U.S. Geological Survey Subduction Zone Science at Many Scales

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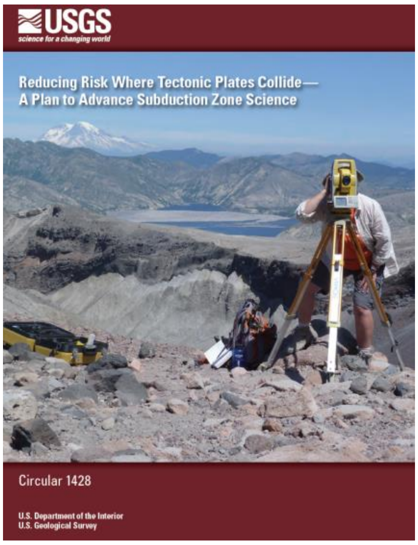
The U.S. Geological Survey (USGS) shares the growing enthusiasm for advancing subduction zone science to reduce the risks associated with nature's most powerful geologic hazards, expressed by Earth scientists in academia and various government agencies worldwide. The USGS's enthusiasm has motivated new goals and activities, guided by its 2017 publication "Reducing Risk Where Tectonic Plates Collide—A Plan to Advance Subduction Zone Science". The Plan describes strategies to advance the science that enables the USGS to address stakeholder needs. It focuses on three themes, which consider not only the primary geologic hazards – earthquakes, tsunamis, volcanic eruptions, and landslides – but also the cascade of phenomena these initiate.



The first theme is understanding subduction zone processes. An illustrative earthquake-related example focuses on understanding the plate-boundary earthquake cycle, by developing new methods to date paleo-events more precisely and accurately. The second theme aims to quantify hazards and risks. Example projects explore the use of landslide signatures to constrain earthquake chronologies, high-resolution bathymetry and offshore subsurface imaging to map splay faults and potential submarine tsunami-genic slope failures, and high-resolution ground-motion modeling. Engagement with engineers, emergency managers, ecologists, policy makers, and insurers should ensure that products such as high-resolution probabilistic tsunami or urban hazard maps, effectively convey the likelihood and impacts of earthquakes in useful ways. The third theme addresses the USGS's mission to provide forecasts and situational awareness. For earthquakes, example projects build on current capabilities by expanding post-event forecasts to include cascading phenomena, such as the impacts of long-lived land-level changes following megathrust earthquakes. The Plan acknowledges the key need to nurture multi-disciplinary partnerships within and outside the USGS, to share expertise and resources. While focused on U.S. subduction zone processes and their impacts, the Plan emphasizes the need to engage in global activities, as exemplified by this UJNR Panel on earthquake research.

Significant progress toward meeting some of the Plan's goals has been made over the last few years, particularly with respect to earthquakes in Cascadia, which is a current focus area for the programs that comprise the USGS Natural Hazards Mission Area. One major project addresses the specific charge of quantifying the sizes and repeat times (recurrence) of great Cascadia megathrust earthquakes, in a way that is consistent with all possible observations and physical models. These include constraints from paleoseismic studies of land-level changes, tsunami deposition, and upper-plate faulting; geologic and geomorphic records and models of past landslides; offshore evidence of turbidites and seafloor morphology; historic and modern seismicity; geodetic observations; and numerical models of the earthquake cycle and its signatures. In addition to integrating all existing data, observational gaps are being identified and activities are underway to fill them, particularly offshore. Some preliminary findings of paleoseismic studies suggest established interpretations of the slip distribution in the last, great megathrust earthquake of 1700 may require significant modification. New analyses of the signatures of turbidites in offshore cores illuminate tremendous non-uniqueness in often-cited interpretations of these data and inferred earthquake chronologies.