Dissolved carbon biogeochemistry and export from a mangrove estuary

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Mangroves sequester atmospheric CO_2 at a rate higher than other ecosystems based on net primary production estimates, but over half of the CO_2 fixed by mangroves cannot be accounted for. This "missing sink" is ca. 0.1 PgC y^{-1}, and therefore represents a non-trivial part of the global carbon budget. It is hypothesized that this "missing sink" is due to the transformation of organic to dissolved inorganic carbon (DIC). Subsequently, this mangrove derived DIC is either exported to the coastal ocean or exchanged with the atmosphere. However, there is currently not sufficient data to examine this hypothesis.

In order to determine the fate of CO_2 sequestered by mangroves, sources and sinks of dissolved organic carbon (DOC) and DIC were examined in Shark River, Florida, located entirely within Everglades National Park and situated in the largest contiguous mangrove forest in North America. Measurements of DIC, pCO_2, TAlk, pH, O_2, $\delta^{13}C_{DIC}$, DOC, $\delta^{13}C_{DOC}$, CDOM, $\delta^{18}O$, δD, Ra, and Rn, were made to examine sources of DOC and DIC in the estuary. A $^3He/SF_6$ tracer release experiment was conducted to quantify residence time of water in the estuary and gas transfer velocities, in order to determine the flux of DOC and DIC to the coastal ocean and CO_2 exchange across the air-water interface. Results from the experiment show that dissolved carbon export was mainly as DIC, with 80% of total dissolved carbon, and 90% of mangrove-derived carbon being exported as DIC. Of the DIC exported from the estuary, longitudinal flux to the coastal ocean accounted for 64%, and with the remaining being air-water CO_2 flux.