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Typhoon-Induced Ground Deformation

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Geodetic instruments now offer compelling sensitivity, allowing to investigate how solid Earth and surface processes interact. By combining surface air pressure data, nontidal sea level variations model, and rainfall data, we systematically analyze the volumetric deformation of the shallow crust at seven borehole strainmeters in Taiwan induced by 31 tropical cyclones (typhoons) that made landfall to the island from 2004 to 2013. The typhoon's signature consists in a ground dilatation due to air pressure drop, generally followed by a larger ground compression. We show that this compression phase can be mostly explained by the mass loading of rainwater that falls on the ground and concentrates in the valleys towards the strainmeter sensitivity zone. Further, our analysis shows that borehole strainmeters can help quantifying the amount of rainwater accumulating and flowing over a watershed during heavy rainfalls, which is a useful constraint for building hydrological models.