Answers to referee #2

General Comments

This article uses the ISWFoam model developed based on OpenFOAM to realize the simulation study of the generation, propagation and evolution of the internal solitary wave (ISW). By comparing with the experimental data, the authors point out that the ISWFoam model with unstructured grids and local mesh refinement can accurately simulate the generation and evolution of ISWs, the ISW breaking phenomenon and the interaction between ISWs and complex structures and topography. Due to the interpretation of the article and the code, some questions need to be solved. Compared with the original code in OpenFOAM, ISWFoam does not reflect its own characteristics and innovation. The ISWFoam built in this paper is an integration of the OpenFOAM base tools, rather than a new developed code. Compared to the existing works on the ISW simulated by OpenFOAM, ISWFoam does not show its advantages and comprehensiveness. Based on the above reasons, I suggest to reject this manuscript.

Specific Comments

Q1: 1. The manuscript mentions that "the wave generation method is essential for a two-layer system" on Page3 line 85, as described in the manuscript and code, the ISWFoam generates the ISW by the horizontal velocity derived from ISW theory. The corresponding code is in 'setUFields.C'. The initial density distribution in the flow field is established by the ISW theory with the hyperbolic tangent function profile. The corresponding code is in 'setRhoFields.C'. The mere comparison of the DJL equation and the eKdV equation does not show that the ISW generation method used in this manuscript is excellent. More equations including KdV, mKdV, MCC et al., should be examined in the ISWFoam. The article does not do enough work on ISW generation. In addition, the initial flow fields can be set using 'setFields' in OpenFOAM and 'funkySetFields' in swak4foam.

Answer: The complete sentence in the paper is "*Though recent work by Ding et al (2020) and Li et al (2021) considered continuous stratification in density, the wave generation method is essential for a two-layer system*". The objective of this sentence is to show that Ding et al (2020) and Li et al (2021) considered continuous density stratification in their model, but their wave generation theories are still strongly stratified (a two-layer system), does not consider continuous stratification in density, which is inconsistent with the actual situation. However, ISWFoam not only considers continuous density stratification in the solution process, but also considers continuous density stratification in the wave generation theory (the ISW generated by the fully nonlinear models of the Dubreil-Jacotin-Long (DJL) equation). Section 2.3.1 also gives the difference in wave generation with and without considering continuous stratification in density. The results show that the wave generation theory

considering continuous density stratification is more reasonable. It is worth noting that ISWFoam is not a two-layer system (such as interFoam), which can also be seen from the code. To express the idea more clearly, we have changed the sentence as follows. "Though recent work by Ding et al (2020) and Li et al (2021) considered continuous stratification in density, their wave generation theories does not consider continuous stratification in density."

The wave generation of the numerical cases in this paper adopts the method of initializing the field with the fully nonlinear models of the DJL equation. The purpose of comparing the DJL and eKdV equations is just to highlight that the DJL equation is more reasonable (although it can be obtained from the equation itself), so other weakly nonlinear theories such as KdV, mKdV, MCC et al are not discussed in depth.

Without modifying the code, **neither** OpenFoam's original functions setFields and funkySetFields in swak4foam can solve the initial field of ISWs.

Q2: According to the introduction of the governing equations in the article and the code, by taking the variation in density into account, 'interFoam' enables a simulation study of ISW, and the value of the authors' work is not reflected. The section 2, which describes the model and the various methods, also comes with OpenFOAM and can be found in the user manual. The article should describe the characteristics of ISWFoam and how it differs from the original program.

Answer: At present, the official version of OpenFOAM® does not have a solver or boundary conditions for solving the ISW in continuously stratified fluids. The two-layer system model interFoam in OpenFOAM is strictly incompressible, and the density of the water is a constant value, and continuous density stratification of the water cannot be considered. In order to solve the internal solitary waves in the real ocean environment, a new solver (ISWFoam) was developed by independent programming to simulate internal solitary waves in continuously stratified, incompressible, viscous fluids based on a fully three-dimensional (3D) Navier-Stokes equation using the open source code OpenFOAM. The turbulence model has also been modified accordingly to the variable density field.

Q3: It has been explained in the Introduction that ISW research has already been implemented using OpenFOAM, what are the differences or advantages of ISWFoam from those existing codes?

Answer: At present, the official version of OpenFOAM® does not have a solver or boundary conditions for solving the ISW in continuously stratified fluids. Incompressible fluid solver in OpenFOAM is strictly incompressible, and the density of the water is a constant value, and continuous density stratification of the water cannot be considered. However, ISWFoam not only

considers continuous density stratification in the solution process, but also considers continuous density stratification in the wave generation theory (the ISW generated by the fully nonlinear models of the Dubreil-Jacotin-Long (DJL) equation).

In the introduction, it is introduced that some researchers simulate ISWs by modifying the OpenFOAM® code, most of these studies are based on a two-fluid system (for example interFoam) without continuous density stratification in the solution process, such as Meng and Zhang (2016) and Li et al (2017). Though recent work by Ding et al (2020) and Li et al (2021) considered continuous stratification in density, their wave generation theories does not consider continuous stratification in density. ISWFoam not only considers continuous density stratification in the solution process, but also considers continuous density stratification in the wave generation theory. At the same time, the turbulence model has also been modified accordingly to take account of .

At the same time, the turbulence model has been modified accordingly to take account of continuous stratification in density.

Q4: The meaning of the star icon in Figs. 4 and 5 should be indicated.

Answer: Thanks for the suggestions. We have revised and removed the star icon.

Q5: If a rigid lid is used for the top boundary, then the free surface should not be labelled in Figs. 6 and 7.

Answer: Thanks for the suggestions. Fig. 6 is the experimental diagram, which we draw in accordance with the experimental layout diagram given by Hsieh et al. (2014). And Fig. 7 is the numerical simulation result, we did not mark the free surface.