

Harvard University -- Solid Earth Physics Seminar
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***Earthquake surface ruptures as a
tool to get insights into earthquake
behavior and fault segmentation***

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Abstract:

During recent years several catastrophic earthquakes have struck various part of the world, with a very large number of fatalities and major economic losses. Although in most cases earth-scientists knew the faults responsible for these large events, it yet remains impossible to forecast earthquake occurrence to limit their impact on the society.

Several competitive models of earthquake occurrence exist, which propose various scenarios, ranging from totally random earthquake distribution to perfectly periodic earthquake series, following probabilistic or deterministic approaches to determine the maximum magnitude earthquake to be expected on a fault. Careful observation of field evidence related to past earthquakes might be a way to bring some constraints to limit the range of possible models and to give some insight on the fault structure itself.

A systematic measurement of landform offsets related to a series of earthquakes along the Fuyun fault, in China, revealed that along that fault earthquake rupture would tend to be identical during each earthquake, promoting, in that case, the model of characteristic slip.

Using air-photos shot right after the 1940 Imperial fault earthquake, USA, we could look into more details of the slip distribution and show how the slip patches seen at the ground surface match the slip patches determined by seismologists, suggesting that some segmentation of the fault exists that control the seismic rupture.

On that base, a systematic observation of ground rupture maps and kinematic slip inversions for large strike-slip earthquakes in continental setting reveals that the segmentation is present, and that its characteristic length seems to be independent of local tectonic context and rather be related to the thickness of the seismogenic crust. These several examples show that if field observation cannot directly improve our capability to forecast earthquakes, it can be helpful to predict earthquake behavior and build more realistic rupture scenarios.