USING MEDIUM AND HIGH RESOLUTION SATELLITE IMAGES IN MONITORING WATER QUALITY SURROUNDING THE DISCHARGES OF DESALINATION PLANTS IN THE UAE

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1. INTRODUCTION

Today, various processes of seawater desalination are used to satisfy the increasing demand of fresh water. Desalination plants filter the seawater through their intakes and release the effluents back to the sea through their outfalls. The discharged effluent, also called brine, has a high salinity level, high temperature and high concentration of other suspended matters which may cause negative environmental effects on the water quality surrounding the discharge point. Higher temperature and salinity of the effluents can result in lower dissolved oxygen concentrations affecting water quality in the surrounding ecosystem. Moreover, the high chlorine in the brine can introduce toxic substances into the water. The high salt concentration of effluents may destroy organisms near the outfall. In addition, the effluents are more-dense than seawater and would sink to the bottom causing adverse impacts to benthic species. The metals originally contained within the feed water would become concentrated in the upper few micrometers of the seas, which would be toxic to plankton, fish-eggs and larvae [1].

The objective of this project is to evaluate the potential of remote sensing technology to monitor water quality surrounding the discharges of desalination plants in the UAE coastal areas. Jebel Ali desalination plant, shown in figures 1&2, has been selected in this project as a study area, since it is the largest desalination plant in the UAE.

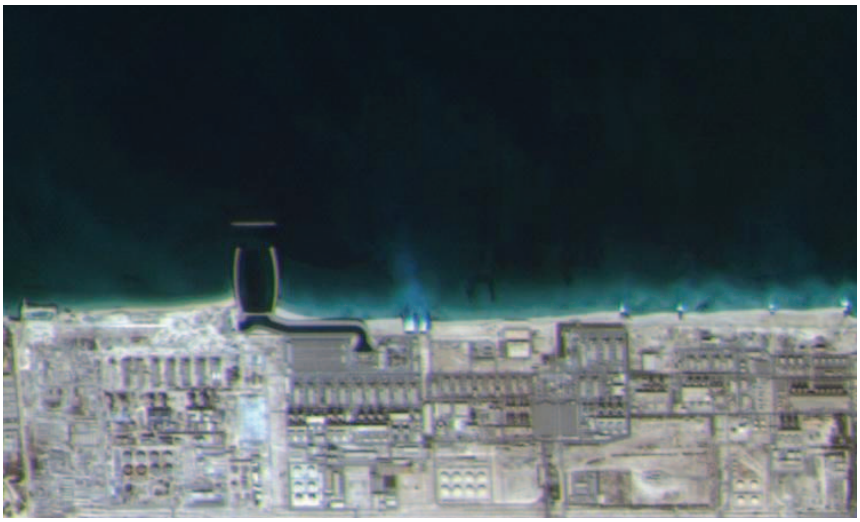


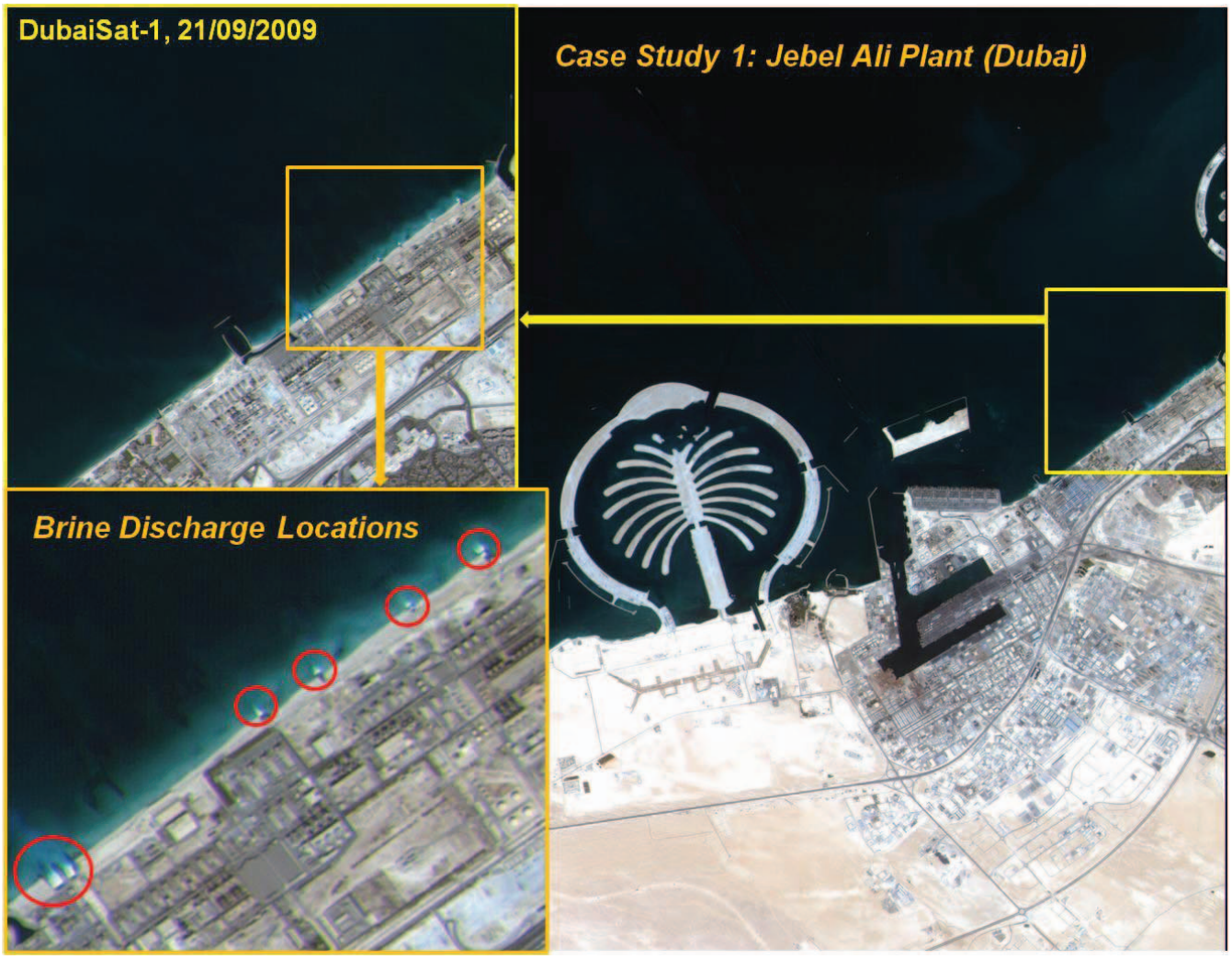
Figure 1: Monitored desalination station

2. LITERATURE REVIEW

Several studies related to environmental impacts of desalinated plants in the Arabian Gulf have been carried out in the past 10 years. In 2002, Abdul Azis et al. [2] presented a set of environmental data collected in the Saudi coastal waters near Al-Jubail desalination plant. Water samples from six different sites covering the intake and discharge zones were collected between 1997 and 1998. Twenty-eight species of phytoplankton were identified and analyzed. This study found that the desalination plant discharge has no significant effect on phytoplankton and chlorophyll pigments [2]. Another study was also performed in 2005 by Abu Dhabi Water & Elec. Authority [3] to evaluate the environmental impact of Umm Al-Nar desalination station in the UAE. This station is surrounded by a sensitive ecosystem with extensive areas of mangroves and seagrass meadows. The spatial distribution of high temperature and salinity as well as water flow properties surrounding the desalination plant has been observed and studied. Their observation had shown no significant deterioration of water quality surrounding the plant.
Other type of environmental study was also performed to evaluate and mitigate the potential damage of an eventual oil spill accidents. Elshorbagy and Elhakeem (2007) have produced a set of 10 hazard contour maps for the prediction of oil spill travel time and critical wind direction in association with five selected mega-desalination plants along the UAE coast: Al-Shuwayhat, Al-Marfa, Umm AlNar, Taweelah, Jebel Ali and Al-Layah. The author produced hazard maps using a three-dimensional coupled set-up of a hydrodynamic model (Mike3-HD) and oil spill model (Mike3-SA) [4].

3. METHODOLOGY

In this paper, medium and high resolution satellite data collected by MODIS and DubaiSat-1 (DS-1), respectively, were used to derive average digital value and its spatial variability surrounding Jebel Ali plant. Satellite-derived sea surface temperature (SST) was derived and compared to field measured temperature collected between January and December 2008. In order to have a better understanding of the spectral and spatial characteristics of satellite data, the mean squared error (MSE) and peak signal to noise ratio (PSNR) were also calculated for different locations in the study area with determined window's size. Structural SIMilarity (SSIM) factor was used to compare two locations, one with pollution and the other without pollution [5].



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