Establishment of Soil Preferential Flow Model Based on Modern Observation Technology

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Abstract: Preferential flow is a term used for soil water movement in recent years. This is a sign to study the mechanism of soil water movement from uniform and uneven field. In the case of soil heterogeneity, referring to the composite effect of water and solute, the phenomenon of unsteady infiltration occurs along a specific path. Preferential flow is one of the main causes of geological disasters such as farmland rainfall landslide, mud flow, groundwater pollution and nutrient loss. Therefore, it is very important to study the priority process in detail. Starting from the definition of priority process, this paper mainly reviews the development of mathematical model of priority process and the technical methods and methods of research priority process. Finally, the paper summarizes the research and development trend of priority process.

1. Introduction

Since the middle of the century, global warming has become more and more serious. The frequency of secondary disasters caused by extreme weather processes such as rainstorm and abnormal high temperature is increasing[1]. The rainstorm area is related to the formation of regional and large-scale slope disasters such as landslides and debris flows in the vast valley area. About this phenomenon, the general research thought is "the landslide caused by rainfall", this is a conventional saying. From the point of view of slope hydrology and hydrogeology, rainfall does not induce vegetation growth and slope instability. Its own ground water changes due to rainfall. From the point of view of time series, rainfall and landslides are caused by rainfall, part of which runs through vegetation.

2. Concept of Priority Flow

Preferential flow is a concept of soil hydrology. Because of the heterogeneity of soil, it is a more general form of soil water movement[2]. At present, there is no unified concept of priority process. Many scientists view their research results from different perspectives. Different understanding of the priority process is proposed. In response to the phenomenon of soil rapid movement in 1982, Beven and Germann expanded the preferential flow, and proposed that the preferential flow was the phenomenon that the water around the soil matrix moved down rapidly through the atmospheric pores. Limited to the conditions and understanding at that time, this condition takes precedence over the narrow process[3]. Hendrickx and fury mentioned the preferential flow of non-uniform flow. The non-equilibrium flow is a phenomenon that water and solute move along some specific paths, bypass some porous media and penetrate downward. In this paper, different methods of quantification for other preferential flows in suzanu are reviewed, and it is proposed that the preferential flow is the passage of water (together with dissolved and suspended substances) in a full pore network[4]. This prospect provides insight into the priority process from the perspective of spatial network scale comparison. In general, various viewpoints are the unsteady infiltration along a specific path under the combined action of many external factors, which is a typical feature, namely, the heterogeneity of soil. Therefore, the movement of water in the unsaturated zone is not a simple one-dimensional vertical downflow, but across most of the soil volume, through the priority

path flow, its wet front far ahead of the flow forward. According to the results predicted by Richards equation in low velocity laminar flow, that is to say, the study of preferential flow in soil is more complex than that of steady flow in low velocity.

Table 1 Physical property parameters of soil in the test area

Soil type	Depth	Soil texture		
		>50 µm	2~50 µm	<2 µm
Loam	0~10	29.4	49.2	21.4
	>10~20	28.2	49.4	22.4
	>20~50	31.3	46.2	22.5
	>50~100	32.1	44.8	23.1

3. Research on Priority Flow

Because of the non-uniformity of soil and the existence of large holes like worm holes in dry cracks, plant roots and soil, the preferential flow of soil has its own flow patterns. Based on the analysis and summary of the research results of other scholars, this paper puts forward that the research mainly includes air hole flow, surrounding flow, pipe flow, fingerprint flow, funnel flow, slot flow, short-circuit flow and partial displacement flow[5]. Underground strong outflow, unsaturated gravitational flow, uneven flow, leakage flow and low level supplement. According to the comments on different research methods of preferential flow, it is pointed out that preferential flow can be divided into crazing flow, cave flow, fingerprint flow, lateral flow and macroflow. In the current research, the priority flow mainly focuses on three kinds of non-equilibrium seepage flow, namely gap flow and funnel flow.

4. Influencing Factors of Preferential Flow

There are many factors that affect the formation of preferential flow, such as soil structure and texture, initial and boundary conditions of human infiltration, and unsteady (nonlinear) flow movement, which can lead to the emergence of preferential flow and affect the development of preferential flow.

4.1. Soil Texture and Structure

The movement of soil animal and plant roots forms the huge gap of soil, and the main reasons of soil shrinkage and cracking are the important path of soil preferential flow[6]. Therefore, the opening degree, curvature degree and connection degree of macropores have an important influence on the formation and development of soil preferential flow. The movement of soil water in large gap L is nonlinear and has a velocity Hal much higher than that of matrix flow[7]. Therefore, when seepage carries pollutants, it will cause more serious groundwater pollution. Macrobolas structure plays an important role in the formation and development of preferential flow in soil. Macropolo city acts as a capillary to shield the flow of water acting on the flowing soil. Water and solute move along the macropolo water path and cannot enter the soil matrix. Matrix flow and preferential flow play a role of separation, restricting the flow of soil water in the stable matrix, and making large pores form high-speed unstable flow. Soil texture affects the generation and development of priority processes. In sandy soil, the soil water resistance will affect the preferential flow[8]. The waterproof soil is not easy to be soaked by water, and is connected with the formation of the priority channel. Water and solute move the unsaturated zone through the main channel. Other studies have shown that large pore flows usually occur in Sirte and clay soils; unsaturated, gravity and fingered flows are more frequent than in sand or beautiful splashing pen soils, and generally, radon in funnel flow distribution stations, more than one coarse inclined surface and scattered soil image are easier in soils.

4.2. Initial and Boundary Conditions of Infiltration

The initial soil water component mainly affects the depth of soil water penetration and the heterogeneity of preferential flow. Philip et al. 151 painted bright blue spots on the early "wet" and "dry" soils. Another is when bright blue moves deeper in wet soil. Merdun et al. Indicated that when the initial soil water content was low, the heterogeneity of preferential flow was high, and the preferential movement effect was more significant[9]. Weak J of derooijt $1L Sheng Feng et al. When the initial soil moisture content is very low, the effect of initial soil moisture content on preferential flow is obvious. When the irrigation speed and rainfall intensity exceed the infiltration speed of soil water, preferential flow occurs[10]. The larger the precipitation is, the rapid movement of chemicals occurs. However, the influence of boundary conditions on the flow of preferential conditions is also contradictory. For example, Ghodrati and Jury conducted two experiments in order to study the generation of preferential flow under farm conditions, namely, the study of 5cm's capillary sandy soil in the head of 10cm high water penetration and spray irrigation. Under the condition, the penetration depth of the material is shallower than that under the condition of sprinkler irrigation. It indicates that the solute movement speed under sprinkler irrigation is faster than that under the set water condition. In Sheng et al. Tracker experiment, the nonuniformity of selective flow changes regularly with the increase of human infiltration. Stop the development trend. Generally speaking, when the flow is relatively uniform and the amount of permeated water is high, the horizontal and vertical directions of horizontal uneven flow are fully developed, and the number of flow paths also increases the degree of uneven flow, which means that the full penetration of human beings increases, the diffusion and connection of the priority flow paths in the horizontal direction, and the overall trend becomes even again.

5. First Flow Model Theory

5.1. Continuity Model Theory

The continuous model theory and homogeneous medium hypothesis based on experimental scale are the main theoretical methods to describe soil water movement and solute transport. In the continuous model theory, soil hydrodynamics parameters are important data that affect and control the movement and transportation of water and solute. In order to simulate the movement and transfer of water and solute under the condition of spatial variation, many researches are based on the analysis of spatial variation of hydrodynamic parameters. The continuous formula is used to simulate the non-uniformity and non-uniformity of the movement and distribution of the water and solute determinacy 1671. In recent years, the rate rate rate simulation method has been used to simulate the flow in the heterogeneous medium, which directly considers the natural anisotropy. The important step in the application of Monte Carlo method is to determine the moving parameters of units and the statistics of soil properties in the study, that is, the examples of average, dispersion and spatial changing structures. After the structural parameters are determined, the movement of simulated soil and water into solute and the statistical characteristics of tidal current are analyzed. In order to use the numerical parameters as the input parameter distribution, the conditional or unconditional method for the generation of random distribution field in hydrodynamics is used. According to the spatial variability and scale characteristics of soil hydrodynamics parameters, a lot of experimental research and theoretical analysis have been carried out. However, it is very difficult to measure the parameters of soil hydrodynamics in the field conditions, which is expensive and time-consuming. It is more difficult to measure the parameters of soil hydrodynamics in large-scale conditions.

5.2. Discrete Model Theory

In recent years, discrete models have been gradually used to describe the uneven flow from the point of view of the difficulties of continuous model foundation and practicality. Different from the continuous model, the discontinuous model treats the water body in the soil as a kind of "particle" structure with some information. These "particle" structure types have complex spatial distribution

through simple motion rules. Statistically, there were distribution patterns and non-uniform movement patterns of soil water flow in 1791. Both the diffusion limited rate condensation model and the permeation model belong to this method.

6. Conclusion

Preferential flow is a general and important form of water transport. Macroporous flow and fingerprint flow are two priority flow patterns recently studied. Other priority flow models have attracted more and more attention due to various hydrological and environmental geological problems. There are many factors that affect the formation of selection flow. The structure and texture of soil, the initial and boundary conditions of infiltration, and the instability (non-linear) of water flow lead to the generation of preferential flow and affect the development of preferential flow. In order to correctly simulate and predict the temporal and spatial characteristics of soil preferential flow, researchers at home and abroad have proposed a variety of model theories and experimental methods. Among them, continuous model theory, discrete model theory and fractal model theory are the most commonly used priority flow model theory. Methods: Dye drawing technology, light ion color tracking technology, micro emotion measurement technology, audio technology, detection technology, non-invasive image acquisition technology of permeability curve, underground radar detection technology, resistance technology and other common flow observation technology. In recent years, many researchers at home and abroad have carried out researches on soil preferential flow, but so far there is no unified definition and recognition standard. Due to the formation and influence factors of preferential flow, the discovery of preferential flow, the rapid non-equilibrium characteristics of preferential flow, and the highly uneven characteristics of soil, the current model theory and observation technology for the study of preferential flow are not perfect. Therefore, to establish the unified standard of soil preferential flow, to improve the appropriateness of preferential flow model theory, and to develop special observation technology and devices for preferential flow are the main directions and major issues to be solved urgently.

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