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Weights and Balances: Integrating Models for Prevention and Response to Southern California Offshore Oil Spills

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Outline

- Background
  - Offshore oil production in US
  - Historic oil spills
  - Regulatory Agency: U.S. Department of Interior's Bureau of Safety and Environmental Enforcement (BSEE)
- Southern California Leases
- Integrated Modeling: Inform BSEE/BOEM Decision-makers
  - BLOSOM
  - CSIL
  - SWIM
- Next Steps

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History of U.S. Oil Use and Development

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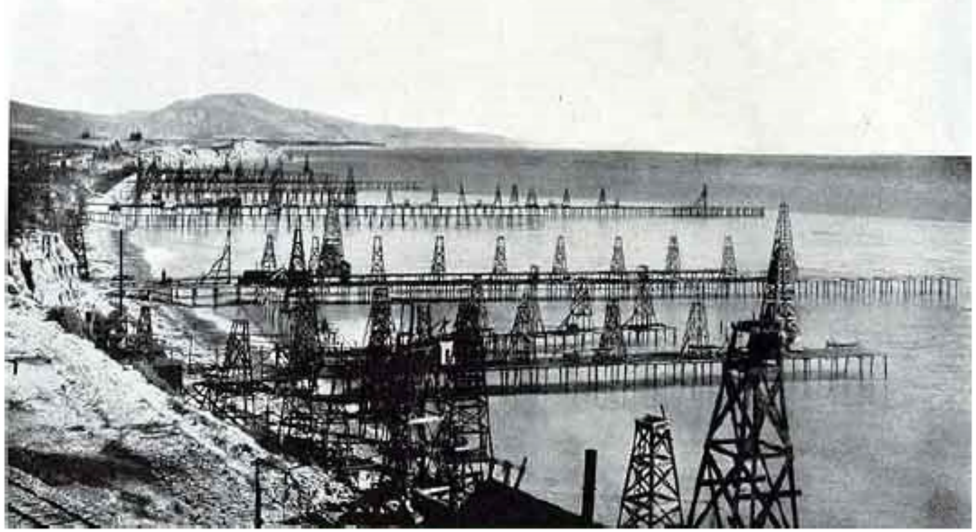
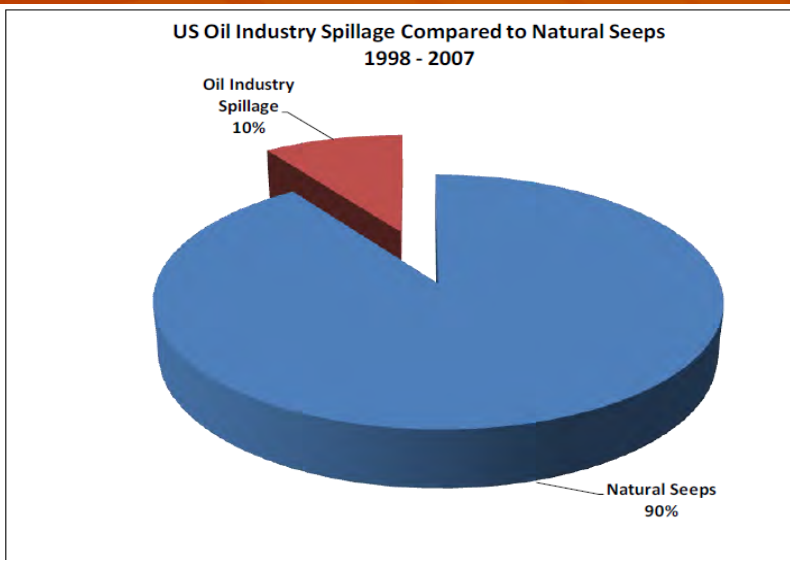
- 1748 – Peter Kalm publishes map showing oil springs in Oil Creek, PA
- 1767 – Sir William Johnson (NY) records Native Americans practice of skimming oil
- 1854 – Pennsylvania Rock Oil Co. is first U.S. oil company
- **1861 – U.S. annual production of crude oil increases from 0.5 million bbls to 2.1 million bbls**
  First international marine shipment of oil to London
- 1863 – PA legislature passes first anti-pollution law preventing oil spills into creeks.
- 1895 – CA produces 1.2 million barrels of crude oil
- **1896 – The 1st offshore well is drilled in CA at the end of a pier in Summerland**
- 1900 – 8000 automobiles are owned in U.S. (1/2 purchased this year)
- 1919 – Gasoline replaces kerosene as fuel
- 1920 – US has 8.5 million registered vehicles
- **1969 – CA's Union Oil Blowout**. Birth of the environmental movement and EPA
- 1985 – Peak CA production: 424 million bbls/yr.
- Offshore oil is16.2% of total production.
- **1989 – Exxon's Valdez spill**
- **2010 – Deepwater Horizon** spill leads to additional environmental protection laws and the birth of BOEM and BSEE

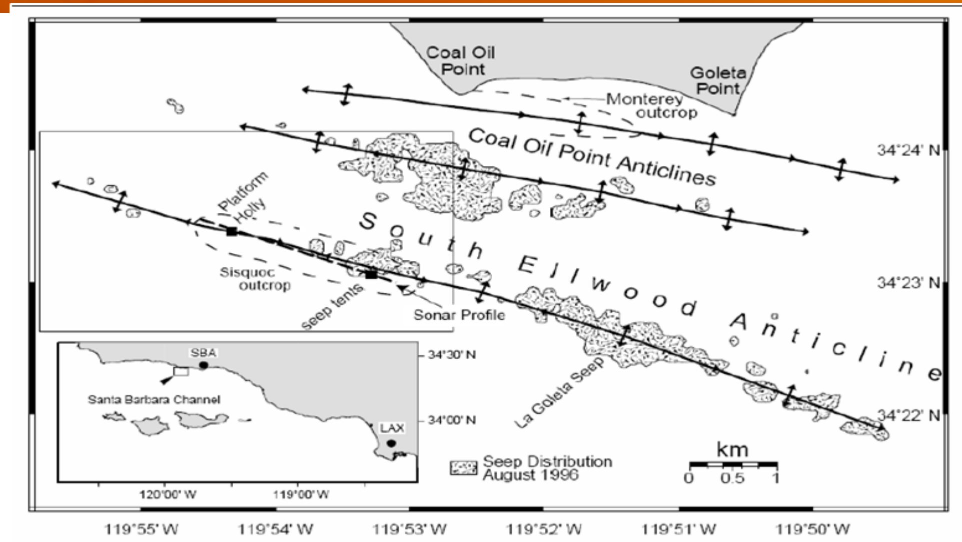


Late 19th century offshore petroleum production piers at Summerland, CA.

Note: 1 Barrel (bbl) of crude Oil is equivalent to about 42 gallons of oil. One tonne (toe) of oil equals 7.33 bbls.

Oil Spills and Oil Seeps





Oil seeps off Santa Barbara, California[16]

The biggest 3 U.S. oil spills (in order of size):

- Deepwater Horizon; 2010, Gulf of Mexico: 4.2 billion bbls
- Exxon Valdez; 1989, Alaska: 262,000 bbls
- Union Oil Co. Blowout; 1969, Santa Barbara, CA.: 100,000 bbls
- Southern CA. *SEEPS*, spills 200,000 – 360,000 bbls **annually**.

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Oil Industry Spillage Goes Down Over Time

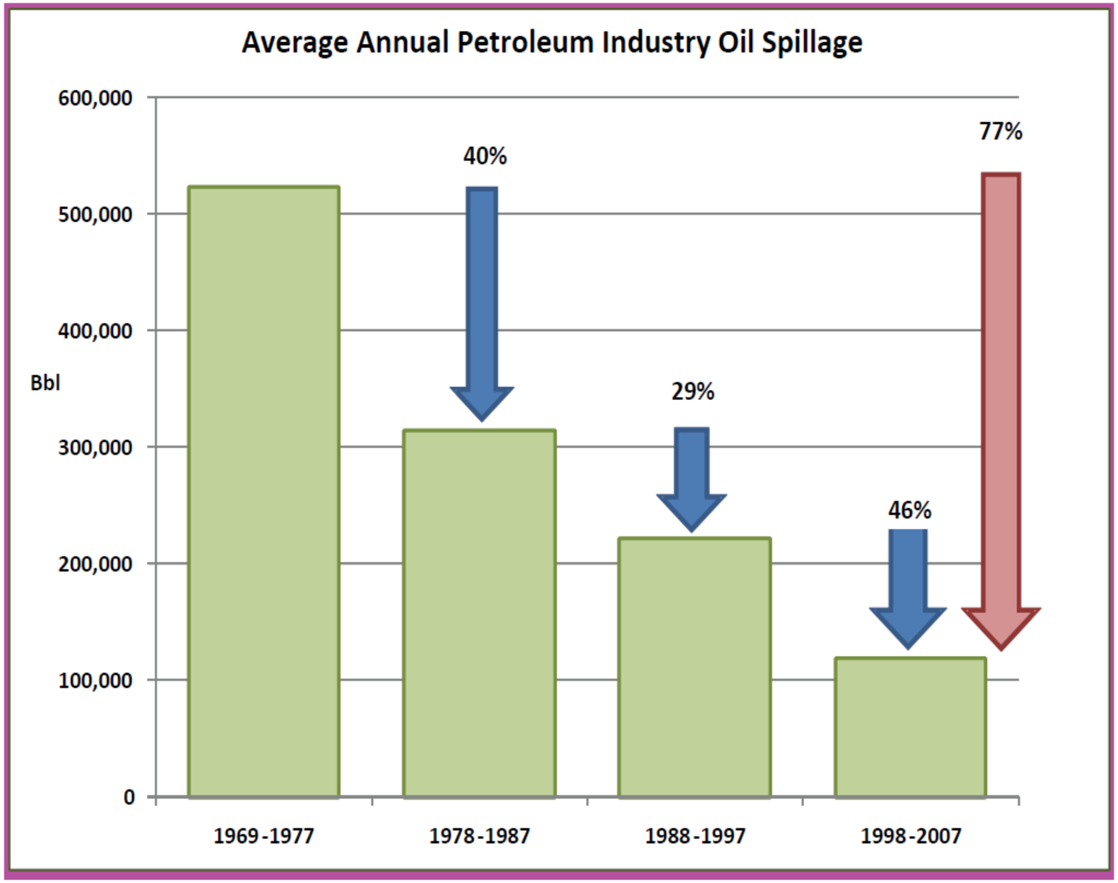

Figure A: Average Annual Oil Spillage from Petroleum Industry Sources by Decade

Average annual oil spillage from petroleum industry sources, including: spillage related to oil exploration and production platforms and offshore pipelines; spillage from coastal and inland pipelines, spillage from oil transport by tank vessels, railroads, and tanker trucks; spillage from oil refineries; and spillage at gas stations.

The Union Oil Co. Blowout Site, 1969
Off Southern California Coast

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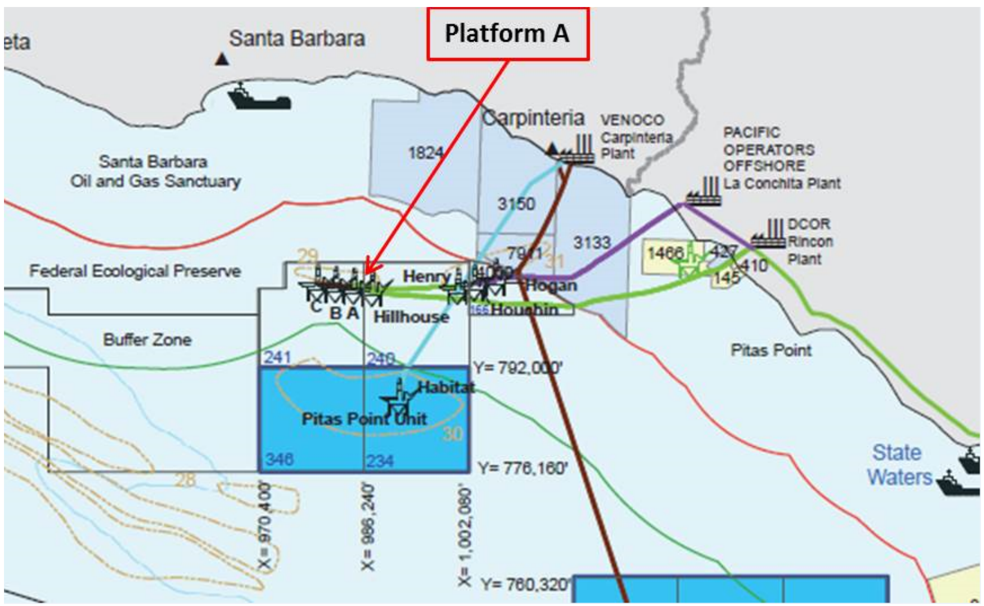
The four platforms producing from the Dos Cuadras Field, as seen from Summerland, California. They are, in order from left to right: Platforms Hillhouse, "A", "B", and "C". Santa Cruz Island in background.

Union Oil Co. Blowout at Platform A:

- First, large offshore oil spill in US waters
- Led to heightened public watchfulness
- Revisions in way US produces and recovers energy



Aerial view Santa Barbara Harbor during Clean-up

Southern California Offshore Oil Production

21st Century California:

- Produces around 350 million bbls/year offshore
- Another 680,000 bbls/day transported through southern CA ports
- More than 10,000 ships dock/year in ports

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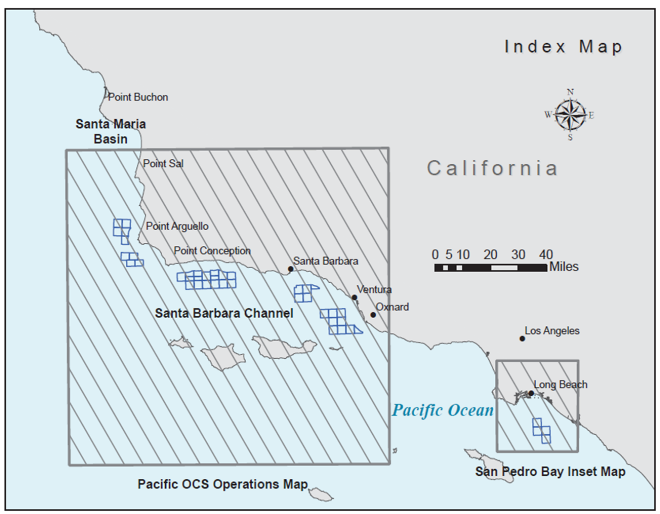
Southern California Offshore Oil Production



Area of Study. Blue squares are Lease Areas.

Objective: To Provide Tools for BSEE To Evaluate Oil Lease Applications

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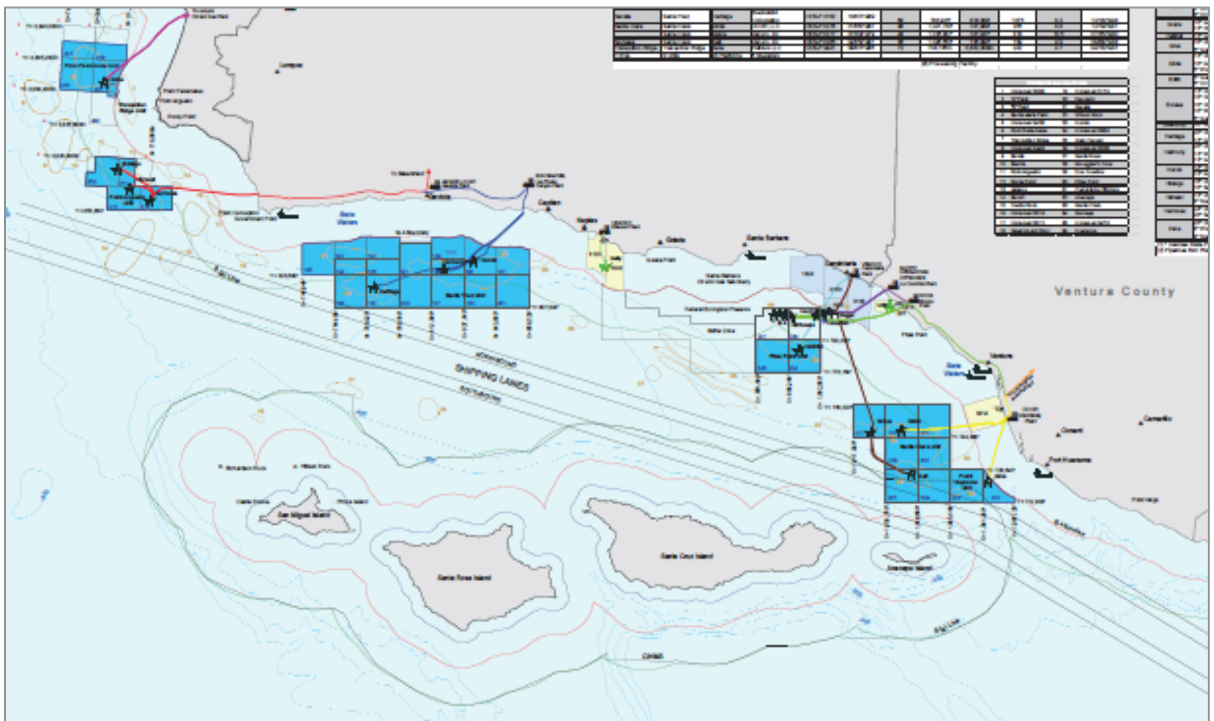
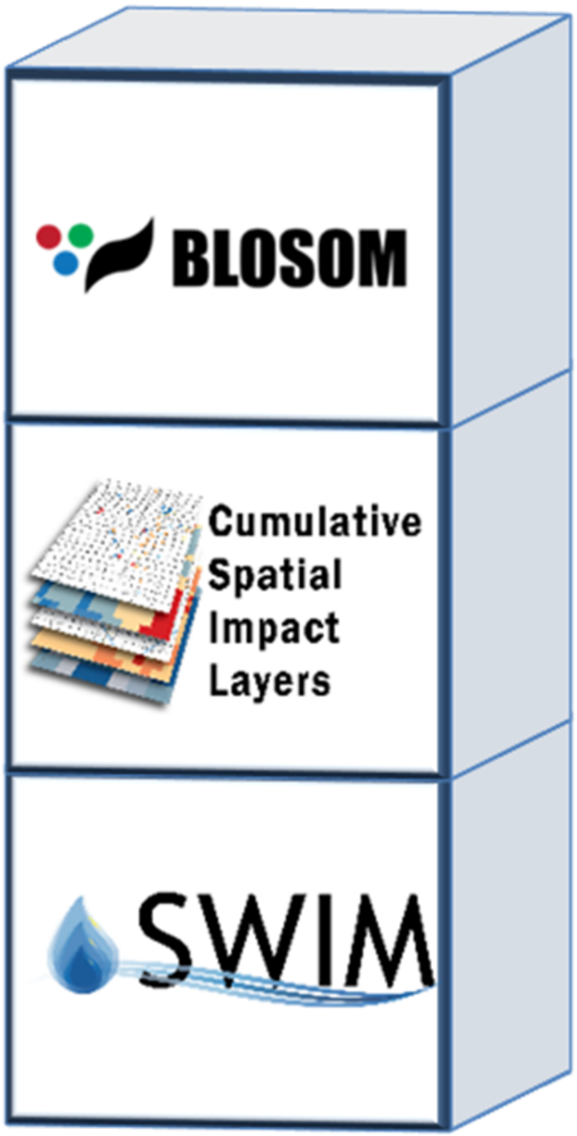
- BOEM : U.S. Dept. Interior's Bureau of Ocean Energy Management
- BSEE : Bureau of Safety and Environmental Enforcement
  - Oversees licensing of offshore oil and gas leases
  - Processes applications for leasing oil and gas
  - Applicant provides BSEE with:
    - Models results of **Worst Case Discharge Scenarios**
    - Plans for the response to **Worst Case Discharge Scenario**

Definition of **Worst Case Discharge Scenario**: Single highest daily flow rate of liquid hydrocarbon during an uncontrolled wellbore flow event.



Tools for BSEE



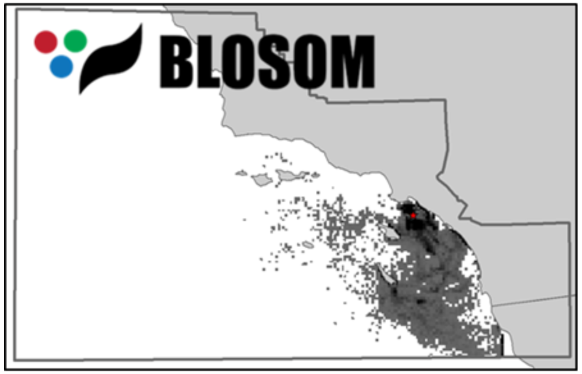
- Models are designed to inform and assist BSEE in checking plausibility of the applicants' plan to respond to the worst case discharge scenario:
  - **BLOSOM (BLOwout and Spill Occurrence Model)**: Predicts the trajectory and extent of oil coverage over time
  - **CSIL (Cumulative Spatial Impacts Layers)**: Identifies important factors over a region (Southern California) and the intersections with BLOSOM output
  - **SWIM (Spatially Weighted Impact Model)**: Adds the values of the factors in the region of the oil spill and allows the users to change the "weights" and importance of each factor to balance the outcomes.

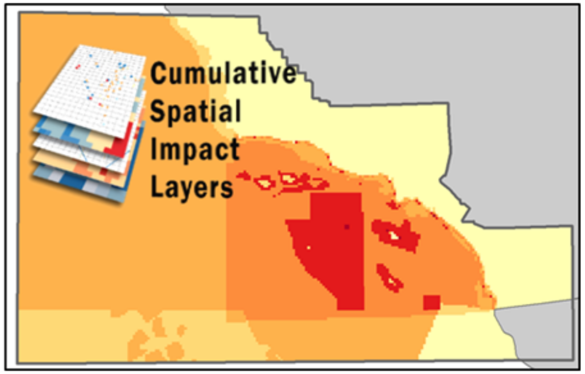
How do the Models Work Together?

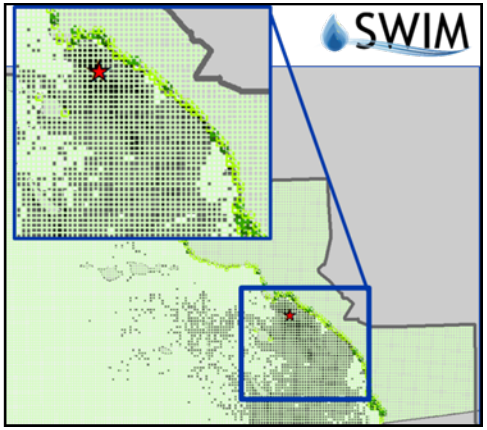
BLOSOM – Tracks where oil will go

CSIL – Identifies "factors" present in path of the oil spill

SWIM – Adds up the effected factors present and "weights" the importance of each







Factors Considered in CSIL

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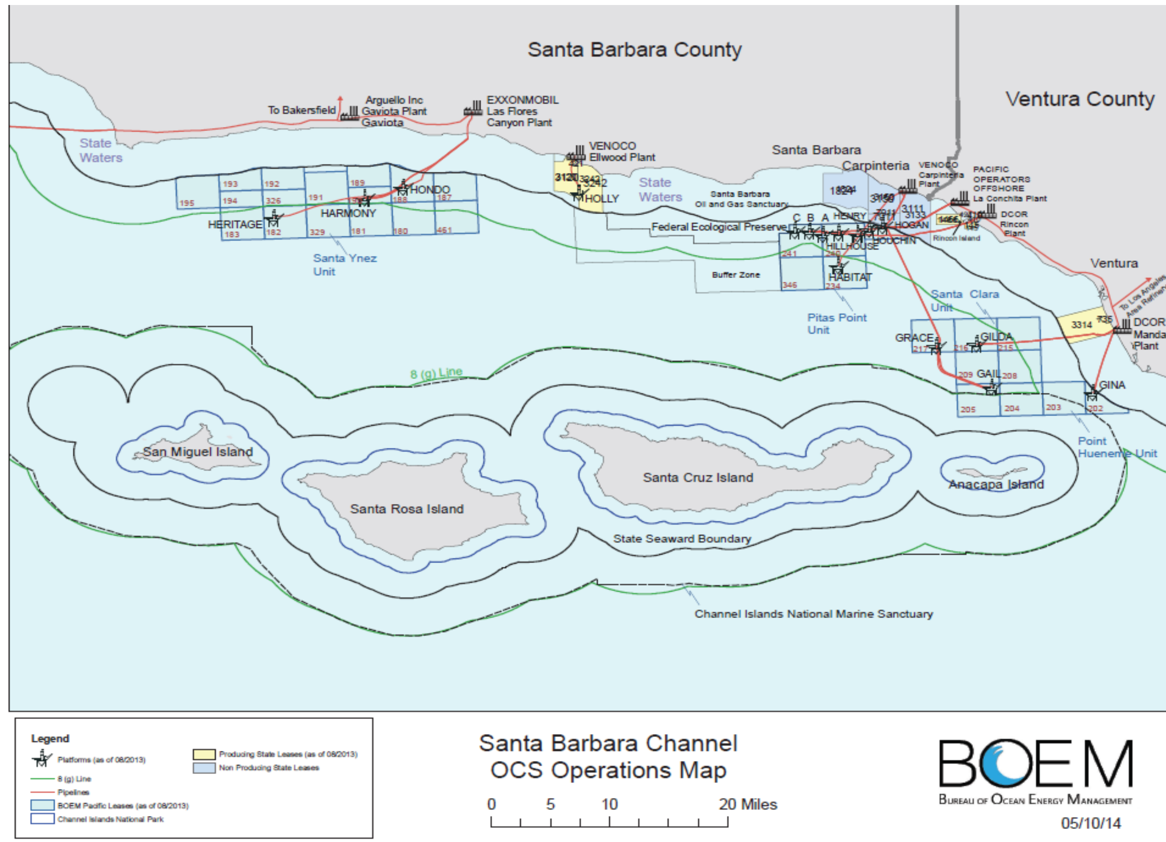
CSIL: Identifies important factors over a region (Southern California) and the intersections with BLOSOM output



Factors include:

- Commercial Transportation
- Environmental Habitat
- Environmental Species
- Commercial Fisheries
- Public Infrastructure
- Oil and Gas Industry
- Tourism
- Oil Spill Responses

Example of Factors Along the California Coast

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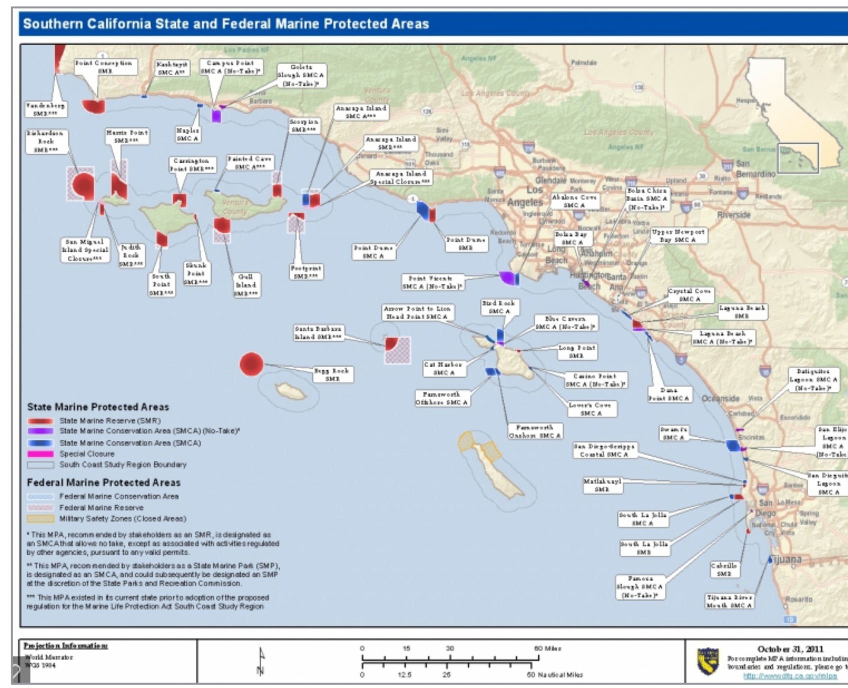
Oil and Gas Industry within Study Area

Environmental Habitat and Environmental Species



Example: Outputs of BLOSOM, CSIL, SWIM

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Evaluating Multivariate Risk Factors BLOSOM parameters:

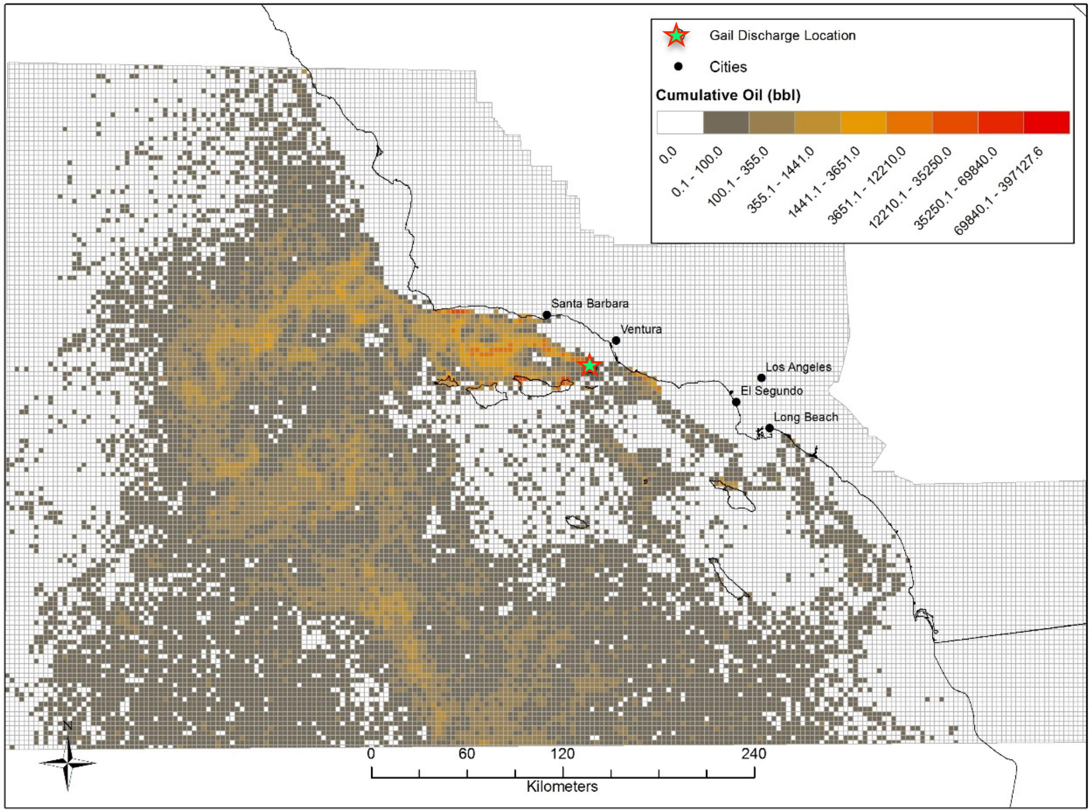
Platform Name: Gail
Spill Start Date: January
Cumulative Loss of Oil: 1,800,000 bbls
Total Extent of Spill: 108,000 km^2

SWIM Model Results:

Cumulative Impact (SWIM): 8300
SWIM Rank*: 4

*Scale 1 to 50,
1=Worst Case

GailJanuary CSIL



Geospatial trajectory and extent of oil spill output from BLOSOM displayed over spatial layers for each factor in CSIL

Next Steps

- To continue running numerous scenarios with the suite of Models which include different times of the year and different volumes of a projected oil spill,
- To change the relative weights of SWIM factors to balance the importance of stakeholders' values for potential areas,
- To identify stakeholders' interests and adjust model weights to incorporate regionally important factors.

Acknowledgements

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