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Geoscientific Model Development Discussions

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).

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 6×6 matrix for linear analysis, as if it was for 6×6 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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