

HOW DO YOU ESTIMATE SLIP RATES FOR A SITE YOU CANNOT ACCESS? BUILDING A FRAMEWORK FOR SURFACE AGE INFERENCE FROM MODERN REMOTE SENSING DATA

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One challenge for many slip rate studies is finding an appropriate site that contains faulted features and datable material. This can be difficult under ideal circumstances, yet there are many situations where field visits are unfeasible, due to concerns of safety, accessibility, or regulatory concerns. One such example is the central Garlock fault, at the intersection of the Garlock, Brown Mountain (Panamint Valley), and Owl Lake faults, which is co-located with a 50+ year old bombardment range and represents a significant safety risk from unexploded ordnance for field-based studies of slip rates on those faults. Widely available LiDAR datasets allow for the remote measurement of offset geomorphic surfaces and fault scarps, yet inference of surface age is a greater challenge. Additionally, recent work has highlighted the variability of surface ages within a single fan surface unit, such that a single or few ages on a fan may be inadequate.

Quaternary alluvial surfaces in arid environments follow a predictable change in morphology and surface character with increasing age. Bar and swale morphology eventually degrades into a smoother desert pavement, which is eventually dissected and eroded. Surfaces darken with age with the deposition of desert varnish and with the winnowing of fines. These properties are well documented and are commonly used for the determination of relative ages and pose a promising means of estimating the absolute age of a surface. To establish a relationship linking surface properties and the absolute age, we cataloged hundreds of existing surface ages across the Mojave Desert and adjoining regions. Many of these sites are surveyed with LiDAR and imaging spectroscopy, and all are imaged with standard instruments like ASTER, Landsat 8/9, Sentinel 1 & 2, and ALOS PALSAR. We use these data, along with observations of surface roughness and estimations of the erodibility of surface materials to determine the relationships linking these properties and surface age. This varied collection of complementary data types lends itself well to machine learning techniques such as ensemble regression and supervised learning with artificial neural networks. We are building this methodology to be a useful new tool for estimating the age of unknown surfaces and interpolating the age of surfaces with a known age.

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