



Passive acoustic emission in soils: a new way to apprehend soil structure and monitor its dynamics?

Marine Lacoste, Siul Ruiz, Dani Or

► To cite this version:

Marine Lacoste, Siul Ruiz, Dani Or. Passive acoustic emission in soils: a new way to apprehend soil structure and monitor its dynamics?. 5. AgreenSkills Annual Meeting, Jun 2018, Edinburgh, United Kingdom. , 2018. hal-02788525

HAL Id: hal-02788525

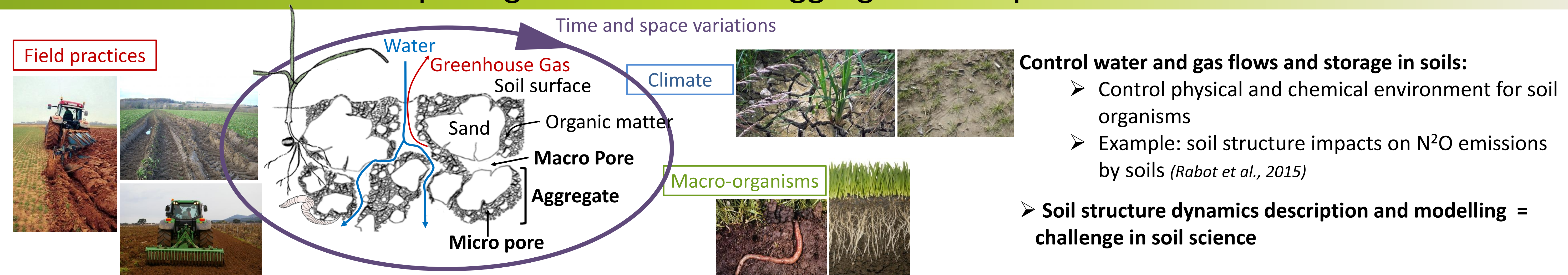
<https://hal.inrae.fr/hal-02788525>

Submitted on 5 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

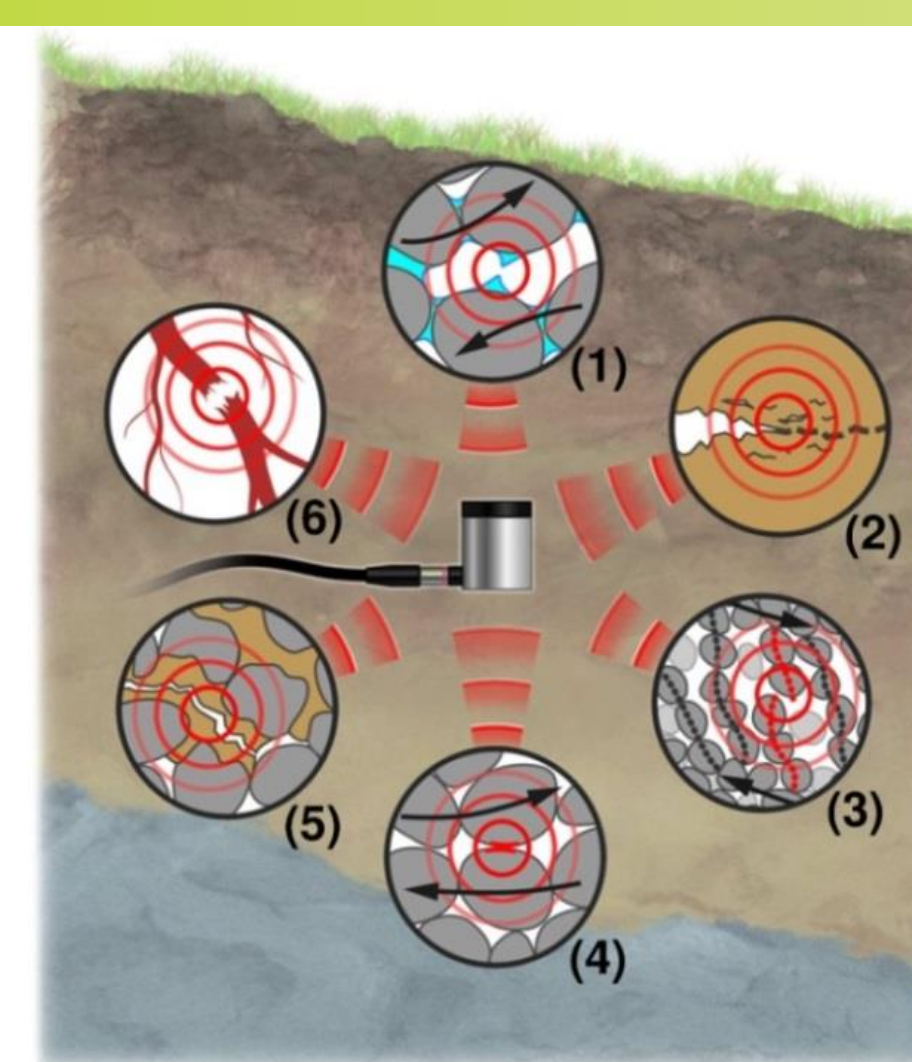
1. Soil structure: macroscopic organisation of soil aggregates and pores (Dexter, 1988)



Which tools to monitor soil structure dynamics?

2. Acoustic Emissions (EA)

- Characteristics of measured AE:**
 - Passive AE: signal spontaneously produced by the material
 - *In-situ* and dynamic monitoring
 - Method sensible to movements (physical and biological)
- Applications:**
 - AE used in civil engineering to study damages occurrence in infrastructures (bridges, etc.)
 - Ground movements and avalanche monitoring
 - AE not used in soil science → **methodological innovation**



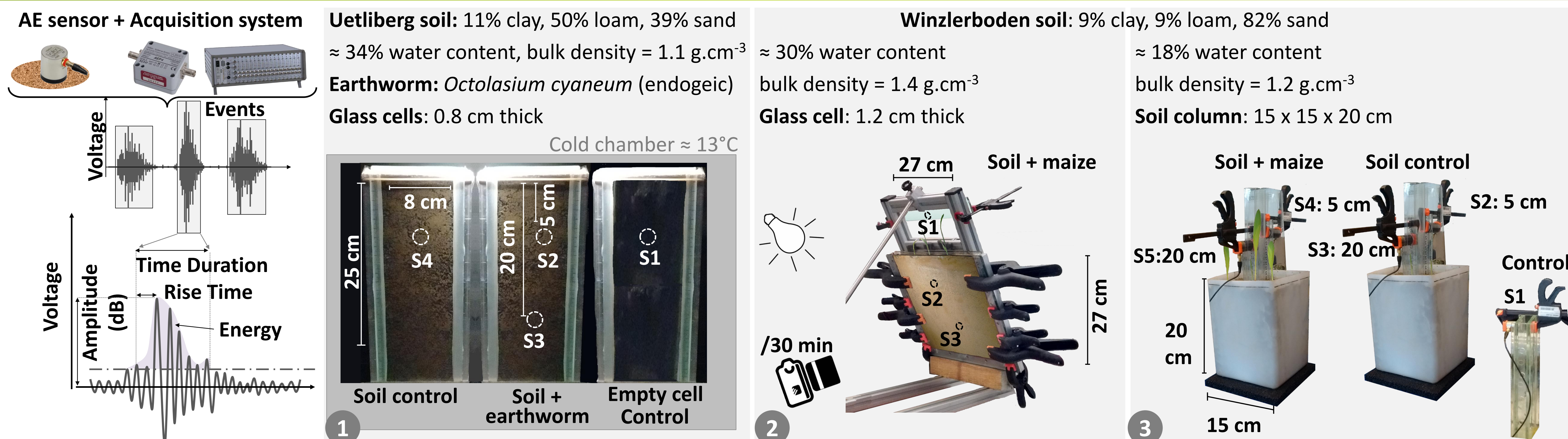
AE source mechanisms in soils

1. Liquid bridge rupture
2. Crack development
3. Release of force chains
4. Grain friction
5. Grain cementation fracture
6. Rupture of soil fibres

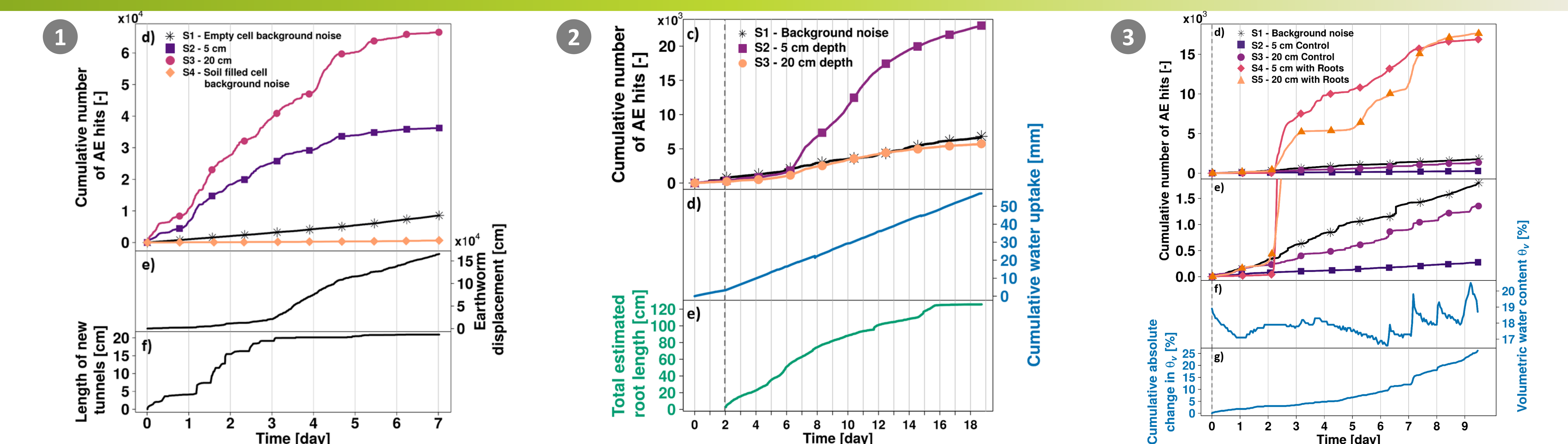
(Michlmayr, et al., 2012)

Can AE monitoring in soils characterize the dynamics of soil structure?

3. Materials & Methods: three lab experiments



4. Results



5. Conclusions and perspectives

Promising results

- AE signals correlate with earthworm burrow lengths and with root growth.
- AE from the soil columns: several orders of magnitude larger than AE emanating from bare soil under similar conditions.

AE monitoring

- **A window into largely unobservable biomechanical processes important for soil structure formation**
- **Insight into root development and earthworm ecology**

Results still exploratory: the method requires further development and refinement.

References. Lacoste, M., Ruiz, S., Or, D. Listening to earthworms burrowing and roots growing - acoustic signatures of soil biological activity. *Scientific Report* (minor revisions)

Dexter, A.R., 1988. Advances in characterization of soil structure. *Soil and Tillage Research* 11: 199-238. DOI: [http://dx.doi.org/10.1016/0167-1987\(88\)90002-5](http://dx.doi.org/10.1016/0167-1987(88)90002-5)
Rabot, E., Lacoste, M., Hénault, C., Cousin, I., 2015. Using X-ray Computed Tomography to Describe the Dynamics of Nitrous Oxide Emissions during Soil Drying. *Vadose Zone Journal* 14. DOI: 10.2136/vzj2014.12.0177
Michlmayr G., Cohen D., Or D., 2012. Sources and characteristics of acoustic emissions from mechanically stressed geologic granular media - A review. *Earth-Science Reviews* 112: 97-114. DOI: 10.1016/j.earscirev.2012.02.009