Three-D simulations of burrow systems made by earthworm communities and study of some physical consequences

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Abstract:

In the past decade, X-ray tomography was successfully adopted as a mean to study earthworm burrow systems under natural or artificial conditions. However this method has some limitations such the size of the soil core, the existence of a border effect, and cost. Recently a new apparatus, called the “Colonne Gamma”, was developed that enabled to study the trajectory of radio-labelled earthworm belonging to different species in soil cores. The accurate knowledge of (i) the burrowing behaviour of earthworm and (ii) the 3D characteristics of the burrow systems gave the necessary information to develop a simulator. The input parameters are: (i) the earthworm community (and principally the ratio anecic/endogeic), (ii) the interaction between earthworms (avoidance or not) and (iii) the rate of burrow refilling. Hundred simulations were made for each parameter set and several output parameters were computed such as (i) volume and area of burrows connected to the surface and (ii) the verticality of the burrow systems. The first set of parameters was used in another model to simulate water flow through the burrow systems. Interestingly, we observed that increasing interactions between earthworms increased the verticality of the burrow systems. Regarding water flow, we observed that the key parameters were unsurprisingly the proportion of anecic earthworm and the intensity of the burrow refilling. These examples illustrate the potential use of our simulator to study the effect of behavioural parameters on the resulting burrow systems.

(poster)