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Interactive comment on "Reanalysis of vertical mixing in mesocosm experiments: PeECE III and KOSMOS 2013" *by* Sabine Mathesius et al.

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The study presents a one-dimensional model for estimation of vertical mixing conditions in mesocosms. The authors offer the model output from two mesocosm experiments as a freely available dataset for further analysis and claim the model to be extendable on other mesocosm experiments.

Alone the focus on the model description makes the suitability of the study to a data-oriented journal like ESSD questionable: It does not seem to find a proper audience here. Under some conditions, however, the model and the generated dataset could attract the attention of other researchers, as if the model would describe a "nontrivial statistical and other methods employed (e.g. to filter, normalize, or convert raw data to primary published data) as well as nontrivial instrumentation or operational methods" (citation from Aims and Scope of ESSD). Unfortunately, the method proposed

here does not fit this definition. Moreover, the background assumptions of the model, its validity for the modeled system, and the usefulness of the generated data appear questionable.

The vertical turbulent diffusion is the main output of the model to be used as an independent variable in research on vertical transport of plankton, nutrients, dissolved gases and other "passive" tracers. The method applied to the estimation of the vertical diffusion is however far from being physically sound or justified for mesocosm conditions. The authors use the Osborn (1980) relationship for diapycnal diffusivity (Eq. 2 of the Discussions paper) as a core for their model, without giving a try to justify this choice for modeling mixing intensity in mesocosms. Several objections against this choice can be raised. I mention here one: if the mesocosm is well-mixed vertically then $N_z = 0$, and k_z in Eq. (2) turns to ∞. One could suggest a narrow range of conditions in mesocosms where the Osborn model would still be applicable, but the authors further simplify it by replacing the major variable — the dissipation rate of the kinetic energy of turbulence ε with a constant c and stating that "...our model assumes that c is constant for all depths and the whole time period of the experiment. . ." At this point, the baby is thrown out with the bath water. Reformulated in a straightforward way, it means that the vertical turbulent fluxes are explicitly set constant in time and space and decoupled from any forces producing them. The dubious assumption is compensated by fitting of c to the observed changes of temperature/salinity, allowing the model results to eventually agree with observations. Such a workaround apparently loses information about temporal variations in the vertical turbulent fluxes during the fitting period. On the other hand, the measured temperature (salinity) profiles can be directly applied for estimation of k_z by time-space integration of Eq. 9 (without a correction term) with varying spatial integration limits. This straightforward one-equation procedure without loss of temporal variability is known since at least 1925 and is often called the "flux-gradient method'' (see e.g. Powell and Jassby 1974 https://doi.org/10.1029/WR010i002p00191 for a review). In this regard, the proposed model is clearly underperforming and has an insufficient predictive power. I encourage the authors to discard the model in favor

of more robust methods and to make instead available the original temperature and salinity data provided with an appropriate description (if not done yet). *The use of the model results for further analysis and application of the model to other mesocosm experiments is not advised*.

A potentially useful model of mesocosm mixing would benefit from paying attention to the mesocosm-related effects on the vertical mixing: reduced solar radiation due to the wall shadowing, heat exchange across the mesocosm walls, reduced wind mixing at the surface. A model incorporating these effects would significantly contribute to analysis of a large number of mesocosm experiments.

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