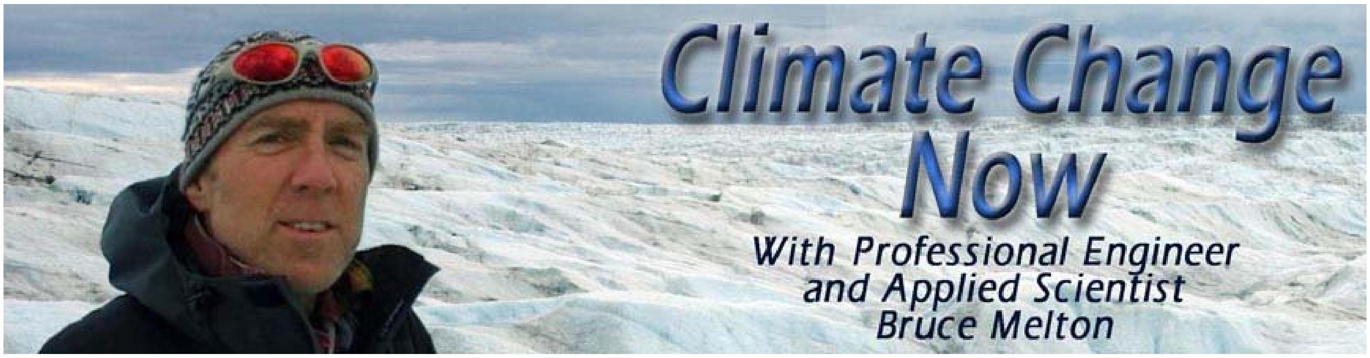

Methane in the Gulf – The Oil Spill: Toxic Popsicle or Extinction Event?

July 6, 2007

Tar balls have hit Galveston now, observations from Monday show patches of oil south of Vermillion Bay Louisiana, half way between New Orleans and Texas, but poor observation conditions due to rough seas may be hampering the identification of oil.

Image by John L. Walthen www.bpoilslick.blogspot.com

The oil spread models for the Gulf south of Western Louisiana and Eastern Texas show that strong southeast winds have set up a strong westward current which could result in impacts to Texas.

NOAA says there is a 60% chance that Miami Beach will be hit, and although the models show the oil ejecting far out into the North Atlantic on the Gulf Stream, NOAA is saying that it is increasingly unlikely that anything north of North Carolina will be affected.

It is also interesting to understand how these models work. The current NOAA model says that the "The coastlines with the highest probability for impact (81 to 100 percent) extend from the Mississippi River Delta to the western panhandle of Florida…"

Science is science. There are *industry standards* in the world of science that dictate how scientists behave. To say that there is only an 81% probability of oil hitting the coast from Louisiana to Florida, may be perfectly valid to a computer modeler. But tell that to the wildlife, the fishermen, the business owners and the generation(s?) of people who will have to live with the results of this modeling.

The model uses 90 days of spill at 33,000 barrels per day, or just about 3 million barrels (120 million gallons). The official Deepwater Horizon Spill Response numbers for what is actually coming out of the blowout are between 35,000 and 60,000 barrels per day or up to 2.5 million gallons per day.

As per July 6, the 77 days of spill could have released 4.6 million barrels or 193 million gallons of oil. This would be equal to 17 Exxon Valdez spills. This volume of oil is now approaching the level of the largest spill ever – the Gulf War spill in Kuwait.

British Petroleum (BP) says they have captured about 10 million gallons of oil and 28 million gallons of oily water.

Eighty one thousand square miles of the Gulf are closed to fishing, an area larger than the six New England States and New Jersey combined. Enough boom has been placed to almost stretch from Phoenix Arizona to Pensacola Florida. More than 45,000 personnel are working the spill with the on and offshore response. More than 1.7 million gallons of dispersant have been deployed.

Five hundred miles of shoreline are oiled, but the area of marsh impacted is not readily available. I was able to dig up this quote from Plaquemines Parish (on the Mississippi delta in Louisiana) president Billy Nungesser “Well, they can go to Pensacola and find tar balls. If they want to find 4,000 acres of thick oil, destroying wildlife, eating up the marsh, where everything is dead, come to Plaquamines Parish.”

What Nungesser is saying is a something that is feared in the environmental community. When oil soaks a marsh, it not only kills the vegetation, but it can form a seal on the marsh muck where the marsh plants have their roots. Once this happens, oxygen is cut off and the roots of the plants die, along with the all of life that lives in the muck (a lot more than just crabs and crawdads.)

Without this life, the countless number of air channels and decomposition gas pockets (think of rotten eggs) and root paths and such that gave the marsh muck that good old mucky feel - well all of that collapses. Once it collapses, it can take years, or even decades to regenerate.

So now we have a situation like we have in the Rockies where the forests are dieing because their changed climate is just too warm. The foresters say that the trees will grow back in 100 years but in 100 years the temperature will be 13 degrees warmer than it is now (The Rockies will warm like the polar regions - at a much greater rate than the rest of the planet).

If the forests are dieing now because of a few degrees of temperature change, how will they grow back with five times that much change?

In Louisiana, the marshes are struggling with sea level rise, subsidence and lack of sediment nourishment already. But that will not complete the death sentence of the marshes. Sea level rise is rapidly accelerating.

For most of the 20th century sea level rise was about 1.5 mm per year. Since the turn of the Century it has jumped to 3.4 mm per year and is rapidly accelerating.

I know 3.4 mm per year doesn't sound like much, but it is cumulative. And the Army Corp of Engineers has recently published a report stating that , in healthy ecosystems, when sea level rise reaches 7 mm per year, the dynamical processes will begin to disintegrate – meaning that, even healthy marshes will disappear. How will these marshes devastated by oil be able to cope?

To keep some of the spill from hitting shore, 275 fires have been set in the Gulf to burn oil corralled by containment booms. These fires are the fires that have reportedly burned sea turtles alive, confirmed by testimony from NOAA scientists in a Huffington Post Article on July 2.

Image courtesy of the National Oceanic and Atmospheric Administration, NOAA

The wildlife report below is of course the official statistics for the subject. None of the turtles burned in the 275 offshore fires were included in this report. These are just the numbers of reported impacts by the official collectors and rehabilitates. The actual number of impacted individuals animals is also unknown, but are likely far in excess of the official statistics.

Wildlife Report

	Total Number	Dead
Oiled birds collected	940	1387
Sea turtles impacted	157	444
Mammals impacted (includes dolphins)	5	53

The Ixtoc blowout in the Bay of Campeche in the far southwestern Gulf of Mexico in 1979, the second largest oils pill ever, dumped 140 million gallons in nine months. The Deepwater Horizon surpassed this milestone in late June, after about ten weeks. The difference in scale too is dramatic. The Ixtoc was in 160 feet of water and the well was 10,000 feet deep. The Deepwater Horizon is in 4,100 feet of water and the well is 18,000 or maybe even 25,000 feet below the ocean bed (there seems to still be some uncertainty in the permitted and actual numbers.)

The biggest difference between the Deepwater Horizon and most other oil wells though is the amount of natural gas in this particular oil field. The spill contains enormous amounts of natural gas, or methane.

This methane has caused a lot of trouble beginning with the actual blowout itself. Natural gas in an oil well is common, but not in large amounts and it is usually not a good thing. A lot of natural gas is even worse.

With this well pushing the limits in so many ways -- with the combination of the deep water, the deep well and the high natural gas concentration – and then we add in the technical mistakes to be determined at a later date, which we will not be able to fully determine until some time in the future.

The methane continued to cause problems, as the oil recovery devices became clogged with methane ice, or what is really called methane clathrates – a combination of methane and water ice that can freeze when the temperature is above 32 degrees and the pressure is high enough (like at the bottom of the ocean.)

But this is not the worst that methane can do. Texas A&M Oceanographer John Kessler says that deep-ocean methane levels from the Deepwater Horizon blowout are hundreds of thousands of times higher than background levels and even approached one million times higher than normal in some of the samples that his team made while researching the "oil plumes" around the blowout.

One million times greater than background is indeed astonishing, but when put into context it becomes all the more sobering.

Methane is the same as natural gas that we burn in our stoves. It is a greenhouse gas with one carbon and four hydrogen atoms. It has a global warming potential many times that of carbon dioxide, but when burned as a fuel only emits 71% the CO2 as oil and 56% as much as coal. (Some say it is a good transition fuel to get us off of coal.)

This well has a tremendous amount of natural gas estimated to be 40% by weight of the total spill by Kessler and 50% by Samantha Joye at the University of Georgia. This is compared to about 5% from normal oil deposits.

By day 160 of the blowout we will hopefully have the pipe plugged. It will be mid August and the relief wells should be finished. But we should note that it took the Mexican oil firm Pemex nine months to get their relief well to work on the Ixtoc blowout. Ixtoc was only 10,000 feet deep in 160 feet of water. And by the time 160 days have elapsed, the Deep Horizon will have spilled 236 million barrels of natural gas.

To put this much methane into perspective, we have to understand its global warming potential. Normally, we know that methane, as a greenhouse gas, is capable of capturing about twenty five times more heat than carbon dioxide. But recent studies have shown this is low. Because our planet is warming and the natural CO2 sinks are slowing, methane really has about 34 times the heat trapping capacity of CO2. But wait, that's not all.

Thirty four times the heat trapping capacity is for time spans of 100 years. In the not too distant past, this was an appropriate time span to consider for climate change. But that was 20th century climate change. A decade - a half generation - has passed since those times. The climate change times scale of relevance today is 20 or 30 years, not a century.

So when we understand the heat trapping capacity of methane should now be based on a short 20 or 30 year times scale, the number increases to something more like 62 times more potent, not 25, or even 34.

Methane's warming capacity is 62 times more than carbon dioxide. This is like the difference in heat capacity between baby food and jalepeno peppers. When we calculate the global warming potential of those 236 million barrels of methane (by weight = 300 billion cubic feet of gas), it is equal to about 5 percent of the total U.S. transportation fleet emissions of carbon dioxide. This is one incredibly huge well.

But are the emissions really important? Drs. Kessler and Joye are finding that little of the methane is making it to the surface. It is becoming dissolved in the great ocean depths and suspended with the oil in those massive plumes.

Microbiologic activity then begins to consume the methane (and the oil). It is this bioactivity that consumes the oxygen in the water and creates hard times for the organisms that live there. Kessler and Joye say that oxygen depletion has not reached a critical level yet, only falling about 30 to 40 percent below normal. But this was about three weeks ago and at the time they said that levels were falling 1 to 2 percent per day.

This oxygen depletion would put the waters in question down in the 4 ppm (parts per million) range. Levels of 2 ppm stress most fish. Levels below 1.4 ppm are deadly. The plumes are still 30 to 40 miles long, miles wide and thousands of feet thick. The closer to the well, the lower are the oxygen contents and the higher are the methane concentrations.

Anecdotal reports are coming form all over the oil impacted coastal areas of strange fish behavior, of sharks and turtles congregating near shore, dolphins disappearing and such. There are also reports of other oxygen deprived waters in the Gulf. These reports are not associated with the great Mississippi Delta dead zone and are currently unexplainable.

Dead zones are increasing significantly in our world's oceans because of warming oceans (warmer water holds less oxygen) and increased nutrient runoff from agricultural industrialization. Further study is needed concerning these new Gulf of Mexico dead zones.

Methane occurs naturally in seawater; it is released as a byproduct of the decomposition of organic material. The organic material gets there because of the constant cycling of life; fish live and die and organic debris is washed into the oceans from rivers, but mostly it comes from what is called primary productivity. This is the planetary sized mass of life that creates half of the oxygen on Earth – the algae and plankton of the oceans.

These single and few celled organisms are like grass and trees on land. They are the fundamental building blocks of life in the oceans. There are approximately 50 gigatons of primary productivity in our oceans (one gigatons is a billion tons). To put this to scale, there are about 2 gigatons of crops on earth.

Over tens and hundreds of thousands of years, this natural production of methane collects in sediments. Below a couple of thousand feet in depth, pressures are so high and water temperature is generally cool enough that the methane decomposition products can freeze, just like the natural gas coming out of the busted blowout preventer froze and clogged up the top hat spill collector that BP had deployed.

The frozen methane, or methane clathrates collect in the ocean sediments and over tens and hundreds of millions of years of sediment deposition form oil deposits deep below the ocean floor.

This is where the methane that clogged the tops hat oil collector that BP deployed came from - four to five miles beneath the bottom of the Gulf of Mexico.

Shallow depth methane clathrate formation though, continues. The Gulf of Mexico contains some of the greatest shallow methane clathrates deposits in the world and the oil giants are itching to get their hands on them.

There is only one problem. Methane clathrates can be very unstable. They form on the edge of the envelope of pressure and temperature. Just a little warming or decrease in pressure and they become unstable. The recent Congressional inquiry into the Deep Horizon incident brought up this point:

"Offshore drilling operations that disturb methane hydrate-bearing sediments could fracture or disrupt the bottom sediments and compromise the wellbore, pipelines, rig supports, and other equipment involved in oil and gas production from the seafloor."

Destabilization of methane clathrates has also been identified as a likely culprit in some of Earth's more punctuating moments. These moments usually took tens to hundreds of thousands of years, as the earth's climate naturally changed from warm to cold because of solar influences and natural feedbacks.

But at some point, an additional forcing, like an asteroid striking the Yucatan Peninsula, or something, caused a perturbation in the natural cycle. The additional warming triggered the instability of the methane clathrates, great amounts of methane were released causing great warming, and abrupt climate changes occurred that caused great extinction events.

This is a very critical path that our planet occasionally follows. Right now mankind is increasing the CO2 concentration on this planet faster than at any time in the last 20 million years and likely as fast as when the giant asteroid hit the Yucatan Peninsula and the dinosaurs went extinct 65 million years ago.

Methane concentrations on earth have started to rise again after a decade of stability. It is thought that contemporary agricultural techniques and their expansion across the world had halted the increase in our planet's methane emission, and this is probably what happened.

The new increase is likely coming from methane clahtrates in the Laptev Sea on the edge of Siberia and the Arctic Ocean. This are of the planet has warmed 7 to 9 degrees F in the last 20 years and the methane clahtrates on the bottom of the Laptev Sea have started to vent. The venting is so large that it rivals all the rest of the methane emissions from all of the rest of the world's oceans combined.

The methane gas melts beneath the clahtrates too. The heat of the earth can cause free methane gas to collect beneath the solid sheet of methane ice in the sediments at the bottom of the sea. This sheet of ice has become perforated in the Laptev Sea. But what happens when the clathrates are on a slope like in the Gulf of Mexico and Mississippi Canyon where the Deepwater Horizon is?

In the past, things called methane outburst occurred when their overlying methane ice laden sediment became destabilized. Scars from dozens of massive tsunami causing landslides along the continental shelf of the east coast are evident from prehistoric times.

These things happen when out climate is rapidly changing. Eight thousand years ago when Earth had just warmed out of the depths of the last ice age, a great undersea landslide took place off of the shores of Norway.

It is called the Storrega slide. It was 200 miles across and the slide traveled for 800 miles under the Atlantic Ocean, most of the way to Greenland. The tsunami it produced was 65 to 82 feet tall. The 2004 Indian Ocean Tsunami, that killed 200,000, was 50 feet tall.

I am not saying that anything of the sort is imminent. I am saying that there are some important things to understand about our Earth and the way it operates. Clathrates can be unstable on slopes. The Deepwater Horizon is on a big slope, and the product coming out of the blowout is 180 degrees Fahrenheit.

The man caused methane releases into the Gulf of Mexico are unprecedented in this world. Impacts to wildlife are beginning to become extreme because of the spill. The gross effects of methane released are as yet unknown, but not encouraging.

The spill will continue through mid August (four months) at the absolute minimum. Attempts to cap the only similar blowout in history, that was far shallower with only about 30% of the flow, took over nine months.

There are threats from this blowout that go far beyond the scope of this article. Human health effects and regional economic collapse are just a few. But the ramifications of what will happen if the relief wells fail, beyond the big tsunami thing of course, may be the most troubling.

This well could go wild for years. The well bore could fail because of methane destabilization leading to even greater releases of oil and gas that could continue until the pressure in the oil field subsides. This could mean oil releases a hundred or more times what have already occurred.

Are the rewards big enough to allow this sort of drilling to continue? Do we know enough about the risks? Are government controls likely to become good enough to help? Should we be hedging our bets until some of these questions are answered?

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