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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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First of all, we should like to thank you for your time in reading and making a written critique of our article, and to thank you for the indications and suggestions made by the anonymous reviewer. We will attempt to answer the observations made:

-Temporal and spatial scales. Usefulness of the Study In general, when making calculations of recharge, both the time period and well as the timescale adopted (in addition to normally being conditioned by each other) need to take in to account the objective behind the calculation. Mostly, the relationship between the two timescales is proportional, varying from several hectares and days, to a number of kilometres squared and years. In the case of estimating groundwater resources, a global value over a decade

will be sufficient to avoid, for example, exploitation of the water resource without long-term loss of groundwater reserves. An overall evaluation of groundwater resources for an entire country can admit a greater amplitude over both scales and it is this context that we consider in this study. We do not know the lower limit of the area to which this method could be applied without large errors, and although we assume this depends on the case, we can say that it has been applied successfully in Spain to hydrographic catchments of 19.000 km2.

-Statistics for the sample of springs with flow exceeding 10 l/s Estimates of the functions of hydraulic inflows according to lithology were addressed in our earlier studies (Sanz, 1996, 2001), on the basis of the number of springs with flows greater than 10 l/s. Amongst other reasons adduced for this threshold, one factor is that data for these larger springs was good and the sample could be considered complete. For the lithological groups that were considered as poorly permeable (quartzites, slates, plutonic rocks and others) only a few springs were included in the first interval of 11 to 50 l/s. If we consider, in addition, that the estimates were limited to smaller geographical areas, this further reduces the samples to a number insufficient to allow any estimate to be made. Moreover, it is relevant that the joint contribution from these four lithological groups represents only 5.5% of the total hydraulic inflow. A subsequent estimate of the rubric group of "other lithologies", even though it is less well defined than the other groups, would hardly increase the margin of error due to its small contribution.

-Natural hydrological state under natural recharge Indeed, as affirmed in Sanz (1996, pag.1033), this study on the hydraulic resources of Spanish springs is a mixture of natural and influenced regimes, since the statistical sample included springs affected by pumping, for example. It has already been pointed out that the recharge figure used for earlier calculations consisted of flow of all springs that emerge at the ground surface (17.321 hm3/year), and excluded diffuse discharges to rivers, seas, etc. However, although initially springs were considered as a whole, whether influenced or not, an adjustment was made and the result was elevated to take account of the total estimated recharge. This total estimated recharge was calculated using other methods (a highly detailed mathematical model) by MIMAN (2000), and gave a figure of 28,719 hm3/year. In other words, the 11,392 hm3/year discrepancy corresponds to diffuse discharges, etc. In an article by Sanz el al.(2011) the procedure of adjusting the total recharge in this way is explained.

-Validation of Results We should add that, to a certain degree, the application of the method in Spain, the region in which the method was devised, may be a little bit of a vicious circle. However, the same cannot be said for the results that are undisputedly good in other countries, where recharge has been calculated using different procedures.

References cited

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