Integrating remote sensing geodetic observations for 3D coseismic deformation monitoring

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Understanding surface deformation and damage due to earthquakes is crucial for seismic hazard mitigation and earthquake science studies. With the improvement of geodetic techniques, therefore, geodetic observations have been widely used to detect such surface displacements at local and regional scales. Here we demonstrate some examples of integrating geodetic observations derived from different remote sensing imagery and UAV results to identify surface rupture and surface displacements. For large earthquakes with significant deformation, the pixel offset method is useful for estimating the amount of surface motion and for resolving 3D displacements. For moderate earthquakes, DInSAR, MAI, and pixel offset can provide certain estimates. At a local scale, aerial photos, UAV images, and terrestrial geodetic observations can help us precisely capture surface rupture and localized topographic change. Especially, we focus on the case of the 2022 Taitung earthquake series. The 2022 Taitung earthquake series including M6.4 Guanshan foreshock on September 17 and M6.8 Chihshang main shock on September 18 occurred in the Longitudinal Valley and generated surface rupture for several tens of kilometers. We use ALOS-2 images from JAXA to generate line-of-sight displacements through the DInSAR technique and Sentinel-2 images from ESA to generate N-S deformation through sub-pixel correlation method. The imaging geodesy result shows that major rupture boundary lies along the Yuli fault and part of the Longitudinal Valley fault. The maximum surface displacement is more than a meter. The result of field investigations show that the surface ruptures are along the western and eastern Longitudinal Valley between Rueisuei and Chihshang. The surface deformation pattern suggests that the west-dipping structure should be seismogenic for this event. Together with several major earthquakes along the western valley in recent years, the west-dipping Central Range fault shows separated asperities and high segmentation.

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