The present global carbon budget has major discrepancies, especially when parsing inland water inputs and outputs. To resolve these discrepancies, more detailed observational studies across various landscapes are necessary.

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

* Inland waters—streams, rivers, lakes, ponds, and wetlands—are integral to global carbon cycling, functioning as the drainage network for the terrestrial biosphere, and despite only encompassing 1% of Earth's area, are disproportionately active within 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 to the oceans.
* The other 80% is fated to either for sediment burial mineralized, or degassed to the atmosphere.
* The carbon discharged to the ocean is the byproduct aquatic biogeochemical transformations and losses as water transitions from the terrestrial uplands to coastal marshes.
* The global carbon cycle and the hydrologic cycle are intrinsically coupled, and inland waters, streams and wetlands in particular, play a vital role.
* Streams are “active pipes” that “plumb” the terrestrial landscape by transporting, storing, and transforming uphill litterfall and debris.

Terrestrial-stream carbon exports are double the carbon load delivered to oceans, and stream CO2 emission is equal to terrestrial net ecosystem productivity.

* In total, stream carbon exports are not equal to the sum of terrestrial inputs and respired carbon, creating major uncertainties at the global scale.
* Of the 3.4 Pg-C/year exported from the terrestrial landscapes, (hypothesized) 0.6 Pg-C/year is buried in sediment, 0.3 Pg-C/year is mineralized, 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 for water and nutrients.
* Functionally unique from inland waters, wetland emergent vegetation sequester CO2 from the atmosphere while hydric soil bury carbon for months to decades.
* Although wetland contribute to GHG emissions, wetland productivity and carbon burial offset carbon emissions.
* In addition to global carbon sinks, wetlands are also global hotspots.
* Wetland hydric soils re-mineralize and store carbon, as well exported processed carbon downstream.
* 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