Application of Hack's law to predict in channel features of ecological interest with coarse scale watershed variables

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Abstract. Hack developed a model that related channel slope to the ratio of median substrate size to contributing drainage area raised to some power that, since its introduction, has received relatively little attention in practical applications. Subsequent investigation has shown that Hack's relationship, which was developed for streams in Virginia and Maryland, applies to streams of the Eifel, Germany, southeast England, and the Yazoo and Yalobusha basins of Mississippi. These investigations include study sites from broad ranges of watershed scale, stream gradient and substrate size, suggesting that Hack's relationship is widely applicable across differing stream morphologies. One important implication of Hack's relationship is that it explains the interplay between slope and substrate size across different scales. Work in progress suggests that Hack's relationship can be used to explain differences in slope between streams of varying size that have similar channel morphology by scaling slope to some power of drainage area. The aim of this work is principally to determine: (1) whether watershed scale variables can be utilized to predict reach scale channel features of ecological interest, (2) if Hack's law can specifically be employed to predict a range of substrate sizes or a dominant channel morphology through the use of watershed scale variables, and (3) if the size (scale) of the watershed plays an important role in fluvial classification systems. Hack's law will be employed to develop a model to use contributing drainage area and slope to predict the reach scale morphology, which is the basis of the Montgomery and Buffington classification system, for sites in the Pacific Northwest. Remotely sensed data will be utilized to calculate a channel slope and contributing drainage area at each site. A discriminating factor will then be calculated by scaling slope at a stream site by some power of the contributing drainage area. This factor will then be used to predict the dominant channel morphology (i.e. cascade, step-pool, pool-riffle, etc.) by sorting each stream according to where this factor lies with respect to streams of known morphology. Other data for reaches of varying morphology will be used to develop ranges of values of this factor. The accuracy of these predictions will be tested by field inspection in the summer of 2002.