

## ***Interactive comment on “Features of fluid flows in strongly nonlinear internal solitary waves” by S. Semin et al.***

### **Anonymous Referee #1**

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Features of fluid flows in strongly nonlinear internal solitary waves Semin et al

**General Comments** This paper uses the fully nonlinear numerical model MITgcm to compute internal solitary waves in a tank. The waves are generated by the gravitational collapse of a finite volume of fluid in a lock release type system. The results are compared with previous experimental (Carr & Davies 2006) and numerical (Thiem et al 2011) investigations. It is shown that the MITgcm model simulates the laboratory findings of Carr & Davies 2006 slightly better than the Bergen Ocean Model (BOM) of Thiem et al 2011 does. The improvement is attributed to a difference in the choice of the viscosity coefficient.

The study highlights the sensitivity of the system to the choice of the viscosity coefficient. However this finding has already been reported in Thiem et al 2011 and I am

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not sure where the originality lies in this paper. The paper does show that the MITgcm offers slightly improved correlation with the laboratory results than the BOM does but I do not feel this finding alone is sufficient to warrant publication in NPG. The authors present some interesting and original results in section 6 and I would strongly encourage them to rewrite the paper refocusing attention on and expanding upon this aspect of the work.

**Specific Comments** I have checked back with the original papers with which the paper cites and I noticed that there may be a breach of copyright in the reproduction of figures. For example Fig 2 (a) looks like fig 4 of Carr & Davies 2006 and figures 5 & 6 look like overlays of figures from Thiem et al 2011. Can the authors clarify this please? Page 1 Line 22: It is true all references cannot be given but some key ones should be. Page 2 Line 2/3: I am not sure what the authors mean here. Do they mean only mode 1 waves can be supported? Olsthoorn et al 2013 (NPG) and Brandt & Shipley 2014 (Physics of Fluids) have recently shown that mode 2 waves are generated in a similar system to the one being modelled by the authors. Line 10-14: The authors say that they are essentially repeating the work done in Thiem et al 2011 using the MITgcm but the motivation to do so is not clear. Is it to reduce the differences that occur between the BOM and the lab? If so for what purpose? Page 7 Line 4: The comparison made in figure 2 is of two different things. If I have read Carr & Davies 2006 correctly, fig 2(a) is a time series with a horizontal axis of time while fig 2(b) is in the laboratory frame and hence has a spatial horizontal axis. The authors should clarify this in their discussion. Line 16: I cannot see this. Line 15: But isn't the wave considered here highly non-linear? Line 22: The upper boundary condition in the laboratory is known to have a significant effect upon internal wave dynamics for example see Luzzatto-Fegiz & Helfrich 2014, Journal of Fluid Mechanics and Carr et al 2008 Physics of Fluids. Page 9 Line 15: I cannot see the numbers in fig 6a. Line 18-20: I am not sure what the authors mean here about the reverse flow smoothing the horizontal flow.

**Technical Corrections** The paper requires a thorough grammatical check, see exam-

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ples of changes below: Page 2 Line 16: affect THE underwater Line 17: force platforms (remove 'the') Line 18: ..2011), AND affect the propagation ... Line 22/23: Laboratory experiments allow the study of soliton characteristics in controlled conditions and validation of numerical ... Page 3 Line 2: This is quite a convenient approach .. Line 8: THE Bergen Ocean Model Line 12: THE Massachusettes ... Line 25: literature, for example see Carr ... Line 26/27/onto next page: In the basin, a two layer stratification is created with ... the upper layer HAS thickness  $h_2$  and density  $\rho_2$ , and the lower layer HAS thick.. and density ... Page 4 Line 5: ... (Fig. 1b). Fluid with density ... Line 8: ... tank. Thus ...with density Line 11: right IT is .. Line 12: right IT is .. Line 14: Is sharply the correct word to use here ? Page 5 Line 5: I am not sure exactly what the authors mean here Line 19: ..wave. The value of these parameters were chosen to ensure good consistency with previous laboratory and numerical results. (and cite relevant papers) Page 7 Line 2: is appeared – APPEARS, remove 'the time moment' Line 27: ..measured). It is known from linear theory, that after ... Page 8 Line 1: ..effects. Fig 4 also shows ... Line 7: ... soliton. A detailed analysis ... Line 14: ...the BOM ... the MITgcm ... Line 17: ...pointed out in Thiem et al 2011 ... Line 22: ..of a weak ... Page 9 Line 2: ...,leading to separation of the boundary layer. Line 24: ...Fig 7. It can be seen that, ... Line 25: Replace about with approximately Page 12 Line 2: ..for calculating sediment transport. As a first step ... Line 11: located at (a) the initial ..., (b) in the pycnocline ...and (c) near ... Page 20: Fig 1(b) caption ... after inserting the gate Page 21: Caption: ..in (a) the laboratory and (b) numerical experiments ... Page 22: Caption: diagram of (a) free ...and (b) the pycnocline ... Page 23: Caption: (a) Field density ..., (b) the vertical ...and (c) horizontal speed..... Page 25: Caption: (a) Horizontal and (b) vertical ... Page 28: Caption: ...particles at (a) the initial ...(b) the pycnocline and (c) the bottom.

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Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 1919, 2014.