**Dielectric models of soil as a heterogeneous mixture**

The research planned in this topic include:

a)       review of existing literature,

b)       numerical modelling of complex dielectric permittivity of heterogeneous mixtures with the use of electromagnetic simulations (FEM and FDTD methods),

c)       selection of soils and collecting of appropriate number of samples,

d)       performing the measurements of basic physicochemical parameters of the collected soils (density, density of the solid phase, organic carbon content, specific surface area, particle-size distribution, retention curve, electrical conductivity),

e)       performing the dielectric measurements (TDR and FDR methods) of the samples with moisture content from air-dry to saturation (min. 6 moisture levels) and performing thermogravimetric moisture measurement,

f)       analysis of the results and parametrization of the existing dielectric models of soils based on the obtained simulated and experimental data.

The existing models of soils as heterogeneous dielectric mixtures require individual parametrization with respect to soil texture and physicochemical parameters. It is so because soil dielectric permittivity is most commonly measured with the use of the TDR technique in a frequency range that is not well known. The use of the FDR method enables measuring complex dielectric permittivity in a broadband frequency range. Therefore, it is possible to account for dielectric dispersion phenomena, which affect TDR measurements. The aim of the research will be the development and verification of a soil dielectric properties model that includes dielectric dispersion and physicochemical parameters of soil. The developed model will provide new practical knowledge, which subsequently can be used for the improvement of accuracy of soil moisture and salinity measurements with the use of dielectric methods. The acquired knowledge will also be useful for modelling of dielectric properties of heterogeneous materials of biological origin.

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Requirements for candidates:

- Master of Physics, Chemistry, Engineering or related,
- Knowledge of English enabling reading of the specialized literature,
- Knowledge of MS Excel and MS Word programs,
- Knowledge of at least one programming language or at least one software packages from the list: Matlab, Statistica, OriginLab,
- Self-reliance and commitment.