Air-water CO_2 exchange in continental and coastal systems – regional and global budgets

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The CO_2 exchange between continental waters and the atmosphere (FCO_2) is an important component of the land-ocean transfer of biologically fixed carbon (C). Here, we present spatially explicit, data driven FCO_2 estimates at regional to global scales. The total global FCO2 is estimated at 930 Tg C yr-1, with rivers, lakes/reservoirs, estuaries and the coastal ocean contributing 650 Tg C yr-1, 320 Tg C yr-1, 150 Tg C yr-1, and -185 Tg C yr-1, respectively (negative fluxes represent sinks of atmospheric CO2). Combining riverine and lacustrine FCO_2 with the estimated fluvial DOC and POC exports from GlobalNEWS, the total lateral export of C biologically fixed on land and in wetlands to the aquatic system adds up to 1.3 Pg C yr^{-1}.

Our spatially explicit estimates reveal distinct patterns. For riverine FCO_2, we identified a strong latitudinal gradient, with the zone between 10°N and 10°S contributing about half of the global flux. With the exception of dry and mountainous areas, the riverine CO_2 evasion exceeds the export of organic carbon to the coast. In tropical Africa and South America, the proportion exceeds even 75%.

Similarly strong patterns can be found for the coastal ocean. While the artic shelfs represent a strong CO_2 sink, tropical shelfs are weak sources of CO_2 to the atmosphere.