Empirical Model of Bedform Migration – Preliminary Results

M. Lin, J.G. Venditti,
Dept. of Geography, Simon Fraser University, Burnaby, BC, Canada V5A 1S6

Bedform migration rate (R) is important for estimating sediment transport in rivers. Migration rate is difficult to estimate because empirical relations between R and various flow parameters (e.g. mean velocity, Froude number, velocity head) are not well defined. In addition, the relations between various measures of the transport stage and migration rates have not been extensively explored. Transport stages (i.e. bedload, suspended load and mixed) control bedform geometry (height, length, aspect ratio), which directly influences migration rate. Therefore, an empirical relation may exist between migration rate and transport stage. Here, we examine several existing field and flume datasets that contain information on migration rate and other flow sediment parameters, which can be used to calculate the Shields number ($\tau^*$), which we use as a measure of the transport stage. The data are stratified into dunes and ripples, according to the original authors’ classification. All data sets show positive correlations between R and $\tau^*$. The slopes of the relation vary considerably between ripples and dunes and for different data sets. Generally, ripple migration rate varies more than dune migration rates at the same transport stage; on the other hand, dune migration rate displays higher correlation with $\tau^*$. The dune migration data were further stratified by two measures of the relative roughness: the ratio of flow depth $d$ to dune height $h$ ($d/h$) and the ratio of flow depth $d$ to median grain size $D$ ($d/D$). There was no improvement in the relation between R and $\tau^*$ when data are stratified by $d/h$. However, when the dune data are stratified by $d/D$, the relation between R and $\tau^*$ is linear and the slopes of the relation for each category of $d/D$ have similar values. The analysis highlights the important role transport stage and grain-size play in bedform kinematics and suggests empirical relations between R and $\tau^*$ can be derived. A series of flume experiments are currently underway to further explore the relation between bedload-dominated, suspended-load-dominated and mixed transport stages and bedform kinematics.