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Interactive comment on "Modelling complex geological angular data with the Projected Normal distribution and mixtures of von Mises distributions" *by* R. M. Lark et al.

A Jordán (Editor)

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Dear authors:

Congratulations for your excellent work.

After peer-review, three referees have recommended minor revision. So, I guess that the paper will be soon published in its definitive form.

After carefully reading the paper and the reviews and consulting some colleagues, I have some more comments which, in my opinion, can help to improve some minor aspects of the manuscript.

I really appreciated this study because it clearly shows an application to real geological cases of the statistical analysis of angular data. In particular, more simple models, like the von Mises or Wrapped Normal distributions are only rough approximations to describe real, multimodal and asymmetric samples. Therefore, the methodology explored in this manuscript would be of great help to model such complex, natural cases. To my knowledge, mathematics underlying the manuscript is correct, as is the application of this methodology to the West Cumbria and Bangladesh examples. However, some aspects should be modified or discussed further to reinforce the conclusions.

GENERAL COMMENTS: The topic of the manuscript should be more focused, because the title and the first sentences of the abstract and introduction section refer to a very general subject: angular data. However, angular data can be distributed on the circle (2D) or on the sphere (3D; e.g. Fisher et al., 1987, Statistical Analysis of Spherical Data, Cambridge). Clearly, this manuscript only deals with circular data (e.g., von Mises distribution). This must be clarified in the title and in the first part of the main text. Apart from this, the straight line whose orientation is represented by angular data, can be directed or undirected (see lines 13 to 18 of page 2182), and this is commonly referred to as vector and axial data, respectively (e.g., Mardia, 1972, Statistics of Directional Data, Academic Press; Fisher et al., 1987; Mardia and Jupp, 2000). The authors should consider using this standard terminology across the manuscript. The Bangladesh data are of axial nature. The classical procedure for circular axial data (at least since the times of Krumbein, 1939, Jour. Geology, 47) was to double the original orientation data, and this has been done in this case (lines 21 to 23 of page 2191). However, a short sentence explaining the need to perform that modification is lacking. Moreover, as this is a well-known case (e.g., Davis, 1986, Statistics and Data Analysis in Geology, John Wiley), it becomes clear that the rose diagrams (Fig. 1c, d) represent the doubled angles, and the rest of statistic computations are performed on those modified data. However, this must be clearly stated in the manuscript and in the corresponding figure captions. The final concern is about the arrangement and structure of sections 3 (case studies) and 4 (conclusions). The transition from discussion of the

two studied cases to the conclusions is rather sharp. To ensure a continuous flow in reasoning, the authors should consider to add a new section or sub-section summarizing and discussing the main topics analyzed in the manuscript. Parts of the original section 3 can be used to build this new section. Furthermore, the conclusions (section 4) only consider the Bangladesh site, with no reference to the West Cumbria results and the rest of valuable findings of this work.

MINOR POINTS:

Lines 5 and 6, page 2183: "For example, Coblentz and Richardson (1995) examined global data on maximum horizontal compressive strength . . .". However, the paper of Coblentz and Richardson (1995) deals with stress indicators and the spatial distribution of the maximum horizontal compressive stress orientation at the scale of the World Stress Map. Therefore, the word "stress" should be used instead "strength".

Lines 9 and 10, page 2193: "This sequence of models can be regarded as nested: Models 2 and 3 are particular cases of Model 1 with certain parameters set to common values". Nevertheless, Table 3 shows that Model 3 is indeed the more general, with Model 2 sharing some parameters (correlation coefficients, standard deviations) and Model 1 showing pooled, single values for all parameters, including mean vectors.

Finally, congratulations again.

Antonio Jordán

Interactive comment on Solid Earth Discuss., 5, 2181, 2013.