Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2022-198

Anonymous Referee #1

Referee comment on "A generalized spatial autoregressive neural network method for three-dimensional spatial interpolation" by Junda Zhan et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-198-RC1, 2022

The paper "A generalized spatial autoregressive neural network (GSARNN) method for three-dimensional spatial interpolation" proposed a hybrid machine learning framework for interpolating three-dimensional spatial variables by combining SARNN and a newly developed generalized spatial distance neural network (GSDNN). This mixed neural network can capture the complicated spatial correlation between sample sites and produce a more representative estimate of spatial distance. The authors demonstrate the improved performance of the proposed method over the common interpolation methods of inverse distance weighted and regular Kriging, as well as the SARNN model, using simulated and measured datasets. This work is well-written overall, the approach is clearly explained, and the results are properly examined. However, I believe there are a few topics that require elaboration in order to increase the overall quality of this article. I'm excited to see a new version of this paper.

Major improvements:
1. GSDNN is critical in enhancing the GSARNN model's fitting accuracy. This highlights the significance of obtaining the correct spatial correlation between sample points by taking into account both the dataset's local and global qualities. I'm simply wondering if using GSDNN with traditional approaches will result in better interpolation results.
2. Section 2.1.2 should go over the kriging approach in greater detail. Please explain how the weight coefficient I is calculated.
3. The phrase "weight matrix" appears for the first time on Page 5, Line 6. Please provide some context.
4. You say in section 2.3.3 that you utilize variable learning rate for network training and explain how it changes during the training process. You should also consider the benefits of this customized learning rate.
5. The difference between all of these interpolation solutions is difficult to notice in Figure 11. I recommend graphing the difference between the interpolated and real values (interpolation error) and modifying the color scheme accordingly.
6. It is unclear what the x-axis signifies in Figures 8 and 12. Please include some text and figure descriptions.

Minor suggestions:
1. In section 3.1.1, from Line 19 to Line 22, I suggest not overly emphasizing the benefits of this experiment using the simulated data. This point has been mentioned in earlier paragraphs.
2. In Formula 10, since k_{ij} is 1 for the situation $i \neq j$, then should the off-diagonal elements simply be written as ρ_{ij}?
3. Multiline formulas, such as Formula 6, Formula 19, Formula 30, should be left aligned. The "int" in Formula 26 and Formula 27 seems to be redundant.
4. Page 2, Abstract, Line 3: "which is one of the most important" to "a fundamental".
5. Page 2, Abstract, Line 10: "compared" to "compared with traditional methods".
6. Page 2, Line 17: "continuous data" to "continuous field".
7. Page 2, Line 32: "They" to "These methods".
8. Page 3, Line 7: "Zeng et al." to "In particular, Zeng et al.".
9. Page 3, Line 23: "by combining the GSDNN unit with the SARNN to integrate generalized distances into the spatial interpolation method, we developed" to "by combining the GSDNN unit with the SARNN, we integrated generalized distances into the spatial interpolation method and developed".
10. Page 4, Line 14: "deposit reserves" to "mineral deposit predication".
11. Page 6, Line 6: "speed" to "rate".
12. Page 9, Line 15: "the feature extraction and fitting ability of the GSARNN model are fully and persuasively tested" to "we can fully test the feature extraction and fitting ability of the GSARNN model".
13. Page 9, Line 17: "the most authentic" to "the authentic".
14. Page 10, Line 4: "sudden change" to "sudden variation".
15. Page 10, Line 17: "adds" to "imposes".
16. Page 10, Line 18: "ε" to "The term ε".
17. Page 11, Line 25: "has" to "achieves".
18. Page 16, Line 21: "in low depth area" to "at shallow depths".
19. Page 17, Line 5: "indicating that there may be individual outliers" to "indicating the presence of potential outliers".