**Assessing the impact of lumbricid earthworms (keystone species) on greenhouse gasses and ecosystem multifunctionality**

Alexandru Milcu1,2, Damien Landais1, Clement Piel1, Joana Sauze1, Emmanuel Gritti1, Françoise Binet3, Matti Barthel4, Ivan Capowiez5, Johanne Nahmani2, Francois Malique6, Klaus Butterbach-Bahl6, Rainer Gasche6, Jeremy Puissant7, Robert Griffiths7, Alain Brauman8 & Jacques Roy1

1CNRS Ecotron, UPS 3248,1 Chemin du Rioux, 34980 Montferrier-sur-Lez, France.

2Centre d'Ecologie Fonctionnelle et Evolutive, CEFE, UMR 5175 CNRS - Université de Montpellier - Université Paul-Valéry Montpellier – EPHE – IRD, 1919 Route de Mende, 34293 Montpellier Cedex 5, France.

3UMR 6553 ECOBIO, Avenue du Général Leclerc, Campus de Beaulieu, F-35042 RENNES Cedex, France.

4ETH Zurich, Department of Environmental Systems Science, TAN G1, Tannenstrasse 1, 8092 Zurich, Switzerland.

5INRA, UMR 1114, EMMAH, Site Agroparc, Avignon, France.

6Karlsruhe Institute of Technology (KIT), Atmospheric Environmental Research (IMK-IFU), Kreuzeckbahnstraße 19 D-82467 Garmisch-Partenkirchen, Germany.

7Centre for Ecology and Hydrology, Wallingford, United Kingdom.

8IRD, UMR Eco&Sols, Montpellier SupAgro, 2 place Viala,34060 Montpellier Cedex 2, France.

One of the main aims of the Paris Climate Agreement (COP 21, 2015) is to reduce the emissions of greenhouse gases (GHG) in a manner that does not threaten food production. In an agricultural context, lumbricid earthworms (family Lumbricidae) have always been considered indicators of soil fertility and productivity. However, a couple of recent meta-analyses suggested that earthworms enhance the emissions of soil GHG (CO2 and N2O) and can reduce soil carbon storage. These findings have been received with reservation by a part of the scientific community arguing that they may stem from unrealistic microcosm experiments and discontinuous measurements of GHG. In addition to this shortcoming, we also currently lack information regarding the impact of earthworms on the multitude of ecosystem functions present in nature - ecosystem multifunctionality – including, but not limited to, primary productivity, nutrient cycling and carbon storage, water fluxes, pest resistance, pesticide degradation, etc.

To address these knowledge gaps, we started a large experiment using the 12 Macrocosms with lysimeters (5m2, 1.5 m deep and weighting 13 tonnes each) at the CNRS Ecotron facility (www.ecotron.cnrs.fr), and established treatments with and without different earthworm functional groups (none, anecic and endogeic). Our overarching hypotheses are that: i) in contrast to the methodologically biased meta-analyses using predominantly data from unrealistic microcosm experiments, in realistic field conditions including plants, earthworms reduce greenhouse gas emissions and increase soil carbon stabilization and sequestration and ii) in a multifunctional context earthworms will have an overwhelming positive effect on multiple ecosystem functions.

In this presentation, we will discuss the experimental design, preliminary results and opportunities for collaborations.