The big picture:

Modern agriculture relies on innovative and more efficient ways of investigation and monitoring the physicochemical processes, which take place in the root zone. With nowadays fast changing climate perhaps this matter is even more concerning as we need rapid ways of assessing plant adaptability to changing environments and of increasing productivity on a more restricted available space.

My background:

In the past three years, for my PhD thesis, I have been studying the suitability of using geoelectrical methods in corroboration with other soil assessment methods, such as X-ray Computed Tomography, for assessing soil structure and monitoring its impact on soil hydrodynamic processes. Geoelectrical methods have a simple functionality principle: an electrical current is injected into the ground and based on the subsurface resistance to the current flow we can non-invasively have an idea of what is the soil composition. Recent advancements of computational technology allows us to even obtain 4D images of the subsurface unravelling new aspects about time and space development of soil processes.

Charcoal and soil:

University of Liège has a wonderful team of researchers interested in developing agro-bio technological applications. One of their current projects is CHAR. It aims to analyse the crop systems responses to the variations of pedological and hydrodynamic soil properties induced by charcoal accumulation over more than 150 years as an analogue to biochar (a carbon rich solid phase produced by pyrolysis) accumulation (Fig. 1). The latter is widely considered to substantially improve soil fertility and waterholding capacity while sequestering carbon in soils. There are many studies dealing with the biochar short-term effects on the agronomic and environmental functioning of agricultural soils, however there is an urgent need to document their long-term effects. In order to study such effects they have divided the workload into three work packages (WP) that tackle the pedogenic processes (1), the water dynamics (2) and crop quality monitoring (3).

Figure 1. Soil pit dug on the CHAR observatory fieldsite in Belgium. The pit wall shows a very distinctive charcoal enriched A horizon.

My contribution:

I have joined CHAR project as part of WP2, which uses geophysical methods to assess the hydrodynamic character of the charcoal enhanced soil. My expertise with imaging technology and geoelectrical methods was useful here as quantifying the impact of soil structure is crucial in order to understand the soil water dynamics.

Upon the X-ray scan of field sampled soil cores we observed a correlation between patterns in the variation of electrical resistivity and absolute values of air-filled porosity and pore connectivity (Fig. 2). The high porosity exhibited by the charcoal soil was also associated with high levels of macroaggregation determined within CHAR project WP 1. Also, during desaturation, Charcoal samples exhibited a higher electrical polarization than its corresponding reference soil, which can be explained by the size and distribution of the porespace.

Figure 2. Laboratory set-up that allowed us to explore the electrical signature of the reference soil sampled from CHAR observatory fieldsite

A wonderful experience and its outlook:

Working alongside such a vibrant team of researchers, passionate about their work, was truly exciting. In addition, the spare time I had during my stay allowed me to explore Belgium, a wonderful country filled with picturesque landscapes and amazing beer. With many aspects of our work and new ideas still to consider and write about, our collaboration did not end with my departure. This will continue remotely, across the English Channel, and will contribute to the strong relationship between the two research communities.

Figure 3. Collage of some of the photos I took while exploring Belgium