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Reducing landslide risk in an increasingly crowded world

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Much progress has been made in recent decades in understanding, retrospectively, why and how slopes fail. To date, however, earth scientists have not been able to use this improved knowledge to predict exactly where or when landslides will happen. Fatalities and economic losses from unanticipated landslides continue to increase, driven in large part by the relentless increase in human numbers everywhere on Earth. The continued unacceptable economic and life loss will increase pressure on governments, land-use officials, planners, and ultimately earth scientists to develop tools and protocols to reduce landslide risk. Fortunately, we are now equipped with new tools that allow us to better evaluate and monitor potentially dangerous slopes. Traditionally, geomorphology has been an important element in this 'tool kit' – a geoscientist who is able to read the land surface using the lens of geomorphology is best able to evaluate potential hazardous processes, including landslides and debris flows. Geomorphology, however, is no longer sufficient on its own; newer remote sensing tools, notably Lidar, InSAR, and UAVs, have revolutionized landslide science. Used together, they allow earth scientists to view and interpret Earth's surface with a level of clarity that was not possible a few decades ago. In the future, it is likely that automated InSAR routines will be used over large areas to identify sites where slopes are deforming, even at rates as small as a few millimetres per year (a metaphor is finding 'needles in a haystack'). Pinpointing these sites offers the possibility of effectively prioritizing limited resources that are available for detailed ground-based work. In tandem, engineering geologists are making strides in improving the physical characterization of Earth materials and developing and applying sophisticated new codes to numerically model potentially unstable slopes and simulate their failure. A limitation in all landslide studies is sparse subsurface data. Yet advances are being made even here with the development and use of new geophysical tools are being to map the subsurface more accurately than was possible in the past. The greatest challenge to reducing landslide risk lies outside natural sciences and within the arena of societal decision-making process. In this context, important questions that must be answered include: How can our improved scientific understanding of landslide hazards at local and regional levels be effectively incorporated into land-use decisions? What procedures can we offer governments and the public to allow them to better understand landslide hazards and risk and to decide what level of that risk is acceptable?