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Constraining the kinematics of large earthquake sources with the phases of the Earth's free oscillations

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By using Very Long Period seismological and gravimetric data, we have recently shown (Lambotte et al., 2006) that it is possible to measure the phase of the individual split singlets of the Earth's gravest free oscillations excited by large enough earthquakes. These phases contain the information of the synchronization among the different ringing modes and are intimately related to the kinematics of the earthquake source. In the present work, we explicitly address the question of the nature of the relationship linking the kinematic source model parameters and the dataset containing the phases of the singlets. First we state the solution of the direct problem, in which a source model is given and we search to predict the phases (and amplitudes) of the individual split singlets. We consider models with different degree of complexity: unilateral or bilateral rupture propagation, constant or tapered slip distribution, constant or variable rupture velocity, etc. Secondly we focus on the inverse problem. In this case, a set of phase measurements is supposed known and we search for the model best explaining these measurements. We particularly explore the question of the uniqueness of the solution with more or less complete datasets. This is important in practice because of the high variability of the degree of excitation of different singlets, even within a given multiplet for the same event and station. Finally, we apply these results to some recent large earthquakes: Peru 2001, Sumatra, 2004; Nias, 2005 and compare to available independent results.

References

Lambotte, S., L. Rivera and J. Hinderer, (2006), Rupture length and duration of the 2004 Aceh-Sumatra earthquake from the phases of the Earth's gravest free oscillations, *Geophys. Res. Lett.*, in-press.