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# *Interactive comment on* "Quasi-hydrostatic equations for climate models and the study on linear instability" *by* Robert Nigmatulin and Xiulin Xu

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*Dear Robert Nigmatulin and Xiulin Xu,*

**1 "For the vertical momentum equation, the buoyancy term $-b'$ is included in (13). In our set of equations, the vertical inertial is totally ignored in the vertical momentum equation, the sixth equation of (2.23)."**

Is there any connection between "vertical inertial is totally ignored" and ignoring of buoyancy term $-b'$? Do you want to tell that you have ignored buoyancy perturbations in your hydrostatic approximation model, and vertical gradient of pressure deviation is no more balanced? In such a case vertical hydrostatic balance would be violated and its not very clear what you are studying. Or may be you have misinterpreted your own writings?

**2 " To close the system of equations, we use a new independent variable $\dot{M}$ and the equation corresponding to this variable, the fifth equation of (2.23).'**

Let's look at your "independent" variables:

$$(\rho, v_x, v_y, v_z, \dot{M}, M),$$

where

$$M = \int_z \rho dz \tag{1}$$

$$\dot{M} = -\int_z div_{hor}(\rho v_{hor})dz \tag{2}$$

(such a notation is strange for me since $\dot{M} \neq \frac{dM}{dt}$, especially in the walls of the faculty of mechanics and mathematics, but you can do it).



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I thought before that you made such a trick to make the system evolutionary, since from above it follows f.e.

$$\frac{\partial M}{\partial t} = \dot{M} + \rho v_z \tag{3}$$

But now I've looked in the appendix A for the matrix $B_t$ and it looks like you did not even used the expression above for $\frac{\partial M}{\partial t}$! Instead, you put in your matrices the expression $\frac{\partial M}{\partial z} = -\rho$.

Only three equation in your six-equations system for perturbations are evolutionary, i.e. they have $\frac{\partial}{\partial t}$. And still you give the $6 \times 6$ matrix for linear analysis, as if it was for $6 \times 6$ evolutionary system. It's an amazing approach, but I am lost now what is the connection of such an approach to the analysis of perturbations of the hydrostatic approximation.

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