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Localized Smart Interpretation - a data driven semi-automatic geological modeling method

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Motivation and Goal

When setting up geological models today, an enormous amount of information may be available, e.g. airborne electromagnetic (AEM) data, borehole data, radiometric data, seismic data, geological information, etc. However, it is only possible to incorporate a limited amount of the accessible information in the geological modeling process due to the very time demanding task of manual interpretation work.
We suggest a methodology to target this problem, which infers a statistical model that describes the relation between geological interpretation and the information available to the geologist making the interpretation. This statistical model is then used to perform semi-automatic geological interpretations wherever the same of information, as used for the initial interpretation, are available.

Process

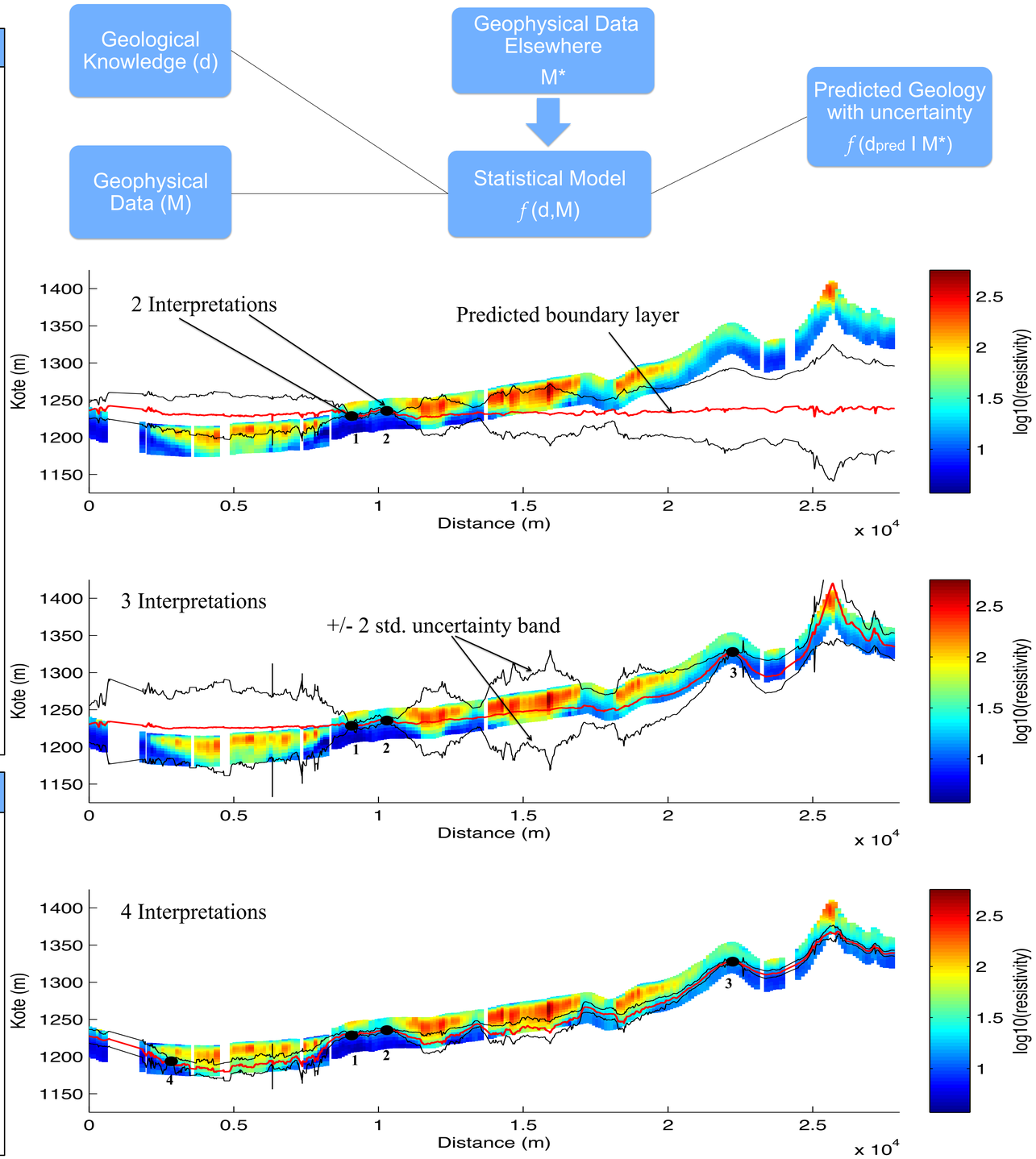
- Parameterize **d** = h (**M**):

$$d_i = \sum_{j=1}^{M} \sum_{p=1}^{P+1} M_{ij}^{p-1} g_{jp}$$

- Find the regression coefficients:

$$g = g_0 + (K^T C_d^{-1} K + C_g^{-1})^{-1} K^T C_d^{-1} (d - K g_0)$$

- Predict geology together with Gaussian Uncertainty.



Figure

The figure shows the 19-layered resistivity model, which is the result of a 1D inversion of EM data from Nebraska. The color represents the resistivity, the black dots represents the depth to a subsurface boundary layer, the red lines represents the predictions for an increasing amount of interpretation points (from 2-4), and the black lines represents the 2 std uncertainty-band of the predictions.

Conclusion

This study shows that LSI is a method, which is able to learn the relation between geological interpretations and a set of attributes, and is able to use this information to very fast and reliably predict a geological interpretation. The method ensures that the predictions are in accordance with the knowledge of the geologist, and is able to use all accessible quantifiable information in the predictions. The speed and the data handling capacity of the method suggest that it will be beneficial to assist in geological interpretation based on large geophysical data sets.

Acknowledgment

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