

Interactive comment on “A comparison of interpolation methods on the basis of data obtained from a bathymetric survey of Lake Vrana, Croatia” by A. Šiljeg et al.

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Anonymous Referee #2: The manuscript's problems are by and large related to organization and focus. On a secondary level, there is too much detail in the discussion of tangential matter and not enough detail in subject matter that is important. Perhaps the easiest way to solve this problem is to be clear about the focus of the manuscript.

Author Response: It is correct that the focus of the work is broader than the title “Comparison of interpolation methods on the basis of data obtained from a bathymetric survey” would suggest. A more appropriate title would probably be “Bathymetric survey of

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Lake Vrana.”

However, we would like to explain why we chose the former title.

In the process of bathymetric survey, the main aim was the development of the water depth map (model) which could be used for other kinds of applications (NOAA Hydrographic Manual Part-1, 1976; IHO, 2005 - Chapter 1: Principles of Hydrographic Surveying). In order to develop a model, it was necessary to gather via specific procedures and technologies, to compare the used interpolation methods and to choose the adequate size of spatial resolution. According to the regulations of the International Hydrographic Organization (described in the Manual of Hydrography, 2005), a bathymetric research included several phases which are of equal importance. For that reason, it is our opinion that the research does not contain explicitly tangential parts. The research includes 6 parts, and the comparison of interpolation methods is just one of its aims. In other words, all aims are equally important, but we decided to emphasize methods of interpolation, because we think that there are a number of authors who seem to be making mistakes in relation to this topic and hence devalue the importance of the gathered data. Taking those points into account, we decided to emphasize the comparison of interpolation methods in our work's title.

We thought that the title “Bathymetric survey of Lake Vrana” would be too general and therefore less attractive for the HESS magazine office. Most lakes in the world have been thoroughly researched already, but this is not the case with Lake Vrana (which is the largest lake in the Republic of Croatia). The modern water depth data gathering technology exists since 1980s, or even from earlier times. However, there simply was no political and scientific initiative to perform such a research. Because of that, we believe that this is a type of research that could prove as a basis for any other future researches of various features of Lake Vrana (but also other similar lakes in the world). Within the Lake Vrana Nature Park there are numerous problems, which were mentioned in our work. Without the appropriate and scientifically justified models, it would be difficult to manage this area and make necessary decisions.

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Anonymous Referee #2: The title (A comparison of interpolation methods on the basis of data obtained from a bathymetric survey of Lake Vrana, Croatia) suggests the focus is on geostatistics. That would be fine. However, a good portion of the paper is related to the details of gathering bathymetric data. If the paper is truly about differences between interpolation methods, then it seems to me that any portion of the collected data set would suffice and goal #3 above could be dropped. If, on the other hand, the real focus of this paper is to calculate the surface area and volume of the lake (and to compare differences in the calculation of the raster models; goal #3), then perhaps goals #1 and #2 (above) could be abbreviated. Much of this manuscript is detailed in Šiljeg (2013) – why not simply cite the conclusions (on which interpolation methods work best) and focus on the results of your interpolation?

Author Response: The reason we chose this title was explained in the previous paragraph. In the title we emphasized that the interpolation methods were compared on the basis of data gathered by bathymetric survey. Geostatistics is an important part of the process of bathymetric research, especially when a single-beam sonar is used. Deterministic methods were also used. It is not possible to establish a model or determine the lake's features if the gathered data is not interpolated.

The data gathering phase is an extremely important part of the model development, which has been pointed out by many authors (Weibel & Heller 1991, Hutchinson & Gallant 2000 Hengel et al. 2003, Oksanen 2006, IHO 2005, Erdogan 2009). The accuracy of the model, as well as data derived from DTM depends on the data gathering phase. This phase, in our research, lasted more than 30 days, without the data processing phase. The reason for that was that one of the aims was to develop the most adequate model for future researches. However, we can definitely reduce the size of this phase's description, which was also suggested by other reviewers.

Anonymous Referee #2: Many people are familiar with the Surfer software program and if you clearly state how the bathymetric data was interpolated (and that the volume and area of the lake didn't vary too much with different interpolation methods), I don't

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think there will be much objection.

Author Response: Many scientists are familiar with interpolation methods and pre-made software solutions. However, based on the researches we had looked into, we noticed that a number of authors seem to ignore parameters which significantly influence output results. For example, the final step in the development process is the choice of spatial resolution. By choosing an inadequate resolution, it is possible to completely devalue the model (Hengel, 2006). In relation to interpolation methods, the choice of spatial resolution is even more important. The accuracy of the developed model was tested in the field. It is difficult to assume which interpolation method is "the most appropriate" in a scientific work. The best example would be that of Li and Heap (2008), who performed a research based on 51 studies, comparing various interpolation methods. Results are dependent on many parameters and each research is specific, due to its methods, techniques, data gathering procedures, data filtering, processing and so on. One of the aims of this work was to point out an important fact – that it is necessary to test interpolation methods before making a choice and to emphasize the importance of data gathering process (from the choice of technology to data processing). Of course, this part of the paper could be shortened as well, according to the reviewer's suggestions.

Anonymous Referee #2: If I understand correctly, what is really new here is the bathymetric map of the lake.

Author Response: We developed a model of Lake Vrana as well, not just bathymetric map. The map is a final part of the modelling process, which has many phases and sub-phases described in this research.

Anonymous Referee #2: If you can map the lake, relate the water level (at any given time) to a fixed elevation, and show how changes in water level affect total lake area and total lake volume, then I think this could be very useful. For instance, changes in evaporation or precipitation or exchange with the Adriatic Sea could quickly be trans-

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lated to the area of shoreline exposed or submerged. Some sort of hypsographic curve is the expression I think I'm looking for.

Author Response: We mentioned the possible future applications of the model in the paper. We used it to calculate the percentage of the flooded habitats, which were of importance for the Nature Park management, and the percentage of the flooded agricultural parcels. The reviewer's suggestion is very constructive and can offer good topics for the future researches of Lake Vrana (as well as any other habitat of similar features).

Anonymous Referee #2: Even with improved focus, the authors need to improve the organization of the paper. Methods belong in the methods section, discussion in the discussion section, etc. Details also need to be provided. E.g., nowhere in the current manuscript is there a complete list of all 16 interpolation methods (and their associated acronyms). Figure legends are woefully incomplete (see for instance Fig. 8).

Author Response: Based on the reviewer's suggestions, we propose the next changes:

- a correction of the Fig. 8 legend (and, if necessary, any others)
- reduce the size of the chapter dealing with gear and technology description, as well as the chapter dealing with bathymetric data gathering (chapter 2.1.)
- in the Table 7, change the units from ha to km² (due to consistency)
- instead of "mnm", use "meters above sea level" as a unit
- reduce the size of the text relating to the bathymetric data gathering
- make a list of interpolation methods in the introductory chapter
- modify the title of the paper in order to make the focus more precise and avoid misunderstandings related to the most important aims
- reduce the number of aims, from 6 to 3:

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(1) to compare the efficiency of 16 methods of interpolation in order to determine the most appropriate interpolators for the development of a raster model of the lake, (2) to calculate the surface area, volume of the lake and develop the first bathymetric map of Lake Vrana (3) to develop a scenario for changes in water level in order to determine the potentially flooded areas

Also, to achieve a better organization of the paper, and according to the suggestions of the reviewer, we suggest the following changes:

- remove the aims and purpose of the research from the chapter 2.1. (sub-chapter 2.1.2.) in order to avoid repetition
- move the part of the text from "The bathymetric... bathymetric map" to the chapter "Research Methods", since it relates to a specific method we used in the research – page 4
- move the part of the text "This research ... 2007" in the same manner – pages 4 and 5
- in the chapter "Research Results", move the part of the text "In order ... parameters" to the "Research Methods" chapter, since it explains the way we obtained the results – page 12
- in the sub-chapter "Surface Area and Volume of the Lake", move the part of the text "The final phase ... methods used" to "Research Methods", since the part relates to the methodological explanation – page 16
- remove exact numerical data relating to the results from the "Discussion", in order to avoid repetition

We believe it is evident that we have implemented most of the reviewer's suggestions and hope that this will make the paper more appropriate and better in quality. We hope that you will accept such version of the paper as appropriate for the publication in HESS.

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