Identification of spatial models of the seasonal variability of δ^{18}O in rainfall over Spain using genetic algorithms

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Abstract. The content of oxygen stable isotope on rainfall is a function of the climatological conditions at the source area of the water vapor, its temporal evolution along its trajectory and at the location of rainfall occurrence. In hydrogeology, the spatial distribution of the value of δ^{18}O in rainfall can help to identify the areas of recharge and transit time, especially if its seasonal character is taken into account. Some of the explicative variables of the spatial distribution of δ^{18}O in rainfall are geographical (temperature, rainfall, relative humidity, wind speed, atmospheric pressure and the NAO index). A regression model to describe the spatial distribution of δ^{18}O in rainfall can include those parameters in a variety of terms: lineal, quadratic, cubic, reciprocal or logarithm; and in single or cross-products. Because of that, the number of possibilities, that is, of possible models to consider is so large that it is impossible to apply traditional methods in order to select the best combination of variables (branch and bound, inclusions or successive interchanges). On the other hand there is the possibility of choosing soft-computing techniques, like genetic algorithms, for stochastic optimization in regression problems with a large number of dependent variables. Several fitting functions are used in order to account for the parsimony principle and the goodness of fitness. The stochastic optimization was done for three groups of parameters: geographical only, climatological only and both. The results have allowed to identify the relevant modelling parameters and to discuss the importance of the geographical parameters as proxies of the climatic ones. The identification of these optimal models will allow a better understanding of the spatio-temporal variability of δ^{18}O in rainfall and a better identification of the runoff origin in surface hydrology.

Keywords: stable isotopes, soft computing, hydrologic cycle, climatology, rainfall