Coastal ecosystems are highly influenced by the presence of organic matter in the form of carbon, nitrogen, and phosphorous. Dissolved and particulate organic carbon (DOC/POC respectively) are produced in terrestrial ecosystems and transported to the coast by rivers and streams through runoff processes. Globally, such processes account for an input of \((0.43 \text{ Pg-C yr}^{-1})\) (Schlunz 2000) which significantly affects the biogeochemistry of coastal ecosystems. Carbon mobilization and transport is expected to change drastically in the near future due to changes in land use, temperature, and precipitation. The changing flux of carbon to the coast will alter the biogeochemistry of coastal ecosystems and affect many aspects of their functionality, including the severity and frequency of harmful algal blooms and the productivity of local fisheries (Roesler et al. 2008).

To better understand how the changing flux of carbon will alter coastal ecosystems in Maine, we must first investigate the processes that factor into carbon mobilization and transport. Not much is known about the effects of land cover or land use change on carbon export, or the effects a warming earth will have on the rate at which carbon is mobilized. For example, the relative abundance of wetlands, coniferous forests, deciduous forests, agriculture, and urban environments may alter carbon export from watersheds, but little is known about how these land cover types affect carbon export in rivers and delivery to the coastal ocean in Maine.

To address these limits of understanding, I proposed a study that evaluates five questions. (1) How does carbon export change from tributaries draining watersheds with different land use types? (2) How does carbon export change across the three major river systems in Maine (Androscoggin/Kennebec, Penobscot, and St. John), which vary broadly as a function of climate and land use type? (3) How do the seasonal dynamics of carbon export change from spring thaw to summer? (4) How do direct measurements of DOC/POC correlate with optical proxies measured using in situ fluorescence instruments developed by Professor Roesler? (5) What is the flux of carbon to the coastal waters of the Gulf of Maine and the Bay of Fundy, and how do these values compare to what is known from satellite-based estimates of carbon delivery to the coastal ocean?

In order to investigate these questions, we took ~monthly measurements along these rivers and their associated tributaries to determine the amount of carbon being loaded from each watershed. The watersheds analyzed were previously determined by Professors Camill, Roesler, and Lichter, based on the coverage of different land cover types and proximity to USGS discharge gage stations. Measurements were also taken at the mouth of rivers to measure the total influx of organic carbon into coastal ecosystems and the times at which they are most amplified (i.e. after storm events, or seasonal change). Using sensors in estuaries, we can track carbon as it makes it way to the coast and better understand how organisms consume and recycled it back into the water. Using Professor Roesler’s sensing techniques, we can determine specific properties about the water quality using in-water optical properties, which help us determine the amount and stratification of particulate matter in the water. This allows us to calibrate the sensor proxy data to real-time estimates of DOC/POC flux, giving us a season-long time series at hourly time intervals. These methods will help us attain our long-term goal of understanding the effects that changing carbon influx will have on coastal ecosystems and their organisms.

Although we sampled each river system three times this summer, our data is very limited to the water quality at each location (i.e. temperature, salinity, conductivity, pH) Throughout the year we plan to analyze each sample for nutrient content and attain decadal land use change data for all of Maine for the past 40 years. Once this data is gathered and synthesized, we can start to understand and quantify Maine’s coastal carbon export.

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