Outline:

I want to include a graphical abstract.

* **Big picture: introduce stream and wetland contribution to the global carbon budget**
* Inland waters- streams and wetlands- play a crucial role in the global carbon budget, functioning as the primary drainage network for their watersheds (Cole et al., 2007; Drake et al., 2018; Raymond et al., 2013).
* Streams, the “active pipes” of the watershed, “plumb” the terrestrial uplands transporting and transforming uphill debris and particulates (Abril & Borge; Cole et al, 2007).
* Wetlands are “capacitors” for their watersheds serving as storage reservoirs for water and nutrients. Nutrients held within wetlands can circulate through the watershed via subsurface or overland flow pathways while the stored water raises the local water table, providing a watershed-scale buffer against drought (Evenson et al., 2018; Li et al., 2023; McLaughlin et al., 2014) (CITE, Cohen & Kaplan).
* Through the streams downstream movement of water and the lateral flow from wetlands, inland waters form a dual-pathway transport network (Leibowitz et al., 2018), with wetlands acting as stream headwaters and catchments, and streams facilitating connectivity between the upstream and downstream boundaries (Abril & Borges, 2019; Casson et al., 2019; Li et al., 2023; Moustapha et al., 2022).
* The exchange of water and its nutrients, and the subsequent transformation of nutrients as it passes through each ecosystem, creates a distinct biogeochemical fingerprint of the watershed (maybe sight Bernhardt? Fingerprint stuff).
* **Discuss the current issues with current global carbon budget in relation to inland waters (Dive deeper into streams as pipes)**
* Current global C-budget models estimate that of the 4.5 Pg-C/year produced by the terrestrial landscape, 3.4 Pg-C/year is fated to settle in streams (Regnier et al., 2022).
* As a result, stream carbon is predominantly allochthonous (sourced from the terrestrial uplands), and is therefore regarded as a global carbon source, emitting more carbon dioxide (CO2) than what is accounted for by stream metabolism alone (Cole et al., 2007; Raymond et al., 2013, Battin et al., 2009; Regnier et al., 2022).
* Utilizing mass counting and employing estimated global stream-CO2 emissions, 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.
* This tremendous gap, by default, is assumed to be degassing from groundwater seepage (Hotchkiss et al., 2015), however, current global carbon budgets exempt wetlands, leaving their contributions to stream carbon unclear, and potentially overestimating groundwater’s significance. (Battin et al., 2009; Drake et al., 2018; Kirk & Cohen, 2023; Regnier et al., 2022).
* Wetlands, at the global scale, are challenging to delineate; wetlands are not terrestrial nor are they always aquatic, often drying outside of the wet season and thus, are frequently excluded from global C budget assessments (Raymond et al., 2013; Vlek, 2014). (Harvey & Gooseff, 2015; Kirk & Cohen, 2023; Leibowitz et al., 2018; Vázquez et al., 2007)
* This oversight likely overestimates global groundwater influence while overlooking wetlands carbon contribution.
* Furthermore, few studies have observed the long-term trends in stream carbon transport and fluxes.
* Most publications target hot-spot moments, namely post-disturbance responses, or have a single, wet-season study period.
* Projects with longer study periods, largely only periodically sample for dissolved organic carbon (DOC), ignoring or inferring trends on dissolved inorganic carbon (DIC).
* Sampling and processing all carbon species (organic carbon, carbonate, CO2, and CH4) is laborious; carbon-detecting instruments are costly, DIC samples expire quickly, and researchers are always battling with the inevitable degassing of gaseous carbon (CO2, CH4) and its reactivity (DIC, CH4) of their samples.
* However, with the advancements of high-frequency, durable and submersible sensors, and the subsequent research push to develop alternative, low-cost options, understanding the detailed mechanisms of stream carbon transport and transformation is now possible.
* For my dissertation, I aim to investigate the detailed mechanism of stream carbon within Bradford Experimental Forest (BEF), a flatwood landscape located in North Florida. Primarily managed for pine stands, BEF features a low relief terrain dotted with numerous wetland depressions ideal for carbon storage. Due to the Hawthorne Formation and BEF’s dense wetland area
* Deep groundwater seepage from the Upper Floridia Aquifer (UFA) is minimal, and the flux of carbon to streams is driven by lateral transport via the shallow water table where particulates flow laterally downhill before ultimately discharging into tannic, blackwater streams.
* My dissertation is divided into three chapters: stream carbon, river corridor carbon, and surrounding landscape influences.
  + Chapter 1. Exploring the seasonal timing of stream carbon and its relationship to discharge,
  + Chapter 2. The carbon contribution and fluxes of the river corridor,
  + Chapter 3. The surrounding landscapes influence, namely wetland area, to stream carbon fluxes.
* From my findings, I will establish a detailed understanding of how landscape hydrology dictates stream carbon flux and transport, and aid in future research endeavors exploring and how carbon is stored (wetlands, soils) and lost (downstream transport and fluxes), as well as draw broad inferences of stream carbon patterns with discharge and its surrounding landscape outside of my ecosystem of interest.
* Furthermore, this research will provide evidence that hydrologic management can (or cannot) be used as a means to optimize carbon sequestration and storage, optimizing managed land for fiscal gain as well as ecosystem services.

Word Bank:

* **Conclusion:** A widely adopted best management practice for water conservation in North Florida is the water credits program. Simply, this program compensates forest and agriculture landowners for conserving water. For instance, pine stands, typical of the North Florida flatwoods, heavily rely on groundwater. Paying timber harvesters to reduce planting without sacrificing profit benefits both pine plantations and groundwater preservation. Water management districts are now proposing a similar program for carbon (C) storage, known as carbon credits. The flatwoods of North Florida, characterized by their low-relief topography and confined aquifer, provide an ideal landscape for C storage due to their abundance of wetlands. Despite strong legal incentives in Florida to preserve wetlands and natural streams, forest landowners often clear ecotonal zones, such as riparian wetlands, in pursuit of greater profits- the more land cleared for pine stands, the greater the profit. The proposed carbon credit program has the potential to reverse this trend. By compensating forest landowners for stored C, the program promotes wetland conservation, offsets CO2 emissions, and benefits foresters. However, there are significant knowledge gaps concerning C cycling in low-relief, wetland-rich plantation landscapes that need to be addressed. These include understanding river corridor C storage capacity and the overall influence of wetlands on stream CO2 emissions. Through my research, I aim to shed light on the often-overlooked role of riparian wetlands in inland water systems and provide insights into managing low-relief, wetland-rich landscapes for enhanced C storage.
* The Bradford Forest tract, spanning 27,000 acres in Bradford County, Florida, encompasses a contiguous pine flatwoods landscape situated within the Hawthorne Formation.