ESPERE, a multiple-method Microsoft Excel application for estimating aquifer

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Natural groundwater recharge mainly comes from the fraction of rainfall that infiltrates and replenishes the aquifer. Methods described in the literature for estimating it (e.g., Healy 2010) vary in terms of the time scale and the nature of the data they treat. To obtain both a realistic estimation of groundwater recharge and a confidence interval at the hydrogeological basin scale, it is important to use a variety of approaches that complement each other (Scanlon et al. 2006).

The Microsoft Excel application ESPERE was developed for this purpose. It includes several commonly used methods that are run simultaneously to estimate the recharge of an aquifer. Depending on the available data, the user can choose which methods to apply: empirical methods, such as the one proposed by Turc (1954); the water budget method presented by Thornthwaite (1948) and improved on by Dingman (2002); the water table fluctuation (WTF) method (Delin 2007): and the

three streamflow time-series treatments proposed by Gustard et al. (1992), Chapman et al. (1996) and Eckhardt (2005).

The user fills in a table with a few parameter values, such as the surface of the catchment area, the soil maximum storage capacity (needed for the water budget methods), the infiltration/effective rainfall ratio, or the specific yield (for the WTF method only). The user then provides daily time-series data for at least precipitation and potential evapotranspiration and, if available, data for temperature, main river streamflow at the catchment outlet, and groundwater level. Daily effective rainfall and recharge values previously calculated using other models can also be supplied in order to be included in the final graphs for comparison of results.

ESPERE presents a separate result worksheet for each method, which includes a short text describing the method. A summarizing worksheet compiles tables showing the results of all the methods applied. When possible, results are presented at different time steps (daily, monthly, inter-annual monthly mean, annual). Spatial scaling is done automatically, which allows the results of all the methods to be compared for a given recharge area. The calculated recharges are also converted into annual infiltrated volumes to enable later comparison of several aquifers. To facilitate a comparison among methods, the results are automatically displayed as bar graphs. Finally, several descriptive statistical elements (mean, maximum, minimum, standard deviation, median, and top and bottom deciles) are generated for comparison of the annual infiltrated volumes in the form of tables and box plots.

About ESPERE

Both light and complete version of ESPERE_1.5 were developed in Visual Basic for Applications with Excel Office 2010 within Windows 7. The complete version requires

XLSTAT© by Addinsoft for the post-process on statistical analysis. ESPERE_1.5 is freely available (in both French and English) on request from espere@brgm.fr.

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Supporting Information

Appendix S1: ESPERE User Guide.

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