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UC **SANTA BARBARA**
Department of Earth Science

Earth Science Colloquium

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Inferring the Subsurface Geometry and Strength of Slow-moving Landslides

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The hazardous impact and erosive potential of slow-moving landslides depends on properties such as velocity, surface and subsurface geometry, and the frequency of occurrence. However, constraints on subsurface geometry are lacking because these types of landslides rarely fully evacuate material to create measurable hillslope scars. As a result, most measurements of landslide thickness come from isolated boreholes, which are logistically challenging and expensive to install and are difficult to extrapolate over an entire landslide. Here we use pixel offset tracking with data from the NASA/JPL Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) to measure the three-dimensional surface deformation of 134 slow-moving landslides in the northern California Coast Ranges. We apply volume conservation to infer the actively deforming thickness, volume, geometric scaling, stress, and friction angle of each landslide. We found that the thickness of these landslides can vary by tens of meters within a single landslide and that their geometric scaling falls between typical soil and bedrock landslide scaling. We also found that the largest landslide complexes in our dataset become large primarily by increasing in area rather than thickness. In addition, these slow-moving landslides display scale-dependent frictional strength, such that large landslides tend to be weaker than small landslides. This decrease in frictional strength with landslide size is likely because larger landslides are composed of higher proportions of weak material. Our study represents the first to use the conservation of volume approach for numerous landslides occurring under the same environmental conditions. Our results provide key insights into the subsurface geometry and stresses that control the behavior of slow-moving landslides. Our work shows how state-of-the-art remote sensing techniques can be used to better understand landslide processes for hazards and to quantify their contribution to landscape evolution.