The dynamic cellular automata landscape evolution modelling platform CDP

Barkwith, A., Wang, L., Jackson, C.R., Hurst, M., and Ellis, M.

The CAESAR-DESC Platform (CDP) acts as a base for high-resolution modelling of environmental sensitivity over daily to centennial timescales. The Dynamic Environmental Sensitivity to Change (DESC) project couples cellular automata modelling from various backgrounds to generate the CDP; a geomorphological simulator that allows a variety of Earth system interactions can be explored. A derived version of the well established CAESAR model, CAESAR-Lisflood, is used as the platform kernel. The two dimensional modular design allows great versatility in the range of simulated spatio-temporal scales to which it can be applied. CAESAR has been used to investigate a variety of sediment transport, erosional and depositional processes under differing climatic and land-use scenarios in river reaches and catchments around the world. The recent addition of Lisflood to the code has improved river flow representation within the model by incorporating momentum. Non-Lisflood controlled surface hydrology is replaced with a new distributed model (SLiM), and an unconfined cellular automaton groundwater model. Surface-subsurface water exchanges within the CDP are coupled by recharge to groundwater and groundwater discharge to rivers. To deal with the complex energy and sediment fluxes that occur during a debris flow a modified version of the SCIDDICA model, originally developed to simulate flow-like landslides, has been incorporated into the CDP. As the surface hydrology drives the processes within the platform, CDP facilitates the analysis of climate change influences on a range of environmental processes. The dynamic application of climate factors also opens up the possibility of including a decadal-scale evolving vegetation within the model, which could be used to improve both the partitioning of water between the surface processes and the adhesion properties of vegetation-covered sediment with time.