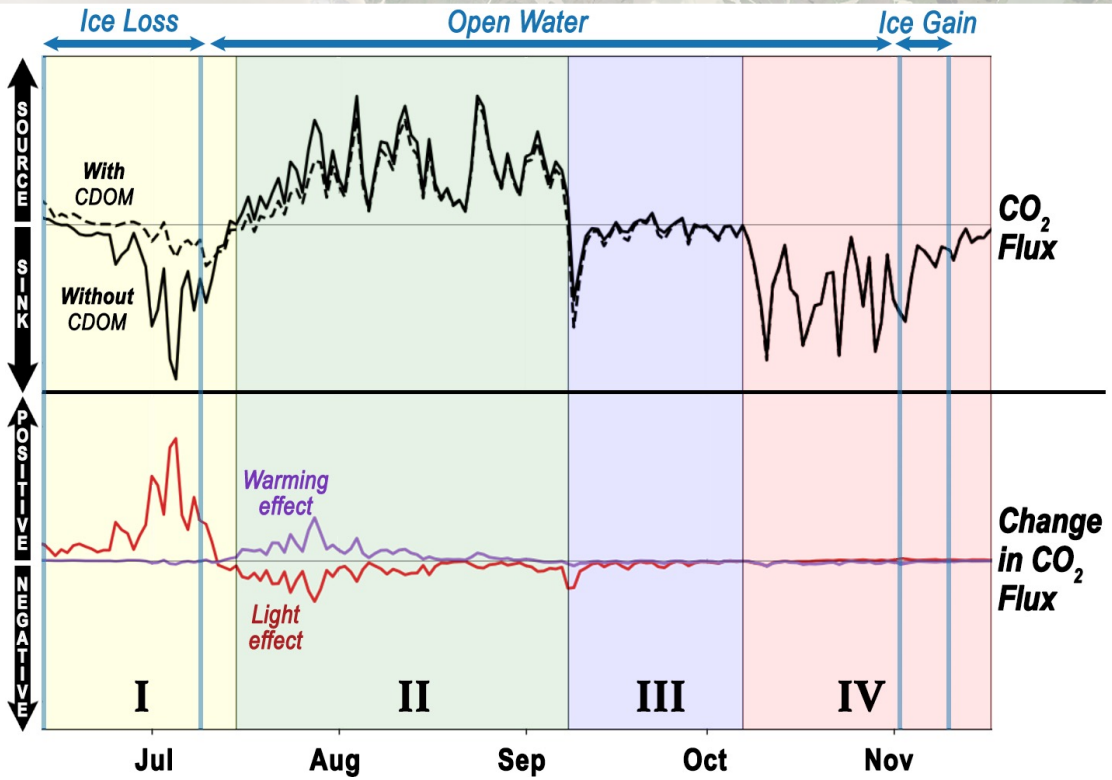
Arctic River Brown Waters Cause CO_2 Outgassing

- Brown river waters impact coastal water biophysical properties through **light attenuation**
- We modified a regional **ECCO-Darwin** simulation of the Mackenzie River Shelf **to include export of colored dissolved organic matter (CDOM)**
- CDOM light attenuation triggers a **2-week delay in seasonal phytoplankton blooms and increases sea surface temperature by 1.7°**
- Browning **switches the coastal zone** from an annual sink of CO_2 **to an annual source (7.35 Gg C yr^{-1})**

During Arctic summer and fall *without* CDOM (solid black line), four distinct phases of air-sea CO_2 exchange occur. **Phase I** exhibits a substantial net CO_2 **sink**, caused by phytoplankton growth. **Phase II** has significant net CO_2 outgassing from the decline of phytoplankton and warming effects. **Phase III** has air-sea CO_2 flux near zero. **Phase IV** shows a strong CO_2 sink.

Overall, temperature is a dominant factor in the transition of the river plume from a sink to a source, as it dampens the increased CO_2 uptake due to phytoplankton growth in early summer.

Bertin, C. et al. (2025) Colored dissolved organic matter (CDOM) alters the seasonal physics and biogeochemistry of the Arctic Mackenzie River plume, Biogeosciences, 22, 6607-6629, doi: 10.5194/bg-22-6607-2025



TOP: Simulated air-sea CO_2 flux in the plume region ***with*** (dashed) and ***without*** (solid) CDOM biophysical feedback. BOTTOM: Changes in CO_2 flux due to ocean warming and light attenuation are purple and red lines. Phases I-IV indicate switches in CO_2 flux.

We demonstrate the importance of CDOM biophysical feedback in Arctic river plume regions. This includes strong implications of CDOM radiative heating on air-sea CO_2 fluxes.