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Multi-configuration electromagnetic induction measurements at long term agricultural test sites in Germany with different fertilizer and irrigation managements

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Electromagnetic induction (EMI) data are often being used to investigate large scale soil properties including clay content, soil water content, and salinity changes for a wide range of applications. For agricultural sites, different management practices such as organic/mineral fertilization, tillage, and/or irrigation are important when interpreting the measured apparent electrical conductivity (ECa). Here, we present EMI data recorded at two long term field experiment (LTFE) agricultural test sites in Thyrow near Berlin (Germany), where different long term fertilizer and irrigation management practices were applied. We used two fixed-boom multi-coil EMI instruments that simultaneously measure over nine different depths of investigation (DOI), recording information ranging between the very shallow (0-0.25 m) ploughing zone including the organic matter and the surface soil (A-Horizon) down to the relatively deep (0-2.7 m) subsoil (B-Horizon) or even substratum (C-Horizon). At both test sites, the prevailing sandy to silty sand in the A- and B-Horizon is underlain by a glacial till C-Horizon resulting in generally low ECa values between 0.5 and 5 mS/m. At one test site, a “static nutrient deficiency experiment” is performed since 1937, where organic fertilizer (farm yard manure) and mineral fertilizers (nitrogen-phosphate-potassium (NPK) and liming) are applied at specific grids. Comparing the fertilizer application grid to the measured EMI data, the lowest ECa values coincide to unfertilized grids whereas the ECa values increase with liming, farm yard manure, and NPK. The visually observed correlation between ECa and the liming treatment was possibly due to the increased pH of the soil, because the fertilizer application increases ion contents that increase the soil electrical conductivity. At the second test site, a “Static Irrigation and Fertilizer Experiment” is conducted, where next to the fertilizer treatment (farm yard manure and nitrogen) part of the field is irrigated with a yearly average of 78 mm. Preliminary results show that for the irrigated area, the ECa values increased up to 80% compared to the non-irrigated zones for the deepest sensing coils, whereas farm yard manure increased ECa up to 10% for coils with intermediate DOI. These results obtained at the two LTFE sites strongly indicate that irrigation and fertilizer treatments influence the ion contents of soils from A- to B-Horizons as reflected by the higher apparent electrical conductivities measured with EMI and should be considered when interpreting ECa measurements to obtain soil properties of interest.