

Interactive comment on “Numerical study of the seasonal thermal and gas regimes of the large artificial reservoir in Western Europe using LAKE2.0 model” by Maksim Iakunin et al.

Anonymous Referee #1

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Review for Journal: GMD Title: Numerical study of the seasonal thermal and gas regimes of the large artificial reservoir in Western Europe using LAKE2.0 model Author(s): Maksim Iakunin et al. MS No.: gmd-2019-309

In their paper the authors show measurements and numerical simulation results with the two layer model FLake and the onedimensional model LAKE2.0. The authors compare temperature and heat fluxes and dissolved gases such as CO₂ and O₂. In general, the results of Lake2.0 are better than FLake. This is no surprise and FLake is a simpler approach. Lake2.0 reproduces temperatures in general with an error of 1°C. The simulation of dissolved gases in general is good. However the daily variation is missing

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because the model does not reflect biological activity completely enough and during deep recirculation modelled oxygen lies higher than measured.

The accuracy of temperature stratification of 1°C indicates careful set-up of the model, and can only be achieved by considering the variable light absorption during the year. The good agreement between modelled dissolved oxygen and measurements during the stratification period indicates that the oxygen concentration in the surface layer is controlled mainly by exchange with the atmosphere, as biological processes are not reflected in the model; as a consequence during winter and during strong blooms the modelled oxygen is not as good anymore. I suspect there could be an upwelled oxygen demand during deep recirculation that is not included in the model.

This manuscript is significant as it shows that temperature of reservoirs can well be represented with 1_d models: Lake2.0 is an option. Modelling oxygen and carbon dioxide is possible with simple assumptions (without biological model); however for representation of oxygen during deep recirculation and during algal blooms as well the daily variation of CO₂, a more detailed model is necessary: Scientific significance 2.3; Scientific quality: the modelling is well done; the improvement of absorption was a smart step; the manuscript gives a competent impression; measurements suited for checking simulation: scientific quality 1.6. Scientific reproducibility: 1.5 see below Presentation quality: 2; English writing: in general good: see comments below. The fonts in Figures are generally too small: especially: Figs. 1, 2, 5, 7; number of figures is appropriate.

Important issues: 1) I would recommend not to use a contour plot to judge onset and end of stratification: the authors claim stratification starts and ends of April: Fig. 11 indicates clearly, the reservoir was stratified on 2019 March 1st and 29th. An earlier onset of stratification explains the better oxygen simulation in Fig 10 from ca. Feb 8th. Better look at temperature tracks of sensors of different depths. 2) At two places the pH dependence of CO₂ solubility is mentioned, e.g. line 177. Do the authors indicate the Henry coefficient depends on pH; or does this refer to the much stronger pH dependence of the carbonate equilibrium? Has bicarbonate been modelled, or DIC

(dissolved inorganic carbon)? – connected with this: I cannot really follow what the altered pH on line 179 may indicate. 3) There could be a mention of the two most common 1D lake models: DYRESM (Imberger) and GLM (e.g. Bruce et al. of Hipsey et al) Technical details: Line 8: capable OF . . . Line 98 : BEING used . . . Line 125: are -> is Line 137 "into account" to the end of phrase Line 147. Check sentence Line 155: unit is missing Line 162: THE chose period Line 165 capital T Line 173: comma after stage? Line 185: how is density rho calculated (including solutes?) Line 191: comma after hours (possibly also before bigger) Caption Fig. 4: include the information of 6-hours mean Caption Fig. 4: errors-> temperature difference Line 221: that -> which Line 237. Remove "is" Line 251: covariAnce Line 255: constant -> continuous Line 266: which WAS SET TO A VALUE OF 8.48, which correspondED . . . Figure 8: remove useless data between 10 and 17 March (or explain what can be seen) Line 274 comma after period Line 270: good -> well

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