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Surface Deformation due to Weak Layer in Urban Area: A Case Study by Multi-Temporal InSAR on Dazhi, Taipei

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The structural collapse incident in Dazhi district, Taipei, during September 2023 has triggered concerns regarding the stability and safety of urban locales. To investigate the root causes and contributing factors to this catastrophic event, an extensive investigation can be conducted using advanced remote sensing techniques. In recent years, multi-temporal InSAR has been widely employed to provide detailed spatio-temporal insights for the urban deformation analysis. Therefore, in this study, MT-InSAR processing were conducted prior to collapsing incident to understand the historical deformation evidence in the Dazhi district. The InSAR results before 2023 unveiled a prolonged localized subsidence hotspot concentrated within a specific block, which includes the site where the building collapsed. These findings also highlight potential construction risks in this particular area. In this research, in-depth analysis revealed a uniform subsidence rate of the order of 20 mm/year over a one-year duration, based on the Small Baseline Subset (SBAS) MT-InSAR technique. This continual downward movement suggests the existence of of a subsurface factor slowly inducing localized ground sinking, presenting a risk specific to the block rather than a broader region. To comprehend the subsurface factor, borehole data from the Taipei Basin were collected, revealing a soil layer with a thickness exceeding 25 m beneath the surface in Dazhi, characterized by a fines content over 60%. The extensive distribution of this thick layer of weak soil has been postulated as the predominant risk factor for construction in the area. Additionally, an analysis of an older map of Taipei City indicated the existence of an ancient lake in the present Dazhi area. The coverage of the ancient lake coincides with the localized distribution of the weak layer the focal point of subsidence within Dazhi. This case study emphasizes the potential of long-term InSAR observation for the monitoring on localized event. Subsequently, a thorough analysis utilizing extended InSAR observations has the potential to proactively assess deformation risks, thereby contributing to the improvement of public safety in urban areas.

Keywords: SBAS; InSAR; subsidence; Dazhi collapse