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Inputs of UAS surveys to the shallow Kuenshan (September 17th, 2022) and Chishang (September 18th, 2022) doublet earthquakes (Longitudinal Valley - Eastern Taiwan)

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Two major shallow earthquakes (EQ hereafter) hit the Longitudinal Valley, Eastern Taiwan. The Kuanshan EQ September 17th, 2022 with a 6.4 magnitude and 8.6km depth; and Chishang EQ September 18th, 2022, magnitude 6.8 with a 7.8km depth respectively. The main disasters included one death more than 170 injuries, two houses completely collapsed and many buildings have been damaged. In addition, many bridges had been broken or collapsed as well as roads are affected. So, walking around field studies are limited in space and remain time-consuming. Consequently, we looking for an efficient way to get rapidly and instantaneously a bird's eye view of the major deformations, topographic offsets and destructions that occur after a major earthquake.

We have completed two UAS flights within the Longitudinal Valley flat lowlands, more precisely between north of Fuli and south of Juishui. The first flight was done on September 30th, 2022, in early morning with low elevation of the sun-lights and lead to acquire 7528 aerial photographs above the Central part of the Longitudinal Valley, Eastern Taiwan with a fixed wings UAS. A second UAS survey was settled on October 7th in the late morning with the same planes but with a consistent cloud cover. We acquired 6524 aerial photographs. Both surveys had been processed in order to create two orthophoto mosaic images of the whole area characterized by a ground resolution of 7 to 8cm. Two Digital Surface Models (hereafter DSM) of the whole area had also been processed with the same ground resolution and vertical accuracy of 30cm. Those two UAS surveys show slightly different results due to the progressive erosion with time of the tectonic features, due also to the different sun-light angle and contrasts: the slow elevation of sun lights in early morning highlight small vertical offsets from shadows.

The morpho-structural and micro-tectonic analyses of the whole area had then been done. It gives us a unique overview of the topographic surface deformation due to these earthquakes. Consequently, we first described, localized and mapped the different deformations observed, then we interpreted those in terms of structural, tectonic, gravitational, and hydrogeological point of view due to both major earthquake events. Additionally, for some specific targets, we conducted local flights with quadcopter. These observations were confirmed and validated in the fields.

Consequently, this work enables us to propose an original and common-sense methodology to monitor efficiently and globally, the whole affected area after a major earthquake. The HR

ortho-images are key features highlighting various tectonic deformations and associated deformations, while herein the DSM data appear to be less informative. We show the interest of both investigations of a fixed-wings UAS survey to monitor the global area as quickly as possible after the EQ event in order to select the key areas to study in the fields as well as to monitor locally with quadcopter. The latter greatly improves ground resolution in the short time after an earthquake. This approach needs to be carried out on-site in selected areas to study drone observations from a geotechnical, as well as geological and structural perspective.