Determination of the streambed hydraulic conductivity across an entire stream network

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The hydraulic conductivity of streambed sediment affects the surface-subsurface hydrological exchange and the residence time of chemically reactive solutes in the hyporheic zone. Determining the streambed hydraulic conductivity over a certain range is always a challenge owing to the time-consuming field test or a limited collection of sediment samples. Previous studies mainly focus on hydraulic conductivity in a specific study site or its spatial variations along the mainstem of a river channel. Less attention has been paid to the hydraulic conductivity across an entire watershed. A systematic collection and harmonization of spatially scattered hydraulic conductivity data are required for upscaling streambed hydraulic conductivity distribution to a larger scale, i.e., the watershed. In the present study, the streambed sediment median particle size (d50) that is considered as a surrogate for hydraulic conductivity, was firstly obtained through field measurement and laboratory analysis in the Xin’anjiang watershed. Then the overall distribution of streambed sediment d50 in Xin’anjiang watershed was predicted through a statistical model (the SSN model). The results showed that the predicted d50 value versus the measured value presented a high goodness-of-fit, suggesting the high reliability of the SSN model. The median particle size across the entire watershed presents a broad range from 0.38 mm to 100.28 mm with an average value of about 39.74 mm, which indicates a very high hydraulic conductivity heterogeneity across the Xin’anjiang Watershed. Results also showed that the median particle size decreases from low-order stream to high-order stream following the effects of sediment deposition and sorting processes.