3-D STRUCTURAL MODELING USING REMOTE SENSING AND GROUND-BASED LIDAR DATA

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High-resolution remote sensing data and 3D modeling techniques offer new tools for structural analysis that improve the efficiency, accuracy and precision of geologic mapping, and provide insight into the structure of an area that is difficult to obtain otherwise. We combine conventional remote sensing data and geologic mapping with laser survey data into a complete 3D model that constrains the surface and subsurface geometry of a part of the Catalan Coastal Range at the edge of the Ebro Basin, Spain.

For lower relief areas two approaches are used to interpret orthophotos: we interpret on orthophotos in map view and then visualize the interpretation in 3-D by draping the interpretation and photos over digital elevation models, secondly we interpret directly on the draped orthophotos. We find the later approach to be much more accurate in interpreting the surface geology. In areas that are impossible to map in a conventional sense with any precision, such as vertical cliff faces 100’s of meters high, we employ 20 cm resolution ground-based LIDAR. These data are of such high fidelity that surfaces generated from the scans allow delineation of individual beds that can be interpreted directly on the surface in 3-D, similar to interpreting draped orthophotos as discussed above.

To extend the surface interpretation into the subsurface we use an iterative technique exploiting the local 3-D information of surface contacts with cross section construction to ultimately build a self-consistent 3-D model. For surface contacts that have demonstrable relief change, a shallow subsurface 3-D model is created. These provide local structural control for balanced cross-section construction. The cross sections are then used as a framework for building an initial 3-D model. The 3-D model is evaluated with respect to the surface data in areas away from the cross sections for consistency resulting in modification of the cross sections and rebuilding of the model where appropriate. We found that making use of surface data in a 3-D environment such as that described above provides greater understanding of the structure of an area than can be obtained by conventional mapping alone.