This article presents an innovative framework regarding an inverse problem. One presents the extension of a global optimization algorithm to estimate not only an optimal set of modeling parameters, but also their optimal distributions. Regarding its characteristics, differential evolution algorithm is used to demonstrate this extension, although other population-based algorithms may be considered. The adaptive empirical distributions algorithm is here introduced for the same purpose. Both schemes rely on the minimization of the dissimilarity between the empirical cumulative distribution functions of two data sets, using a goodness-of-fit test to evaluate their resemblance.