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Interactive comment on "Calculating the average natural recharge in large areas as a factor of their lithology and precipitation" *by* E. Sanz et al.

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This article deals with the calculation of recharge rates for large regions (thousands of square kilometres) as a simple fraction of mean annual precipitation. The approach is based on an analysis of spring discharges over the whole of Spain published by us as part of other studies. The authors observe that, when the spring discharges are summed over such large regions, the total spring discharge is related only to the lithology and the size of the region. (This is a useful observation).

The statistical technique used is relatively new, and it is both simple and useful. It is employed to determine the mean annual value of recharge for a sufficiently large region, and does not consider the relative importance of the various factors involved

in that recharge. Therefore, at no point does it claim to eliminate or discount other important factors that feature in the recharge process, nor of course, does it reject other, very useful, methods of calculation.

What is presented is a method for calculating recharge that requires solely the lithology and the precipitation to be known. This is one of the useful points about the statistic, since it allows complex natural phenomena to be simplified using only a few parameters. Furthermore, the method has been validated by applying it to data from other European countries, and this undeniably confirms that the recharge values obtained compare well.

The study demonstrates how, statistically, highly complex phenomena such as natural recharge, can be simplified by taking sufficiently large samples (17,000 springs) when the study is made on a large geographical scale. The proof is apparent from the results.

Taking natural recharge as a variable, this depends on a complex series of factors (lithology, vegetation, topography, precipitation etc.). Characterisation of its variability also engenders characterisation of the correlation of recharge with these factors. The assumed function (of correlation) would also include the random character of recharge that we observe, as well as the spatial distribution of the variability of the values we observe in reality. If the interpretations made using the function produce coherent and acceptable solutions to the variety of problems that appear in practice, then the said function is justified a posteriori.

In the same way as for other mathematical models that attempt to reflect a particular aspect of reality, the present study (and the statistic) establishes a series of hypotheses and develops them until certain conclusions are reached. If these conclusions fit what is observed in reality, then we can stipulate that the model is valid (within its limitations). This means that, based on samples of a population, it is possible to estimate parameters for that population (the value for natural recharge over large areas) by accepting the statistical inductive inference.

We can affirm that the spring data used is everything that is available in Spain at an official level (inventory of water points, internal reports), together with published data from in books, journals and conference proceedings. Citation of all these bibliographic sources would involve citing hundreds of references.

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