# A smoking gun for carbon cycle change in the Canadian arctic?

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On their way to the oceans, rivers capture and export organic carbon (OC) from the terrestrial biosphere. Across the northern high latitudes, warming and associated permafrost thaw may alter hydrological flow pathways and erosion processes. These factors could affect the mobilization and transport of OC by rivers, impacting regional and global carbon budgets. In large Arctic rivers, existing measurements of the radiocarbon activity of dissolved organic carbon ($^{14}$C-DOC) suggest that this pool is mainly derived from recently-fixed carbon of plants and shallow soil horizons, suggesting little hydrologic interaction with depth [1]. These observations contrast with predictions of an amplified release of aged organic carbon from Arctic watersheds with increasing temperatures as permafrost soils thaw [2,3].

We examine DOC mobilisation in the Arctic drainage basins by sampling the spring floods of the Mackenzie River and its major tributaries (Peel, Arctic Red) from consecutive sampling campaigns. We collect depth-profiles of $^{14}$C-DOC, along with alkalinity and dissolved ions comparing those with a longer time-series (2003 to 2013) on the same fluvial system. While $^{14}$C-DOC measurements from June 2017 are consistent with the time-series data, and exhibit fraction modern ($F^{14}$C) values generally >1.0, those from 2018 are significantly lower despite no marked change in concentration. Pollution, contribution from bedrocks or changes in flow conditions during sample collection are excluded as a cause due to the necessary magnitude of aged carbon input. Instead, we attribute this change to enhanced efficiency of soil hydrological processes due to sustained warming observed in the preceding winter and spring. A deepening of the thaw depth allows groundwater to access deeper, older mineral-rich permafrost soil layers and the subsequent export of aged DOC to rivers. Should such a change persist it would represent a marked shift in the arctic carbon cycle.

[1] Raymond at al. (2007) Global Biogeochem. Cycles **21**. [2] Frey and Smith (2005) Geophys. Res. Lett **32**. [3] Schuur et al. (2015) Nature **520**, 171-179.