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Solid Earth
Discussions

Interactive comment on "AxiSEM: broadband 3-D seismic wavefields in axisymmetric media" *by* T. Nissen-Meyer et al.

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AxiSEM represents probably the most effective computational advance in global seismology since the development of the reflectivity method fifty years ago - all the alternatives, including Specfem, are hampered by practical or theoretical limitations. I therefore welcome very much the publication of this paper, which is written for the average user, who may be glad not to have to struggle through the original papers!

I have not had the time to download the latest software and try it, so this review is purely based on reading the m/s. On the whole the paper is very readable, it gives just enough theoretical information to allow the reader/user to understand what is in the 'black box', and it is full of useful suggestions. I have however a few suggestions for improvement:

(a) I understand this version can deal with real oceans, i.e. a fluid layer over a solid crust and mantle. If that is correct, this is a major improvement, since oceans were not present in the original papers from 2007/8 and real ocans are still absent from Specfem. Yet it is only mentioned in passing, and not even in the abstract! Though I understand the authors wish to refrain from an extensive theoretical description, this seems a little too modest, since it leaves me with a few questions: is the meshing for the fluid layer automatic or does the user have to be careful? Has it been tested? I assume one cannot yet implement an ocean only over part of the surface since topography is on the 'todo' list.

(b) I am unhappy with the discussion of 2.5D applications in sections 5.5 and 5.6; in a global setting no geological or geodynamic features extend for long in the azimuthal direction, not even subduction zones. The modeling of such features by implementing the heterogeneities in AxiSEM is thus fundamentally unrealistic, but - since it overestimates the visibility of effects in the seismogram - can be used to show that features are unresolvable given the frequency content of the wave. *Not more than that!* For 3D effects, only Born theory can be used to model reflected energy in the waveforms, model small time shifts of transmitted waves (but to a very limited extent), or predict cross-correlation delays (over a much larger range of velocity anomalies). Thus, I disagree strongly with the statement at the end of section 5.5 that such 2.5D modeling gives 'a realistic grasp of wave effects', and I am afraid that innocent readers may start modeling ULVZ effects using AxiSEM. I disagree equally with the statement in section 5.6 that tomography models 'can be honored by a 2.5D rendition'. Please do not encourage use of 2.5D to model wave propagation in 3D - if users start doing this it will create havoc in the literature, lead to wrong papers being accepted by unwary reviewers, or to large numbers of rejections if the reviewer is alert, and sooner or later give computational seismology a bad name.

(c) Fig 7 on my printout the top figure (mesher) is not well visible, and there are not enough numbers to ake it easy to read th vertical axis

(d) Legend of Fig 8: explain ewhat is the 's-direction'

(e) Fig 12, legend: at first I did not understand the last sentence: '... and includes phase (PM)...', until I noticed this refers to the text written above, and not to 'Time in these panels...'.

(f) Fig 13: I would be curious to see a comparison of the phase, since this is much more diagnostic than the amplitude spectrum.

(g) Fig 18: Am I mistaken or is this a seismograph at (large) depth? If so why not at the surface?

Interactive comment on Solid Earth Discuss., 6, 265, 2014.