Geoscientific
Model Development
Discussions

Interactive comment on "An analytical verification test for numerically simulated convective flow above a thermally heterogeneous surface" *by* A. Shapiro et al.

C. van Heerwaarden (Referee)

chiel.vanheerwaarden@mpimet.mpg.de

General comments

I recommend **minor** revisions. The paper presents a validation test for solvers for buoyancy driven flows. To the reviewer's knowledge it is the first validation test for wall-bounded Boussinesq flows including buoyancy and therefore deserves publishing. I have tested the MicroHH (http://github.com/microhh/microhh) code against the analytical solution provided in the paper and it gives the correct solutions (see attached figures).

Nonetheless, there are a couple of improvements that could be made. First of all, it would be great if the reference cases could be presented in a non-dimensional framework, to make them more general. Second, GMD suggests strongly to submit code for benchmarking papers. I would appreciate if the authors can provide their code, to enable the readers to use the test case with their own code.

Minor comments

- *Abstract* Maybe the authors can stress here that there are very few, or maybe even no analytical solutions for wall-bounded buoyancy driven flows around and their paper is therefore really a novelty.

- *Page 2850* Can the authors shortly explain how they got to their set of equations?

- *Page 2857* It would be good if the authors can write some guidelines on how to use their validation test with a model with staggered grids. For instance, if u is interpolated, how fine does the analytical solution need to be in order to have reference data for which the error in the analytical solution is negligible to the model error?

- *Formula 41* Why don't the authors define the first Reynolds number as the vorticity advection divided by the vorticity diffusion?

- *Page 2859* Why are 50.000 terms taken? Isn't this an enormous amount?

- *Page 2864* Do I understand correctly that the authors underline statements by previous papers that models on a staggered grid do not require a pressure boundary condition?

- *Page 2865* In the last statement the authors mention the numerical boundary layers. Are these a problem in explicit codes as they are using as well, or does this problem only play a role in case implicit diffusion has to be applied?

- *Figure 6* Why are the results asymmetric? You are solving a purely symmetric system. Which process introduces the asymmetry in the solution?

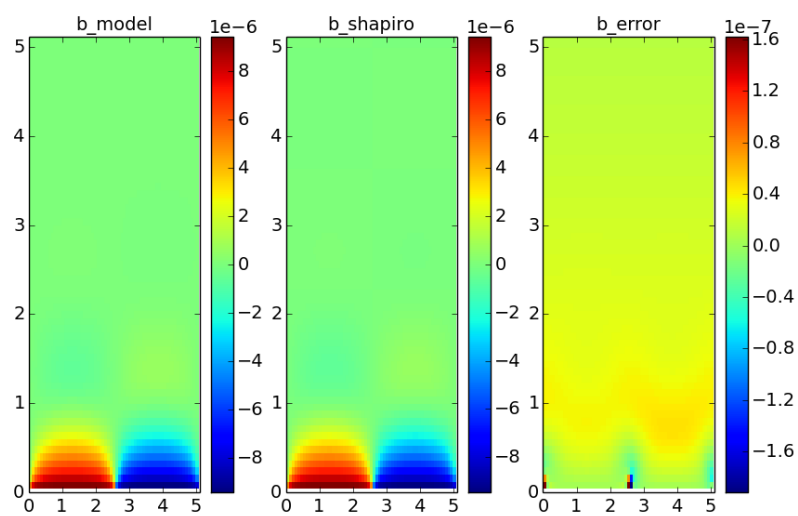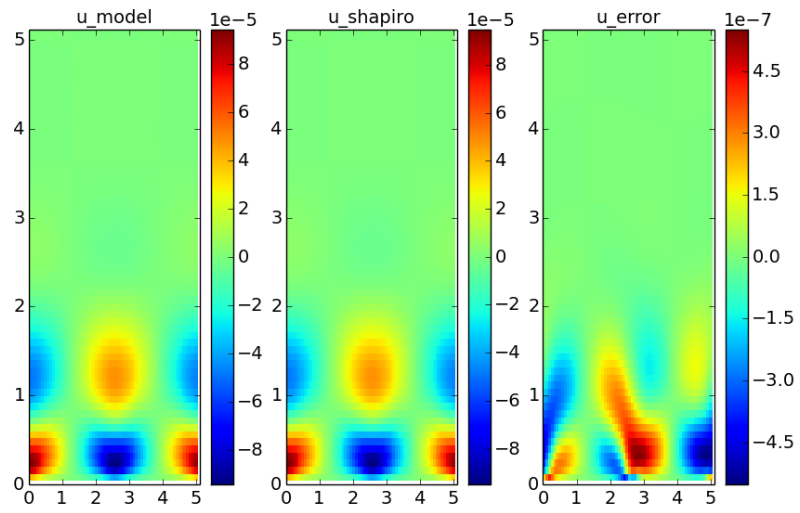Interactive comment on Geosci. Model Dev. Discuss., 8, 2847, 2015.
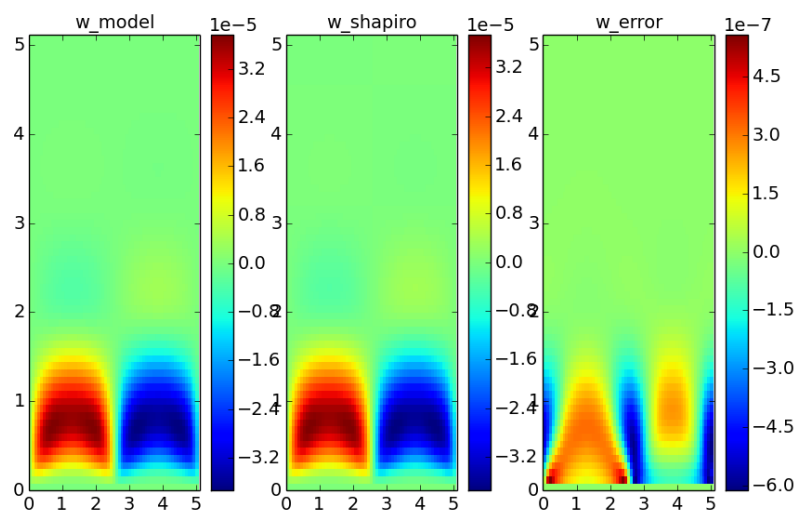
Fig. 1. buoyancy

Fig. 2. horizontal velocity

Fig. 3. vertical velocity