

***Interactive comment on* “The role of integrated high resolution stratigraphic and geophysic surveys for groundwater modelling” by S. Margiotta et al.**

Anonymous Referee #3

Received and published: 21 February 2009

The paper reports geological, hydrogeological, and geophysical surveys conducted in the Brindisi area. The paper also discusses the effects of "Asse Attrezzato" on the groundwater flow and pollution. I am interested in the topic of the paper, but major revisions would be required for publication in HESS.

GENERAL EVALUATION

1) Does the paper address relevant scientific questions within the scope of HESS?

Yes. The objective and methods used in this work are interesting and effective.

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2) Does the paper present novel concepts, ideas, tools, or data?

Yes. The work (1) described the Brindisi sands, previously included in the subapennine Clays, and suggested the importance of this formation, and (2) demonstrated the effects of "Asse Attrezzato" on the groundwater flow and pollution using a hydrological model (MODFLOW) and ERT.

3) Are substantial conclusions reached?

No. The main conclusions of this paper, given in Page 2877 Line 18-21, are (1) that fine-scale stratigraphical and physical features play a key role in modeling groundwater flow and (2) that the main advantages of an integrated stratigraphical, hydrogeological, and geophysical methods lie in its multidisciplinary approach and in the fact that it may productively be used for the study of other areas. Indeed, the geological and hydrogeological surveys provide important information for modeling groundwater flow, and are also useful for interpreting the ERT profiles. More information we obtain, better or more accurately we can understand the groundwater flow; this is too natural. Rather, it would be more useful (1) to organize the merits and demerits of each survey (cost, time, ease of interpretation ...etc), (2) to demonstrate to what extent each survey clarified the subsurface structure and groundwater flow and what each survey could not detect or clarify, (3) to demonstrate what was made possible when integrated surveys were used for groundwater modeling, and (4) to discuss what is the best choice or process of surveys for investigating a contaminated area such as the studied site.

4) Are the scientific methods and assumptions valid and clearly outlined?

No. Especially, Section 4 needs more detailed descriptions. In Section 4.2, the authors measured temperature, pH, dissolved oxygen, and salinity in some boreholes, and described the permeability of each formation. I am not familiar with MODFLOW, but I guess MODFLOW requires other hydraulic parameters than described in Section 4.2; these parameters should be shown and described in Section 4.2. Moreover, the authors used the stratigraphic and hydraulic data deriving from borehole cores and

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the geological sections obtained by integrated stratigraphic and geophysical data as the targets for assessing calibration quality. What were these parameters specifically? Groundwater level at the borehole locations? A figure showing the observed and computed parameter values is also necessary to support the final conclusion that the value of residuals, less than 10%, points out the good calibration of the model (Page 2872 Line 20-21).

5) Are the results sufficient to support the interpretations and conclusions?

No. For example, the authors show in Fig. 4 the examples of geological cross sections. They were for 1-1' and 2-2' sections, both of which are located in the north-eastern part of the studied area. Hence, the statement in Page 2863 Line 24-25 that the topsoil lies over almost all the area under examination cannot be concluded from Fig.4. For this statement to be valid, the geological cross sections for the other sections should be shown. Also, Table 1 shows one of the results of the hydrogeological survey, although a total of 18 surveys were performed. It should be described where the survey the results of which were shown in Table 1 was conducted. Moreover, it seems that showing the results for only one of the 18 surveys is too insufficient to lead the brief considerations summarized in Page 2869 Line 16-25. A few more data sets of the hydrogeological surveys are required for supporting these considerations.

6) Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?

Partially yes. More detailed descriptions would be required for Section 4, as described in 4).

7) Do the authors give proper credit to related work and clearly indicate their own new/original contribution?

Yes.

8) Does the title clearly reflect the contents of the paper?

I do not think so. From the current title, one may imagine that this paper discusses to what extent the integrated use of the stratigraphic and geophysical surveys can improve the poor accuracy of the groundwater modeling obtained by using the results of the surveys separately. Moreover, the geophysical surveys (i.e., ERT) were very effective for investigating the subsurface structure and location of groundwater pollution in the micro-area; however, as described in Page 2878 Line 8-10, the main contribution of the ERT survey is to reconstruct in detail the stratigraphy improving the spatial resolution of the data and consequently the scale of observation, not to characterize the groundwater flow more accurately nor to reflect in the groundwater modeling. Thus, the title does not reflect the contents of the work accurately.

9) Does the abstract provide a concise and complete summary?

Yes, but revisions would be required to reflect the comments given by the referees or other reviewers.

10) Is the overall presentation well structured and clear?

Partially no. Sections 6 and 7 can actually be regarded as Discussion and Conclusions and can be merged. It seems that Sections 3-5 correspond to "Results" instead of Section 6.

11) Is the language fluent and precise?

I cannot give any comment on this aspect since English is not my native language. At least, I did not have any trouble in reading the text.

12) Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?

Yes.

13) Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

Yes, as described in 4) and 5).

14) Are the number and quality of references appropriate?

Yes.

15) Is the amount and quality of supplementary material appropriate?

No. More figures or table are necessary, as described above. Moreover, the following issues can be raised. (1) In Fig. 1, some parts are shaded to show five zones (i.e., the coastal marshy area, industrial area ...etc). Of these zones, it is very difficult to distinguish between the coastal marshy area and Cerano power station. Moreover, the Cerano power station is also shown in Fig. 2. Using the same fill pattern as used in Fig. 1 may be useful. (2) Figures 4 and 6 need refinement to increase legibility. (3) Figure 8 shows the geological section used for MODFLOW calculation. The section consists of three layers, but the color of each layer changes by gradation. What does this gradation mean? In addition, Fig. 8 also includes the black zone penetrating the three layers on the right. What does this black zone indicate? These explanations should be given in the text or caption. (4) In Figs. 9-11, the unit for the head data is not shown. (5) Figure 11: what does this figure mean? It seems that all the depths at a single point had the identical head value. Moreover, the shallow layers remain plain. Are they out of the range of the calculation? (6) Two panels in Fig. 12 compare the groundwater flow in presence and absence of the "Asse Attrezzato". It should explicitly be labeled which panel shows which condition. (7) The ERT was carried out using two arrays: Wenner-Schlumberger and Dipole-Dipole. Why is the ERT profile P1 using Dipole-Dipole arrays not shown in Fig. 14? (8) Table 1 shows the result of hydrogeological survey. The four panels shown here include the data plotted at the depth of 1 m. What does this positive value of the depth mean? Moreover, according to the table shown at the top, the groundwater level (G. L.) was 4.10 m, probably indicating that the groundwater table lay 4.10 m below the ground surface. However, the four panels show the data above the groundwater table (i.e., above -4.10 m). Temperature can be

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measured for above and below the groundwater table, but how did you measure the pH, dissolved oxygen, and salinity above the groundwater table?

SPECIFIC COMMENTS

1. This paper includes many proper nouns indicating the name of land, inlet, incision ...etc, such as "Salina Vecchia", "Seno di Levante", "Fiume Grande" ...etc, but most of them are not shown in the maps. Indicating the location of them in the maps would be very helpful to follow the text, especially in Sections 2 and 3.
2. Page 2866 Line 24-27: The description of the permeability is the hydrogeological aspect, and therefore should be moved to Section 4.
3. Page 2869 Line 14: Where is "the Brindisi agricultural area"?
4. Section 5: Why did you use two methods for electrode arrays (i.e., Wenner-Schlumberger and Dipole-Dipole)? Either of them can serve the purpose here.
5. Page 2877 Line 13-15: The anomalously high resistivity zone observed at profile 2 was attributed to the groundwater pollution by Sb, Cd, Pb ...etc. Generally, high concentration of the chemicals should decrease the resistivity. How can this inconsistency be explained in your study site?

TECHNICAL CORRECTIONS

It is difficult for me to give any comment on the technical aspect since English is not my native language, but I would like to list some corrections which seem obviously mistake.

1. Page 2866 Line 22: "content water" should be "water content".
2. Page 2871 Line 20: A period is needed after "journals".
3. Page 2873 Line 19: "Res2dinv" should be "Res2Dinv".
4. Caption of Fig. 5: Following Fig. 3, "SB" should be written in lower-case letters.
5. Caption of Fig. 7: Following Page 2868 Line 11, the head of each word in "Pleis-

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5, S2580–S2586, 2009

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ocene marine terraced deposits" should be written in upper-case letters, except for "marine".

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 2859, 2008.

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