NASA TECH BRIEF

Ames Research Center

Optical Detection of Oil on Water

Three radiometric techniques utilizing sunlight reflected and backscattered from water bodies have potential application for remote sensing of oil spills. These techniques measure (1) individual polarization components of radiance, (2) differences between these components, and (3) total radiance. Detection is based on the comparison of radiance signals obtained from natural and contaminated water. Measurements are performed in the ultraviolet or far-red portions of the spectrum where the backscattered component is small, and oil is distinguishable from water by the surface reflected light.

A detailed study was made to evaluate these techniques. Preliminary facets of the study involved Fresnel front-surface reflectance, Rayleigh skylight polarization, experimental measurements of skylight intensity and polarization, and airborne measurements of total radiance under clear and overcast skies. Measurements were made at various wavelengths between 0.37 and 1.0 micrometer.

It was found that incident light polarized perpendicular to the vertical plane is relatively highly reflected by liquids and, for this component, oil always appears brighter than water. In comparison, light polarized parallel to the vertical plane is weakly reflected in a manner to cause a reversal in contrast with viewing angle; that is, at elevation angles greater than 37° oil is brighter than water, and at lesser angles water is brighter than oil. The effects of light backscattered from beneath the water surface can be eliminated by measuring the difference between polarization components.

In the measurement of total radiance, the sum of the polarization components is measured and, therefore, the available energy is generally high. If the incident skylight happens to be mostly parallel polarized, however, the measurement involves chiefly the parallel polarization component, and a reversal in contrast can occur.

The results of the study indicate that oil on water can best be detected by viewing the perpendicular polarization component of reflected light or the difference between polarization components. Detection can best be performed in the ultraviolet or far-red portions of the spectrum and in azimuth directions toward or opposite the sun.

Reference:

Millard, J. P., and Arvesen, J. C.: Airborne Optical Detection of Oil on Water. Applied Optics, vol. 11, no. 1, p. 102, 1972.

Notes:

No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
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Patent status:

NASA has decided not to apply for a patent.

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Category 03