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Multi-scale segmentation of continental and coastal waters and application to the global carbon budget.

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The coastline of the Earth is over 400 000 km long and about 40% of the world's population lives within 100km of the sea. The segmentation of the global coastline and its classification into various coastal settings have been designed from a continental perspective based on an analysis of watershed properties (COSCATS) or from an oceanic perspective, constructed around a regionalization of the proximal and distal continental margins (LME). Here, we propose a segmentation delineating comprehensive ensembles which retain the most important physical characteristics of both the land and shelf areas (Meybeck et al., 2006; Liu, 2010). The various geographical units include the whole aquatic continuum with its riverine, estuarine and shelf sea components.

The proposed segmentation results in a distribution of global exorheic river basins, estuaries and continental shelf seas among 45 major zones and 151 sub-units. Geographic and hydrologic parameters such as the surface area, volume and fresh water residence time are calculated for each segment. Next, a multi-scale typological analysis is used to classify river basins, estuaries and continental shelf seas according to climatic, lithologic, morphologic and hydrodynamical criteria.

Finally, the segmentation is combined with global databases (GLORICH, GlobalNEWS, SOCAT) to improve the quantification of lateral carbon fluxes and establish regional carbon budgets. At the global scale, about 1/3 of the organic carbon delivered by rivers transit through estuarine filters where further carbon processing occurs while the remaining 2/3 directly reaches continental shelf seas. Our spatially resolved approach allows also to estimate the respective contribution of each estuarine type (small deltas, tidal systems, lagoons, fjords) to the atmospheric CO_2 emissions. Together, they contribute to a global net CO_2 flux to the atmosphere of 0.3 Pg C yr-1, which is comparable to the CO_2 sink of -0.2 Pg C yr-1 attributed to the continental shelf seas (Laruelle et al. 2010).