A Brief Introduction to Ocean Oil Spills

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What are Causes of Ocean Oil Spills?

* Oil drilling rig malfunctions/blowouts (<1%, 2008 est.)[+]

* Shipping accidents – running aground/collisions (70%), overfilling tanks, bilge pumping [+]

* Pipeline breaks and leaks

* Acts of war – e.g., Gulf War –greatest spill to date at 10-11 million bbls

Interestingly, major oil spills contribute only 5% to total oil input to the ocean.

85% of petroleum input (~700,000 bbls) in N. America waters comes from land runoff (i.e., from streets, floods), rivers, airplanes, and boats

Note that there are also natural oil seeps –
e.g., Santa Barbara Channel (up to 70 bbls/day)

[+] *Patin et al., 2008*

Oil Spills: Why Crisis Situations?

* Often caused by accidents with loss of life and injuries

* Long-term (months to decades) impact to environment, ecosystems (sfc. and beach organisms + birds most affected)

-impacts depend on form of hydrocarbons (i.e., light vs. heavy crude) spilled

-greatest effects on coastal regions, where over 50% (and growing) of world's human population resides and where many organisms begin life cycle[+]

* Economic impacts: loss of oil product, costs of cleanups ($2 Billion for Exxon Valdez), fisheries, tourism, jobs

* Costly litigation– e.g., Exxon Valdez – over $1 Billion

* Political fallout – blame game

[+] *Creed, 2003*

Oil Spill Impacts to Marine Life

+ Oil affects bird's temp., buoyancy, flight, physiology (toxicity)
+ Mammals experience similar effects – hypothermia, lack of O_2 ('dead zones'), dehydration, digestion, toxicity
+ Phytoplankton/plant life affected by reduced light avail.
  – base of food chain issue

Note that though visible damage is apparent at the surface, there is also damage in the water column and on the ocean bottom where benthic flora and fauna (i.e., clams, etc.) reside as well as coral reefs.

Where Do Oil Spills Occur*?

Gulf of Mexico (267 spills)

Northeastern U.S. (140 spills)

Mediterranean Sea (127 spills)

Persian Gulf (108 spills)

North Sea (75 spills)

*** Note: These are spills exceeding 10,000 gal or about 240 barrels where 1 barrel of oil = 1 bbl = 42 U.S. gallons**

Ref. : Etkin, D.S. 1997

What have been the largest ocean oil spills?

Gulf War – Persian Gulf (off Kuwait) - ~10-11 million bbls

Ixtoc – Gulf of Mexico – 3.5 million bbls

11 others exceeding 700,000 bbls

Exxon Valdez – Alaska – 250,000 bbls

Current BP Gulf of Mexico Spill

Ongoing BP Deepwater Horizon – Gulf of Mexico – estimates of 12,000-24,000 bbls/day or 430,000 -930,000 bbls as of May 28, 2010

Santa Barbara Channel - 1969

Drilling rig blowout – Union Oil's Platform A (see above)

80,000-100,00 bbls, areal coverage – 25 X 60 mi.

> 10,000 birds killed, sea life impacts, loss of tourism income

Spill triggered the 'Environmental Movement'

Exxon Valdez – Prince William Sound, AK - 1989

Ship grounding - 250,000 bbls – 1300 miles of coastline, 11,000 sq mi area - > $1 B lawsuit, >$2 B cleanup costs

BP Deepwater Horizon – Gulf of Mexico

Located 40 miles southeast of Louisiana

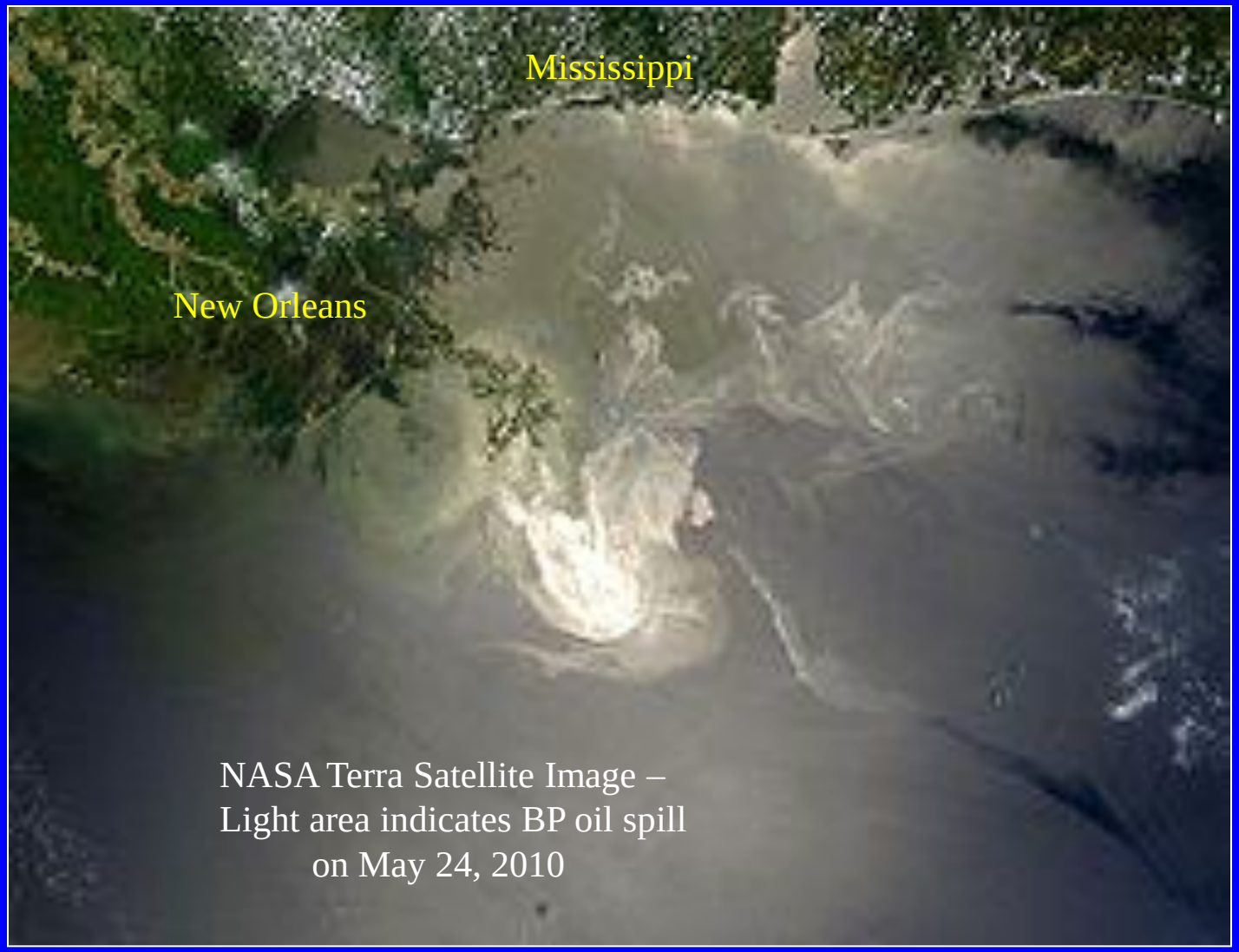
Photo provided by BP

Wellhead blowout killed 11 and injured 17 workers April 20, 2010

Estimates of 12,000-24,000 bbls/day or 430,000 -930,000 bbls as of May 28, 2010

About 4 times more than Exxon Valdez so far, still 10 times less than Gulf War spill and 3 times less than Ixtoc spill, areal coverage TBD – est. cleanup costs TBD

Surface Areal Extent of BP Oil Spill



NASA Terra Satellite Image –
Light area indicates BP oil spill
on May 24, 2010

Because of dispersant use, there may be as much oil below the surface as at the surface in plumes of oil droplets 10's of mi long and wide.

BP Deepwater Horizon – Gulf of Mexico

Photo provided by BP

Remotely operated underwater vehicle attempting to turn on blowout preventer at 5000 ft depth in Gulf of Mexico 40 mi. southeast of Louisiana coast.

BP Deepwater Horizon – Gulf of Mexico

U.S. Environmental Service workers preparing oil containment booms during BP Deepwater Horizon oil spill in Gulf of Mexico

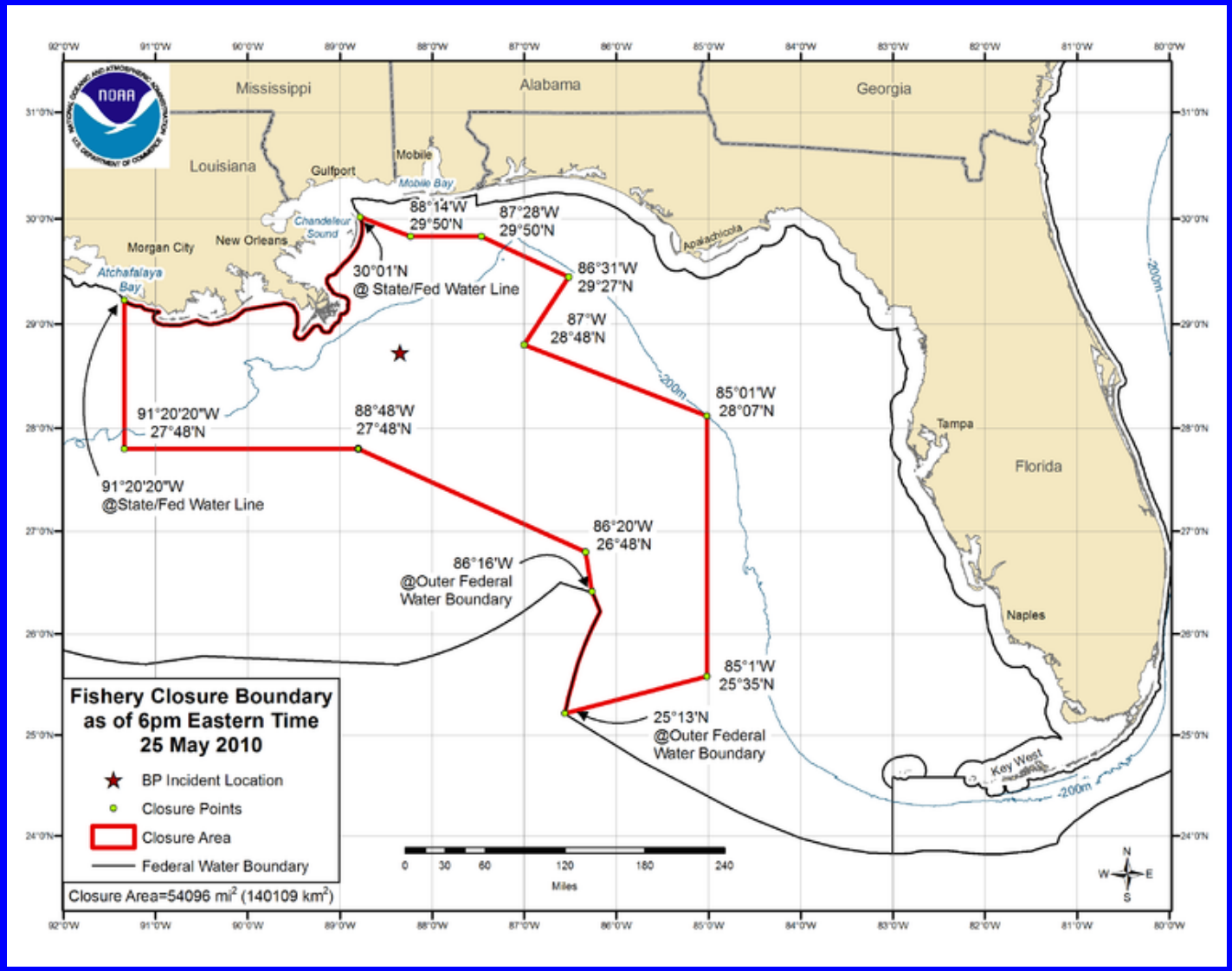
BP Deepwater Horizon – Gulf of Mexico

Smoke billowing from controlled burns of surface oil slick caused by the BP Deepwater Horizon blowout in April 2010

BP Deepwater Horizon – Gulf of Mexico

Oil dispersing chemicals being dropped by a C-140 Hercules aircraft on a surface oil slick produced by the BP Deepwater Horizon Oil spill

BP Deepwater Horizon – Gulf of Mexico



Closed fishing region as of May 25, 2010 of over 54,000 square miles in the Gulf of Mexico caused by oil released during the BP Deepwater Horizon Oil spill

Other Notes on BP Deepwater Horizon

* Macondo Prospect oil field est. of 50 million bbls prior to blowout

* Blowout caused by failure of a cement casing and escaping methane gas which expanded as pressure decreased as it rose and exploded/ignited.

* Heavy drilling muds initially held methane gas down in pipe.

* Deepwater Horizon, floating platform, sank on April 22, 2010 after 1 day burn (heat from fire melted paint on rescue boats)

* May 30, 2010 (day 41 of spill) est. rate of discharge is 12,000 – 24,000 bbl/day

* Leak history – began April 20, so est. of 500,000 – 1,000,000 bbls spilled to date (Exxon Valdez totaled ~250,000 – 1,000,000 bbls)

Other Notes on BP Deepwater Horizon

* Dept of Interior exempted BP from detailed environmental impact study/spill deemed unlikely by agency

* Questions about BP's wellhead blowout preventer

* In March, 2010, and just prior to the BP spill, President Obama opened access to waters for offshore drilling in the Atlantic and eastern Gulf of Mexico (167 million acres) noting technological advances in the drilling industry. Quoting Obama, "It turns out, by the way, that oil rigs today generally don't cause spills. They are technologically very advanced." After the spill, he rescinded the opening of new oil field exploration.

* Public opinion polls showing major disapproval of BP and Obama responses

Other Notes on BP Deepwater Horizon

* Attempts to stop flow as of May 30, 2010):
  ROV's sent down to cap well – unsuccessful
  Subsea oil recovery system over wellhead –unsuccessful/methane hydrate form.
  'Junk shot' approach of dumping heavy items like golf balls etc. - unsuccessful
  'Top hat' lowered for recovery – unsuccessful
  Riser insertion tube - collected some gas and oil
  'Top kill' – pumping drilling muds over well to cap it – unsuccessful

* Next steps
  Removal of riser and cutting of top of blowout preventer to allow placement of a new containment valve to force oil into pipes to surface and a tanker for oil collection at surface/not all oil would be collected from the gusher

  Drilling of new holes near the gusher to draw oil into them and reduce flow from the presenttly gushing hole – this will take months to execute

* Dire estimates
  If the spill is contained by Aug. 1, 2010 – spill volume will amount to 36,000 to 2.5M barrels; if by Aug. 31 – 1.6M to 2.9M bbls

* Hurricane season appproaches – would spread spill well inland into New Orleans, other parts of the Gulf Coast including, Miss., Ala., Flor.

Other Notes on BP Deepwater Horizon

* Major controversy on type of dispersants (BP vs. US Gov't.) – toxicity and effectiveness as well as availability issues

* State vs. Federal government issues over use of berms and other methods

* Investigations underway by National Academy of Engineering, U.S. Coast Guard, Mineral Management Service (MMS)

* MMS head, S. Elizabeth Birnbaum, resigned in May/major organization shake-up likely because of issues such as relationships of MMS and corps.

* Samantha Joye of the Univ. of Georgia suggests it will take decades for ecosystem to recover from this spill as reduced oxygen, toxicity etc. will impact the whole food chain

* Financial impacts – Initial est. of $2.5 B to fishing, Florida tourism of $3 B, BP has already spent ~$800 M excluding legal claims

* Reports of possible takeover of BP by Shell and Exxon because of declining BP stock values

Factors Controlling the Areal Extent of Oil Spill

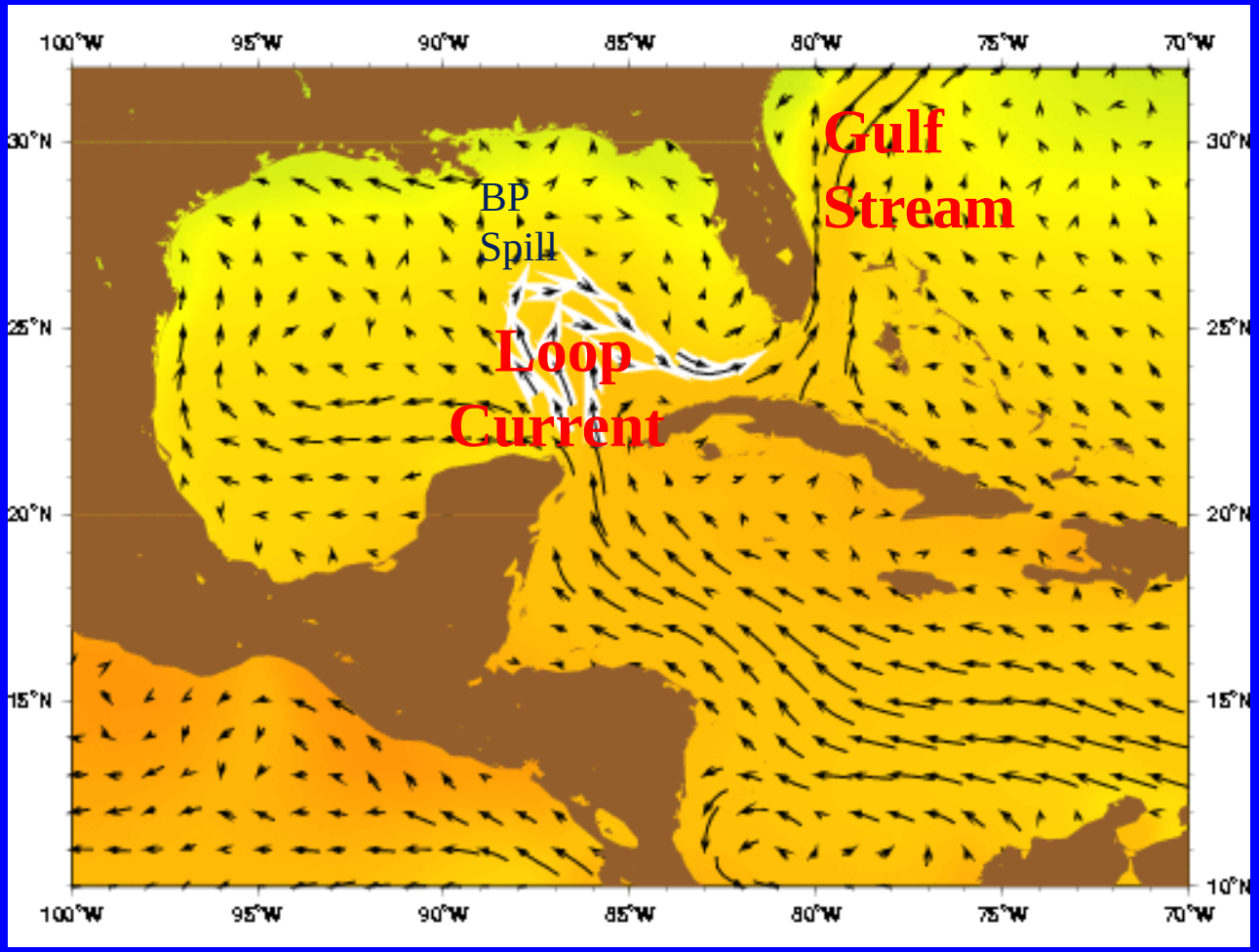
Density and constituency of the oil at different temps., ages, dispersants used

Winds driving surface currents & mixing

(e.g., hurricanes/storm surge; > 165,000 bbls from Katrina)

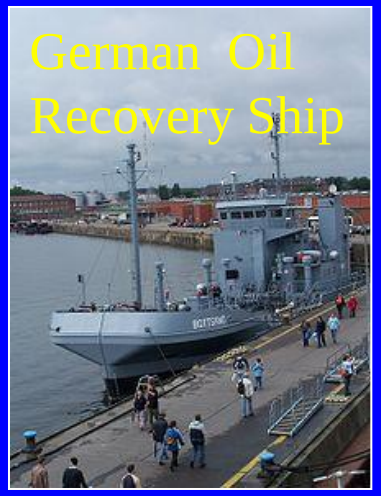
Ocean circulation including strong currents & eddies

Gulf of Mexico's Ocean Circulation



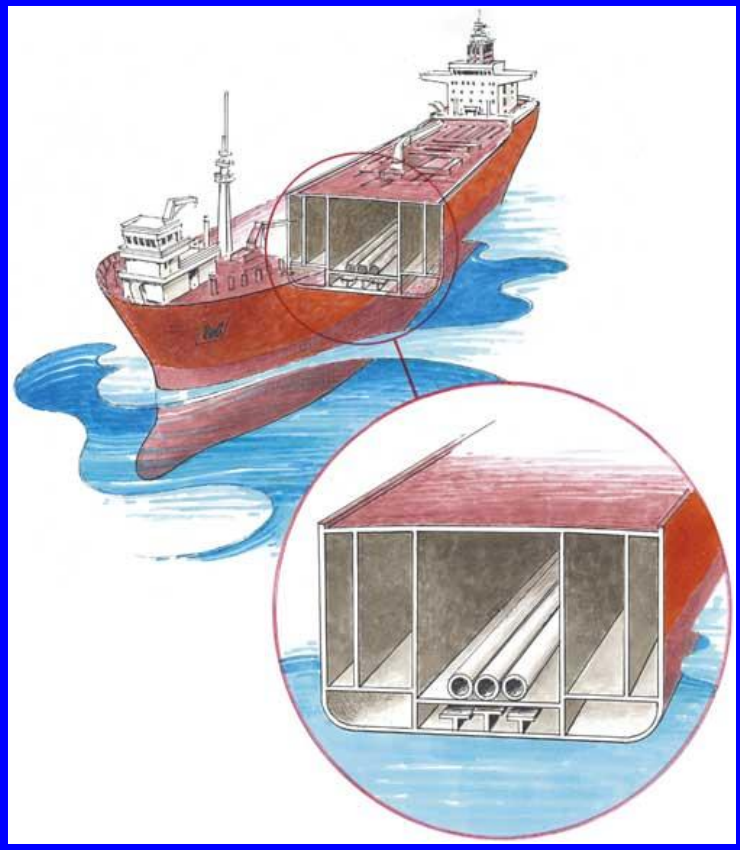
The Loop Current is shown in white; this is an average current map and the current's path varies considerably. The Loop Current feeds the Gulf Stream which speeds northward along the U.S. east coast from the Florida Strait. Spilled oil could in principle move into the Loop and Gulf Stream Currents. Hurricanes could cause storm surges and move more oil coastward. On May 19, there were reports that some of thre oil had reached the Loop Current and could reach Florida in a week.

Mitigation/Remediation Methods



-Skimmers & ships to recover oil (generally new spilled oil floats)
-Booms (incl. some absorbant and some designed for fire burns) to constrain spill
-Berms to protect beaches/vacuums to retrieve oil
-Chemicals to cause dispersion+sinking of oil/tar ball effect
-High pressure washing (can be problematic)
-Biological agents (bioremediation)– added nutrients, O_2, and organisms to accelerate microbial degradation of oil
- Need for centralized command to quickly and effectively respond to spills using adequate methods and personnel

Ocean Oil Spill Prevention Methods



+ Use of double hull ships and new blowout preventers and backup systems
+ Predictions of weather and ocean conditions for ships to avoid and rigs to prepare for
+ Improved ship and oil rig safety conditions and better training of ship and oil rig personnel

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Environment losing out to the bottom line

Eugene **Robinson**

In June of 1969, the stretch of the Cuyahoga River that runs through Cleveland was so polluted that it caught fire. Time magazine described the Cuyahoga this way: "Chocolate-brown, oily, bubbling with subsurface gases, it oozes rather than flows."

The spectacle of a river in flames helped galvanize the environmental movement, and the following year, with Richard Nixon as president, the Environmental Protection Agency was established. In 1972, Congress passed the landmark Clean Water Act. Today, the Cuyahoga is clean enough to support more than 40 species of fish.

We still don't know the full extent of the environmental disaster unfolding in the Gulf of Mexico — the impact on avian and aquatic life, on fisheries, on tourism, on the delicate ecology of coastal marshes and barrier islands. We do know, though, that it is the worst oil spill in our nation's history, far surpassing the Exxon Valdez incident. And maybe the shocking images from the Gulf of dead fish, oiled pelicans and shores lapped by viscous "brown mousse" will refocus attention on the need to preserve the environment, not just exploit it.

"Drill, baby, drill" isn't just the bizarrely inappropriate chant that we remember from the Republican National Convention two years ago. It's a pretty good indication of where the national ethos has drifted. Environmental regulation is seen as a bureaucratic imposition — not as an insurance policy against catastrophe, and certainly not as a moral imperative.

Yes, many Americans feel good about going through the motions of environmentalism. We've made a religion of recycling, which is an important change.

We turn off the lights when we leave the room — and we're even beginning to use fluorescent bulbs. Some of us, though not enough, understand the long-term threat posed by climate change; a subset of those who see the danger are even willing to make lifestyle changes to try to avert a worst-case outcome.

But where the rubber hits the road — in public policy — we've reverted to our pre-enlightenment ways. When there's a perceived conflict between environmental stewardship and economic growth, the bottom line wins.

> Barack Obama is, in many admirable ways, our most progressive president in decades. But as an environmentalist, let's face it, he's no Richard Nixon. Before the Deepwater Horizon rig exploded — allowing, by some estimates, up to a million gallons of crude oil to gush into the Gulf of Mexico each day for more than a month — Obama had announced plans to permit new offshore drilling.
>
> "I don't agree with the notion that we shouldn't do anything," Obama said at the time. "It turns out, by the way, that oil rigs today generally don't cause spills. They are technologically very advanced."

Obama has wisely backed away from that decision. The technology involved in deep-sea oil drilling turned out to be far more advanced than the technology needed to halt a spill if something goes wrong — essentially, like engineering a car to double its top speed without thinking to upgrade the brakes.

This oversight, apparently, wasn't noticed by anyone who had the power to correct it. Calls for Obama to somehow "take over" the emergency response ring hollow. Take it over with what?

Hands-on intervention has never been government's role in this kind of situation. BP and the other oil companies had the undersea robots and the deep-water experience. Other private companies owned and operated the skimmers that remove the oil from the surface. There is no huge government reserve of the booms that are needed to protect Louisiana's beaches and marshlands; those are made by private firms and are being deployed by unemployed fishermen.

Obama has rethought his enthusiasm for offshore drilling. Now he, and the rest of us, should rethink the larger issue — the trade-off between economic development and environmental protection. In the long run, our natural resources are all we've got. Defending them must be a higher priority than our recent presidents, including Obama, have made it.

Energy policy is one of Obama's priorities. He talks about "clean coal," which I believe to be an oxymoron, and favors technologies — such as carbon capture and sequestration — that are new and untested. The environmental risks must be a central and paramount concern, not a mere afterthought. Let's preclude the next Deepwater Horizon right now.

— Eugene Robinson writes for the Washington Post. E-mail address is eugenerobinson@washpost.com.

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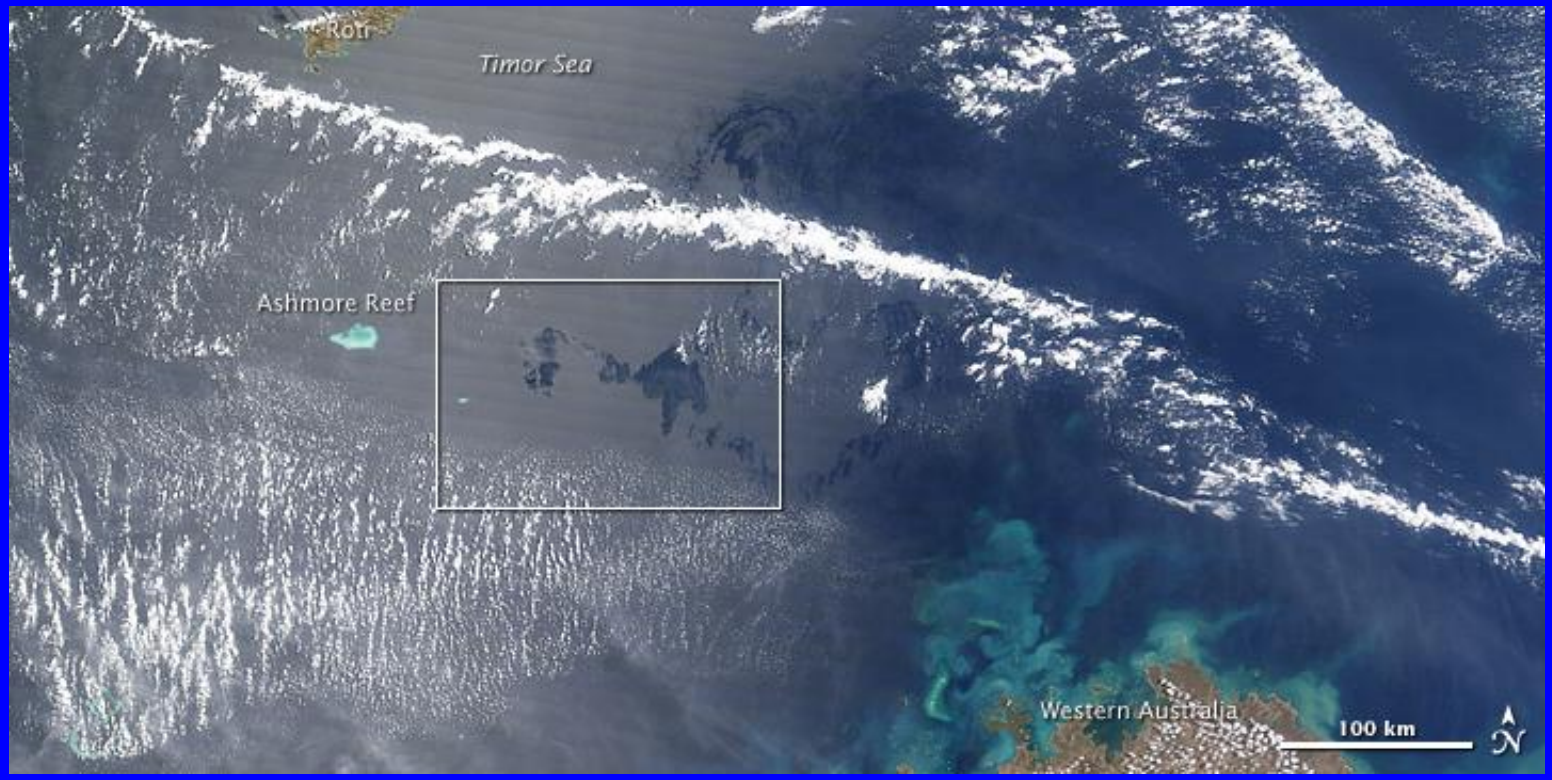
Detection Methods



Examples of Major Oil Spills

Persian Gulf- 1991-

Intentional release by Saddam Hussein –

Spill volume - 10-11 million bbls

Refs: US Intelligence report, National Geographic