Geophysical Research Abstracts,
Vol. 11, EGU2009-6109, 2009
EGU General Assembly 2009

The effects of secondary flow and transverse bed slope on meander evolution

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This study numerically investigates the effects of secondary flow and transverse bed slope on the evolution of meandering channels. Meander evolution processes can be simulated by two-dimensional, depth-averaged, steady-flow, Reynolds-averaged Navier-Stocks equations in channel-fitted, curvilinear, orthogonal coordinates. Assuming the ratios of flow depth and channel width to the radius of channel curvature are small and neglecting the second-order terms, the first-order solution of streamwise velocity is obtained. Among the parameters in the solution, A is the scour factor, which characterizes the transverse bed slope; and As represents the momentum redistribution effect exerted by the secondary current. Meanwhile, the author put forward the basal erosion and retreat model (BERM) which includes the secondary-flow term. The meander model used herein integrates BERM with the hydrodynamic solution. Numerical experiments indicate that the influence secondary flow is only noticeable in highly-sinuous channels, while transverse bed slope affects the timing, magnitude, and direction of channel migration. Sensitivity analysis of the scour factor A indicates that the parabolic distribution of A yields the best fit for measuring data.