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ANALYSIS OF THE SPREAD OF THE CALLAO OIL SPILL OFF THE COAST OF LIMA, PERU USING EARTH OBSERVATION DATA

Abstract

The Humboldt Current System (HCS) is one of the most productive marine ecosystems in the world. In this current system, the upwelling of cold, nutrient-rich water drives the production of planktonic organisms which make up the base of the food web.

This paper analyzes data associated with the Callao oil spill off the Peruvian coast, caused by tidal waves created by the 2022 eruption of the Hunga Tonga volcano in the South Pacific. The spillage of oil into the marine ecosystem has caused damage to natural resources and has had significant negative socio-economic consequences.

The areas of upwelling are directly influenced by regional wind patterns. Winds and waves are two key factors driving forces that cause upwelling phenomena in coastal areas and the open oceans. During oil spill events, oil slicks cover the ocean surface and thus change the surface roughness and affect the Ekman transport by minimizing the wind effect on the ocean surface. These effects are characterized in this research.

The methodology considered in this study is to analyze the impact and evolution of the oil spill on a sample of three different sites off the coast of Lima, Peru. Synthetic Aperture Radar (SAR) imagery is analyzed to identify and track the exact location of the spills. To assess the environmental impact, the following parameters are used: sea surface temperature (SST), sea surface salinity (SSS), iron (FE), chlorophyll (CHL), nitrates (NO3) levels, upwelling index (Ekman transport based), wind speed and direction, and sea surface height (SSH). In addition, both the bathymetry (BAT) and ocean currents are analyzed in the areas of study to assess their influence on other variables. The correlations between these parameters are characterized to provide a better understanding of the potential consequences of oil spills.

The results allow for the definition of the oil spill movement off the coast of Peru and the prediction of its environmental impact on marine life and socio-economic impact on aquaculture activities. This study allows for refined modeling of oil spills, enabling a better understanding of spill evolution using Earth Observation data.