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Journal Name:	Physical Science International Journal
Manuscript Number:	Ms_PSIJ_31581
Title of the Manuscript:	SPATIAL VARIATION MODELING OF GEOTHERMAL GRADIENT AND HEAT FLOW IN EASTERN PARTS OF NIGER DELTA SEDIMENTARY BASIN, NIGERIA.
Type of the Article	Review paper

General guideline for Peer Review process:

This journal's peer review policy states that **NO** manuscript should be rejected only on the basis of '**lack of Novelty**', provided the manuscript is scientifically robust and technically sound.

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(<http://www.sciencedomain.org/page.php?id=sdi-general-editorial-policy#Peer-Review-Guideline>)



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PART 1: Review Comments

	Reviewer's comment	Author's comment (if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)
<u>Compulsory</u> REVISION comments	The paper lacks a review of the model and the validation of the model results. The interpretations of the model are ill presented given the lack of information on the model output. Specifically, the cluster of data used to generate the model are not distributed in a way to confirm that any of the geothermal gradient information presented along the eastern edge of the domain are real. There is only one data point used in the model. Similarly, with the heat flow, the highest predicted flows are associated with the areas with the least (or no data) in the area. While kriging and variograms are an effective tool, the models need to be validated. How well do the modelled values compare to the observed/measured values. What is the confidence of the model outside of the area of the data? Speaking to the data, there is no information provided about the vertical distribution of the gradient and heat flow data. Are the values from the same formations and depths or different depths and formations? If at different depths and formations, how do the authors justify there inclusion in the model? Within the discussion, the authors present possible reasons for the spatial distribution of the gradient and heat flow patterns. The first issue (stated above) is how realistic are the model outputs? Second, the authors suggest a number of factors influencing the thermal regime including tectonic evolution, depth to basement, sedimentary thickness and hydrothermal convection. A statement is made (line 252-254) that the gradients and heat flow are in agreement with other regions that are tectonically inactive, but no data or references are provided to vet the statement. Seismic activity (faults) are stated as a possible migration network for fluid, but no information about the distribution or orientation of the faults	The model has been changed and the result fit the measured data. The vertical distribution was not consider because the maximum bottom hole temperature per well is 4. Outside the measured area the confidence of the model is good. Model is from different depth but within the Agbada formation of the Niger delta.



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	are provided. Are the faults aligned with in a manner that supports the given pattern? Given the differing trends of the heat flow and the gradient, a map showing the distribution of faults would be insightful, but another question needs to be asked concerning the connectivity of the faults to the zones from which the data were derived. Finally, the thickness of the sediment is postulated; however, no information about the thickness of sediment is provided nor is there any information on the distribution of the sediment thickness within the basin (or model domain). While the potential factors may be real, there is no support and reasoning behind any of them. Within the conclusion, the authors state, “The ordinary kriging maps obtained from the variogram models shows a very good estimate of the missing data at the unsampled points.” – There is no verification of this statement within the paper. How is “very good estimate” defined and determined? A presentation of how the modeled data compare to the observed data would help speak to this point. More information about the lithostratigraphy is needed. How thick are the individual units/formations? What is the distribution of the thicknesses? How do the geothermal gradients and heat capacity data relate to the formations presented?	
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<u>Minor</u> REVISION comments		
<u>Optional/General</u> comments	Line 38 – replace “reservd” with reserves Lines 42-55 – Different set of units are presented for geothermal gradient. Both °F/ft and °C/Km are used. Line 45 capitalize d in delta; there are other instances of this capitalization error within the paper that need to be corrected. Line 50-51 – delete the return at the end of line 50 Line 52 – Consistency in the presentation of references – here you provide the authors name with the numbered reference, elsewhere you just present the numbered reference. Line 54 – Delta state is used – this is the first and only use of Delta state, and I am not sure how it is used or what it represents (it may be the Niger Delta-please clarify) Line 56 – “...spatially vary from place to place.” Is redundant Line 70 – “methods is” should be “methods are” Line 71 – insert “to” before predict for parallel phrases Line 58 – “Longitude” does not need to be capitalized Line 85 – replace lithostratigraphy with lithostratigraphic units Line 86 – insert a comma after Agbada. Line 87 – capitalize formation Line 88 – insert a comma after sands Line 89 – replace underlies with underlain Line 89 – insert a coma after Formation Line 95 – insert a comma after phase Line 96-97 – The Rivers Niger and Benue are mentioned in the text as a source of sediment, but their placement/location within the basin is not presented. Include and label the rivers within figure 1 Line 98 – insert a comma after Delta Figure 1 – The values along the x- and y-axes are hard to read. Provide a general/regional location of the area for reference. The data presented for the model domain is a rectangle, use the same shape on the map and make the entire domain is highlighted. The current highlighted area appears smaller than what is defined in the text and within figures 3 and 4. Lines 101-109 – Are the data used distributed consistent along the	



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	vertical dimension? How were outliers defined? It is stated that "...data that are below and above certain values were removed...", but what were the "certain values" and how were they defined? Line 112 – "there is" should be "there are" Line 121 – add an "s" to explain Line 124 – insert a comma after semi-variogram Line 134 _ capitalize and an "s" to gaussian Line 148 – with $Z(s_i)$, the "i" should be subscript Line 148 – add an "s" to account Figure 4 – include the units for geothermal gradient in the axis label. Figure 5 - include the units for heat flow in the axis label. Note that there are only 17 data points accounted for not 18 as mentioned in the text. Table 1 – Include the units for geothermal gradient and heat capacity Figures 7 & 8 – Include the location of the control data points for reference. Note that the units along the x- and y-axes have changed from those in Figures 2 & 3, making it difficult to compare the presented data. Line 232 – the data are stated to be normally distributed, but a visual review of the histograms (Figure 4 and 5), suggest that both datasets are skewed. Were the datasets subjected to normality tests to determine if they are indeed normal distributions? Line 249 – replace "infers" with "inferred" Line 264 – replace "has" with "have"	
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