Groundwater Salinity Detection and Mapping Using Three-Dimensional Bayesian Inversion of Audiomagnetotelluric Data

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Since the conductivity of the water is closely connected to its salinity, monitoring of the salt contents of the ground water could be carried out by means of EM methods. An example of the detection of seawater invasion into a shallow coastal fresh water aquifer and mapping the boundaries of the salty water by means of 3D inversion of audiomagnetotelluric (AMT) data is considered. The real AMT data measured at the earth surface are simulated by synthetic ones calculated for 3D conductivity model of shallow coastal aquifer in the frequency range 50-200 Hz.

Three-dimensional inversion of AMT data is carried out by means of a Bayesian statisitical approach. The information available is determined in terms of the a'priori probability law of the conductivity distribution. The parameters to be found are the a'posteriori conductivity values in the domain of search. Thus, the solution of the inverse problem is reduced to the determination of the a'posteriory conductivity distribution by means of successive solution of the forward problem for the a'priori values of the conductivities (“palette”) preset in sub-domains. The iteration process converges to the correct solution in the most cases in 15-20 iterations, which enables to solve the inverse problem in a reasonable time even using micro-PC.

The results obtained demonstrate that the method elaborated and tested using synthetic data could be used to interpret different types of input data in the conditions of uncertainty and to develop finally a scientifically substantial methodology of the groundwater quality monitoring using EM data.