Environmental implication of nutrient fluxes associated with submarine groundwater discharge to an urbanized river in Daya Bay, China

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The water quality in a coastal estuary is strongly influenced not only by riverine input but also by submarine groundwater discharge (SGD), which has been identified as a typical process of land-ocean interactions in coastal zones. We investigated the potential contribution of SGD to water pollution in Danao river, Daya Bay, China, integrating the methods of radium isotopes and Acoustic Doppler Current Profiler (ADCP). The concentrations of nutrients, such as dissolved inorganic nitrogen, phosphorus and silicon, and radium isotopes (^{223}Ra, ^{224}Ra, ^{226}Ra and ^{228}Ra) in estuarine surface water and groundwater were investigated from the river upstream reach to the estuary. The results showed that the radium concentrations in brackish groundwater were an order of magnitude higher than those in estuarine surface water. The radium concentrations in both estuarine surface water and groundwater decreased from the estuary to the upstream reach. SGD based on ^{223}Ra and ^{224}Ra was estimated to be comparable to the mean river discharge rate. The mean fluxes of SGD-derived nutrients including dissolved inorganic nitrogen, phosphorus, and silicate were much higher than those from marine inputs and riverine ones. This vital source of nutrient inputs from groundwater is most likely caused by the anthropogenic pollutants from the urbanized and industrialized areas on both sides of the river.

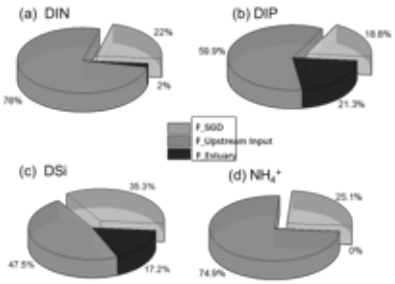

Figure 1. The contribution percentages of upstream fresh water, estuarine seawater and groundwater to (a) DIN, (b) DIP, (c) DSi and (d) NH4 in the Danao river.