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Temperature as tracer of the hydraulic dynamic of an anchialine cave (coastal submerged cave) of Krka Estuary (Croatia)

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A series of temperature, conductivity and water level loggers were used to characterize the hydraulic dynamic of a submerged cave (anchialine cave) in Krka Estuary. Litno Cave is a sub-horizontal gallery, less than 5 m in diameter and one meter below sea level. Apart from some sections that contain occasional air pockets under the ceiling, the cave is completely flooded. Outflow discharge through the cave is continuous during the year (>30 l/s). During several months vertical temperature profiles were measured in three locations inside the cave at 20, 60 and 100 m from the cave entrance, whereas another vertical profile was set in the estuary in front of the cave. Thermometers from the estuary measured thermal gradients to characterize position and evolution of the thermocline up to a depth of 3.5 m.

Tides measured in the estuary are synchronous to those recorded in the cave and their amplitudes (20 to 40 cm in the estuary) are the same or smaller depending on cave outflow discharge. Records of cave water temperature show a non-linear response to tides due to the vertical displacement of the thermocline. During neap tides the thermocline was located in the aquifer below the cave, whereas during spring tides only thermometers in the top meter of the cave were not affected by the thermocline vertical displacement. After the first significant rains of the hydrological year, the freshwater contribution increased the cave outflow discharge by one order of magnitude. Thus, conductivity decreased in response to rains from 16000 $\pm$1000 μS/cm to <700 μS/cm at the bottom of the cave. Under these conditions variability of cave water temperature was less than 0.1 ºC, although a 0.4 ºC long-term variability was recorded. These data shows that the discharge of freshwater to the estuary determines the dynamic of this submerged cave, limiting the influence of estuarine water intrusion in the coastal aquifer and the impact of tides. This research shows that temperature is a powerful tracer of the dynamic of this coastal cave. This proxy provides valuable information on the freshwater discharge to the subterranean estuary and the influence of tides on the costal aquifer.

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