Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
https://doi.org/10.5194/gmd-2021-250-RC2, 2021

Comment on gmd-2021-250

Victor Stepanenko (Referee)

Referee comment on "Effects of dimensionality on the performance of hydrodynamic models for stratified lakes and reservoirs" by Mayra Ishikawa et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-250-RC2, 2021

The paper brings valuable information for the limnological community on the relative performance of models of different spatial dimensionality applied to an artificial reservoir with significant longitudinal variation of water properties. 1D, 2D and 3D models are compared to measurements carried out at Brazilian drinking reservoir, in terms of water level, temperature, velocity, turbulence and passive tracer. Results elucidate capabilities and limitations of models used, which allowed authors to formulate recommendations on their further applications. I suggest to publish the paper after minor revisions.

My two major concerns on the paper are:

- What was the model calibration procedure? Please clearly describe for each model. Usually, in intercomparison studies some parameters are set the same for all models, the others are allowed to be calibrated individually. Please provide reasoning on the choice of such parameter groups in your case.
- 1D models by construction simulate the *horizontally averaged fields*, e.g. temperature; this means it is strictly speaking incorrect to state that 1D model simulates the temperature of point observations better or worse, than 2D/3D model, because there is a possibility in a latter case to take temperature from a cell nearest to observation location; this is what should be mentioned in discussion on results of the model intercomparison for intake region; my suggestion is also to add 1D model comparison to horizontally averaged data from reservoir-wide surveys which you use in Section 6.2.2

Specific comments:

The title: hydrodynamic models of what? (reservoir?)

Line 29: please change “identical”

Line 125: I suggest to change: lateral -> transversal

Line 130: explain the choice of turbulent scheme in this study

Line 135: shallow water equations are 2D in space; this is not the same as 3D dynamics with hydrostatic approximation

Line 138: I suggest to change: resolved -> parameterized

Line 169: As one can judge from this section, downwelling longwave radiation was not measured and used to force models, rather empirical formulae applied; this might be one of error sources, please indicate in discussion

Table 1: I suggest to change: wind coefficient -> drag coefficient

Table 1: the light extinction coefficient was put different in models; have you had any measured transparency properties like Secchi disk?

Table 1: “branches width” or “segment width” in 2-d raw?

Table 1: what is 0.85 m in raw 3? grid spacing?

Table 1: specify compiler in computational time section

Table 1: longwave radiation schemes are different, what are the implications?

Table 1: “Kinematic viscosity of water” -> did you mean molecular viscosity?

Table 1: Lines “Vertical eddy viscosity” and “Vertical eddy diffusivity” should contain coefficients not simulated by “Turbulence closure model”, namely, background values; this is not clear by formulation “Computed”, etc.

Table 1: please replace “Computed …” by concrete information on computation scheme

Heat exchange with sediments neglected, what are implications, esp. for shallow zones?

Line 223: water level is not a boundary condition (understanding boundary conditions in mathematical sense as additional constrains at boundaries for partial differential equations)

Line 325: do evaporation differences explain level discrepancy between models?

Line 364: p-value is given for which hypothesis? Please clearly explain so that the reader understands the hypothesis being tested every time you mention p-value

Fig. 6 b,c,d: better to add regression line

Lines 466-468: I can’t follow this sentence

Line 469: what is interflow, underflow, overflow?

Lines 483-485: better to put in beginning of section as definitions of terms used