



Interactive comment on “The link between great earthquakes and the subduction of oceanic fracture zones” by R. D. Müller and T. C. W. Landgrebe

Anonymous Referee #1

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This paper provides evidence for an association of great earthquakes and the locations where major fracture zones impinge on subduction zones. The greatest earthquakes are composite events covering at least 500 km of the coupling zone. The initial phase of such events, which is most likely to be influenced by local structure, may well be no larger than Mw 8.0. What is not established in this analysis is a reason why the influence of a fracture zone should extend across a substantial swath of a subduction zone and thereby encourage the production of the largest events. What physical process is likely to set the 150 km threshold for the zone around the presence of a fracture zone? The circumstantial correlation is intriguing, but not fully compelling.

C531

The "top-N" analysis has its merits, but the fact that the second largest event does not show an association with the presence of a fracture zone means that despite the strong correlation of 13 /15 largest events, we cannot rely on this association. Clearly the presence of fracture zones should be taken into consideration for possible other sites of great earthquakes but it cannot be the sole criterion. In consequence the "seismic hazard" map in Figure 5 needs to be described in terms of this particular contribution. Seismic hazard is commonly described by probabilistic representation of ground acceleration and this is not what is presented in Figure 5!

The critical figure 1 is presented at far too small scale, even with a factor of 4 enlargement it is difficult to pick out the red stars for the largest events. Ironically the grey symbols for the next group of events are easier to see. For these biggest events an oval shape representative of the extent of the event along the coupling zone would seem more appropriate, with perhaps a star at the epicenter. If the authors wish to press for an association with just the epicenter, then they need to provide some reasoning for why the presence of a structural feature would encourage triggered larger failure. The apparent separation of sites of high and low frequency radiation in the 2011 Tohoku event by a structural feature that might be the extension of the Kashima FZ, does not by itself explain why the great event occurred in that region.

With respect to the way that a fracture-zone should interact with the coupling zone for megathrust events a number of questions come to mind as to the expected effects: How much of the fracture-zone ridge topography can be expected to survive into the subduction zone? What is the influence of the strike of a transform relative to the trench and convergence direction?

Tomographic studies seem to suggest that the arrival of major volcanic ridges/plateaus can have a significant effect on the overall morphology of subduction zones, in contrast to seamounts. It may well be that these two types of interaction should be treated separately, but in that case the issue of statistics for very small numbers becomes even more important.

C532

Minor points:

Mb - body wave magnitude saturates at around Mw 5.5 so is only suitable for small events - not as stated.

Section 2.5: A clearer explanation is needed of the "arbitrary case" - it appears that this means the situation in which an event occurs by chance - but perhaps "stochastic" would be a better term.

Section 2.6: The term "baseline hazard zone" appears suddenly - is this meant to be the same as the "baseline coupling zone". This entire section could benefit from expansion so that the arguments are easier to follow.

In Figure 3 it is not clear whether the convergence rates are trench perpendicular or absolute.

The slip mechanisms from Robinson (2007) shown in Figure 4 seem rather different from other published models for the 2004 Sumatran event that would not appear to show such a direct link to impinging structure. Further is "slip" rather than "energy release" the right quantity to consider? Slip is highly dependent on the local seismic wavespeed structure.

Interactive comment on Solid Earth Discuss., 4, 1229, 2012.