SOIL Discuss., 1, C22–C23, 2014
www.soil-discuss.net/1/C22/2014/

Interactive comment on "Coupled cellular automata for frozen soil processes" *by* R. M. Nagare et al.

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Received and published: 1 July 2014

The paper presents an interesting approach to simulation complex processes using the principles of cellular automata (CA). The approach is based on the model which is an extension of classical von-Neumann CA, which differs from a classical CA not only because it is composed of several CA, but also due to using a set of real numbers as a cell state alphabet, each number characterizing temperature(T), water content (theta), thermal conductivity (C)of the corresponding cell. Moreover, updating rules are not simple. They require complicated computation based on physical relations. The obtained results show, that the idea is successful. This fact manifests the simulating power of CA principle, consusting of direct iterative updating global CA state, by computing as transition functions of neighboring cells states in all cells. Meanwhile, from methodological point of view, the mathematical description of a CA model is presented

rather poorly. Indeed, only global CA behavior is given formally, while cell updating rules are embedded into the flow-chart (Fig.2) Although, there is a commonly used way of CA presentation in the form of set of notions : Alphabet, Cellular space, transition rule. To describe a collection of CA, operating in common, composition techniques are used [Hoekstra, A. G., Kroc J., and Sloot P. M. A., 2010, Chapter 5]. Of course, authors have the right to chose formalism to be used in their paper. But, I think, it would be better to have a unified formalisms for CA simulation theory and methodology. 1. The agreement between the analytical solutions and CA simulations in all cases is wonderful. 2. Computation of functions in simulation thermal conduction and hydraulic conduction are independent and may be implemented in parallel yielding in decrease of computation time. But are these processes independent in real physics? 3.The assumption that the soil is homogenous enough to consider its properties in bulk is very strong. Real soil pores are different in size and in form, if there are caverns and hygrophilous inclusions. It would be good if the model may be modified to simulate water movement inside the pores. 4.What about 2D case and 3D case, which should be needed in case of anisotropy? My remarks are not intended for correcting the paper text. The text is good and self contained. The remarks are for thinking about future work.

Interactive comment on SOIL Discuss., 1, 119, 2014.