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Reduced-complexity flow routing models for sinuous single-thread channels

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Reduced-complexity models of fluvial processes use simple rules that neglect much of the underlying governing physics. This approach is justified by the potential to use these models to investigate long-term and/or fundamental river behaviour. However, little attention has been given to the validity or realism of reduced-complexity process parameterizations, despite the fact that the assumptions inherent in these approaches may limit the potential for elucidating the behaviour of natural rivers. This study presents two new reduced-complexity flow routing schemes developed specifically for application in single-thread rivers. Output from both schemes is compared with that from a more sophisticated model that solves the depth-averaged shallow water form of the Navier-Stokes equations. This comparison provides the first demonstration of the potential for deriving realistic predictions of in-channel flow depth, unit discharge, energy slope and unit stream power using simple flow routing schemes. It also highlights the inadequacy of modelling unit stream power, shear stress or sediment transport capacity as a function of local bed slope, as has been common in previous reduced-complexity models.