Automated Chambers in a Tidal Wetland Collect High-Frequency Methane Measurements

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Due to the dynamic nature of the coastal Terrestrial-Aquatic Interface (TAI), the processes that regulate decomposition are of greater significance at the TAI than in upland systems, especially because decomposition in anaerobic environments is accomplished through multiple interacting microbial processes that influence carbon storage and emissions of greenhouse gases, including methane (CH_4). However, we have little knowledge of how climate stressors such as salinity, inundation, and warming interact to drive CH_4 cycling and other decomposition processes, even though accurately modeling these processes is critical for incorporating the coastal TAI into Earth systems models. Our past modeling and experimental work has highlighted that we need more information on the processes that couple climate stresses, decomposition pathways, and net primary productivity in order to characterize feedbacks between biological, physical, and biogeochemical processes, and also to identify, and thus model, heterogenous soil conditions that lead to "hot spots" or "hot moments".

In coastal wetlands, tidal and precipitation events can contribute to "hot moments" of CH_4 emissions, but these events are easily missed with typical chamber sampling frequency. To address this problem, we installed a network of 12 automated chambers in the Smithsonian's Global Change Research Wetland in spring 2021. The sampling system is controlled by an LGR Ultraportable Greenhouse Gas Analyzer and two multiplexers. Every 6 minutes, one chamber automatically closes and collects a 5-minute measurement of CH_4 and CO_2 emissions or uptake, leading to 240 flux measurements per day. An AquaTROLL 200 continuously measures water level and salinity for the entire site. Inside the chambers, a network of low-cost DIY I^2C sensors measure CO_2 (K30 from Sensaire), air temperature, humidity, and pressure (BME680 chip), and soil temperature at 10 and 25 cm (thermistors) at 10 second intervals. All data streams are sent to CR1000 loggers and synchronized for downstream analysis. Using this system, we can identify high flux events and start to pinpoint the environmental conditions that lead to their occurrence.