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Interactive comment on "A 3-D RBF-FD elliptic solver for irregular boundaries: modeling the atmospheric global electric circuit with topography" *by* V. Bayona et al.

Anonymous Referee #2

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This paper describes a numerical model for simulation of the global atmospheric electric circuit. It is quite an impressive work, where a number of modelling challenges are addressed. The earths topography, which clearly is relevant for the problem is accurately represented, and the model is evaluated for real observational data. The results are very good, showing that using RBF-FD is a very promising direction, and they are nicely illustrated. The language is of high quality. The introduction gives an excellent overview of the literature on the subject. Some specific comments and question follow:

1. p 3528: The RBF-FD systems are non-singular for the RBFs in Table 1, but not for all choices. The accuracy can be increased by adding polynomials, but by adding a constant the order of accuracy will not be improved as a second order operator is

approximated. The statement is a bit too broad and makes the reader wonder why you don't then add more polynomial terms. Suggestion: adding a low order polynomial term can be beneficial...

2. p 3529: This feature makes the method independent of the number of dimensions. This is true in the sense of mathematical formulation and implementation. However, to me independent of dimension also indicates that the computational cost should be independent of the dimension which is not the case.

3. p 3531: mute point -> moot point

4. p 3534: Why would the differentiation matrix become singular by eigenvalues crossing the imaginary axis? Do you mean unstable?

5. p 3535: You use ILU+GMRES for the preconditioner solve. Do you solve that system to a high accuracy? For inner-outer where the inner solver is inexact, flexible GMRES (FGMRES) should be used. Perhaps you can comment on the tolerance for the inner solve.

6. p 3539: The problem size is quite large. The second author has been involved in a number of papers where parallel implementations of RBF-FD methods have been investigated. Perhaps some comments about this could be added. (As this speaks in favor of the model that it can be parallelized.)

Interactive comment on Geosci. Model Dev. Discuss., 8, 3523, 2015.