Remote sensing & GIS Based Approach for Oil Spill Detection and Monitoring

Submitted By:

Hussam Elzain Osman

Instructor:

Dr. Baqer Al-Ramadan

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Introduction

What’s oil spill ???
What are the causes?
Problem statement
Objective

- Real-time oil spill detection and monitoring.
- Build up oil spill distribution map.
Methodology

1. Remote sensing technique.
2. Geographic Information system (GIS).
Remote sensing multi-disciplines
Passive airborne sensors
Active Laser-Fluorescence Sensor

Schematic of the geometrical arrangement associated with a laser fluorosensor.
SAR image concept
Area of the Baltic Sea with the German island of Fehmarn, 2007.
Area of the Baltic Sea with the German island of Fehmarn (in the center) (This ERS-2 SAR image was acquired on 10 May 1998 at 21:15 UTC over the Baltic Sea; orbit: 15972, frame: 1089, frame center: 54° 28'N, 11° 13'E, imaged area: 100 km x 100 km).
GIS approach

Information being received by GIS and its outputs (Ivanov and Zatyagalova, 2008)
Deepwater Horizon Incident, Gulf of Mexico

As the nation’s leading scientific resource for oil spills, NOAA has been on the scene of the BP oil spill from the start, providing coordinated scientific weather and biological response services to federal, state and local organizations. More

GeoPlatform.gov/gulfresponse [leaves OR&R site] is a new online tool that employs the Environmental Response Management Application (ERMA®), a web-based GIS platform that provides you with near-real time information about the response effort. The site offers you a “one-stop shop” for spill response information.

The site integrates the latest data the federal responders have about the oil spill’s trajectory with fishery area closures, wildlife data and place-based Gulf Coast resources — such as pinpointed locations of oiled shoreline and current positions of deployed research ships — into one customizable interactive map.

Updated daily
Situation: July 7, 2010

Administration Launches New, Centralized, Streamlined Oil Spill Response Website

WASHINGTON—National Incident Commander Admiral Thad Allen today announced the launch of a new federal web portal —RestoreTheGulf.gov—dedicated to providing the American people with clear and accessible information and resources related to the BP Deepwater Horizon oil spill response and recovery.
Gulf Response GeoPlatform through NOAA's ERMA (2010).
The Official Deepwater Horizon Response (2010) website now replaced by the Restore the Gulf website (2010)
Andrei Yu. Ivanov (2007) using GIS and SAR imagery for oil spill mapping in THE ASIAN SEAS, he concludes that both GIS and SAR image useful for decision makers of pollution authorities and experts of environmental protection agencies and also discuss GIS to be an ideal solution to understand spatial/temporal distribution of oil spills in the marine environment.

Lucy Aukett (2012) used modeling of geographic information system for mapping and delineate spill-affected Preparedness area in Australia. GIS provides an ideal tool for oil spill contingency planning and response facilitating and informing efficient specific responses underpinned by tailored analyses and interpretation of relevant data.

Victoria V. Zatyagalova et al. (2000) used SAR imagery ENVISAT for estimation and mapping of natural oil spill in the SOUTHERN CAPSIAN SEA. They reported that Advanced Synthetic Aperture Radar (ASAR) power tool for mapping and estimate oil seepage specially in SW Caspian Sea Where the spill rate is estimated about 2,000-16,000 metric tons of oil per year.

Peng Liu et al (2007), used SAR imagery based on fuzzy logic algorithm to identified ocean oil spills and their impact on marine life. They conclude Synthetic aperture radar (SAR) has been proven under low to moderate wind conditions to be a useful tool for oil spill detection and Ocean oil spills cause serious damage to the marine environment, especially around coastal waters.

Oscar Garcia-Pineda et al. (2009) using SAR imagery with a texture-classifying neural network (TCNNA) algorithm to delineate ocean oil slicks in Gulf of Mexico. Combination with a large archive of SAR images over the Gulf of Mexico, TCNNA also will allow characterization of a multiyear process like flux variation of a natural hydrocarbon seepage source and estimation of the entire Gulf of Mexico contribution of hydrocarbon transfer from the ocean to the atmosphere.
APPLICATION OF ENVISAT SAR IMAGERY FOR MAPPING AND ESTIMATION OF NATURAL OIL SEEPS IN THE SOUTH CASPIAN SEA  Victoria V. Zatyagalova, Andrei Yu. Ivanov, (1)(2) Boris N. Golubov(3)
• Location

• Oil production activity

• Ecosystem marine

• SAR image covered
Development oil field in caspian sea
Environmental impact in Caspian Sea
Seven pair image SAR coverage Caspian Sea 2004-2006
Analysis of SAR Image
Processing of SAR Image
Interpretation Of SAR Image
Layers of GIS in Caspian sea

Layer of GIS in Caspian sea, after CEP.
GIS map shows integral distribution of oil seepage related to oil slicks based on seepage rate contour line.
GIS map shown oil slicks distribution SW Caspian Sea in relation to perspective (dark grey) oil and revealed (light brown) and gas bearing structures.
GIS distribution map of the slicks on the surface of the Caspian Sea related oil products, crude oil and other man-made pollution, oil slick accumulations shown by Ellipses areas over bottom seepages (violet), river run-off (red) and oil production fields (blue)
Result

- Analysis of reveals that the majority of the oil spills were detected in the southern part of the Caspian Sea.

- The sea was most polluted near the marine exploitation areas, oil rigs, close to seashore refinery plants, river mouths as well over the bottom oil seeps.

- The main sources of oil pollution there are both point sources from rigs, terminals or seeps and distributed ones like slicks related to river runoff.
The environmental impact of the oil spill on marine biodiversity is expected to be Devastating.

Integration of remote sensing and GIS technologies can significantly improve managing oil spills and allows making the final products – oil spill distribution maps.

the Caspian Sea and its coastal zones have a very high risk of oil pollution with a long-term effect on the sea and coastal marine resources.
Thank you very much!