

Assessing the Impacts of Climate Change and Fire on Terrestrial Organic Matter Export to the Arctic Ocean



Robert G.M. Spencer: rgspencer@fsu.edu

Background: Wildfires have produced black carbon (BC) since land plants emerged. Condensed aromatic compounds, a form of BC, have accumulated to become a major component of the soil carbon pool. Condensed aromatics leach from soils into rivers, where they are termed dissolved black carbon (DBC). The transport of DBC by rivers to the ocean is a major term in the global carbon and BC cycles. To provide a first estimate of Arctic riverine DBC export, 25 samples were collected from the six largest Arctic Rivers (Figure 1) and analyzed for dissolved organic carbon (DOC), colored dissolved organic matter (CDOM) and DBC.

Results & Discussion: A simple linear regression between DOC and DBC (Figure 2a) indicated that DBC accounted for $8.9 \pm 0.3\%$ of DOC exported by Arctic rivers. To improve upon this estimate an optical proxy for DBC was developed based upon the correlation between DBC concentrations and CDOM light absorption coefficients (Figures 2b&c) which was shown to be robust out to wavelengths long enough to allow for future estimates via remote sensing. Comparatively easy and inexpensive to measure CDOM a_{254} values were determined for 410 Arctic river samples collected over a 7 year period. Utilizing the relationship in Figure 2c each of these a_{254} values was converted to a DBC concentration providing an extended record of DBC concentration data. Coupling this record with daily discharge data from the six major rivers allowed for an estimation of riverine DBC loads. Scaling to the full pan-Arctic watershed results in an estimated flux of 2.8 ± 0.3 million tons of DBC from land to the Arctic Ocean each year. This equates to 8% of Arctic river DOC export, slightly less than indicated by the simpler DBC vs. DOC concentration based estimate. Both fire and riverine discharge are predicted to increase in a warmer Arctic suggesting the export of BC to the Arctic Ocean is likely to increase.



Figure 1. Map of Arctic study watersheds and pan-Arctic watershed (red line). Red dots are sampling locations; watershed color corresponds to data points in Figure 2.

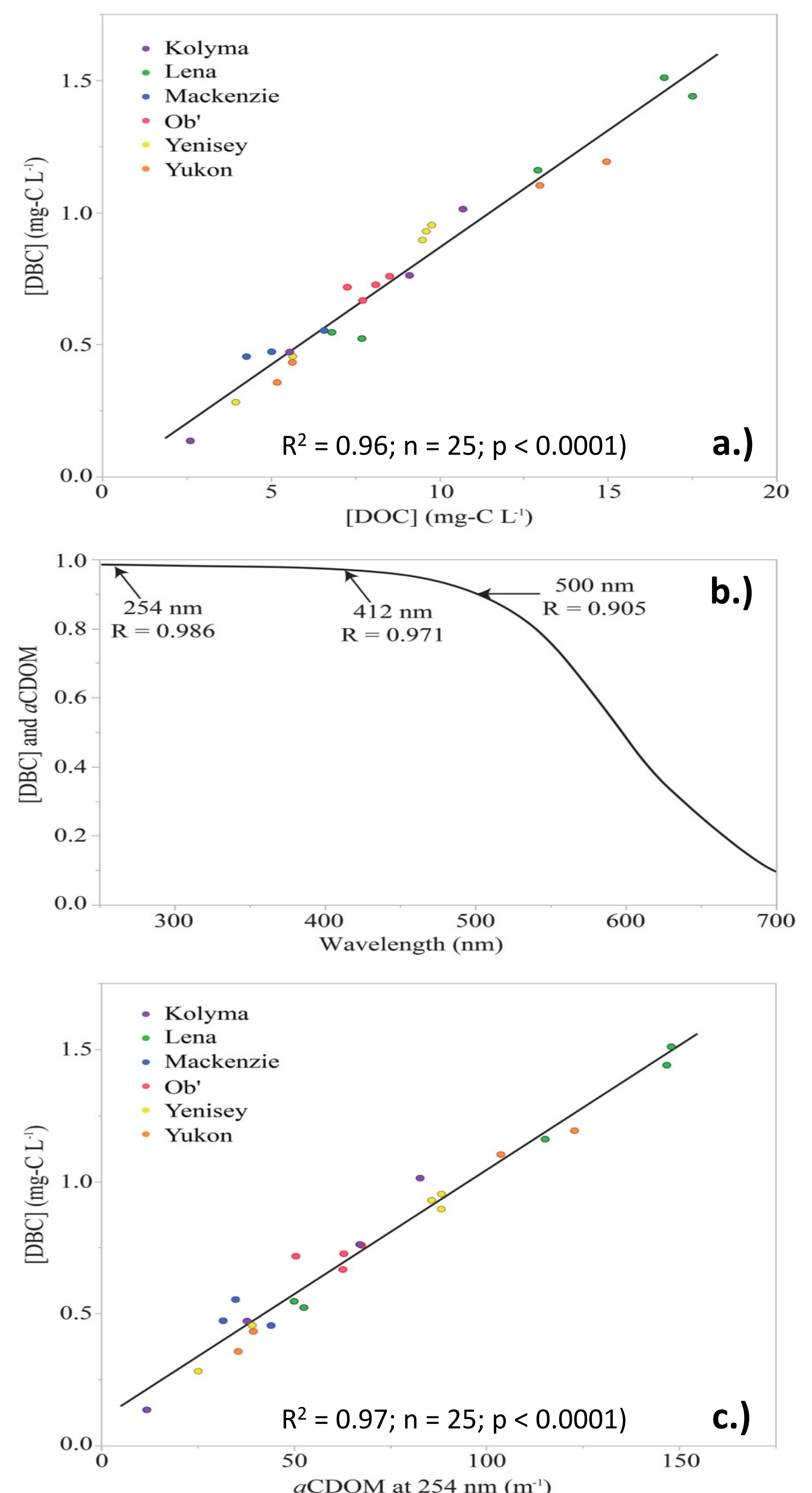


Figure 2a. DBC vs. DOC concentration; **b.)** Correlation coefficient (R values) for linear regressions of DBC vs. CDOM wavelengths; **c.)** DBC vs. CDOM a_{254} .