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Estimating the Cross-Shelf Export of Riverine Materials

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Rivers deliver large amounts of fresh water, nutrients, and other terrestrially derived materials to the coastal ocean, but a global quantification of the fate of this delivery is lacking. Where inputs accumulate on the shelf, harmful effects such as hypoxia and eutrophication can result. In contrast, where export to the open ocean is efficient, riverine inputs contribute to global biogeochemical budgets. Assessing the fate of riverine inputs is, however, difficult on a global scale. Global ocean models are generally too coarse to resolve the relatively small-scale features of river plumes. High-resolution regional models have been developed for individual river plume systems, but it is impractical to apply this approach globally to all rivers. As a result, river inputs in global models are often parameterized using an "all or nothing" approach. Following the work by Sharples et al. (GBC, 2017), we used an idealized numerical model to perform a large number of numerical simulations under different forcing conditions in order to derive empirical relationships to estimate export in river plumes which are dependent only on the river's discharge and latitude, as well as the local shelf width. We then applied these empirical functions to obtain global estimates for open-ocean export of fresh water and dissolved nutrients based on riverine inputs in the NEWS database. We show that at least half of the input material is retained on shelves globally, with efficient export only occurring within the tropics. Geographic differences in inputs further entail that dissolved silicate is the most efficiently exported nutrient, while dissolved inorganic nitrogen is least efficiently exported to the open ocean. Our results are consistent with previous estimates and provide a simple way to parameterize export to the open ocean in global models.