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Interactive comment on “Tomography of the 2011 Iwaki earthquake (M 7.0) and Fukushima nuclear power plant area” by P. Tong et al.

Anonymous Referee #2

Received and published: 4 January 2012

This paper makes use of an excellent earthquake dataset to generate detailed seismic images of the crust and uppermost mantle beneath the region of the 2011 Iwaki earthquake and Fukushima nuclear power plant area. The results provide important new insight into the plate dynamics of the region and have implications for mitigating risk associated with future earthquake hazard. I would recommend publication after a few minor corrections/clarifications.

SPECIFIC COMMENTS:

(1) It would be useful to have a few more details about the finite frequency tomography, such as the range of frequencies that are exploited. I realise that in the interests of brevity, this may not be possible, but perhaps a paragraph in the supplementary section would be useful.

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(2) Were hypocenter locations simultaneously inverted together with the velocity structure? I presume it is the same as the 2011 paper (by the same author) that is cited, but it would be good if it were stated explicitly in this paper.

(3) The V_p and V_s images that are produced are quite convincing, but the maps of Poisson's ratio are perhaps less so. This is because the V_p/V_s ratio is obtained simply by taking two independent measurements from separate inversions and dividing them. If solution non-uniqueness wasn't a factor, then this would be fine, but in reality an iterative non-linear inversion approach is used and solution uncertainty is poorly known. Thus, implicit and explicit regularisation will play a role in the production of the particular solution that is retrieved, and while the pattern of anomalies recovered may well be robust, the amplitudes of the anomalies are likely to be less so. Given that the pattern of Poisson anomalies is in general not a function of the pattern of V_p and V_s anomalies, then it is vital that the amplitudes are correct. It has been long recognised in local earthquake tomography that separately inverting for V_p and V_s and then combining the result to obtain the V_p/V_s anomalies doesn't usually work, which is why most people simultaneously invert for V_p and V_p/V_s ratio. However, this assumes that the P and S paths are identical, so is probably not ideal in regions of high heterogeneity. I'm not really suggesting any wholesale changes here, just a bit more discussion as to the implications. I suppose it may be that the data coverage is so good that amplitude recovery is reasonable (as suggested by the recovery tests), particularly when finite frequency tomography is used, so the approach taken is acceptable. The fact that the ray and finite frequency results appear similar is also an argument that could be used.

TECHNICAL CORRECTIONS:

(1) Figure 6: Part (b) should be labelled as V_p , not V_s

Interactive comment on Solid Earth Discuss., 3, 1021, 2011.

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