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Active tectonic structures of Tapo, Longitudinal Valley Fault, Eastern Taiwan, Inputs of HR UAS-DSM combined with PSInSAR

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Taiwan is the result of rapid active collision of the Eurasian and the Philippine Sea Plates (annual average convergence rate: 10 cm.y-1). The Longitudinal Valley is 125km long tectonic active crustal suture zone, trending NNE (N020°E), that separates the Eurasian-related metamorphic Central Range (CeR) from the volcanically-related Coastal Range (CoR). The Longitudinal Valley presents both inter-seismic creeping displacement (Champenois et al., 2013, Deffontaines et al., 2018, and many others…) and was hit by major earthquakes of magnitudes larger than 5 monitored during the last 70 years which highlights its high seismic hazards. We focus and monitor herein on the Tapo area, one of the most active tectonic place by acquiring high resolution topographic data.

We acquired many high-resolution aerial photographs using several drones flying at 350 meters above the ground level. After photogrammetric processing, we calculate both (1) a high-resolution Digital Elevation Model (UAS-HR-DSM) that takes into account buildings and vegetations, and deduce (2) a Digital Terrain Model (UAS-HR-DTM) corresponding to the ground altitudes. Our ground validation (GCP's) leads us to get a 7cm planimetric resolution (X, Y) and not more than 30cm vertical accuracy (Z).

We analyse and interprete structurally our different high resolution UAS surveys done in May 20, 2015, and October 7, 2022, as well as the existing Taiwan available "high resolution topographic DTMs". We made both (1) a morpho-structural photo-interpretation, and (2) from a quantitative displacement point of view using a preliminary PSInSAR (PALSAR-JAXA) processing. The latter led us to better characterize the active tectonic features through a detailed morphostructural analysis. It also permits us to map into much details the active structures and consequently to update the pre-existing geological mappings (e.g. Shyu et al., 2005, 2006, 2007, 2008, CGS geological maps, Lin et al., 2009, and others…). Then we up-date and combined our new structural scheme with geodetic data (levelings, GPS…) and PALSAR PSInSAR results acquired during the same monitoring time period to locate, characterize and quantify the active tectonic structures, taking into account previous works (e.g. Yu et al., 1997; Lee et al., 2008; Hsu et al., 2009; Huang et al., 2010; Chang et al., 2018; Huang, 2020…). Finally, we accurately determined the structural geometries and some geological processes as well as the locations of active folds and active faults during the PSInSAR monitoring time-period. This approach may help to better constrain the seismic hazards and the earthquake cycles of the Chihshang Fault a part of the Longitudianl Valley Fault.

Keywords: UAS DSM, Morphostructural analysis, Active tectonics, structural geology, Tapo area, Longitudinal Valley, Eastern Taiwan