Interactive comment on "Expert modelling of a geological cross-section from boreholes: sources of uncertainty and their quantification" *by* R. M. Lark et al.

Anonymous Referee #1

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At the outset of the paper, the authors clearly explain the motive for the study: the increasing use of three-dimensional models of subsurface geologic structures emphasizes the need for better methods to predict the variability of interpretation errors of subsurface data (e.g. boreholes). The authors explicitly state the hypothesis driving the study in the introduction (page 1690, lines 6-7), and this hypothesis follows logically from the original motivation. The components of the statistical model that form the centerpiece of the study are appropriately aligned with the hypothesis and the data collected. In the conclusions, the authors also restate the hypothesis and summarize the findings.

However, the motivation for the study is largely explained without reference to other

work, and the only prior work cited is that of the first author and colleagues. In the conclusions, there is just one citation, again to the work of the first author and colleagues.

The study is a compelling story, but it loses some of its credibility with the absence of a more detailed literature review upfront and a discussion that fails to relate this work to the findings of others at the end. Two references of interest might be Bond et al., GSA Today, November 2007 ("What do you think this is? 'Conceptual uncertainty' in geoscience interpretation") and Saltus and Blakely, GSA Today, December 2011 ("Unique geologic insights from 'non-unique' gravity and magnetic interpretations").

The primary concern for this paper is the way in which the statistical model is explained in the data analysis section. The language is not especially accessible. Prior to that section, the authors effectively explain the motivation and the experiment of the study. It is clear why the information is being presented as it is. Moreover, later in the paper, the language of the results and conclusions sections is logical and purposeful. But in sections 3.2 and 3.3 (and to lesser extents in 3.1 and 3.4), the language switches into more of a "how to" style. While the focus on the derivation of the model is understandable, the shift in writing is stark. The "how to" style risks overwhelming a reader who is interested in knowing the function of each component of the model without necessarily needing to know the justification for its statistical assumptions and decisions.

Specific line comments:

Page 1690, Line 8, "...the distance to nearest borehole": To what does this refer? The distance to nearest borehole from where?

Page 1691, Line 21, "The 51 available boreholes which prove the base of the London Clay were subdivided by independent random sampling without replacement into ten batches...": The term "batches" is a key unit of analysis throughout this paper. But the way the term is used is very confusing. Further along in this same paragraph, the reader is introduced to the "interpretation subset of 46 boreholes" that are separate from the 5 "validation batches." Then later, in the explanation of the experiment it says

that "Batches were allocated to participants in order as they presented so that a more or less even distribution of participants over batches was achieved" (Page 1692; line 20-12). Is the point that participants received different combinations of 46 boreholes and each combination is thought of as a "batch"? If so, this needs to be made more explicit. What is a batch? If the term is used in more than one way, please clarify those different uses explicitly.

Page 1692, Lines 1-8 and 22-27: I would recommend moving these two paragraphs to be next to each other. Also, these paragraphs indicate that the participants in this study represent a range of experience in modeling. In fact, referring to those with two years of experience in modelling as experts (as done in the title of this paper) is surprising given that, within research literature on expertise, two years of experience is not a typical metric for identifying an expert. In the title, the phrase, "expert modelling" does not seem wholly necessary. It would seem just as apt to title the paper something like "Quantitative modelling of uncertainty in geologic cross-sections."

As a separate question, was the task on the computer in a format that would have been familiar to the participants with experience in modeling?

Page 1693, Line 4-5, "We therefore had a total of 129 comparisons of interpreted and observed elevation available for analysis with between 10 and 20 observations in any batch.": Please explain more specifically the origin of the 129 comparisons. Do these "comparisons" become the "observations" later referred to in lines 21-23 ("The random effects represent sources of variation in the observations...")?

Page 1693, Lines 22-23: Please expand on the definitions of "between batches of validation boreholes" and "between the sites of the validation boreholes within batches."

Page 1697, Lines 20-22, "However, in the current experiment, each geologist appears at each site within the batch to which he or she was allocated.": This is an awkward sentence. What does this mean?

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Interactive comment on Solid Earth Discuss., 6, 1687, 2014.