Carbon SIRGE: A Method for Carbon Capture, Flood Protection, and Wildfire Suppression

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Background/Objectives. Coastal flooding and wildfires are scourges of a warming climate brought on by excess carbon dioxide in the atmosphere. The future includes an urgent need for methods of adapting to these climate-induced problems, while removing carbon from the atmosphere to mitigate the severity of the problems. We have been motivated to seek an approach to develop a solution that meets the needs of both adaptation and mitigation.

Approach/Activities. Our approach is to inject solid carbon into coastal sediments in volumes that are large enough to raise the ground surface. This would reduce both the concentrations of CO_2 in the atmosphere and the flood risks caused by sea-level rise. Wood is approximately half carbon, and it can be injected as a slurry of wood particles. Injected slurries are widely known to form layers in the subsurface that lift the ground surface. Once in the subsurface and submerged in water, wood particles are expected to be nearly inert and immobile, providing a mechanism for long-term carbon storage. A variety of wood could be used for this process, and woody brush from the understory of forests is one candidate. Increased harvesting of woody brush can reduce risks and severity of wildfire. Significant economic benefit could be realized by reducing risks of flood and wildfire. This would motivate, and may subsidize, storage of carbon in shallow geologic formations.

We have demonstrated the viability of the concept by injecting wood particles into shallow residuum soils in upstate South Carolina with equipment commonly used to support remediation of contaminated soil. The upward displacement of the ground surface above the injection locations was measured with surveying equipment.

Results/Lessons Learned. More than 13,000 kg of wood particles derived from a local source was suspended in viscosified water and injected into 10 injection casings that were driven 1.8 to 2.4 m into the underlying residuum soil. Over 200 injection events comprised the effort. The average injection rate was approximately 1800 tons of carbon per year.

Nine of the injection wells were located on a 3 x 3 square array about five meters apart. Daily surveys of 90 elevation targets placed across the array showed the ground surface to be elevated an average of 3 cm across an area of about 800 m^2.

Order of magnitude scale-up is straightforward, and a rate increase of three orders of magnitude seems feasible.