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Estimates of natural hydrocarbon flux in the Gulf of Mexico basin from remote sensing data

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A budget for carbon released from natural seeps should include gaseous and liquid hydrocarbon consumed by microbial processes in seafloor sediment and similar material released to the water column. Remote sensing observations and measurements of seep dynamics can constrain the magnitudes of the released carbon.

Separate inventories of backscatter anomalies (slicks) in satellite synthetic aperture radar (SAR) images have been compiled for the entire Gulf of Mexico basin [1,2]. These targets were judged to be, floating oil naturally released from seafloor sources because their shape are consistent with observed confirmed seeps and they persist in the same locality among multiple images. These targets emanate from ∼400 separate sources distributed from the basin margins to the abyss. The SAR images indicate that water is covered with oil amounts to, conservatively ∼850 sq. km of the in the northern Gulf of Mexico and ∼150 sq. km in the southern Gulf of Mexico.

It is possible to calculate the total annual seepage of oil in the basin based on the following assumptions: 1. Assuming 0.1 um layer thickness for visible oil one gets 100 liters/sq km or $\sim 10^5$ l for the total visible volume of oil. 2. From standard estimates of the specific gravity of petroleum, assume 755 g C per l and 7.5 x 10^7 g C as the instantaneous magnitude of all seeps. If visible oil persists for somewhere between 8-24 h after it surfaces, and the single volume estimate persists for a year, then the annual carbon flux from natural seepage is 2.7 to 6.5 10^{10} g C y^{-1} due to oil. This magnitude is not significant in terms of the global carbon budget, it exceeds estimates for the global input of oil to the ocean from natural sources [3].

The carbon flux from methane is not directly measurable from remote sensing data. However, seafloor observations show that the processes by which oil drops reach the surface probably include release of substantial free gas [4,5]. By combining these observations and extrapolating on the number of sources found in the satellite data, it is possible to include the contribution methane to the basin-wide flux. The field data indicate that a “typical” seep—one which produces a persistent SAR target—releases gas at the rate of $\sim$10 l s^{-1} (STP equivalent). This is the equivalent of 1600 M h^{-1} or 1.9 x 10^4 g C h^{-1}. The annual rate from 400 such sources would be $\sim$6.7 x 10^{10} g C y^{-1}.

While these magnitudes are not a significant fraction of the global methane budget, they demonstrate a process that would have profound impact on the biogeochemistry of the deep-ocean ecosystem. Additional findings documenting direct measurements of water column methane concentrations will further constrain the basin-wide carbon budget of the Gulf of Mexico.

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