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Alpine fold-and-thrust structures revealed: A 3D model from the Helvetic Zone (Säntis area, Switzerland)

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To investigate the geometrical relationships between folding and thrust faulting, a 3D model of the Helvetic fold-and-thrust belt in Eastern Switzerland is built from several cross-sections in the Säntis area, between Hoher Kasten and Wildhaus. Existing cross-sections from Schlatter (1941), Kempf (1966), and Pfiffner (2000; 2011) were partly redrawn and cross-checked for line length balancing. Additional cross-sections based on surface geology were newly constructed to fill areas with a low cross-section density and to solve geological problems.

The interpolation of the formation interfaces and the thrusts between the cross-sections allowed generating six main surfaces corresponding to the base of the Öhrli and Betlis Limestones, the Helvetic Kieselkalk, the Schrattenkalk and Garschella Formations, and the Seewen Limestone. The main structural elements in the Säntis area, such as the Säntis Thrust or the Sax-Schwende Fault, are also implemented in the model.

The 3D model highlights the shape of the main anticline-syncline pairs (e.g., Altmann-Wildseeli, Schafberg-Moor, Roslenfirst-Mutschen, etc...) and how these fold trains vary in amplitude and wavelength along strike. The model also clearly shows the lateral extension, the trend, and the variation in displacement of the principal faults. The reconstruction of 3D horizons allows the geologists investigating cross-sections along any given direction. The 3D model is useful to understand how the changes of the internal nappe structures, namely folds and thrust faults, change along strike. Such changes occur either across transverse faults or in a more gradual manner. The model can and will also be used as a base to perform retrodeformation and strain estimation. Shortening will be calculated using the base Schrattenkalk as the reference horizon.

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