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Developing high-resolution geological maps by using LiDAR data in 3D environments: Case study of the Shuanghsi quadrangle map, Taiwan

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The most commonly used 1:50,000 geological maps, which are generally in low resolution, provide only conceptual drawing for geological features. For advanced applications in science and engineering, the traditional geological maps no longer satisfy the requirements of precise 3D geological structures and accurate lithological distribution, particularly for engineering purposes. In order to solve the problem of insufficient accuracy of geological maps, we must apply a feasible set of techniques to further develop high-precision geological maps. Although various types of space measurement technology have made great progress in recent years, their application in producing geological maps is still seriously stagnant. This may be related to difficulty in obtaining comprehensive high-precision terrain models, lack of three-dimensional visual mapping environments, and especially failure to effectively develop techniques or modules needed to produce high-precision geological maps. In this study we used existing high-resolution LiDAR data and the latest computerized 3D environments to conduct and explore high-precision geological mapping. We developed computational modules for geological map production and explore various geological features in three dimensions for overcoming difficulties in traditional mapping. We mapped the terrain of the sedimentary rocks in the fold-and-thrust belt of western Taiwan, which contains typical strata from the Oligocene to Miocene. The study provides a new three-dimensional concept of geological mapping with a finished case example from the Shuanghsi quadrangle map in northern Taiwan. This research is expected to modify traditional geological mapping concepts and provides preliminary mapping techniques to enhance the foundation and strength of three-dimensional geological mapping for the future.