

Predicting flow resistance in mountain streams

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Abstract. We present a new empirical model for predicting Darcy-Weisbach friction factor (f) for a wide range of gravel bed stream types. Channel characteristics and measured friction factors were compiled from eight sources yielding a combined data set with 357 observations of f from 102 stream sites with friction slopes ≥ 0.002 . Multiple regression was used to develop new empirical predictive models, and these models were evaluated using a four-fold cross-validation procedure. For streams with a friction slope (S_f) of less than 0.04, the Darcy-Weisbach friction factor was best predicted by S_f and relative submergence (ratio of hydraulic radius to D_{84}), while relative submergence and the ratio of D_{84} to D_{50} were the best predictors for steeper streams. The overall adj. R^2 for these two equations was 0.71 and the mean percent error was 7%. Comparisons against existing empirical models (Hey 1979; Jarrett 1984; Bathurst 1985; Mussetter 1989; Bathurst 2002) indicate that the new model is substantially more accurate for streams with S_f values greater than 0.04.

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