Estimating Water Temperature Changes Though Hyporheic Flow Paths: Possible Implications for Stream Temperature Modeling

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Abstract. Stream temperature is an important aspect of water quality that can be affected in many ways. Although solar radiation has the largest influence, heat exchange also occurs at the streambed interface. Hyporheic exchange is the movement of channel water into and out of bed sediments caused mainly by pressure gradients, and while temperature averages will be comparable between hyporheic and surface waters in any stream, overall temperature patterns can be quite different. Although the scale of this exchange may not be large enough to influence total stream temperature, it may serve to increase thermal heterogeneity within the stream and therefore create cool water refuges for some freshwater species. A small-scale laboratory experiment demonstrated that conduction between water and bed sediments occurs very quickly, so as to be near-instantaneous, especially when hyporheic velocities are slow. A model was then developed that uses surface water temperature time series and adjusts them according to a "damping coefficient," calculated based on how long water is in contact with hyporheic sediments. Short hyporheic flow paths may have temperatures patterns that differ very little from channel water, but the longer the travel time through the hyporheic zone, the more changed the water will be. Model results found that if waters travel time within a hyporheic pathway is longer than about four days, the temperature pattern is almost indistinguishable from a line representing the temperature average. These results have implications for within-stream temperature modeling, where hyporheic exchange is often ignored due to its apparent complexity.