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Siberian Arctic inland waters emit mostly contemporary carbon

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Inland waters (rivers, lakes and ponds) are important conduits for the emission of terrestrial carbon in Arctic permafrost landscapes. These emissions are driven by turnover of contemporary terrestrial carbon and additional “pre-aged” (Holocene and late-Pleistocene) carbon released from thawing permafrost soils, but the magnitude of these source contributions to total inland water carbon fluxes remains unknown. Here we present unique simultaneous radiocarbon age measurements of inland water CO₂, CH₄ and dissolved and particulate organic carbon in northeast Siberia during summer. We show that >80% of total inland water carbon emissions were contemporary in age, but that pre-aged carbon contributed >50% at sites strongly affected by permafrost thaw. CO₂ and CH₄ were younger than dissolved and particulate organic carbon, suggesting emissions were primarily fuelled by contemporary carbon decomposition. The study region was a net carbon sink (-876.9 ± 136.4 Mg C for 25 July to 17 August), but inland waters were a source of contemporary (16.8 Mg C) and pre-aged (3.7 Mg C) emissions that respectively offset 1.9 ± 1.2% and 0.4 ± 0.3% of CO₂ uptake by tundra (1897 ± 115 Mg C). Our findings reveal that inland water carbon emissions from permafrost landscapes may be more sensitive to changes in contemporary carbon turnover than the release of pre-aged carbon from thawing permafrost.