Braided River Simulation with Swarm

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Braided rivers are high-energy, multi-channel rivers that carry very high loads of sediments with particle sizes ranging from sand particles to large boulders and very common in the New Zealand landscape. The riverbeds are typically quite wide and the river itself meanders over limited portions of the bed for the majority of time. Water flows shift the riverbed sediments with particle sizes and distances coupled to the magnitude of the flows. At higher flows, river flows shape the bed, but at lower flows, flow direction is affected by the sediments; there is a subtle feedback between the two. Spatial and temporal power law scaling have been identified in several aspects of braided river dynamics, including rates of channel evolution, number of islands, and number of channels. Capturing these factors in traditional river modelling is difficult; agent-based modelling offers a wider range of possibilities for simulating braided river dynamics, especially given abilities to model hierarchical systems and asynchronous potential.

This work treats braided rivers as self-organising complex systems driven by feedback between river flows and sediments. Swarm is used as a platform for exploring some basic thermodynamic hypotheses on the observed patterns and a prototype model has been developed. This will be demonstrated and future directions elaborated on. These include the use of multi-scale river beds (i.e. a model with an explicit hierarchy of spatial and temporal scales) and incorporating different flow velocities in the model.