Studies in the Coal Oil Point Marine Hydrocarbon Seep Field
where oil and gas meet sea and surf

Ira Leifer (UCSB)
Bruce Luyendyk (UCSB)
Tonya Del Sontro (UCSB)
Thor Egland (L3 Corp)

Prevention First
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Study Goals

- Estimate total oil and gas emissions
- Identify sources of emission variability
- Predict the fate of emitted oil
- Identify major sources of tar on area beaches
Seep Studies are Relevant!

Seeps are a major pollution source that stresses humans and the environment.

The Coal Oil Point Seep Field is an *ideal* natural laboratory to study oil in the ocean.

www.bubbleology.com  seeps.geol.ucsb.edu
Wise words of KK - Its the oil!!

Caveat (it’s the methane too - a potent GHG 22 times more powerful than CO2)
Where is the Coal Oil Point seep field?

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Stats - 100,000 m³ methane per day
100 bbl oil per day

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That’s one exxon valdez every 5-7 years
Jackpot seep

100 bbl/day is normal

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Some days are not normal!

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So what happens on a bad day?
Then where does the tar come from?
Where does the tar come from?

Oil slicks advected by winds and currents and aged by the sun and evaporation and other processes
Tool for studying oil slick evolution
CATDRUMs - Catamaran Rotating Drum Slick Sampler
Particle Slick Tracking

Hollow glass microspheres
~35 µm radius

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The spheres track the slick
Can be followed from a boat
and are visible from the air
On this day, the slick tracked almost due east
while the slick tracked east . . .
a drift buoy tracked NNW

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Standard model run
Predicted slick to track WNW

Model - NOAA GNOME

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Introduction of a current factor allowed model to track the true slick trajectory.

Slick tracking studies improve modeling capabilities.
So what happens on a bad day?
Conditions favorable for beach tar
Step 1 - Convergence Zone Accumulation

Trilogy Seep

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Step 1 - Convergence Zone
Accumulation

Seep Tent Seep

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Step 2 - Currents draw into long slicks
Sea breeze pushes oil slicks towards shore and weathers oil.
Very weathered oil begins sinking
and what doesn’t sink . . .
beaches!
When and why are there bad days?
Beach tar in study area at Coal Oil Point

20,000 m² surveyed.
1500+ points per survey

Feb 27
Tar was classified by size during surveys along 12 transects.
A clear seasonal variation

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Some conditions unfavorable

offshore

B. Daily Hours of North Winds

Some conditions favorable

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onshore

C. Daily Hours of South Winds
Swell seems related too...
but other factors seem largely and generally unrelated
And then there was Feb 27 . . . .

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How to quantify field-wide emissions?

Sonar Survey!
Sonar returns can be calibrated and sonar surveys rapidly cover large areas to estimate field gas emissions.
Fish and noise (red) are removed and for a selected window, sonar returns are calculated.
They noise level is set based on the sonar return probability function.
Next we compare three trilogy lines surveyed April 2005 and Sept 2005
The Trilogy lines show significant differences spring to fall.
Analysis of 2005, 2006, & 2007 data will produce contour maps to compare with previous surveys.
and then there are those exceptional days
One of which was Feb 27 . . . .
What was unusual winter 2005 were the exceptional rains
Propose: Hydraulic pressure via aquifers can greatly increase emissions
Including perhaps . . .

![Image of diver and pre-ejection]
by submarine . . .

~1m

$\ t = 0.6 \text{ s}$
blowouts

\[ t = 1.2 \text{ s} \]

\[ \sim 1 \text{ m} \]
... when aquifer pressure ...

t = 20.2 s

1 m

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... opens new vents ...
. . . freeing trapped oil . . .

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Thank you for . . .
... learning about the Coal Oil Point seep field ...
an extraordinary natural laboratory
and scientific play field

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