Carbon fluxes in the land to ocean continuum: Updated synthesis and implications for the anthropogenic CO_2 budget

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This contribution provides an updated synthesis of the contribution of terrestrial-aquatic interface carbon fluxes and aquatic systems-atmosphere CO_2 fluxes in the global carbon budget. In particular, we assemble the first global map of CO_2 fluxes for all connected aquatic systems (river network, estuaries, coastal and open ocean) at a spatial resolution of 0.5°. Next, we attempt a decomposition of all component fluxes into a natural background and an anthropogenic perturbation loops. So far, traditional approaches used to determine the global carbon budget (as synthesized by GCP or the IPCC) omit the continuous displacement and fate of anthropogenic carbon along the land to ocean aquatic continuum (LOAC). Our results highlight that only a portion of the anthropogenic CO_2 taken up by land ecosystems remain sequestered in soil and biomass pools. Some of the exported anthropogenic carbon is stored in the LOAC and some is released back to the atmosphere as CO_2, the magnitude of the air-water flux resulting from a delicate balance between outgassing from freshwaters and estuaries and a fast increasing uptake by coastal seas. A poorly known fraction of anthropogenic carbon displaced by the LOAC is transferred to the open ocean where it accumulates. Thus, the incorporation of the LOAC in the analysis has profound ramifications for the terrestrial carbon balance and for the anthropogenic CO_2 budget at the global scale.