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An Improved Stream Temperature Model for Continuous Simulation and Its Application to Formosan Landlocked Salmon's Habitat Assessment

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This study incorporated solar radiation adjustment and surface/subsurface runoff mixing into a previous physics-based stream temperature model to enhance the model capability on simulating continuous stream temperature. The enhanced model is applied onto the habitat of Formosan Landlocked Salmon (Oncorhynchus masou formosanus) which is an endangered and temperature-sensitive species. We proposed a new index which takes the daily air temperature variation to mimic the shortwave radiation reduction mainly caused by cloud effects. This newly index embedded on the model significantly reduces the stream temperature overestimation compared to the previous model. Our results suggest that reducing shortwave radiation reaching stream is effective to mitigate the stream temperature in boreal summer under warming climate. Meanwhile, the incorporation of surface/subsurface runoff further improves the short-term simulations in the hottest and coldest seasons, respectively, revealing the hydrological influence on heat transmit in watershed and the potential to trace flow pathways. This study also demonstrates the seasonal transition of the dominance of thermal sources along the reach and indicated the significance of groundwater discharge on stream temperature in such small mountainous rivers. This improved model can be a tool in a warning system to assess the impacts of the short-term weather variability on stream temperature.