Microscale characterization of the migration of NAPL spills in dissimilar soil samples

Supervisors: Prof. Philippe Baveye; Dr. María Balseiro-Romero

Location: AgroParisTech, Grignon (for part of the work, with stays at other institutions when needed)

Timeframe: February 1 – July 31, 2018

Monthly stipend: 554.4 € per month

The transport and storage of fuel has resulted in significant releases in the environment. The study of the migration and behaviour of non-aqueous phase liquids (NAPLs) (as fuels are) in porous media is still in its infancy, and faces difficulties related to the non-uniform transport of this phase, principally due to the interaction of NAPLs with soil constituents (*i.e.*, clays and organic matter). NAPL migration may be hindered due to sorption and entrapment in pores, forming "pools" above less porous soil layers[1], slowing down its downwards migration, and becoming an almost permanent contamination source. Therefore, the study of the soil processes that affect the migration pattern of a fuel plume is very much needed at this point, will have a significant impact on the research about fuel spill migration, and will provide a firm basis to develop forecast models.

The innovation of the proposed work relies on the use of X-ray computed tomography (CT) to obtain a 3-dimensional images of the NAPL within soil pores (Figure 1) and to monitor with time its movement under different soil-NAPL scenarios. CT has been widely used in the geosciences to study the structure, porosity and/or permeability of rocks and soils[2], the development and architecture of root systems[3], or the movement of water through soil pores[4,5]; but only a few references use this technique to detect NAPL in soils[6].

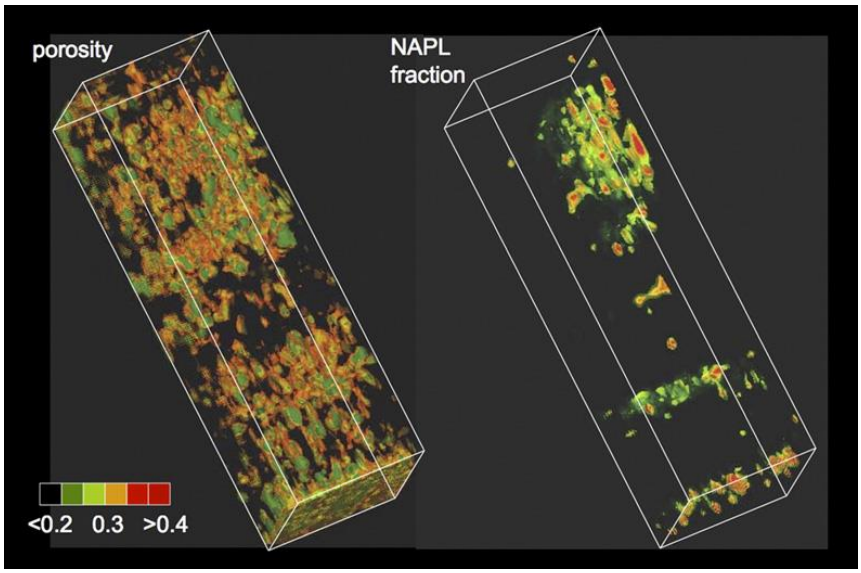

Figure 1. Example of three-dimensional image showing distribution of X-ray CT derived porosity and NAPL fraction in soil columns[6].

The research project in which the internship will be integrated aims to study the influence of soil properties on the behaviour, dynamics and spatial distribution of NAPL spills. For this, we will simulate spills in small columns and in a number of scenarios, using combinations of different soil types (soil samples with different properties, such as, porosity, texture, or clay/lime/sand/organic matter composition) and of NAPL (including petroleum derived fuels, such as gasoline or diesel). The data obtained will be used in dynamic 3D-models to predict the migration and behaviour of NAPL spills in soil environments, taking into account the properties of the soil-fuel scenarios tested. The results of these experiments are expected to have a significant impact on the understanding of the migration of fuel spills, according to the properties of the soil.

In close collaboration with Dr. María Balseiro-Romero, who is in charge of the research, the intern will carry out a subset of the experiments and of modelling, as permitted within the 6 months of the internship. A definite objective of the internship will be the writing of a publication (in English) on which the intern will be a co-author. The intern will also present a poster concerning his/her work at an international workshop to be held in June 2018 in Saint Loup Lamairé (Deux-Sèvres, France).

References

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(3) Mooney, S. J.; Pridmore, T. P.; Helliwell, J.; Bennett, M. J. Developing X-ray Computed Tomography to non-invasively image 3-D root systems architecture in soil. *Plant Soil* **2012**, *352* (1), 1–22.

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