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Hydrology and Earth System Sciences Discussions

Interactive comment on "What can we learn from long-term groundwater data to improve climate change impact studies?" *by* S. Stoll et al.

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General comments

A data set of time series of groundwater level (n.15) and spring discharge (n.15) of north Switzerland and Southern Germany have been analyzed in relation to climate variables. Data come from unconfined aquifers, dominated by direct recharge. Practically allogenic recharge is excluded and direct connections between atmospheric and groundwater exists. The recharge has been estimated using the MIKE SHE models. In this way, the recharge time series have been compared with groundwater level/spring discharge time series (normalized series). The analyses carried out allow authors to investigate the role of the climate variables on the groundwater levels and spring dis-

charges, and to evaluate the role of other main factors, as the pumping and land use. Even if some basilar assumptions have been done to simplify the complexity of a wide area, data and methods used allow to reach interesting results. For these reason article is a very important attempt to understand the role of the climate and human land use on the groundwater recourses in a wide area. However some specific points appear unclear and would need to be detailed.

Specific comments

Information on the number and location of the rain gauges used to evaluate the recharge is missing. Description on the method used to evaluate the recharge has been given, also reporting references, but data used or details on the series used (rainfall and temperature) are not shown. Besides, authors should explain better how the recharge is obtained when they describe "As calculated recharge values cannot be compared directly with measured groundwater levels or spring discharges, and the main interest is the groundwater dynamics, monthly values are normalized and a twelve month running average is calculated." (pag.7629, line 11-14). Are the series plotted in Fig.2-3 smoothed by the 12-years moving average? Which series authors use in the correlation of Table 2? Authors found that, generally, trend test for the model calculation do not show significant trends (pag. 7635, line 18-19). So, why the authors suppose the possible occurrence of "increased water demand due to increased temperature and precipitation deficit can trigger groundwater drought in dry periods" (pag.7638, line 18-19)? Figure 8 shown the winter precipitation of the ZH-Fluntern rain gauge (location of rain gauges is missing in Fig.1); it should be interesting to show similar data of other rain gauges to highlight the common droughts. As intense drought is characterized by wide spatial extension, the drought of 1970/71 and 1971/72 should appear in almost all stations. Why only ZH-Fluntern rain gauge has been shown?

Technical corrections

Table 1: some details are missing. For example the annual mean of the spring dis-

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charge should be given for each spring, which is more important than GW depth given for groundwater series. The role of the powerful spring (high annual mean discharge) appears to be higher that the minor spring (low annual mean discharge). Figure 1: location of the main towns, mountain peaks, etc. are missing. Figure 2 and 3: add the number given in table 1 also in the figure 2 and 3; in this way is to easy follow when reading the article. Pag. 7636, 4.4 Trends. There is another paragraph called Trends (pag. 7631, 3.3 Trends)

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