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Satellites, sonars, and seafloor cameras: a tripod approach for mapping marine hydrocarbon fluxes

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Marine oil seeps are a significant source of methane and higher hydrocarbons to the water column and atmosphere. However, because active seeps are geographically patchy and temporally intermittent, localizing and inventorying seeps is problematic.

An index of ∼37000 RADARSAT-1 SAR images collected over the Gulf of Mexico shows the relative concentrations of effort for satellite remote sensing of seeps (and other processes) in a marine hydrocarbon basin. Future efforts could compile similar levels of coverage in other basins, such as the Black Sea, the Gulf of Guinea, or the Pakistan Margin. Neural network training sets are used to automate the detection of floating oil in SAR images. With a large image inventory, statistical methods can control for effects of depth and weather to compare fluxes among geographically separate seeps or at the same seep over time.

Satellite detection of seeps can be obscured by weather conditions or, in some cases, overwhelmed by extremely prolific seeps that literally cover the sea surface with oil. Geophysical data can be used to localize seep formations and water column acoustics (e.g. parasound) can detect bubbles rising from seeps. However, geological formations often over-estimate the extent of active seeps, while gas “flares” tend to be highly localized within seeps. Visual inspection is required to map the extent and character of seeps targeted by satellite and geophysical data. Deep-diving ROVs serve this purpose, but developing countries can achieve useful results from cost-effective camera

platforms.