Are groundwater inputs into river-dominated areas important? The Chao Phraya River [Gulf of Thailand

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ABSTRACT: We used the natural geochemical tracers radon-222 and radium isotopes (^{223}Ra, ^{224}Ra, ^{226}Ra, ^{228}Ra) to assess exchange rates between the Chao Phraya River and the Gulf of Thailand, and the magnitude of groundwater discharge in the estuary. We performed tracer surveys during two periods in 2004, in January (dry season, gauged river discharge 47 m^3 s^{-1}) and in July (wet season, 430 m^3 s^{-1}). The isotopic data suggested that there are at least three different sources of these tracers in the estuary: river water, seawater, and groundwater. We estimated the extent of each input via a mixing model using ^{222}Rn, ^{223}Ra, and ^{224}Ra activities and ^{224}Ra : ^{223}Ra ratios. Our analysis showed that the largest groundwater outflow occurs near the mouth of the river. Our groundwater discharge estimates based on the mixing model are 10 and 16 m^3 s^{-1} for January and July, respectively. An independent estimate of groundwater discharge in July using a mass balance of excess ^{226}Ra together with our estimated water exchange rates based on ^{224}Ra : ^{223}Ra ratios resulted in a range of 14-19 m^3 s^{-1}, depending upon the estimated amount of desorbable radium. Our estimated groundwater inputs therefore represent about 20% of the river flow during low flow in January and 4% during high flow conditions in July 2004. The unit shoreline flux (~200 m^3 m^{-1} d^{-1} in July) for the area around the river mouth is over one order of magnitude higher than two other areas of the Gulf of Thailand where groundwater fluxes have been evaluated.

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