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Thermal reactivity of the the hyporheic zone

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The evolution of the hyporheic zone (HZ) water temperature and its associated heat fluxes exert a major control on aquatic habitats and the ecosystem ecological state. In this study, a synthetic case is developed to characterize the behaviour of the HZ submitted to climatic and hydrological forcings as well as to various hydraulic and thermal properties, representative of a wide range of lithofacies from clay to gravel/sand. The thermal regime of the river/aquifer system is driven by two pseudo-periodic cycles: the annual cycle and the diurnal cycle. A 2D finite element thermo-hydrogeological model coupled with a parameter sampling script is used. The results highlight the drivers that mostly influence heat fluxes: first, the climatic conditions through the seasonal thermal gradients established between the stream and the aquifer during winter and summer periods, and then the HZ hydraulic conductivity. Depending on the HZ hydraulic conductivity values, two thermal regimes exist: for high hydraulic conductivities (> 10-5 m s-1) advective fluxes clearly prevail, while for lower hydraulic conductivities, conductive fluxes are in most cases predominant. The thermally active depth as defined in this work varies between 0.2 and 6 m. This depth is reduced in upwelling cases and modulated by the HZ thermal regime. Results from this study provide a better insight into the HZ and heat fluxes which will ultimately result in better stream temperature models and a better use of heat as a flow tracer inside the HZ.