From GoogleEarth to 3-D Geology: Seeing below the surface of the Digital Earth

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The visualisation of structural features in a three-dimensional context is an essential aspect of geological understanding - both implicit in the context of imagination, as well as explicit in the form of generated 3-D geometric models. Still, this understanding and intuition does not come naturally to all students, and requires significant teaching effort in structural geology classes. We show here our approach to support this effort with the development of a method that allows the construction of 3-D geological models, directly from features identified in GoogleEarth.

Digital terrain models (DTMs) and satellite images are now widely available and employed in teaching. We use here a specifically easy-to-use combination in the framework of GoogleEarth. This platform allows not only the visualisation of draped satellite images on digital terrain surfaces, but also the selection of significant points, for example identified interface positions between significant geological layers, or the selection of multiple points belonging to a single plane, that can be used to determine its orientation. We provide dedicated Python programs to then process this information for further analysis (e.g. to generate plots of structural data), and to use it as an input for direct 3-D geological model construction on the basis of the newly developed open-source geomodeling package gempy. The result is a geological model which can be visualised and analysed in cross-sections and 3-D views. Furthermore, the intersection with the DTM allows the generation of a geological map, which can be re-imported into GoogleEarth as a map overlay for a direct interpretation of results.

In combination, we aim to provide students methods to gain a better 3-D understanding of features identified in GoogleEarth, and also an insight into the fantastic possibilities that are offered through widely available open data, especially in combination with some basic programming skills and the extensive range of dedicated open-source packages for geoscientific data analysis and visualisation.