Geogenic Inputs to the Gulf of Mexico Airshed

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Minerals Management Service
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Minerals Management Service (MMS)

- U.S. Department of Interior Agency
- Responsible for regulating offshore oil and gas industry
- Gulf of Mexico (GOM) comprises 90+% of offshore production
Gulf of Mexico (GOM) Outer Continental Shelf (OCS):

- Provided 8% of the nation’s crude oil demands in 1999.
- Supplied 22% of U.S. natural gas consumption in 1999.
Gulf of Mexico (GOM) Outer Continental Shelf (OCS):

- Regulated by the Minerals Management Service.
- Royalties provide second greatest source of income for federal government (only $4.2 billion in 2000).
Energy Exploration!

Renewable Resources
- Not well developed
- Research lagging
- Funding follies

So…
Energy Exploration:

Non-renewable Resources:
- Infrastructure in place
- Beaucoup investment
- Research well-funded
- Track record “clean”
Gulf-wide Offshore Activities Database System (GOADS)

- Calendar year 2000
- Includes following activities:
  - Oil & gas E&D activities
  - Tanker and cargo shipping
  - Recreational boating
  - Commercial fishing
  - Natural (geogenic) sources
Purpose of GOADS

Determine offshore significance to:

1. Ozone Formation and Transport
2. Regional Haze Formation
Gulf of Mexico (GOM) Environment
GOM Natural Environment

- Air quality assumed better than NAAQS
- MMS delegated to protect AQ
GOM Human Environment

- Commercial and recreational fishing
- Cargo and tanker transport
- Military exercises
- Oil and gas exploration and production
Natural Oil and Gas Seeps

- Used to locate hydrocarbon reserves.
- Appear as seismic anomalies in radar imagery.
  - Mud volcanoes
  - Surface faults
  - Gas hydrates
  - Chemosynthetic communities
Chemosynthetic Communities

- Use hydrocarbons as energy source.
- Found along the continental slope.
- Form over seeping surface faults.
Natural Oil Slicks

- Evident from orbiting satellites
- Quantifiable
- Temporal and spatial variability
Continental Margin Fluid Seeps

Quantity

- Lots!
- Global Rate = 2 million barrels/yr
- 1.2 million barrels/yr migrates directly to the surface
- VOC emissions = 105,000 tons/year
High-end Estimated Flow Rates

- Area ~ 15,000 km$^2$, centered at 91.5$^\circ$ W, 27.5$^\circ$ N, Northern GOM
- Process (Seepage) Rate = 20,000 m$^3$/yr
  = 120,000 barrels/yr
- VOC emission factor (oil) = 105 lbs/bbl

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\frac{120,000 \text{ bbl/yr} \times 105 \text{ lbs/bbl}}{2000 \text{ lbs/ton}} = 6300 \text{ tpy}
\]
Entire Northern GOM

- Process (Seepage) Rate = 500,000 barrels/yr
- VOC emission factor (oil) = 105 lbs/bbl

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\frac{500,000 \text{ bbl/yr} \times 105 \text{ lbs/bbl}}{2000 \text{ lbs/ton}} = 26,250 \text{ tpy}
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Natural “gas estimations”

- Seeps below 400 m form gas hydrates.
  - Frozen methane: Trapped!!
- Above 400 m, most dissolves.
  - High solubility in sea water.
Natural Gas Estimations

- Very shallow seeps may reach the surface soon after discharge.
  - Only quantified in Santa Barbara Channel (Southern California).
  - Not applicable to most GOM gas seeps.
    - Dissolve before reaching the surface.
Conclusions

- Upper-end estimation is \( \sim 30,000 \) tons TOC per year from GOM oil seeps.
- ROG fraction much less: \( \sim 6,000 \) tpy.
  - Six percent (6\%) of oil & gas total VOC emissions for the Northern Gulf of Mexico.
- Should be included in ozone modeling.