Geophysical Research Abstracts
Vol. 16, EGU2014-8170, 2014
EGU General Assembly 2014

The Mechanics and Energetics of Soil Bioturbation by Plant Roots and Earthworms - Plastic Deformation Considerations

Siul Ruiz, Dani Or, and Stanislaus Schymanski
Eidgenössische Technische Hochschule Zürich(siul.ruiz@usys.ethz.ch)

Soil structure plays a critical factor in the agricultural, hydrological and ecological functions of soils. These services are adversely impacted by soil compaction, a damage that could last for many years until functional structure is restored. An important class of soil structural restoration processes are related to biomechanical activity associated with burrowing of earthworms and root proliferation in impacted soil volumes. We study details of the mechanical processes and energetics associated with quantifying the rates and mechanical energy required for soil structural restoration. We first consider plastic cavity expansion to describe earthworm and plant root radial expansion under various conditions. We then use cone penetration models as analogues to wedging induced by root tip growth and worm locomotion. The associated mechanical stresses and strains determine the mechanical energy associated with bioturbation for different hydration conditions and root/earthworm geometries. Results illustrate a reduction in strain energy with increasing water content and trade-offs between pressure and energy investment for various root and earthworm geometries. The study provides the basic building blocks for estimating rates of soil structural alteration, the associated energetic requirements (soil carbon, plant assimilates) needed to sustain structure regeneration by earthworms and roots, and highlights potential mechanical cut-offs for such activities.