THE ISSUE: Braided rivers are dynamic systems with a continually-shifting network of channels responding to water and sediment supply. Our understanding of how these channels will evolve over decades to centuries, and how they will respond to alterations in water or sediment supply resulting from climate or land use change, remains unclear, and current computational models are inadequate for answering these questions.

BACKGROUND: Given the sensitivity of braided rivers to floods, which may completely rearrange channel form in a matter of hours to days, it’s reasonable to wonder what effect human factors (such as climate change and land use), which can alter flood size and frequency and/or the amount of sediment delivered to these streams, might have on the form of these streams and their associated habitat. In cases like this, we can turn to field work to document the effect of numerous floods and infer the different mechanisms by which they alter channel form. But given that flood/sediment influencing factors, such as climate change, might take decades to centuries to manifest, it would take many years of field work to understand these mechanisms of change.

In such instances, we can turn to modeling as a tool with which to predict the form of braided rivers in response to shifting water and sediment inputs. Unfortunately such long-term predictions (10’s-100’s of years) that document channel change can be taxing on even powerful computers, given the sensitivity of braided rivers to floods, which may completely rearrange channel form in a matter of hours to days, it’s reasonable to wonder what effect human factors (such as climate change and land use), which can alter flood size and frequency and/or the amount of sediment delivered to these streams, might have on the form of these streams and their associated habitat. In cases like this, we can turn to field work to document the effect of numerous floods and infer the different mechanisms by which they alter channel form. But given that flood/sediment influencing factors, such as climate change, might take decades to centuries to manifest, it would take many years of field work to understand these mechanisms of change.

Our model allows for the exploration of bar-scale morphodynamics over decadal and centennial timescales, which were impossible using previous morphodynamic models.

EXAMPLE APPLICATION & VERIFICATION: Figure 2 shows an early version of the morphodynamic model on the River Feshie, a braided stream in the Scottish Highlands for which repeat topographic surveys have been completed (2000-2007 and 2013). Our initial modeling efforts highlight the ability of the algorithm to reproduce process zones, such as confluence pool scour and subsequent local deposition, along with scour of the outside of channel bends. They emphasize the need for discrete inclusion of certain processes, particularly bank erosion. Ongoing research includes validation of hydraulic modeling components, development of a bank erosion algorithm, and exploration of process representation with regard to mechanisms which promote braiding.

TAKE AWAY: • Our model allows for the exploration of bar-scale morphodynamics over decadal and centennial timescales, which were impossible using previous morphodynamic models.
  • The model agrees well with field data but requires additional development with regard to particular braiding mechanisms.
  • The model will be used to explore channel change under scenarios of altered sediment and water delivery.