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Interactive comment on "Practical analytical solutions for benchmarking of 2-D and 3-D geodynamic Stokes problems with variable viscosity" *by* I. Yu. Popov et al.

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Dear Referee, Thank you for useful remarks and suggestions. We rewrite the manuscript in accordance with your review. Namely, the following changes were made. We improve language throughout the paper.

1. It may be redundant to use three kinds of norms to show the error. I think using one of them, e.g. L2-norm, may be good enough. For these norms shown in the tables, please clearly indicate that they are absolute value: ||vxn-vxa||, or they are relative value (||vxn-vxa||)/||vxa||.

Different norms of errors show slightly different features of the algorithm convergence.

That is why we calculate all three errors. It does not add new figures. We deal with relative values. Now we indicate it.

2. For the three figures in each set, it is better to reverse the order of Fig.1 and Fig. 2. I like to first see the viscosity and density structure, then see the velocity and pressure field (similarly, reverse the order of Fig. 4 and Fig. 5, ïĂžïĂăïĂžïĂăïĂž, etc.)

Thank you. It is corrected.

3. In all the figures showing vx, vy and pressure, the last subfigure is smaller than others, please correct. In addition, the magnitude for pressure error in Fig. 4 is probably wrong.

Thank you. It is corrected.

4. In all the figures showing viscosity and density structure, it is better to use one as the aspect ratio.

Thank you. It is corrected.

5. In Figure 3, are there two lines overlapping each other? I can only see eight lines in total.

Thank you. It is corrected.

6. In Fig10 – Fig 12, for figure caption, change "linearly varying viscosity" to "exponentially varying viscosity"?

Thank you. It is corrected.

7. For 3D geometry, it is not necessary to show the result of the two cases with low viscosity contrast. The four 3D cases can be reduced to two.

We reduced the number of figures and tables in the paper. Part of them is given in supplementary materials to the electronic version of the paper/

8. Is it possible to develop a similar generalized analytical solution with a viscosity

jump? For example, with the classic propagate matrix method, we can set the lithosphere viscosity as 100, and the underlying mantle as 1 and still get the analytical solution.

The suggested approach is applicable to the case of continuous variation of the viscosity (it can vary strongly, but continuously). As for the viscosity jump, there is another approach related with the mathematical theory of self-adjoint extensions of symmetric operators. We suggest some numerical scheme based on this background. The corresponding paper will appear soon in Applied Mathematics and Computations.

Thank you for your useful remarks and suggestions.

Sincerely yours,

I.Yu.Popov, I.S.Lobanov, A.I.Popov, S.I.Popov, T.V.Gerya

Interactive comment on Solid Earth Discuss., 5, 2203, 2013.