Discontinuity of Stage-Discharge Rating Curves Due to Dunes.

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Abstract. Many investigators have observed that in mobile sand bed streams, there is a range of flows over which two subcritical depths of flow are possible. This phenomenon is typically attributed to a hysteresis effect in which the discharge is changing more rapidly than the bed forms can adjust to the new discharge. This theory is supported by the fact that higher depths of flow are typically observed on the ascending limb of the hydrograph, while shallower depths tend to occur on the descending limb of the hydrograph. The magnitude of the discontinuity would then primarily be a function of the time rate of change in the discharge, and would not have to be a unique value. An alternative hypothesis, presented by the writers, demonstrates that in mobile sand bed channels where bed forms occur, two depths of flow are numerically and physically possible. Data collected by other researchers were used to develop a bed form friction factor predictor for narrow flumes and wide sand bed channels with appropriate corrections for side roughness. The friction factor predictor is used in conjunction with Einstein-s method for the separation of wall roughness from bed roughness to predict the depth of flow for a given discharge. It is demonstrated that, under some hydraulic conditions, there are two numerical solutions to the system of equations used to predict the depth of flow. Both of the solutions appear to be physically possible. The two depths of flow are referred to as sequential depths. Application of the method to field data collected by Colby shows that the magnitudes of the sequential depths are approximately equal to the two depths observed by Colby.