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Interactive comment on "Causes of earthquakes and lithospheric plates movement" *by* L. Ostřihanský

Anonymous Referee #2

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General comments

There are many attempts to detect a clear correlation between earthquake occurrences and the lunisolar phenomenon. One of these is the contribution by L. OstřihanskÃ¡ "Causes of earthquakes and litospheric plate movement". The title is misleading; it suggests indirectly that the seismic activity is due to lunar and to a lesser extent due to solar gravitational influence on the Earth and not due internal dynamical processes of the Earth. Author has two targets:

1) he is going to prove triggering earthquakes by LOD variations in the frequency band

of zonal tides and among them first of all by the lunar declinational wave Mf,

and

2) to describe plate motions as a consequence of gravitational influence of the Moon on the terrestrial tidal bulge. In this second case Author's usage is sometimes not accurate: here the discussed phenomenon is non-tidal but gravitational.

1)The presence of all three lunisolar components (sectorial, tesseral and zonal) in LOD records is proved since the middle of nineties of last century by VLBI and continuous GPS observations completed by the International GPS service. The amplitudes of main tidal waves are (10-3-10-4) second. As far as the corresponding rotational energy variations (ΔErot) are concerned, which can be calculated with ΔErot=1/2Cω2$\Delta\omega$= 1/2Cω2ΔLOD(LOD)-1 (ω is the angular speed of Earth's axial rotation) the zonal tides are the most important. ΔErot in case of Mf wave is 7.4ïČŮ1020 J. The comparison of ΔErot with energy released by greatest seismic events suggests that the energy variations caused by ΔLOD probably can influence the temporal distribution of the seismic activity, because they energies are well above the earthquake energy values. Based on the foregoing, I have to say that Author's attempt to study the triggering of earthquakes by LOD is reasoned. However, I would like to note the following - Due to the fact that ΔLOD caused by zonal tides generates flattening variations, the elastic stress accumulation is different at different latitudes. Between the equator and latitude 48.20 (critical latitude) the azimuthal stresses are dominant above the meridional ones (strike-slip province), while at higher latitudes the role of these two stress components is similar (normal fault province). If zonal tide triggering does play a role this stress distribution also should be detected. - It is not clear what kind of seismological data was used by the Author for his studies. For example it is mentioned in Table 3 that for the East Honsu region he used some hundred events M$\geq$5.8 for the time-interval 2000-2011.06. But all the events after of the Tohoku earthquake from this source region are not independent (they are aftershocks). Probably the events some weeks before 11. 03. 2011 are also not

independent from the main shock M=9.0 (foreshocks). The use of these events for a statistical investigation therefore is questionable. The time dependence of independent and not-independent seismic events should be investigated independently. Furthermore it seems to me (although the resolution of Fig. 5a at my disposal is not sufficient) that the main event and its foreshocks are situated in the close vicinity of extremum of the LOD curve but not exactly on its peak. -Fig. 2b not illustrates the displacement of the whole Okhotsk plate eastward over the Pacific plate. The displacements are connected with movements within the source zone. Most of the 27 focal mechanisms given in the Harvard CMT Catalog for the deep events of this area with MW $\geq$ 7.0 occurred in the time interval 1976-2005 have a major extensional component consistent with an accelerated mantle flow through narrow structures (e.g. Hilst van der, R. D. 1995. Complex morphology of subducted lithosphere in the mantle beneath the Tonga trench, Nature 374: 154–157) across the lower boundary of the C layer, so the Pacific plate penetrates under the Okhotsk plate. Link of this event with the South American events seems to me unfounded. Unfortunately, similar remarks can be made in case of other source zones investigated in the paper. - It should be mentioned that the triggering effect by Mf wave was mentioned earlier by several authors (e.g. Defraigne P., and Smits I., 1999, "Length of day variations due to zonal tides for an inelastic earth in non-hydrostatic equilibrium", Geophys. J. Int., 139, pp. 563-572; Stavinschi M., and Souchay J., 2003, "Some correlations between earthquakes and earth tides", Acta Geod. Geoph. Hung., 38(1), pp. 77-92). 2) When Author describes plate motions as a consequence of gravitational influence of the Moon on the terrestrial tidal bulge it should be mentioned that the main source of plate motion is the mantle convection. The gravitational effect of the Moon on tidal bulge, the tidal friction, is not a tidal phenomenon; physical nature of it is gravitational. According to many authors the despinning of the axial rotation influences (but not determines) the plate motion (e.g. Doglioni C., Carminati E., Cuffaro M. and Scrocca D. 2007. Subduction kinematics and dynamic constraints. Earth Sci. Rev., 83, 125-175; Doglioni C., Tonarini S., Innocenti F., 2009. Mantle wedge asymmetries along opposite subduction zones. Lithos,

113, 179-189; Bostrom,R.C.,2000.Tectonic consequences of the Earth' s rotation. In Oxford University Press, pp.1–266; Bostrom,R.C.,1971.Westward displacement of the lithosphere. Nature 234, 356–538).

Specific and technical comments

I believe conclusions concerning displacements of plates (including the case the paleocontinents) in their present form are not suitable for publication. Author's claims are unfounded. As far as the part of the paper dealing with triggering of earthquakes by LOD variations is concerned it should be developed: more exact use of input seismological data is necessary and a physical model is needed to explain how the LOD acts on seismic sources when triggering the quakes. The formal errors make more difficult the understanding of the text. The referenced literature in the text not corresponds exactly to the listed references at the end of the text. Equations in Section 3.1 are related not to the plates as it is suggested by the title but to the tidal bulges. The origin of the equations in this section needs or references or some explanation and the meaning of notations (e.g. Re, mS) should be given throughout.

Interactive comment on Solid Earth Discuss., 4, 1411, 2012.