PhD Prospectus: Carbon fluxes and fates in the Flatwoods of North Florida

* Inland waters- streams, river,lakes, ponds, and wetlands- are integral to global carbon cycling, functioning as the drainage network for the terrestrial biosphere.
* Despite only encompassing 1% of Earth’s area, inland waters are disproportionally active with in the carbon cycle.
* Of the 4.5 Pg-C/year delivered to streams from the terrestrial landscape, only ~20% (0.95 Pg-C/year) returns the oceans.
* The other 80% is fated to settle in streams, either buried within sediment, mineralized, or degassed to the atmosphere.
* The remainder discharged to the ocean is the byproduct aquatic biogeochemical transformations and losses as water transitions from the terrestrial uplands to coastal marshes.
* The globa carbon cycle and the hydrologic cycle are intrinisically coupled, and of the inland waters, streams and wetlands, in particular, play a vital role.
* Streams are the “active pipes” of the landscape, “plumbing” the terrestrial landscape by transporting, storing, and transforming uphill litterfall and particulates.
* The transfer of terrestrial C to streams and rivers is double than carbon delivered to oceans, yet stream CO2 degassing is roughly equal to terrestrial net ecosystem productivity.
* The gap between delivered terrestrial carbon and total stream carbon is externally sourced, likely from internal mineralization and groundwater degassing, but how much and the temporal dynamics is largely unknown, and estimates are preliminary. More CO2 is effluxed from flowing waters than can be accounted for by stream metabolism alone.
* Of the 3.4 Pg-C/year produced by terrestrial landscapes, 0.6 Pg-C/year is buried in sediment, 0.3 Pg-C/year is photosynthesized, and 0.95 Pg-C/year is transported to oceans, leaving a significant 1.5 Pg-C/year gap.
* Wetlands, in contrast, are “capacitors” for the watershed serving as storage reservoirs, water, nutrients, and carbon.
* Functionally unique, wetland emergent vegetation productivity and carbon burial offset wetland greenhouse gas (GHG) emissions, and are considered global carbon sinks.
* The majority of wetland carbon is buried while the remainder is either assimilated by emergent vegetation, mineralized or transported downstream through lateral subsurface or surface (“spill-and-fill”) flow paths.
* Wetlands are considered an infinite source of stream carbon, and the potential to be “carbon pumps.”
* Through the streams downstream export of carbon out of the watershed, and wetland lateral flux of carbon, stream-wetland coupling form a transport network with wetland acting as stream headwaters, and stream facilitating overland connectivity between upstream and downstream wetlands, in or out of the watershed.
* This exchange of water as it passes through each ecosystem creates the distinct biogeochemical fingerprint of the landscape.
* However, estimates of wetland contributions to stream carbon are preliminary and debatable.
* Wetlands are the intermediates between the terrestrial and aquatic, and as a result, often exempt from carbon budgets.
* The necessity for global carbon budgeting is to identify and quantify the significant players and the key exchanges among them.
* Improving our understanding of the global carbon budget, and how aquatic pathways link these players can constrain and improve carbon flux estimations, provide insight into climate change mitigation, better CO2 management, and predict feedback loops.
* As for the “stream CO2 gap,” sources and contributions by groundwater, transient soil storage, and wetlands are provisional and likely under-estimated. Difficulties associated with delineating the extent of wetlands and flowing waters, namely headwater streams, and the unknowns related to inland water processing create keystone unknowns.
* Few studies have observed the long-term temporal dynamics of streams