



The 5th International Colloquium  
on Unsaturated Soils

EPFL

Topic: Unsaturated soils and arid areas

## PLENARY CONFERENCE

### Pr. LYESSE LALOU



PROFESSOR, SWISS FEDERAL INSTITUTE OF TECHNOLOGY, EPFL  
FULL MEMBER, SWISS ACADEMY OF ENGINEERING SCIENCES  
EDITOR IN CHIEF, GEOMECHANICS FOR ENERGY AND THE ENVIRONMENT  
EUROPEAN VICE PRESIDENT, ISSMGE

[lyesse.laloui@epfl.ch](mailto:lyesse.laloui@epfl.ch)

- h-index of 48 (Scopus)
- 13 written and edited books
- Over 350 peer reviewed papers.

# FUNDAMENTALS OF SOIL DRYING

#### ABSTRACT

Soil drying and subsequent cracking is a critical issue in geoenvironmental engineering that is becoming increasingly important nowadays with the global warming. In fact, cracking increases the permeability of the soil and affects its strength, thus hindering the overall stability of the relevant structure in many applications such as clay liners, natural slopes, embankments, and engineered barriers for nuclear waste disposal. To prevent or assess damage caused by soil drying, the processes involved and the physical laws behind it must be discovered. The objective of this presentation is to reveal these processes through experimental and numerical investigations for fine-grained soil drying at the micro, meso and macro scales and to improve our understanding of the hydro-mechanical behaviour of unsaturated soils. The results of desiccation tests showed that macroscopic cracking is possible in the presence of boundary constraints and/or a moisture gradient inducing tensile stress accumulation. Based on triaxial tensile tests, a new tensile failure criterion has been proposed, which can predict the onset of cracks. Discrete element models of soil drying were then used to simulate the propagation of cracks and the related challenges. Finally, mesoscale experiments with the drying of model clusters of smooth glass grains revealed new features of air entry mechanisms which explain the stress concentration inducing cracking.