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Using Radon-222 as a Naturally Occurring Tracer to investigate the streamflow-groundwater interactions in a typical Mediterranean fluvial-karst landscape: the interdisciplinary case study of the Bussento river (Campania region, Southern Italy).

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Karst aquifers provide 25% of the overall drinking water resources to the world's population and sustain aquatic life in most fluvial systems, providing several ecological services to human beings, although, because of their complex links between surface and groundwater, turn out to be very vulnerable to contamination and pollution. This paper describes the preliminary findings from Radon-222 activity concentration measurement data collected in streamflow and instream springs during monthly field campaigns, performed from September 2007 to December 2008, in a typical Mediterranean karst river: the Bussento river (Campania region, Southern Italy). The general aim is to investigate the complex interactions and exchanges between streamflow and groundwater, at scales that are imperceptible to standard hydrological and hydraulic analyses. In fact, the study area is located inside the Cilento and Vallo di Diano National Park and, therefore, the management of its relevant water resources requires not only groundwater protection for domestic drinking use, but also riverine wildlife preservation and coastal water quality maintenance. As a support for hydro-geomorphological and hydrological modelling for planning tasks, in application of the European Water Framework Directive (EWFD), a Bussento River Monitoring System (BRMS) has been built, at basin, segment and reach scale. Experimental data about 222Rn concentrations, in addition to physical-chemical and streamflow rate, have been acquired and managed from BRMS selected stations, sampling the streamflow and inflow spring waters by means of the Radon-in-Air analyzer, RAD7, together with the Radon-in-water accessories, Radon Water Probe and RAD7H2O (DURRIDGE Co. Inc.), for continuous and batch sampling measurements, respectively. During preliminary surveys, appropriate sampling procedures and measurement protocols have been tested, taking into account the different local hydrogeological and hydrological situations occurring along the Bussento river basin. At segment scale, data elaborations from the Bussento mid-lower segment provide the location and downstream influences of the groundwater inflows from river banks and bed, also in absence of valuable streamflow discharge increments. At river reach scale, more detailed data enable to improve a preliminary model about the 222Rn degassing rate, related to the hydro-geomorphological Rosgen stream type and provide a first contribution to surficial-groundwater seasonal hydrograph separation. Finally, the analysis of the seasonal data trends from karst springs confirms the hydrogeological conceptual model, highlighting the complex behaviour of a multilevel groundwater circuits, the uppermost in caves, the mid in conduits and the lowermost in fracture network, corresponding to the differentiated recharge types in the fluvial-karst hydro-geomorphological system.