Solid Earth
Discussions

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Interactive comment on "Density structure and isostasy of the lithosphere in Egypt and their relation to seismicity" *by* Mikhail K. Kaban et al.

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Received and published: 9 April 2018

Mikhail Kaban and colleagues present in their paper an interesting study linking the seismicity distribution, mantle density structure and isostasy in Egypt and the southeastern Mediterranean region. They compile an extensive database of controlled-source and passive seismology data to constrain the crustal model. The conversion of global shear wave velocity model for the mantle is done using mineral physics constraints. The starting density model is further improved using the inversion of both gravity anomalies and residual topography. Their results show that the dense lithosphere in northern Egypt corresponds to a low-seismicity region whereas the less dense lithosphere in the northern Red Sea and the Gulf of Aqaba are more seismically active. The authors also find an intersting relation between isostatic anomalies and distribution of

seismicity.

The presentation of the paper can be improved. The first-order structure of the lithosphere: the regions of continental cratonic and extended/oceanic lithosphere is not easy grasp from the figures. The location of plate boundaries and continent-ocean boundaries would be very useful to show in the figures (both in Red Sea and Mediterranean). Would useful to emphasize which lithospheric plates are involved (Africa, Arabia, Sinai. . .). The figures can be improved. The small symbols for earthquakes are hardly seen (both in maps and cross-sections). Perhaps, zoomed plots for the seismically active regions can be included. The density perturbation plots are a bit confusing. Perhaps, a couple of transects with absolute densities and seismic velocities can be shown. Could the location of transects located be added to the maps showing the distribution of seismic events?

Detailed comments to address for improving the paper:

Page 2. Line 2. Âń..compositional variationsÂż in the mantle. What about compositional variations in the crust vs temperature Line 12. Which studies: controlled-source, ambient noise etc. please, detail. Line 25. "..satellite and terrestrial data" including land areas (complementary to satellite radar altimetry). Line 30. "1-2 parameters" what are these paramteres? Thicknesses, densities? Line 31-32. "..gravity approach". Do you mean inversion? Page 3. Line 1. "entirety" do you mean entire? Line 5. "marginally touches" ? do you mean "partly covers"? Line 6. "low seismicity in northern Egypt..". Why does it appear anomalous? Please, explain. Line 9. "shear zones". Where are these shear zones located? Hardly can be seen in the figures..Please, show these shear zone more in the figure. Figure 1 can be improved to make visible earthquakes and faults. Line 24 Do you mean Arabian Plate? Please, detail.. Page 4. Figure is very busy. Perhaps, presenting zoomed northern Egypt would be useful. Please, show more clearly shear zones.. What are the "principal trends" of plate motion? Page 5 Line 23. "existing global dynamic models". Which one is used in this study? Page 6. How do you find the isostatic topography? Do you do iterations? Do you have analytic

formula? Page 7. Please, add COB and location and type of plate boundaries in the figure. Page 8. "p-wave" velocity, "P-wave" velocity or "Vp" ? please, choose one. Page 9. Location of seismic determinations are confusing because of association with seismicity distribution. Could you improve it? Is the interpolation/extrapolation of crustal thickness based on singular measurements (e.g. southern part of figure)? Perhaps, would be necessary to blank the area beyond certain search radius of interpolation. Could you add an uncertainty estimate from kriging? Line 18. "initial density model". Sometimes absolute densities and density perturbations are interchanged in the text and formulas. Could you make it clear what you are talking about in each particular case? Page 10. Line 17. The absolute densities would be important for computation of residual topography. Please, detail. Page 11. Line 7. 1x1 degree resolution. What do you mean? Grid cell size? Line 9. Why 325 km depth? Please, explain why you chose with depth as a lower limit of the model. Page 12. Line 6. "rho_ref". Does it refer to Table 1? Please, comment on the application of this formulation to oceanic domains.. Page 13. What is the difference between "t_res" and "t_dyn" do you use the different "B" operators to compute them. Do you obtain isostatic topography using the compensation depth of 325km given mantle density model? Do you iterate? Please, detail..

Line 14. "The anomalies at the 45 km depth". What kind of anomalies (not clear)? Gravity anomalies? Page 14. Can you show a difference plot between starting and final density model? This would be very useful to appreciate the inversion results. How much the initial model was updated comparing various regions? Page 15. Please, show a profile with absolute density/seismic velocity to better present the lithospheric structure. Please, show the location of transects and epicenters on the same map. Line 3. "vertical resolution". What resolution you are talking about? Do you have a reference for that? Page 17. Line 3. "neutral or slightly positive densities". Better small positive density anomalies. "Shallow Moho discontinuity..material". Do you mean this material is mantle rocks and located below the Moho? Line 12. Please, replace "section" to "Profile" to denote transects in the text. Otherwise, to me it is confusing

with the manuscripts sections. Line 31. Reference to "Steckler, M. and U. ten Brink 1986. Lithospheric strength variations as a control on new plate boundaries: examples from the northern Red Sea. Earth and Planetary Science Letters, v. 79, nos. 1 and 2, p. 120-132" would be useful here.

Page 18. Line 1-3. What does it low and high density anomalies reflect? Temperature, different composition? Please, explain. Line 14. "mantle batholiths in the upper crust". Do you mean granite batholiths or mantle plumes? Please, explain.

Line 17-18. "Standard simple models ... differ from the real density structure". "Models" and "structures" not exactly comparable things.. Line 23. "long-wavelength FIELD" do you mean gravity anomalies? What are these wavelengths that you are considering long? Line 24. Do you mean about 10 mGal variation? Page 19. Figure 9. Symbols are too small to be seen. Leave just "mGal" for colorbar. The plot is very busy the symbols are masked by the color of the background.

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2018-4, 2018.