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## Real-time soil nutrients monitoring

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The availability of nutrients is one of the main factors in soils that affect plant growth. This is something that has always been worrying humans; initially using natural fertilizers such as animal and human waste to enhance crop productivity. However, the industrial revolution brought the Haber-Bosch process (artificial nitrogen fixation), which posed a milestone on artificial fertilizers. The production of fertilizers increased exponentially during the twentieth century and is still increasing although at a slower pace. It has had not only positive results, e.g. food production, but is also causing major environmental, health and economic problems.

Because of these problems, it is critical to improve soil management strategies at the precise spatial scales in order to protect human health and the environment, while food production is also guaranteed. To do so, what is needed is a low-cost way to measure nutrients in the soil, in real-time, at different spatial scales.

During recent years, researchers have been working on the adaptation and modification of Ion Selective Electrodes for the analysis of nutrients directly in the soil. However, low precision and accuracy, intense instrument handling (pre and post-calibration), and complex data processing is preventing its general use.

We will present here two modifications of our first prototype of a low-cost ISE-based sensor probe. The probe allows measurements *in situ* and/or continuous monitoring of up to 16 chemical species. We will here showcase preliminary data obtained by measuring four replicates of four analytes. We also apply the Bayesian calibration methodology previously developed by us in order to improve the precision and accuracy of measurements.