTAL EROSION IN AL BATINAH, SULTANATE OF OMAN

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Coastal erosion and accretion occur in several areas in the Sultanate of Oman, in part, as natural processes and the continuing change of the shoreline. However, severe and irreversible erosion, which is attributed to the construction of major engineering projects, are occurring in certain areas along Al Batinah. Al Batinah coast which stretches for more than 200 km along the Gulf of Oman from the capital Muscat in the east to the United Arab Emirates border in the northwest, is not more than 20 m above sea level. The coast alignment is fairly straight for a long distance and is composed of sand beaches (soft materials), sabkha, tombolos and several tidal inlets and lagoons, with stands of mangroves near the drainage of major wadis. Because the area is flat and fertile, it is the most favorable place for human settlement and human activities, including agriculture, housing, and fishing (Figure 1).

Al Batinah coastal plain has been experiencing rapid development in the past three decades including residential housing, agricultural and fishing activities. Major infrastructure, including roads, corniches, markets, mosques and fishing harbors have also been constructed along the coast. A wide range of small and large-scale structures, like fishing harbors, intakes for desalination plants, groins, and ports are located along Al Batinah coast. The most significant coastal engineering structures are the Navy Harbor at Widam, Sohar Industrial Port, Majis Jetty, Sohar industrial area water intake, Al Ghubrah desalination plant intake and brine disposal, and fishing harbors at Al Khaburah, Saham, and Sohar (Figure 1). The main impact of such structures is the blocking of the sediment transport along the coastline. Newly planned projects along the coastline include The Wave in Muscat and Blue City (Al Madinah Az Zarqa) in Ras As Sawadi. Thirteen recharge dams have been built on the major wadis in Al Batinah and adjacent areas. The net effect of the dams is the reduction of terrestrial sediments supplied to the shore. The corollary of the coastal structures and the recharge dams is potential changes in the longshore sand transport as well as accretion and erosion patterns along Al Batinah coast.

In this study, remote sensing data are used to map and assess their usefulness in mapping coastal erosion in Al Batinah. Remote sensing study is part of an ongoing study at Sultan Qaboos University to monitor erosion in Al Batinah which includes analysis of beach profile changes and current and wave measurements. Multitemporal aerial photos, Landsat Thematic Mapper (TM), and high-resolution Ikonos and QuickBird imagery acquired between 1968 and 2007 are used to map and monitor changes in Al Batinah coastal area. Detailed studies are restricted to areas east and west of the major engineering structures. The satellite images and aerial photos were orthorectified using a digital elevation model (DEM) image of Oman, and rectified to the UTM zone 40 and WGS84 to facilitate their comparisons and to map changes between images recorded at different times. Selective principal component analysis was used to map changes that had occurred between the images recorded on two different dates. The technique uses either two bands from the same image or one band from each of the two images as input to principal component analysis [1, 2].

In Sohar and surrounding areas multitemporal Landsat TM and ETM+ images show that farming activities have extended much further inland from the coast due to urban expansion and seawater intrusion. Ikonos images and field observation show erosion occurring on the east side and accretion on the west side of the Al Ghubrah desalination plant. Aerial photos and Ikonos images show drastic changes at the mouth of Wadi Al Hawasnah, near Al Khaburah, after the construction of a recharge dam upstream in 1995. The images show gradual blocking of the mouth of Wadi Al Hawasnah

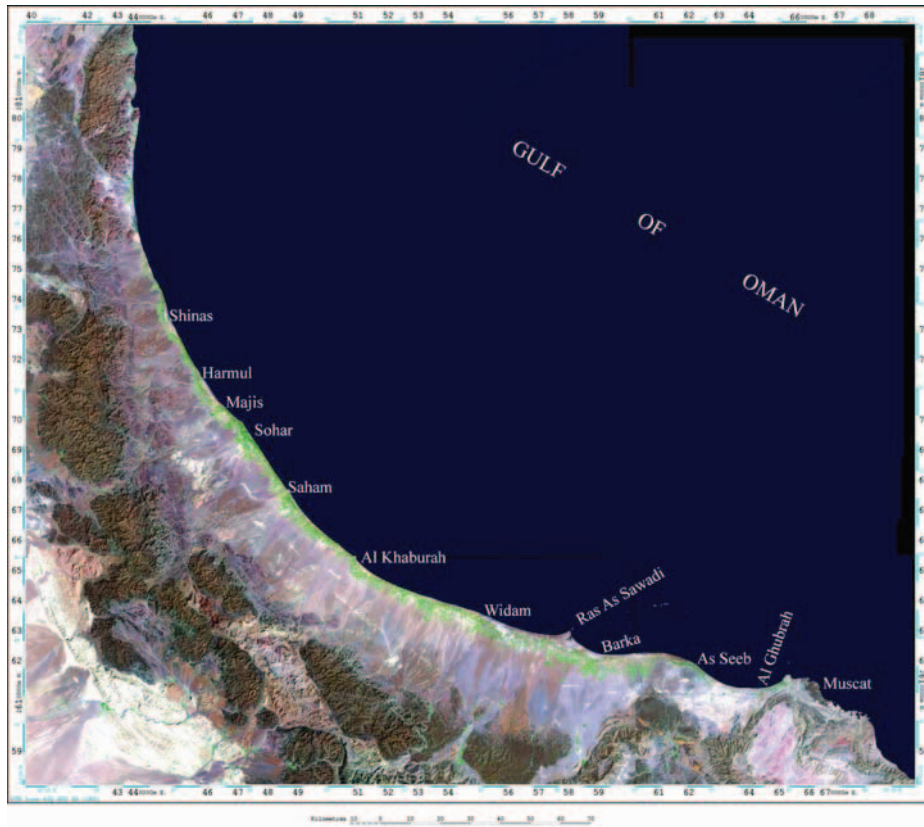


Figure 1. Landsat TM bands 7, 4, and 2 color composite showing the Batinah and surrounding areas recorded in 2001. Vegetation depicted in shades of green, show human settlements along the Batinah coast.

due to the paucity of water and sediments from the wadi. The morphological changes in the spit and tidal inlet in the areas are ascribed to the dam constructed on Wadi Al Hawasnah. In general, the image data mapped localized disturbances in the sediment movement patterns from constructed structures in the form erosion and accretion over time. High-resolution image show the sediment movement patterns around structures when the images were recorded. The data and field observation indicate deposition on the updrift side and erosion on the other side of the structures. Al Batinah area is mesotidal (maximum tide range 3 m) and subject to moderate wave energy, so sand transport is moderate and mainly in the surf zone. Where this longshore transport has been seriously interrupted erosion and/or accretion can occur. All cases of significant accretion seem to be man-made, resulting from harbors and groynes – examples include Al Ghubrah desalination plant, Widam Harbor, and Sohar Port.

REFERENCES

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