Dissolved material transports by terrestrial groundwater discharge and recirculated salt-water discharge into the ocean

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Recognition of the importance of submarine groundwater discharge (SGD) has been for water and material transport from land to ocean. Defining and measuring SGD has presented a dilemma for hydrologists and oceanographers for several years. Hydrologists have defined SGD to be the net meteorically-derived groundwater discharge to the ocean which comes essentially from aquifer recharge. On the other hand, oceanographers have defined SGD to be the direct fluid outflow across the ocean-land interface into the ocean which includes saline groundwater (seawater that infiltrates the subsurface, reacts with aquifer solids, and is discharged with a modified composition) as well as terrestrial waters. Recent studies consider SGD to be the result mainly of groundwater discharge driven by the terrestrial hydraulic head, outflow due to wave-setup-induced groundwater circulation, and outflow due to wave or current-driven oscillating flow. Global-scale assessment of both fresh and saline groundwater discharges based solely on observational data suggest that fresh groundwater discharge and recirculated seawater is represent 7 % and 160 % of the global river discharge. We show via automated measurements that precipitation and wave pumping are important controls of terrestrial (fresh) and marine-induced (recirculated seawater) subterranean flows, respectively. Dissolved material transports by SGD were evaluated in some Asian coastal zones. Phosphate, silicate and ammonium transports by SGD at Gulf of Thailand were evaluated to be 58 - 71 % 15 - 44 % and 37 - 47 % of the material transports of river discharge.