The Effectiveness of Using MODIS Products to Map Sea Surface Oil

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Goals

This project describes the effectiveness of using standard Moderate Resolution Imaging Spectroradiometer (MODIS) imagery and products, produced by NASA and distributed through the Distributed Active Archive Centers (DAACs), to monitor and map oil on the surface of the Gulf of Mexico from the oil release at the Deepwater Horizon site.

Introduction

The Deepwater Horizon oil well rupture of April 20, 2010 resulted in oil leaking from the well at the seafloor. The resulting surface oil needed to be tracked to facilitate oil skimming and collection, verification of models and other public information needs. The availability of public MODIS (Moderate Resolution Imaging Spectroradiometer) imagery and some standard products on a daily level is well suited for use in assessing the extent of the surface oil. MODIS imagery has previously been used in relation to oil spills, and a major resource used is MODIS imagery that has sun glint. MODIS imagery and ocean standard products were assessed for a time period of May 5 to May 15, 2010 for seas in the area of the Deepwater Horizon well rupture within the Gulf of Mexico. This time period corresponded with a trip of the research vessel Pelican for the National Institute for Undersea Science and Technology (NIUST) from which surface water samples and photography were taken within and outside of oil contaminated areas. Figure 1 (page 2) shows the location of the samples.

Methodology and Data

MODIS standard products are produced by applying atmospheric corrections and algorithms to selected bands of MODIS data. Six different products were examined, but the products that showed the greatest potential for oil detection were sea surface temperature and chlorophyll concentration. Figure 2 (page 2) shows the comparison of the chlorophyll concentration from May 12, 2010 to the approximate oil area from May 11, 2010 which showed a possible correlation. When compared to the surface samples taken by the NIUST researchers near the Deepwater Horizon site, a positive correlation may exist, but it is not conclusive. The high concentration of chlorophyll east of the mouth of the Mississippi River in this area seems atypical and no report of an algal bloom from NOAA could be found. The remaining standard products that were examined seemed inadequate for detecting surface oil. A large factor in this inadequacy is from a lack of data resolution.

The use of MODIS imagery and products has limiting factors that affect the ability to detect oil on the sea surface, which include: cloud cover, surface oil thickness, low resolution of data products, and in this particular event, the use of dispersant. The dispersal of the oil may have reduced the oil thickness and changed the optical properties of the oil so that it is not as detectable as in previous studies.

Conclusions

The use of publicly available daily MODIS standard products was not as effective as other methods for mapping sea surface oil for the Deepwater Horizon oil well rupture, the biggest oil disaster in history. Using combinations of resources such as SAR and high temporal resolution satellite imagery is very effective at mapping surface oil and rather economical as well. The most consistent method for detecting the oil in this Deepwater Horizon oil disaster has been using sun glint on true color imagery. The use of satellite imagery is not as accurate as other methods of oil spill detection like airborne methods (laser fluorosensors, IR/UV sensors, microwave radiometer sensors, and others), but that does not mean that it should be discounted or not be used in conjunction with other methods. Further investigation into how dispersants affect the properties of oil on water is needed.

Collaborators

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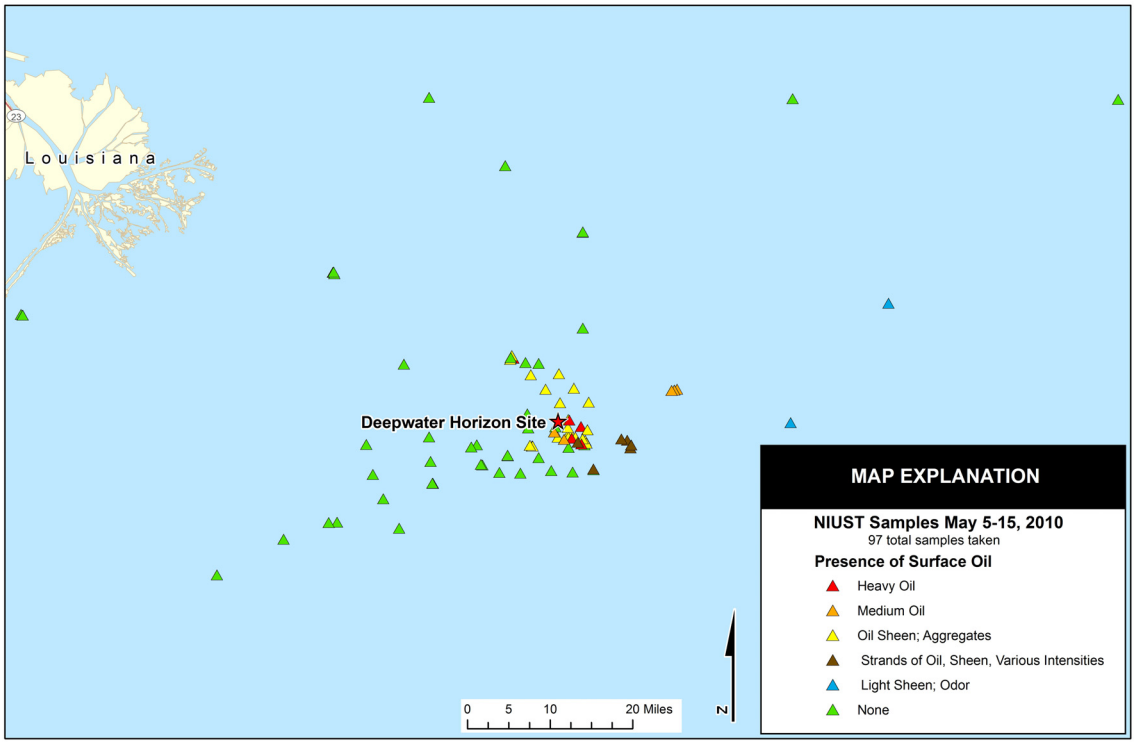

Figure 1. Location of NIUST samples taken from May 5-15, 2010 in the Gulf of Mexico.

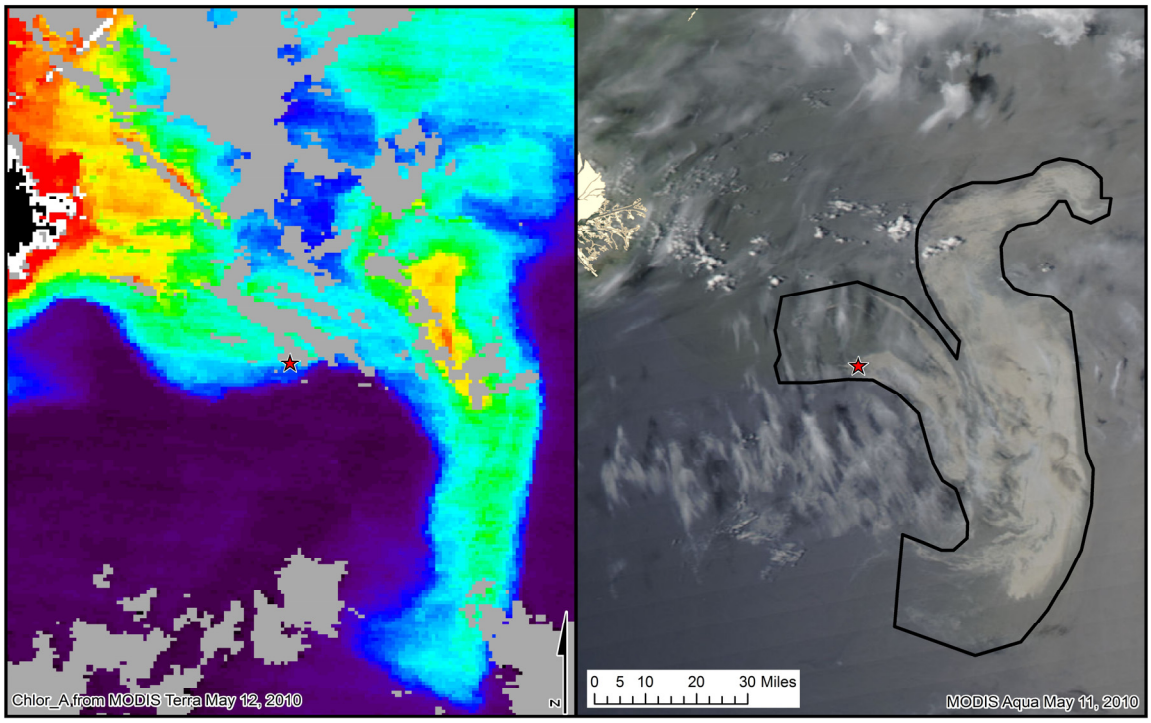

Figure 2. Comparison of chlorophyll concentration from May 12, 2010 to approximate oil area (outlined in black) from May 11, 2010. Deepwater Horizon site is the red star.