United Nations Office for Outer Space Affairs (UNOOSA)

Space4Youth Competition 2021

"Space as a tool to foster climate mitigation and adaptation"

ENACTMENT OF RADAR IMAGERY FOR OIL SPILL DETECTION IN TRINIDAD

By: Denzil Rajack-Prayag

TABLE OF CONTENTS:

ABSTRACT:

Figure 1: The Catastrophic Gulf of Mexico Oil Spill

Environmental pollution goes hand in hand with oil drilling. Our reliance on oil is fueling climate change resulting in global warming and polluting priceless landscapes as seen in **Figure 1** above.

Oil discharged into the marine environment may occur from natural seeps, land-based and ocean-based sources such as oil spills from ships/tankers and offshore platforms and pipelines.

We are already committed to some level of climate change but responding to climate change involves a two-pronged approach:

1. Reducing emissions of and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere ("mitigation"); and
2. Adapting to the climate change already in the pipeline ("adaptation").

Abstract Word Count: 100

INTRODUCTION:

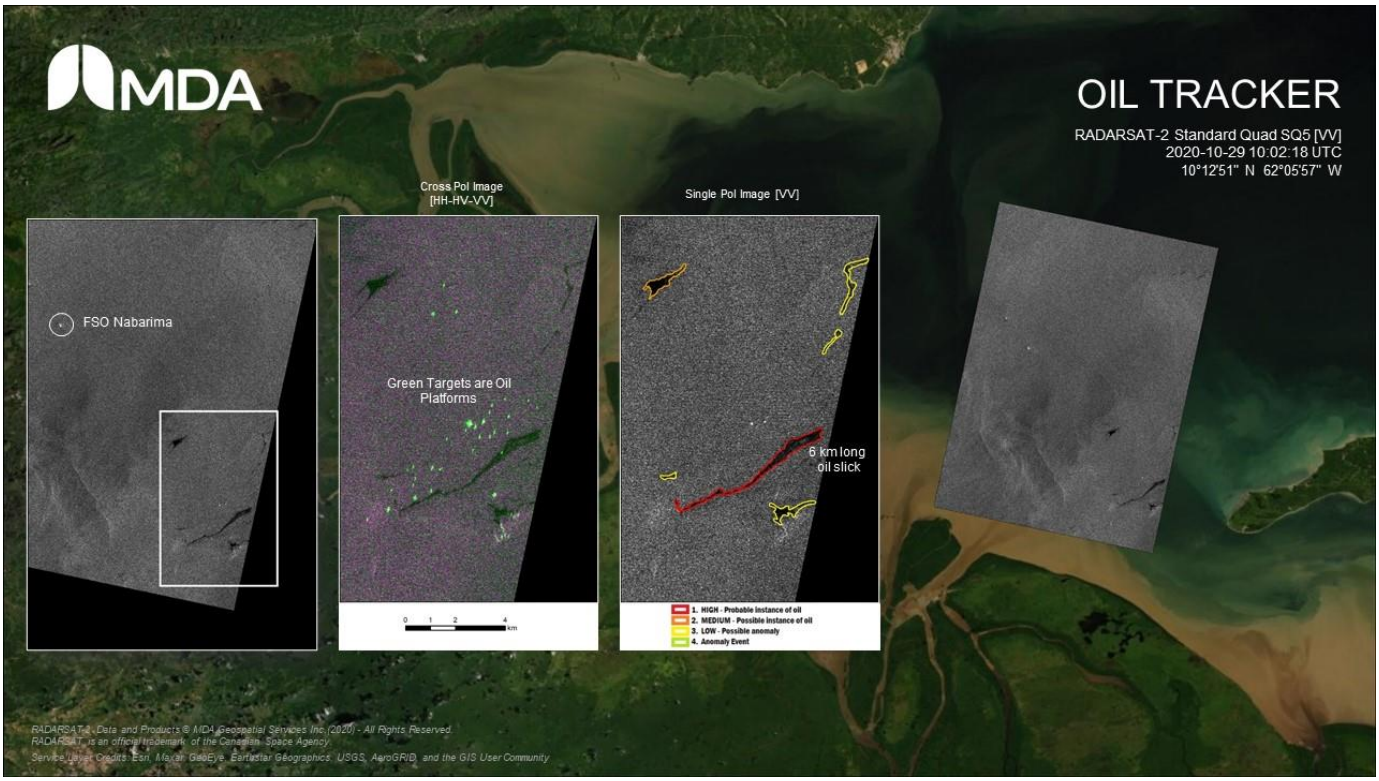

Figure 2: RADASTAT-2 Oil Tracker Radar Imagery

A large majority of the world's petroleum transfer passes through the Caribbean which makes the transfers risky and dangerous. Therefore, Trinidad with its heavy tanker traffic, is always under risk of oil hazards.

An oil spill monitoring and detection system should be used to prevent and identify the spill. The percentage of the oil spill, aerial extent, position and the nearest ship position if any as illustrated in **Figure 2**, which shows the sinking of the FSO Nabarima oil vessel off the coast of Trinidad.

SYNTHETIC APERTURE RADAR (SAR) SATELLITES:

This essay focuses on the operation of radar imagery instruments that use microwave radiation, the same way as a ship's sonar uses sound, to send out a pulse of waves and analyze the signal that returns.

These 'active' sensors will allow us to 'see through' clouds and measure heights very accurately. This means they can be used for monitoring changes in sea levels by producing accurate maps and examining the effect of earthquakes also it is being used presently to monitor the La Soufriere Volcanic activity in St Vincent.

For Trinidad's purpose, a satellite-based oil pollution monitoring system needs to be used to take precautions and determine the possible polluter. **Synthetic Aperture Radar (SAR) Satellites** such as the **RADARSAT-2** are the main data sources used to detect the oil spills discharged into the sea with sufficient accuracies as seen in **Figure 2**.

The **MDA's** satellite systems and components provide expert radar imagery and robust scientific data needed to understand climate change and observation. The goal for Trinidad's implementation of a satellite monitoring system would enable local policymakers to fully account for the many sources and "sinks" of carbon and assess the liability of damages caused.

FFOS a local NGO notified the population that there was a state of environmental emergency regarding the sinking of the **FSO Nabarima** oil tanker with its 1.3 million barrels of oil. If the oil spilled, it would threaten the entire Southern Caribbean, luckily the issue was mitigated however there was still some extent of spillage and damage caused to the marine ecosystem.

The goal of mitigation is not only adhering to the Paris Agreement but the avoidance of significant human interference with the climate system. To stabilize greenhouse gas levels in a timeframe sufficient to allow ecosystems to adapt naturally to climate change. This ensures that food production on land and in the sea is not threatened and enables economic development to proceed in a sustainable manner.

CORAL REEF PROTECTION:

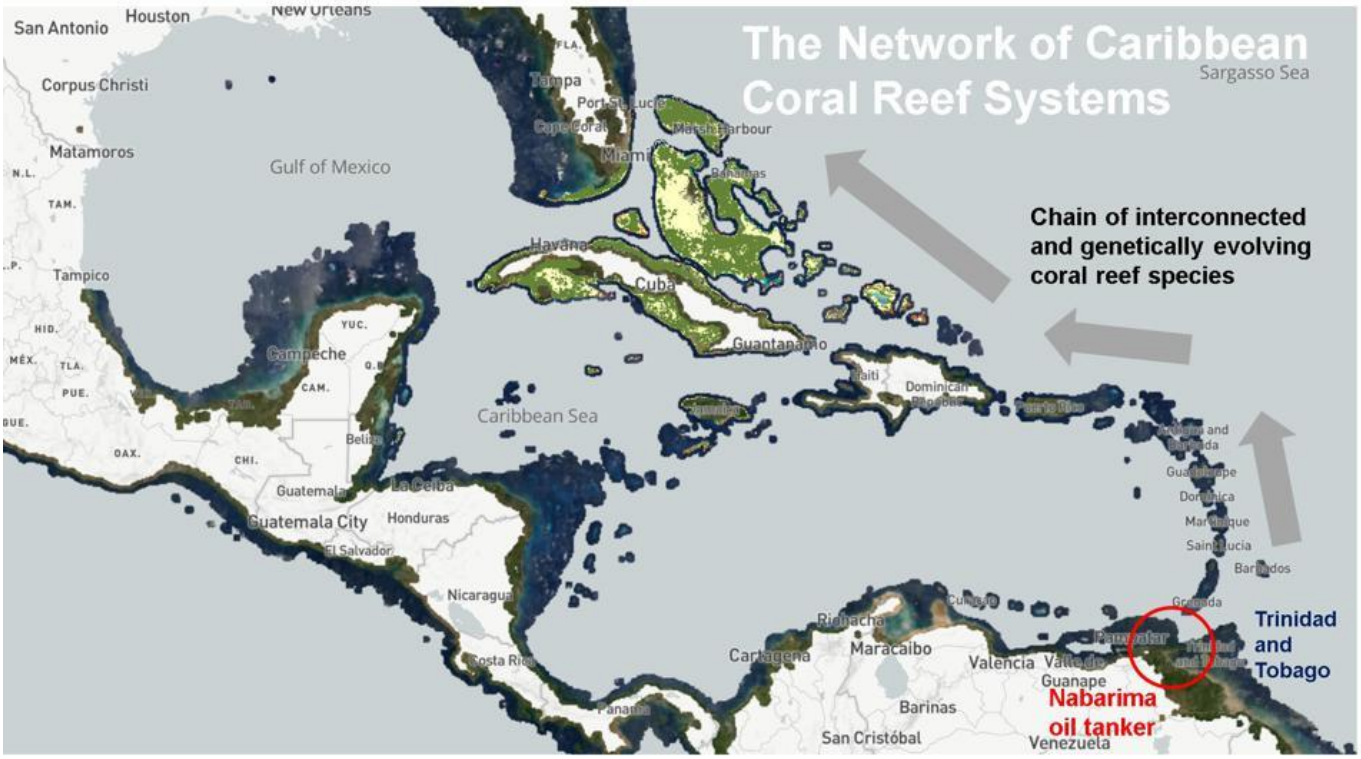

Figure 3: Caribbean Reefs are all connected and have genetically evolved from Trinidad's.

Once oil encounters corals, it can kill them or impede their reproduction, growth, behavior, and development. Each island has a genetically unique set of corals that initially evolved from Trinidad's corals as depicted in **Figure 3.**

Oil spills can have serious negative environmental and socio-economic impacts on marine life, coastal habitats, wildlife species, recreational activities and to coral reefs. The increase of overseas transportation is an detrimental factor contributing to global climate changes and damage of the marine ecosystem.

OIL SLICK DETECTION:

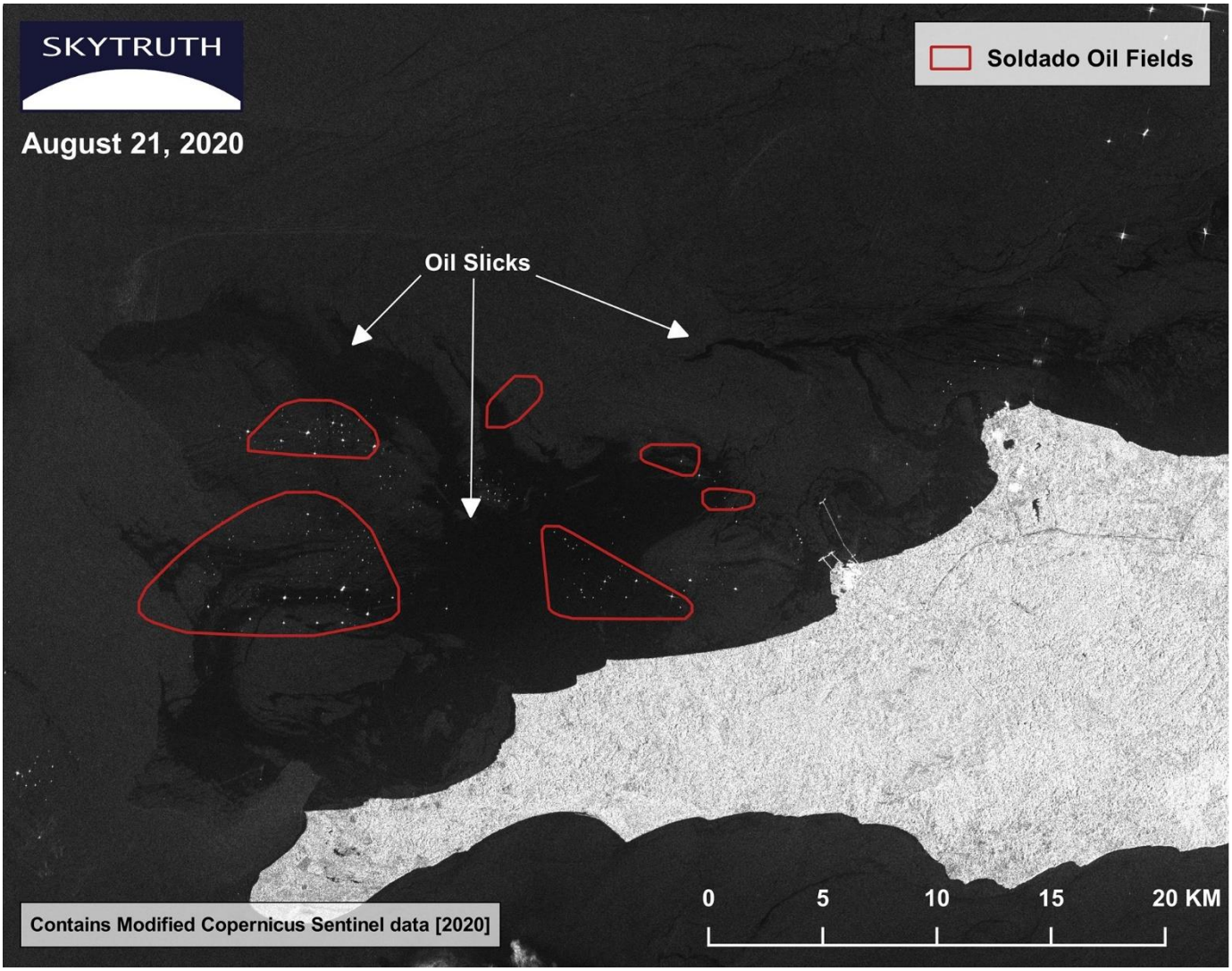

Figure 4: Skytruth Radar Imagery of oil slicks off the coast of Trinidad.

The need for oil slick detection as provided by **Skytruth** using **RADARSAT-2** is crucial, for the location of polluted areas and to evaluate slick drift to protect the coastline. The establishment of a Trinidadian Satellite-based oil spill monitoring system using radar imagery **SAR** would be implemented to take precautionary measures and allow for mitigation and adaptation.

Skytruth recorded persistent oil leaks in the Soldado Main Field. These satellite images confirm that for many weeks, there have been persistent oil spills in both the south-east and south-west regions of Trinidad as seen in **Figure 4.**

These spills have gone unchecked, unreported or under-reported, with no clean-up activities, no oil-spill containment equipment being deployed, no marine advisory to seafarers and no reporting to the public and other marine stakeholders. As such the damage done to the environment is irreversible and highly detrimental to the marine ecosystem.

OIL DENISTY MAPPING:

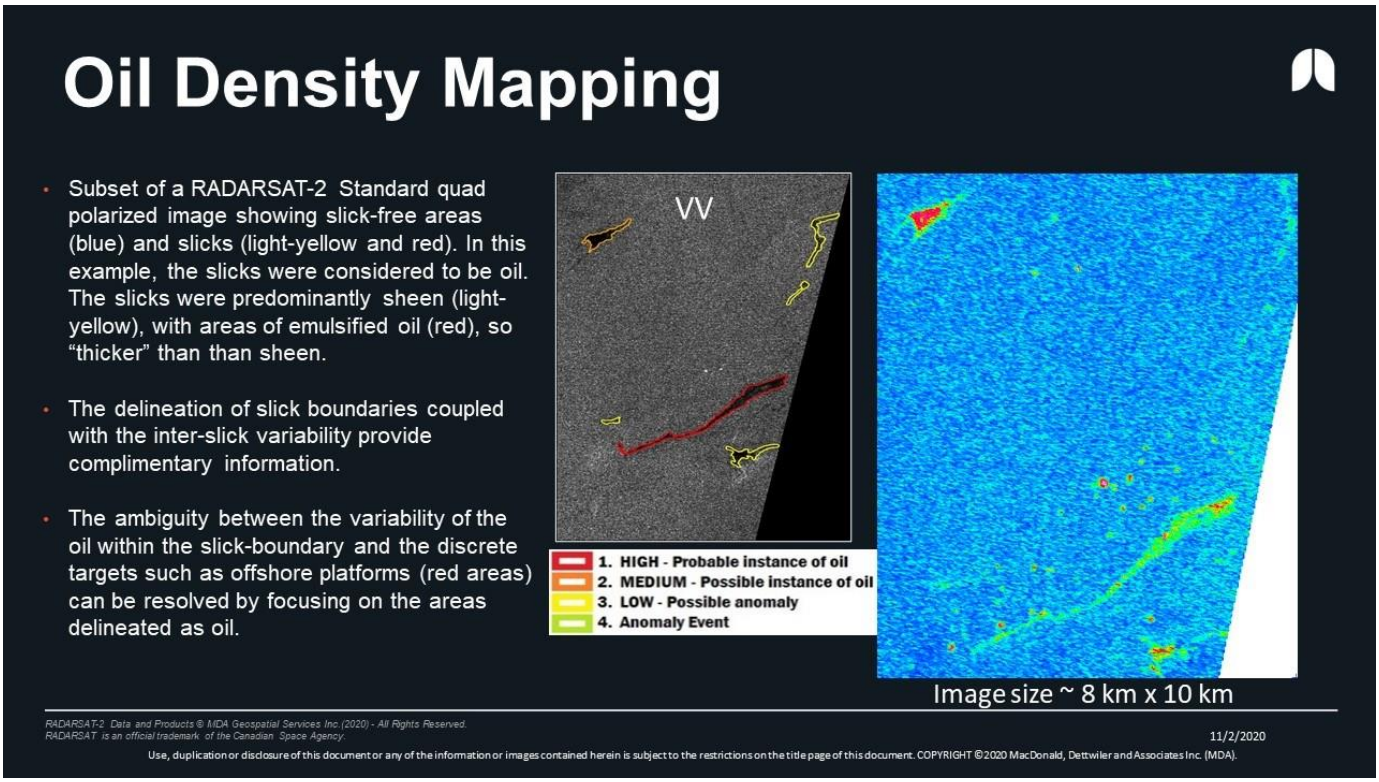

Figure 5: Oil Density Mapping Data produced by RADARSAT-2

Thermal infrared sensors can measure the temperature of the Earth. They work in the same way as the cameras used at airports to detect people infected with **Covid19**. Using satellite sensors to measure the temperatures of the land surface, sea surface and cloud tops would help us to quantify the effects of global warming on the oceans and the atmosphere. Doing this also allows us to explore temperature changes on a smaller scale in islands such as Trinidad and in inaccessible regions including the Arctic and Antarctic.

Radar imagery produced by **(RADASAT-2)** will improve the possibilities for the detection and monitoring of oil spills as they cover large areas in all weather conditions and offer an economical and easier way of continuous coastal areas patrolling as illustrated in **Figure 5.**

The capability of **SAR (RADASAT-2)** in detecting oil slicks over the sea surface is well known and proven by several studies aiming at oil spill detection using **SAR** images. **SAR** imagery depicts any dark spotted area that has a high contrast relative to its surrounding and should be examined in case of any oil spills.

CONCLUSION:

The detection and monitoring of the oil spills have critical importance for rapid emergency response activities. These should cover six basic issues; i) prevention, ii) alarm, iii) monitoring, iv) mitigation, v) adaptation and vi) damage quantification.

Whatever its source is, oil spill pollution will continue to occur therefore, to lessen its effect contributing to global warming, the improvement of its detection and continuous monitoring are the most important issues to effectively plan a countermeasure response.

The objective of the Oil Spills Detection system is to strengthen national and by extent regional preparedness and response capacity to oil spills. The detection system also serves to foster and facilitate co-operation and mutual assistance among other nations and Caribbean territories in cases of emergency to prevent and control major oil spill incidents.

Synthetic Aperture Radar Satellite Imagery can provide valuable information in monitoring and policing the marine-pollution problems. The suggested methods should be developed to establish an operational oil spill monitoring system to protect the national, regional and international waters of Trinidad.

Essay Word Count: 1000

BIBLIOGRAPHY:

allencoralatlas.org. (n.d.). Allen Coral Atlas. [online] Available at: https://allencoralatlas.org/.

Moussu, N. (2014). Transnational Climate Change Governance, Harriet Bulkeley et al., 2014, New York, Cambridge University Press, 212 p. Études internationales, 45(4), p.665

Espedal, H. A., 1998, Detection of oil spill and natural film in the marine environment by spaceborne synthetic aperture radar. PhD thesis, Department of Physics University of Bergen and Nansen Environment and Remote Sensing Center, Norway.

Gade, M., Scholz, J. And Viebahn, C., 2000, On the detectability of marine oil pollution in European marginal waters by means of ERS SAR imagery. International Geoscience and Remote Sensing Symposium (IGARSS 2000), VI, pp. 2510–2512.

GEO ExPro. (2019). The Value of Satellite Data in the Oil and Gas Sector. [online] Available at: https://www.geoexpro.com/articles/2019/10/the-value-of-satellite-data-in-the-oil-and-gas-secto

MDA. (n.d.). RADARSAT-2 Continuity Mission. [online] Available at: https://mda.space/en/form/

oils.gpa.unep.org. (n.d.). Global Marine Oil Pollution Information Gateway. [online] Available at: http://oils.gpa.unep.org/

Solomon, S. et al. (eds.) (2007), Climate Change 2007: The Physical Science Basis, Cambridge University Press

Topouzelis, K., Karathanassi, V., Pavlakis, P. And Rokos, D., 2002, Oil spill detection:SAR multi-scale segmentation and object features evaluation. In 9th InternationalSymposium on Remote Sensing (SPIE), pp. 77–87.

Womens Earth Alliance. (2021). U.S. set to rejoin the Paris Agreement. [online] Available at: https://womensearthalliance.org/in-the-news/u-s-set-to-rejoin-the-paris-agreement/

www.oecd.org. (n.d.). OECD Space Forum - OECD. [online] Available at: http://oe.cd/spaceforum