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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.

P. D. Williams et al.

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We thank the anonymous referee for his/her comments, dated 21 October 2008, which will help to substantially improve the paper.

1. General comments

We will make the minor revisions to the paper recommended by the Referee, as detailed below.

2. Specific comments

We would prefer not to modify the introductory sections of the paper, since they clearly motivate the need for the construction of a new multi-layer quasi-geostrophic annulus

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model.

The historical development of QUAGMIRE has proceeded as follows. QUAGMIRE v1.0 did not include topographic forcing or stochastic forcing, and there were only 21 plot options in the Matlab diagnostics software. In QUAGMIRE v1.1, stochastic forcing was introduced, and 9 further options were added to the diagnostics software. In QUAGMIRE v1.2, topographic forcing was introduced, and 2 further options were added to the diagnostics software. Finally, in QUAGMIRE v1.3, many improvements to the source code, shell script and diagnostics software have been made. QUAGMIRE v1.3 is the first version to be released for public use. We will add this historical summary to the paper.

QUAGMIRE implements both hyperdiffusion and stochastic forcing, in order to represent sub-gridscale features. The hyperdiffusion is necessary to prevent an unphysical build-up of energy at the grid scale. The stochastic forcing is necessary to capture regime transitions between different baroclinic wave modes (e.g. Williams et al., 2004), nominally due to sub-gridscale inertia-gravity waves, which are not captured by the hyperdiffusion approach. We will clarify this distinction in the paper. We will also quantify the very small error caused by the use of hyperdiffusion, as the Referee suggests.

The Referee suggests deleting Section 5 and using it to create a separate reference manual. Section 5 is quite short and is strongly linked to the preceeding sections of the paper. For example, the source code files listed in Section 5.1 each implement a different aspect of the model described in Sections 3 and 4. Therefore, we would prefer to leave Section 5 in the paper to give a single, self-contained document detailing all aspects of the model.

QUAGMIRE uses the NAG library for performing fast Fourier transforms, solving band matrix equations, and the value of π. There are free libraries for these tasks, but potential users of QUAGMIRE are likely to be based in universities, where the NAG library is widely available. Also, the free libraries are not always as efficient as the NAG

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ones. Finally, the existing examples of QUAGMIRE in the literature (e.g. Williams et al., 2003, 2004, 2005) have used the NAG library, and any switch to a different library could lead to problems of reproducibility. We will include the option of using a free library in future versions of QUAGMIRE, if it becomes clear that the use of a proprietary library is limiting the accessibility of the model.

3. Technical corrections

3.1 Major issues

- Interfacial tension is scale-selective, affecting small scales much more strongly than large scales. Therefore, although interfacial tension effects are almost always negligible in real geophysical flows, they can be important in the analogous laboratory flows. We will mention this in the paper.
- We think the formula for the grid box area is correct: the prefactor in square brackets should equal $1/2$ if $i = 1$ or $i = N_{\mathsf{rad}}$, to represent the division of the grid box area by two due to the sidewalls, but should equal 1 otherwise.
- The assumption of linearly-extrapolated ghost points appears to be inconsequential, because we find good agreement between model and laboratory flows (Section 6). We will mention this in the paper.
- We would prefer the comma to remain, because "of size Δt" is a separate clause.
- We agree that the table could be better typeset, e.g. by inserting more space. We leave this to the publishers.
- We have removed the spurious "for the".
- We agree that the terms should be aligned using the equals signs. We leave this to the publishers.

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- (We presume this comment applies to Figure 2, not Figure 1.) The use of double arrowheads to denote acceleration vectors is standard notation. Greater precision is possible if $r = 0$, $r = a$ and $r = b$ are set vertically.
- We will ensure that the text is large enough to be readable in the final published paper.
- We will ensure that the text is large enough to be readable in the final published paper.
- We have removed the spurious "the".
- There is no space to define the Jacobian in the figure and so we prefer to leave it in the caption.

3.2 Minor issues

- We agree that the sentence is long but we think the meaning is clear.
- The advantage of using dimensional units is that the link to the laboratory annulus is immediate and clear. The disadvantage is that the nondimensional parameters (e.g. the Rossby number) need to be computed separately. We will mention this in the paper.
- We will ensure consistent use of "gridscale" instead of "grid-scale" in the paper.

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