



FINITE ELEMENT MODELING OF THE 2004 GIANT SUMATRA EARTHQUAKE POSTSEISMIC DISPLACEMENT FIELD

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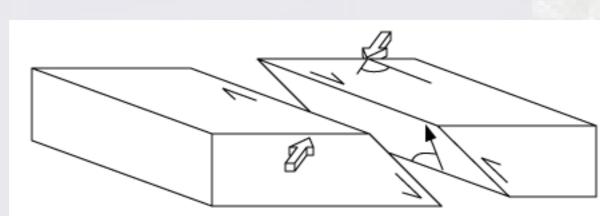
Horizontal displacement

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INTRODUCTION

The great Sumatra-Andaman earthquake of December 26, 2004 was one of the largest earthquakes ever recorded since 1900. The earthquake resulted from complex slip on the fault along the subduction zone where the oceanic portion of the Indian Plate slides under the Eurasian Plate, by the Indonesian island of Sumatra. The direction of convergence of the subducting plate relative to the overriding plate is oriented oblique to the trench axis and the rupture occurred for 1200 km along the interplate megathrust.



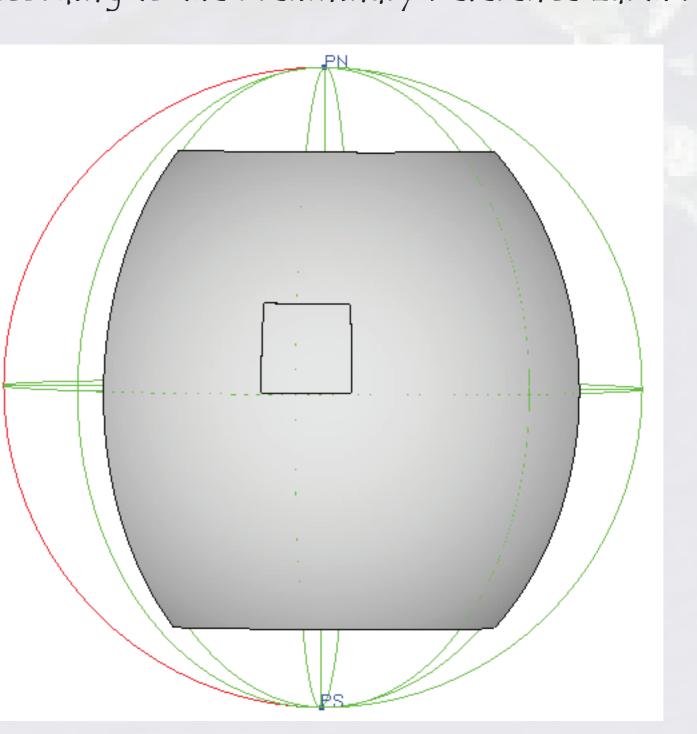
In the present work we use a new computational FEM strategy to model the deformation field associated with the Sumatra earthquake. We are able to study the joint effects of sphericity and 3D geometrical and rheological heterogeneities on the investigated observables. The comparison between our synthetic results and the available deformation data will allow us to ascertain if complexities in the physical properties of the medium could play an important role in assessing the deformation field besides source properties.

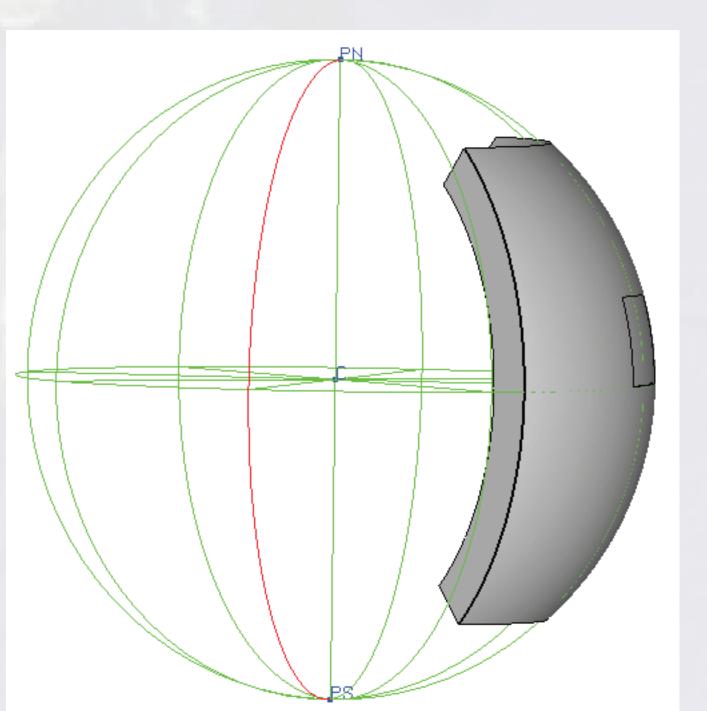


THE MODEL

We built up a spherical domain consisting of a portion of spherical zone \sim 1000 km thick spanning about 90×10^6 km² on the Earth surface.

A layered model having elastic rheology was introduced, based on the volume averaged mean values of the Lamè parameters according to the Preliminary Reference Earth Model (PREM, Dziewonski & Anderson, 1981).





For this preliminary study, the domain was meshed with 38348 20-nodes brick elements resulting in a mesh containing 171534 nodes. Such a mesh takes 44 minutes for each simulation on a 64-bit Intel Xeon 3.2 GHz, 8 GB RAM.

Next investigations will require the same domain discretized with a much finer mesh to increase resolution and capture more detailed features.

For details on the method we refer to poster "FEMSA: A Finite Element Simulation Tool for Quasi-static Seismic Deformation Modeling" (Ref. number 1484).

As far as the SOURCE is concerned, we started from the model proposed by Tsai et al. 2005, consisting of five CMT point sources. Then we overcame this model going towards next levels of approximation, i.e. linear and planar source.

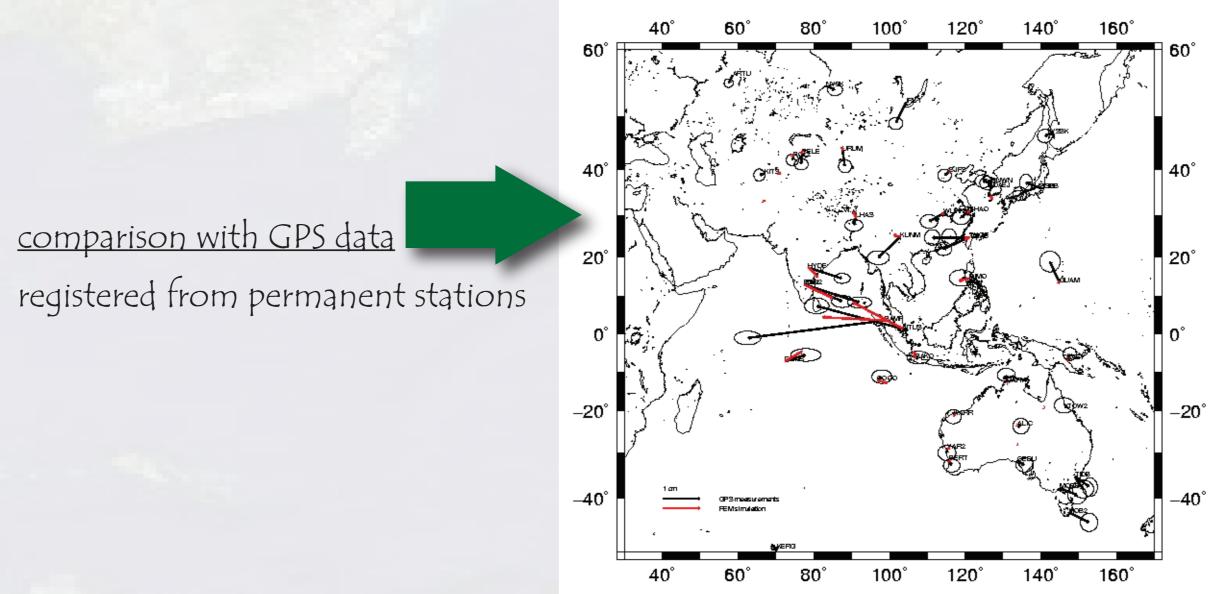
V.C. Tsai, M. Nettles, G. Ekstrom and A.M.

Dziewonsky, GRL 32 (2005): L17304

Table 2. Source Parameters for the Final, Five-Source Model^a

components of the individual sources are also listed. The centroid locatio

and time for the composite source are 6.6°N, 93.0°E and 214 s.



Standing on our preliminary results, the fault geometry (as far as a homogeneous moment release is considered) seems to be not crucial in defining the displacement field generated by the earthquake, at the spatial scale involved in our analysis. Obviously the model needs to be improved, introducing a more realistic rheology and adding lateral variations of the medium properties and heterogeneous moment release. It could be expected that such geometrical and

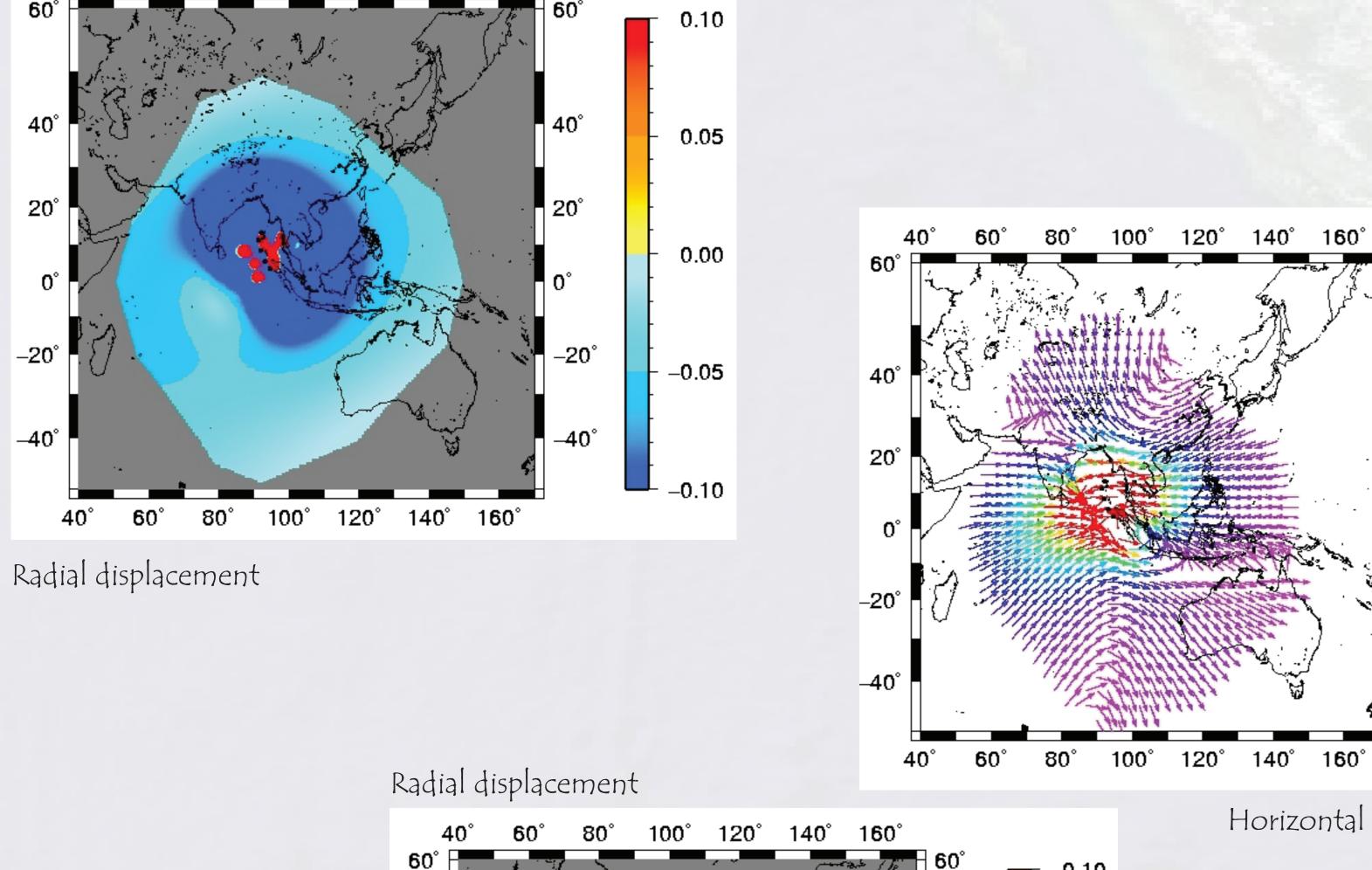
CONCLUSIONS AND PERSPECTIVES

We started to investigate the 2004 Sumatra earthquake by means of a novel 3D finite element approach. At first, a quite rough model based on an elastic layered spherical domain was used, obtaining promising and encouraging results, as confirmed by the comparison with GPS

rheological complexities play a relevant role.

WHAT DO WE WANT TO DO IN THE NEXT FUTURE?

- 3D meshing (mechanical and rheological lateral heterogeneities)
- heterogeneous moment release
- modeling of the slab
- surface topography
- internal interface topography



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