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Effect of lithospheric model assumptions on the interpretation of geodetic data

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The use of geodetic measurements to evaluate the slip rate (thus slip deficit) along a fault during the interseismic period is a very important tool for seismic hazards assessment. The geodetic measurement itself, however, is only telling us the movement (or relative movement) of selected points and therefore is not a direct measurement of the fault slip rate. In order to determine the fault slip we need to introduce different assumptions on the behavior and the properties of the lithosphere surrounding the fault. Different assumptions are used to model geodetic data: from fairly simple rigid plate motions or elastic half-space dislocations to more complex numerical models taking into account more complex rheologies and/or geometry. Although all these models have different rationales for why they are used, it is important to recognize that the choice of the model can influence the geological interpretation of the data. For example the widely used elastic half-space model is a very easy to implement and fast way to analyze the data. Despite its overly simplistic assumptions this model in general can be made to fit the geodetic data quite well. Unfortunately, this model does not incorporate the effects of the earthquake cycle and the viscoelastic behavior of the lower crust/upper mantle. These effects can be very large in cases where the recurrence time of seismic events on the fault is very long with respect to the viscous relaxation time. This can introduce large biases if we are interested in partitioning the strain among faults in different stages of their earthquake cycle. On the other hand the modeling community is moving toward models that are increasingly complex to better represent geologic reality. Here we test the effects of some of the assumptions in widely used models on the observable surface velocity field in order to evaluate (1) how these assumptions can bias our interpretations and (2) how well resolved are these assumed model complexities. In particular we look at the effect of 3 different charac-

teristic times of the system: a tectonic time-scale (earthquake cycle), a rheological time (relaxation time), and an observational time.