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Up-scaling river planform discriminators to include large river systems

S.Y. Krasnoshchekov, P.A. Carling

School of Geography, University of Southampton, Southampton, SO17 1BJ, UK
(syk@soton.ac.uk/+44 23 8059 3295

The most well known diagram that is used to separate different channel types is the *QS*-diagram which purports to separate channel types, notably braided from meandering, depending on slope (S) and discharge (Q). In all the different applications of this approach, data for braided channels consistently plot above meandering ones, and often a discriminatory line is drawn between the two existence fields. The physical meaning of *QS*-diagrams lies in the equation of stream power, that is braided channel have high power than meandering ones. In a general form the discriminatory equation can be written as$S = aQ^{-b}$, where S is slope, Q is discharge, a is an empirical coefficient, which depends on bed grain size and b is an exponent, previously considered as a constant.

Data obtained from a variety of small-scale laboratory studies have been used to populate *QS*-diagrams and these plots reveal important results. The main finding is that at this small-scale, channel slope is the prevalent control discriminating between meandering and braiding. The channel type present does not depend upon discharge magnitude or upon discharge fluctuations. In fact, from the laboratory studies the value of the exponent b is small (0.1-0.2) and this reflects the small influence of discharge on channel types.

However, when data are added to *QS*-diagrams from natural rivers the exponent increases as the scale of the system increases. This behaviour of the exponent has not been systematically evaluated previously. Rather, different authors have obtained different values for b. Other than inherent statistical variability, one explanation for the different values is that authors have used different parameters to quantify $Q$and S. For example, for the slope term – channel or valley slope, for discharge – mean annual,

bankfull or median flood discharges. However, an analysis of a large data set reveals that these slight differences in parameter selection are not germane to the problem. Rather the exponent depends on the values of discharge, in other words it is strongly dependent on the size of the river system. The discriminator for larger rivers systems is characterised by a larger negative exponent. This trend reflects changes in grain size and sediment load as systems get larger. The implication for explaining the change in river planform from meandering to braided, anabranch and anastomosed systems, especially for some of the largest river systems in the world. are discussed.