Optical Characterization of Dissolved Organic Matter in Maine Rivers

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The coastal waters of the Gulf of Maine are significantly impacted by the input of fresh water from a distributed river system. As a part of the NASA Three Rivers Project, this study focused on the four largest watersheds (Androscoggin, Kennebec, Penobscot and St. John) that contribute to the freshwater inputs. In particular, we investigated Dissolved Organic Carbon (DOC) using parallel factor analysis (PARAFAC) of excitation/emission matrix fluorescence spectroscopy. Using this approach, five individual fluorophores were identified in the water samples (Figure 1).

In this study, we investigated the role of water quality properties and landscape coverage in the mobilization and flux of DOC components and how those properties vary spatially across the landscape and temporally over seasons and between years. Monthly sampling of over 65 stations for three years has yielded a wealth of information about tributary characteristics. This study provides novel insights into carbon cycling in the Gulf of Maine.

Across all rivers, humic-like materials were the most prevalent components at the river mouths, accumulating along the rivers due to sequential tributary inputs. The relative intensity concentration of humic-like materials increased latitudinally from the Androscoggin to St John, a geographic progression in source material also correlated to climate variations, land coverage or bedrock acidity. Dissolved proteins displayed positive relationships with climatological Chlorophyll a and Nitrogen values. In all rivers, peak fluorescence of dissolved proteins was observed during summer months, with the maximum intensity observed in the Androscoggin. The magnitude and pattern of seasonal flux of fluorescent materials into the Gulf was similar between the Penobscot and the Kennebec. The flux of all DOM components was highest during the spring freshet, with a secondary peak during fall precipitation maxima and lowest during August, likely due to both low mobilization and photo degradation of river borne materials.

Figure One: The fluorescent properties of the five individual fluorophores present in the natural water samples tested in this project

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