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# Impacts of the Deep Water Horizon Oil Spilling on the Gulf Coastal Salt Marsh and its Carbon Sequestration Capacity

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The Deepwater Horizon (DWH) oil spill is one of the largest marine oil discharges in the United States [1]. The DWH oil spill released 4,900,000 barrels of crude oil into the northern Gulf of Mexico for the duration of 87 days. The proliferation of the oil discharge reached to more than 650 miles of the Gulf coastal habitats [2]. The wetlands of northern Gulf of Mexico were severely damaged with significant oiling to vegetation, soil, and wildlife. Although immediate short-term impacts of the DWH oil spill on coastal wetland vegetation are obvious, the long-term ecological impacts and recovery from this oil spill are practically unknown. The crude-oil deposition can have a dominant impact on the wetland ability to sequester carbon.

Wetlands are vital to absorbing atmospheric carbon [3]. Pristine wetlands perform carbon sequestration through their dense vegetation, algal activity, and soils. Pristine wetlands also normalize processes such as anaerobic decomposition which produces methane and nitrous oxide. These gases correspondingly have 21 and 310 times more global warming influence than that of carbon dioxide over a 100 year timeframe [4-12]. Wetlands capacity to consume and sequester carbon varies widely depending on the type of wetland, temperature and water availability [13]. Further investigation continues to improve understand and identify the processes involved, and how these processes will be affected by climate changes. Carbon sequestration is site specific, which regulates the wetland's role as a source or sink. As wetlands act as carbon sinks, their drainage and management may result in substantial carbon emissions [12].

All wetlands have the capacity to sequester and store carbon through photosynthesis and organic matter accumulated in soils, sediments, and plant biomass [14]. Wetland plants cultivate at a more expeditious rate than they decompose, contributing to a net carbon. Coastal wetland ecosystems, which consist of salt marshes, mangroves, and sea grass beds, are capable of storing large amounts of carbon due to two main reasons: Wetland soils are chiefly anaerobic as a result organic carbon decomposes at a slower rate and causes an accumulation of carbon in the sediments/soils for hundreds or even thousands of years (carbon storage) [15]. Simultaneously, plant growth each year contributes in large amounts of carbon dioxide sequestered.

Soil organic matter (SOM) is consisting of organic compounds that are highly enriched in carbon. Soil organic carbon (SOC) rates correlates with the quantity of organic matter contained in soil [11]. SOM is consist of soil microbes such as bacteria and fungi, decomposing materials from once-living organisms such as plant and animal tissues, fecal material, and products formed from their decomposition [11]. SOC rates result from the exchanges of numerous ecosystem processes, of which photosynthesis, respiration, and decomposition are essential processes [5]. Soil is the largest terrestrial carbon pool in comparison to other sources in the biosphere [9,16-19]. The global C storage in soils was estimated in 2300–3000 Pg (including both organic C and inorganic carbon) [6,7,20]. Carbon storage in the atmosphere and in plants amounts to 730–750 and 500–560 Pg C, respectively [6].

We have studied the terrestrial C storage and potential C in the 11 south and southeast US states [16,17] The results showed total terrestrial carbon pools in southeast and south-central US (11 states) were estimated to be 21.8 Pg C Soil organic matter is the biggest terrestrial carbon pool, totaling 16.54 Pg C and representing 76% of the overall terrestrial carbon pools in the region, followed by forest biomass carbon pool (4.5 Pg C, or 20.5%). Carbon storage in agricultural crops and grass biomass and carbon in housing/furniture/other wood products is relatively small, totaling 774 Tg C and accounting for 3.6% of total terrestrial carbon pools. We also found that current annual terrestrial carbon storage in soil, forest, crop, pasture and housing/furniture in the region could compensate for 40% of the total annual greenhouse gas emission in the region in the early 1990's. Current annual carbon sequestration in regional forests and soil, the more stable form in the terrestrial ecosystem, accounts for 18.3% of the total annual emission. Globally through improved management of world croplands, agricultural soils could sequester 40–80 Pg C over this century, which may offset 7 to 11% of the world's emissions from fossil fuel combustion at 1990 levels [15-18].

In the terrestrial ecosystems, soil organic carbon (SOC) is deposited as a product of photosynthesis or net primary productivity [8]. The carbon from photosynthesis can be transferred to roots, converted to biomass, or to microorganisms. The capture and long-term storage of organic carbon is referred to as carbon sequestration [21]. Soils play a critical role in human civilization as soil production, soil protection, soil quality, and climate change [22].

Wetlands sources of organic carbon include: organic matter from the Spartina alterniflora, Juncus roemarianus, terrestrial upland plants and organic matter [23]. Because Spartina alterniflora and Juncus roemarianus are significant biomass carbon sources that can be investigated in future studies to identify the decomposing rates under different biogeochemical conditions, determine the annual carbon input of DOC, as well as the total organic carbon (TOC) contributions. This type of research would be significant because the role of wetlands in the global carbon cycle requires further research, particularly on wetland plant dynamics and their function as both sources and sinks of greenhouse gases (carbon).

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It is expected that sensitivities to spilling petroleum will vary among wetland plant species. The tolerant plant species are more likely to survive, thus introducing disturbances to the plant community. For example, Spartina alterniflora exhibited the best rate of recovery as well as the greatest ground coverage growth after the spill, suggesting that this species was more resilience to petroleum than other cordgrass species in the same area [24]. Studies reveal that plants withstand more impairment when exposed to petroleum during the growing season (spring), than at the end of the growing season (fall). Effects of the oil spill can cause toxicity or suffocation of wetland plants and soil surface which further causes reduced photosynthesis from the blockage of the stomata and transpiration pathways. As a result, the carbon cycle will be significantly impacted [10]. If petroleum leaking causes the plant community to die from the exposure, the roots will die away as well. This causes the soil to erode resulting in flooding that may prevent plants from growing back. Crude oil also disrupts wetland natural microbial processes which results in the disruption of the marshes biochemistry [15]. Therefore, the long-term eco-impacts of petroleum leaking on wetland ecosystem health, functions and full recover require continuous monitor and assessment.

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