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Research Letter

Fresh Submarine Groundwater Discharge to the Near-Global Coast

YaoQuan Zhou, Audrey H. Sawyer, Cédric H. David, James S. Famiglietti

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Abstract

The flow of fresh groundwater to the ocean through the coast (fresh submarine groundwater discharge or fresh SGD) plays an important role in global biogeochemical cycles and coastal water quality. In addition to delivering dissolved elements from land to sea, fresh SGD forms a natural barrier against salinization of coastal aquifers. Here we estimate groundwater discharge rates through the near-global coast (60°N to 60°S) at high resolution using a water budget approach. We find that tropical coasts export more than 56% of all fresh SGD, while midlatitude arid regions export only 10%. Fresh SGD rates from tectonically active margins (coastlines along tectonic plate boundaries) are also significantly greater than passive margins, where most field studies have been focused. Active margins combine rapid uplift and weathering with high rates of fresh SGD and may therefore host exceptionally large groundwater-borne solute fluxes to the coast.

Plain Language Summary

Fresh groundwater flows from land to sea through coastal rocks and sediment. While the amount of groundwater flow is small compared with rivers, it plays an important role in carrying dissolved chemicals like nutrients to sea, and it helps protect aquifers against salinization. We estimate groundwater flow through the near-global coast. Tropical regions have more groundwater flow, while dry midlatitudes have less. Dry midlatitude regions are therefore more vulnerable to salinization, which is problematic because these regions are also more likely to depend on groundwater to meet their water needs. Additionally, mountainous coastlines along tectonic plate boundaries have relatively large rates of groundwater discharge and may be associated with higher dissolved chemical fluxes to the coast.