A floating sensing system to evaluate soil variability of flooded paddy fields

Mohammad Monirul Islam* and Marc Van Meirvenne
Research Group Soil Spatial Inventory Techniques, Department of Soil Management, Faculty of Bioscience Engineering, Ghent University, Coupure 653, 9000 Gent, Belgium
*mohammadmonirul.islam@ugent.be

Abstract

Every growing season, paddy fields are kept flooded for a significant period of time. Water is deliberately recessed by draining the fields during crop maturity and harvesting. Due to the sequence of flooding and draining, the physico-chemical behavior of these soils is different than under constant aerated soil conditions. However, proximal sensing technologies for the collection of high-resolution soil information from these paddy fields are severely obstructed by difficulties related to field accessibility and availability of an appropriate sensing system. In addition to that, because of practical reasons, soils of these fields are mostly sampled under dry conditions. But, representativity of the results when applied to wet growing conditions can be questioned. Therefore, a Floating Soil Sensing System (FloSSy) using an EM38 electromagnetic induction sensor to acquire and process in real time detailed geo-referenced soil information under flooded conditions was developed. This mobile system measures the soil apparent electrical conductivity (ECa) and records the geo-referenced information in a field laptop. Usefulness of the system was tested under both dry and wet conditions on a typical paddy field situated in the Brahmaputra floodplain soils of Bangladesh. Results of the surveys under contrasting moisture conditions were geostatistically analysed and compared. The mean ECa (27.5 mS m^{-1}) in flooded condition was slightly higher than the mean (23.6 mS m^{-1}) in dry condition due to the increased conductivity of the saturated water layer. Standardized variograms of both ECa survey data sets had the same range and a very similar behaviour of their structured part. However, the nugget variance was considerably higher for dry (16 %) than for wet (6 %) ECa. Hence, results obtained in wet conditions were more reliable due to the absence of soil moisture differences and the increased operational stability of the sensing platform during measurement over the field. Furthermore comparison of dry and wet ECa krigged maps showed that the largest differences between ECa under wet and dry conditions were found in those parts of the field where the sand content was higher. This study confirmed the usefulness of the system for measuring the within-field variation of soil properties which is a prerequisite to introducing precision agriculture to such a type of land use. Hence, the conclusion was that an ECa survey on flooded fields with FloSSy has an added value to precision soil management.