Stream-Aquifer Interaction: Unsolved Puzzles

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Stream-Aquifer interaction has long been recognized as one of the most important issues in hydrological sciences, and has gained great attention among hydrologists and environmental scientists. Although sophisticated numerical models might be needed to deal with realistic situations of stream-aquifer interaction, many input parameters needed in those models might not always be available, thus, analytical models are still commonly used by hydrologists and water managers. Among those conceptual models, Hantush's model [1965] deals with a fully penetrating stream with consideration of stream-bed. This model has been criticized for its use of fully penetrating stream assumption, thus has not gained enough attention. In this study, we have proved that the Hantush's model [1965] in a half-domain can be extended to a whole-domain and becomes identical to that of Hunt [1999] for a shallow and infinitely narrow stream, provided that the Dupuit assumption is used. This proof helps correct a false concept that regards the Hantush's model as less useful because of its fully penetrating stream assumption.

A semi-analytical solution of pumping induced interaction of an aquifer with two parallel streams based on the Hantush's model is derived in this study. This study shows that the aquitard hydraulic conductivity is the most important factor controlling the stream depletion, followed by the aquitard thickness. Aquitard storages do not play significant roles unless the two streams are very close to each other or the well is very close to either stream. The results in this study provide guidance for managing stream-aquifer systems.