Some thoughts on the visualization of 3D geological models and their uncertainty

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Visualization of geological cross-sections
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Extension to the visualization of 3D geological models

Model from: Zehner, 2010, „Constructing a volumetric model from a complex 3D structural pilot area in the German North Sea Sector“, RING Meeting 2018, Nancy, France
Visualization of 3D geological models

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Volume rendering versus visualization of geom. primitives (triangles, rectangles)

\[
\begin{pmatrix}
  r \\
  g \\
  b
\end{pmatrix} = 0.3 \begin{pmatrix}
  0 \\
  0 \\
  255
\end{pmatrix} + (1-0.3) \begin{pmatrix}
  255 \\
  0 \\
  0
\end{pmatrix}
\]

Blue box: opacity $\alpha = 0.3$

\[
\begin{pmatrix}
  r \\
  g \\
  b
\end{pmatrix} = \begin{pmatrix}
  0 \\
  0 \\
  255
\end{pmatrix}
\]

Red beam: opacity $\alpha = 1$

\[
\begin{pmatrix}
  r \\
  g \\
  b
\end{pmatrix} = \begin{pmatrix}
  255 \\
  0 \\
  0
\end{pmatrix}
\]
Artificial Model from Zehner et al. (2016), Computers & Geosciences 86
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### Different types of uncertainty

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<td>Presence</td>
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Overview on different methods and examples: State of the art report, GeoERA – 3DGEO-EU project, WP4, June 19
Structural uncertainty
2D color transfer functions (color mapping)

Skua-Gocad color selection dialogs

From Zehner et al. (2010), Computer & Geosciences 36, Elsevier
Geological cross section indicating uncertainty

Uncertainty has been calculated for demonstration purposes only – in reality no quantitative uncertainty assessment has been done.
Imagine a glass cube where the different geological units are shown by using colored glass and where each hue (fully saturated color) represents a different stratigraphic unit. However, near to the interfaces, the presence of a certain unit is increasingly uncertain and for this reason loses its color, becoming transparent or milky. Where different glass-units are glued together (faults, interfaces) reflections become visible.
VTK-Export via plugin

Alternatives:
- ParaviewGeo
- GST

Skua-Gocad, 3D Modeling and Data preparation

Paraview, [www.paraview.org](http://www.paraview.org) „Scientific Visualization“, open source

Export as X3D files

Blender, [www.blender.org](http://www.blender.org), Open source, high quality rendering
Uncertainty has been calculated for demonstration purposes only – in reality no quantitative uncertainty assessment has been done.