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3D Stratigraphic and geomorphic modelling from source to sink

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Tellus is a 3-D parallel geomorphic and stratigraphic modelling framework capable of deriving surface processes and their impacts with the geosphere. Tellus framework is written in an object oriented style and is based on a two-level parallelisation method, one which handles the unstructured grid partitioning and the other the flow computation. This code is designed to model landscape evolution and stratigraphic reconstruction at multiple space and time scales. The physics for surface processes is primarily based on shallow-water equations solved within a Lagrangian formulation using a particle-in-cell approach. This method has the advantage of allowing the flow to follow the surface topography in a very natural way. Flow velocity and sediment load are represented at points that move with the fluid. Based on several assumptions on flow motion as well as erosion-deposition rules, Tellus is able to simulate a variety of gravity flows such as rivers, debris flows and turbidity currents. In addition, vertical displacement fields, sea level variations and rainfall pattern evolution can be imposed in order to simulate stratigraphy evolution, and also assess the impact of these forcing parameters on sedimentary architecture and space and time heterogeneities. Thus it makes the framework a powerful tool for investigating high-resolution landscape and stratigraphy evolution under various types of scenarios. We demonstrate the use of this framework with a generic example of Source to Sink experiment. Concurrent of tectonic and climatic forces are imposed over a given elevation model and we investigate the evolution of landform and flow pathways, as well as the construction of sedimentary structures (facies distribution, deposit thickness and lateral heterogeneities, porosity variation) over the modelled domain.