Riverine Groundwater Discharge Estimation in a Dynamic River Corridor Using 222Rn

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Groundwater discharge into rivers is essential information for the conservation and management of aquatic ecosystems and resources. One way to estimate area-integrated groundwater discharge into surface water bodies is to measure the concentration of a groundwater tracer within the water body. We assessed groundwater discharge using 222Rn, a tracer common in many surface water studies, through field measurements, surface water 222Rn mass balance modeling, and groundwater flow simulation, for the seldom studied but ubiquitous setting of a flooding river corridor. The investigation was conducted at the dam-regulated Lower Colorado River (LCR) in Austin, Texas, USA. We found that 222Rn in both the river and groundwater in the river bank changed synchronously over a 12-hour flood cycle. A 222Rn mass balance model allowed for estimation of groundwater discharge into a 500-m long reach of the LCR over the flood. The groundwater discharge ranged between negative values (indicating recharge) to 1570 m3/h; groundwater flow simulations corroborated these estimates. However, for the dynamic groundwater discharge estimated by the 222Rn box model, assuming whether the groundwater 222Rn endmember was constant or dynamic led to notably different results. The resultant groundwater discharge estimates are also highly sensitive to river 222Rn values. We thus recommend that when using this approach to accurately characterize dynamic groundwater discharge, the 222Rn in near-stream groundwater should be monitored at the same frequency as river 222Rn. If this is not possible, the 222Rn method can still provide reasonable but approximate groundwater discharge given background information on surface water-groundwater exchange time scales.