



Contribution ID: 721

Type: Oral Presentation

## On Fuzzy-Systems Modeling of Subsurface Flow

*Monday, 31 May 2021 20:35 (15 minutes)*

Data sets collected from field or laboratory experiments for the determination of unsaturated hydraulic parameters—water retention curves and unsaturated hydraulic conductivity—are often uncertain, imprecise, incomplete or vague because of a vague delineation of subsurface heterogeneities and preferential flow zones. The other source of uncertainty is inconsistency between the real physical processes and the physics of the field and laboratory measurements. The use of soil physical and hydraulic parameters, which are commonly expressed using crisp relations, often leads to significant uncertainties in predictions.

One of the modern approaches to deal with uncertain data is the use of the fuzzy systems modeling. Fuzzy systems modeling, based on the application of the possibility theory, is a tool to evaluate the uncertainty of predictions of complex systems, given the uncertainty of input parameters. Possibility theory is concerned with event ambiguity, that is the extent to which some event occurs, given incomplete information expressed in terms of fuzzy propositions or fuzzy numbers.

The goal of this presentation is to present an approach to the prediction and uncertainty evaluation of hydrogeological systems based on a combination of the statistical and fuzzy-system modeling analyses. In particular, a rationale for representing heterogeneous soil and fractured rock systems as a fuzzy system will be presented. Fuzzy C-means clustering is applied to partition the 11 soil types of the UNSODA database into a series of overlapping clusters based on the fuzzy degree of membership. Fuzzy relations of the van Genuchten and Brooks-Corey unsaturated hydraulic parameters are derived, and these fuzzy relations are then applied for the fuzzy-systems time series predictions of the infiltration flux. Predictions are based on a fuzzy-form of Darcy's equation for unsaturated-saturated subsurface media. Fuzzy modeling techniques are well suited to utilize the imprecise input information for the uncertainty evaluation of predictions, risk assessment, and management of soil and hydrological systems.

### Time Block Preference

Time Block C (18:00-21:00 CET)

### References

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**Primary authors:** Dr FAYBISHENKO, Boris (Lawrence Berkeley National Laboratory); Dr RAMAKRISHNAN, Lavanya (Lawrence Berkeley National Laboratory); Dr AGARWAL, Deborah (Lawrence Berkeley National Laboratory)

**Presenter:** Dr FAYBISHENKO, Boris (Lawrence Berkeley National Laboratory)

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