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Bed Shear Stress under Complex Flow Conditions - The Case of Megech River, Ethiopia

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Bed shear stress is a fundamental variable in river studies to link flow conditions to sediment transport. It is, however, difficult to estimate this variable accurately, particularly in complex flow conditions. This study compares shear stress estimated from the log profile, the depth-slope product and outputs from a two-dimensional hydraulic model. Vertical velocity profile observations from Megech River (one of the main rivers flowing into Lake Tana, upper Blue Nile Basin, Ethiopia) using SEBA Mini current meter M1attached with signal counter Z6-SEBA HAD under typical field conditions are used to evaluate the precision of different methods for estimating local boundary shear stress from velocity measurements. Results show that the velocity profile approach gives consistently lesser shear stress estimates. A comparison of the shear stress distributions derived using the two-dimensional hydraulic model and those estimated using the 1D reach-averaged equation (i.e. the depth-slope product) shows a close correspondence. Mean shear stresses determined using local depth and mean channel slope are only 14% greater than those values determined for the same data using local predictions of both depth and energy slope. As the overall mean shear stress provides a useful index of flow strength, this comparison suggests a good level of confidence in using the reach averaged one-dimensional equation, for which data can easily be collected from cross sectional surveys. However, the variance of the modelled shear stress distribution shows some differences by a factor of 3 to that calculated using the mean channel slope because of the larger uncertainity associated with point depth measurements. Although such models using 1D reach averaged equations are limited to different channel characteristics adhering to diverse model assumptions, they can still provide a useful tool for river-rehabilitation design and assessment, including sediment transport studies.