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Geoscientific
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Interactive comment on "QUAGMIRE v1.3: a quasi-geostrophic model for investigating rotating fluids experiments" *by* P. D. Williams et al.

Anonymous Referee #5

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1 General Comments:

The paper presents the recent version of the QUAGMIRE model (v1.3) which is a quasi-geostrophic numerical model for simulations of rotating fluid experiments. The contents is in the scope of the GMD.

The paper is well structured, the language is fluent and precise and only a few type errors are found. Some figures/tables should be improved (see specific comments below). Scientific methods and mathematical descriptions are clearly outlined.

The paper should be accepted after a minor revision.

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2 Specific Comments

Obviously, the authors set a high value on details not only in the introduction chapter but also in the following sections. While I enjoyed all the statements very much, I am not sure whether the paper would, at least in part, benefit from a more straightforward view. For example, section 2 'Models of the rotating annulus' gives an overview with advantages/disadvantages of different dynamical and geometrical choices. This section could be written in a more goal-oriented manner, i.e. 1) that QUAGMIRE is a balanced model using quasi-geostrophic equations and 2) that a new geometrical model has to be build for the special case of multi-layer annulus simulations. However, this is a 'soft' comment and the authors are free to consider it or not.

The progress in the development of the QUAGMIRE model is found in only one sentence in the abstract where it is written that version 1.3 does consider the case of a two layer fluid. It would be interesting to know what else can be simulated with the recent version, i.e. what kinds of annulus experiments are possible to simulate. I think there will be a number of various annulus experiments that can be simulated with QUAGMIRE? What is the history of QUAGMIRE? This should of course not be written in the abstract but may be given in the introduction or in the summary.

Section 3 describes the derivation of the two-layer quasi-geostrophic coupled partial differential equations and the way of how to find solutions very well. Also the 'boundary conditions' section is well written and the arguments are clear.

In section 4, the discretized equations are derived, appropriate boundary and initial conditions are given, and the time steeping scheme (leapfrog with a Robert filter) is introduced. Furthermore, in section 4.6.3, a second-order hyperdiffusion term as well as s stochastic parameterization (sect. 4.6.4) is discussed which are both implemented in QUAGMIRE. Here, I miss a statement about the advantage/disadvantage of each of the sub-gridscale representatives. In particular, the authors mention that a (very) small error is included using the hyperdiffusion term but do not give a quantitative statement.

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In section 5, a reference of code subroutines, etc. is given. This section can be treated as a How-To and I am not sure whether it should be given in this paper. On the other hand, it completes the description of the new QUAGMIRE version anyhow. Nevertheless, I recommend to discard this section here and to give it in the reference manual of the code. Instead this long version, here, a hint should be given in the summary section (sect. 6), and also the existence of the (very useful) Matlab diagnostic routines should be noted in short.

Finally, QUAGMIRE make use of the non-free NAG-library, as described. This library is probably not accessible to all scientists. May be, version 1.4 (or then 2.0?) can make use of free alternatives? This would allow for a worldwide application of the model code without any restrictions.

3 Technical Corrections

3.1 Major Issues

- sect.2, page 193, 2nd paragraph: the significance of interfacial tension is mentioned. Please give examples or a few further informations.
- sect. 4.1, page 210, last paragraph: type error in the definition of the grid box area (a '1' is subscripted that is wrong)
- sect. 4.2, page 212, last paragraph: it is stated that there will be a small error in the calculation of the discretized Laplacian. Even if there is no other way to discretize the Laplacian, what are the consequences/effects of this error?
- sect. 4.6.1, page 216, line 12: type error (no comma between 'step' and 'of'): 'At each step of size ...'

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- table 1: the table is not well arranged. Please find a better adjustment.
- table 2: sentence 2 of the caption has an error: 'The analogous conditions for the for the...'; remove one 'for the'
- table 2: I recommend to use the equals signs to adjust the terms, and not using a center environment.
- figure 1: the vector of the acceleration due to gravity has a double arrowhead. The terms 'r=0' 'r=a' 'r=b' should be set in horizontal mode, if possible.
- figure 4: enhance the font size.
- figure 5: use larger font size.
- figure 5, error in caption, sentence one: 'Organigram showing in detail the the model ...'; remove one 'the'
- figure 5, caption: the equation of the Jacobian J(w',q') should be placed in the figure and not in the caption.

3.2 Minor Issues

- sect. 3.1, page 194, line 11-18: The ambient text is not as clear as it could be.
- sect.3.1, page 198, line 12 and 13: Is there an advantage/a disadvantage of using dimensional units in the QUAGMIRE model? Please make one remark here.
- sect. 4.6.3 and ff: Wouldn't it be better to type the word 'gridscale' consistent, i.e. 'gridscale' instead of 'grid-scale'

Interactive comment on Geosci. Model Dev. Discuss., 1, 187, 2008.

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