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Characterization of braided rivers in natural environment (Canterbury plain, New-Zealand) and numerical models

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Braiding is a striking instability of river dynamics, whose geometrical complexity is not rendered by the traditional morphological descriptor of rivers, such as slope or bankfull bed width. The organisation in bars and channels, scour and riffle zones, confluences and divergences, requires more complex descriptors to approach natural geometries and, we guess, some basic elements of the dynamics.

After a review of the braiding indicators, we propose a further analysis based on the distribution of channel characteristics. In particular we calculate the effective width of a braided river as the width of the single channel that would erode or transport sediment with the same efficiency as the actual river. This parameter is obviously model-dependant. We also calculate an effective number of channels by weighting each channel with the flow that it carries. This parameter is no more an integer but a real number often much smaller than the total number of channels. It aims at being a good descriptor of the flow partitioning.

This quantitative description has been applied on some spectacular braided rivers of the Canterbury plains (New-Zealand) thanks to high-resolution imagery analysis. The planform evolution reveals a variability of both the efficient width and channel number

along river. Part of the variations is due to local external forcings (lithology, tectonic variations . . .); part reveals the self-organizing braiding instability.

Finally we compare measures made on these natural rivers with numerical simulations performed with the code Eros developed in Rennes. Eros is a cellular-automaton program, which incorporates some basic ingredients of erosion and sediment transport (non-linear erosion, out-of-equilibrium deposition, lateral erosion ...). The model successfully reproduces both wide straight channels and braided patterns. It allows us to link the geometrical characteristics of river forms described by the indexes cited above with the underlying physical processes (as long as they are described in the numerical model).