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Simulation of fan topography and soil profile using a coupled soilscape-landscape evolution model

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In this study the evolution of a fluvial fan, its topography and soil profile grading under erosion and deposition and soil profile weathering was simulated using SSPAM coupled soil-landscape evolution model. A constant rainfall was simulated on a synthetic landform and a fluvial fan depositional structure was allowed to form at the latter part of the landform. At each time step the geomorphological and particle size distribution information of the fan was recorded. Using this recorded information, the evolutionary characteristics of the fan as well as the surface and subsurface sediment characteristics was examined and compared with experimental and field observation data. Different fan profile sections were also derived from the recorded data and analysed. The simulation produced a fluvial fan semicircular in shape, with concave up long profiles and convex up cross profiles. The surface sediment sizes of the simulated fan were coarsest near the fan apex and fines toward the fan toe with coarse grained sediment filaments extending radially from the fan apex. These geomorphological features and surface sediment distribution agrees well with field observations of natural fans. The results of the simulation also show that the fan develops as a result of the channel bringing sediments in to the fan and periodically changing its path due to steepening of channel gradient by sediment deposition. The position of the channel is fixed at the fan apex and the channel path constantly changes along any radial direction form the fan apex. This process is remarkably similar to the process of “Fan head trenching” described in literature which is the dominant process in fluvial fan development in the field. Finally, the analysis of fan cross-sections revealed complex sediment layering patterns in the fan profile. The simulation results of the SSSPAM coupled soilscape-landscape evolution model provide qualitatively correct geomorphological and sedimentary characterization of the fluvial fan development process.