A CELLULAR AUTOMATA EMPIRICAL METHOD FOR THE SIMULATION OF ACENTRIC COMPLEX GEOLOGICAL PHENOMENA

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Cellular Automata (CA), a Parallel Computing paradigm, sometime represent a valid alternative to differential equations methods in modeling complex phenomena, whose behavior can be described in terms of local interactions of their constituent parts (acentrism). They are based on a regular division of space in cells, each one embedding an identical finite automata (fa), whose input is given by the states of neighboring cells; fa have an identical transition function, which is simultaneously applied to each cell. At the time t=0, fa are in arbitrary states and the CA evolves changing the state of all the fa simultaneously at discrete times.We developed an empirical method for modeling macroscopic phenomena: a) each characteristic, relevant to the evolution of the system and relative to the space portion corresponding to the cell, is individuated as a substate; b) the values associated to such substates can vary depending on interactions among substates inside the cell (internal transformations) and local interactions among cells; c) the local interactions are treated in terms of flows towards the neighbors in order to reach equilibrium conditions according to a relaxation rate.This method was applied to the simulation of some types of lava flows, debris/mud flows, types of soil erosion by rainfall with good results in comparison with real cases.Applications of the validated models concern a) the prediction of the evolution of a real event; b) the possibility to consider different scenarios in order to create microzonal maps of risk; c) the verification of human interventions, modifying the initial conditions of the system.