Some of Earth's climate troubles should face burial at sea, scientists say

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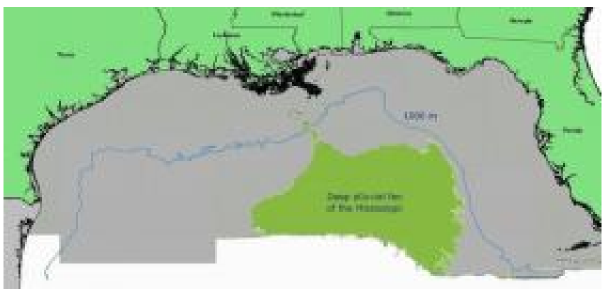

Just past the continental shelf in the Gulf of Mexico -- the shelf is marked with the blue line -- a fan of sediment has formed on the seafloor made up of silt and debris that settles out of Mississippi River waters flowing into the gulf. These alluvial, or submarine, fans are found wherever rivers run into the ocean. Crop residues sunk in such fans would become covered with silt, further ensuring that carbon would be locked away for long periods. S. Strand/UW/U.S. Geological Survey

(PhysOrg.com) -- Making bales with 30 percent of global crop residues -- the stalks and such left after harvesting -- and then sinking the bales into the deep ocean could reduce the build up of global carbon dioxide in the atmosphere by up to 15 percent a year, according to just published calculations.

That is a significant amount of carbon, the process can be accomplished with existing technology and it can be done year after year, according to Stuart Strand, a University of Washington research professor. Further the technique would sequester -- or lock up -- the carbon in seafloor sediments and deep ocean waters for thousands of years, he says.

All these things cannot be said for other proposed solutions for taking carbon dioxide out of the atmosphere, methods such as ocean fertilization, growing new forests or using crop residues in other ways, says Strand, who is lead author of a paper on the subject in the journal *Environmental Science & Technology*, published by the American Chemical Society.

Strand has devised a formula to measure the carbon-sequestration efficiency of this process and others using crop residues, something no one has done before.

Carefully tallying how much carbon would be released during the harvest, transportation and sinking of 30 percent of U.S. crop residues and comparing that to how much carbon could be sequestered, Strand says the process would be 92 percent efficient. That's more efficient than any other use of crop residue he considered, including simply leaving crop residue in the field, which is 14 percent efficient at sequestering carbon, or using crop residue to produce ethanol, which avoids the use fossil fuels, but is only 32 percent efficient.

Worldwide, farming is mankind's largest-scale activity. Thirty percent of the world's crop residue represents 600 megatons of carbon that, if sequestered in the deep ocean with 92 percent efficiency, would mean the amount of carbon dioxide in the atmosphere would be reduced from 4,000 megatons of carbon to 3,400 megatons annually, Strand says. That's about a 15 percent decrease.

The proposed process would remove only above-ground residue. Strand bases his calculations on using 30 percent of crop residue because that's what agricultural scientists say could sustainably be removed, the rest being needed to maintain carbon in the soil. Crop residue would be baled with existing equipment and transported by trucks, barges or trains to ports, just as crops are. The bales would be barged to where the ocean is 1,500 meters, or nearly a mile, deep and then the bales would be weighted with rock and sunk.

"The ocean waters below 1,500 meters do not mix significantly with the upper waters," Strand says. "In the deep ocean it is cold, oxygen is limited and there are few marine organisms that can break down crop residue. That means what is put there will stay there for thousands of years."

The article calls for research on the environmental effects of sinking crop residues in the ocean, effects that most likely will be borne by organisms living in the ocean sediments where the bales fall.

Strand says one way to minimize environmental effects would be to drop the residue onto alluvial fans found off the continental shelf wherever rivers pour into the ocean. Alluvial fans, sometimes call submarine fans when underwater, form as silt and debris from river water settles to the seafloor. Runoff from current agricultural fields means alluvial fans in the ocean are already partly made up of crop residue. Any bales dumped there would quickly be covered with silt, further ensuring the carbon would be sequestered for long periods.

Effects might also be minimized by concentrating the residue in a compact area. At the Mississippi alluvial fan in the Gulf of Mexico, spreading 30 percent of U.S. crop residue in an annual layer 4 meters, or 13 feet, deep would cover 260 square kilometers, or 100 square miles. That's about 0.02 percent of the area of the Gulf of Mexico, Strand says.

"Whatever the environmental impacts of sinking crop residue in the oceans turn out to be, they will need to be viewed in light of the damage to oceans because of acidification and global warming if we don't remove carbon dioxide from the atmosphere," Strand says.

Co-author of the paper is Gregory Benford, a professor of physics at the University of California, Irvine.

Strand, a faculty member with the UW's College of Forest Resources, is an environmental engineer known for his work on using plants to remediate contaminated groundwater, soil and sediment. He said he's been interested in ways to remove carbon dioxide from the atmosphere for nearly a decade and first read about sequestering crop residue in the deep ocean in Climatic Science in 2001. Benford was a co-author on that paper.

Strand says he thinks any method for removing excess carbon dioxide must do seven things: move hundreds of megatons of carbon, sequester that carbon for thousands of years, be repeatable for centuries, be something that can be implemented immediately using methods already at hand, not cause unacceptable environmental damage and be economical. He says sequestering crop residue in the deep ocean fits the criteria better than any other proposed solution.

"To help save the upper ocean and continental ecosystems from severe disruption by climate change, we must not only stop our dependence on fossil fuels, but also go carbon negative," Strand says. "Fossil fuels that are removed from sediments and burned are producing the increased atmospheric carbon that is driving climate warming. Sequestering crop residue biomass in the deep ocean is essentially recycling atmospheric carbon back into deep sediments."

Provided by University of Washington